ENGINEERING
TOMORROW

Programming Guide

VLT® Aqua Drive FC 202

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1 Introduction

1.1 Purpose of the Programming Guide

This programming guide provides information required for setting up parameters in a drive. The guide contains the following main areas:

- How to use the local control panel (LCP)
- Detailed descriptions of all parameters
- Troubleshooting

1.2 Supported Software Versions

Supported software versions: 5.4X

This programming guide can be used for all FC 202 drives. The software version number can be read from ***parameter 15-43 Software Version***.

1.3 Type Approvals and Certifications

The following table shows examples of possible type approvals and certifications for Danfoss drives.

NOTICE

Drives of enclosure size T7 (525–690 V) are not UL listed.

Table 1: Type Approvals and Certifications

CE	ErP READY		DNV·GL
c UL US	EAC	089	OSHPD
BUREAU VERITAS 1828	LR		RINA 1861
ClassNK			
ABS FOUNDED 1862			

NOTICE

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

For more information on UL 508C thermal memory retention requirements, refer to the section Motor Thermal Protection in the product-specific design guide.

For more information on compliance with the European Agreement concerning International Carriage of Dangerous Goods by Inland Waterways (AND), refer to the section AND-compliant Installation in the product-specific design guide.

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

The guide also includes ISO warning symbols related to hot surfaces and burn hazard, high voltage and electrical shock, and referring to the instructions.

	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electrical shock
	ISO action symbol for referring to the instructions

2.2 Safety Precautions

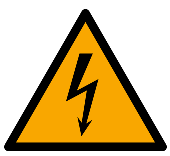
WARNING

LACK OF SAFETY AWARENESS

This guide provides important information on preventing injury and damage to the equipment or the system. Ignoring this information can lead to death, serious injury, or severe damage to the equipment.

- Make sure to fully understand the dangers and safety measures present in the application.
- Before performing any electrical work on the drive, lock out and tag out all power sources to the drive.

WARNING



HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

WARNING

UNINTENDED START

When the drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. Start the motor with an external switch, a fieldbus command, an input reference signal from the local control panel (LCP), via remote operation using MCT 10 software, or after a cleared fault condition.

- Disconnect the drive from the mains.
- Press *[Off/Reset]* on the LCP before programming parameters.
- Ensure that the drive is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.

WARNING

DISCHARGE TIME

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The discharge time is specified on the drive nameplate.
- Use a measuring device to make sure that there is no voltage before opening the drive or performing any work on the cables.

NOTICE

USING THE SAFE TORQUE OFF

When using the Safe Torque Off, always follow the instructions in the VLT® Frequency Converters - Safe Torque Off Operating Guide.

NOTICE

CONTROL SIGNALS

Control signals from, or internally within, the drive may in rare cases be activated in error, be delayed, or fail to occur entirely. When used in situations where safety is critical, for example, when controlling the electromagnetic brake function of a hoist application, do not rely on these control signals exclusively.

NOTICE

HAZARDOUS SITUATIONS

Hazardous situations must be identified by the machine builder/integrator who is responsible for considering the necessary preventive means. More monitoring and protective devices may be included, always according to valid national safety regulations, for example, law on mechanical tools and regulations for the prevention of accidents.

2.3 Protection Mode

Once a hardware limit on motor current or DC-link voltage is exceeded, the drive enters protection mode. Protection mode means a change of the PWM modulation strategy and a low switching frequency to minimize losses. This continues for 10 s after the last fault and increases the reliability and robustness of the drive while re-establishing full control of the motor.

The following situations cause the drive to enter protection mode:

- Undervoltage, the voltage has dropped below the low limit.
- Overvoltage, the voltage has exceeded the upper limit. Protection mode can be avoided by activating overvoltage control in ***parameter 2-17 Overvoltage Control***. However, activating overvoltage control extends the ramp times.
- Overcurrent, the current has exceeded the limit defined in ***parameter 4-18 Current Limit***.
- Ground fault, a ground fault has appeared.

To remove protection mode, set ***parameter 14-26 Trip Delay at Inverter Fault*** to 0.

3 Electrical Wiring

3.1 Electrical Wiring - Control Cables

3.1.1 Wiring Diagram

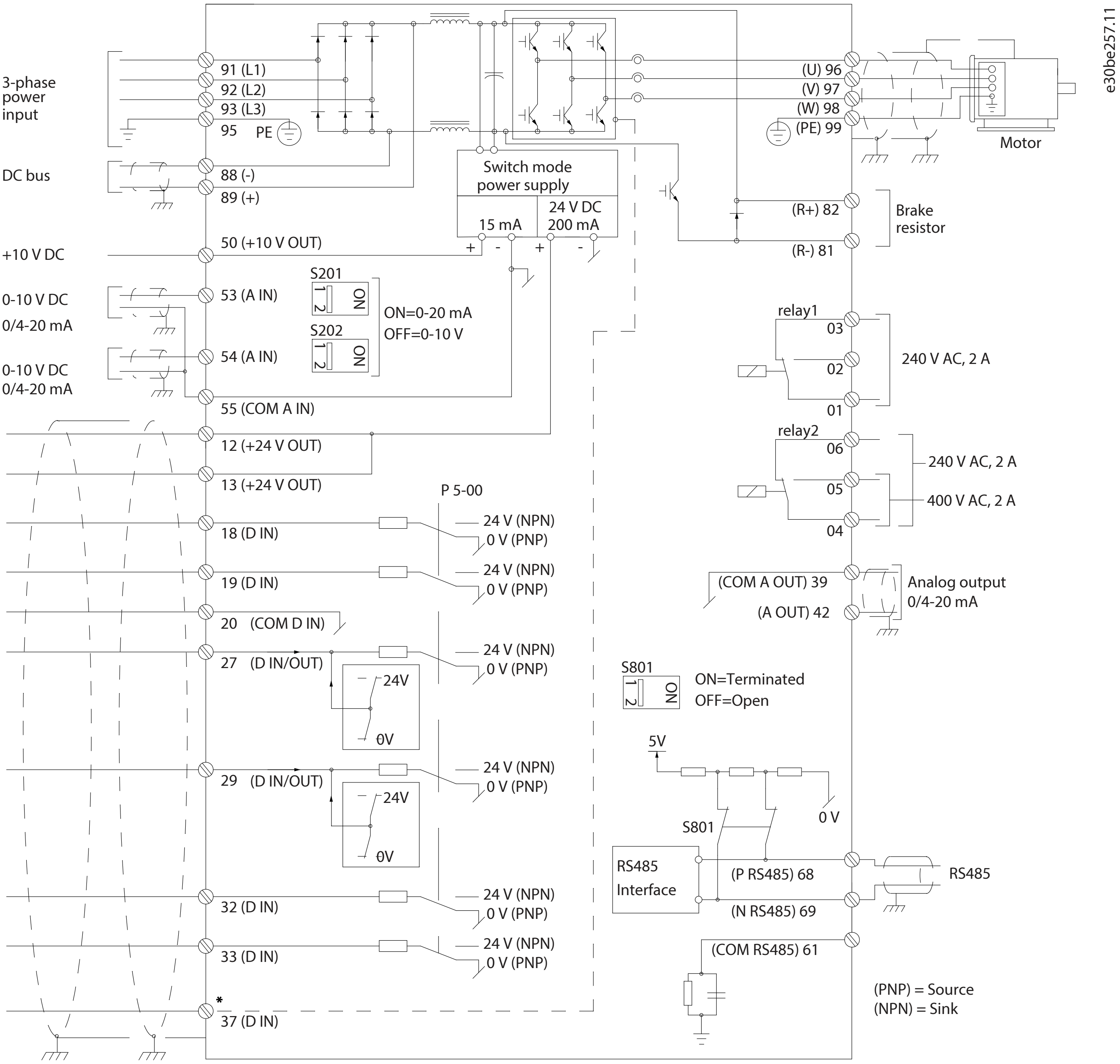


Figure 1: Wiring Diagram

A = Analog, D = Digital

Terminal 37 is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the VLT® Frequency Converters - Safe Torque Off Operating Guide.

Long control cables and analog signals may in rare cases, and depending on installation, result in 50/60 Hz ground loops due to noise from mains supply cables.

If this occurs, it may be necessary to break the shield or insert a 100 nF capacitor between shield and enclosure. Connect the digital and analog inputs and outputs separately to the common inputs (terminals 20, 55, and 39) of the drive to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

3.1.2 Input Polarity of Control Terminals

NOTICE

Control cables must be shielded.

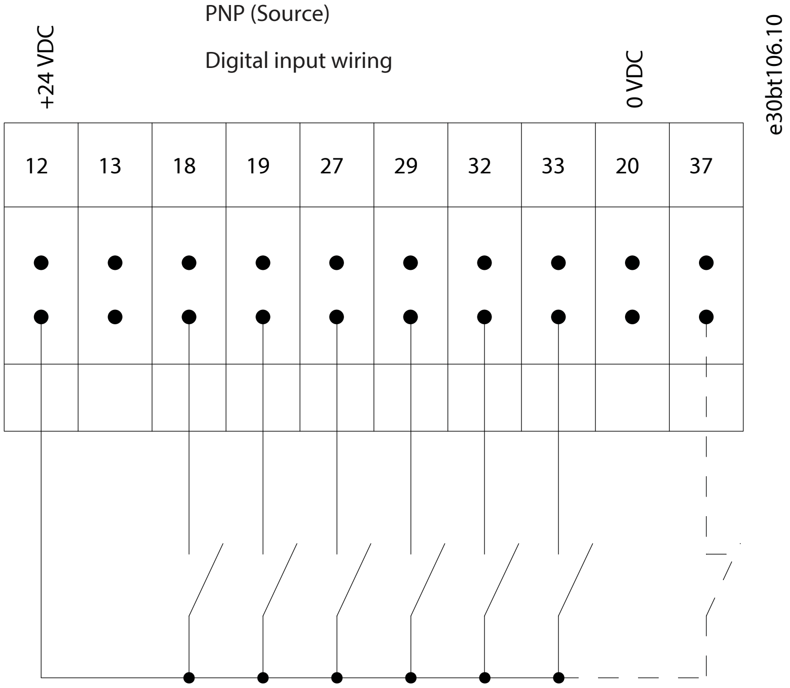


Figure 2: PNP (Source)

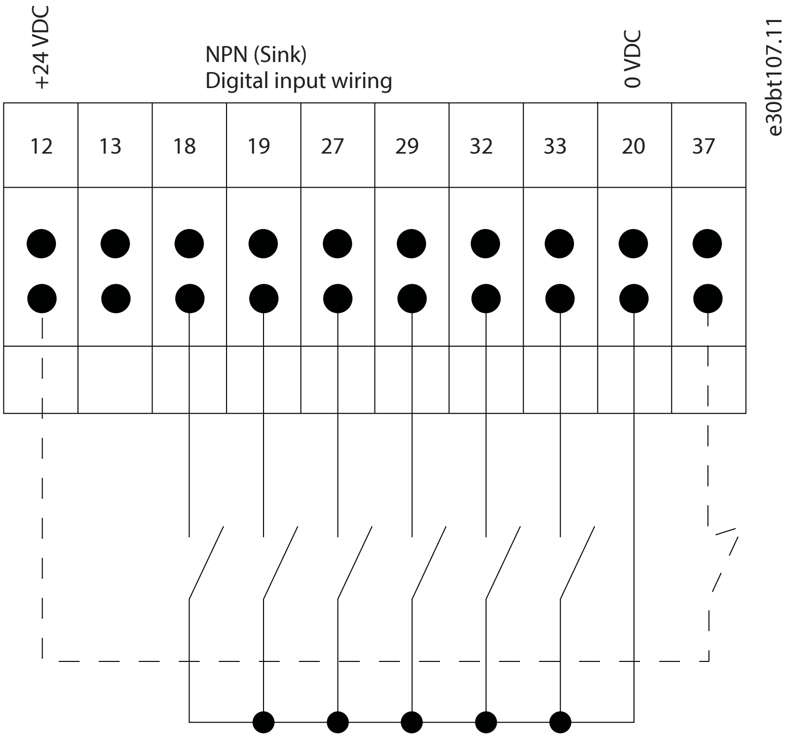


Figure 3: NPN (Sink)

3.1.3 Grounding of Shielded/Armored Cables

See the section *Grounding* in the design guide for the correct termination of control cables.

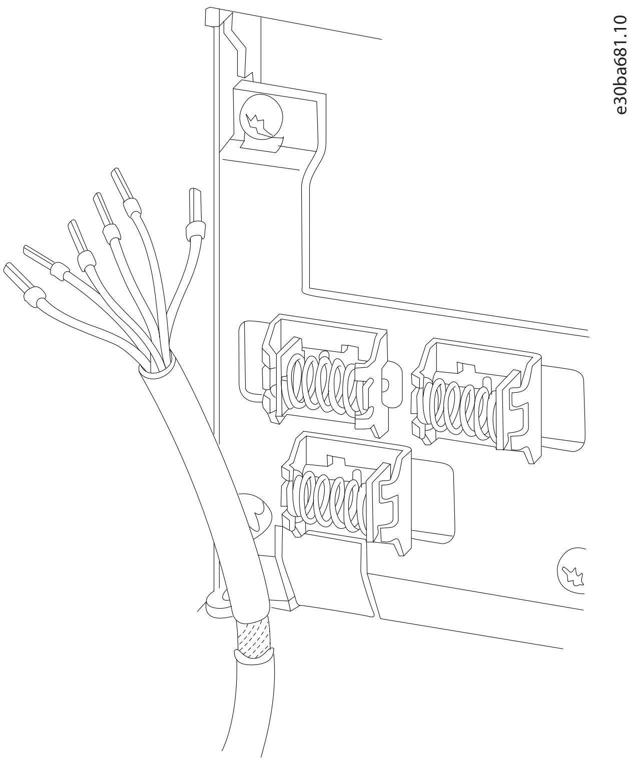


Figure 4: Grounding of Shielded/Armored Cables

3.2 Other Wiring Examples

3.2.1 Start/Stop

Terminal 18 = ***Parameter 5-10 Terminal 18 Digital Input***, ***[8] Start***.

Terminal 27 = ***Parameter 5-12 Terminal 27 Digital Input***, ***[0] No Operation*** (default ***[2] Coast inverse***).

Terminal 37 = Safe Torque Off (where available).

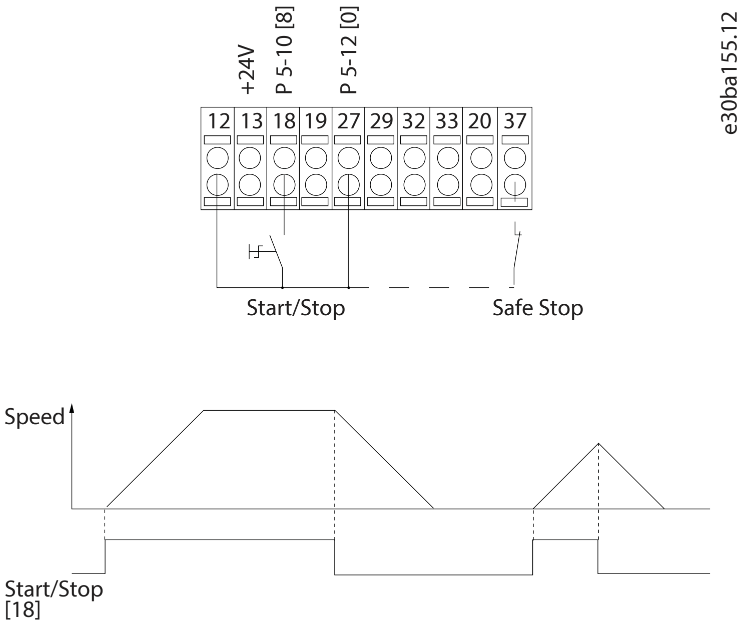


Figure 5: Start/Stop

3.2.2 Pulse Start/Stop

Terminal 18 = ***Parameter 5-10 Terminal 18 Digital Input***, ***[9] Latched start***.

Terminal 27 = ***Parameter 5-12 Terminal 27 Digital Input***, ***[6] Stop inverse***.

Terminal 37 = Safe Torque Off (where available).

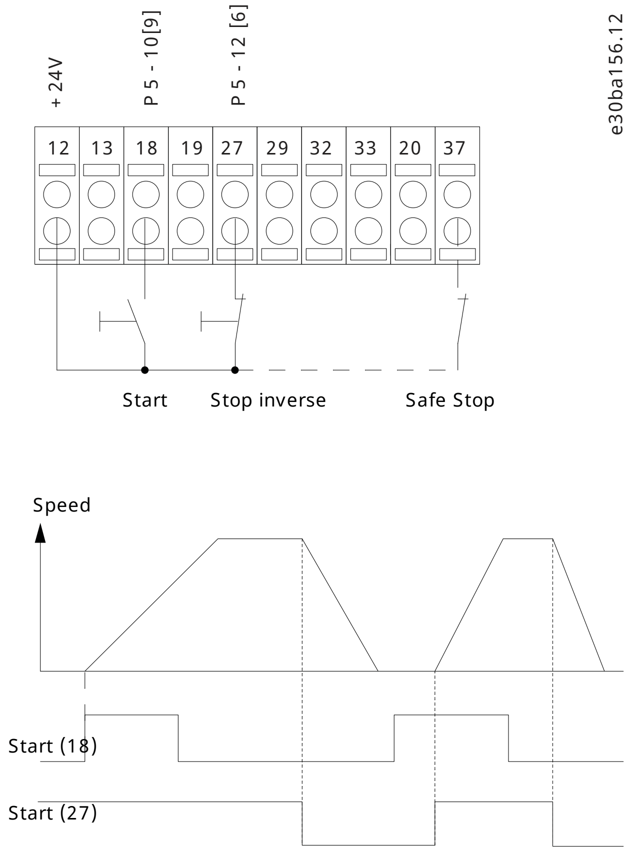


Figure 6: Pulse Start/Stop

3.2.3 Speed Up/Down

Terminals 29/32 = Speed up/down

Terminal 18 = ***Parameter 5-10 Terminal 18 Digital Input***, ***[9] Start*** (default).

Terminal 27 = ***Parameter 5-12 Terminal 27 Digital Input***, ***[19] Freeze reference***.

Terminal 29 = ***Parameter 5-13 Terminal 29 Digital Input***, ***[21] Speed up***

Terminal 32 = ***Parameter 5-14 Terminal 32 Digital Input***, ***[22] Speed down***

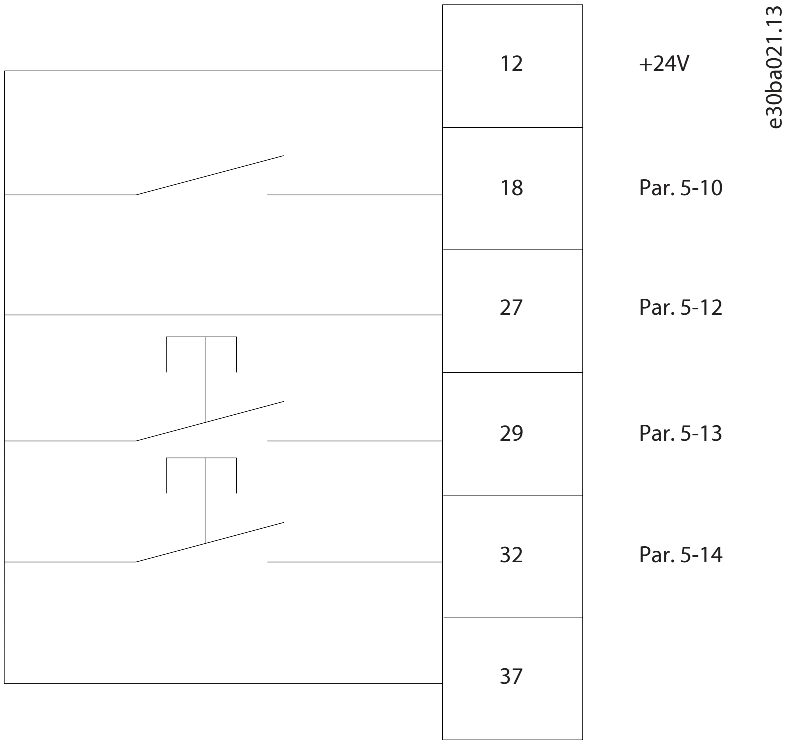


Figure 7: Speed Up/Down

3.2.4 Potentiometer Reference

Voltage reference via a potentiometer

Reference source 1= ***[1] Analog input 53*** (default).

Terminal 53, Low Voltage = 0 V.

Terminal 53, High Voltage = 10 V.

Terminal 53, Low Ref./Feedback = 0 RPM.

Terminal 53, High Ref./Feedback = 1500 RPM.

Switch S201 = OFF (U).

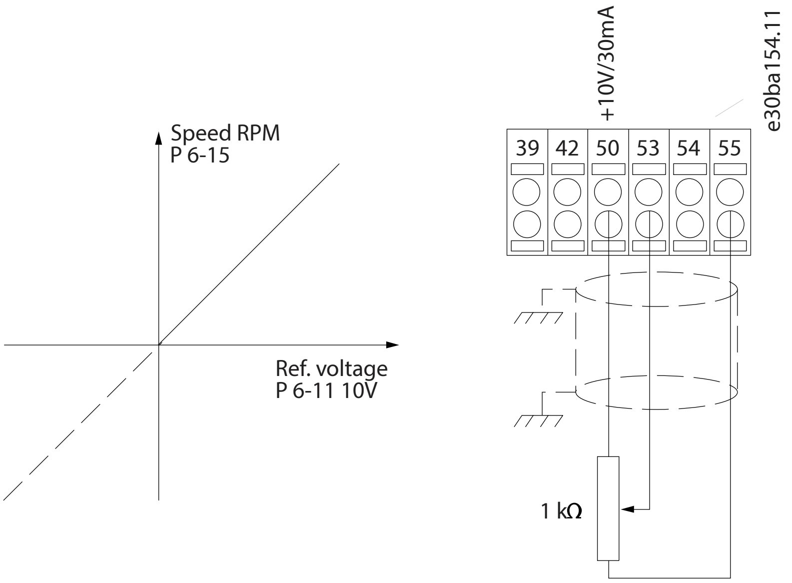


Figure 8: Potentiometer Reference

4 How to Program

4.1 The Local Control Panel

4.1.1 Overview of the LCP

Easily program the drive via the local control panel (LCP).

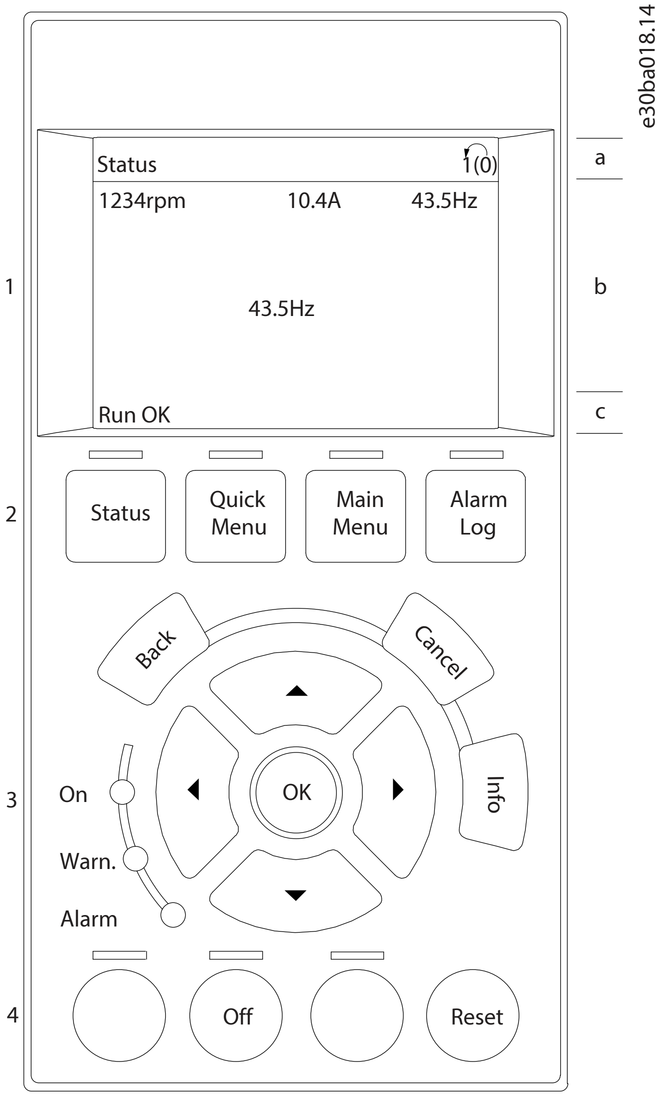


Figure 9: The LCP

1	Graphical display with status lines.	**2**	Menu keys and indicator lights - changing parameters and switching between display functions.
3	Navigation keys and indicator lights.	**4**	Operation keys and indicator lights.
a	Status line: Status message showing icons and graphics.	**b**	Line 1–2: Operator data lines showing data defined or selected. Add up to 1 extra line by pressing [Status].
c	Status line: Status messages showing text.		

The LCP display can show up to 5 items of operating data while showing *Status*.

NOTICE

If start-up is delayed, the LCP shows the INITIALIZING message until it is ready. Adding or removing options can delay the start-up.

4.1.2 LCD Display

The display has backlight and a total of 6 alpha-numeric lines. The display lines show the direction of rotation (arrow), the selected setup, and the programming setup. The display is divided into 3 sections.

Top section

The top section shows up to 2 measurements in normal operating status.

NOTICE

The EM-x number in the middle of the top line indicates the active setup in ***parameter groups 24-0x Emergency Mode*** and ***24-4x Emergency Mode 2***. The active emergency mode setup can also be read in ***parameter 0-17 Active Emergency Setup***.

Middle section

The top line shows up to 5 measurements with related unit, regardless of status (except in the case of alarm/warning).

Bottom section

The bottom section always shows the state of the drive in *Status* mode.

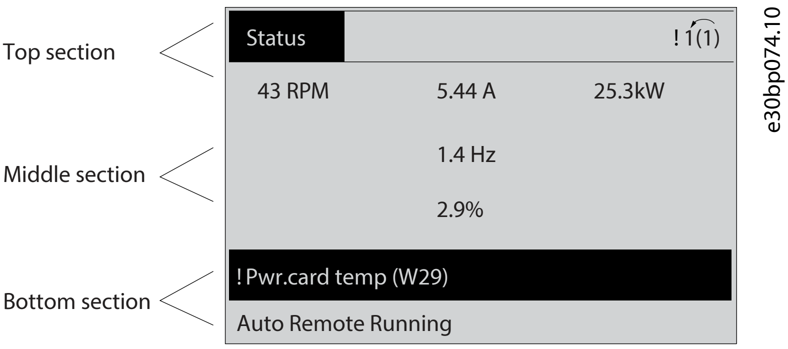


Figure 10: Overview of the Display

The active setup (selected as the active setup in ***parameter 0-10 Active Set-up***) is shown. When programming another setup than the active setup, the number of the programmed setup appears to the right.

Display contrast adjustment

Press [Status] and [▲] for darker display.

Press [Status] and [▼] for brighter display.

Most parameter setups can be changed immediately via the LCP, unless a password has been created via ***parameter 0-60 Main Menu Password*** or via ***parameter 0-65 Quick Menu Password***.

Indicator lights

If certain threshold values are exceeded, the alarm and/or warning indicator lights up, A status and alarm text appear on the LCP. The ON indicator light is activated when the drive receives mains voltage, via a DC bus terminal, or 24 V external supply. At the same time, the back indicator light is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.

- Flashing Red LED/Alarm: Indicates an alarm.

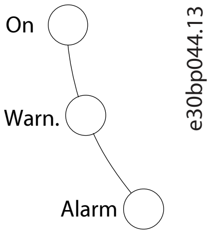


Figure 11: Indicator Lights

4.1.3 LCP Keys

Control keys

The control keys are divided into functions. The keys below the display and indicator lights are used for parameter setup, including option of display indication during normal operation.

Table 2: LCP Keys and Description

LCP keys	Description
[Status]	Indicates the status of the drive and/or the motor. Select between 3 different readouts by pressing [Status]: 5 line readouts, 4 line readouts, or smart logic control. Press [Status] for selecting the mode of display or for changing back to display mode from either the quick menu mode, the main menu mode, or the alarm mode. Also use [Status] to toggle single or double readout mode.
[Quick Menu]	Allows quick access to different quick menus such as: • My personal menu • Quick set-up • Function set-ups • SmartStart • Changes made • Loggings • Water and pumps Press [Quick Menu] to program the parameters belonging to the Quick Menu. It is possible to switch directly between quick menu mode and main menu mode.
[Main Menu]	Use the main menu for programming all parameters. It is possible to switch directly between main menu mode and quick menu mode. Parameter shortcut can be carried out by pressing down [Main Menu] for 3 s. The parameter shortcut allows direct access to any parameter.
[Alarm Log]	Shows and alarm list of the 5 latest alarms (numbered A1–A5). To obtain more details about an alarm, press the navigation keys to maneuver to the alarm number and press [OK]. Information about the condition of the drive before it enters the alarm mode is shown.

Table 2: LCP Keys and Description (continued)

LCP keys	Description
[Back]	Returns to the previous step or layer in the navigation structure.
[Cancel]	Last change or command is canceled as long as the display has not been changed.
[Info]	Supplies information about a command, parameter, or function in any display window. [Info] provides detailed information whenever help is needed. Exit info mode by pressing either [Info], [Back], or [Cancel].
Navigation keys	The 4 navigation keys are used to navigate between the different options available in Quick Menu, Main Menu, and Alarm Log. Press the keys to move the cursor.
[OK]	Press to select a parameter marked by the cursor and to enable the change of a parameter.

Local control keys

Local control keys are at the bottom of the control panel.

Table 3: Local Control Keys and Description

LCP keys	Description
[Hand On]	Enables control of the drive via the LCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-40 [Hand On] Key on LCP***. External stop signals activated with control signals or a fieldbus override a start command via the LCP. The following control signals are still active when [Hand On] is activated: • [Hand On] - [Off] - [Auto On] • Reset • Coast stop inverse • Setup select bit 0 - Setup select bit 1 • Stop command from serial communication • Quick stop • DC brake
[Off]	Stops the connected motor. The key can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-41 [Off] Key on LCP***. If the external stop function is not selected and the [Off] key is inactive, the motor can be stopped by disconnecting the voltage.

Table 3: Local Control Keys and Description (continued)

LCP keys	Description
[Auto On]	Enables the drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the drive starts. The key can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-42 [Auto On] Key on LCP***. **NOTICE** An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand On] – [Auto On].
[Reset]	Use [Reset] for resetting the drive after an alarm (trip). It can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-43 [Reset] Key on LCP***. The parameter shortcut can be carried out be pressing down the [Main Menu] key for 3 s. The parameter shortcut provides direct access to any parameter.

4.1.4 Quick Transfer of Parameter Settings between Multiple Drives

When setup of a drive is completed, store the data in the LCP. Then connect the LCP to another drive and copy the parameter settings to the new drive.

4.1.5 Transferring Data

4.1.5.1 Transferring Data from the Drive to the LCP

1. Go to ***parameter 0-50 LCP Copy***.
2. Press [OK]
3. Select ***[1] All to LCP***.
4. Press [OK].

4.1.5.2 Transferring Data from the LCP to the Drive

1. Go to ***parameter 0-50 LCP Copy***.
2. Press [OK].
3. Select ***[2] All from LCP***.
4. Press [OK].

4.1.6 Display Mode

In normal operation, up to 5 different operating variables can be indicated continuously in the middle section: 1.1, 1.2, and 1.3, as well as 2 and 3.

4.1.7 Display Mode - Selection of Readouts

It is possible to toggle between 3 status readout screens by pressing [Status].

Operating variables with different formatting are shown in each status view (status view I, status view II, and status view III).

Refer to Table 4 to see the measurements that can be linked to each of the operating variables. When options are mounted, more measurements are available.

Define the links:

- ***Parameter 0-20 Display Line 1.1 Small***.
- ***Parameter 0-21 Display Line 1.2 Small***.
- ***Parameter 0-22 Display Line 1.3 Small***.
- ***Parameter 0-23 Display Line 2 Large***.
- ***Parameter 0-24 Display Line 3 Large***.

Access the parameters via [Quick Menu], *Q3 Function Set-ups*, *Q3-1 General Settings*, *Q3-11 Display Settings*.

Each readout parameter selected in ***parameter 0-20 Display Line 1.1 Small*** to ***parameter 0-24 Display Line 3 Large*** has its own scale and digits after a possible decimal point. The larger the numeric value of parameter is, the fewer digits are shown after the decimal point.

Example: Current readout 5.25 A, 15.2 A, 105 A.

Table 4: Units

Operating variable	Unit
Parameter 16-00 Control Word	hex
Parameter 16-01 Reference [Unit]	[Unit]
Parameter 16-02 Reference [%]	%
Parameter 16-03 Status Word	hex
Parameter 16-05 Main Actual Value [%]	%
Parameter 16-06 Actual Position	
Parameter 16-09 Custom Readout	
Parameter 16-10 Power [kW]	[kW]
Parameter 16-11 Power [hp]	[hp]
Parameter 16-12 Motor Voltage	[V]
Parameter 16-13 Frequency	[Hz]
Parameter 16-14 Motor current	[A]
Parameter 16-15 Frequency [%]	%
Parameter 16-16 Torque [Nm]	Nm
Parameter 16-17 Speed [RPM]	[RPM]
Parameter 16-18 Motor Thermal	%
Parameter 16-20 Motor Angle	
Parameter 16-21 Torque [%] High Res.	%
Parameter 16-22 Torque [%]	%
Parameter 16-23 Motor Shaft Power [kW]	kW
Parameter 16-24 Calibrated Stator Resistance	Ω

Table 4: Units (continued)

Operating variable	Unit
Parameter 16-25 Torque [Nm] High	Nm
Parameter 16-30 DC Link Voltage	V
Parameter 16-32 Brake Energy /s	kW
Parameter 16-33 Brake Energy Average	kW
Parameter 16-34 Heatsink Temp.	°C
Parameter 16-35 Inverter Thermal	%
Parameter 16-36 Inv. Nom. Current	A
Parameter 16-37 Inv. Max. Current	A
Parameter 16-38 SL Controller State (This is an array parameter with the selections 16-38.0–16-38.3).	
Parameter 16-39 Control Card Temp.	°C
Parameter 16-40 Logging Buffer Full	
Parameter 16-42 Service Log Counter	
Parameter 16-43 Timed Actions Status	
Parameter 16-45 Motor Phase U Current	A
Parameter 16-46 Motor Phase V Current	A
Parameter 16-47 Motor Phase W Current	A
Parameter 16-48 Speed Ref. After Ramp [RPM]	RPM
Parameter 16-49 Current Fault Source	
Parameter 16-50 External Reference	
Parameter 16-51 Pulse Reference	
Parameter 16-52 Feedback[Unit]	[Unit]
Parameter 16-53 Digi Pot Reference	
Parameter 16-57 Feedback [RPM]	RPM
Parameter 16-60 Digital Input	bin
Parameter 16-61 Terminal 53 Switch Setting	V
Parameter 16-62 Analog Input 53	
Parameter 16-63 Terminal 54 Switch Setting	V
Parameter 16-64 Analog Input 54	
Parameter 16-65 Analog Output 42 [mA]	[mA]
Parameter 16-66 Digital Output [bin]	[bin]
Parameter 16-67 Pulse Input #29 [Hz]	[Hz]

Table 4: Units (continued)

Operating variable	Unit
Parameter 16-68 Freq. Input #33 [Hz]	[Hz]
Parameter 16-69 Pulse Output #27 [Hz]	[Hz]
Parameter 16-70 Pulse Output #29 [Hz]	[Hz]
Parameter 16-71 Relay Output [bin]	
Parameter 16-72 Counter A	
Parameter 16-73 Counter B	
Parameter 16-74 Prec. Stop Counter	
Parameter 16-80 Fieldbus CTW 1	hex
Parameter 16-82 Fieldbus REF 1	hex
Parameter 16-84 Comm. Option STW	hex
Parameter 16-85 FC Port CTW 1	hex
Parameter 16-86 FC Port REF 1	hex
Parameter 16-87 Bus Readout Alarm/Warning (This is an array parameter with the selections 16-87.0–16.87.2).	
Parameter 16-88 Fieldbus Torque FF.	
Parameter 16-89 Configurable Alarm/Warning Word	
Parameter 16-90 Alarm Word	hex
Parameter 16-92 Warning Word	hex
Parameter 16-93 Warning Word 2	hex
Parameter 16-94 Ext. Status Word	hex
Parameter 16-95 Ext. Status Word 2	hex
Parameter 16-96 Maintenance Word	hex
Parameter 16-97 Alarm Word 3	hex
Parameter 16-98 Warning Word 3	hex

4.1.8 Status Views

4.1.8.1 Status View I

The readout state is standard after start-up or initialization. Press [Info] to obtain information about the units linked to the shown operating variables (1.1, 1.2, 1.3, 2, and 3). See the operating variables in the following illustration.

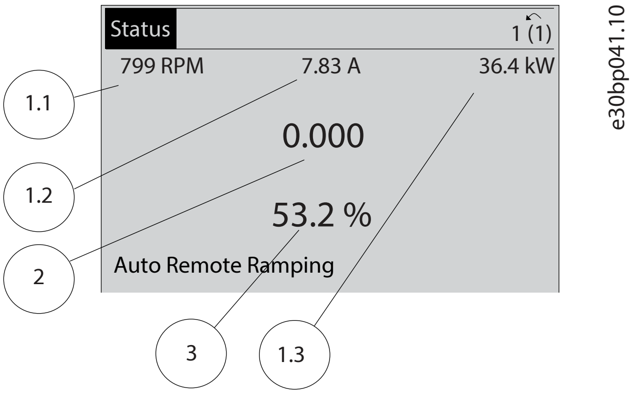


Figure 12: Status View I

4.1.8.2 Status View II

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the following illustration. In the example, speed, motor current, motor power, and frequency are selected in the 1st and 2nd lines.

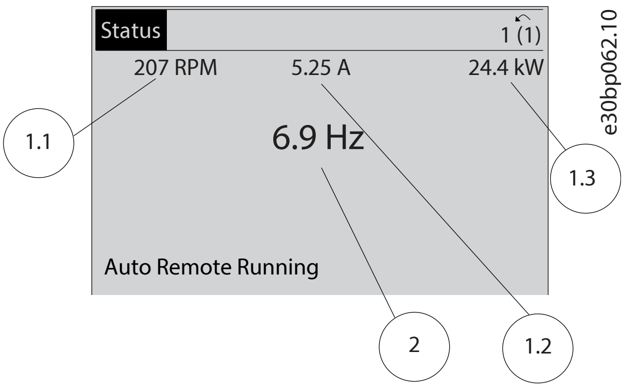


Figure 13: Status View II

4.1.8.3 Status View III

This state shows the event and action of the smart logic control.

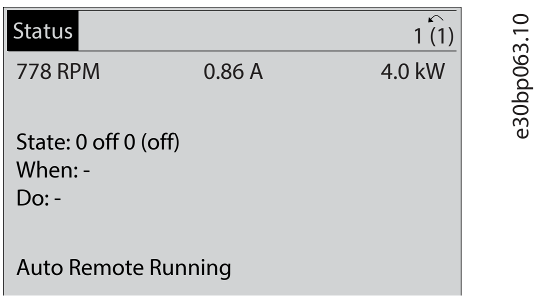


Figure 14: Status View III

4.1.9 Quick Menu Key Functions

Press [Quick Menu] to enter a list of different areas contained in the Quick Menu.

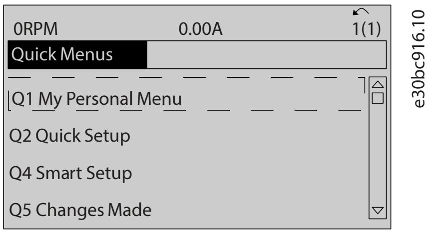


Figure 15: Quick Menus

Select *Q1 My Personal Menu* to show the selected personal parameters. These parameters are selected in ***parameter 0-25 My Personal Menu***. Up to 50 different parameters can be added in this menu.

Select *Q2 Quick Setup* to go through a selection of parameters to get the motor running almost optimally. The default settings for the other parameters consider the required control functions and the configuration of signal inputs/outputs (control terminals).

Parameters are selected via the navigation keys. The parameters in Table 5 are accessible.

Table 5: Selection of Parameter

Parameter	Setting
Parameter 0-01 Language	Select the language. Default is ***[0] English***.
Parameter 1-20 Motor Power [kW]	[kW]
Parameter 1-22 Motor Voltage	[V]
Parameter 1-23 Motor Frequency	[Hz]
Parameter 1-24 Motor Current	[A]
Parameter 1-25 Motor Nominal Speed	[RPM]
Parameter 5-12 Terminal 27 Digital Input	***[0] No function***
Parameter 1-29 Automatic Motor Adaptation (AMA)	***[1] Enable complete AMA***
Parameter 3-02 Minimum Reference	[RPM]
Parameter 3-03 Maximum Reference	[RPM]
Parameter 3-41 Ramp 1 Ramp Up Time	[s]
Parameter 3-42 Ramp 1 Ramp Down Time	[s]
Parameter 3-13 Reference Site	Select whether to control the drive via digital inputs, LCP, or remote control.

*1) If terminal 27 is set to **[0] No operation**, no connection to +24 V on terminal 27 is necessary.*

Select *Changes made* to get the information about:

- The last 10 changes. Use the [▲] [▼] navigation keys to scroll between the last 10 changed parameters.
- The changes made since default setting.

Select *Loggings* to get information about the shown line readouts. The information is shown as graphs. Only parameters selected in ***parameter 0-20 Display Line 1.1 Small*** and ***parameter 0-24 Display Line 3 Large*** can be viewed. It is possible to store up to 120 samples in the memory for later reference.

4.1.10 Q2 Quick Setup

The parameters can easily be set up for most applications only by using the Quick Setup. After pressing [Quick Menu], the different options in the Quick Menu are listed.

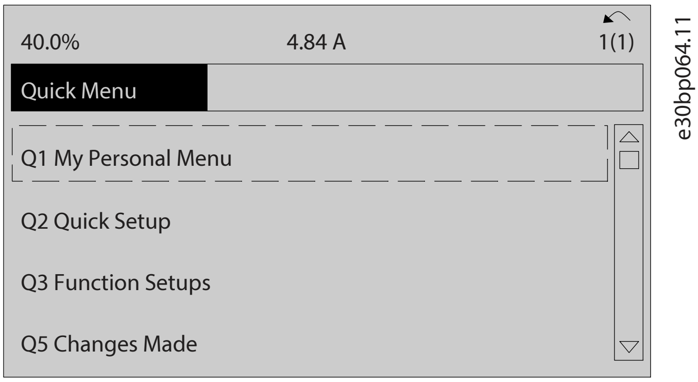


Figure 16: Quick Menu View

The Quick Setup provides access to the 18 most important setups in the drive.

Table 6: Quick Setup Parameters

Parameter		[Unit]
Parameter 0-01 Language		
Parameter 1-20 Motor Power [kW]		[kW]
Parameter 1-21 Motor Power [HP]		[hp]
Parameter 1-22 Motor Voltage(1)		[V]
Parameter 1-23 Motor Frequency		[Hz]
Parameter 1-24 Motor Current		[A]
Parameter 1-25 Motor Nominal Speed		[RPM]
Parameter 1-28 Motor Rotation Check		[Hz]
Parameter 3-41 Ramp 1 Ramp Up Time		[s]
Parameter 3-42 Ramp 1 Ramp Down Time		[s]
Parameter 4-11 Motor Speed Low Limit [RPM]		[RPM]
Parameter 4-12 Motor Speed Low Limit [Hz](1)		[Hz]
Parameter 4-13 Motor Speed High Limit [RPM]		[RPM]
Parameter 4-14 Motor Speed High Limit [Hz](1)		[Hz]
Parameter 3-19 Jog Speed [RPM]		[RPM]
Parameter 3-11 Jog Speed [Hz](1)		[Hz]

Table 6: Quick Setup Parameters (continued)

Parameter		[Unit]
Parameter 5-12 Terminal 27 Digital Input		
Parameter 5-40 Function Relay		

*1) The information shown in the display depends on the selections made in **parameter 0-02 Motor Speed Unit** and **parameter 0-03 Regional Settings**. The default settings of **parameter 0-02 Motor Speed Unit** and **parameter 0-03 Regional Settings** depend on which region of the world the drive is supplied to, but can be reprogrammed as required.*

*2) **Parameter 5-40 Function Relay** is an array. Select between **[0] Relay1** or **[1] Relay2**. Standard setting is **[0] Relay1** with the default option **[9] Alarm**.*

NOTICE

If ***[0] No Operation*** is selected in ***parameter 5-12 Terminal 27 Digital Input***, start can be enabled without connecting +24 V on terminal 27.

4.1.11 Programming in the Quick Setup

This procedure shows an example of how to program the ramp-down time in the Quick Setup.

Procedure

1. Select *Quick Setup*.

   ➲ ***Parameter 0-01 Language*** appears in Quick Setup.

2. Press [▼] repeatedly until ***parameter 3-42 Ramp 1 Ramp Down Time*** appears with the default setting of 20 s.
3. Press [OK].
4. Press [◀] to highlight the 3rd digit before the comma.
5. Change *0* to *1* by pressing [▲].
6. Press [▶] to highlight the digit *2*.
7. Change *2* to *0* by pressing [▼].
8. Press [OK].

➲ The new ramp-down time is now set to 100 s.

4.1.12 Q3 Function Set-ups

The Function Set-ups provide quick access to all parameters required for most water and wastewater applications, including:

- Variable torque
- Constant torque
- Pumps
- Dosing pumps
- Well pumps
- Booster pumps
- Mixer pumps
- Aeration blowers

The Function Set-up parameters are grouped as follows:

- Other pumps
- Fan applications

Among other features, the Function Set-ups also include parameters for selecting the following:

- Which variables to show on the LCP.
- Digital preset speeds.
- Scaling of analog references.
- Closed-loop single-zone and multi-zone applications.
- Specific functions related to water.
- Wastewater applications.

4.1.13 Function Set-ups Overview

4.1.13.1 Function Set-up Q3-1 General Settings

Table 7: Q3-1 General Settings

Q3-1 General settings			
Q3-10 Clock settings	Q3-11 Display settings	Q3-12 Analog output	Q3-13 Relays
Parameter 0-70 Date and Time	***Parameter 0-20 Display Line 1.1 Small***	***Parameter 6-50 Terminal 42 Output***	Relay 1 ⇨ ***Parameter 5-40 Function Relay***
Parameter 0-71 Date Format	***Parameter 0-21 Display Line 1.2 Small***	***Parameter 6-51 Terminal 42 Output Min Scale***	Relay 2 ⇨ ***Parameter 5-40 Function Relay***
Parameter 0-72 Time Format	***Parameter 0-22 Display Line 1.3 Small***	***Parameter 6-52 Terminal 42 Output Max Scale***	Option relay 7 ⇨ ***Parameter 5-40 Function Relay***
Parameter 0-74 DST/ Summertime	***Parameter 0-23 Display Line 2 Large***	–	Option relay 8 ⇨ ***Parameter 5-40 Function Relay***
Parameter 0-76 DST/ Summertime Start	***Parameter 0-24 Display Line 3 Large***	–	Option relay 9 ⇨ ***Parameter 5-40 Function Relay***
Parameter 0-77 DST/ Summertime End	***Parameter 0-37 Display Text 1***	–	–
–	***Parameter 0-38 Display Text 2***	–	–
–	***Parameter 0-39 Display Text 3***	–	–

4.1.13.2 Function Set-up Q3-2 Open-loop Settings

Table 8: Q3-2 Open-loop Settings

Q3-2 Open-loop settings	
Q3-20 Digital reference	Q3-21 Analog reference
Parameter 3-02 Minimum Reference	***Parameter 3-02 Minimum Reference***
Parameter 3-03 Maximum Reference	***Parameter 3-03 Maximum Reference***
Parameter 3-10 Preset Reference	***Parameter 6-10 Terminal 53 Low Voltage***
Parameter 5-13 Terminal 29 Digital Input	***Parameter 6-11 Terminal 53 High Voltage***

Table 8: Q3-2 Open-loop Settings (continued)

Q3-2 Open-loop settings	
Q3-20 Digital reference	**Q3-21 Analog reference**
Parameter 5-14 Terminal 32 Digital Input	***Parameter 6-14 Terminal 53 Low Ref./Feedb. Value***
Parameter 5-15 Terminal 33 Digital Input	***Parameter 6-15 Terminal 53 High Ref./Feedb. Value***

4.1.13.3 Function Set-up Q3-3 Closed-loop Settings

Table 9: Q3-3 Closed-loop Settings

Q3-3 Closed-loop Settings	
Q3-30 Feedback settings	**Q3-31 PID settings**
Parameter 1-00 Configuration Mode	***Parameter 20-81 PID Normal/Inverse Control***
Parameter 20-12 Reference/Feedback Unit	***Parameter 20-82 PID Start Speed [RPM]***
Parameter 3-02 Minimum Reference	***Parameter 20-21 Setpoint 1***
Parameter 3-03 Maximum Reference	***Parameter 20-93 PID Proportional Gain***
Parameter 6-20 Terminal 54 Low Voltage	***Parameter 20-94 PID Integral Time***
Parameter 6-21 Terminal 54 High Voltage	–
Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	–
Parameter 6-25 Terminal 54 High Ref./Feedb. Value	–
Parameter 6-00 Live Zero Timeout Time	–
Parameter 6-01 Live Zero Timeout Function	–

4.1.14 Quick Menu, Q4 SmartStart

SmartStart runs automatically on the 1st power-up of the drive or after a reset to factory settings. SmartStart guides users through a series of steps to ensure correct and most efficient motor control. SmartStart can also be started directly via the Quick Menu.

The following settings are available via SmartStart:

- Single pump/motor: In open loop or closed loop.
- Motor alternation: 2 motors share 1 drive.
- Basic cascade control: Speed control of a single pump in a multi-pump system. For example, this can be a cost-effective solution in booster sets.
- Master/follower: Control of up to 8 drives and pumps to ensure smooth operation of the overall pump system.

4.1.15 Main Menu Mode

Press [Main Menu] to enter the main menu mode. The readout in the following illustration appears on the display. The middle and bottom sections in the display show a list of parameter groups, which can be selected by toggling the [▲] and [▼] keys.

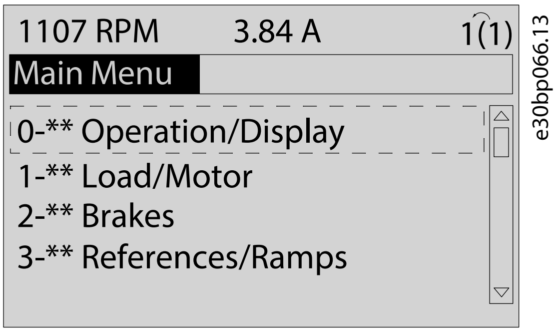


Figure 17: Main Menu Mode

Each parameter has a name and number which remain the same regardless of the programming mode. In the main menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. However, depending on the choice of configuration (***parameter 1-00 Configuration Mode***), some parameters can be hidden. For example, open loop hides all the PID parameters, and other enabled options make more parameter groups visible.

4.1.16 Parameter Selection

In the main menu mode, the parameters are divided into groups. Select a parameter group with the navigation keys.

After selecting a parameter group, select a parameter with the navigation keys.

The middle section on the display shows the parameter number and name, and the selected parameter value.

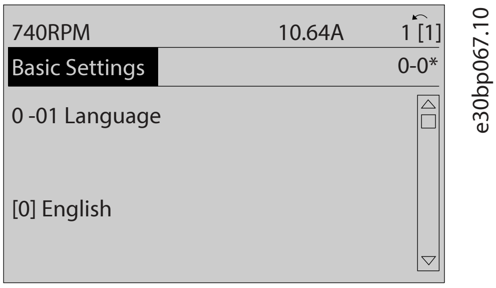


Figure 18: Parameter Selection

4.1.17 Changing Data

The procedure for changing data in the quick menu mode and the main menu mode is the same. Press [OK] to change the selected parameter.

The procedure for changing data depends on whether the selected parameter represents a numeric data value or a text value.

4.1.18 Changing a Text Value

If the selected parameter is a text value, change the text value with the [▲] [▼] keys.

Place the cursor on the value to save and press [OK].

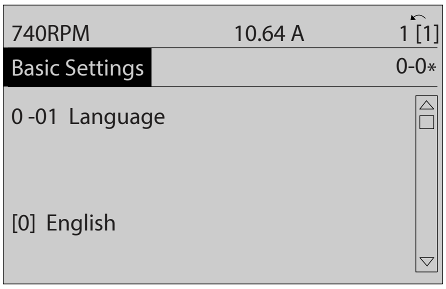


Figure 19: Changing a Text Value

4.1.19 Changing a Data Value

If the selected parameter shows a numeric data value, change the selected data value with the [◀] [▶] and the [▲] [▼] navigation keys. Press the [◀] [▶] keys to move the cursor horizontally.

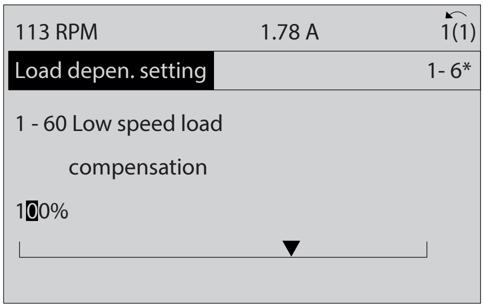


Figure 20: Changing a Data Value

Press the [▲] [▼] keys to change the data value. [▲] increases the data value, and [▼] decreases the data value. Place the cursor on the value to save and press [OK].

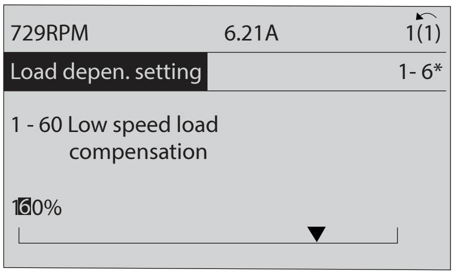


Figure 21: Saving a Data Value

4.1.20 Infinitely Variable Change of Numeric Data Value

If the selected parameter shows a numeric data value, select a digit with [◀] [▶].

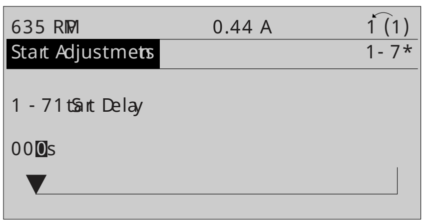


Figure 22: Selecting a Digit

Change the selected digit infinitely variably with [▲] [▼]. The cursor indicates the selected digit. Place the cursor on the digit to save and press [OK].

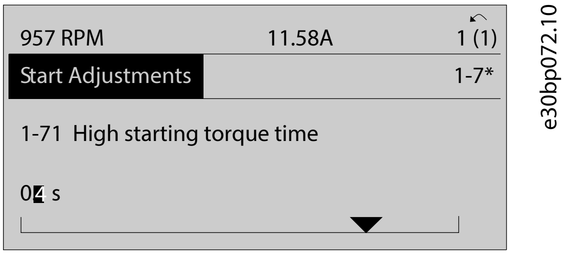


Figure 23: Saving

4.1.21 Value, Step by Step

Certain parameters can be changed step by step. This applies to:

- ***Parameter 1-20 Motor Power [kW]***.
- ***Parameter 1-22 Motor Voltage***.
- ***Parameter 1-23 Motor Frequency***.

The parameters are changed both as a group of numeric data values and as numeric data values that are infinitely varying.

4.1.22 Readout and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack. ***Parameter 15-30 Fault Log: Error Code*** to ***parameter 15-32 Alarm Log: Time*** contain a fault log, which can be read out. Select a parameter, press [OK], and press the [▲] [▼] keys to scroll through the value log.

4.1.23 Changing Values of Indexed Parameters

Change ***parameter 3-10 Preset Reference*** as an example.

Procedure

1. Select the parameter, press [OK], and press [▲] [▼] to scroll through the indexed values.
2. To change the parameter value, select the indexed value and press [OK].
3. Change the value by pressing [▲] [▼].
4. Press [OK] to accept the new setting.
5. Press [Cancel] to abort. Press [Back] to leave the parameter.

4.2 The Numerical Control Panel

4.2.1 Overview of the Numerical LCP

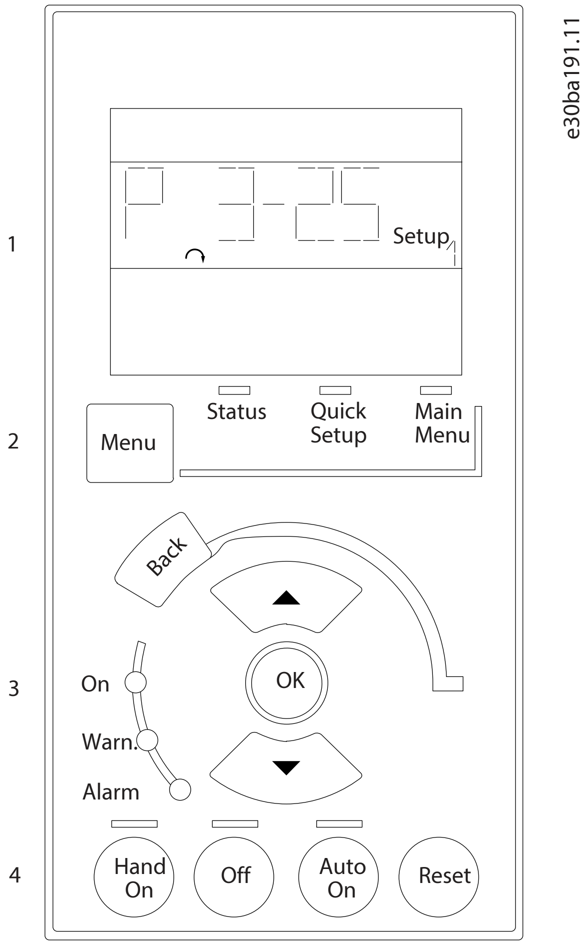


Figure 24: NLCP

1	Numeric display.	**2**	Menu keys and indicator lights - changing parameters and switching between display functions.
3	Navigation keys and indicator lights.	**4**	Operation keys and indicator lights.

Display line

Status messages showing icons and numeric value.

Indicator lights

- Green LED/On: indicates if control section is on.
- Yellow LED/Wrn: indicates a warning.
- Flashing red LED/Alarm: indicates an alarm.

4.2.2 LCP Keys, Numerical LCP

The control keys are divided into functions. The keys below the display and indicator lights are used for parameter setup, including option of display indication during normal operation.

Table 10: LCP Keys and Description

<table>
<tr><th>LCP keys</th><th>Description</th></tr>
<tr><td>[Status]</td><td>Indicates the status of the drive and/or the motor.
If an alarm occurs, the NLCP automatically switches to status mode. Several alarms can be shown.

NOTICE
Parameter copy is not possible with LCP 101 numerical local control panel.

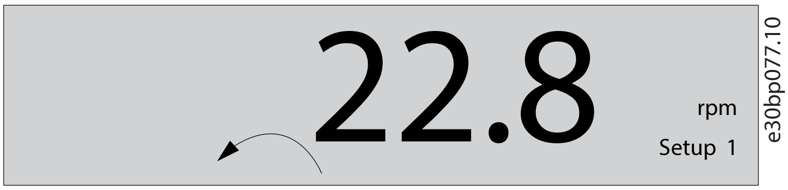


Figure 25: Status Mode

Figure 26: Alarm</td></tr>
<tr><td>[Quick Menu]/[Main Menu]</td><td>Used for programming the parameters in the Quick Menu and Main Menu, respectively. When the value flashes, press [▲] or [▼] to change parameter values. Parameters with functional options show values such as [1], [2], and so on. For a description of the different options, see the individual parameter descriptions in the section Parameter Descriptions.

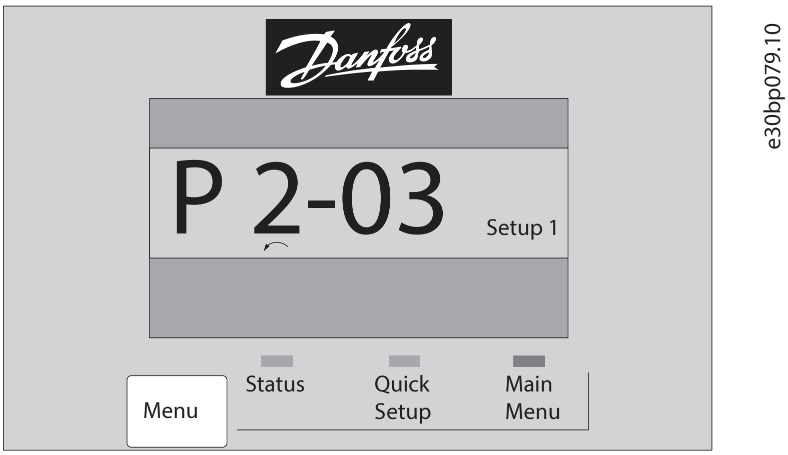


Figure 27: Main Menu/Quick Setup</td></tr>
<tr><td>[Back]</td><td>Returns to the previous step or layer in the navigation structure.</td></tr>
<tr><td>Navigation keys</td><td>The 2 navigation keys are used to navigate between the different options available in Quick Menu and Main Menu. Press the keys to move the cursor.</td></tr>
<tr><td>[OK]</td><td>Press to select a parameter marked by the cursor and to enable the change of a parameter.</td></tr>
</table>

Local control keys: Local control keys are at the bottom of the control panel.

Table 11: Local Control Keys and Description

LCP keys	Description
[Hand On]	Enables control of the drive via the LCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-40 [Hand on] Key on LCP***. External stop signals activated with control signals or a fieldbus override a start command via the LCP. The following control signals are still active when [Hand On] is activated: • [Hand On] - [Off] - [Auto On] • Reset • Coast stop inverse • Reversing • Setup select lsb - Setup select msb • Stop command from serial communication • Quick stop • DC brake
[Off]	Stops the connected motor. The key can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-41 [Off] Key on LCP***. If the external stop function is not selected and the *[Off]* key is inactive, the motor can be stopped by disconnecting the voltage.
[Auto On]	Enables the drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the drive starts. The key can be selected as ***[1] Enable*** or ***[0] Disable*** via ***parameter 0-42 [Auto on] Key on LCP***. **NOTICE** An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand On] – [Auto On].
[Reset]	Is used for resetting the drive after an alarm (trip). It can be selected as ***[1] Enable*** or ***[0] Disable via parameter 0-43 [Reset] key on LCP***.

4.3 Restoring Factory Default Settings

4.3.1 Restoring Factory Default Settings Using the Recommended Initialization

NOTICE

LOSS OF DATA

Restoring default settings results in a loss of programming, motor data, localization, and monitoring records.

- To create a backup, upload data to the LCP before initialization.

1. Press [Main Menu] twice to access parameters.
2. Go to ***parameter 14-22 Operation Mode*** and press [OK].

   Parameter 14-22 Operation Mode does not reset the following settings:

   - Running hours.
   - Serial communication options.
   - Personal menu settings.
   - Fault log, alarm log, and other monitoring functions.
3. Scroll to *Initialization* and press [OK].
4. Remove power to the unit and wait for the display to turn off.
5. Apply power to the unit. Default parameter settings are restored during start-up. Start-up takes slightly longer than normal.
6. After *alarm 80, Drive initialized* appears, press [Reset].

4.3.2 Restoring Factory Default Settings Using Manual Initialization

NOTICE

LOSS OF DATA

Restoring default settings results in a loss of programming, motor data, localization, and monitoring records.

- To create a backup, upload data to the LCP before initialization.

NOTICE

A manual initialization also resets serial communication, RFI filter settings, and fault log settings.

Procedure

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] simultaneously while applying power to the unit (approximately 5 s or until an audible click sounds and the fan starts).

   Manually initializing does not reset the following parameter settings:

   - ***Parameter 15-00 Operating Hours***
   - ***Parameter 15-03 Power Up's***
   - ***Parameter 15-04 Over Temp's***
   - ***Parameter 15-05 Over Volt's***

   Start-up takes slightly longer than normal.

5 Parameter Descriptions

5.1 Selecting Parameters

The parameters are grouped into various parameter groups for easy selection of the correct parameter for optimal operation of the drive.

Parameter descriptions and selections are shown in the LCP. Access the parameters by pressing [Quick Menu] or [Main Menu] on the LCP. The Quick Menu is used mainly for commissioning the unit at start-up by providing parameters necessary to start operation. The Main Menu provides access to all parameters for detailed application programming.

All digital input/output and analog input/output terminals are multifunctional. All terminals have factory setting functions suitable for a wide range of relevant applications. If other special functions are required, they must be programmed in *parameter groups 5-** Digital In/Out* or *6-** Analog In/Out*.

An asterisk (*) following an option number in a parameter indicates a default setting.

5.2 Parameter Group 0-** Operation and Display

5.2.1 Introduction to Parameter Group 0-** Operation and Display

Parameters related to the basic functions of the drive, function of the LCP keys, and configuration of the LCP display.

5.2.2 0-0* Basic Settings

0-01 Language

Default value:	[0] English	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Defines the language to be used in the display. The drive is delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.

Option	Name	Description
[0]*	English	Part of language packages 1–4.
[1]	Deutsch	Part of language packages 1–4.
[2]	Français	Part of language package 1.
[3]	Dansk	Part of language package 1.
[4]	Español	Part of language package 1.
[5]	Italiano	Part of language package 1.
[6]	Svenska	Part of language package 1.
[7]	Nederlands	Part of language package 1.
[10]	Chinese	Part of language package 2.
[20]	Suomi	Part of language package 1.
[22]	English US	Part of language package 4.
[27]	Greek	Part of language package 4.

Option	Name	Description
[28]	Bras. Port	Part of language package 4.
[36]	Slovenian	Part of language package 3.
[39]	Korean	Part of language package 2.
[40]	Japanese	Part of language package 2.
[41]	Turkish	Part of language package 4.
[42]	Trad.Chinese	Part of language package 2.
[43]	Bulgarian	Part of language package 3.
[44]	Srpski	Part of language package 3.
[45]	Romanian	Part of language package 3.
[46]	Magyar	Part of language package 3.
[47]	Czech	Part of language package 3.
[48]	Polski	Part of language package 4.
[49]	Russian	Part of language package 3.
[50]	Thai	Part of language package 2.
[51]	Bahasa Indonesia	Part of language package 2.
[52]	Hrvatski	Part of language package 2.

0-02 Motor Speed Unit

Default value:	[0] RPM	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Changing the motor speed unit resets certain parameters to their initial value. Select the motor speed unit before modifying other parameters.

The information shown in the display depends on the settings in ***parameter 0-02 Motor Speed Unit*** and ***parameter 0-03 Regional Settings***. The default settings of ***parameter 0-02 Motor Speed Unit*** and ***parameter 0-03 Regional Settings*** depend on the region to which the drive is supplied.

Option	Name	Description
[0]*	RPM	Select to show motor speed variables and parameters using motor speed (RPM).
[1]	Hz	Select to show motor speed variables and parameters using output frequency (Hz).

0-03 Regional Setting

Default value:	[0] International	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

The display output depends on the settings in ***parameter 0-02 Motor Speed Unit*** and ***parameter 0-03 Regional Settings***. The default settings of ***parameter 0-02 Motor Speed Unit*** and ***parameter 0-03 Regional Settings*** depend on which region of the world the frequency converter is supplied to. Reprogram the settings as required. The settings not used are made invisible.

Option	Name	Description
[0]*	International	Activate ***parameter 1-20 Motor Power [kW]*** for setting the motor power in kW and set the default value of ***parameter 1-23 Motor Frequency*** to 50 Hz.
[1]	North America	Activate ***parameter 1-21 Motor Power [HP]*** for setting the motor power in hp and set the default value of ***parameter 1-23 Motor Frequency*** to 60 Hz.

0-04 Operating State at Power-up (Hand)

Default value:	[0] Resume	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the operating mode upon reconnection of the drive to mains voltage after power-down in hand-on mode.

Option	Name	Description
[0]*	Resume	Restart the drive, maintaining the start/stop settings (applied by [Hand On]/[Off]) selected before the power-down of the drive.
[1]	Forced stop, ref=old	Restart the drive with a saved local reference after mains voltage reappears and after pressing [Hand On].

0-05 Local Mode Unit

Default value:	[0] As motor speed	**Parameter type:**	Option

Setup:	2 setups	**Conversion index:**	–
Data Type:	Uint8	**Change during operation:**	False

This parameter defines if the local reference unit should be shown as the motor shaft speed (in RPM/Hz) or as percent.

Option	Name	Description
[0]*	As motor speed unit	
[1]	%	

5.2.3 0-1* Set-up Operations

Define and control the individual parameter setups. The drive has 4 parameter setups that can be programmed independently of each other. This makes the drive flexible in use and able to meet the requirements of many different water system control schemes, often saving the cost of external control equipment. For example, the setups can be used to program the drive to operate according to 1 control scheme in 1 setup and another control scheme in another setup. Alternatively, they can be used by an air handling unit or an OEM unit to identically program all their factory-fitted drives for different equipment models within a range to have the same parameters. During production/commissioning, select a specific setup depending on the drive model. Select the active setup (the setup in which the drive is operating) in ***parameter 0-10 Active Set-up***. The LCP then shows the selected active setup. Using multi setup, it is possible to switch between setups when the drive running or stopped, via digital input, or serial communication commands (for example, for night setback). If it is necessary to change setups while running, ensure that ***parameter 0-12 This Set-up Linked to*** is programmed as required. For most water/wastewater applications, it is not necessary to program ***parameter 0-12 This Set-up Linked to***even if change of setup is required when running. However, for complex applications using the full flexibility of the multiple setups, it may be required. Using ***parameter 0-11 Programming Set-up***, it is possible to edit parameters within any of the setups while continuing the drive operation in the active setup. The active setup can be a different setup to the one being edited. Using ***parameter 0-51 Set-up Copy***, it is possible to copy parameter settings between the setups to enable quicker commissioning if similar parameter settings are required in different setups.

0-10 Active Set-up

Default value:	[1] Set-up 1	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the setup to control the drive functions.

Option	Name	Description
[0]	Factory setup	Cannot be changed. It contains the data set and can be used as a data source when returning the other setups to a known state.
[1]*	Set-up 1	***[1] Set-up 1*** to ***[4] Set-up 4*** are the 4 separate parameter setups within which all parameters can be programmed.
[2]	Set-up 2	
[3]	Set-up 3	

Option	Name	Description
[4]	Set-up 4	
[9]	Multi Set-up	Remote setup selections using digital inputs and the serial communication port. This setup used the settings from ***parameter 0-12 This Set-up Linked to***. Stop the drive before making changes to open-loop and closed-loop functions.

0-11 Edit Set-up

Default value:	[9] Active set-up	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the setup to be edited (that is programmed) during operation, either the active setup or 1 of the inactive setups.

Option	Name	Description
[0]	Factory setup	Cannot be edited, but it is useful as a data source to return the other setups to a known state.
[1]	Set-up 1	***[1] Set-up 1*** to ***[4] Set-up 4*** can be edited freely during operation, independently of the active setup.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]*	Active Set-up	Can also be edited during operation. Edit the selected setup from a range of sources: LCP, FC RS485, FC USB, or up to 5 fieldbus sites.

0-12 This Set-up Linked to

Default value:	[0] Not linked	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

To enable conflict-free changes from 1 setup to another during operation, link setups containing parameters which are not changeable during operation. The link ensures synchronizing of the not changeable during operation-parameter values when moving from 1 setup to another during operation. Not changeable during operation-parameters can be identified by the label FALSE in the *Change during operation* field. ***Parameter 0-12 This Set-up Linked to*** is used by ***[9] Multi set-up*** in ***parameter 0-10 Active Set-up***. Multi setup is used to move from 1 setup to another during operation.

Option	Name	Description
[0]*	Not linked	
[1]	Set-up 1	

Option	Name	Description
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	

0-13 Readout: Linked Set-ups

Default value:	0	**Parameter type:**	Range, 0 – 255, Array [5]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View a list of all the setups linked by ***parameter 0-12 This Set-up Linked to***. The parameter has 1 index for each parameter setup. The value for each index shows which setups are linked to that parameter setup.

Table 12: Setup Link Example

Index	LCP value
0	{0}
1	{1,2}
2	{1,2}
3	{3}
4	{4}

0-14 Readout: Edit Set-ups/Channel

Default value:	0	**Parameter type:**	Range, -2147483648–2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the setting of ***parameter 0-11 Edit Set-up*** for each of the 4 different communication channels. When the number is shown as a hex number, as it is in the LCP, each number represents 1 channel. Numbers 1–4 represent a setup number; F means factory setting; and A means active setup. The channels are, from right to left: LCP, FC bus, USB, HPFB1-5.

0-15 Readout: Actual Set-up

Default value:	0	**Parameter type:**	Range, 0–255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Makes it possible to read out the active setup, also when ***[9] Multi Set-up*** is selected in ***parameter 0-10 Active Set-up***.

0-17 Active Emergency Setup

Default value:	0	**Parameter type:**	Range, 0–255

Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Read out the active emergency setup selected by either digital inputs or via fieldbus.

5.2.4 0-2* LCP Display

Define the variable shown in the LCP.

NOTICE

For information on how to write display texts, refer to:

- ***Parameter 0-37 Display Text 1***
- ***Parameter 0-38 Display Text 2***
- ***Parameter 0-39 Display Text 3***

0-20 Display Line 1.1 Small

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable for display in line 1, left position.

Option	Name	Description
[0]	None	No display value selected.
[15]	Readout: actual setup	
[17]	Active emergency setup	
[37]	Display text 1	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[38]	Display text 2	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[39]	Display text 3	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[89]	Date and time readout	Shows the current date and time.
[592]	Application bus control	
[953]	PROFIBUS Warning Word	Shows the PROFIBUS communication warnings.
[1005]	Readout transmit error counter	View the number of CAN control transmission errors since the last power-up.
[1006]	Readout receive error counter	View the number of CAN control receipt errors since the last power-up.
[1007]	Readout bus off counter	View the number of bus off-events since the last power-up.

Option	Name	Description
[1013]	Warning parameter	View a DeviceNet-specific warning word. One separate bit is assigned to every warning.
[1230]	Warning parameter	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1500]	Operating hours	
[1501]	Running hours	View the number of running hours of the motor.
[1502]	kWh counter	View the mains power consumption in kWh.
[1580]	Fan running hours	
[1587]	kWh counter hires	
[1600]	Control word	View the control word sent from the drive via the serial communication port in hex code.
[1601]	Reference [Unit]	Total reference (sum of digital/analog/preset/bus/freeze reference/catch up and slow down) in selected unit.
[1602]	Reference %	Total reference (sum of digital/analog/preset/bus/freeze reference/catch up and slow down) in percent.
[1603]	Status word	Present status word.
[1605]	Main actual value [%]	View the 2-byte word sent with the status word to the bus master reporting the main actual value in %.
[1609]	Custom readout	View the user-defined readouts as defined in: • *Parameter 0-30 Custom Readout Unit* • *Parameter 0-31 Custom Readout Min Value* • *Parameter 0-32 Custom Readout Max Value*
[1610]	Power [kW]	Actual power consumed by the motor in kW.
[1611]	Power [hp]	Actual power consumed by the motor in hp.
[1612]	Motor voltage	Voltage supplied to the motor.
[1613]	Frequency	Motor frequency, that is, the output frequency from the drive in Hz.
[1614]	Motor current	Phase curent of the motor measured as effective value.
[1615]	Frequency [%]	Motor frequency, that is, the output frequency from the drive in percent.
[1616]	Torque [Nm]	Actual motor torque in Nm.
[1617]	Speed [RPM]	Speed in RPM (revolutions per minute), that is, the motor shaft speed in closed loop.
[1618]	Motor thermal	Thermal load on the motor calculated by the ETR function.

Option	Name	Description
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	
[1622]	Torque [%]	Present motor load as a percentage of the rated motor torque.
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	DC-link voltage in the drive.
[1631]	System temp.	
[1632]	Brake energy /s	Present brake power transferred to an external brake resistor. Stated as an instant value.
[1633]	Brake energy average	Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 s.
[1634]	Heatsink temp.	Present heat sink temperature of the drive. The cutout limit is 95 ±5 °C (203 ±9 °F); cutting back in occurs at 70 ±5 °C (158 ±9 °F).
[1635]	Inverter thermal	Percentage load of the inverters.
[1636]	Inv. nom. current	Nominal current of the drive.
[1637]	Inv. max. current	Maximum current of the drive.
[1638]	SL controller state	State of the event executed by the control.
[1639]	Control card temp.	Temperature of the control card.
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	Sum of the external reference as a percentage, that is, the sum of analog/pulse/bus.
[1652]	Feedback [Unit]	Reference value from programmed digital inputs.
[1653]	Digi pot reference	View the contribution of the digital potentiometer to the actual reference feedback.
[1654]	Feedback 1 [Unit]	
[1655]	Feedback 2 [Unit]	
[1656]	Feedback 3 [Unit]	

Option	Name	Description
[1658]	PID output [%]	
[1659]	Adjusted setpoint	
[1660]	Digital input	Signal states from the 6 digital terminals (18, 19, 27, 29, 32, and 33). There are 16 bits in total, but only 6 of them are used. Input 18 corresponds to the far left of the used bits. Signal low=0; Signal high=1.
[1661]	Terminal 53 switch setting	Setting of input terminal 54. Current=0; Voltage=1.
[1662]	Analog input 53	Actual value at input 53 either as a reference or protection value.
[1663]	Terminal 54 switch setting	Setting of input terminal 54. Current=0; Voltage=1.
[1664]	Analog input 54	Actual value at input 54 either as reference or protection value.
[1665]	Analog output 42 [mA]	Actual value at output 42 in mA. Use *parameter 6-50 Terminal 42 Output* to select the value to be shown.
[1666]	Digital output [bin]	Binary value of all digital outputs.
[1667]	Pulse input #29 [Hz]	Actual value of the frequency applied at terminal 29 as an impulse input.
[1668]	Pulse input #33 [Hz]	Actual value of the frequency applied at terminal 33 as an impulse input.
[1669]	Pulse output #27 [Hz]	Actual value of impulses applied to terminal 27 in digital output mode.
[1670]	Pulse output #29 [Hz]	Actual value of impulses applied to terminal 29 in digital output mode.
[1671]	Relay output [bin]	View the settings of all relays.
[1672]	Counter A	Application-dependent (for example, SLC control).
[1673]	Counter B	Application-dependent(for example, SLC control).
[1675]	Analog in X30/11	Actual value at input X30/11 either as reference or protection value.
[1676]	Analog in X30/12	Actual value at input X30/12 either as reference or protection value.
[1677]	Analog out X30/8 [mA]	Actual value at output X30/8 in mA. Use ***parameter 6-60 Terminal X30/8 Output*** to select the value to be shown.
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1680]	Fieldbus CTW 1	Control word (CTW) received from the bus master.
[1682]	Fieldbus REF 1	Mains reference value sent with control word from the bus master.
[1684]	Comm. option STW	Extended fieldbus communication option status word.
[1685]	FC port CTW 1	Control word (CTW) received from the bus master.

Option	Name	Description
[1686]	FC port REF 1	Status word (STW) sent to the bus master.
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	One or more alarms in a hex code.
[1691]	Alarm word 2	One or more alarms in a hex code.
[1692]	Warning word	One or more warnings in s hex code.
[1693]	Warning word 2	One or more warnings in a hex code.
[1694]	Ext. status word	One or more status conditions in a hex code.
[1695]	Ext. status word 2	One or more status conditions in a hex code.
[1696]	Maintenance word	The bits reflect the status for the programmed preventive maintenance events in *parameter group 23-1* Maintenance* .
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog input X42/7 [V]	
[1834]	Analog input X42/9 [V]	
[1835]	Analog input X42/11	
[1836]	Analog input X48/2 [mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warnin count	

Option	Name	Description
[1850]	Sensorless readout [Unit]	
[1860]	Digital input 2	
[1870]	Mains voltage	
[1871]	Mains frequency	
[1872]	Mains imbalance	
[1873]	Worst inrush	
[1874]	Inrush mode	
[1875]	Rectifier DC volt.	
[1876]	Mains voltage2	
[1877]	Mains frequency2	
[1878]	Mains imbalance2	
[1879]	Rectifier DC volt.2	
[2117]	Ext. 1 reference [Unit]	
[2118]	Ext. 1 feedback [Unit]	
[2119]	Ext. 1 output [%]	
[2137]	Ext. 2 reference [Unit]	
[2138]	Ext. 2 feedback [Unit]	
[2139]	Ext. 2 output [%]	
[2157]	Ext. 3 reference [Unit]	
[2158]	Ext. 3 feedback [Unit]	
[2159]	Ext. 3 output [%]	
[2230]	No-flow power	
[2316]	Maintenance text	
[2580]	Cascade status	
[2581]	Pump status	
[2587]	Inverse interlock	
[2791]	Cascade reference	
[2792]	% of total capacity	
[2793]	Cascade option status	
[2794]	Cascade system status	
[2795]	Advanced cascade relay output [bin]	
[2796]	Extended cascade relay output [bin]	
[2920]	Derag power [kW]	

Option	Name	Description
[2921]	Derag power [HP]	
[2965]	Totalized volume	
[2966]	Actual volume	
[2969]	Flow	
[3110]	Bypass status word	
[3111]	Bypass running hours	
[3401]	PCD 1 write to MCO	
[3402]	PCD 2 write to MCO	
[3403]	PCD 3 write to MCO	
[3404]	PCD 4 write to MCO	
[3405]	PCD 5 write to MCO	
[3406]	PCD 6 write to MCO	
[3407]	PCD 7 write to MCO	
[3408]	PCD 8 write to MCO	
[3409]	PCD 9 write to MCO	
[3410]	PCD 10 write to MCO	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	
[3430]	PCD 10 read from MCO	
[4521]	Status	
[4522]	Progress	
[4523]	Baseline result info	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	

Option	Name	Description
[4594]	Sensor 2 [%]	
[4595]	Sensor 2 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	

0-21 Display Line 1.2 Small

The options are the same as those listed for ***parameter 0-20 Display Line 1.1 Small***. Select a variable to show in line 1, center position.

0-22 Display Line 1.3 Small

The options are the same as those listed for ***parameter 0-20 Display Line 1.1 Small***. Select a variable to show in line 1, right position.

0-23 Display Line 2 Large

The options are the same as those listed for ***parameter 0-20 Display Line 1.1 Small***. Select a variable to show in line 2.

0-24 Display Line 3 Large

The options are the same as those listed for ***parameter 0-20 Display Line 1.1 Small***. Select a variable to show in line 3.

0-25 My Personal Menu

Default value:	Size related	**Parameter type:**	Range, 0 - 9999, Array [50]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Define up to 50 parameters to appear in the *Q1 Personal Menu*, accessible via the [Quick Menu] key on the LCP. The parameters are shown in the *Q1 Personal Menu* in the order they are programmed into this array parameter. Delete parameters by setting the value to 0000. For example, this can be used to provide quick, simple access to just 1 or up to 50 parameters, which require changing on a regular basis (for example, for plant maintenance reasons) or by an OEM to enable simple commissioning of their equipment.

5.2.5 0-3* LCP Custom Readout

It is possible to customize the display elements for various purposes:

- Custom readout. Value proportional to speed (linear, squared, or cubed depending on the unit selected in ***parameter 0-30 Custom Readout Unit***.
- Display text. Text string stored in a parameter.

Custom readout

The calculated value to be shown is based on the settings in:

- ***Parameter 0-30 Custom Readout Unit***.
- ***Parameter 0-31 Custom Readout Min Value***(linear only).
- ***Parameter 0-32 Custom Readout Max Value***.
- ***Parameter 4-13 Motor Speed High Limit [RPM]***.
- ***Parameter 4-14 Motor Speed High Limit [Hz]***.

- Actual speed.

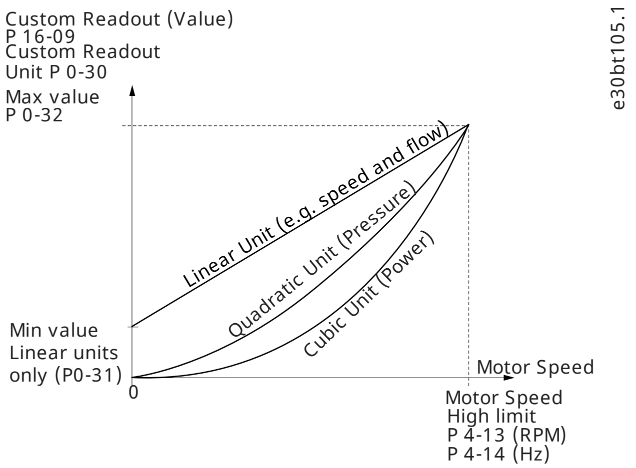


Figure 28: Custom Readout

The relation depends on the type of unit selected in ***parameter 0-30 Custom Readout Unit***.

Table 13: Speed Relations for Different Unit Types

Unit type	Speed relation
Dimensionless	Linear
Speed	
Flow, volume	
Flow, mass	
Velocity	
Length	
Temperature	
Pressure	Quadratic
Power	Cubic

0-30 Unit for User-defined Readout

Default value:	[1] %	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

It is possible to program a value to be shown in the display of the LCP. The value has a linear, squared, or cubed relation to speed. This relation depends on the unit selected (see Table 3.2). The actual calculated value can be read in ***parameter 16-09 Custom Readout***, and/ or shown in the display by selecting ***[16-09] Custom Readout*** in ***parameter 0-20 Display Line 1.1 Small*** to ***parameter 0-24 Display Line 3 Large***.

Option	Name	Description
[0]	None	
[1]*	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	

Option	Name	Description
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	hp	

0-31 Min Value of User-defined Readout

Default value:	Size related	**Parameter type:**	Range, -999999.99 CustomReadoutUnit - 100.00 CustomReadoutUnit
Setup:	All setup	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

This parameter sets the minimum value of the custom-defined readout (occurs at 0 speed). Only possible to set different from 0 when selecting a linear unit in ***parameter 0-30 Unit for User-defined Readout***. For quadratic and cubic units, the minimum value is 0.

0-32 Max Value of User-defined Readout

Default value:	100 CustomReadoutUnit	**Parameter type:**	Range, par. 0-31 -999999.99 CustomReadoutUnit
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

This parameter sets the maximum value to be shown when the speed of the motor has reached the set value for ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]*** (depends on setting in ***parameter 0-02 Motor Speed Unit***).

Parameter 0-37 Display Text 1

Default value:	0	**Parameter type:**	Range, 0 - 25
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

Enter a text which can be viewed in the graphical display by selecting ***[37] Display Text 1*** in

- ***Parameter 0-20 Display Line 1 Small***
- ***Parameter 0-21 Display Line 1.2 Small***
- ***Parameter 0-22 Display Line 1.3 Small***
- ***Parameter 0-23 Display Line 2 Large***
- ***Parameter 0-24 Display Line 3 Large***

0-38 Display Text 2

Default value:	0	**Parameter type:**	Range, 0–25
Setup:	1 setup	**Conversion index**	0
Data type:	VisStr[25]	**Change during operation:**	True

Enter a text which can be viewed in the graphical display by selecting ***[38] Display Text 2*** in

- ***Parameter 0-20 Display Line 1 Small***
- ***Parameter 0-21 Display Line 1.2 Small***
- ***Parameter 0-22 Display Line 1.3 Small***
- ***Parameter 0-23 Display Line 2 Large***
- ***Parameter 0-24 Display Line 3 Large***

0-39 Display Text 3

Default value:	0	**Parameter type:**	Range, 0–25
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

Enter a text which can be viewed in the graphical display by selecting ***[39] Display Text 3*** in

- ***Parameter 0-20 Display Line 1 Small***
- ***Parameter 0-21 Display Line 1.2 Small***
- ***Parameter 0-22 Display Line 1.3 Small***
- ***Parameter 0-23 Display Line 2 Large***
- ***Parameter 0-24 Display Line 3 Large***

5.2.6 0-4* LCP Keypad

Enable, disable, and password protect individual keys on the LCP.

0-40 [Hand On] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Disabled	No effect when [Hand On] is pressed. Select ***[0] Disabled*** to avoid accidental start of the drive in hand-on mode.
[1]*	Enabled	The LCP switches to hand-on mode directly when [Hand On] is pressed.
[2]	Password	After pressing [Hand On] a password is required. If ***parameter 0-40 [Hand on] Key on LCP*** is included in *My Personal Menu*, define the password in ***parameter 0-65 Personal Menu Password***. Otherwise define the password in ***parameter 0-60 Main Menu Password***.
[3]	Enabled without OFF	
[4]	Password without OFF	
[5]	Enabled with OFF	
[6]	Password with OFF	
[9]	Enabled, ref=0	

0-41 [Off] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Disabled	Avoids accidental stop of the drive.
[1]*	Enabled	
[2]	Password	Avoids unauthorized stop. If ***parameter 0-41 [Off] Key on LCP*** is included in the Quick Menu, then define the password in ***parameter 0-65 Personal Menu Password***.

0-42 [Auto On] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Disabled	Avoids accidental stop of the drive in auto-on mode.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If ***parameter 0-42 [Auto on] Key on LCP*** is included in the Quick Menu, then define the password in ***parameter 0-65 Personal Menu Password***.

0-43 [Reset] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Disabled	No effect when [Reset] is pressed. Avoids accidental alarm reset.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If ***parameter 0-43 [Reset] Key on LCP*** is included in the Quick Menu, then define the password in ***parameter 0-65 Personal Menu Password***.
[3]	Enabled without OFF	Resets the drive without setting it in Off mode.
[4]	Password without OFF	Resets the drive without setting it in Off mode. A password is required when pressing [Reset] (see option ***[2] Password***).
[5]	Enable with OFF	
[6]	Password with OFF	

0-44 [Off/Reset] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is only available when a VLT® Bypass Option MCB 104 is installed in the drive.

Enable or disable the [Off/Reset] key.

Option	Name	Description
[0]	Disabled	No effect when [Reset] is pressed. Avoids accidental alarm reset.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If ***parameter 0-43 [Reset] Key on LCP*** is included in the Quick Menu, then define the password in ***parameter 0-65 Personal Menu Password***.

0-45 [Drive Bypass] Key on LCP

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is only available when a VLT® Bypass Option MCB 114 is installed in the drive.

Press [Off] and select ***[0] Disabled*** to avoid unintended stop of the drive. Press [Off] and select ***[2] Password*** to avoid unauthorized bypass of the drive. If ***parameter 0-45 [Drive Bypass] Key on LCP*** is included in the Quick Menu, define the password in ***parameter 0-65 Personal Menu Password***.

Option	Name	Description
[0]	Disabled	Disables the key.
[1]*	Enabled	
[2]	Password	

5.2.7 0-5* Copy/Save

Copy parameters from and to the LCP. Use these parameters for saving and copying setups from 1 drive to another.

0-50 LCP Copy

Default value:	[0] No copy	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	No copy	
[1]	All to LCP	Copies all parameters in all setups from the drive memory to the LCP memory.

Option	Name	Description
[2]	All from LCP	Copies all parameters in all setups from the LCP memory to the drive memory.
[3]	Size indep. from LCP	Copy only the parameters that are independent of the motor size. This selection can be used to program several drives with the same function without disturbing motor data.
[10]	Delete LCP copy data	Use to delete the copy after the transfer is complete.

0-51 Set-up Copy

Default value:	[0] No copy	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Option	Name	Description
[0]*	No copy	No function.
[1]	Copy to set-up 1	Copies all parameters in the present programming setup (defined in ***parameter 0-11 Edit Set-up***) to set-up 1.
[2]	Copy to set-up 2	Copies all parameters in the present programming setup (defined in ***parameter 0-11 Edit Set-up***) to set-up 2.
[3]	Copy to set-up 3	Copies all parameters in the present programming setup (defined in ***parameter 0-11 Edit Set-up***) to set-up 3.
[4]	Copy to set-up 4	Copies all parameters in the present programming setup (defined in ***parameter 0-11 Edit Set-up***) to set-up 4.
[9]	Copy to all	Copies the parameters in the present setup to each of the setups 1 to 4.

5.2.8 0-6* Password

0-60 Main Menu Password

Default value:	100	**Parameter type:**	Range, -9999 - 9999
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation**	True

Define the password for access to the Main Menu via the [Main Menu] key. If ***parameter 0-61 Access to Main Menu w/o Password*** is set to ***[0] Full access***, this parameter is ignored.

0-61 Access to Main Menu w/o Password

Default value:	[0] Full access	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Full access	Disables password defined in ***parameter 0-60 Main Menu Password***.
[1]	LCP: Read only	Prevent unauthorized editing of Main Menu parameters.
[2]	LCP: No access	Prevent unauthorized viewing and editing of Main Menu parameters.
[3]	Bus: Read only	Read-only functions for parameters on fieldbus and/or FC standard bus.
[4]	Bus: No access	No access to parameters is allowed via fieldbus and/or FC standard bus.
[5]	All: Read only	Read-only function for parameters on LCP, fieldbus, or FC standard bus.
[6]	All: No access	No access from LCP, fieldbus, or FC standard bus is allowed.

0-65 Personal Menu Password

Default value:	200	**Parameter type:**	Range, -9999 - 9999
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Define the password for access to the Quick Menu via the [Quick Menu] key. If ***parameter 0-66 Access to Personal Menu w/o Password*** is set to ***[0] Full access***, this parameter is ignored.

0-66 Access to Personal Menu w/o Password

Default value:	[0] Full access	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

If ***parameter 0-61 Access to Main Menu w/o Password*** is set to ***[0] Full access***, this parameter is ignored.

Option	Name	Description
[0]*	Full access	Disables password defined in ***parameter 0-65 Personal Menu Password***.
[1]	LCP: Read only	Prevent unauthorized editing of Quick Menu parameters.
[3]	Bus: Read only	Read-only functions for Quick Menu parameters on fieldbus and/or FC standard bus.
[5]	All: Read only	Read-only function for Quick Menu parameters on LCP, fieldbus, or FC standard bus.

0-67 Bus Password Access

Default value:	0	**Parameter type:**	Range, 0 - 9999

Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Use this parameter to unlock the drive via fieldbus or VLT® Motion Control Tool MCT 10.

When a valid password is entered, the drives is unlocked for 30 minutes.

5.2.9 0-7* Clock Settings

Set the time and date of the internal clock. The internal clock can be used for functions such as:

- Timed actions
- Energy log
- Trend analysis
- Date/time stamps on alarms
- Logged data
- Preventive maintenance

It is possible to program the clock for daylight saving time/summertime, weekly working days/non-working days including 20 exceptions, for example, holidays. Although the clock settings can be set via the LCP, they can also be set along with timed actions and preventive maintenance functions using the VLT Motion Control Tool MCT 10.

NOTICE

The drive has no back-up of the clock function and the set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. If no module with back-up is installed, only use the clock function if the drive is integrated into the BMS using serial communications, with the BMS maintaining synchronization of control equipment clock times. In ***parameter 0-79 Clock Fault***, it is possible to program the occurrence of a warning if the clock has not been set properly, for example, after a power-down.

NOTICE

If mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

0-70 Date and Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

Sets the date and time of the internal clock. The format to be used is set in ***parameter 0-71 Date Format*** and ***parameter 0-72 Time Format***. When using the VLT® Real-time Clock MCB 117 option, the time is synchronized at 15:00 every day.

0-71 Date Format

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the date format to be used in the LCP.

Option	Name	Description
[0]	YYYY-MM-DD	
[1]	DD-MM-YYYY	
[2]	MM/DD/YYYY	

0-72 Time Format

Default value:	[0] 24 h	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	24 h	
[1]	12 h	

0-73 Time Zone Offset

Default value:	0 min	**Parameter type:**	Range, -780 - 780 min
Setup:	2 setups	**Conversion index:**	70
Data type:	Int16	**Change during operation:**	False

Enter the time zone offset relative to UTC. This parameter is required for the automatic daylight saving time adjustment.

0-74 DST/Summertime

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select how to handle daylight saving time/summer time. For manual setting of DST/summer time, enter the start date and end date in ***parameter 0-76 DST/Summertime Start*** and ***parameter 0-77 DST/Summertime End***.

Option	Name	Description
[0]*	Off	
[2]	Manual	

0-75 Last Power Off Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [5]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter stores the last 5 drive power-off timestamps. Index [0] is the latest power-off time, whereas index [4] is the oldest.

0-76 DST/Summertime Start

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	1 setup	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

Sets the date and time when DST/summer time starts. The date is programmed in the format selected in ***parameter 0-71 Date Format***.

0-77 DST/Summertime End

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	1 setup	**Data type:**	TimeOfDay
Change during operation:	True		

Sets the date and time when DST/summer time ends. The date is programmed in the format selected in ***parameter 0-71 Date Format***.

0-79 Clock Fault

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables or disables the clock warning when the clock has not been set, or has been reset due to a power-down and no back-up is installed.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

0-81 Working Days

Default value:	Depending on the selected array element.	**Parameter type:**	Option, Array [7]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Array with 7 elements [0]–[6] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Set for each weekday if it is a working day or a non-working day. The first element of the array is Monday. The working days are used for timed actions.

Option	Name	Description
[0]	No	
[1]	Yes	

0-82 Additional Working Days

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [5]
Setup:	1 setup	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

Array with 5 elements [0]–[4] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Defines dates for additional working days that would normally be non-working days according to ***parameter 0-81 Working Days***.

0-83 Additional Non-working Days

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [15]
Setup:	1 setup	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

Array with 15 elements [0]–[14] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Defines dates for additional working days that would normally be non-working days according to ***parameter 0-81 Working Days***.

0-84 Time for Fieldbus

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Shows the time for fieldbus.

0-85 Summer Time Start for Fieldbus

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [2]
Setup:	All setups	**Conversion index:**	0
Parameter type:	Uint32	**Change during operation:**	True

Shows the summer time start for fieldbus.

0-86 Summer Time End for Fieldbus

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Shows the summer time end for fieldbus.

0-88 Clock Restore at Powerup

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Disabled	Restoring the time at power-up is disabled.
[1]	Enabled	Restoring the time at power-up is enabled.

0-89 Date and Time Readout

Default value:	0	**Parameter type:**	Range, 0 - 2
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

Shows the current date and time. The date and time is updated continuously. The clock does not begin counting until a setting different from default has been made in ***parameter 0-70 Date and Time***.

5.3 Parameter Group 1-** Load and Motor

5.3.1 1-0* General Settings

Define whether the drive operates in open or closed loop.

1-00 Configuration Mode

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter cannot be changed while the motor is running.

NOTICE

When set to ***[3] Closed loop***, the commands reversing and start reversing do not reverse the motor direction.

Select the application control principle to be used when a remote reference (that is via analog input or fieldbus) is active. A remote reference can only be active when ***parameter 3-13 Reference Site*** is set to ***[0] Linked to Hand/Auto*** or ***[1] Remote***.

Option	Name	Description
[0]	Open loop	Motor speed is determined by applying a speed reference or by setting the speed when in hand-on mode. Open loop is also used if the drive is part of a closed-loop system based on an external PID controller providing a speed reference signal as output.
[3]	Closed loop	Motor speed is determined by a reference from the built-in PID controller varying the motor speed as in a closed-loop control process (for example, constant pressure or flow). Configure the PID controller in *parameter group 20-** Feedback* or via the Function Set-ups accessed by pressing [Quick Menu].

1-01 Motor Control Principle

Default value:	[1] VVC+	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select which motor control principle to employ.

Option	Name	Description
[0]	U/f	
[1]*	VVC+	Voltage vector control principle is suitable for most applications. The main benefit of VVC+ operation is that it uses a robust motor model.
[2]	Flux sensorless	Flux vector control without encoder feedback, for simple installation and robustness against sudden load changes.

1-03 Torque Characteristics

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Parameter 1-03 Torque Characteristics has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, non-salient SPM***.

Select the torque characteristic required. VT and AEO are both energy-saving operations.

Option	Name	Description
[0]	Constant torque	For speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1]	Variable torque	For speed control of centrifugal pumps and fans. Also to be used when controlling more than 1 motor from the same drive (for example, multiple condenser fans or cooling tower fans). Provides a voltage which is optimized for a squared torque load characteristic of the motor.
[2]	Auto energy optim. CT	For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in ***parameter 14-43 Motor Cosphi***. The parameter has a default value, which is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an AMA function can be carried out using ***parameter 1-29 Automatic Motor Adaptation (AMA)***. It is rarely necessary to adjust the motor power factor parameter manually.
[3]	Auto energy optim. VT	For optimum energy-efficient speed control of centrifugal pumps and fans. Provides a voltage optimized for a squared torque load characteristic of the motor. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in ***parameter 14-43 Motor Cosphi***. The parameter has a default value and is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an AMA function can be carried out using ***parameter 1-29 Automatic Motor Adaptation (AMA)***. It is rarely necessary to adjust the motor power factor parameter manually.

1-04 Overload Mode

Default value:	[1] Normal torque	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Use this parameter to configure the drive for either high or normal overload. When selecting the drive size, always review the technical data in the operating guide or the design guide to know the available output current.

Option	Name	Description
[0]	High torque	Allows up to 160% overtorque.
[1]*	Normal torque	For oversized motor. Allows up to 110% overtorque.

1-06 Clockwise Direction

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

This parameter defines the term clockwise corresponding to the LCP direction arrow. Used for easy change of direction of shaft rotation without swapping motor wires.

Option	Name	Description
[0]*	Normal	The motor shaft turns in clockwise direction when the drive is connected U⇨U, V⇨V, and W⇨W to the motor.
[1]	Inverse	The motor shaft turns in counterclockwise direction when the drive is connected U⇨U, V⇨V, and W⇨W to the motor.
[2]	Inverse all	Inverts motor direction, feedback direction, and angle offset on PM motor.

5.3.2 Motor Setups

5.3.2.1 Asynchronous Motor Setup

Enter the following motor data. Find the information on the motor nameplate.

- ***Parameter 1-20 Motor Power [kW]*** or ***parameter 1-21 Motor Power [HP]***.
- ***Parameter 1-22 Motor Voltage***.
- ***Parameter 1-23 Motor Frequency***.
- ***Parameter 1-24 Motor Current***.
- ***Parameter 1-25 Motor Nominal Speed***.

When running in flux control principle, or for optimum performance in VVC+ mode, extra motor data is required to set up the following parameters. Find the data in the motor datasheet (this data is typically not available on the motor nameplate). Run a complete automatic motor adaptation (AMA) using ***parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA*** or enter the parameters manually. ***Parameter 1-36 Iron Loss Resistance (Rfe)*** is always entered manually.

- ***Parameter 1-30 Stator Resistance (Rs)***.
- ***Parameter 1-31 Rotor Resistance (Rr)***.
- ***Parameter 1-33 Stator Leakage Reactance (X1)***.
- ***Parameter 1-34 Rotor Leakage Reactance (X2)***.
- ***Parameter 1-35 Main Reactance (Xh)***.

- *Parameter 1-36 Iron Loss Resistance (Rfe)*.

Application-specific adjustment when running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

5.3.2.2 PM Motor Setup

This section describes how to set up a PM motor. Danfoss offers 2 types of PM motors: [1] Non-salient PM and [3] Salient PM. The following example covers a non-salient PM motor.

5.3.2.3 Programming of PM Motors

5.3.2.3.1 Initial Programming Steps

1. To activate PM motor operation, select ***[1] PM, non-salient SPM*** in ***parameter 1-10 Motor Construction***.

5.3.2.3.2 Programming Motor Data

After selecting a PM motor, the PM motor-related parameters in *parameter groups 1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active. The necessary data is on the motor nameplate and on the motor datasheet.

1. Set ***parameter 1-24 Motor Current***.
2. Set ***parameter 1-25 Motor Nominal Speed***.
3. Set ***parameter 1-26 Motor Cont. Rated Torque***.
4. Set ***parameter 1-39 Motor Poles***.
5. Run a complete AMA by setting ***parameter 1-29 Automatic Motor Adaptation (AMA)*** to ***[1] Enable complete AMA***.
6. If a complete AMA is NOT performed, configure the following parameters manually:
   a. ***Parameter 1-30 Stator Resistance (Rs)***: Enter the line-to-common stator winding resistance (Rs). If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
   b. ***Parameter 1-37 d-axis Inductance (Ld)***: Enter the line-to-common direct axis inductance of the PM motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
   c. ***Parameter 1-40 Back EMF at 1000 RPM***: Enter the line-to-line back EMF of the PM motor at 1000 RPM (RMS value). Back EMF is the voltage generated by a PM motor when no drive is connected and the shaft is turned externally. It is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is, for example, 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage/RPM)x1000 = (320/1800)x1000 = 178.
7. For IPM motors, configure the inductance values in the following parameters:
   a. ***Parameter 1-38 q-axis Inductance (Lq)***.
   b. ***Parameter 1-44 d-axis Inductance Sat. (LdSat).***
   c. ***Parameter 1-45 q-axis Inductance Sat (LqSat).***
   d. ***Parameter 1-49 q-axis Inductance Sat. Point***.

NOTICE

IPM motors may be missing some inductance values on the nameplate or in the datasheets. Perform AMA to get the valid values.

5.3.2.3.3 Testing Motor Operation

1. Start the motor at low speed (100–200 RPM). If the motor does not turn, check the installation, general programming, and motor data.
2. Check if the start function in ***parameter 1-70 Start Mode*** fits the application requirements.

5.3.2.3.4 Rotor Detection

This function is the recommended selection for applications where the motor starts from standstill, for example, pumps or conveyors. On some motors, a sound is heard when the drive performs the rotor detection. This does not harm the motor.

5.3.2.3.5 Parking

This function is the recommended selection for applications where the motor is rotating at slow speed, for example, windmilling in fan applications. ***Parameter 2-06 Parking Current*** and ***parameter 2-07 Parking Time*** can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

5.3.2.3.6 Application-specific Adjustments when Running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. See recommendations for various applications in Table 14.

Table 14: Recommendations for Various Applications

Application	Settings
Low-inertia applications $I_{Load}/I_{Motor}<5$	Increase ***parameter 1-17 Voltage Filter Time Const.*** by factor 5–10. Reduce ***parameter 1-14 Damping Gain***. Reduce ***parameter 1-66 Min.Current at Low Speed*** (<100%).
Low-inertia applications $50>I_{Load}/I_{Motor}>5$	Keep the default values.
High-inertia applications $I_{Load}/I_{Motor}>50$	Increase ***parameter 1-14 Damping Gain***, ***parameter 1-15 Low Speed Filter Time Const.***, and ***parameter 1-16 High Speed Filter Time Const***.
High load at low speed <30% (rated speed)	Increase ***parameter 1-17 Voltage filter time const***. Increase ***parameter 1-66 Min. Current at Low Speed*** to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of ***parameter 30-20 High Starting Torque Time [s]*** and ***parameter 30-21 High Starting Torque Current [%]***). Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.

If the motor starts oscillating at a certain speed, increase ***parameter 1-14 Damping Gain***. Increase the value in small steps. Depending on the motor, this parameter can be set to 10–100% higher than the default value.

5.3.2.4 SynRM and PMaSynRM Motor Setup

This section describes how to set up a synchronous reluctance motor and a PMaSynRM motor.

5.3.2.5 Programming of SynRM and PMaSynRM Motors

5.3.2.5.1 Initial Programming

1. To activate SynRM and PMaSynRM motor operation, select ***[3] SynRM*** or ***[6] PMaSynRM***in ***parameter 1-10 Motor Construction***.

5.3.2.5.2 Programming Motor Data

After selecting a SynRM or PMaSynRM motor, the motor-related parameters in *parameter groups 1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active. The necessary data is on the motor nameplate and on the motor datasheet.

1. Set ***parameter 1-24 Motor Current***.
2. Set ***parameter 1-25 Motor Nominal Speed***.
3. Set ***parameter 1-26 Motor Cont. Rated Torque***.
4. Set ***parameter 1-39 Motor Poles***.
5. For PMaSynRM motors, set ***parameter 1-40 Back EMF at 1000 RPM***.
6. Run a complete AMA by setting ***parameter 1-29 Automatic Motor Adaptation (AMA)*** to ***[1] Enable complete AMA***.
7. If a complete AMA is NOT performed, configure the following parameters manually:
   a. ***Parameter 1-30 Stator Resistance (Rs)***: Enter the line-to-common stator winding resistance (Rs). If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
   b. ***Parameter 1-37 d-axis Inductance (Ld)***: Enter the line-to-common direct axis inductance of the PM motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
   c. ***Parameter 1-38 q-axis Inductance (Lq)***: Enter the line-to-common quadrature axis inductance of the motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
   d. ***Parameter 1-44 d-axis Inductance Sat. (LdSat).***: Enter the line-to-common saturated value of the d-axis inductance. This is the value at a current higher than the nominal current where the inductance is fully saturated.
   e. ***Parameter 1-45 q-axis Inductance Sat (LqSat).***: Enter the line-to-common saturated value of the q-axis inductance. This is the value at a current higher than the nominal current where the inductance is fully saturated.
   f. ***Parameter 1-48 Inductance Sat. Point***: Enter the percentage of nominal current where the d-axis inductance is half-saturated, meaning that it has the average value of the non-saturated and saturated values.

NOTICE

Motors may be missing some inductance values on the nameplate or in the datasheets. Perform AMA to get the valid values.

5.3.2.5.3 Testing Motor Operation

1. Start the motor at low speed (100–200 RPM). If the motor does not turn, check the installation, general programming, and motor data.
2. Check if the start function in ***parameter 1-70 Start Mode*** fits the application requirements.

5.3.2.5.4 Rotor Detection

This function is the recommended selection for applications where the motor starts from standstill, for example, pumps or conveyors. On some motors, a sound is heard when the drive performs the rotor detection. This does not harm the motor.

5.3.2.5.5 Parking

This function is the recommended selection for applications where the motor is rotating at slow speed, for example, windmilling in fan applications. ***Parameter 2-06 Parking Current*** and ***parameter 2-07 Parking Time*** can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

5.3.2.5.6 Application-specific Adjustment when Running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

Start the motor at nominal speed. If the application does not run well, check the VVC+ SynRM and PMaSynRM settings. See recommendations for various applications in Table 15.

Table 15: Recommendations for Various Applications

Application	Settings
Low-inertia applications $I_{Load}/I_{Motor}<5$	Increase ***parameter 1-17 Voltage Filter Time Const.*** by factor 5–10. Reduce ***parameter 1-14 Damping Gain***. Reduce ***parameter 1-66 Min.Current at Low Speed*** (<100%).
Low-inertia applications $50>I_{Load}/I_{Motor}>5$	Keep the default values.
High-inertia applications $I_{Load}/I_{Motor}>50$	Increase ***parameter 1-14 Damping Gain***, ***parameter 1-15 Low Speed Filter Time Const.***, and ***parameter 1-16 High Speed Filter Time Const***.
High load at low speed <30% (rated speed)	Increase ***parameter 1-17 Voltage filter time const***. Increase ***parameter 1-66 Min. Current at Low Speed*** to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of ***parameter 30-20 High Starting Torque Time [s]*** and ***parameter 30-21 High Starting Torque Current [%]***). Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.

If the motor starts oscillating at a certain speed, increase ***parameter 1-14 Damping Gain***. Increase the value in small steps. Depending on the motor, this parameter can be set to 10–100% higher than the default value.

5.3.3 1-1* Motor Selection

1-10 Motor Construction

Default value:	[0] Aynschron	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the motor design type.

Option	Name	Description
[0]*	Asynchron	Use for ASM/IM motors.
[1]	PM, non salient SPM	Use for SPM motors, surface-mounted magnet. PM motors are divided into 2 groups, with either surface-mounted (SPM)/non-salient magnets or interior-mounted (IPM)/ salient magnets.
[2]	PM, salient IPM	Use for IPM motors, interior-mounted magnet. PM motors are divided into 2 groups, with either surface-mounted (SPM)/non-salient magnets or interior-mounted (IPM)/ salient magnets.

Option	Name	Description
[5]	SynRM	Use for SynRM, synchronous reluctance motors.
[6]	PMaSynRM	Use for PMaSynRM, Permanent Magnet assisted synchronous reluctance motors.

5.3.4 1-1* VVC+ for Synchronous Motors

The default control parameters for VVC+ synchronous motors are optimized for applications where inertia load in the range of 50>Jl/Jm>5. Jl is load inertia from the application and Jm is machine inertia. For low-inertia applications (Jl/Jm<5), increase ***parameter 1-17 Voltage Filter Time Const.***, ***parameter 1-16 High Speed Filter Time Const.***, and ***parameter 1-14 Damping Gain*** to improve performance and stability.

For high-inertia at low speed (<30% of rated speed), increase ***parameter 1-17 Voltage Filter Time Const.*** due to non-linearity in the inverter at low speed.

1-14 Damping Gain

Default value:	120%	**Parameter type:**	Range, 0 - 250%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

The damping gain stabilizes the PM machine to run smoothly and with stability. The value of damping gain controls the dynamic performance of the PM machine. High damping gain gives high dynamic performance and low damping gain gives low dynamic performance. The dynamic performance is related to the machine data and load type. If the damping gain is too high or low, the control becomes unstable.

1-15 Low Speed Filter Time Const.

Default value:	Size related	**Parameter type:**	Range, 0.01 - 20 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The time constant is used below 10% rated speed. Obtain quick control through a short dampening time constant. However, if this value is too short, the control becomes unstable.

1-16 High Speed Filter Time Const.

Default value:	Size related	**Parameter type:**	Range, 0.01 - 20 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The time constant is used above 10% rated speed. Obtain quick control through a short dampening time constant. However, if this value is too short, the control becomes unstable.

1-17 Voltage Filter Time Const.

Default value:	Size related	**Parameter type:**	Range, 0.001 - 2 s
Setup:	All setups	**Conversion index:**	-3

Data type:	Uint16	**Change during operation:**	True

Reduces the influence of high frequency ripple and system resonance in the calculation of supply voltage. Without this filter, the ripples in the currents can distort the calculated voltage and affect the stability of the system.

5.3.5 1-2* Motor Data

This parameter group contains input data from the nameplate on the connected motor.

NOTICE

Changing the value of these parameters affects the setting of other parameters.

NOTICE

The following parameters have no effect when ***parameter 1-10 Motor Construction*** is set to ***[1] PM, non-salient SPM***, ***[2] PM, salient IPM***, ***[5] Sync. Reluctance***:

- ***Parameter 1-20 Motor Power [kW]***.
- ***Parameter 1-21 Motor Power [HP]***.
- ***Parameter 1-22 Motor Voltage***.
- ***Parameter 1-23 Motor Frequency***.

1-20 Motor Power [kW]

Default value:	Size related	**Parameter type:**	0.09 - 2000.00 kW
Setup:	All setups	**Conversion index:**	1
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive. This parameter is visible in the LCP if ***parameter 0-03 Regional Settings*** is set to ***[0] International***.

1-21 Motor Power [HP]

Default value:	Size related	**Parameter type:**	Range, 0.09 - 500.00 hp
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	False

Enter the nominal motor power in hp according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive. This parameter is visible in the LCP if ***parameter 0-03 Regional Settings*** is set to ***[1] North America***.

1-22 Motor Voltage

Default value:	Size related	**Parameter type:**	Range, 10 - 1000 V
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

NOTICE

Setting this parameter sets the following parameters to their default settings:

- ***Parameter 1-15 Low Speed Filter Time Const.***
- ***Parameter 1-16 High Speed Filter Time Const.***
- ***Parameter 1-17 Voltage Filter Time Const.***
- ***Parameter 1-24 motor Current***
- ***Parameter 1-30 Stator Resistance (Rs)***
- ***Parameter 1-31 Rotor Resistance (Rr)***
- ***Parameter 1-33 Stator Leakage Reactance (X1)***
- ***Parameter 1-34 Rotor Leakage Reactance (X2)***
- ***Parameter 1-35 Main Reactance (Xh)***
- ***Parameter 1-36 Iron Loss Resistance (Rfe)***
- ***Parameter 4-18 Current Limit***
- ***Parameter 14-31 Current Lim Ctrl, Integration Time***
- ***Parameter 14-43 Motor Cosphi***
- ***Parameter 16-36 Inv. Nom. Current***
- ***Parameter 16-37 Inv. Max. Current***
- ***Parameter 45-33 Alarm High***
- ***Parameter 45-62 Load Threshold***

Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

1-23 Motor Frequency

Default value:	50 Hz	**Parameter type:**	Range, 20 - 1000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Select the motor frequency value from the motor nameplate data. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt ***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 3-03 Maximum Reference*** to the 87 Hz application.

1-24 Motor Current

Default value:	Size related	**Parameter type:**	Range, 0.1 - 10000.00 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Setting this parameter sets the following parameters to their default settings:

- ***Parameter 1-15 Low Speed Filter Time Const.***
- ***Parameter 1-16 High Speed Filter Time Const.***
- ***Parameter 1-17 Voltage Filter Time Const.***
- ***Parameter 1-30 Stator Resistance (Rs)***
- ***Parameter 1-31 Rotor Resistance (Rr)***
- ***Parameter 1-33 Stator Leakage Reactance (X1)***
- ***Parameter 1-34 Rotor Leakage Reactance (X2)***
- ***Parameter 1-35 Main Reactance (Xh)***
- ***Parameter 1-36 Iron Loss Resistance (Rfe)***
- ***Parameter 4-18 Current Limit***
- ***Parameter 14-31 Current Lim Ctrl, Integration Time***
- ***Parameter 14-43 Motor Cosphi***
- ***Parameter 45-33 Alarm High***
- ***Parameter 45-62 Load Threshold***

Enter the nominal motor current value from the motor nameplate data. The data is used for calculating torque, motor overload protection, and so on.

1-25 Motor Nominal Speed

Default value:	Size related	**Parameter type:**	Range, 100 - 60000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter cannot be adjuste while the motor is running.

NOTICE

Changing this parameter will affect settings of other parameters.

Enter the nominal motor speed value from the motor nameplate data. The data is used for calculating motor compensations.

$$n_{m,n} = n_s - n_{slip}$$

1-26 Motor Cont. Rated Torque

Default value:	Size related	**Parameter type:**	Range, 0.1 - 10000.0 Nm
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	False

NOTICE

Changing this parameter sets certain other parameters to their default settings.

Enter the value from the motor nameplate data. The default value corresponds to the nominal rated output. This parameter is available when ***parameter 1-10 Motor Construction*** is set to ***[1] PM, non-salient SPM***, ***[2] PM, salient IPM***, ***[5] SynRM***, and ***[6] PMaSynRM***.

1-28 Motor Rotation Check

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index.**	–
Data type:	Uint8	**Change during operation:**	False

WARNING

HIGH VOLTAGE

Drives contain high voltage when connected to AI mains input, DC supply, or load sharing. Disconnecting motor cables while mains power is turned on can result in death or serious injury.

- Remove mains power before disconnecting motor phase cables.

NOTICE

Once the motor rotation check is enabled, the display shows: *Note! Motor may run in wrong direction*. Pressing [OK], [Back], or [Cancel] dismisses the message and shows a new message: *Press [Hand On] to start the motor. Press [Cancel] to abort*. Pressing [Hand On] starts the motor at 5 Hz in forward direction and the display shows: *Motor is running*. Check if the motor rotation direction is correct. Press [Off] to stop the motor. Pressing [Off] stops the motor and resets ***parameter 1-28 Motor Rotation Check***. If motor rotation direction is incorrect, interchange 2 motor phase cables.

Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except external interlock and STO (if Included).

Option	Name	Description
[0]*	Off	Motor rotation check is not active.
[1]	Enabled	Motor rotation check is enabled.

1-29 Automatic Motor Adaptation (AMA)

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjsuted while the motor is running.

The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters (***parameter 1-30 Stator Resistance (Rs)*** to ***parameter 1-35 Main Reactance (Xh)***) at motor standstill. Activate the AMA function by pressing [Hand On] after selecting ***[1] Enable Complete AMA*** or ***[2] Enable Reduced AMA***. See also the *section Automatic Motor Adaptation* in the Design Guide. After a normal sequence, the display reads: *Press [OK] to finish AMA*. After pressing [OK], the drive is ready for operation.

NOTICE

Ensure that a value is set in ***parameter 14-43 Motor Cosphi*** before running AMA II.

Option	Name	Description
[0]*	Off	
[1]	Enable complete AMA	Performs • AMA of the stator resistance R_s • The rotor resistance R_r • The stator leakage reactance X_1 • The rotor leakage reactance X_2 , and • The main reactance X_h Do **not** select this option if an LC filter is used between the drive and the motor. For best performance, it is recommended to obtain the advanced motor data from the motor manufacturer to enter into ***parameter 1-31 Rotor Resistance (Rr)*** through ***parameter 1-36 Iron Loss Resistance (Rfe)***. Complete AMA cannot be performed on permanent magnet motors.
[2]	Enable Reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. This option is available for standard asynchronous motors and non-salient PM motors. Select this option if an LC filter is installed between the drive and the motor.
[3]	Enable reduced AMA II	Performs AMA of the stator resistance R_s, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_{21}, and the main reactance X_h.
[4]	Enable reduced AMA II	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the drive and the motor. The AMA II is a variant of AMA, based on the principles of the torque calibration. It is recommended for special motors (for example S3) and high-power motors.

NOTICE

- For the best adaptation of the drive, run AMA on a cold motor.
- AMA cannot be performed while the motor is running.
- AMA cannot run with a sine-wave filter connected.

NOTICE

It is important to set *parameter group 1-2* Motor Data* correctly, since these form part of the AMA algorithm. Perform an AMA to achieve optimum dynamic motor performance. It may take up to 10 minutes, depending on the power rating of the motor.

NOTICE

Avoid generating external torque during AMA.

NOTICE

If 1 of the settings in *parameter group 1-2* Motor Data* is changed, ***parameter 1-30 Stator Resistance (Rs)*** to ***parameter 1-39 Motor Poles***return to their default settings.

NOTICE

AMA works problem-free on 1 motor size down, typically works on 2 motor sizes down, rarely works on 3 sizes down, and never works on 4 sizes down. Keep in mind that the accuracy of the measured motor data is poorer when operating on motors smaller than the nominal drive size.

5.3.6 1-3* Adv. Motor Data

Parameters for advanced motor data. Ensure that the motor data in ***parameter 1-30 Stator Resistance (Rs)*** to ***parameter 1-39 Motor Poles*** matches the motor. The default settings are based on standard motor values. If the motor parameters are not set correctly, a malfunction of the drive system may occur. If the motor data is unknown, running an AMA (automatic motor adaptation) is recommended. See ***parameter 1-29 Automatic Motor Adaptation (AMA)***.

Parameter groups 1-3 Adv. Motor Data* and *1-4* Adv. Motor Data II* cannot be adjusted while the motor is running.

NOTICE

A simple check of the $X_1 + X_h$ sum value is to divide the line-to-line motor voltage by the sqrt(3) and divide this value by the motor no load current. [VL-L/sqrt(3)]/INL = $X_1 + X_h$. These values are important to magnetize the motor properly. For high-pole motors, it is highly recommended to perform this check.

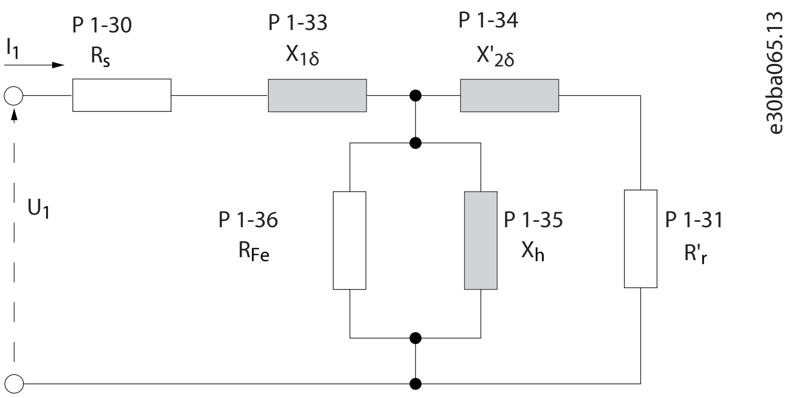


Figure 29: Motor Equivalent Diagram for an Asynchronous Motor

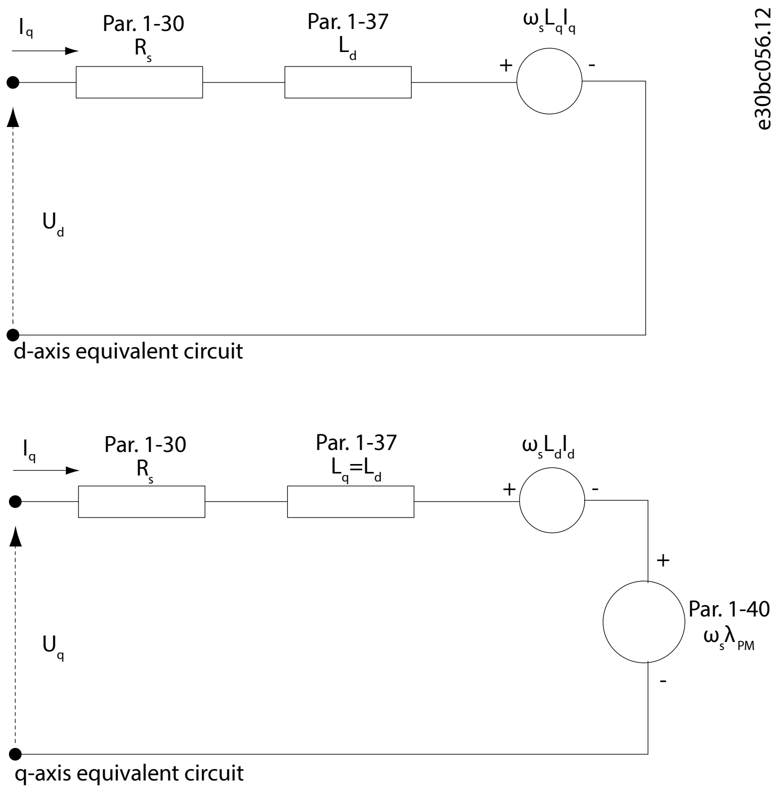


Figure 30: Motor Equivalent Circuit Diagram for a PM Non-salient Motor

1-30 Stator Resistance (Rs)

Default value:	Size related	**Parameter type:**	Range, 0.0140 - 140.0000 Ohm
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

Set the line-to-common stator resistance value. Enter the value from a motor datasheet or perform an AMA on a cold motor.

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in *parameter 1-47 Torque Calibration*.

1-31 Rotor Resistance (Rr)

Default value:	Size related	**Parameter type:**	Range, 0.0100 - 100.0000 Ohm
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

NOTICE

Parameter 1-31 Rotor Resistance (Rr) has no effect when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, *[2] PM, salient IPM*, *[5] SynRM*, and *[6] PMaSynRM*.

Set the rotor resistance value R_r to improve shaft performance using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor. All compensations are reset to 100%.
- Enter the R_r value manually. Obtain the value from the motor supplier.
- Use the R_r default setting. The drive establishes the setting based on the motor nameplate data.

1-33 Stator Leakage Reactance (X1)

Default value:	Size related	**Parameter type:**	Range, 0.0400 - 400.0000 Ohm
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter is only relevant for asynchronous motors.

Set the stator leakage reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_1 value manually. Obtain the value from the motor supplier.
- Use the X_1 default setting. The drive establishes the setting based on the motor nameplate data.

NOTICE

The parameter value is updated after each torque calibration if option ***[3] 1st start with store*** or option ***[4] Every start with store*** is selected in ***parameter 1-47 Torque Calibration***.

1-34 Rotor Leakage Reactance (X2)

Default value:	Size related	**Parameter type:**	Range, 0.0400 - 400.0000 Ohm
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter is only relevant for induction motors.

Set the rotor leakage reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_2 value manually. Obtain the value from the motor supplier.
- Use the X_2 default setting. The drive establishes the setting based on the motor nameplate data.

NOTICE

The parameter value is updated after each torque calibration if option ***[3] 1st start with store*** or option ***[4] Every start with store*** is selected in ***parameter 1-47 Torque Calibration***.

1-35 Main Reactance (Xh)

Default value:	Size related	**Parameter type:**	Range, 1.0000 - 10000.0000 [Ohm]
Setup:	All setups	**Conversion index:**	-4

Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Parameter 1-35 Main Reactance (Xh) has no effect when ***parameter 1-10 Motor Construction*** is set to ***[1] PM, non-salient SPM***.

Set the main reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_h value manually. Obtain the value from the motor supplier.
- Use the X_h default setting. The drive establishes the setting based on the motor nameplate data.

NOTICE

The parameter value is updated after each torque calibration if option ***[3] 1st start with store*** or option ***[4] Every start with store*** is selected in ***parameter 1-47 Torque Calibration***.

1-36 Iron Loss Resistance (Rfe)

Default value:	Size related	**Parameter type:**	Range, 0 - 10000.000 Ohm]
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the equivalent iron loss resistance (R_{Fe}) value to compensate for iron loss in the motor. The R_{Fe} value cannot be found by performing an AMA. The R_{Fe} value is especially important in torque control applications. If R_{Fe} is unknown, leave ***parameter 1-36 Iron Loss Resistance (Rfe)*** on default setting.

1-37 d-axis Inductance (Ld)

Default value:	Size related	**Parameter type:**	Range, 0.001 - 1000.000 mH
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

NOTICE

This parameter is only active ***parameter 1-10 Motor Construction*** is set to ***[1] PM, non-salient SPM***.

Enter line-to-common direct axis inductance of the PM motor. Obtain the value from the permanent magnet motor datasheet.

For induction motors, stator resistance and d-axis inductance values are normally described technical specifications as between line and common (starpoint). For PM motors, they are typically described in technical specifications as between line-to-line. PM motors are typically built for start connection.

Table 16: Parameters Related to PM Motors

Parameter	Function
Parameter 1-30 Stator Resistance (Rs) (line to common).	This parameter gives stator winding resistance (R_s) similar to asynchronous motor stator resistance. The stator resistance is defined for line-to-common measurement. For line-to-line data, where stator resistance is measured between any 2 lines, divide by 2.
Parameter 1-37 d-axis Inductance (Ld) (line to common).	This parameter gives direct axis inductance of the PM motor. The d-axis inductance is defined for phase-to-common measurement. For line-to-line data, where stator resistance is measured between any 2 lines, divide by 2.
Parameter 1-40 Back EMF at 1000 RPM RMS (line to line value).	This parameter gives back EMF across stator terminal of PM motor at 1000 RPM mechanical speed specifically. It is defined between line-to-line and expressed in RMS value.

NOTICE

Motor manufacturers provide values for stator resistance (***parameter 1-30 Stator Resistance (Rs)***) and d-axis inductance (***parameter 1-37 d-axis Inductance (Ld)***) in technical specifications as between line and common (starpoint) or line between line. There is no general standard. The different setups of stator winding resistance and induction are shown in the illustration *Stator Winding Setups*. Danfoss AC drives always require the line-to-common value. The back EMF of a PM motor is defined as induced EMF developed across any of 2 phases of stator winding of a free-running motor. Danfoss AC drives always require the line-to-line RMS value measured at 1000 RPM, mechanical speed of rotation, see the illustration *Machine Parameter Definitions of Back EMF of PM Motors*.

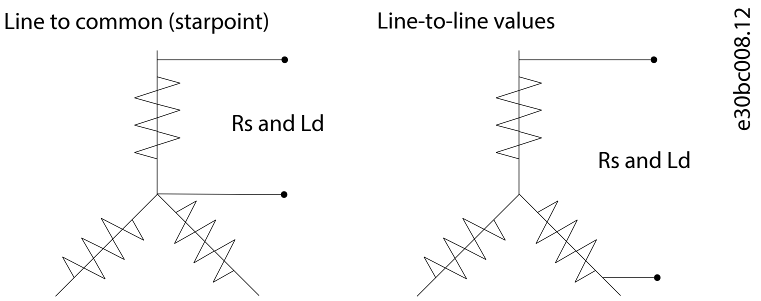


Figure 31: Stator Winding Setups

Permanent magnet motors

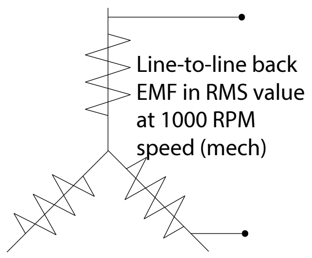


Figure 32: Machine Parameter Definitions of Back EMF of PM Motors

1-38 q-axis Inductance (Lq)

Default value:	Size related	**Parameter type:**	Range, 0.001 - 1000 mH
Setup:	All setups	**Conversion index:**	-6
Data type:	Int32	**Change during operation:**	False

Set the value of the q-axis inductance. See the motor datasheet.

1-39 Motor Poles

Default value:	Size related	**Parameter type:**	Range, 2 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the number of motor poles. The number of motor poles is always an even number as it refers to the total number of poles, not pairs of poles.

Table 17: Pole Number for Normal Speed Ranges

Poles	~n_n@50 Hz	~n_n@60 Hz
2	2700–2880	3520–3460
4	1350–1450	1625–1730
6	700–960	840–1153

The table shows the pole number for normal speed ranges of various motor types. Define motors designed for other frequencies separately. The motor pole value is always an even number because it refers to the total pole number, not pairs of poles. The drive creates the initial setting of ***parameter 1-39 Motor Poles*** based on ***parameter 1-23 Motor Frequency***and ***parameter 1-25 Motor Nominal Speed***.

1-40 Back EMF at 1000 RPM

Default value:	Size related	**Parameter type:**	Range, 1 - 9000 V
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Conversion index:**	False

NOTICE

This parameter is only active when ***parameter 1-10 Motor Construction*** is set to options that enable PM (permanent magnet) motors.

Set the nominal back EMF for the motor when running at 1000 RPM. Back EMF is the voltage generated by a PM motor when no drive is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows:

$$BackEMF = (Voltage \div RPM) \times 1000$$

In an example where the voltage is 320 V and RPM is 1800, the back EMF at 1000 RPM is:

$$(320 \div 1800) \times 1000 = 178$$

1-44 d-axis Inductance Sat. (LdSat)

Default value:	Size related	**Parameter type:**	Range, 0.001 - 1000 mH
Setup:	All setups	**Conversion index:**	-6
Data type:	Int32	**Change during operation:**	False

This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as ***parameter 1-37 d-axis Inductance (Ld)***. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

1-45 q-axis Inductance Sat. (LqSat)

Default value:	Size related	**Parameter type:**	Range, 0.001 - 1000 mH
Setup:	All setups	**Conversion index:**	-6
Data type:	Int32	**Change during operation:**	False

This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as ***parameter 1-38 q-axis Inductance (Lq)***. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

1-46 Position Detection Gain

Default value:	120%	**Parameter type:**	Range, 20 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Adjusts the amplitude of the test pulse during position detection at start. Adjust this parameter to improve the position measurement.

1-47 Torque Calibration

Default value:	[0] Off	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to optimize the torque estimate in the full speed range. The estimated torque is based on the shaft power, $P_{shaft} = P_m - R_s \times I^2$. Make sure that the R_s value is correct. The R_s value in this formula is equal to the power loss in the motor, the cable, and the drive. When this parameter is active, the drive calculates the R_s value during power-up, ensuring the optimal torque estimate and optimal performance. Use this feature in cases when it is not possible to adjust ***parameter 1-30 Stator Resistance (Rs)*** on each drive to compensate for the cable length, drive losses, and the temperature deviation on the motor.

Option	Name	Description
[0]*	Off	
[1]	1st start after pwr-up	Calibrates at the 1st start-up after power-up and keeps this value until reset by a power cycle.
[2]	Every start	Calibrates at every start-up, compensating for a possible change in motor temperature since last start-up. The value is reset after a power cycle.
[3]	1st start with store	The drive calibrates the torque at the 1st start-up after power-up. This option is used to update motor parameters: • ***Parameter 1-30 Stator Resistance (Rs).*** • ***Parameter 1-33 Stator Leakage Reactance (X1).*** • ***Parameter 1-34 Rotor Leakage Reactance (X2).*** • ***Parameter 1-37 d-axis Inductance (Ld).***
[4]	Every start with store	The drive calibrates the torque at every start-up, compensating for a possible change in motor temperature since last start-up. This option is used to update motor parameters: • ***Parameter 1-30 Stator Resistance (Rs).*** • ***Parameter 1-33 Stator Leakage Reactance (X1).*** • ***Parameter 1-34 Rotor Leakage Reactance (X2).*** • ***Parameter 1-37 d-axis Inductance (Ld).***

1-48 d-axis Inductance Sat. Point

Default value:	Size related	**Parameter type:**	Range, 1 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

NOTICE

Run an AMA to set the value of this parameter. Edit the value manually only when the application requires a value other than determined by AMA.

Select the d-axis inductance saturation point. The drive uses this value to optimize the performance of SynRM motors. Select the value that matches the point where the inductance equals the mean value of ***parameter 1-37 d-axis Inductance (Ld)*** and ***parameter 1-44 d-axis Inductance Sat. (LdSat)***, as percentage of nominal current.

1-49 q-axis Inductance Sat. Point

Default value:	Size related	**Parameter type:**	Range, 1 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

NOTICE

Run an AMA to set the value of this parameter. Edit the value manually only when the application requires a value other than determined by AMA.

Enter the q-axis inductance saturation point. The drive uses this value to optimize the performance of IPM motors. Select the value that matches the point where the inductance equals the average value of ***parameter 1-38 q-axis Inductance (Lq)*** and ***parameter 1-45 q-axis Inductance Sat. (LqSat)***, as a percentage of nominal current.

5.3.7 1-5* Load Indep. Setting

1-50 Motor Magnetization at Zero Speed

Default value:	100%	**Parameter type:**	Range, 0 - 300%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-50 Motor Magnetisation at Zero Speed has no effect when ***parameter 1-10 Motor Construction = [1] PM, nonsalient SPM***.

Use this parameter along with ***parameter 1-51 Min Speed Normal Magnetising [RPM]*** to obtain a different thermal load on the motor when running at low speed. Enter a value which is a percentage of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

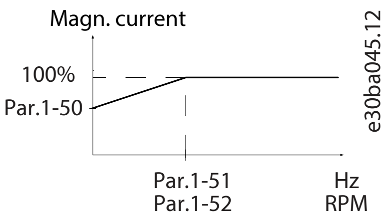


Figure 33: Motor Magnetization

1-51 Min Speed Normal Magnetising [RPM]

Default value:	Size related	**Parameter type:**	Range, 10 - 300 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-51 Min Speed Normal Magnetising [RPM] has no effect when ***parameter 1-10 Motor Construction = [1] PM, nonsalient SPM***.

Set the required speed for normal magnetizing current. If the speed is set lower than the motor slip speed, ***parameter 1-50 Motor Magnetisation at Zero Speed*** and ***parameter 1-51 Min Speed Normal Magnetising [RPM]*** are of no significance. Use this parameter along with ***parameter 1-50 Motor Magnetisation at Zero Speed***.

1-52 Min Speed Normal Magnetising [Hz]

Default value:	Size related	**Parameter type:**	Range, 0.3 - 10.0 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-52 Min Speed Normal Magnetising [Hz] has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, non-salient SPM***.

Set the required frequency for normal magnetizing current. If the frequency is set lower than the motor slip frequency, ***parameter 1-50 Motor Magnetisation at Zero Speed*** is inactive. Use this parameter along with ***parameter 1-50 Motor Magnetisation at Zero Speed***.

1-53 Model Shift Frequency

Default value:	Size related	**Parameter type:**	Range, 4 - 18.0 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Flux model shift: Enter the frequency value for shifting between 2 models for determining motor speed. Select the value based on settings in *parameter 1-00 Configuration Mode* and *parameter 1-01 Motor Control Principle*. There are the following options:

- Shift between variable current mode and flux model 2.
- No shift between models at low speed if *parameter 40-50 Flux Sensorless Model Shift* is set to option *[0] Off*.

Variable current - flux model - sensorless: This model is used when *parameter 1-00 Configuration Mode* is set to *[0] Speed open loop* and *parameter 1-01 Motor Control Principle* is set to *[2] Flux sensorless*. In speed open loop in flux mode, the speed is determined from the current measurement. Below f_{norm} x 0.1, the drive runs on a variable current model. Above f_{norm} x 0.125 the drive runs on a flux model.

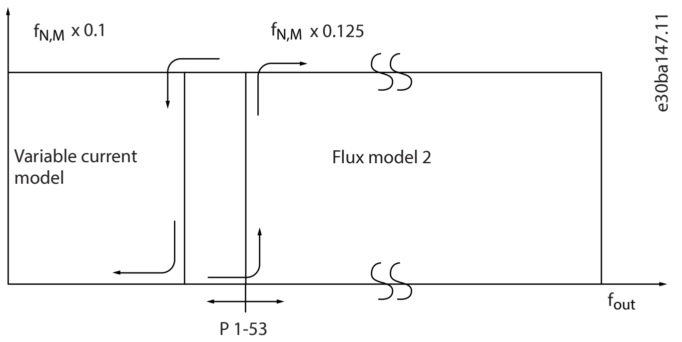


Figure 34: Parameter 1-00 Configuration Mode = [0] Speed Open Loop, Parameter 1-01 Motor Control Principle = [2] Flux Sensorless

1-54 Voltage Reduction in Fieldweakening

Default value:	0 V	**Parameter type:**	Range, -50 - 100 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

The value of this parameter reduces the maximum voltage available for the flux of the motor in field weakening, providing more voltage for torque. Increasing the value increases the risk of stalling at high speed. When reducing the voltage below 0, the output voltage is increased and at some point the current controller is forced into "Voltage Limit".

1-55 U/f Characteristic - U

Default value:	Size related	**Parameter type:**	Range, 0 - 1000 V, Array [6]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the voltage at each frequency point to manually form a U/f characteristic matching the motor. The frequency points are defined in ***parameter 1-56 U/f Characteristic - F***. This parameter is an array parameter [0-5] and is only accessible when ***parameter 1-01 Motor Control Principle*** is set to ***[0] U/f***.

1-56 U/f Characteristic - F

Default value:	Size related	**Parameter type:**	Range, 0 - 1000.0 V, Array [6]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the frequency points to form a U/f characteristic manually matching the motor. The voltage at each point is defined in ***parameter 1-55 U/f Characteristic - U***. This parameter is an array parameter [0–5] and is only accessible when ***parameter 1-01 Motor Control Principle*** is set to ***[0] U/f***.

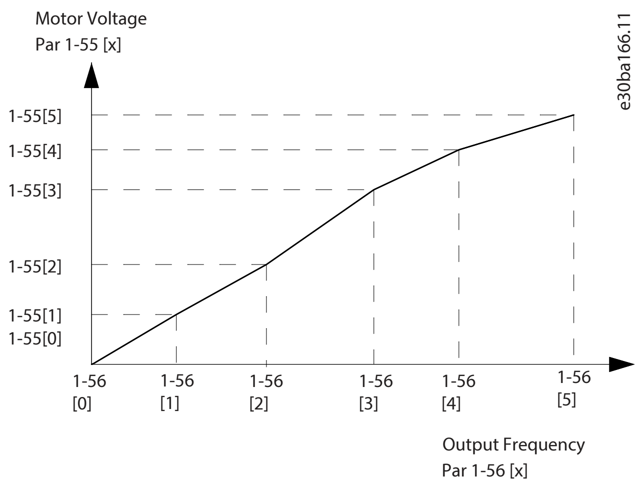


Figure 35: U/f Characteristic

1-58 Flying Start Test Pulses Current

Default value:	Size related	**Parameter type:**	Range, 0 - 200%

Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter is only available in VVC+.

NOTICE

This parameter is active when ***parameter 1-73 Flying Start*** is enabled.

Sets the current level for the flying start test pulses that are used to detect the motor direction. 100% means $I_{m,n}$. Adjust the value to be high enough to avoid noise influence, but low enough to avoid affecting the accuracy (current must be able to drop to 0 before the next pulse). Reduce the value to reduce the generated torque. Default is 30% for asynchronous motors. For PM motors, the default may vary, but a general setting of 20% is recommended. For adjusting PM motors, the value tunes for back EMF and d-axis inductance of the motor.

1-59 Flying Start Test Pulses

Default value:	Size related	**Parameter type:**	Range, 0 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter is active when ***parameter 1-73 Flying Start*** is enabled. The value range and function depend on ***parameter 1-10 Motor Construction***: ***[0] Asynchron***: [0-500%] Control the percentage of the frequency for the pulses used to detect the motor direction. Increasing this value reduces the generated torque. In this mode, 100% means 2 times the slip frequency. ***[1] PM non salient*** and ***[2] PM, salient IPM***: [0-10%] This parameter defines the motor speed (in % of nominal motor speed) below which the parking function (see ***parameter 2-06 Parking Current*** and ***parameter 2-07 Parking Time***) becomes active. This parameter is only active when ***parameter 1-70 Start Mode*** is set to ***[1] Parking*** and only after starting the motor.

5.3.8 1-6* Load Depend. Setting

1-60 Low Speed Load Compensation

Default value:	100%	**Parameter type:**	Range, 0 - 300%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

NOTICE

Parameter 1-60 Low Speed Load Compensation only has effect when ***parameter 1-10 Motor Construction*** = ***[0] Asynchron***.

Enter the % value to compensate voltage in relation to load when the motor is running at low speed and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active.

Motor size [kW]	Changeover [Hz]
0.25–7.5	<10
11–45	<5
55–550	<3–4

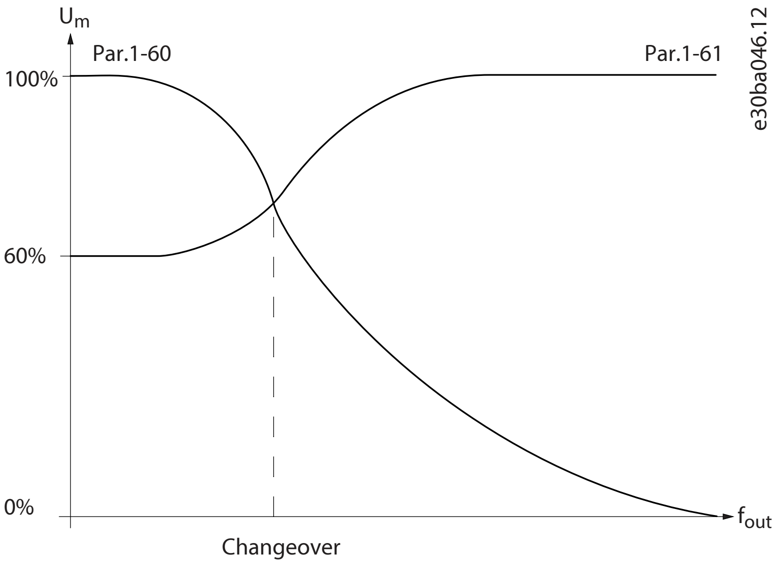


Figure 36: Low-speed Load Compensation

1-61 High Speed Load Compensation

Default value:	100%	**Parameter type:**	Range, 0 - 300%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

NOTICE

Parameter 1-61 High Speed Load Compensation only has effect when ***parameter 1-10 Motor Construction = [0] Asynchron***.

Enter the % value to compensate voltage in relation to load when the motor is running at high speed and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active.

Motor size	Changeover
0.25–7.5 kW	>10 Hz
11–45 kW	>5 Hz
55–maximum powerHz size kW	>3–4

1-62 Slip Compensation

Default value:	0%	**Parameter type:**	Range, -500 - 500%
Setup:	All setups	**Conversion index:**	0

Data type:	Int16	**Change during operation:**	True

NOTICE

Parameter 1-62 Slip Compensation only has effect when ***parameter 1-10 Motor Construction = [0] Asynchron***.

Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, that is on the basis of the nominal motor speed $n_{M,N}$. Slip compensation is calculated automatically based on the rated motor speed $n_{M,N}$.

1-63 Slip Compensation Time Constant

Defaul value:	Size related	**Parameter type:**	Range, 0.05 - 5 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-63 Slip Compensation Time Constant only has effect when ***parameter 1-10 Motor Construction = [0] Asynchron***.

Enter the slip compensation reaction speed. A high value results in slow reaction, and a low value results in quick reaction. If low-frequency resonance problems arise, use a longer time setting.

1-64 Resonance Damping

Default value:	Size related	**Parameter type:**	Range, 0 - 500%
Setup:	All setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-64 Resonance Damping only has effect when *parameter 1-10 Motor Construction = [0] Asynchron*.

Enter the resonance damping value. Set ***parameter 1-64 Resonance Damping*** and ***parameter 1-65 Resonance Damping Time Constant*** to help eliminate high-frequency resonance problems. To reduce resonance oscillation, increase the value of ***parameter 1-64 Resonance Damping***.

1-65 Resonance Damping Time Constant

Default value:	5 ms	**Parameter type:**	Range, 1 - 50 ms
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint8	**Change during operation:**	True

NOTICE

Parameter 1-65 Resonance Damping Time Constant only has effect when ***parameter 1-10 Motor Construction = [0] Asynchron***.

Set ***parameter 1-64 Resonance Damping*** and ***parameter 1-65 Resonance Damping Time Constant*** to help eliminate high-frequency resonance problems. Enter the time constant that provides the best dampening.

1-66 Min. Current at Low Speed

Default value:	Size related	**Parameter type:**	Range, 1 - 200%

Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

NOTICE

If ***parameter 40-50 Flux Sensorless Model Shift*** is set to ***[0] Off***, this parameter is ignored.

Enter the minimum motor current at low speed, see ***parameter 1-53 Model Shift Frequency***. Increasing this current improves motor torque at low speed. ***Parameter 1-66 Min. Current at Low Speed*** is enabled when ***parameter 1-00 Configuration Mode*** is set to ***[0] Speed open loop*** only. The drive runs with constant current through motor for speeds below 10 Hz. For speeds above 10 Hz, the motor flux model in the drive controls the motor. *Parameter 4-16 Torque Limit Motor Mode* and/or *parameter 4-17 Torque Limit Generator Mode* automatically adjust ***parameter 1-66 Min. Current at Low Speed***. The parameter with the highest value adjusts ***parameter 1-66 Min. Current at Low Speed***. The current setting in ***parameter 1-66 Min. Current at Low Speed*** is composed of the torque generating current and the magnetizing current. **Example:** Set ***parameter 4-16 Torque Limit Motor Mode*** to 100% and set ***parameter 4-17 Torque Limit Generator Mode*** to 60%. ***Parameter 1-66 Min. Current at Low Speed*** automatically adjusts to about 127%, depending on the motor size.

1-67 Load Type

Default setting:	[0] Passive load	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Passive load	For conveyors, fans, and pump applications.
[1]	Active load	For hoisting applications. This option allows the drive to ramp up at 0 RPM. When ***[1] Active Load*** is selected, set ***parameter 1-66 Min. Current at Low Speed*** to a level which corresponds to maximum torque.

1-68 Motor Inertia

Default value:	0 kgm	**Parameter type:**	Range, 0.0000 - 10000.0000 kgm^2
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

Enter the motor inertia to obtain an improved torque readout and therefore a better estimate of the mechanical torque on the shaft. Available in flux control principle only.

1-69 System Inertia

Default value:	Size related	**Parameter type:**	Range, 0.0000 - 0.4800 kgm^2
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

The system inertia and ***parameter 7-08 Speed PID Feed Forward Factor*** is used to calculate acceleration feed forward for the speed PID controller. Automatic measurement of system inertia and setting of this parameter is activated by setting the parameter to 0. System inertia is calculated after the 1st running cycle with sufficient data and the parameter is automatically set after stop. The function is only active when ***parameter 1-01 Motor Control Principle*** is set to ***[2] Flux Sensorless***. Accelerate to at least model shift frequency (***parameter 1-53 Model Shift Frequency***) + 10 Hz and decelerate to produce a result. Measurement is possible in both speed, position, or synchronization mode.

5.3.9 1-7* Start Adjustments

1-70 Start Mode

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the start-up mode. This is done to initialize the VVC+ control core for previously free-running motor. Both selections estimate the speed and angle. Active for PM and SynRM motors in VVC+ only.

Option	Name	Description
[0]	Rotor detection	Estimates the electrical angle of the rotor and uses this as a starting point. Standard selection for automation applications.
[1]	Parking	The parking function applies DC current across the stator winding and rotates the rotor to electrical 0 position (typically selected for HVAC applications). Parking current and time are configured in ***parameter 2-06 Parking Current*** and ***parameter 2-07 Parking Time***.
[2]	Rotor det. w/parking	Combining rotor detection with the parking function.

1-71 Start Delay

Default value:	00 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the time delay between the start command and the time when the drive supplies the power to the motor. This parameter refers to the start function selected in ***parameter 1-72 Start Function***. Enter the time delay required before commencing acceleration.

1-72 Start Function

Default value:	[2] Coast	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the start function during start delay. This parameter is linked to ***parameter 1-71 Start Delay***.

Option	Name	Description
[0]	DC hold/motor preheat	Energize the motor with a DC hold current (***parameter 2-00 DC Hold Current***) during the start delay time.
[2]*	Coast	Motor coasted during the start delay time (inverter off).

1-73 Flying Start

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This function is not recommended for hoisting applications. For power levels above 55 kW, flux mode must be used to achieve the best performance.

NOTICE

To obtain the best flying start performance, the advanced motor data, ***parameter 1-30 Stator Resistance (Rs)*** to ***parameter 1-35 Main Reactance (Xh)***, must be correct.

This function makes it possible to catch a freely spinning motor, for example coasted because of mains dropout. When ***parameter 1-73 Flying Start*** is enabled, ***parameter 1-71 Start Delay*** has no function. Search direction for flying start is linked to the setting in ***parameter 4-10 Motor Speed Direction***. ***[0] Clockwise***: Flying start searches in clockwise direction. If not successful, a DC brake is carried out. ***[2] Both Directions***: The flying start first searches in the direction determined by the last reference (direction). If the speed is not found, flying start searches in the other direction. If not successful, a DC brake activates in the time set in ***parameter 2-02 DC Braking Time***. Start then takes place from 0 Hz.

Option	Name	Description
[0]	Disabled	No function.
[1]	Enabled	Enable after coast.
[2]	Enabled always	Enable at every start.
[3]	Enabled ref. dir.	Enable after coast, search in reference direction only.
[4]	Enab. always ref. dir.	Enable at every start, search in reference direction only.
[11]	v2 Enabled	Enable flying start version 2, after coast.
[12]	v2 Enabled Always	Enable flying start version 2, at every start.
[13]	v2 Enabled Ref. Dir.	Enable flying start version 2, after coast, search in reference direction only.
[14]	v2 Enab. Alw. Ref. Dir.	Enable flying start version 2, ok at every start, search in reference direction only.

The flying-start function used for PM motors is based on an initial speed estimation. The speed is always estimated as the 1st thing after an active start signal is given. Based on the setting of ***parameter 1-70 Start Mode***, the following happens:

Parameter 1-70 Start Mode = ***[0] Rotor Detection***: If the speed estimate appears as greater than 0Â Hz, the drive catches the motor at that speed and resumes normal operation. Otherwise, the drive estimates the rotor position and starts normal operation from there.

Parameter 1-70 Start Mode = ***[1] Parking***: A speed estimate lower than the setting in ***parameter 1-59 Flying Start Test Pulses Frequency*** engages the parking function (see ***parameter 2-06 Parking Current*** and ***parameter 2-07 Parking Time***). Otherwise, the drive catches the motor at that speed and resumes normal operation. Refer to the description of ***parameter 1-70 Start Mode*** for recommended settings.

Current limitations of the flying-start principle used for PM motors:

- The speed range is up to 100% nominal speed or the field weakening speed (whichever is lowest).
- PMSM with high back EMF (>300 VLL(rms)) and high-winding inductance (>10 mH) needs more time for reducing short-circuit current to 0 and may be susceptibe to error in estimation.
- Current testing limited to a speed range up to 300 Hz. For certain units, the limit is 250 Hz; all 200–240 V units up to and including 2.2 kW (3.0 hp) and all 380–480 V units up to and including 4 kW (5.0 hp).
- Current testing limited to a machine power size up to 22 kW (30 hp).
- Prepared for salient-pole machine (IPMSM) but not yet verified on those types of machines.
- For high-inertia applications (that is, where the load inertia is more than 30 times larger than the motor inertia), use a brake resistor to avoid overvoltage trip during high-speed engagement of the flying-start function.

1-77 Compressor Start Max Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - ***parameter 4-13 Motor Speed High Limit [RPM]***
Setup:	All setups	**Conversion index:**	67
Data type:	Uint 16	**Change during operation:**	True

NOTICE

Parameter 1-77 Compressor Start Max Speed [RPM] has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, nonsalient SPM***.

The parameter enables high starting torque. This is a function where the current limit and torque limit are ignored during start of the motor. The time from the start signal is given, until the speed exceeds the speed set in this parameter, becomes a start-zone where the current limit and motoric torque limit is set to what is maximally possible for the drive/motor combination. This parameter is normally set to the same value as ***parameter 4-11 Motor Speed Low Limit [RPM]***. When set to 0, the function is inactive. In this starting-zone, ***parameter 3-82 Starting Ramp Up Time*** is active to ensure extra acceleration during the start and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the current limit and torque limit must not exceed the value set in ***parameter 1-79 Compressor Start Max Time to Trip***. If the value in ***parameter 1-79 Compressor Start Max Time to Trip*** is exceeded, the drive trips with *alarm 18, Start failed*. When this function is activated to get a fast start, ***parameter 1-86 Trip Speed Low [RPM]*** is also activated to protect the application from running below minimum motor speed, for example when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, enter appropriate values for start delay/start speed/start current.

1-78 Compressor Start Max Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - ***parameter 4-14 Motor Speed High Limit [Hz]***
Setup:	All setups	**Conversion index:**	-1

Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-78 Compressor Start Max Speed [Hz] has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, nonsalient SPM***.

The parameter enables high starting torque. This is a function where the current limit and torque limit are ignored during start of the motor. The time, from the start signal is given until the speed exceeds the speed set in this parameter, becomes a start-zone where the current limit and motoric torque limit is set to what is maximally possible for the drive/motor combination. This parameter is normally set to the same value as ***parameter 4-11 Motor Speed Low Limit [RPM]***. When set to 0, the function is inactive. In this starting-zone, ***parameter 3-82 Starting Ramp Up Time*** is active instead of ***parameter 3-41 Ramp 1 Ramp Up Time*** to ensure extra acceleration during the start, and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the current limit and torque limit must not exceed the value set in ***parameter 1-79 Compressor Start Max Time to Trip***. If the value in ***parameter 1-79 Compressor Start Max Time to Trip*** is exceeded, the drive trips with *alarm 18, Start failed* . When this function is activated to get a fast start, ***parameter 1-86 Trip Speed Low [RPM]*** is also activated to protect the application from running below minimum motor speed, for example when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, enter appropriate values for start delay/start speed/start current.

1-79 Compressor Start Max Time to Trip

Default value:	0 s	**Parameter type:**	Range, 0 - 3600.0 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

Parameter 1-79 Compressor Start Max Time to Trip has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, non-salient SPM***.

The time from the start signal is given until the speed exceeds the speed set in ***parameter 1-77 Compressor Start Max Speed [RPM]*** must not exceed the time set in the parameter. If the time set is exceeded, the drive trips with *alarm 18, Start failed* . Any time set in ***parameter 1-71 Start Delay*** for use of a start function must be executed within the time limit.

5.3.10 1-8* Stop Adjustments

1-80 Function at Stop

Default value:	[0] Coast	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the drive function after a stop command or after the speed is ramped down to the settings in ***parameter 1-81 Min Speed for Function at Stop [RPM]***. Available selections depend on ***parameter 1-10 Motor Construction***:

- ***[0] Asynchronous***:
  - ***[0] Coast***
  - ***[1] DC hold***
  - ***[2] Motor check, warning***
  - ***[6] Motor check, alarm***

- ***[1] PM non-salient***:
  - ***[0] Coast***

Option	Name	Description
[0]*	Coast	Leaves motor in free mode. The motor is disconnected from the drive.
[1]	DC hold/motor preheat	Energizes the motor with a DC hold current (see ***parameter 2-00 DC Hold Current***).
[2]	Motor check, warning	The drive issues a warning if 1 or more motor phases are missing.
[6]	Motor check, alarm	The drive issues an alarm if 1 or more motor phases are missing.

1-81 Min Speed for Function at Stop [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - 600 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the speed at which to activate ***parameter 1-80 Function at Stop***.

1-82 Min Speed for Function at Stop [Hz]

Default:	Size related	**Parameter type:**	Range, 0 - 20.0 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the output frequency at which to activate ***parameter 1-80 Function at Stop***.

Advanced minimum speed monitoring for submersible pumps

Some pumps are sensitive to operating at low speed. Insufficient cooling or lubrication at low speed are typical reasons.

Under overload conditions, the drive protects itself using its integral protection features, which include lowering the speed. For example, the current limit controller can lower the speed. Sometimes, the speed may go lower than the speed specified in ***parameter 4-11 Motor Speed Low Limit [RPM]*** and ***parameter 4-12 Motor Speed Low Limit [Hz]***.

If the speed drops below a certain value, the advanced minimum-speed monitoring feature trips the drive. If the pump does not reach the speed specified in ***parameter 1-86 Trip Speed Low [RPM]*** within the time specified in ***parameter 1-79 Pump Start Max Time to Trip***(ramping takes too long), the drive trips. Timers for ***parameter 1-71 Start Delay*** and ***parameter 1-79 Pump Start Max Time to Trip*** start at the same time when the start command is issued. For instance, this means that if the value in ***parameter 1-71 Start Delay*** is more than or equal to the value in ***parameter 1-79 Pump Start Max Time to Trip***, the drive never starts.

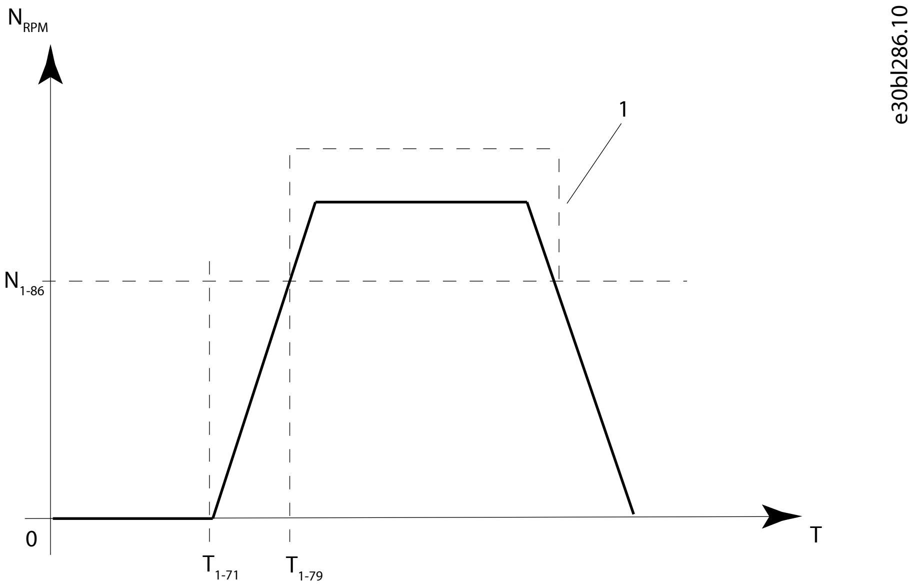


Figure 37: Advanced Minimum Speed Monitoring

T$_{1-71}$	***Parameter 1-71 Start Delay***	**T**$_{1-79}$	***Parameter 1-79 Pump Start Max to Trip***. This time includes the time in T$_{1-71}$.
N$_{1-86}$	***Parameter 1-86 Trip Speed Low [RPM]***. If the speed drops below this value during normal operation, the drive trips.	**1**	Normal operation.

1-86 Trip Speed Low [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - parameter 4-13 Motor Speed High Limit [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is only available if ***parameter 0-02 Motor Speed Unit*** is set to *[11] RPM*.

Enter the low limit for the motor speed at which the drive trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the drive trips with *alarm 49, Speed Limit*.

1-87 Trip Speed Low [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - ***parameter 4-14 Motor Speed High Limit [Hz]***
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is only available if ***parameter 0-02 Motor Speed Unit*** is set to *[1] Hz*.

Enter the low limit for the motor speed at which the drive trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the drive trips with *alarm 49, Speed Limit*.

5.3.11 1-9* Motor Temperature

1-90 Motor Thermal Protection

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Motor thermal protection can be implemented using a range of techniques:

- Via a PTC sensor in the motor windings connected to 1 of the analog or digital inputs (***parameter 1-93 Thermistor Resource***). See 5.3.11.1.1 PTC Thermistor Connection.
- Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. See 5.3.11.1.2 ETR and 5.3.11.1.3 ATEX ETR.
- Via a mechanical thermal switch (Klixon type). See 5.3.11.1.4 Klixon.

For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

Option	Name	Description
[0]	No protection	Continuously overloaded motor when no warning or trip of the drive is required.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts if there is a motor overtemperature.
[2]	Thermistor trip	Stops (trips) the drive when connected thermistor in the motor reacts if there is a motor overtemperature.
[3]	ETR warning 1	Calculates the load when setup 1 is active and activates a warning on the display when the motor is overloaded. Program a warning signal via 1 of the digital outputs.
[4]	ETR trip 1	Calculates the load when setup 1 is active and stops (trips) the drive when the motor is overloaded. Program a warning signal via 1 of the digital outputs. The signal appears in the event of a warning and if the drive trips (thermal warning).
[5]	ETR warning 2	Same as ***[3] ETR warning 1***, but for setup 2.
[6]	ETR trip 2	Same as ***[4] ETR trip 1*** but for setup 2.
[7]	ETR warning 3	Same as ***[3] ETR warning 1*** but for setup 3.
[8]	ETR trip 3	Same as ***[4] ETR trip 1*** but for setup 3.
[9]	ETR warning 4	Same as ***[3] ETR warning 1*** but for setup 4.
[10]	ETR trip 4	Same as ***[4] ETR trip 1*** but for setup 4.

Option	Name	Description
[20]	ATEX ETR	Activates the thermal monitoring function for Ex-e motors for ATEX. Enables ***parameter 1-94 ATEX ETR cur.lim. speed reduction***, ***parameter 1-98 ATEX ETR interpol. points freq.***, and ***parameter 1-99 ATEX ETR interpol points current***.
[21]	Advanced ETR	

1-91 Motor External Fan

Default value:	[0] No	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No	No external fan is required, that is the motor is derated at low speed.
[1]	Yes	Applies an external motor fan (external ventilation), so no derating of the motor is required at low speed. The upper curve in the illustration below (f_{out} = 1 x $f_{M,N}$) is followed if the motor current is lower than nominal motor current (see ***parameter 1-24 Motor Current***). If the motor current exceeds nominal current, the operation time still decreases as if no fan was installed.

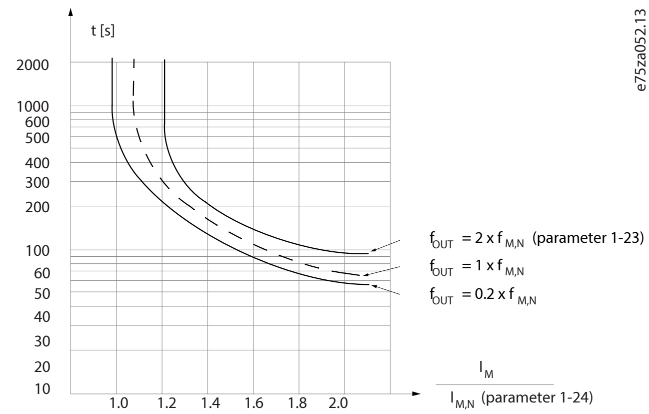


Figure 38: ETR Profile

1-93 Thermistor Resource

Default value:	[0] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Set digital input to ***[0] PNP - Active at 24 V*** in ***parameter 5-00 Digital I/O Mode***.

NOTICE

When using VLT® PTC Thermistor Card MCB 112 always always select ***[0] None***.

Select the input to which the thermistor (PTC sensor) should be connected. An analog input option ***[1] Analog Input 53*** or ***[2] Analog Input 54*** cannot be selected if the analog input is already in use as a reference source (selected in ***parameter 3-15 Reference Resource 1***, ***parameter 3-16 Reference Resource 2***, or ***parameter 3-17 Reference Resource 3***).

Option	Name	Description
[0]*	None	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Digital input 18	
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	

1-94 ATEX ETR Cur. Lim. Speed Reduction

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	2 setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Only visible if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR***.

1-95 Thermistor Sensor Type

Default value:	[0] KTY Sensor 1	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the used type of thermistor sensor.

Option	Name	Description
[0]*	KTY sensor 1	1 kΩ at 100 °C (212 °F).
[1]	KTY sensor 2	1 kΩ at 25 °C (77 °F).
[2]	KTY sensor 3	2 kΩ at 25 °C (77 °F).

Option	Name	Description
[3]	Pt1000	1 kΩ at 0 °C (32 °F).
[4]	Ni1000 (6178 ppm/K)	1 kΩ at 0 °C (32 °F).
[5]	Ni1000-LG (TC5)	Examples: • Siemens LG-Ni1000 • Tasseron RTD Ni1000-TC5 1000 Ohm

1-96 Thermistor Sensor Resource

Default value:	[0] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select analog input terminal 54 to be used for connection of KTY/Pt1000/Ni1000 thermistor sensor. Terminal 54 cannot be selected as thermistor source if otherwise used as reference (see ***parameter 3-15 Reference Resource 1*** to ***parameter 3-17 Reference Resource 3***).

NOTICE

Connection of thermistor sensor between terminals 54 and 55 (GND).

Option	Name	Description
[0]*	None	
[2]	Analog input 54	

1-97 Thermistor Threshold Level

Default value:	80 °C	**Parameter type:**	Range, -40 - 220 °C
Setup:	1 setup	**Conversion index:**	100
Data type:	Int16	**Change during operation:**	True

Select the thermistor sensor threshold level for motor thermal protection.

1-98 ATEX ETR Interpol. Points Freq.

Default value:	Size related	**Parameter type:**	Range, 0 - 1000.0 Hz, Array [4]
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Only visible if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR***.

Enter the 4 frequency points [Hz] from the motor nameplate into this array.

NOTICE

All frequency/current limit points from the motor nameplate or motor datasheet must be programmed.

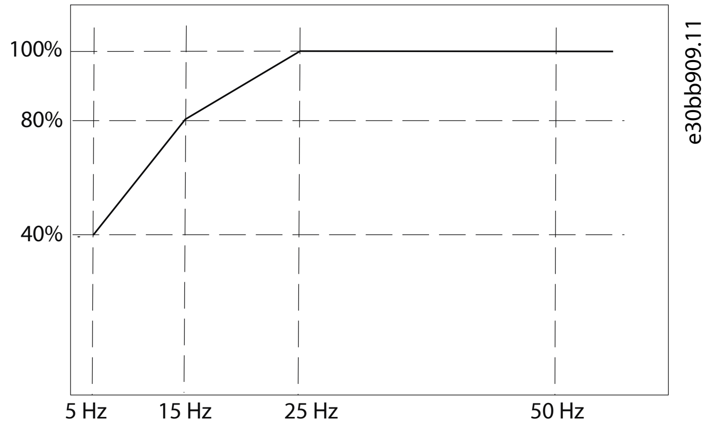


Figure 39: Example of ATEX ETR Thermal Limitation Curve

1-99 ATEX ETR Interpol. Points Current

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [4]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Definition of the thermal limitation curve. For example, see ***parameter 1-98 ATEX ETR Interpol. Points Freq***.

5.3.11.1 Connections Related to Motor Temperature Control

5.3.11.1.1 PTC Thermistor Connection

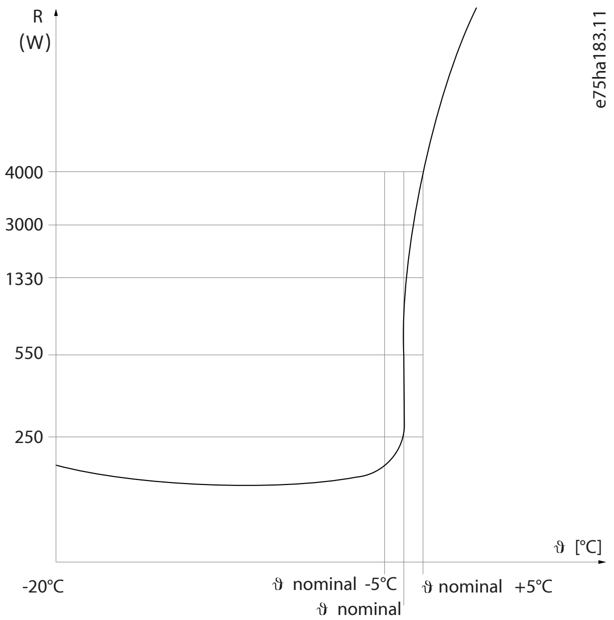


Figure 40: PTC Profile

Using a digital input and 10 V as supply: Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set ***parameter 1-90 Motor Thermal Protection***to ***[2] Thermistor Trip***.
- Set ***parameter 1-93 Thermistor Source*** to ***[6] Digital Input***.

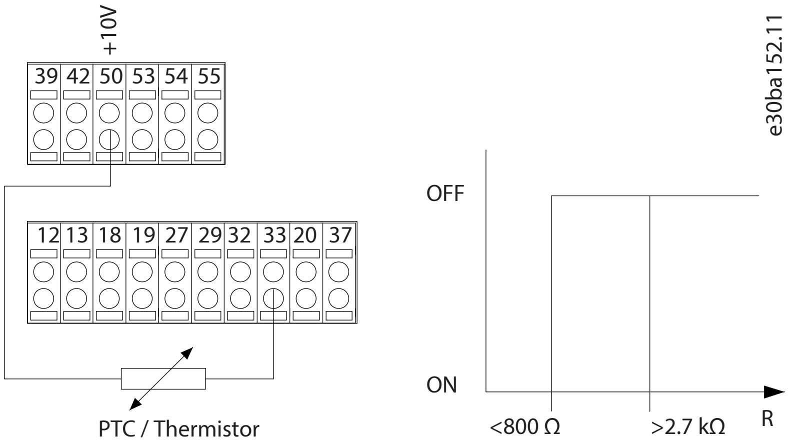


Figure 41: PTC Thermistor Connection - Digital Input

Using an analog input and 10 V as supply: Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set ***parameter 1-90 Motor Thermal Protection***to ***[2] Thermistor Trip***.
- Set ***parameter 1-93 Thermistor Source*** to ***[2] Analog Input 54***.

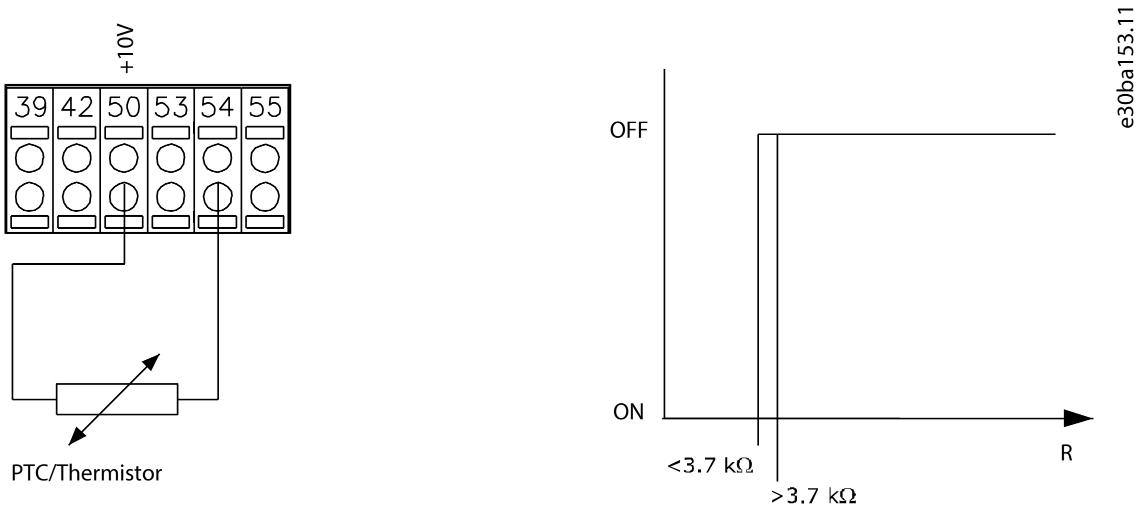


Figure 42: PTC Thermistor Connection - Analog Input

Table 18: Threshold Cutout Values

Input digital/analog	Supply voltage	Threshold cutout values
Digital	10 V	<800 Ω⇨2.7 kΩ
Analog	10 V	<3.0 kΩ⇨3.0 kΩ

NOTICE

Check that the selected supply voltage follows the specification of the used thermistor element.

5.3.11.1.2 **ETR**

The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.

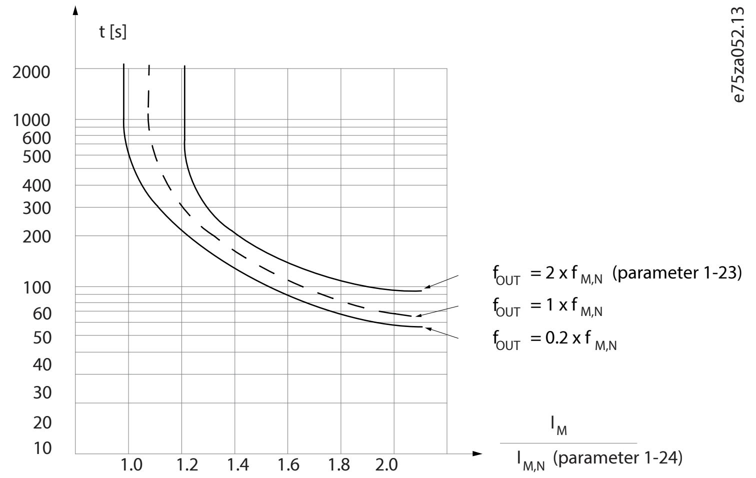


Figure 43: ETR Profile

5.3.11.1.3 ATEX ETR

The VLT® PTC Thermistor Card MCB 112 offers ATEX-approved monitoring of motor temperature. Alternatively, an external ATEX-approved PTC protection device can be used.

NOTICE

Only use ATEX Ex-e-approved motors for this function. See motor nameplate, approval certificate, datasheet, or contact motor supplier.

When controlling an Ex-e motor with increased safety, it is important to ensure certain limitations. The parameters that must be programmed are presented in Table 19.

Table 19: Parameters

Function	Setting
Parameter 1-90 Motor Thermal Protection	***[20] ATEX ETR***
Parameter 1-94 ATEX ETR cur.lim. speed reduction	20%
Parameter 1-98 ATEX ETR interpol. points freq.	Motor nameplate.
Parameter 1-99 ATEX ETR interpol points current	
Parameter 1-23 Motor Frequency	Enter the same value as for ***parameter 4-19 Max Output Frequency***.
Parameter 4-19 Max Output Frequency	Motor nameplate, possibly reduced for long motor cables, sine-wave filter, or reduced supply voltage.
Parameter 4-18 Current Limit	Forced to 150% by 1-90 [20]
Parameter 5-15 Terminal 33 Digital Input	[80] PTC Card 1
Parameter 5-19 Terminal 37 Safe Stop	[4] PTC 1 Alarm
Parameter 14-01 Switching Frequency	Check that the default value fulfills the requirement from the motor nameplate. If not, use a sine-wave filter.
Parameter 14-26 Trip Delay at Inverter Fault	0

NOTICE

Compare the minimum switching frequency requirement stated by the motor manufacturer to the minimum switching frequency of the drive, the default value in ***parameter 14-01 Switching Frequency***. If the drive does not meet this requirement, use a sine-wave filter.

5.3.11.1.4 Klixon

The Klixon type thermal circuit breaker uses a KLIXON® metal dish. At a predetermined overload, the heat caused by the current through the disc causes a trip.

Using a digital input and 24 V as supply:

Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set ***parameter 1-90 Motor Thermal Protection***to ***[2] Thermistor Trip***.
- Set ***parameter 1-93 Thermistor Source*** to ***[6] Digital Input***.

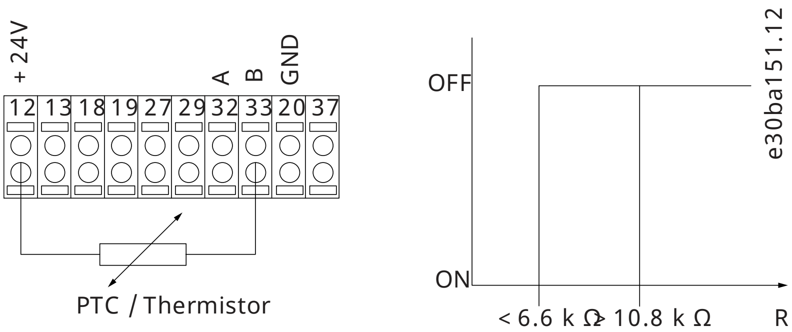


Figure 44: Thermistor Connection

5.4 Parameter Group 2-** Brakes

5.4.1 2-0* DC Brakes

Use the parameters in this group for configuring the DC brake and DC hold functions.

2-00 DC Hold/Preheat

Default value:	50%	**Parameter type:**	Range, 0 - 160%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor. In VVC+ control core, low values (<20%) of DC hold may result in wrong currents with larger motor sizes (>90 kW) and should be avoided. In cases when low DC hold currents with larger motors are required, select Flux control core to ensure the right currents.

Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in ***parameter 1-24 Motor Current***. 100% DC hold current corresponds to $I_{M,N}$. This parameter holds the motor function (holding torque) or preheats the motor. This parameter is active if ***DC hold*** is selected in ***parameter 1-72 Start Function*** or ***parameter 1-80 Function at Stop***.

2-01 DC Brake Current

Default value:	50%	**Parameter type:**	Range, 0 - 1000%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE

The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor.

Enter a value for current as a percentage of the rated motor current $I_{M,N}$, see ***parameter 1-24 Motor Current***. 100% DC brake current corresponds to $I_{M,N}$. DC brake current is applied on a stop command, when the speed is lower than the limit set in ***parameter 2-03 DC Brake Cut In Speed [RPM]***; when the DC brake inverse function is active, or via the serial communication port. The braking current is active during the time period set in ***parameter 2-02 DC Braking Time***.

2-02 DC Braking Time

Default value:	10 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the duration of the DC brake current set in ***parameter 2-01 DC Brake Current***, once activated.

2-03 DC Brake Cut In Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-13 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the DC brake cut-in speed for activation of the DC brake current set in ***parameter 2-01 DC Brake Current***, upon a stop command.

2-06 Parking Current

Default value:	50%	**Parameter type:**	Range, 0 - 1000%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set current as percentage of rated motor current, ***parameter 1-24 Motor Current***. Is used when enabled in ***parameter 1-70 Start Mode***.

2-07 Parking Time

Default value:	3 s	**Parameter type:**	Range, 0.1 - 60 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the duration of the parking current set in ***parameter 2-06 Parking Current***, once activated.

5.4.2 2-1* Brake Energy Funct.

This parameter group contains dynamic brake parameters. The parameters in this group are only valid for drives with brake chopper.

2-10 Brake Function

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Off	No brake resistor installed.
[1]	Resistor brake	A brake resistor is incorporated in the system for dissipation of surplus brake energy as heat. Connecting a brake resistor allows a higher DC-link voltage during braking (generating operation). The resistor brake function is only active in drives with an integral dynamic brake.
[2]	AC brake	Improves braking without using a brake resistor. This parameter controls an overmagnetization of the motor when running with a generatoric load. This function can improve the OVC function. Increasing the electrical losses in the motor allows the OVC function to increase the braking torque without exceeding the overvoltage limit. **NOTICE** The AC brake is not as efficient as dynamic braking with resistor. AC brake is for VVC+ mode in both open and closed loop.

2-11 Brake Resistor (ohm)

Default value:	Size related	**Parameter type:**	Range, 5.00 - 65535 Ohm
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor in ***parameter 2-13 Brake Power Monitoring***. This parameter is only active in drives with an integral dynamic brake. Use this parameter for values without decimals. For a selection with 2 decimals, use ***parameter 30-81 Brake Resistor (ohm)***.

2-12 Brake Power Limit (kW)

Default value:	Size related	**Parameter type:**	Range, 0.001 - 2000.000 kW
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Parameter 2-12 Brake Power Limit (kW) is the expected average power dissipated in the brake resistor over a period of 120 s. It is used as the monitoring limit for ***parameter 16-33 Brake Energy Average*** and thereby specifies when a warning/alarm is to be given. To calculate ***parameter 2-12 Brake Power Limit (kW)***, the following formula can be used. $P_{br,avg}$ is the average power dissipated in the brake resistor. R_{br} is the resistance of the brake resistor. t_{br} is the active braking time within the 120 s period, T_{br}. U_{br} is the DC voltage where the brake resistor is active. This depends on the unit as follows:

$$P_{br,avg}[W] = \frac{U^2_{br}[V] \times t_{br}[s]}{R_{br}[\Omega] \times T_{br}[s]}$$

- T2 units: 390 V
- T4 units: 778 V
- T5 units: 810 V
- T6 units: 943 V/1099 V for D–F enclosures
- T7 units: 1099 V

NOTICE

If R_{br} is not known, or if T_{br} is different from 120 s, the practical approach is to run the brake application, read ***parameter 16-33 Brake Energy Average*** and then enter this + 20% in ***parameter 2-12 Brake Power Limit (kW)***.

2-13 Brake Power Monitoring

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is only active in drives with a brake. This parameter enables monitoring of the power to the brake resistor. The power is calculated based on the resistance (***parameter 2-11 Brake Resistor (ohm)***), the DC-link voltage, and the resistor duty time. If power monitoring is set to ***[0] Off*** or ***[1] Warning***, the brake function remains active, even if the monitoring limit is exceeded. This may lead to thermal overload of the resistor. It is also possible to generate a warning via a relay/digital output. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than ±20%).

Option	Name	Description
[0]*	Off	No brake power monitoring required.
[1]	Warning 120s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (***parameter 2-12 Brake Power Limit (kW)***). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[2]	Trip 120s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[3]	Warning & Trip 120s	Activates both of the above, including warning and alarm.
[4]	Warning 30s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (***parameter 2-12 Brake Power Limit (kW)***). The warning disappears when the transmitted power drops below 80% of the monitoring limit.

Option	Name	Description
[5]	Trip 30s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[6]	Warning & trip 30s	Activates both of the above, including warning and alarm.
[7]	Warning 60s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (***parameter 2-12 Brake Power Limit (kW)***). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[8]	Trip 60s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[9]	Warning & trip 60s	Activates both of the above, including warning and alarm.
[10]	Warning 300s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (***parameter 2-12 Brake Power Limit (kW)***). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[11]	Trip 300s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[12]	Warning & trip 300s	Activates both of the above, including warning and alarm.
[13]	Warning 600s	ctivates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (***parameter 2-12 Brake Power Limit (kW)***). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[14]	Trip 600s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[15]	Warning & trip 600s	Activates both of the above, including warning and alarm.

2-15 Brake Check

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Parameter 2-15 Brake Check is only active in drives with an integral dynamic brake. Select type of test and monitoring function to check the connection to the brake resistor, or whether a brake resistor is present, and then show a warning or an alarm in the event of a fault.

NOTICE

The brake resistor disconnection function is tested during power-up. However, the brake IGBT test is performed when there is no braking. A warning or trip disconnects the brake function.

The testing sequence is as follows:

- 1: The DC-link ripple amplitude is measured for 300 ms without braking.

- 2: The DC-link ripple amplitude is measured for 300 ms with the brake turned on.
  - If the DC-link ripple amplitude while braking is lower than the DC-link ripple amplitude before braking +1%: *Brake check has failed by returning a warning or alarm*.
  - If the DC-link ripple amplitude while braking is higher than the DC-link ripple amplitude before braking +1%: *Brake check is OK*.

NOTICE

Remove a warning arising with ***[0] Off*** or ***[1] Warning*** by cycling the mains supply. The fault must be corrected first. For ***[0] Off*** or ***[1] Warning***, the drive keeps running even if a fault is located.

Option	Name	Description
[0]*	Off	Monitors brake resistor and brake IGBT for a short circuit during operation. If a short circuit occurs, *Warning 25 Brake resistor shortcircuited* appears.
[1]	Warning	Monitors brake resistor and brake IGBT for a short circuit and runs a test for brake resistor disconnection during power-up.
[2]	Trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive cuts out while showing an alarm (trip lock).
[3]	Stop and trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive ramps down to coast and then trips. A trip lock alarm is shown (for example, warnings 25, 27, or 28).
[4]	AC brake	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive performs a controlled ramp-down.

2-16 AC Brake Max. Current

Default value:	100%	**Parameter type:**	Range, 0 - 1000.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Enter the maximum allowed current when using AC braking to avoid overheating of motor windings.

NOTICE

Parameter 2-16 AC brake Max. Current has no effect when ***parameter 1-10 Motor Construction*** = ***[1] PM, non salient SPM***.

2-17 Over-voltage Control

Default value:	[2] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Overvoltage control (OVC) reduces the risk of the drive tripping due to an overvoltage on the DC link caused by generative power from the load.

NOTICE

Do not enable OVC in hoisting applications.

Option	Name	Description
[0]	Disabled	No OVC required.
[2]*	Enabled	Activates OVC.

2-19 Over-voltage Gain

Default value:	100%	**Parameter type:**	Range, 10 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Use this parameter for adjusting the overvoltage gain for ***parameter 2-17 Over-voltage Control***in the low-speed area.

5.5 Parameter Group 3-** Reference/Ramps

5.5.1 3-0* Reference Limits

3-02 Minimum Reference

Default value:	Size related	**Parameter type:**	Range, -999999.999 - 999999.999 Reference-FeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when ***parameter 3-00 Reference Range*** is set to ***[0] Min.- Max***. The minimum reference unit matches:

- The configuration of ***parameter 1-00 Configuration Mode***: For ***[1] Speed closed loop, RPM***; for ***[2] Torque, Nm***.
- The unit selected in ***parameter 3-01 Reference/ Feedback Unit***.

If option ***[10] Synchronization*** is selected in ***parameter 1-00 Configuration Mode***, this parameter defines the maximum speed deviation when performing the position offset defined in ***parameter 3-26 Master Offset***. Also see ***parameter 3-28 Master Offset Speed Ref***.

3-03 Maximum Reference

Default value:	Size related	**Parameter type:**	Range, ***parameter 3-02 Minimum Reference*** - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the maximum reference. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches:

- The configuration selected in ***parameter 1-00 Configuration Mode***: For ***[1] Speed closed loop, RPM***; for ***[2] Torque, Nm***.

- The unit selected in ***parameter 3-00 Reference Range***.

If ***[9] Positioning*** is selected in ***parameter 1-00 Configuration Mode*** , this parameter defines the default speed for positioning.

3-04 Reference Function

Default value:	[0] Sum	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Sum	Sums both external and preset reference sources.
[1]	External/Preset	Use either the preset or the external reference source. Shift between external and preset via a command or a digital input.

5.5.2 3-1* References

Select the preset references. Select ***[16] Preset ref bit 0***, ***[17] Preset ref bit 1***, or ***[18] Preset ref bit 2***for the corresponding digital inputs in *parameter group 5-1* Digital Inputs*.

3-10 Preset Reference

Default value:	0%	**Parameter type:**	Range, -100 - 100%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter up to 8 different preset references (0–7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (***parameter 3-03 Maximum Reference***). If a Ref_{MIN} different from 0 (***parameter 3-02 Minimum Reference***) is programmed, the preset reference is calculated as a percentage of the full reference range, that is on the basis of the difference between Ref_{MAX} and Ref_{MIN}. Afterwards, the value is added to Ref_{MIN}. When using preset references, select preset reference bit 0/1/2 [16], [17] or [18] for the corresponding digital inputs in *parameter group 5-1* Digital Inputs*.

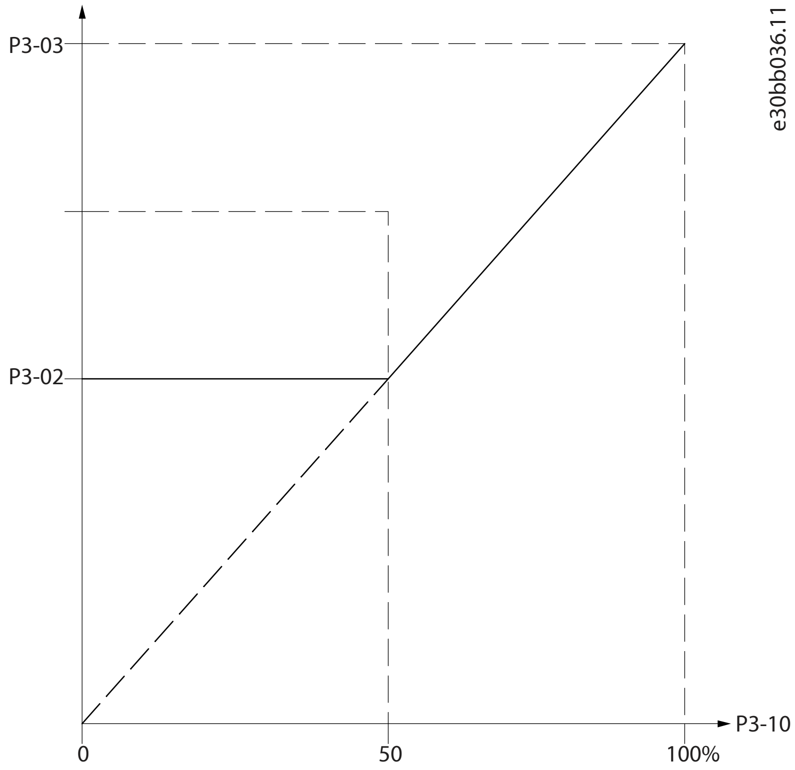


Figure 45: Preset Reference

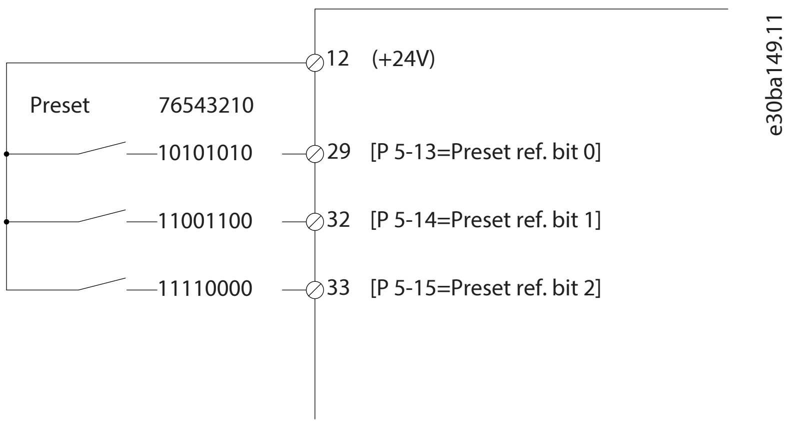


Figure 46: Preset Reference Scheme

Table 20: Preset Referenece Bits

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1

Table 20: Preset Referenece Bits (continued)

Preset ref. bit	2	1	0
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

3-11 Jog Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-14 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

The jog speed is a fixed output speed at which the drive is running when the jog function is activated. See also ***parameter 3-80 Jog/ Homing Ramp Time***.

3-13 Reference Site

Default value:	[0] Linked to hand/auto	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select which reference site to activate.

Option	Name	Description
[0]*	Linked to hand/auto	Use local reference when in hand-on mode, or remote reference when in auto-on mode.
[1]	Remote	Use remote reference in both hand-on mode and auto-on mode.
[2]	Local	Use local reference in both hand-on and auto-on mode. **NOTICE** When set to ***[2] Local***, the drive starts with this setting again after a power-down.
[3]	Linked to H/A MCO	Select this option to enable the FFACC factor in ***parameter 32-66 Acceleration Feed-Forward***. Enabling FFACC reduces jitter and makes the transmission from the motion controller to the control card of the drive faster. This leads to faster response times for dynamic applications and position control. For more information about FFACC, see VLT® Motion Control MCO 305 Operating Instructions.

3-14 Preset Relative Reference

Default value:	0%	**Parameter type:**	Range, -100 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

The actual reference, X, is increased or decreased with percentage Y, which gives the resulting actual reference, Z. The actual reference (X) is the sum of the inputs selected in:

- ***Parameter 3-15 Reference Resource 1***.
- ***Parameter 3-16 Reference Resource 2***.
- ***Parameter 3-17 Reference Resource 3***.
- ***Parameter 8-02 Control Word Source***.

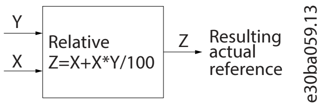


Figure 47: Preset Relative Reference

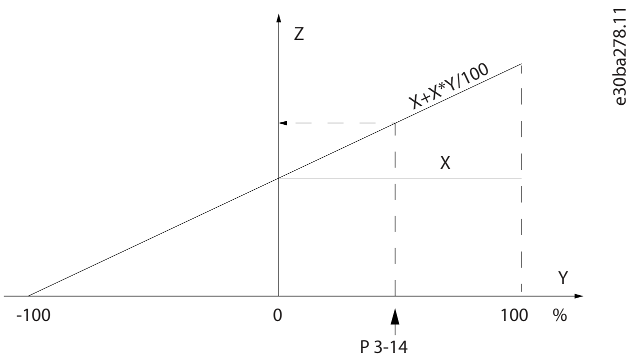


Figure 48: Actual Reference

3-15 Reference Resource 1

Default value:	[1] Analog input 53	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the reference input to be used for the 1st reference signal. ***Parameter 3-15 Resource Reference 1***, ***parameter 3-16 Resource Reference 2***, and ***parameter 3-17 Resource Reference 3*** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]	No function	
[1]*	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	Reference from terminals 68 and 69.
[20]	Digital Potmeter	
[21]	Analog Input X30/11	VLT® General Purpose I/O MCB 101
[22]	Analog Input X30/12	VLT® General Purpose I/O MCB 101

Option	Name	Description
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[35]	Digital input select	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option ***[42] Ref source bit 0*** as 1 of the digital inputs. For more information, see *parameter group 5-1* Digital Inputs*, ***[42] Ref source bit 0***.
[37]	Analog Input X49/1	
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-16 Reference Resource 2

Default value	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the reference input to be used for the 2nd reference signal. ***Parameter 3-15 Resource Reference 1***, ***parameter 3-16 Resource Reference 2***, and ***parameter 3-17 Resource Reference 3*** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]*	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	Reference from terminals 68 and 69.
[15]	MCO Encoder 1 X56	
[20]	Digital Potmeter	
[21]	Analog Input X30/11	VLT® General Purpose I/O MCB 101
[22]	Analog Input X30/12	VLT® General Purpose I/O MCB 101

Option	Name	Description
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[35]	Digital input select	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option ***[42] Ref source bit 0*** as 1 of the digital inputs. For more information, see *parameter group 5-1* Digital Inputs*, option ***[42] Ref source bit 0***.
[37]	Analog Input X49/1	
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-17 Reference Resource 3

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the reference input to be used for the 3rd reference signal. ***Parameter 3-15 Resource Reference 1***, ***parameter 3-16 Resource Reference 2***, and ***parameter 3-17 Resource Reference 3*** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]*	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	Reference from terminals 68 and 69.
[20]	Digital Potmeter	
[21]	Analog Input X30/11	
[22]	Analog Input X30/12	
[23]	Analog Input X42/1	

Option	Name	Description
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[35]	Digital input select	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option ***[42] Ref source bit 0*** as 1 of the digital inputs. For more information, see *parameter group 5-1* Digital inputs*, ***[42] Ref source bit 0***.
[37]	Analog Input X49/1	
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-19 Jog Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-13 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Enter a value for the jog speed n_{JOG}, which is a fixed output speed. The drive runs at this speed when the jog function is activated. The maximum limit is defined in ***parameter 4-13 Motor Speed High Limit [RPM]***. See also ***parameter 3-80 Jog/Homing Ramp Time***.

5.5.3 3-4* Ramp 1

Configure the ramp times for each of the 2 ramps (*parameter group 3-4* Ramp 1* and *parameter group 3-5* Ramp 2*).

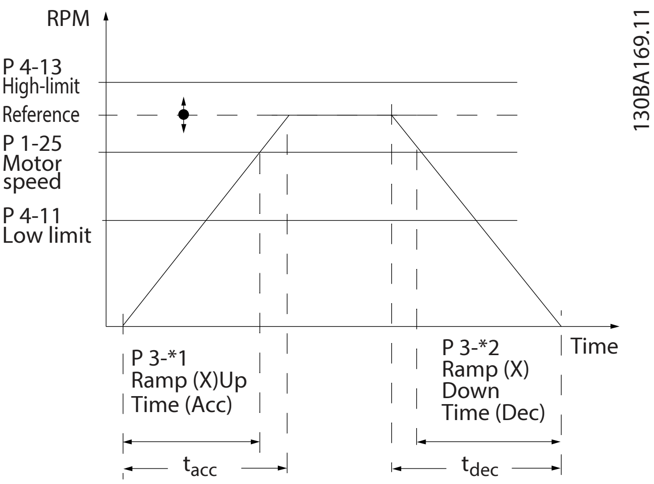


Figure 49: Ramp 1

3-41 Ramp 1 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range, 0.10 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, that is the acceleration time from 0 RPM to ***parameter 1-25 Motor Nominal Speed***. Select a ramp-up time such that the output current does not exceed the current limit in ***parameter 4-18 Current Limit*** during ramping. See ramp-down time in ***parameter 3-42 Ramp 1 Ramp Down Time***.

$$\text{par.3-41} = \frac{t_{acc} \times n_{nom}[\text{par.}]}{\text{ref}[\text{RPM}]}[s]$$

3-42 Ramp 1 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range, 0.10 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, that is the deceleration time from ***parameter 1-25 Motor Nominal Speed***–0 RPM. Select a ramp-down time preventing overvoltage from arising in the inverter due to regeneratibe operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in ***parameter 4-18 Current Limit*** See ramp-up time in ***parameter 3-41 Ramp 1 Ramp Up Time***.

$$\text{par.3-42} = \frac{t_{dec} \times n_{nom}[\text{par.}]}{\text{ref}[\text{RPM}]}[s]$$

5.5.4 3-5* Ramp 2

To select ramp parameters, see *parameter group 3-4* Ramp 1*.

3-51 Ramp 2 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range, 0.10 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, that is the acceleration time from 0 RPM to ***parameter 1-25 Motor Nominal Speed***. Select a ramp-up time such that the output current does not exceed the current limit in ***parameter 4-18 Current Limit*** during ramping. See ramp-down time in ***parameter 3-52 Ramp 2 Ramp Down Time***.

$$\text{par.3-51} = \frac{t_{acc} \times n_{nom}[\text{par.}]}{\text{ref}[\text{RPM}]}[s]$$

3-52 Ramp 2 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range, 0.10 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, that is the deceleration time from ***parameter 1-25 Motor Nominal Speed***–0 RPM. Select a ramp-down time preventing overvoltage from arising in the inverter due to regeneratibe operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in ***parameter 4-18 Current Limit*** See ramp-up time in ***parameter 3-51 Ramp 2 Ramp Up Time***.

$$\text{par.3-52} = \frac{t_{dec} \times n_{nom}[\text{par.}]}{\text{ref}[\text{RPM}]}[s]$$

5.5.5 3-8* Other Ramps

3-80 Jog Ramp Time

Default value:	Size related	**Parameter type:**	Range, 0.1 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the jog ramp time, that is the acceleration/deceleration time between 0 RPM and the nominal motor speed ($n_{M,N}$) (set in ***parameter 1-25 Motor Nominal Speed***). Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in ***parameter 4-18 Current Limit***. The jog ramp time starts after activating a jog signal via the control panel, a selected digital input, or the serial communication port.

$$\text{par.3-80} = \frac{t_{jog} \times n_{nom}[\text{par.}]}{\text{jogspeed}[\text{par.}]}[s]$$

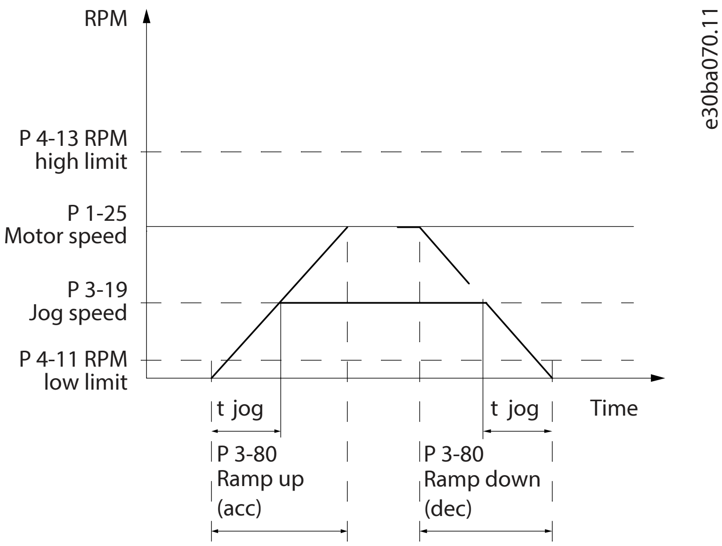


Figure 50: Jog Ramp Time

3-81 Quick Stop Ramp Time

Default value:	Size related	**Parameter type:**	Range, 1.00 - 3600 s
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the quick–stop ramp-down time, that is the deceleration time from the synchronous motor speed to 0 RPM. Ensure that no resulting overvoltage occurs in the inverter due to regenerative operation of the motor required to achieve the given ramp-down time. Ensure also that the generated current required to achieve the given ramp-down time does not exceed the current limit (set in ***parameter 4-18 Current Limit***). Quick stop is activated with a signal on a selected digital input, or via the serial communication port.

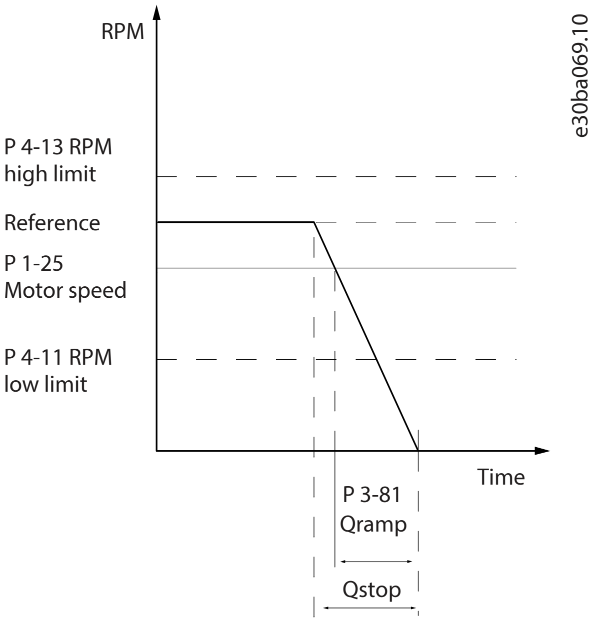


Figure 51: Quick Stop Ramp Time

3-84 Initial Ramp Time

Default value:	0 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the initial ramp-up time from 0 speed to motor speed low limit (***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***). Submersible deep-well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from 0 speed to motor low speed limit, see the figure below.

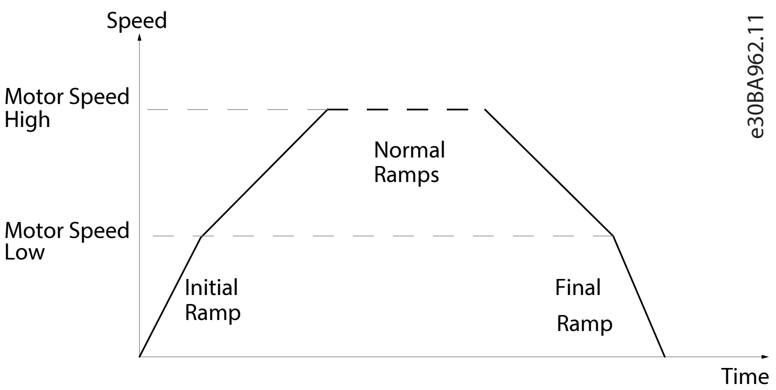


Figure 52: Initial and Final Ramp Time

3-85 Check Valve Ramp

Default value:	0 s	**Parameter type:**	Range, 0 - 650 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

To protect ball check valves in a stop situation, the check valve ramp can be utilized as a slow ramp rate from ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]*** to check valve ramp and speed, which is set in ***parameter 3-86 Check Valve Ramp End Speed [RPM]*** or ***parameter 3-87 Check Valve Ramp End Speed [hz]***. When ***parameter 3-85 Check Valve Ramp Time*** is different from 0 s, the check valve ramp time is effectuated and is used to ramp down the speed from motor speed low limit to the check valve end speed in ***parameter 3-86 Check Valve Ramp End Speed [RPM]*** or ***parameter 3-87 Check Valve Ramp End Speed [Hz]***. See the figure below.

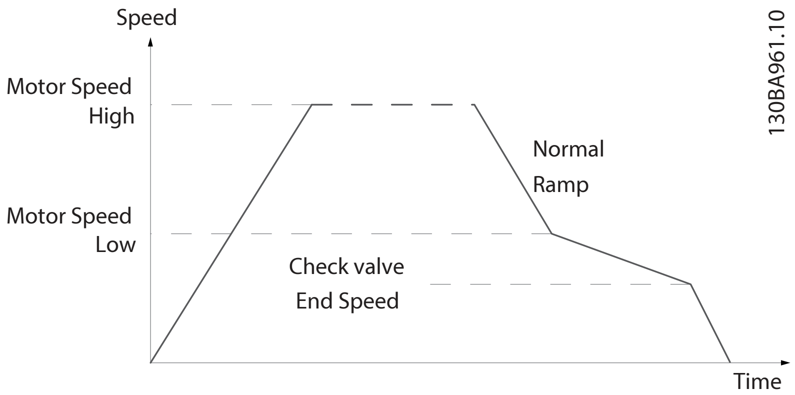


Figure 53: Check Valve Ramp

3-86 Check Valve Ramp End Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-11 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the speed in [RPM] below motor speed low limit where the check valve is expected to be closed. Check that the valve is no longer active.

3-87 Check Valve Ramp End Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-12
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the speed in [Hz] below motor speed low limit where the check valve ramp is no longer active.

3-88 Final Ramp Time

Default value:	0 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the final ramp time to be used when ramping down from ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]*** to 0 speed.

Submersible deep-well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]*** to 0 speed.

5.5.6 3-9* Digital Pot.Meter

Use the digital potentiometer function to increase or decrease the actual reference by adjusting the setup of the digital inputs using the functions increase, decrease, or clear. To activate the function, at least 1 digital input must be set to increase or decrease.

3-90 Step Size

Default value:	0.1%	**Parameter type:**	Range, 0.01 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the increment size required for increase/decrease as a percentage of the synchronous motor speed, n_S. If increase/decrease is activated, the resulting reference is increased or decreased by the value set in this parameter.

3-91 Ramp Time

Default value:	1 s	**Parameter type:**	Range, 0 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp time, that is the time for adjustment of the reference 0–100% of the specified digital potentiometer function (increase, decrease, or clear). If increase/decrease is activated for longer than the ramp delay period specified in ***parameter 3-95 Ramp Delay***, the actual reference is ramped up/down according to this ramp time. The ramp time is defined as the time used to adjust the reference by the step size specified in ***parameter 3-90 Step Size***.

3-92 Power Restore

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Off	Resets the digital potentiometer reference to 0% after power-up.
[1]	On	Restores the most recent digital potentiometer reference at power-up.

3-93 Maximum Limit

Default value:	100%	**Parameter type:**	Range, -200 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Set the maximum allowed value for the resulting reference. This is recommended if the digital potentiometer is used for fine-tuning of the resulting reference.

3-94 Minimum Limit

Default value:	0%	**Parameter type:**	Range, -200 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Set the minimum allowed value for the resulting reference. This is recommended if the digital potentiometer is used for fine-tuning of the resulting reference.

3-95 Ramp Delay

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	-3
Data type:	TimeD	**Change during operation:**	True

Enter the delay required from activation of the digital potentiometer function until the drive starts to ramp the reference. With a delay of 0 ms, the reference starts to ramp when increase/decrease is activated. See also ***parameter 3-91 Ramp Time***.

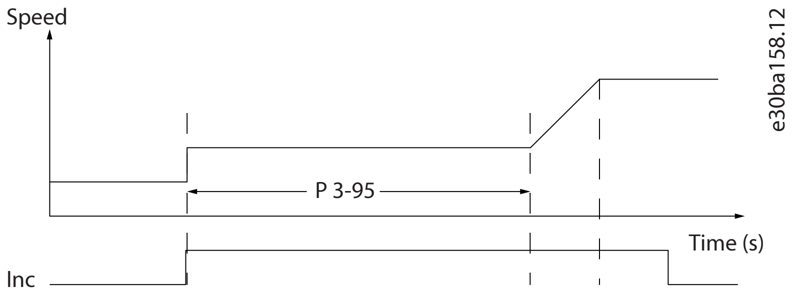


Figure 54: Ramp Delay, Case 1

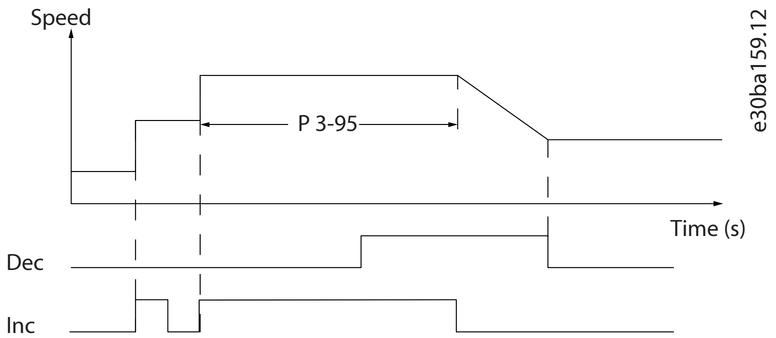


Figure 55: Ramp Delay, Case 2

5.6 Parameter Group 4-** Limits/Warnings

5.6.1 4-1* Motor Limits

Define torque, current, and speed limits for the motor, and the reaction of the drive when the limits are exceeded.

A limit may generate a message in the display. A warning always generates a message in the display or on the fieldbus. A monitoring function may initiate a warning or a trip, after which the drive stops and generates an alarm message.

4-10 Motor Speed Direction

Default value:	[0] Clockwise	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Select the motor speed directions required. Use this parameter to prevent unwanted reversing. When ***parameter 1-00 Configuration Mode*** is set to ***[3] Process***, ***parameter 4-10 Motor Speed Direction*** is set to ***[0] Clockwise*** as default. The setting in ***parameter 4-10 Motor Speed Direction*** does not limit options for setting ***parameter 4-13 Motor Speed High Limit [RPM]***.

Option	Name	Description
[0]*	Clockwise	The reference is set to CW rotation. Reversing input (default terminal 19) must be open.
[2]	Both directions	Allows the motor to rotate in both directions.

4-11 Motor Speed Low Limit [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-13 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the manufacturer's recommended minimum motor speed. The motor speed low limit must not exceed the setting in ***parameter 4-13 Motor Speed High Limit [RPM]***.

4-12 Motor Speed Low Limit [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-14 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The motor speed low limit must not exceed the setting in ***parameter 4-14 Motor Speed High Limit [Hz]***.

4-13 Motor Speed High Limit [RPM]

Default value:	Size related	**Parameter type:**	Range, Setting in par. 4-11 - 60000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Enter the maximum limit for motor speed. The motor speed high limit can be set to correspond to the manufacturer's maximum nominal motor speed. The motor speed high limit must exceed the setting in ***parameter 4-11 Motor Speed Low Limit [RPM]***.

4-14 Motor Speed High Limit [Hz]

Default value:	Size related	**Parameter type:**	Range, Setting in par. 4-12 - setting in par. 4-19
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the maximum limit for motor speed in Hz. ***Parameter 4-14 Motor Speed High Limit [Hz]*** can be set to correspond to the manufacturer's recommended maximum motor speed. The motor speed high limit must exceed the value in ***parameter 4-12 Motor Speed Low Limit [Hz]***. The output frequency must not exceed 10% of the switching frequency (***parameter 14-01 Switching Frequency***).

4-16 Torque Limit Motor Mode

Default value:	Size related	**Parameter type:**	Range, 0 - 1000.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

If changing ***parameter 4-16 Torque Limit Motor Mode*** when ***parameter 1 -00 Configuration Mode*** is set to ***[0] Speed open loop***, ***parameter 1-66 Min. Current at Low Speed*** is automatically readjusted.

NOTICE

When ***parameter 1-00 Configuration Mode*** is set to ***[0] Speed open loop***, ***parameter 1-66 Min. Current at Low Speed*** is automatically readjusted.

NOTICE

The torque limit reacts to the actual, non-filtered torque, including torque spikes. This is not the torque that is seen from the LCP or the fieldbus as the torque is filtered.

This function limits the torque on the shaft to protect the mechanical installation.

4-17 Torque Limit Generator Mode

Default value:	100%	**Parameter type:**	Range, 0 - 1000.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This function limits the torque on the shaft to protect the mechanical installation.

4-18 Current Limit

Default value:	Size related	**Parameter type:**	Range, 1.0 - 1000.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

NOTICE

If *[20] ATEX ETR* is selected in ***parameter 1-90 Motor Thermal Protection***, set ***parameter 4-18 Current Limit*** current limit to 150%.

This is a true current limit function that continues in the oversynchronous range. However, due to field weakening the motor torque at current limit will drop accordingly when the voltage increase stops above the synchronized speed of the motor.

4-19 Max Output Frequency

Default value:	Size related	**Parameter type:**	Range, 1 - 590 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Maximum output frequency cannot exceed 10% of the inverter switching frequency (***parameter 14-01 Switching Frequency***).

Provides a final limit on the output frequency for improved safety in applications where overspeeding is to be avoided. This limit is final in all configurations (independent of the setting in ***parameter 1-00 Configuration Mode***).

5.6.2 4-4* Motor Monitoring

4-49 Motor Check Time Interval

Default value:	[0] As fast as possible	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the time interval at which the connections between the motor and the drive are checked, when the motor is stopped. The motor check is performed at a specified interval, unless the motor is started in between.

Option	Name	Description
[0]*	As fast as possible	The motor time constant (x10) is used as the time interval to check the motor.
[5]	Every 1 hour	
[10]	Every 2 hours	
[15]	Every 12 hours	
[20]	Every 24 hours	

5.6.3 4-5* Adj. Warnings

Define adjustable warning limits for current, speed, reference, and feedback.

Warnings are shown on the LCP and can be programmed to be outputs or to be read out via fieldbus in the extended status word.

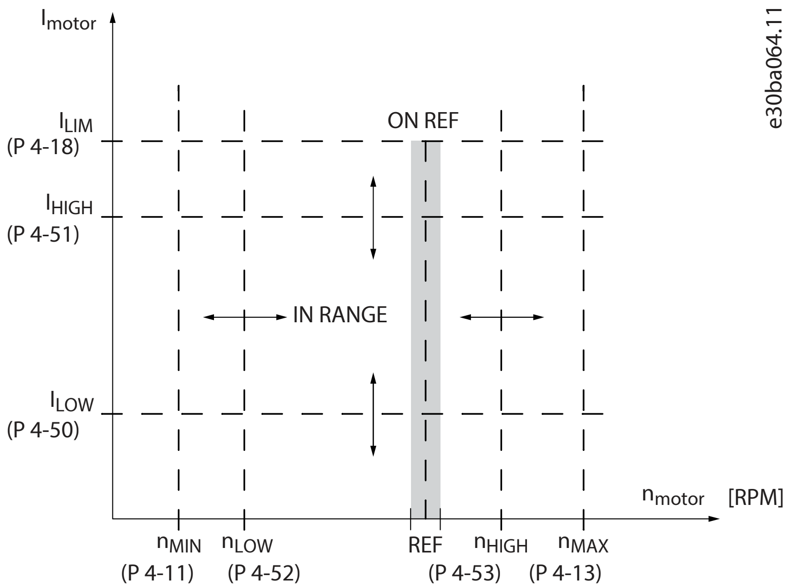


Figure 56: Adjustable Warnings

4-50 Warning Current Low

Default value:	0 A	**Parameter type:**	Range, 0 - setting in par. 4-51
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the I_{LOW} value. When the motor current drops below this limit, the display reads *Current Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-51 Warning Current High

Default value:	Size related	**Parameter type:**	Range, setting in par. 4-50 - setting in par. 16-37
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the I_{HIGH} value. When the motor current exceeds this limit, the display reads *Current High*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29.

4-52 Warning Speed Low

Default value:	0 RPM	**Parameter type:**	Range, 0 - setting in par. 4-53 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Enter the n_{LOW} value. When the motor speed exceeds this limit, the display reads *Speed low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-53 Warning Speed High

Default value:	Size related	**Parameter type:**	Range, setting in par. 4-52 - 60000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Enter the n_{HIGH} value. When the motor speed exceeds this value, the display reads *Speed high*. The signal outputs can be programmed to produce a status signal on terminals 27 or 29 and on relay outputs 01 or 02.

4-54 Warning Reference Low

Default value:	-999999.999	**Parameter type:**	Range, -999999.999 - setting in par. 4-55
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the lower reference limit. When the actual reference drops below this limit, the display indicates Ref_{LOW}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-55 Warning Reference High

Default value:	999999.999	**Parameter type:**	Range, setting in par. 4-55 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the upper reference limit. When the actual reference exceeds this limit, the display reads Ref_{high}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-56 Warning Feedback Low

Default value:	-999999.99ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 WarningFeedbackHigh - setting in par. 4-57
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the lower feedback limit. When the feedback drops below this limit, the display reads $Feedb_{Low}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-57 Warning Feedback High

Default value:	999999.99 ProcessCtrlUnit	**Parameter type:**	Range, par 4-56 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the upper feedback limit. When the feedback exceeds this limit, the display reads $Feedb_{High}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-58 Missing Motor Phase Function

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The function detects missing motor phase while the motor is running. Shows alarms 30, 31, 32 if a motor phase is missing. Enable this function to protect the application and motor from malfunctioning if a motor phase is missing.

Option	Name	Description
[0]	Disabled	The drive does not issue a missing motor phase alarm.
[1]	Trip 100 ms	The drive performs a scan for 100 ms to detect missing motor phase. When a missing motor phase is detected, the drive trips. This selection is recommended when the motor is running at a speed of 10 Hz and above.
[2]	Trip 1000 ms	The drive performs a scan for 1000 ms to detect missing motor phase. When a missing motor phase is detected, the drive trips. This selection is recommended when the motor is running at a low speed of 1 Hz and above.
[5]	Motor check	**NOTICE** The motor automatically resumes operation when the motor is reconnected. This option allows disconnection of the motor with a service switch without issuing an alarm. The drive coasts and automatically resumes operation when the motor is reconnected.

5.6.4 4-6* Speed Bypass

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. A maximum of 4 frequency or speed ranges can be avoided.

4-60 Bypass Speed From [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-13 RPM, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-61 Bypass Speed From [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-14 Hz, Array [4]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-62 Bypass Speed To [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-13 RPM, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4-63 Bypass Speed To [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - setting in par. 4-14 Hz, Array [4]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4-64 Semi-auto Bypass Set-up

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Off	No function.
[1]	Enabled	Starts the semi-automatic bypass setup, which facilitates programming of the frequencies to be skipped due to resonances in the system.

5.6.5 Semi-automatic Bypass Speed Setup

Use semi-automatic bypass speed setup to facilitate the programming of frequencies to be skipped due to resonances in the system.

Procedure

1. Stop the motor.

2. Select *[1] Enabled* in ***parameter 4-64 Semi-auto Bypass Set-up***.
3. Press [Hand On] on the LCP to start the search for frequency bands causing resonances. The motor ramps up according to the ramp set.
4. When Sweeping through a resonance band, press [OK] on the LCP when leaving the band. The actual frequency is stored as the 1st element in ***parameter 4-62 Bypass Speed To [RPM]*** or ***parameter 4-63 Bypass Speed To [Hz]*** (array). Repeat this step for each resonance band identified at the ramp-up (maximum 4 can be adjusted).

   Then maximum speed has been reached, the motor automatically begins to ramp down.

5. Repeat the preceding procedure when speed is leaving the resonance bands during deceleration. The actual frequencies registered when pressing [OK] are stored in ***parameter 4-60 Bypass Speed From [RPM]*** or ***parameter 4-61 Bypass Speed From [Hz]***.
6. When the motor has ramped down to stop, press [OK].

   Parameter 4-64 Semi-auto Bypass Set-up automatically resets to Off. The drive stays in hand-on mode until [Off] or [Auto On] is pressed on the LCP. If the frequencies for a certain resonance band are not registered in the right order, all registrations are canceled, and the following message is shown: *Collected speed areas overlapping or not completely determined. Press [Cancel] to abort*. Registration in the wrong order is when frequency values stored in ***parameter 4-62 Bypass Speed To [RPM]*** are higher than the values in ***parameter 4-60 Bypass Speed From [RPM]***, or if they do not have the same numbers of registrations for the Bypass From and Bypass To.

5.7 Parameter Group 5-** Digital In/Out

5.7.1 5-0* Digital I/O Mode

Parameters for configuring the input and output using NPN and PNP.

5-00 Digital I/O Mode

Default value:	[0] PNP - Active at 24V	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

Perform a power cycle to activate the parameter once it has been changed.

Digital inputs and programmed digital outputs are preprogrammable for operation either in PNP or NPN systems.

Option	Name	Description
[0]*	PNP - Active at 24V	Action on positive directional pulses (0). PNP systems are pulled down to GND.
[1]	NPN - Active at 0V	Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the drive.

5-01 Terminal 27 Mode

Default value:	[0] Input	**Parameter type:**	Option

Setup:	All setups	**Converison index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

5-02 Terminal 29 Mode

Default value:	[0] Input	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Input	Defines terminal 29 as a digital input.
[1]	Output	Defines terminal 29 as a digital output.

5.7.2 5-1* Digital Inputs

The digital inputs are used for selecting various functions in the drive. Refer to Table 21 for functions which can be assigned to digital inputs.

Functions in function group 1 have higher priority than functions in function group 2.

Table 21: Function Groups

Group	Functions
1	Reset, coast stop, reset and coast stop, quick stop, DC brake, stop, and the [Off] key.
2	Start, latched start, reversing, start reversing, jog, and freeze output.

Table 22: Digital Input Functions and Terminals

Digital input function	Select	Terminal
No operation	[0]	All, terminal 32, 33
Reset	[1]	All
Coast inverse	[2]	All, terminal 27
Coast and reset inv	[3]	All
DC-brake inverse	[5]	All
Stop inverse	[6]	All

Table 22: Digital Input Functions and Terminals (continued)

Digital input function	Select	Terminal
External interlock	[7]	All
Start	[8]	All, terminal 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Jog	[14]	All, terminal 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	All
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Emergency mode	[37]	All
Ref source bit 0	[42]	All
Hand/auto start	[51]	All
Run permissive	[52]	All
Hand start	[53]	All
Auto Start	[54]	All
DigiPot increase	[55]	All
DigiPot decrease	[56]	All
DigiPot clear	[57]	All
Counter A (up)	[60]	Terminal 29, 33
Counter A (down)	[61]	Terminal 29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	Terminal 29, 33

Table 22: Digital Input Functions and Terminals (continued)

Digital input function	Select	Terminal
Counter B (down)	[64]	Terminal 29, 33
Reset Counter B	[65]	All
Sleep mode	[66]	All
Reset preventive maintenance. word	[78]	All
PTC card 1	[80]	
Latched pump derag	[85]	All
Flow confirmation	[86]	All
Reset flow totalized volume counter	[87]	All
Reset flow actual volume counter	[88]	All
Reset derag counter	[89]	All
Lead pump start	[120]	All
Lead pump alternation	[121]	All
Pump 1 interlock	[130]	All
Pump 2 interlock	[131]	All
Pump 3 interlock	[132]	All
Pump 4 interlock	[133]	All
Pump 5 interlock	[134]	All
Pump 6 interlock	[135]	All
Pump 7 interlock	[136]	All
Pump 8 interlock	[137]	All
Pump 9 interlock	[138]	All
Pump 1 inverse interlock	[139]	All
Pump 2 inverse interlock	[140]	All
Pump 3 inverse interlock	[141]	All
Pump 4 inverse interlock	[142]	All
Pump 5 inverse interlock	[143]	All
Pump 6 inverse interlock	[144]	All
Pump 7 inverse interlock	[145]	All
Pump 8 inverse interlock	[146]	All
Pump 9 inverse interlock	[147]	All
Emcy mode ref bit 0	[190]	All
Emcy mode ref bit 1	[191]	All

Table 22: Digital Input Functions and Terminals (continued)

Digital input function	Select	Terminal
Emcy mode ref bit 2	[192]	All
Emergency setup bit 0	[193]	All
Emergency setup bit 1	[194]	All
Test emcy mode	[195]	All
Reset emcy mode	[196]	All

All = Terminals 18, 19, 27, 29, 32, 33, X30/2, X30/3, X30/4. X30/ are the terminals on VLT® General Purpose I/O MCB 101.

Functions dedicated to only 1 digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

Table 23: Digital Inputs, Function Descriptions - 1

Option		Function
[0]	No operation	No reaction to signals transmitted to the terminal.
[1]	Reset	Resets the drive after a trip/alarm. Not all alarms can be reset.
[2]	Coast inverse	(Default digital input 27): Coast stop, inverted input (NC). The drive leaves the motor in free mode. Logic 0 = coast stop.
[3]	Coast and reset inverse	Reset and coast stop inverted input (NC). Leaves the motor in free mode and resets the drive. Logic 0 = coast stop and reset.
[5]	DC-brake inverse	Inverted input for DC brake (NC). Stops motor by energizing it with a DC current for a certain time period. See ***parameter 2-01 DC Brake Current*** to ***parameter 2-03 DC Brake Cut In Speed [RPM]***. The function is only active when the value in ***parameter 2-02 DC Braking Time*** is different from 0. Logic 0 = DC brake.
[6]	Stop inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logical level 1 to logical level 0. The stop is performed according to the selected ramp time: • ***Parameter 3-42 Ramp 1 Ramp Down Time***. • ***Parameter 3-52 Ramp 2 Ramp Down Time***. NOTICE When the drive is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the drive stops, configure a digital output to ***[27] Torque limit and stop***. Connect this digital output to a digital input that is configured as coast.

Table 23: Digital Inputs, Function Descriptions - 1 (continued)

Option		Function
[7]	External interlock	Same function as coasting inverse and stop inverse, but this option generates the alarm message *External fault* on the display when the terminal programmed for coast inverse has signal 0. The alarm message is also active via digital outputs and relay outputs if programmed for external interlock. When the external interlock is removed, the alarm can be reset using a digital input or the [Reset] key. A delay can be programmed in ***parameter 22-00 External Interlock Delay***. After applying a signal to the input, the reaction described above is delayed with the time set in ***parameter 22-00 External Interlock Delay***.
[8]	Start	(Default digital input 18): Select start for a start/stop command. Logic 1 = start, logic 0 = stop.
[9]	Latched start	If a pulse is applied for minimum 2 ms, the motor starts. The motor stops when stop inverse is activated, or a reset command (via DI, bus, or LCP) is given.
[10]	Reversing	(Default digital input 19): Change the direction of motor shaft rotation. Select logic 1 to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in ***parameter 4-10 Motor Speed Direction***.
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[14]	Jog	(Default digital input 29): Activate jog speed. See ***parameter 3-11 Jog Speed [Hz]***.
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that ***[1] External/preset*** has been selected in ***parameter 3-04 Reference Function***. Logic 0 = external reference active; logic 1 = 1 of the 8 preset references is active.
[16]	Preset ref bit 0	Preset reference bit 0, 1, and 2 enable a choice between 1 of the 8 preset references according to Table 24.
[17]	Preset ref bit 1	Same as ***[16] Preset ref bit 0***.
[18]	Preset ref bit 2	Same as ***[16] Preset ref bit 0***.

Table 24: Preset Reference Bit

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0

Table 24: Preset Reference Bit (continued)

Preset ref. bit	2	1	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

Table 25: Digital Inputs, Function Descriptions - 2

<table>
<tr><th colspan="2">Option</th><th>Function</th></tr>
<tr><td>[19]</td><td>Freeze ref</td><td>Freezes the actual reference, which is now the point of enable/condition to be used for [21] Speed up and [22] Speed down. If speed up/speed down is used, the speed change always follows ramp 2 (parameter 3-51 Ramp 2 Ramp Up Time and parameter 3-52 Ramp 2 Ramp Down Time) in the range 0–parameter 3-03 Maximum Reference.</td></tr>
<tr><td>[20]</td><td>Freeze output</td><td>Freezes the actual motor frequency (Hz), which is now the point of enable/condition to be used for [21] Speed up and [22] Speed down. If speed up/speed down is used, the speed change always follows ramp 2 (parameter 3-51 Ramp 2 Ramp Up Time and parameter 3-52 Ramp 2 Ramp Down Time) in the range 0–parameter 1-23 Motor Frequency.

NOTICE
When freeze output is active, the drive cannot be stopped via a low [8] Start signal. Stop the drive via a terminal programmed for [2] Coasting inverse or [3] Coast and reset inverse.</td></tr>
<tr><td>[21]</td><td>Speed up</td><td>Select [21] Speed up and [22] Speed down for digital control of the up/down speed (motor potentiometer). Activate this function by selecting either [19] Freeze ref or [20] Freeze output. When speed up/speed down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/speed down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down parameters 3-x1/3-x2.</td></tr>
</table>

Table 26: Shut Down/Catch Up

	Shut down	Catch up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Table 27: Digital Inputs, Function Descriptions - 3

Option		Function
[22]	Speed down	Same as ***[21] Speed up***.
[23]	Set-up select bit 0	Select ***[23] Set-up select bit 0*** or select ***[24] Set-up select bit 1*** to select 1 of the 4 set-ups. Set ***parameter 0-10 Active Set-up*** to ***[9] Multi Set-up***.
[24]	Set-up select bit 1	(Default digital input 32): Same as ***[23] Set-up select bit 0***.
[30]	Counter input	
[32]	Pulse input	Select this option when using a pulse sequence as either reference or feedback. Scaling is done in *parameter group 5-5* Pulse Input*.
[34]	Ramp bit 0	Select which ramp to use. Logic 0 selects ramp 1, while logic 1 selects ramp 2.
[36]	Mains failure inverse	Activates the function selected in ***parameter 14-10 Mains Failure***. Mains failure is active in the logic 0 situation.

Table 28: Preset Ramp Bit

Preset ramp bit	1	0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Ramp 4	1	1

Table 29: Digital Inputs, Function Descriptions - 4

Option		Function
[37]	Emergency mode	A signal applied puts the drive into emergency mode and the preset ref bits 0–2 define the operation mode of emergency mode where all other commands are disregarded. See *parameter group 24-0* Emergency Mode* and *parameter group 24-2* Emergency Mode 2*.
[42]	Ref source bit 1	An active input in bit 0 selects AI54 as the reference source (see *parameter group 3-1* References*, option ***[35] Digital input select***). An inactive iput selects AI53.
[51]	Hand/auto start	Selects hand or auto start. High signal selects auto on only, low signal selects hand on only.

Table 29: Digital Inputs, Function Descriptions - 4 (continued)

Option		Function
[52]	Run permissive	The input terminal, for which the run permissive has been programmed, must be logic 1 before a start command can be accepted. Run permissive has a logic AND function related to the terminal, which is programmed for ***[8] Start***, ***[14] Jog***, or ***[20] Freeze Output***. To start running the motor, both conditions must be fulfilled. If run permissive is programmed on multiple terminals, ***[52] Run permissive*** needs only be logic 1 on 1 of the terminals to carry out the function. The digital output signal for run request (***[8] Start***, ***[14] Jog***, or ***[20] Freeze output***) programmed in *parameter group 5-3* Digital Outputs* or *parameter group 5-4* Relays* is not affected by run permissive. **NOTICE** If no run permissive signal is applied, but either run, jog, or freeze commands are activated, the status line in the display shows either *Run Requested*, *Jog Requested*, or *Freeze Requested*.
[53]	Hand start	A signal applied puts the drive into hand-on mode as if [Hand On] was pressed on the LCP and a normal stop command is overridden. If disconnecting the signal, the motor stops. To make any other start commands valid, another digital input must be assigned to ***[54] Auto Start***, and a signal applied to this. The [Hand On] and [Auto On] keys on the LCP have no impact. The [Off] key on the LCP overrides ***[53] Hand start*** and ***[54] Auto start***. Press either [Hand On] or [Auto On] to make ***[53] Hand start*** and ***[54] Auto start*** active again. If there is no signal on neither ***[53] Hand start*** nor ***[54] Auto start***, the motor stops regardless of any normal start command applied. If signals are applied to both ***[53] Hand start*** and ***[54] Auto start***, the function is auto start. If pressing [Off] on the LCP, the motor stops regardless of the signal on ***[53] Hand start*** and ***[54] Auto start***.
[54]	Auto start	This selection puts the drive into auto mode as if [Auto On] has been pressed. The function is similar to ***[53] Hand start***.
[55]	DigiPot increase	Increase signal to the digital potentiometer function described in *parameter group 3-9* Digital Pot. Meter*.
[56]	DigiPot Decrease	Decrease signal to the digital potentiometer function described in *parameter group 3-9* Digital Pot. Meter*.
[57]	DigiPot Clear	Clears the digital potentiometer reference described in *parameter group 3-9* Digital Pot. Meter*.
[60]	Counter A (up)	(Terminal 29 or 33 only). Input for increment counting in the SLC counter.

Table 29: Digital Inputs, Function Descriptions - 4 (continued)

Option		Function
[61]	Counter A (down)	(Terminal 29 or 33 only). Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B (up)	(Terminal 29 or 33 only). Input for increment counting in the SLC counter.
[64]	Counter B (down)	(Terminal 29 or 33 only). Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[66]	Sleep mode	Forces the drive into sleep mode (see *parameter group 22-4* Sleep Mode*.
[78]	Preset main. word	Resets all data in ***parameter 16-96 Maintenance Word*** to 0.
[80]	PTC card 1	All digital inputs can be set to ***[80] PTC Card 1***. However, only 1 digital input must be set to this option.
[85]	Latched pump derag	Start deragging.
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	Starts/stops the lead pump (controlled by the drive). A start also requires applying a system start signal, for example, to 1 of the digital inputs set for ***[8] Start***.
[121]	Lead pump alternation	Forces alternation of the lead pump in a cascade controller. Set ***parameter 25-50 Lead Pump Alternation*** to either ***[2] At command*** or ***[3] At staging or at command***. ***Parameter 25-51 Alternation Event*** can be set to any of the 4 options.
[130]	Pump 1 interlock	The function depends on the setting in ***parameter 25-06 Number of Pumps***. If set to ***[0] No***, then Pump1 refers to the pump controlled by relay1, and so on. If set to ***[1] Yes***, Pump1 refers to the pump controlled by the drive only (without any of the built-in relays involved) and Pump2 to the pump controlled by relay1. Variable speed pump (lead) cannot be interlocked in the basic cascade controller.
[131]	Pump 2 interlock	See explanation in ***[130] Pump1 interlock***.
[132]	Pump 3 interlock	See explanation in ***[130] Pump1 interlock***.
[133]	Pump 4 interlock	See explanation in ***[130] Pump1 interlock***.
[134]	Pump 5 interlock	See explanation in ***[130] Pump1 interlock***.
[135]	Pump 6 interlock	See explanation in ***[130] Pump1 interlock***.

Table 29: Digital Inputs, Function Descriptions - 4 (continued)

Option		Function
[136]	Pump 7 interlock	See explanation in ***[130] Pump1 interlock***.
[137]	Pump 8 interlock	See explanation in ***[130] Pump1 interlock***.
[138]	Pump 9 interlock	See explanation in ***[130] Pump1 interlock***.
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	Enables a choice between 1 of the 8 preset references according to Table 24.
[191]	Emcy mode ref bit 1	Enables a choice between 1 of the 8 preset references according to Table 24.
[192]	Emcy mode ref bit 2	Enables a choice between 1 of the 8 preset references according to Table 24.
[193]	Emergency mode setup bit 0	Switch between emergency mode setup 1 to 4 in *parameter group 24-0* Emergency Mode*and *parameter group 24-4* Emergency Mode 2* without changing starting setup mode for the rest of the parameters.
[194]	Emergency mode setup bit 1	Switch between emergency mode setup 1 to 4 in *parameter group 24-0* Emergency Mode*and *parameter group 24-4* Emergency Mode 2* without changing starting setup mode for the rest of the parameters.
[195]	Test emcy mode	Activation of emergency mode via ***parameter 24-09 Emergency Mode Alarm Handling***, option ***[2] Trip all alarms/test*** with stop on all alarms and in normal operation mode. The test timer is set in ***parameter 24-42 Timeout for Emergency Mode Test***, and countdown starts when the test signal is active.
[196]	Reset emcy mode	When operating in emergency mode with impulse signals (***parameter 24-43 Emergency Mode Signal Operation***, option ***[2] Impulse, set-reset***), the reset signal stops the emergency mode operation.

5-10 Terminal 18 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range. All functions are described in Table 23, Table 25, Table 27, and Table 29.

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	Hand/auto on	

Option	Name	Description
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	

Option	Name	Description
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency mode setup bit 0	
[194]	Emergency mode setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-11 Terminal 19 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

5-12 Terminal 27 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

5-13 Terminal 29 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range. All functions are described in Table 23, Table 25, Table 27, and Table 29.

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	

Option	Name	Description
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[30]	Counter input	
[32]	Pulse input	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	Hand/auto on	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[60]	Counter A (up)	
[61]	Counter A (down)	

Option	Name	Description
[62]	Reset counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset counter B	
[66]	Sleep mode	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	

Option	Name	Description
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency mode setup bit 0	
[194]	Emergency mode setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-14 Terminal 32 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

5-15 Terminal 33 Digital Inputs

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-13 Terminal 29 Digital Input***.

5-16 Terminal X30/2

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

5-17 Terminal X30/3 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

5-18 Terminal X30/4 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-10 Terminal 18 Digital Input***.

Parameter 5-19 Terminal 37 Safe Stop

Default value:	[1] Safe stop alarm	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Options ***[4] PTC 1 Alarm*** to ***[9] PTC 1 & Relay W/A*** are only available when the VLT® PTC Thermistor Card MCB 112 is connected.

NOTICE

Selecting Auto Reset/Warning enables automatic restart of the drive.

Use this parameter to configure the Safe Torque Off functionality. A warning message makes the drive coast the motor and enables the automatic restart. An alarm message makes the drive coast the motor and requires a manual restart (via a fieldbus, Digital I/O, or by pressing [RESET] on the LCP). When the VLT® PTC Thermistor Card MCB 112 is mounted, configure the PTC options to get the full benefit from the alarm handling.

Option	Name	Description
[1]*	Safe stop alarm	Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[3]	Safe stop warning	Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset.
[4]	PTC 1 alarm	Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[5]	PTC 1 warning	Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset, unless a digital input set to ***[80] PTC Card 1*** is still enabled.
[6]	PTC 1 & Relay A	This option is used when the VLT® PTC Thermistor Card MCB 112 gates with a stop key through a safety relay to terminal 37. Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[7]	PTC 1 & Relay W	This option is used when the VLT® PTC Thermistor Card MCB 112 gates with a stop key through a safety relay to terminal 37. Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset, unless a digital input set to ***[80] PTC Card 1*** is still enabled.
[8]	PTC 1 & Relay A/W	This option enables using a combination of alarm and warning.
[9]	PTC 1 & Relay W/A	This option enables using a combination of warning and alarm.

Table 30: Overview of Functions, Alarms, and Warnings

Function	Number	PTC	Relay
No function	[0]	–	–
Safe Torque Off alarm	[1]*	–	Safe Torque Off [A68 (1)]
Safe Torque Off warning	[3]	–	Safe Torque Off [W68(1)]
PTC 1 alarm	[4]	PTC 1 Safe Torque Off [A71]	–
PTC 1 warning	[5]	PTC 1 Safe Torque Off [W71]	–
PTC 1 and relay A	[6]	PTC 1 Safe Torque off [A71]	Safe Torque Off [A68]
PTC 1 and relay W	[7]	PTC 1 Safe Torque Off [W71]	Safe Torque Off [W68]
PTC 1 and relay A/W	[8]	PTC 1 Safe Torque Off [A71]	Safe Torque Off [W68]
PTC 1 and relay W/A	[9]	PTC 1 Safe Torque Off [W71]	Safe Torque Off [A68]

1) W means warning and A means alarm.

A dangerous failure related to STO issues *alarm 72, Dangerous Failure*.

Parameter 5-20 Terminal X46/1 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range. All functions are described in Table 23, Table 25, Table 27, and Table 29.

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	

Option	Name	Description
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	External interlock	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	

Option	Name	Description
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency setup bit 0	
[194]	Emergency setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-21 Terminal X46/3 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5-22 Terminal X46/5 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5-23 Terminal X46/7 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5-24 Terminal X46/9

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5-25 Terminal X46/11 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5-26 Terminal X46/13 Digital Input

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-20 Terminal X46/1 Digital Input***.

5.7.3 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals. The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in ***parameter 5-01 Terminal 27 Mode*** and set the I/O function for terminal 29 in ***parameter 5-02 Terminal 29 Mode***.

NOTICE
These parameters cannot be adjusted while the motor is running.

5-30 Terminal 27 Digital Output

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital output range.

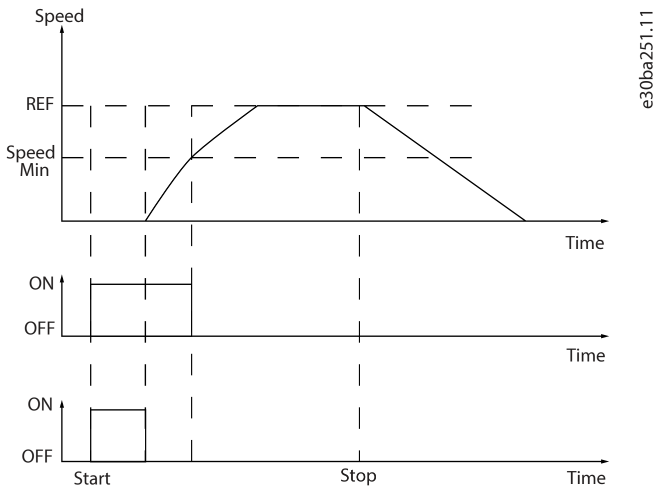
Option	Name	Description
[0]	No operation	Default for all digital outputs and relay outputs.
[1]	Control ready	The control board receives supply voltage.
[2]	Drive ready	The drive is ready for operation and applies a supply signal on the control board.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command has been given (start/disable). There are no warnings.
[5]	Running	The motor is running.
[6]	Running/no warning	The output speed is higher than the speed set in ***parameter 1-81 Min Speed for Function at Stop***. The motor is running and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or warning activates the output.
[11]	At torque limit	The torque limit set in ***parameter 4-16 Torque Limit Motor Mode*** has been exceeded.
[12]	Out of current range	The motor current is outside the range set in ***parameter 4-18 Current Limit***.
[13]	Below current, low	The motor current is lower than the setting in ***parameter 4-50 Warning Current Low***.
[14]	Above current, high	The motor current is higher than the setting in ***parameter 4-51 Warning Current High***.
[15]	Out of speed range	The output speed is outside the ranges set in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[16]	Below speed, low	The output speed is lower than the setting in ***parameter 4-52 Warning Speed Low***.
[17]	Above speed, high	The output speed is higher than the setting in ***parameter 4-53 Warning Speed High***.
[18]	Out of feedb. range	Feedback is outside the ranges set in ***parameter 4-56 Warning Feedback Low*** and ***parameter 4-57 Warning Feedback High***.
[19]	Below feedback, low	Feedback is below the limit set in ***parameter 4-56 Warning Feedback Low***.
[20]	Above feedback, high	Feedback is above the limit set in ***parameter 4-57 Warning Feedback High***.

Option	Name	Description
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[25]	Reverse	Reversing. Logic 1 = relay activated, 24 V DC when the motor rotates clockwise. Logic 0 = relay not activated, no signal, when the motor rotates counterclockwise.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Used in performning a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake war	The brake is ready for operation and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[40]	Out of ref range	Active when the actual speed is outside the settings in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[41]	Below reference, low	Active when the actual speed is below the speed reference setting.
[42]	Above ref, high	Active when the actual speed is above the speed reference setting.
[45]	Bus ctrl.	Controls the output via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. If a bus timeout occurs, the output state is retained.
[46]	Bus ctrl, 1 if timeout	Controls the output via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls the output via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. If a bus timeout occurs, the output state is set low (off).
[51]	MCO controlled	Active when a VLT® Advanced Cascade Controller MCO 102 or VLT® Motion Control MCO 305 is connected. The output is controlled from the option.
[55]	Pulse output	

Option	Name	Description
[59]	Remote,enable,no TW	
[60]	Comparator 0	See *parameter group 13-1* Comparators*. If comparator 0 is evaluated as true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See *parameter group 13-1* Comparators*. If comparator 1 is evaluated as true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See *parameter group 13-1* Comparators*. If comparator 2 is evaluated as true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See *parameter group 13-1* Comparators*. If comparator 3 is evaluated as true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See *parameter group 13-1* Comparators*. If comparator 4 is evaluated as true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See *parameter group 13-1* Comparators*. If comparator 5 is evaluated as true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See *parameter group 13-1* Comparators*. If comparator 6 is evaluated as true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See *parameter group 13-1* Comparators*. If comparator 7 is evaluated as true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See *parameter group 13-1* Comparators*. If comparator 8 is evaluated as true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See *parameter group 13-1* Comparators*. If comparator 9 is evaluated as true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See *parameter group 13-4* Logic Rules*. If logic rule 0 is evaluated as true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See *parameter group 13-4* Logic Rules*. If logic rule 1 is evaluated as true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See *parameter group 13-4* Logic Rules*. If logic rule 2 is evaluated as true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See *parameter group 13-4* Logic Rules*. If logic rule 3 is evaluated as true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See *parameter group 13-4* Logic Rules*. If logic rule 4 is evaluated as true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See *parameter group 13-4* Logic Rules*. If logic rule 5 is evaluated as true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See *parameter group 13-4* Logic Rules*. If logic rule 6 is evaluated as true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See *parameter group 13-4* Logic Rules*. If logic rule 7 is evaluated as true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See *parameter group 13-4* Logic Rules*. If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.

Option	Name	Description
[79]	Logic rule 9	See *parameter group 13-4* Logic Rules*. If logic rule 9 is evaluated as true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[38] Set digital out A high*** is executed. The output goes low whenever the smart logic action ***[32] Set digital out A low*** is executed.
[81]	SL digital output B	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[39] Set digital out B high*** is executed. The output goes low whenever the smart logic action ***[33] Set digital out B low*** is executed.
[82]	SL digital output C	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[40] Set digital out C high*** is executed. The output goes low whenever the smart logic action ***[34] Set digital out C low*** is executed.
[83]	SL digital output D	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[41] Set digital out D high*** is executed. The output goes low whenever the smart logic action ***[35] Set digital out D low*** is executed.
[84]	SL digital output E	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[42] Set digital out E high*** is executed. The output goes low whenever the smart logic action ***[36] Set digital out E low*** is executed.
[85]	SL digital output F	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[43] Set digital out F high*** is executed. The output goes low whenever the smart logic action ***[37] Set digital out F low*** is executed.
[90]	kWh counter pulse	Creates a pulse on the digital output every time the drive uses 1 kWh.
[120]	System on ref	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *Alarm 164 ATEX ETR cur.lim.alarm* is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *Alarm 166 ATEX ETR freq.lim.alarm* is active, the output is 1.
[153]	ATEX ETR cur. warning	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *Alarm 163 ATEX ETR cur.lim.warning* is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *Alarm 165 ATEX ETR freq.lim.warning* is active, the output is 1.
[155]	Verifying flow	

Option	Name	Description
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	
[165]	Local ref active	The output is high when ***parameter 3-13 Reference Site*** = ***[2] Local*** or when ***parameter 3-13 Reference Site*** = ***[0] Linked to hand auto*** at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when ***parameter 3-13 Reference Site*** is set to ***[1] Remote*** or ***[0] Linked to hand/auto*** while the LCP is in auto-on mode.
[167]	Start command activ	**NOTICE** All inverse stop/coast commands must be inactive. The output is high when there is an active start command, for example auto on, and a start command via digital input or bus is active, or [Hand On].
[168]	Hand mode	The output is high when the drive is in hand-on mode (as indicated by the indicator light above [Hand On]).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the indicator light above [Auto On]).
[173]	10Wh counter pulse	
[178]	RS Flipflops 8	
[179]	RS flipflops 9	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. Maintenance	One or more preventive maintenance events programmed in ***parameter 23-10 Maintenance Item*** has passed the time for the specified action in ***parameter 23-11 Maintenance Action***.
[182]	Deragging	Deragging is active.
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	See ***parameter 5-80 AHF Cap Reconnect Delay***.
[189]	External Fan Control	External fan control is active.
[190]	No-flow	A no-flow situation or minimum speed situation has been detected if enabled in ***parameter 22-21 Low Power Detection***.
[191]	Dry pump	A dry-pump condition has been detected. Enable this function in ***parameter 22-26 Dry Pump Function***.
[192]	End of curve	Active when an end-of-curve condition is present.
[193]	Sleep mode	The drive/system has entered sleep mode. See *parameter group 22-4* Sleep Mode*.

Option	Name	Description
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in ***parameter 22-60 Broken Belt Function***.
[195]	Bypass valve control	The bypass valve control (digital/relay output in the drive) is used for compressor systems to unload the compressor during start-up by using a bypass valve. After the start command is given, the bypass valve is open until the drive reaches the value set in ***parameter 4-11 Motor Speed Low Limit [RPM]***. After the limit has been reached, the bypass valve is closed, allowing the compressor to operate normally. This procedure is not activated again before a new start is initiated and the drive speed is 0 during the receiving of the start signal. ***Parameter 1-71 Start Delay*** can be used to delay the motor start.  **Figure 57: Bypass Valve Control Principle**
[196]	Emergency mode	The drive operates in emergency mode. See *parameter group 24-0* Emergency Mode*.
[197]	Emcy mode was act.	The drive has been operating in emergency mode. See *parameter group 24-0* Emergency Mode*.
[198]	Drive bypass	To be used as signal for activating an external electromechanical bypass, switching the motor directly on line. See *parameter group 24-1* Drive Bypass*. **NOTICE** **LOSS OF CERTIFICATION** If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.
[199]	Pipe filling	Active when the pipe fill function is operating. See *parameter group 29-** Water Application Functions*.
[200]	Full capacity	All pumps are running at full speed.

Option	Name	Description
[201]	Pump 1 running	One or more of the pumps controlled by the cascade controller are running. The function also depends on the setting in ***parameter 25-05 Fixed Lead Pump***. If set to ***[0] No***, Pump 1 refers to the pump controlled by relay1, and so on. If set to ***[1] Yes***, Pump 1 refers to the pump controlled by the drive only (without any of the built-in relays involved) and Pump 2 to the pump controlled by relay1.
[202]	Pump 2 running	See ***[201] Pump 1 running***.
[203]	Pump 3 running	See ***[201] Pump 1 running***.
[204]	Pump 4 running	See ***[201] Pump 1 running***.
[205]	Pump 5 running	See ***[201] Pump 1 running***.
[206]	Pump 6 running	See ***[201] Pump 1 running***.
[207]	Pump 7 running	See ***[201] Pump 1 running***.
[208]	Pump 8 running	See ***[201] Pump 1 running***.
[209]	Pump 9 running	See ***[201] Pump 1 running***.
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[241]	RS flipflop 1	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[242]	RS flipflop 2	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[243]	RS flipflop 3	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[244]	RS flipflop 4	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[245]	RS flipflop 5	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[246]	RS flipflop 6	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[247]	RS flipflop 7	See ***parameter 13-15 RS-FF Operand S*** and ***parameter 13-16 RS-FF Operand R***.
[249]	Emcy m. OPR unexpected	Emergency mode input or safe stop is not operating as expected, for example, live zero monitoring on an analog input is activated.

Option	Name	Description
[250]	Emcy mode limits	During emergency mode operation, 1 of the critical alarms has been activated and suppressed by emergency mode. This may lead to reduced drive performance and expected operation lifetime before service is required.
[254]	Testing emcy mode	Emergency mode is activated in a special test mode where the drive stops on all alarms.

Table 31: Pumps Controlled by the Cascade Controller

Setting in *parameter group 5-3* Digital Outputs*	**Setting in** ***parameter 25-05 Fixed Lead Pump***	
	[0] No	[1] Yes
[201] Pump 1 running	Controlled by relay1	Controlled by drive
[202] Pump 2 running	Controlled by relay2	Controlled by relay1
[203] Pump 3 running	–	Controlled by relay2

5-31 Terminal 29 Digital Output

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 5-30 Terminal 27 Digital Output***.

5-32 Term X30/6 Digi Out (MCB 101)

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is active when option module VLT® General Purpose I/O MCB 101 is mounted in the drive. The options for this parameter are the same as those listed for ***parameter 5-30 Terminal 27 Digital Output***.

5-33 Term X30/7 Digi Out (MCB 101)

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is active when option module VLT® General Purpose I/O MCB 101 is mounted in the drive. The options for this parameter are the same as those listed for ***parameter 5-30 Terminal 27 Digital Output***.

5.7.4 5-4* Relays

Parameters for configuring the timing and the output functions for the relays.

5-40 Function Relays

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select options to define the function of the relays. The selection of each mechanical relay is realized in an array parameter.

Option	Name	Description
[0]	No operation	All digital and relay outputs are by default set to No Operation.
[1]	Control ready	The control card is ready.
[2]	Drive ready	The drive is ready to operate. Mains and control supplies are OK.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command is given (start/disable). There are no warnings.
[5]	Running	The motor is running, and shaft torque is present.
[6]	Running/no warning	Output speed is higher than the speed set in ***parameter 1-81 Min Speed for Function at Stop [RPM]***. The motor runs and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output. No warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in ***parameter 4-16 Torque Limit Motor Mode*** or ***parameter 4-17 Torque Limit Generator Mode*** has been exceeded.
[12]	Out of current range	The motor current is outside the range set in ***parameter 4-18 Current Limit***.
[13]	Below current, low	The motor current is lower than set in ***parameter 4-50 Warning Current Low***.
[14]	Above current, high	The motor current is higher than set in ***parameter 4-51 Warning Current High***.
[15]	Out of speed range	Output speed/frequency is outside the frequency range set in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[16]	Below speed, low	Output speed is lower than the setting in ***parameter 4-52 Warning Speed Low***.
[17]	Above speed, high	Output speed is higher than the setting in ***parameter 4-53 Warning Speed High***.

Option	Name	Description
[18]	Out of feedb. range	Feedback is outside the range set in ***parameter 4-56 Warning Feedback Low*** and ***parameter 4-57 Warning Feedback High***.
[19]	Below feedback, low	Feedback is below the limit set in ***parameter 4-56 Warning Feedback Low***.
[20]	Above feedback, high	Feedback is above the limit set in ***parameter 4-57 Warning Feedback High***.
[21]	Thermal warning	Thermal warning turns on when the temperature exceeds the limit either in motor, drive, brake resistor, or connected thermistor.
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and counterclockwise when logic = 1. The output changes as soon as the reversing signal is applied.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Use for performing a coasted stop in a torque limit condition. If the drive has received a stop signal and is in torque limit, the signal is logic 0.
[28]	Brake, no brake war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake module. Use the digital output/relay to cut out the main voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[36]	Control word bit 11	Activate relay 1 by control word from fieldbus. No other functional impact in the drive. Typical application: Controlling auxiliary device from fieldbus. The function is valid when ***[0] FC profile*** in ***parameter 8-10 Control Word Profile*** is selected.
[37]	Control word bit 12	Activate relay 2 by control word from fieldbus. No other functional impact in the drive. Typical application: Controlling auxiliary device from fieldbus. The function is valid when ***[0] FC profile*** in ***parameter 8-10 Control Word Profile*** is selected.
[40]	Out of ref range	Active when the actual speed is outside the settings in ***parameter 4-52 Warning Speed Low*** to ***parameter 4-55 Warning Reference High***.

Option	Name	Description
[41]	Below reference, low	Active when the actual speed is below speed reference setting.
[42]	Above ref, high	Active when actual speed is above speed reference setting.
[45]	Bus ctrl.	Controls digital output/relay via bus. The state of the output is set in ***parameter 5-90 Digital and Relay Bus Control***. The output state is retained in the event of a bus timeout.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in ***parameter 5-90 Digital and Relay Bus Control***. If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in parameter ***5-90 Digital and Relay Bus Control***. If a bus timeout occurs, the output state is set low (off).
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	See *parameter group 13-1* Comparators* . If comparator 0 in SLC is true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See *parameter group 13-1* Comparators* . If comparator 1 in SLC is true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See *parameter group 13-1* Comparators* . If comparator 2 in SLC is true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See *parameter group 13-1* Comparators* . If comparator 3 in SLC is true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See *parameter group 13-1* Comparators* . If comparator 4 in SLC is true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See *parameter group 13-1* Comparators* . If comparator 5 in SLC is true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See *parameter group 13-1* Comparators* . If comparator 6 in SLC is true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See *parameter group 13-1* Comparators* . If comparator 7 in SLC is true, the output goes high. Otherwise, it is low.

Option	Name	Description
[68]	Comparator 8	See *parameter group 13-1* Comparators* . If comparator 8 in SLC is true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See *parameter group 13-1* Comparators* . If comparator 9 in SLC is true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See *parameter group 13-4* Logic Rules* . If logic rule 0 in SLC is true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See *parameter group 13-4* Logic Rules* . If logic rule 1 in SLC is true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See *parameter group 13-4* Logic Rules* . If logic rule 2 in SLC is true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See *parameter group 13-4* Logic Rules* . If logic rule 3 in SLC is true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See *parameter group 13-4* Logic Rules* . If logic rule 4 in SLC is true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See *parameter group 13-4* Logic Rules* . If logic rule 5 in SLC is true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See *parameter group 13-4* Logic Rules* . If logic rule 6 in SLC is true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See *parameter group 13-4* Logic Rules* . If logic rule 7 in SLC is true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See *parameter group 13-4* Logic Rules* . If logic rule 8 in SLC is true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See *parameter group 13-4* Logic Rules* . If logic rule 9 in SLC is true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See ***parameter 13-52 SL Controller Action***. Output A is low on smart logic action ***[32] Set digital out A low***. Output A is high on smart logic action ***[38] Set digital out A high***.

Option	Name	Description
[81]	SL digital output B	See ***parameter 13-52 SL Controller Action***. Output B is low on smart logic action ***[33] Set digital out B low***. Output B is high on smart logic action ***[39] Set digital out B high***.
[82]	SL digital output C	See ***parameter 13-52 SL Controller Action*** . Output C is low on smart logic action ***[34] Set digital out C low***. Output C is high on smart logic action ***[40] Set digital out C high***.
[83]	SL digital output D	See ***parameter 13-52 SL Controller 1 Action***. Output D is low on smart logic action ***[35] Set digital out D low***. Output D is high on smart logic action ***[41] Set digital out D high***.
[84]	SL digital output E	See ***parameter 13-52 SL Controller Action***. Output E is low on smart logic action ***[36] Set digital out E low***. Output E is high on smart logic action ***[42] Set digital out E high***.
[85]	SL digital output F	See ***parameter 13-52 SL Controller Action***. Output F is low on smart logic action ***[37] Set digital out F low***. Output F is high on smart logic action ***[43] Set digital out F high***.
[151]	ATEX ETR cur. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection***is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR*** . If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection***is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR*** . If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[153]	ATEX ETR cur. warning	Selectable if ***parameter 1-90 Motor Thermal Protection***is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR*** . If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if ***parameter 1-90 Motor Thermal Protection***is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[155]	Verifying flow	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	

Option	Name	Description
[165]	Local ref active	The output is high when ***parameter 3-13 Reference Site***is set to ***[2] Local*** or when ***parameter 3-13 Reference Site*** is set to ***[0] Linked to hand/auto*** at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when ***parameter 3-13 Reference Site***is set to ***[1] Remote*** or ***[0] Linked to hand/auto*** while the LCP is in auto-on mode.
[167]	Start command activ	The output is high when there is an active start command (via digital input, bus connection, [Hand On], or [Auto On]), and no stop command is active.
[168]	Hand/Off	The output is high when the drive is in hand-on mode (as indicated by the LED light above [Hand On]).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the LED light above [Auto On]).
[173]	10Wh counter pulse	
[178]	RS flipflop 8	
[179]	RS flipflop 9	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. maintenance	One or more of the preventive maintenance events programmed in ***parameter 23-10 Maintenance Item*** has passed the time for the specified action in ***parameter 23-22 Maintenance Action***.
[183]	Pre/post lube	
[188]	AHF capacitor connect	
[189]	External fan control	The internal logics for internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	The drive/system has entered sleep mode. See *parameter group 22-4* Sleep Mode* .
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in ***parameter 22-60 Broken Belt Function***.
[195]	Bypass valve control	

Option	Name	Description
[196]	Fire mode	The drive operates in fire mode. See *parameter group 24-0* Fire Mode* .
[197]	Fire mode was act.	The drive has been operating in fire mode. In software version 7.2X, this output is only active 1 min after fire mode is stopped. See *parameter 24-0* Fire Mode* .
[198]	Drive bypass	To be used as signal for activating an external electromechanical bypass, switching the motor direct on line. See *parameter group 24-1* Drive Bypass* . **NOTICE** **LOSS OF CERTIFICATION** If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.
[199]	Pipe filling	
[211]	Cascade pump 1	
[212]	Cascade pump 2	
[213]	Cascade pump 3	
[214]	Cascade pump 4	
[215]	Cascade pump 5	
[216]	Cascade pump 6	
[217]	Cascade pump 7	
[218]	Cascade pump 8	
[219]	Cascade pump 9	
[230]	Ext. cascade ctrl	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See *parameter group 13-1* Comparators* .
[241]	RS flipflop 1	See *parameter group 13-1* Comparators* .
[242]	RS flipflop 2	See *parameter group 13-1* Comparators* .
[243]	RS flipflop 3	See *parameter group 13-1* Comparators* .
[244]	RS flipflop 4	See *parameter group 13-1* Comparators* .
[245]	RS flipflop 5	See *parameter group 13-1* Comparators* .

Option	Name	Description
[246]	RS flipflop 6	See *parameter group 13-1* Comparators* .
[247]	RS flipflop 7	See *parameter group 13-1* Comparators* .

5-41 On Delay, Relay

Default value:	0.01 s	**Parameter type:**	Range, 0.01 - 600 s, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the delay of the relay cut-in time. Select 1 of 2 internal mechanical relays in an array function. See ***parameter 5-40 Function Relay*** for details.

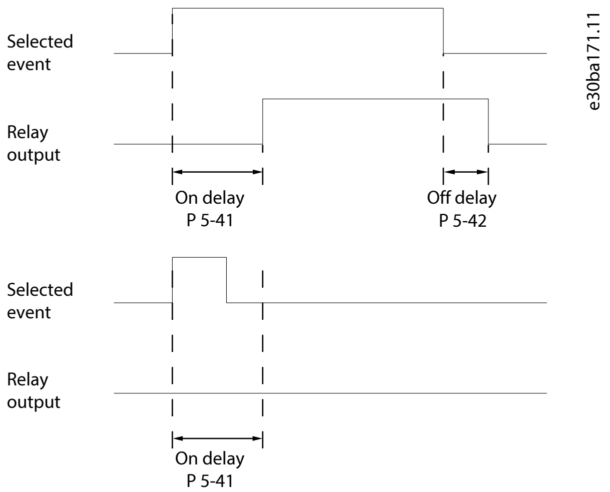


Figure 58: On Delay, Relay

5-42 Off Delay, Relay

Default value:	0.01 s	**Parameter type:**	Range, 0.01 - 600 s, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the delay of the relay cutout time. Select 1 of 2 internal mechanical relays in an array function. See ***parameter 5-40 Function Relay*** for details. If the selected event condition changes before a delay timer expires, the relay output is unaffected.

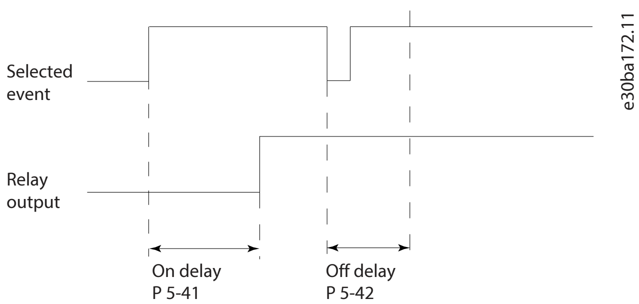


Figure 59: Off Delay, Relay

If the selected event condition changes before the on delay or off delay timer expires, the relay output is unaffected.

5.7.5 5-5* Pulse Input

The pulse input parameters are used to define an appropriate window for the impulse reference area by configuring the scaling and filter settings for the pulse inputs. Input terminal 29 or 33 acts as frequency reference inputs. Set terminal 29 (***parameter 5-13 Terminal 29 Digital Input***) or terminal 33 (***parameter 5-15 Terminal 33 Digital Input***) to ***[32] Pulse input***. If terminal 29 is used as an input, set ***parameter 5-02 Terminal 29 Mode*** to ***[0] Input***.

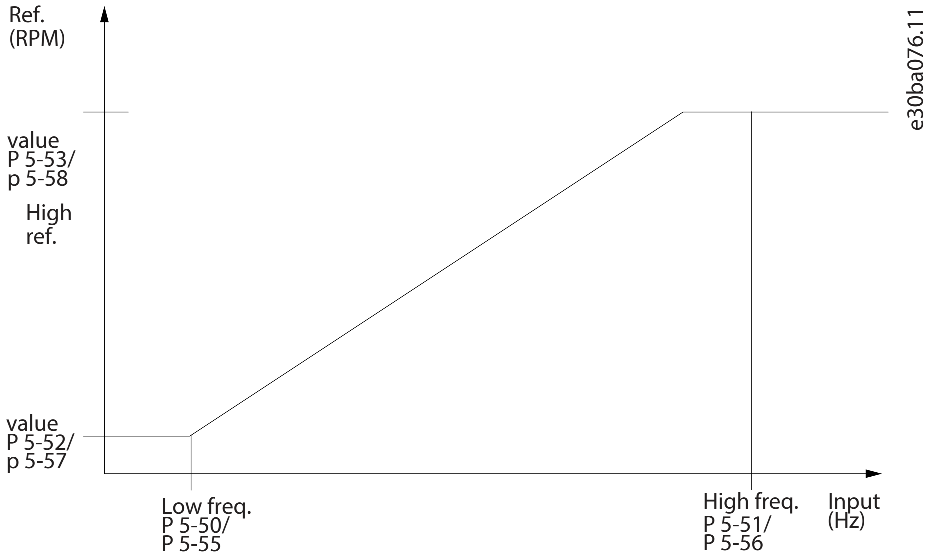


Figure 60: Pulse Input

5-50 Term. 29 Low Frequency

Default value:	100 Hz	**Parameter type:**	Range, 0 – 110000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the low frequency limit corresponding to the low motor shaft speed (that is low reference value) in *parameter 5-52 Term. 29 Low Ref./Feedb. Value*. Refer to Figure 60.

5-51 Term. 29 High Frequency

Default value:	100 Hz	**Parameter type:**	Range, 0 – 110000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the high frequency limit corresponding to the high motor shaft speed (that is high reference value) in ***parameter 5-53 Term. 29 High Ref./Feedb. Value***.

5-52 Term. 29 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 Reference-FeedbackUnit
Setup:	All setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also ***parameter 5-57 Term. 33 Low Ref./Feedb. Value***. Set terminal 29 to digital input (***parameter 5-02 Terminal 29 Mode* = *[0] Input*** (default) and ***parameter 5-13 Terminal 29 Digital Input*** = applicable value).

5-53 Term. 29 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 Reference-FeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also ***parameter 5-58 Term. 33 High Ref./Feedb. Value***. Select terminal 29 as a digital input (***parameter 5-02 Terminal 29 Mode* = *[0] Input*** (default) and ***parameter 5-13 Terminal 29 Digital Input*** = applicable value).

5-54 Pulse Filter Time Constant #29

Default value:	100 ms	**Parameter type:**	Range, 5 - 1000 ms
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	False

Enter the pulse filter time constant. The pulse filter dampens oscillations of the feedback signal. If there is much noise in the system this is an advantage. A high time constant value results in better dampening but also increases the time delay through the filter.

5-55 Term. 33 Low Frequency

Default value:	100 Hz	**Parameter type:**	Range, 0 - 110000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the low frequency corresponding to the low motor shaft speed (that is low reference value) in ***parameter 5-57 Term. 33 Low Ref./Feedb. Value***.

5-56 Term. 33 High Frequency

Default value:	100 Hz	**Parameter type:**	Range, 0 - 110000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in ***parameter 5-58 Term. 33 High Ref./Feedb. Value***.

5-57 Term. 33 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the low reference value [RPM] for the motor shaft speed. This is also the low feedback value, see also ***parameter 5-52 Term. 29 Low Ref./Feedb. Value***.

5-58 Term. 33 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the high reference value [RPM] for the motor shaft speed. See also ***parameter 5-53 Term. 29 High Ref./Feedb. Value***.

5-59 Pulse Filter Time Constant #33

Default value:	100 ms	**Parameter type:**	Range, 5 - 1000 ms
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the pulse filter time constant. The low-pass filter reduces the influence and dampens oscillations on the feedback signal from the control. This is an advantage if there is a lot of noise in the system.

5.7.6 5-6* Pulse Outputs

Parameters for configuring the scaling and output functions of pulse outputs. The pulse outputs are designated to terminal 27 or 29. Select terminal 27 output in ***parameter 5-01 Terminal 27 Mode*** and terminal 29 in ***parameter 5-02 Terminal 29 Mode***.

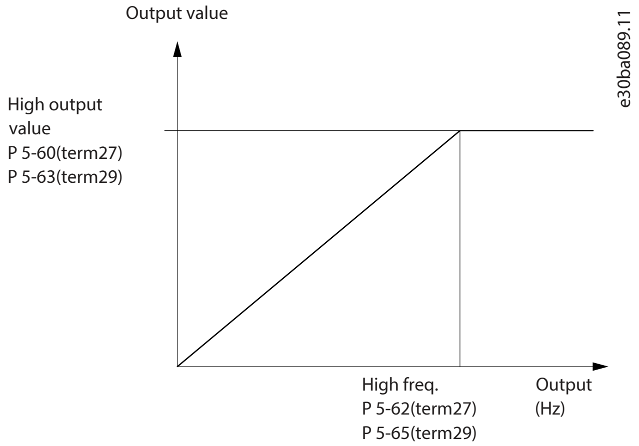


Figure 61: Pulse Output

5-60 Terminal 27 Pulse Output Variable

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No operation	Select the display output for terminal 27.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output freq. 0–100	
[101]	Reference min–max	
[102]	Feedback ±200%	
[103]	Motor cur. 0–I_{MAX}	
[104]	Torque 0–T_{lim}	
[105]	Torque 0–T_{nom}	
[106]	Power 0–P_{nom}	
[107]	Speed 0–HighLim	
[108]	Torque ±160%	
[109]	Out frq 0–F_{MAX}	
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[116]	Cascade reference	

5-62 Pulse Output Max Freq #27

Default value:	5000 Hz	**Parameter type:**	Range, 0 - 32000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in ***parameter 5-60 Terminal 27 Pulse Output Variable***.

5-63 Terminal 29 Pulse Output Variable

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No operation	Select the display output for terminal 27.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output freq. 0–100	
[101]	Reference min–max	
[102]	Feedback ±200%	
[103]	Motor cur. 0–I_{MAX}	
[104]	Torque 0–T_{lim}	
[105]	Torque 0–T_{nom}	
[106]	Power 0–P_{nom}	
[107]	Speed 0–HighLim	
[108]	Torque ±160%	
[109]	Out frq 0–F_{MAX}	
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[116]	Cascade reference	

5-65 Pulse Output Max Freq #29

Default value:	5000 Hz	**Parameter type:**	Range, 0 - 32000 Hz
Setup:	All setups	**Conversion index:**	0

Data type:	Uint32	**Change during operation:**	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in ***parameter 5-60 Terminal 27 Pulse Output Variable***.

5-66 Terminal X30/6 Pulse Output Variable

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No operation	Select the display output for terminal 27.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output freq. 0–100	
[101]	Reference min–max	
[102]	Feedback ±200%	
[103]	Motor cur. 0–I $_{MAX}$	
[104]	Torque 0–T $_{lim}$	
[105]	Torque 0–T $_{nom}$	
[106]	Power 0–P $_{nom}$	
[107]	Speed 0–HighLim	
[108]	Torque ±160%	
[109]	Out frq. 0–F$_{MAX}$	
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[166]	Cascade reference	

5-68 Pulse Output Max Freq #30/6

Default value:	5000 Hz	**Parameter type:**	Range, 0 - 32000 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in ***parameter 5-60 Terminal 27 Pulse Output Variable***.

5.7.7 5-8* I/O Options

AHF capacitor connect output function for digital and relay outputs

Functional description:

- Connect capacitors at 20% nominal power.
- Hysteresis ±50% of 20% nominal power (=minimum 10% and maximum 30% nominal power).
- Off delay timer = 10 s. The nominal power must be below 10% for 10 s to disconnect the capacitors. If the nominal power exceeds 10% during the 10 s delay, the timer (10 s) restarts.
- The capacitor reconnect delay (default = 25 s with a range of 1–120 s, see ***parameter 5-80 AHF Cap Reconnect Delay***) is used for the minimum off-time for the AHF capacitor output function.
- If there is a power loss, the drive guarantees that the minimum off-time is respected when power is restored.

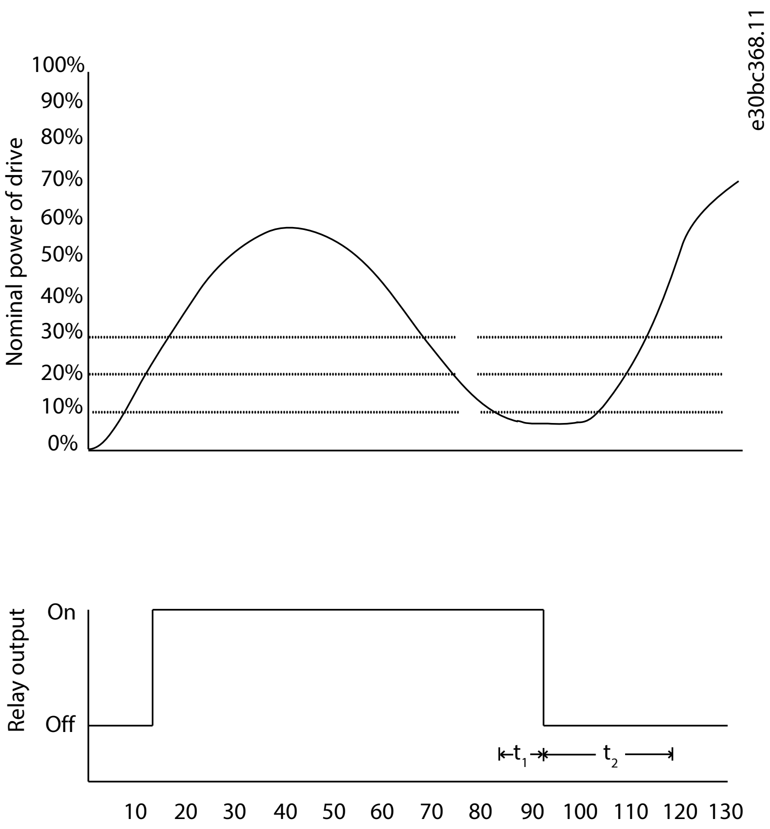


Figure 62: Example of the Output Function

t_1 shows the off delay timer (10 s).

t_2 shows the capacitor reconnect delay (***parameter 5-80 AHF Cap Reconnect Delay***).

When the nominal power of the drive exceeds 20%, the output function turns on. When the power goes below 10%, and off delay timer has to expire before the output goes low. This is represented by t_1. After the output goes low, the capacitor reconnect delay timer has to expire before the output is allowed to be on again, shown by t_2. When t_2 expires, the nominal power is above 30% and the relay does not turn on.

5-80 AHF Cap Reconnect Delay

Default value:	25 s	**Parameter type:**	Range, 1 - 120 s
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Guarantees a minimum off-time for the capacitors. The timer starts once the AHF capacitor disconnects and has to expire before the output is allowed to be on again. It only turns on again if the drive power is 20–30%.

5.7.8 5-9* Bus-controlled

This parameter group selects digital and relay outputs via a fieldbus setting.

5-90 Digital & Relay Bus Control

Default value:	0	**Parameter type:**	Range, 0 - 0xFFFFFFFF
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter holds the state of the digital outputs and relays that is controlled by bus. A logical 1 indicates that the output is high or active. A logical 0 indicates that the output is low or inactive.

5-92 Application Bus Control

Default value:	0	**Parameter type:**	Range, 0 - 0xFFFFFFFF
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Use this parameter for writing control words from BacNetIP to sleep, external interlock, and latched pump derag requests.

5-93 Pulse Out #27 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Set the output frequency transferred to output terminal 27 when the terminal is configured as ***[45] Bus Controlled*** in ***parameter 5-60 Terminal 27 Pulse Output Variable***.

5-94 Pulse Out #27 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to output terminal 27 when the terminal is configured as ***[48] Bus Ctrl Timeout*** in ***parameter 5-60 Terminal 27 Pulse Output Variable*** and a timeout is detected.

5-95 Pulse Out #29 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Set the output frequency transferred to output terminal 29 when the terminal is configured as ***[45] Bus Controlled*** in ***parameter 5-63 Terminal 29 Pulse Output Variable***.

5-96 Pulse Out #29 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to output terminal 29 when the terminal is configured as ***[48] Bus Ctrl Timeout*** in ***parameter 5-63 Terminal 29 Pulse Output Variable*** and a timeout is detected.

5-97 Pulse Out #30/6 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Set the output frequency transferred to output terminal X30/6 when the terminal is configured as ***[45] Bus ctrl.*** in ***parameter 5-66 Terminal X30/6 Pulse Output Variable***.

5-98 Pulse Out #30/6 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Changing during operation:**	True

Set the output frequency transferred to output terminal X30/6 when the terminal is configured as ***[48] Bus Ctrl Timeout*** in ***parameter 5-66 Terminal X30/6 Pulse Output Variable*** and a timeout is detected.

5.8 Parameter Group 6-** Analog In/Out

5.8.1 6-0* Analog I/O Mode

Parameter group for setting up the analog I/O configuration.

The drive is equipped with 2 analog inputs:

- Terminal 53
- Terminal 54

The analog inputs can be allocated freely to either voltage (0–10 V) or current input (0/4–20 mA).

NOTICE

Thermistors may be connected to either an analog or a digital input.

6-00 Live Zero Timeout Time

Default value:	10 s	**Parameter type:**	Range, 1 - 99 s
Setup:	All seutps	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the live zero timeout in s. Live zero timeout time is active for analog inputs, that is terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input drops below 50% of the value set in:

- ***Parameter 6-10 Terminal 53 Low Voltage***
- ***Parameter 6-12 Terminal 53 Low Current***
- ***Parameter 6-20 Terminal 54 Low Voltage***
- ***Parameter 6-22 Terminal 54 Low Current***

for a time period longer than the time set in ***parameter 6-00 Live Zero Timeout Time***, the function selected in ***parameter 6-01 Live Zero Timeout Function*** is activated.

6-01 Live Zero Timeout Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the timeout function. If the input signal on terminal 53 or 54 is below 50% of the value in

- ***Parameter 6-10 Terminal 53 Low Voltage***
- ***Parameter 6-12 Terminal 53 Low Current***
- ***Parameter 6-20 Terminal 54 Low Voltage***
- ***Parameter 6-22 Terminal 54 Low Current***

for a time period defined in ***parameter 6-00 Live Zero Timeout Time***, then the function set in ***parameter 6-01 Live Zero Timeout Function*** is activated. If several timeouts occur simultaneously, the drive prioritizes the timeout functions as follows:

- ***Parameter 6-01 Live Zero Timeout Function***
- ***Parameter 8-04 Control Word Timeout Function***

Option	Name	Description
[0]*	Off	
[1]	Freeze output	Frozen at the present value.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to maximum speed.
[5]	Stop and trip	Overruled to stop with subsequent trip.
[30]	Warning only	

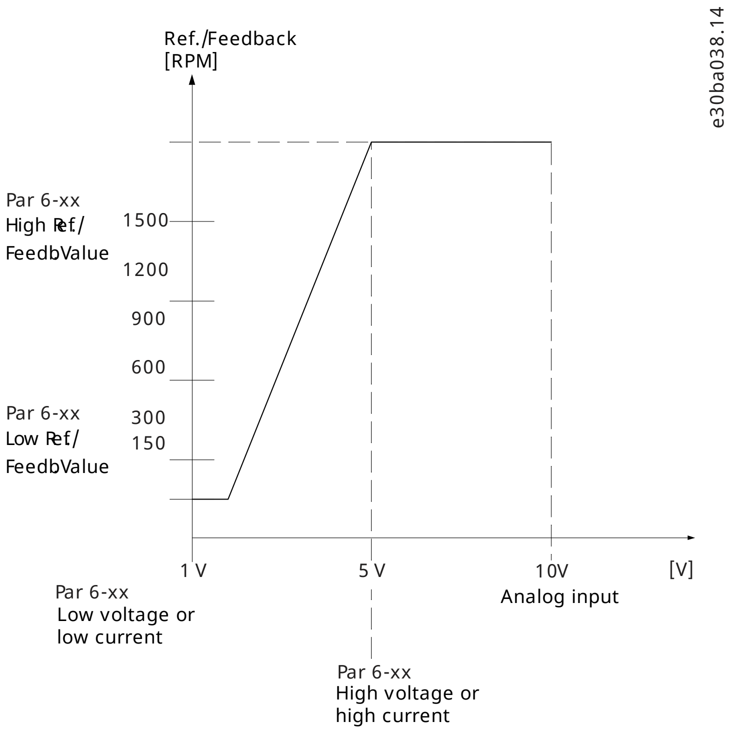


Figure 63: Live Zero Conditions

6-02 Emergency Mode Live Zero Timeout Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the timeout function when emergency mode is active. The function set in this parameter is activated if the input signal on analog inputs is below 50% of the low value for a period defined in ***parameter 6-00 Live Zero Timeout Time***.

Option	Name	Description
[0]*	Off	
[1]	Freeze output	Frozen at the present value.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to maximum speed.

5.8.2 6-1* Analog Input 1

Parameters for configuring the scaling and limits for analog input 1 (terminal 53).

6-10 Terminal 53 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 6-11 V
Setup:	All setups	**Conversion index:**	-2

Data type:	Int16	**Change during operation:**	True

Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value set in ***parameter 6-14 Terminal 53 Low Ref./Feedb. Value***.

6-11 Terminal 53 High Voltage

Default value:	10 V	**Parameter type:**	Range, par. 6-10 V - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the high voltage value. This analog input scaling value should correspond to the high reference feedback value set in ***parameter 6-15 Terminal 53 High Ref./Feedb. Value***.

6-12 Terminal 53 Low Current

Default value:	4 mA	**Parameter type:**	Range, 0 - par. 6-13 mA
Setup:	All setups	**Conversion index:**	-5
Data type:	Int16	**Change during operation:**	True

Enter the low current value. This reference signal should correspond to the minimum reference value, set in ***parameter 3-02 Minimum Reference***. Set the value to exceed 2 mA to activate the live zero timeout function in ***parameter 6-01 Live Zero Timeout Function***.

6-13 Terminal 53 High Current

Default value:	20 mA	**Parameter type:**	Range, par. 6-12 mA - 20 mA
Setup:	All setups	**Conversion index:**	-5
Data type:	Int16	**Change during operation:**	True

Enter the high current value corresponding to the high reference/feedback set in ***parameter 6-15 Terminal 53 High Ref./Feedb. Value***.

6-14 Terminal 53 Low Ref./Feedb. Value

Default value:	Size related	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the low voltage/low current set in ***parameter 6-10 Terminal 53 Low Voltage*** and ***parameter 6-12 Terminal 53 Low Current***.

6-15 Terminal 53 High Ref./Feedb. Value

Default value:	Size related	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the maximum reference feedback value set in ***parameter 6-11 Terminal 53 High Voltage*** and ***parameter 6-13 Terminal 53 High Current***.

6-16 Terminal 53 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This constant is a first-order digital low-pass filter time for suppressing electrical noise in terminal 53. A high value improves dampening but also increases the delay through the filter.

6-17 Terminal 53 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are used to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.3 6-2* Analog Input 2

Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

6-20 Terminal 54 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 6-21 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value set in ***parameter 3-02 Minimum Reference***.

6-21 Terminal 54 High Voltage

Default value:	10 V	**Parameter type:**	Range, par. 6-20 V - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the high voltage value. This analog input scaling value should correspond to the high reference feedback value set in ***parameter 6-25 Terminal 54 High Ref./Feedb. Value***.

6-22 Terminal 54 Low Current

Default value:	4 mA	**Parameter type:**	Range,0 - par. 6-23 mA
Setup:	All setups	**Conversion index:**	-5
Data type:	Int16	**Change during operation:**	True

Enter the low current value. This reference signal should correspond to the minimum reference value, set in ***parameter 3-02 Minimum Reference***. Enter the value that exceeds 2 mA to activate the live zero timeout function in ***parameter 6-01 Live Zero Timeout Function***.

6-23 Terminal 54 High Current

Default value:	20 mA	**Parameter type:**	Range, par. 6-22 mA - 20 mA
Setup:	All setups	**Conversion index:**	-5
Data type:	Int16	**Change during operation:**	True

Enter the high current value corresponding to the high reference feedback value set in ***parameter 6-25 Terminal 54 High Ref./Feedb. Value***.

6-24 Terminal 54 Low Ref./Feedb. Value

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the minimum reference feedback value set in ***parameter 3-02 Minimum Reference***.

6-25 Terminal 54 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	-999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the maximum reference feedback value set in ***parameter 3-03 Maximum Reference***.

6-26 Terminal 54 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE
This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. Increasing the value improves dampening but also increases the time delay through the filter.

6-27 Terminal 54 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are uesd to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.4 6-3* Analog Input X30/11

Parameter group for configuring the scale and limits for analog input 3 (X30/11) placed on VLT® General Purpose I/O MCB 101.

6-30 Terminal X30/11 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 6-31 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Sets the analog input scaling value to correspond to the low reference feedback value (set in ***parameter 6-34 Term. X30/11 Low Ref./ Feedb. Value***).

6-31 Terminal X30/11 High Voltage

Default value:	10 V	**Parameter type:**	Range, par. 6-30 V - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Sets the analog input scaling value to correspond to the high reference feedback value (set in ***parameter 6-35 Term. X30/11 High Ref./ Feedb. Value***).

6-34 Term. X30/11 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

Sets the analog input scaling value to correspond to the low voltage value (set in ***parameter 6-30 Terminal X30/11 Low Voltage***).

6-35 Term. X30/11 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Sets the analog input scaling value to correspond to the high-voltage value (set in ***parameter 6-31 Terminal X30/11 High Voltage***).

6-36 Term. X30/11 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X30/11. Increasing the value improves dampening but also increases the time delay through the filter.

6-37 Terminal X30/11 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (when an analog output does not fulfill any control function, but feeds a data storage device).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.5 6-4* Analog Input X30/12

Parameter group for configuring the scale and limits for analog input 4 (X30/12) placed on VLT® General Purpose I/O MCB 101.

6-40 X30/12 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 6-41 V
Setup:	All setups	**Conversion index:**	-2

Data type:	Int16	**Change during operation:**	True

Sets the analog input scaling value to correspond to the low reference feedback value set in ***parameter 6-44 Term. X30/12 Low Ref./ Feedb. Value***.

6-41 Terminal X30/12 High Voltage

Default value:	10 V	**Parameter type:**	Range, par. 6-40 V - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Sets the analog input scaling value to correspond to the high reference feedback value set in ***parameter 6-45 Term. X30/12 High Ref./ Feedb. Value***.

6-44 Term. X30/12 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Sets the analog output scaling value to correspond to the low voltage value set in ***parameter 6-40 Terminal X30/12 Low Voltage***.

6-45 Term. X30/12 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackValue	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackValue
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Sets the analog input scaling value to correspond to the high voltage value set in ***parameter 6-41 Terminal X30/12 High Voltage***.

6-46 X30/12 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X30/12. Increasing the value improves dampening but also increases the time delay through the filter.

6-47 Terminal X30/12 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (when an analog output does not fulfil any control function, but feeds a data storage device).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.6 6-5* Analog Output 1

Parameters for configuring the scaling and limits for analog output 1 (terminal 42). Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal 39) is the same terminal and has the same electrical potential for analog common and digital common connection. Resolution on the analog output is 12 bit.

6-50 Terminal 42 Output

Default value:	[100] Output freq. 0–100	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Values for setting the minimum reference are found in ***parameter 3-02 Minimum Reference*** and values for maximum reference are found in ***parameter 3-03 Maximum Reference***.

Select the function of terminal 42 as an analog current output. A motor current of 20 mA corresponds to I_{MAX}.

Option	Name	Description
[0]	No operation	
[52]	MCO	
[53]	MCO 4–20mA	
[100]*	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of ***parameter 3-03 Maximum Reference*** (0–20 mA).
[103]	Motor cur. 0–I_{max}	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–20 mA).
[104]	Torque 0–T_{lim}	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–20 mA).
[105]	Torque 0–T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P_{nom}	0–Motor rated power (0–20 mA).

Option	Name	Description
[107]	Speed 0–HighLim	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***, 0—20 mA.
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f_{max}	
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of ***parameter 3-03 Maximum Reference***.
[133]	Motor cur. 4–20mA	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***).
[134]	Torq.0–lim 4–20mA	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit (Hz)***.
[138]	Torque 4–20mA	
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	
[148]	Main act val 4–20mA	
[150]	Out frq 0–F_{max} 4–20mA	
[156]	Flow rate	

Option	Name	Description
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the next 2 tables and the following drawing.
[255]	DC link 4–20mA	The function is the same as ***[254] DC Link 0–20 mA***.

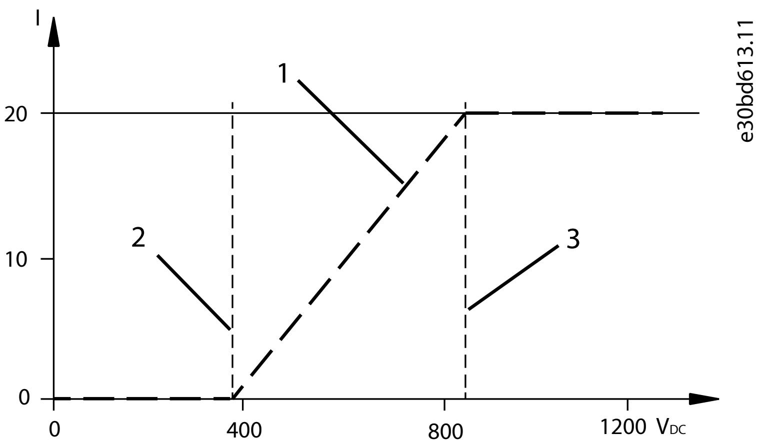
Table 32: Relationship Between the DC-ink Voltage and the Terminal Output

DC-link voltage (V)	Terminal output
V ≤undervoltage limit	0%
V ≥overvoltage limit	100%
Voltage within range: Undervoltage <V <Overvoltage	Linearly interpolated

Table 33: Undervoltage and Overvoltage Limits for Different Drive Sizes

Drive size	Unervoltage limit [V]	Overvoltage limit [V]
T2/S2	185	410
T4/S4	373	855
T6/T7	553	1130

Figure 64: The Analog Output of Terminal 42 on the T4 Drive with Option [254] DC Link 0–20 mA Selected



1	Analog output	**2**	Undervoltage limit
3	Overvoltage limit		

6-51 Terminal 42 Output Min Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale for the minimum output (0 mA or 4 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in ***parameter 6-50 Terminal 42 Output***.

6-52 Terminal 42 Output Max Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal 42. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale; or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value 0–100% of the full-scale output, program the percentage value in the parameter, that is 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows: 20 mA/desired maximum current x 100%

$$10\text{mA}: \frac{20}{10} \times 100 = 200\%$$

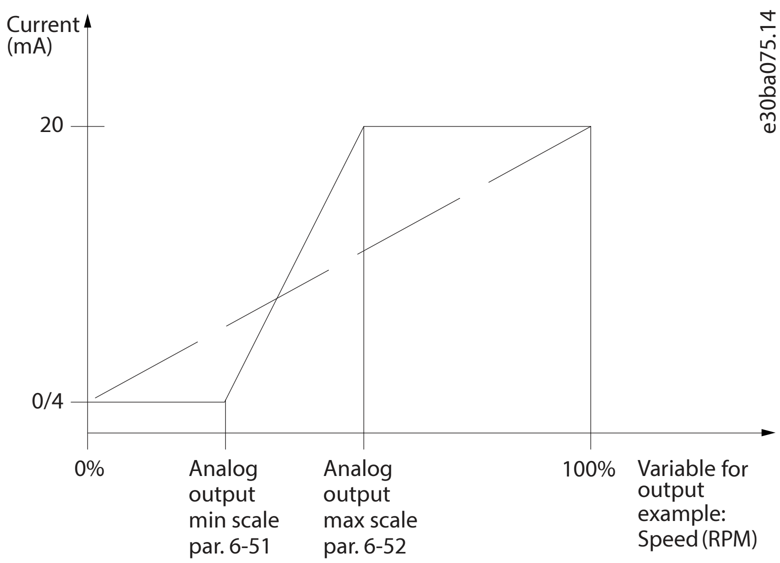


Figure 65: Output Maximum Scale

Example 1

Variable value = output frequency, range = 0–100 Hz.

Range needed for output = 0–50 Hz.

Output signal 0 mA or 4 mA is needed at 0 Hz (0% of range). Set ***parameter 6-51 Terminal 42 Output Min Scale*** to 0%.

Output signal 20 mA is needed at 50 Hz (50% of range). Set ***parameter 6-52 Terminal 42 Output Max Scale*** to 50%.

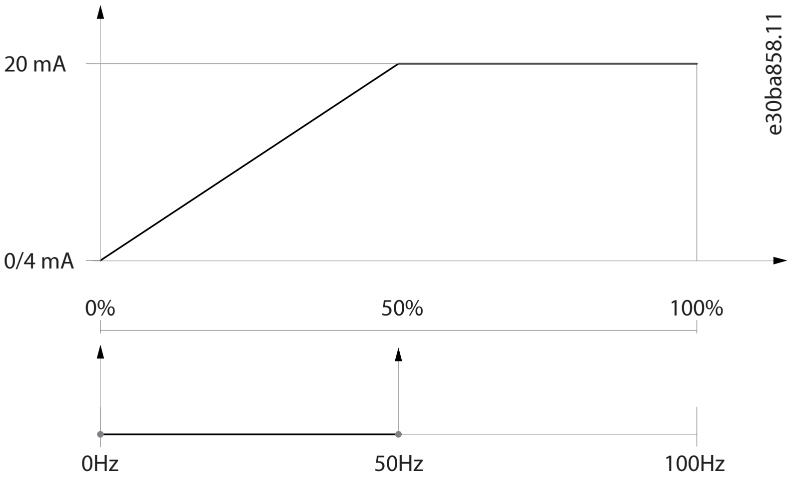


Figure 66: Example 1

Example 2

Variable = feedback, range = -200% to +200%.

Range needed for output = 0–100%.

Output signal 0 mA or 4 mA is needed at 0% (50% of range). Set ***parameter 6-51 Terminal 42 Output Min Scale***to 50%.

Output signal 20 mA is needed at 100% (75% of range). Set ***parameter 6-52 Terminal 42 Output Max Scale*** to 75%.

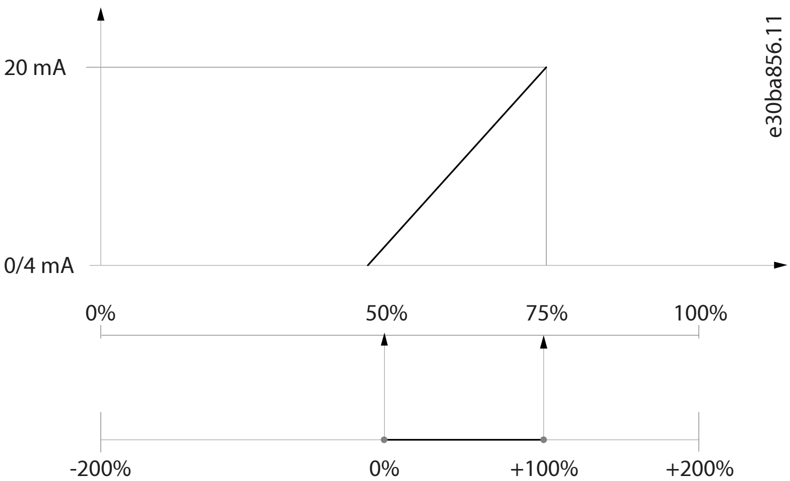


Figure 67: Example 2

Example 3

Variable value = reference, range = minimum reference–maximum reference.

Range needed for output = minimum reference (0%)–maximum reference (100%), 0–10 mA.

Output signal 0 mA or 4 mA is needed at minimum reference. Set ***parameter 6-51 Terminal 42 Output Min Scale*** to 0%.

Output signal 10 mA is needed at maximum reference (100% of range). Set ***parameter 6-52 Terminal 42 Output Max Scale*** to 200%.

(20 mA/10 mA x 100% = 200%).

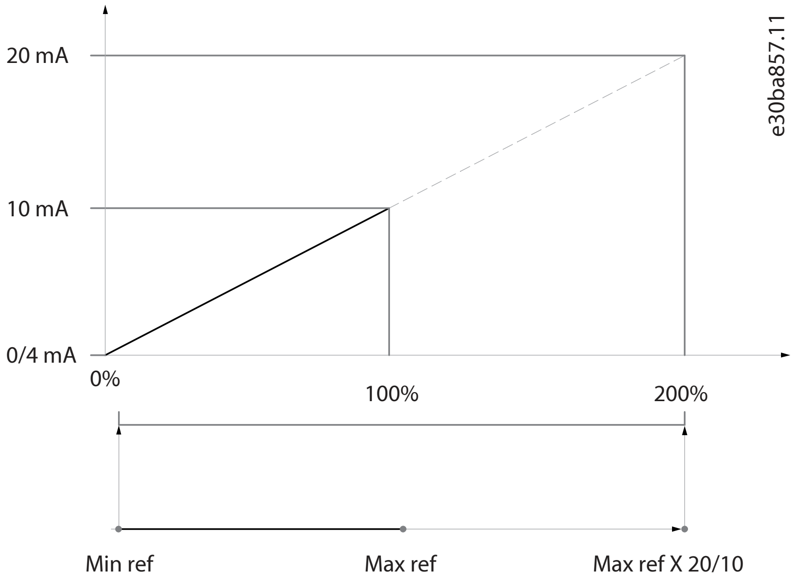


Figure 68: Example 3

6-53 Term 42 Output Bus Ctrl

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of output 42 if controlled by bus.

6-54 Term 42 Output Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of output 42. If a timeout function is selected in ***parameter 6-50 Terminal 42 Output***, the output is preset to this level if a fieldbus timeout occurs.

6-55 Analog Output Filter

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The following readout parameters from selection in ***parameter 6-50 Terminal 42 Output*** have a filter selected when ***parameter 6-55 Analog Output Filter*** is on.

Table 34: Readout Parameters

Selection	0–20 mA	4–20 mA
Motor current (I_{max})	[103]	[133]
Torque limit (0–T_{lim})	[104]	[134]
Rated torque (0–T_{nom})	[105]	[135]
Power (0–$P_{nom)}$	[106]	[136]
Speed (0–$Speed_{max}$)	[107]	[137]

Option	Name	Description
[0]*	Off	Filter off.
[1]	On	Filter on.

5.8.7 6-6* Analog Output X30/8

Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal X30/8) is the same terminal and electrical potential for analog common connection. Resolution on the analog output is 12 bit.

6-60 Terminal X30/8 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Selec the function of terminal X30/8 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[53]	MCO 4–20mA	
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of ***parameter 3-03 Maximum Reference*** (0–20 mA).
[103]	Motor cur. 0–I_{max}	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–20 mA).
[104]	Torque 0–T_{lim}	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–20 mA).
[105]	Torque 0–T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P_{nom}	0–Motor rated power (0–20 mA).

Option	Name	Description
[107]	Speed 0–HighLim	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***, 0—20 mA.
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f_{max}	
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of ***parameter 3-03 Maximum Reference***.
[133]	Motor cur. 4–20mA	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***).
[134]	Torq.0–lim 4–20mA	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit (Hz)***.
[138]	Torque 4–20mA	
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	
[148]	Main act val 4–20mA	
[150]	Out frq 0–F_{max} 4–20mA	
[156]	Flow rate	

Option	Name	Description
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and the illustration in ***parameter 6-50 Terminal 42 Output***.
[255]	DC link 4–20mA	The function is the same as ***[254] DC Link 0–20 mA***.

6-61 Terminal X30/8 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scales the minimum output of the selected analog signal on terminal X30/8. Scale the minimum value as a percentage of the maximum signal value. For example, enter the value 25% if the output should be 0 mA at 25% of the maximum output value. The value can never exceed the corresponding setting in ***parameter 6-62 Terminal X30/8 Max. Scale*** if the value is below 100%. This parameter is active when VLT® General Purpose I/O MCB 101 is mounted in the drive.

6-62 Terminal X30/8 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scales the maximum output of the selected analog signal on terminal X30/8. Scale the value to the required maximum value of the current signal output. Scale the output to give a lower current than 20 mA at full scale or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the fullscale output, program the percentage value in the parameter, that is 50%=20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows: 20 mA/desired maximum current x 100%

$$10\text{mA}: \frac{20-4}{10} \times 100 = 160\%$$

6-63 Terminal X30/8 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of output X30/8 if controlled by bus.

6-64 Terminal X30/8 Output Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%

Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of output X30/8. If a timeout function is selected in ***parameter 6-60 Terminal X30/8 Output***, the output is preset to this level if a fieldbus timeout occurs.

5.8.8 6-7* Analog Output X45/1

Parameters for configuring the scaling and limits for analog output 3, terminal X45/1. Analog outputs are current outputs: 0/4–20 mA. Resolution on the analog output is 11 bit.

6-70 Terminal X45/1 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output of terminal X45/1 of VLT® Extended Relay Card MCB 113.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[53]	MCO 4–20mA	
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of ***parameter 3-03 Maximum Reference*** (0–20 mA).
[103]	Motor cur. 0–I_{max}	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–20 mA).
[104]	Torque 0–T_{lim}	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–20 mA).
[105]	Torque 0–T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P_{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***, 0—20 mA.
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f_{max}	
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).

Option	Name	Description
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of ***parameter 3-03 Maximum Reference***.
[133]	Motor cur. 4–20mA	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***).
[134]	Torq.0–lim 4–20mA	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit (Hz)***.
[138]	Torque 4–20mA	
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	
[148]	Main act val 4–20mA	
[150]	Out frq 0–F_{max} 4–20mA	
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and illustration in ***parameter 6-50 Terminal 42 Output***.
[255]	DC link 4–20mA	The function is the same as ***[254] DC Link 0–20 mA***.

6-71 Terminal X45/1 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the minimum output of the selected analog signal at terminal X45/1 as a percentage of the maximum signal value. For example, if 0 mA (or 0 Hz) is required at 25% of the maximum output value, then program 25%. Scaling values up to 100% can never exceed the corresponding setting in ***parameter 6-72 Terminal X45/1 Max. Scale***.

6-72 Terminal X45/1 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal X45/1. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, for example 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows (example where required maximum output is 10 mA):

$$\frac{I_{RANGE}[mA]}{I_{DESIREDMAX}[mA]} \times 100\% = \frac{20 - 4\ mA}{10\ mA} \times 100\% = 160\%$$

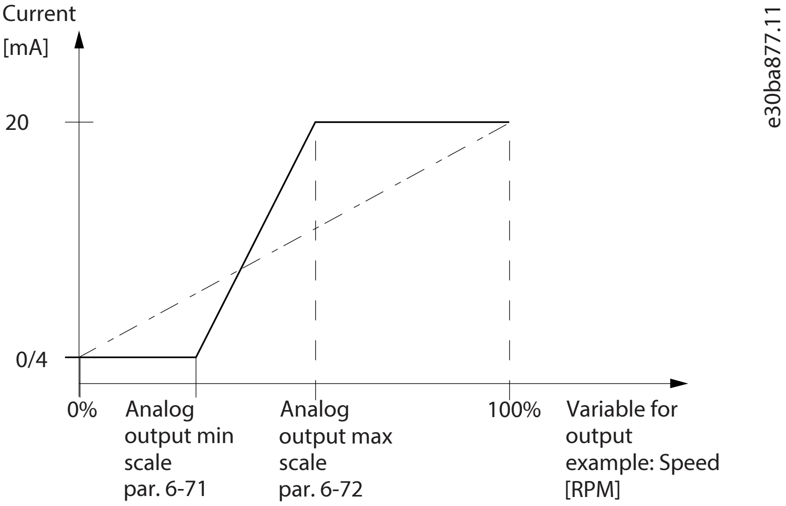


Figure 69: Output Maximum Scale

6-73 Terminal X45/1 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of analog output 3 (terminal X45/1) if controlled by bus.

6-74 Terminal X45/1 Output Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of analog output 3 (terminal X45/1). If there is a fieldbus timeout and a timeout function is selected in ***parameter 6-70 Terminal X45/1 Output***, the output is preset to this level.

5.8.9 6-8* Analog Output X45/3

Parameters for configuring the scaling and limits for analog input 4 (terminal X45/3). Analog outputs are current outputs: 0/4–20 mA. Resolution on the analog output is 11 bits.

6-80 Terminal X45/3 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output of terminal X45/3 of VLT® Extended Relay Card MCB 113.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[53]	MCO 4–20mA	
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of ***parameter 3-03 Maximum Reference*** (0–20 mA).
[103]	Motor cur. 0–I_{max}	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–20 mA).
[104]	Torque 0–T_{lim}	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–20 mA).
[105]	Torque 0–T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P_{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***, 0—20 mA.
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f_{max}	
[113]	Ext. closed loop 1	0–100% (0–20 mA).

Option	Name	Description
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of ***parameter 3-03 Maximum Reference***.
[133]	Motor cur. 4–20mA	0–Inverter maximum current (***parameter 16-37 Inv. Max. Current***).
[134]	Torq.0–lim 4–20mA	0–Torque limit (***parameter 4-16 Torque Limit Motor Mode***).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit (Hz)***.
[138]	Torque 4–20mA	
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	
[148]	Main act val 4–20mA	
[150]	Out frq 0–F_{max} 4–20mA	
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	

Option	Name	Description
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and illustration in ***parameter 6-50 Terminal 42 Output***.
[255]	DC link 4–20mA	The function is the same as ***[254] DC Link 0–20 mA***.

6-81 Terminal X45/3 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scales the minimum output of the selected analog signal on terminal X45/3. Scale the minimum value as a percentage of the maximum signal value, for example, 0 mA (or 0 Hz) is required at 25% of the maximum output value and 25% is programmed. The value can never exceed the corresponding setting in ***parameter 6-82 Terminal X45/3 Max. Scale*** if the value is below 100%. This parameter is active when VLT® Extended Relay Card MCB 113 is mounted in the drive.

6-82 Terminal X45/3 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal X45/3. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, for example 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows (example where required maximum output is 10 mA):

$$\frac{I_{RANGE}[mA]}{I_{DESIREDMAX}[mA]} \times 100\% = \frac{20-4\ mA}{10\ mA} \times 100\% = 160\%$$

6-83 Terminal X45/3 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of analog output 4 (terminal X45/3) if controlled by bus.

6-84 Terminal X45/3 Output Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of output 4 (X45/3). If there is a fieldbus timeout and a timeout function is selected in ***parameter 6-80 Terminal X45/3 Output***, the output is preset to this level.

5.9 Parameter Group 7-** Controllers

5.9.1 Speed PID Droop

This feature implements precise torque sharing between multiple motors on a common mechanical shaft. Speed PID droop is useful for marine and mining applications where redundancy and higher dynamics are required. Speed PID droop allows to reduce inertia by utilizing multiple small motors instead of 1 large motor.

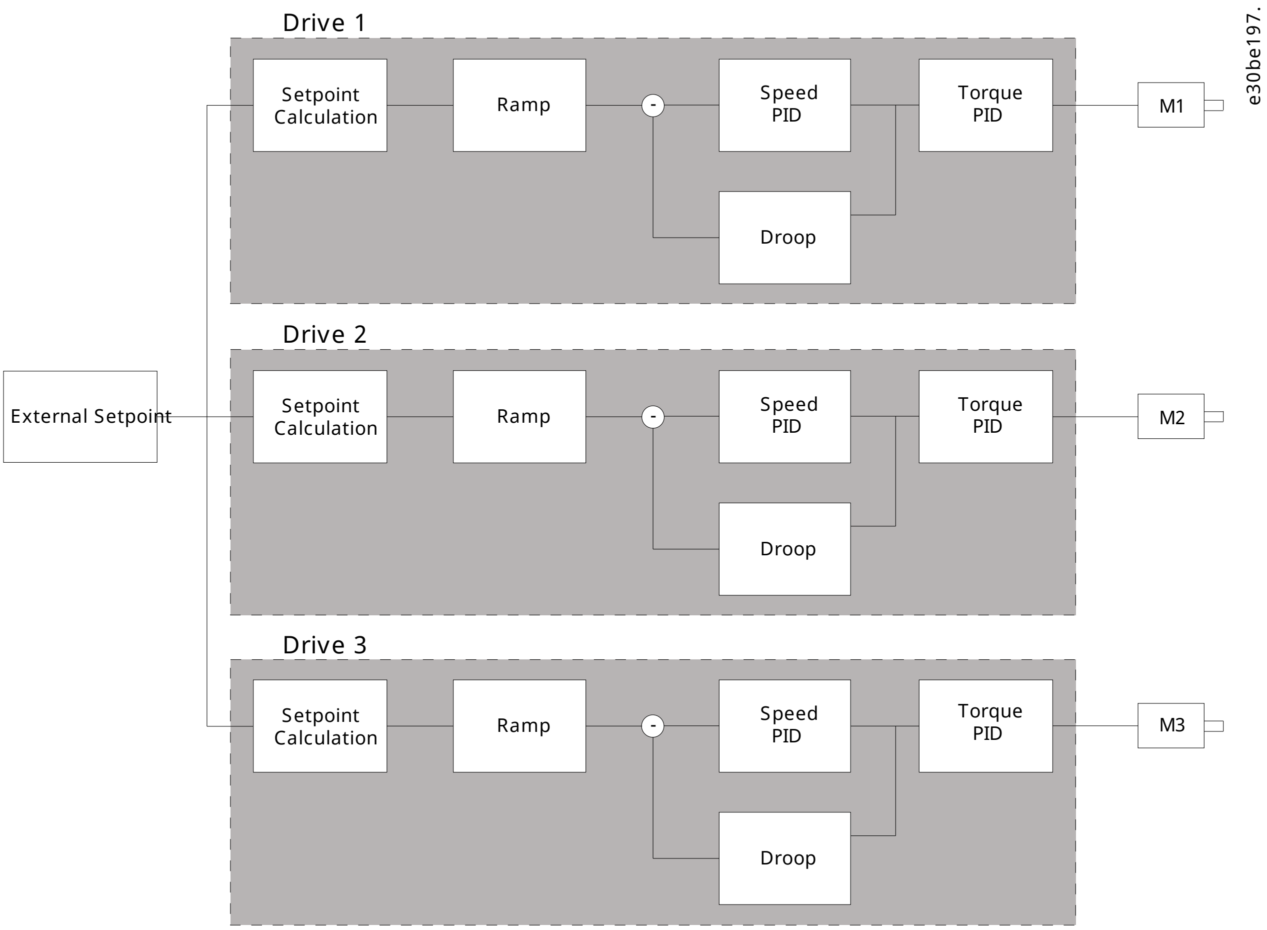


Figure 70: Concept of Speed PID Droop

The value in ***parameter 7-01 Speed PID Droop*** ensures that the load is shared equally between the motors. If the torque on the motor is 100% of nominal motor torque, the drive reduces its output to this motor by 100% of the value in ***parameter 7-01 Speed PID Droop***. If the torque is 50% of nominal motor torque, the drive reduces its output to this motor by 50% of the value in ***parameter 7-01 Speed PID Droop***. This ensures that the motors share the load evenly. A side effect of using speed PID droop is that the actual shaft speed does not match the reference exactly. Speed PID droop is not efficient in low-speed applications because the adjustment range may be insufficient.

Use speed trim if the application requires the following features:

- Accurate speed (the actual shaft speed matches the reference speed).
- Precise speed adjustment down to 0 RPM.

Enabling PID droop

To enable speed PID droop:

- Run the drive in 1 of the following modes:
  - Flux closed loop (***parameter 1-01 Motor Control Principle***, ***[3] Flux w/ motor feedb***).
  - Flux sensorless (***parameter 1-01 Motor Control Principle***, ***[2] Flux sensorless***).
- Run the drive in speed mode (***parameter 1-00 Configuration Mode***, option ***[0] Speed open loop*** or ***[1] Speed closed loop***).
- Ensure that ***parameter 1-62 Slip Compensation*** contains the default value (0%).
- Ensure that all drives in the torque sharing system use the same speed reference and start and stop signal.
- Ensure that all drives in the torque sharing system use the same parameter settings.
- Adjust the value in ***parameter 7-01 Speed PID Droop***.

NOTICE

Do not use overvoltage control when using the PID droop function (select ***[0] Disabled*** in ***parameter 2-17 Over-voltage Control***).

NOTICE

If the speed reference is lower than the value in ***parameter 7-01 Speed PID Droop***, the drive makes the PID droop factor equal to the speed reference.

5.9.2 Speed Trim

The speed trim function is an add-on to the speed PID droop. The speed trim provides torque sharing with precise speed down to 0 RPM. The function requires wiring of analog signals.

In speed trim, the master drive runs normal speed PID without droop. The follower drives use the speed PID droop, but instead of reacting on their own load, they compare their own load to the load of other drives in the system. The follower drives then use that data as input for the speed PID droop. A setup with a single source, where the master drive sends information about torque to all followers, is limited by the number of available analog outputs on the master drive. It is possible to use a cascade principle which overcomes this limitation, but makes the control slower and less accurate. The master drive operates in speed mode. The follower drives operate in speed mode with the speed trim. The trim function uses torque data from all drives in the system.

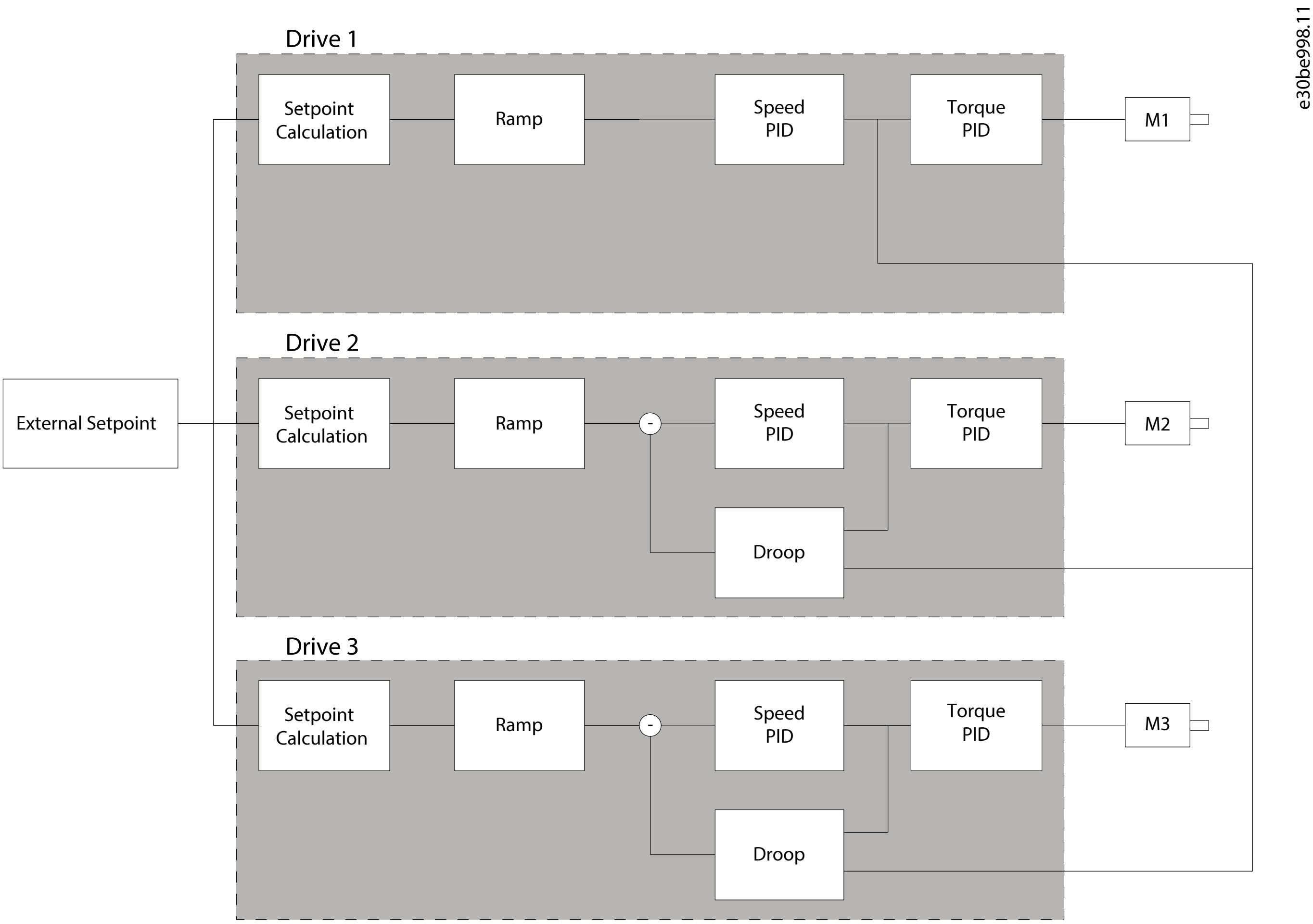


Figure 71: Concept of Speed Trim

The drawing shows a single-source setup where the master sends the torque signal to all followers. The number of available analog outputs on the master limits this setup. To overcome the limitation of the number of analog outputs, use a cascade principle. The cascade principle makes the control slower and less accurate compared with the setup using analog outputs.

5.9.3 7-0* Speed PID Ctrl.

NOTICE

If separate encoders are used, adjust the ramp-related parameters according to the gear ratio between the 2 encoders.

7-02 Speed PID Proportional Gain

Default value:	Size related	**Parameter type:**	Range, 0 - 1
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter the speed controller proportional gain. The proportional gain amplifies the error (that is the deviation between the feedback signal and the setpoint). This parameter is used with ***parameter 1-00 Configuration Mode [0] Speed open loop*** and ***[1] Speed closed loop control***. Quick control is obtained at high amplification. Increasing amplification makes the process less stable. For values with 4 decimals, use ***parameter 30-83 Speed PID Proportional Gain***.

7-03 Speed PID Integral Time

Default value:	Size related	**Parameter type:**	Range, 1.0 - 20000 ms
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	True

Enter the speed controller integral time, which determines the time the internal PID control takes to correct errors. The greater the error, the more quickly the gain increases. The integral time causes a delay of the signal and therefore a dampening effect and can be used to eliminate steady-state speed error. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action, leading to major deviations from the required reference, since the process regulator takes too long to regulate errors. This parameter is used with ***[0] Speed open loop*** and ***[1] Speed closed loop control***, set in ***parameter 1-00 Configuration Mode***.

7-04 Speed PID Differentiation Time

Default value:	Size related	**Parameter type:**	Range, 0 - 200 ms
Setup:	Alll setups	**Conversion index:**	-4
Data type:	Uint16	**Change during operation:**	True

Enter the speed controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the speed feedback. The quicker the error changes, the stronger the gain from the differentiator. The gain is proportional with the speed at which errors change. Setting this parameter to 0 disables the differentiator. This parameter is used with ***parameter 1-00 Configuration Mode***, ***[1] Speed closed loop control***.

7-08 Speed PID Feed Forward Factor

Default value:	0%	**Parameter type:**	Range, 0 - 500%
Setup	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The reference signal bypasses the speed controller by the amount specified. This feature increases the dynamic performance of the speed control loop.

5.10 Parameter Group 8-** Comm. and Options

5.10.1 8-0* General Settings

8-01 Control Site

Default value:	[0] Digital and ctrl. word	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The setting in this parameter overrides the settings in ***parameter 8-50 Coasting Select*** to ***parameter 8-56 Preset Reference Select***.

Option	Name	Description
[0]*	Digital and ctrl.word	Use both digital input and control word.
[1]	Digital only	Use digital inputs only.
[2]	Controlword only	Use control word only.

8-02 Control Word Source

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

Select the source of the control word: 1 of 2 serial interfaces or 4 installed options. During initial power-up, the drive automatically sets this parameter to *[3] Option A* if it detects a valid fieldbus option installed in slot A. When the option is removed, the drive detects a configuration change, sets ***parameter 8-02 Control Word Source*** to default setting *[1] FC port*, and trips. If an option is installed after initial power-up, the setting of ***parameter 8-02 Control Word Source*** does not change, but the drive trips and shows: *Alarm 67, Option Changed*. When retrofitting a bus option into a drive that did not have a bus option installed earlier, change the control to bus-based. This change is required for safety reasons to avoid an unintended change.

Option	Name	Description
[0]	None	
[1]	FC port	
[2]	USB port	
[3]	Option A	
[4]	Option B	
[5]	Option C0	
[6]	Option C1	
[30]	External can	

8-03 Control Word Timeout Time

Default value:	Size related	**Parameter type:**	Range, 1 - 18000 s
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in ***parameter 8-04 Control Word Timeout Function*** is then carried out. A valid control word triggers the timeout counter.

8-04 Control Word Timeout Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the timeout function. The timeout function activates when the control word and reference fails to be updated within the time period specified in ***parameter 8-03 Control Word Timeout Time***.

To change the setup after a timeout, configure as follows:

1. Set ***parameter 0-10 Active Set-up*** to ***[9] Multi setup*** .
2. Select the relevant link in ***parameter 0-12 This Set-up Linked to***.

Option	Name	Description
[0]*	Off	Resumes control via fieldbus (fieldbus or standard), using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at jog frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stops the motor, then resets the drive to restart: • Via the fieldbus. • Via [Reset]. • Via a digital input.
[7]	Select setup 1	Changes the setup after a control word timeout. If communication resumes after a timeout, ***parameter 8-05 End-of-Timeout Function*** either resumes the setup used before the timeout, or retains the setup endorsed by the timeout function.
[8]	Select setup 2	See ***[7] Select set-up 1***.
[9]	Select setup 3	See ***[7] Select set-up 1***.
[10]	Select setup 4	See ***[7] Select set-up 1***.
[20]	N2 Override release	
[27]	Forced stop and trip	
[30]	Warning only	

8-05 End-of-Timeout Function

Default value:	[1] Resume set-up	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action after receiving a valid control word following a timeout. This parameter is active only when ***parameter 8-04 Control Word Timeout Function*** is set to:

- *[7] Setup 1*
- *[8] Setup 2*
- *[9] Setup 3*
- *[10] Setup 4*

Option	Name	Description
[0]	Hold set-up	Retains the setup selected in ***parameter 8-04 Control Word Timeout Function*** and shows a warning until ***parameter 8-06 Reset Control Word Timeout*** toggles. Then the drive resumes its original setup.
[1]*	Resume setup	Resumes the setup that was active before the timeout.

8-06 Reset Control Word Timeout

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is active only when ***[0] Hold set-up*** has been selected in ***parameter 8-05 End-of-Timeout Function***.

Option	Name	Description
[0]*	Do not reset	Retains the setup specified in ***parameter 8-04 Control Word Timeout Function***, following a control word timeout.
[1]	Do reset	Restores the drive to the original setup following a control word timeout. The drive resets and then immediately reverts to the ***[0] Do not reset*** setting.

8-07 Diagnosis Trigger

Default value:	[0] Disable	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter has no function for DeviceNet.

Option	Name	Description
[0]*	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm/warn.	

8-08 Readout Filtering

Default value:	–	**Parameter type:**	Option, Array [1]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this function if the speed feedback value readouts on the fieldbus fluctuate. Select ***[1] Motor Data LP-Filter*** if the function is required. A power cycle is required for changes to take effect.

Option	Name	Description
[0]	Motor data Std-Filt.	Normal fieldbus readouts.
[1]	Motor data LP-Filter	Filtered fieldbus readouts of the following parameters: • ***Parameter 16-10 Power [kW]*** • ***Parameter 16-11 Power [hp]*** • ***Parameter 16-12 Motor Voltage*** • ***Parameter 16-14 Motor current*** • ***Parameter 16-16 Torque [Nm]*** • ***Parameter 16-17 Speed [RPM]*** • ***Parameter 16-22 Torque [%]*** • ***Parameter 16-25 Torque [Nm] High***

8-09 Communication Charset

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the communication character set to be supported.

Option	Name	Description
[0]	ISO 8859-1	
[1]	ANSI X3.4	
[2]	UTF-8	

5.10.2 8-1* Ctrl. Word Settings

8-10 Control Word Profile

Default value:	[0] FC profile	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LCP display. For guidelines in selection of ***[0] FC profile*** and ***[1] PROFIdrive profile***, refer to the product-specific design guide. For more guidelines in the selection of ***[1] PROFIdrive profile***, refer to the Installation Guide for the installed fieldbus.

Option	Name	Description
[0]*	FC profile	
[1]	PROFIdrive profile	
[5]	ODVA	Available only with VLT® DeviceNet MCA 104 and VLT® EtherNet/IP MCA 121.
[7]	CANopen DSP 402	
[22]	PROFIdrive v4_2 profile	

8–13 Configurable Status Word STW

Default value:	[1] Profile default	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LCP display. For more guidelines in the selection of ***[1] PROFIdrive profile***, refer to the installation guide for the installed fieldbus.

Option	Name	Description
[0]	No function	The input is always low.
[1]*	Profile default	Dependent on the profile set in ***parameter 8–10 Control Profile***.
[2]	Alarm 68 Only	The input goes high whenever *Alarm 68 Safe Stop Activated* is active and goes low whenever *Alarm 68 Safe Stop Activated* is not activated.
[3]	Trip excl Alarm 68	Set if a trip occurs, unless alarm 68, Safe Torque Off is set to execute the trip.
[9]	Vir. master on ref.	
[10]	T18DI status	The bit indicates the status of terminal 18. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[11]	T19DI status	The bit indicates the status of terminal 19. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[12]	T27DI status	The bit indicates the status of terminal 27. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[13]	T29DI status	The bit indicates the status of terminal 29. 0 indicates that the terminal is low. 1 indicates that the terminal is high.

Option	Name	Description
[14]	T32DI status	The bit indicates the status of terminal 32. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[15]	T33DI status	The bit indicates the status of terminal 33. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[16]	T37DI status	The input goes high whenever T37 has 0 V and goes low whenever T37 has 24 V.
[17]	X30/2 DI status	
[18]	X30/3 DI status	
[19]	X30/4 DI status	
[20]	CTW timeout toggle inverse	
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, drive, brake resistor, or thermistor.
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/ relay to cut out the main voltage from the drive.
[40]	Out of ref range	
[54]	Running	
[59]	On reference	
[60]	Comparator 0	See *parameter group 13-1* Comparators* . If comparator 0 is evaluated as true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See *parameter group 13-1* Comparators*. If comparator 1 is evaluated as true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See *parameter group 13-1* Comparators*. If comparator 2 is evaluated as true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group 13-1* Comparators . If comparator 3 is evaluated as true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See *parameter group 13-1* Comparators*. If comparator 4 is evaluated as true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See *parameter group 13-1* Comparators*. If comparator 5 is evaluated as true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See *parameter group 13-1* Comparators*. If comparator 6 is evaluated as true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See *parameter group 13-1* Comparators*. If comparator 7 is evaluated as true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See *parameter group 13-1* Comparators*. If comparator 8 is evaluated as true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See *parameter group 13-1* Comparators*. If comparator 9 is evaluated as true, the output goes high. Otherwise, it is low.

Option	Name	Description
[70]	Logic rule 0	See *parameter group 13-4* Logic Rules*. If logic rule 0 is evaluated as true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See *parameter group 13-4* Logic Rules*. If logic rule 1 is evaluated as true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See *parameter group 13-4* Logic Rules*. If logic rule 2 is evaluated as true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See *parameter group 13-4* Logic Rules*. If logic rule 3 is evaluated as true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See *parameter group 13-4* Logic Rules*. If logic rule 4 is evaluated as true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See *parameter group 13-4* Logic Rules*. If logic rule 5 is evaluated as true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See *parameter group 13-4* Logic Rules*. If logic rule 6 is evaluated as true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See *parameter group 13-4* Logic Rules*. If logic rule 7 is evaluated as true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See *parameter group 13-4* Logic Rules*. If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See *parameter group 13-4* Logic Rules*. If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.
[80]	SL digital out A	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[38] Set digital out A high*** is executed. The output goes low whenever the smart logic action ***[32] Set digital out A low*** is executed.
[81]	SL digital out B	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[39] Set digital out B high*** is executed. The output goes low whenever the smart logic action ***[33] Set digital out B low*** is executed.
[82]	SL digital out C	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[40] Set digital out C high*** is executed. The output goes low whenever the smart logic action ***[34] Set digital out C low*** is executed.
[83]	SL digital out D	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[41] Set digital out D high*** is executed. The output goes low whenever the smart logic action ***[35] Set digital out D*** low is executed.
[84]	SL digital out E	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[42] Set digital out E high*** is executed. The output goes low whenever the smart logic action ***[36] Set digital out E low*** is executed.

Option	Name	Description
[85]	SL digital out F	See *parameter group 13-52 SL Controller Action*. The output goes high whenever the smart logic action ***[43] Set digital out F high*** is executed. The output goes low whenever the smart logic action ***[37] Set digital out F*** low is executed.
[86]	ATEX ETR cur. alarm	
[87]	ATEX ETR freq. alarm	
[88]	ATEX ETR cur. warning	
[89]	ATEX ETR freq. warning	
[181]	Prev. maintenance	
[182]	Deragging	
[183]	Port/pre lube	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	
[194]	Broken belt	
[196]	Emcy mode is active	
[197]	Emcy mode was active	
[198]	Emcy mode limits	
[199]	Pipe filling	
[200]	User defined alerts	
[234]	Emcy M. OPR unexpected	
[254]	Testing emcy mode	

8-14 Configurable Control Word CTW

Default value:	[1] Profile default	**Parameter type:**	Option, Array [16]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This is an array parameter with 16 elements, 1 element for each bit in range 0–15. Each of the bits can be configured to any of the following options.

Option	Name	Description
[0]	None	The drive ignores the information in this bit.
[1]*	Profile default	Dependent on the profile set in ***parameter 8–10 Control Profile***.

Option	Name	Description
[2]	CTW valid, active low	If set to 1, the drive ignores the remaining bits of the control word.
[7]	External interlock	
[10]	Bit 10=0 >CTW timeout	
[15]	Relay 1	
[16]	Relay 2	
[20]	Control word toggle command	
[22]	Digital out 27	
[23]	Digital out 29	
[24]	Digital out X30/6	
[25]	Digital out X39/7	
[33]	Bit 10=0 >CTW TO always	
[66]	Sleep mode	
[78]	Reset preventive maintenance word	
[85]	Latched pump derag	
[86]	Flow confirmation	
[189]	Emergency mode	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency setup bit 0	
[194]	Emergency setup bit 1	
[195]	Test emcy mode	
[235]	Setup bit 0	
[236]	Setup bit 1	

8-17 Configurable Alarm and Warningword

Default value:	[1] Off	**Parameter type:**	Option, Array [16]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

This is an array parameter with 16 elements, 1 element for each bit in range 0–15. Each of the bits can be configured to any of the following options.

Option	Name	Description
[0]*	Off	
[1]	10 Volts low warning	
[2]	Live zero warning	
[3]	No motor warning	
[4]	Mains phase loss warning	
[5]	DC link voltage high warning	
[6]	DC link voltage low warning	
[7]	DC overvoltage warning	
[8]	DC undervoltage warning	
[9]	Inverter overloaded warning	
[10]	Motor ETR overtemp warning	
[11]	Motor thermistor overtemp warning	
[12]	Torque limit warning	
[13]	Over current warning	
[14]	Earth fault warning	
[17]	Controlword timeout warning	
[19]	Discharge temp high warning	
[23]	Internal fans warning	
[24]	External fans warning	
[25]	Brake resistor short circuit warning	
[26]	Brake powerlimit warning	
[27]	Brake chopper short circuit warning	
[28]	Brake check warning	
[29]	Heatsink temperature warning	
[30]	Motor phase U warning	
[31]	Motor phase V warning	
[32]	Motor phase W warning	
[34]	Fieldbus communication warning	
[36]	Mains failure warning	
[40]	T27 overload warning	
[41]	T29 overload warning	
[45]	Earth fault 2 warning	
[47]	24V supply low warning	

Option	Name	Description
[58]	AMA internal fault warning	
[59]	Current limit warning	
[60]	External interlock warning	
[61]	Feedback error warning	
[62]	Frequency max warning	
[64]	Voltage limit warning	
[65]	Controlboard overtemp warning	
[66]	Heatsink temp low warning	
[68]	Safe stop warning	
[73]	Safe stop autorestart warning	
[76]	Power unit setup warning	
[77]	Reduced powermode warning	
[163]	ATEX ETR cur limit warning	
[165]	ATEX ETR freq limit warning	
[10002]	Live zero error alarm	
[10003]	No motor alarm	
[10004]	Mains phase loss alarm	
[10007]	DC overvoltage alarm	
[10008]	DC undervoltage alarm	
[10009]	Inverter overload alarm	
[10010]	ETR overtemperature alarm	
[10011]	Thermistor overtemp alarm	
[10012]	Torque limit alarm	
[10013]	Overcurrent alarm	
[10014]	Earth fault alarm	
[10016]	Short circuit alarm	
[10017]	CTW timeout alarm	
[10026]	Brake powerlimit alarm	
[10027]	Brakechopper shortcircuit alarm	
[10028]	Brake check alarm	
[10029]	Heatsink temp alarm	
[10030]	Phase U missing alarm	
[10031]	Phase V missing alarm	

Option	Name	Description
[10032]	Phase W missing alarm	
[10033]	Inrush fault alarm	
[10034]	Fieldbus com faul alarm	
[10036]	Mains failure alarm	
[10037]	Phase imbalance alarm	
[10038]	Internal fault	
[10039]	Heatsink sensor alarm	
[10045]	Earth fault 2 alarm	
[10046]	Powercard supply alarm	
[10047]	24V supply low alarm	
[10048]	1.8V supply low alarm	
[10049]	Speed limit alarm	
[10060]	Ext interlock alarm	
[10061]	Feedback error alarm	
[10063]	Mech brake low alarm	
[10065]	Controlboard overtemp alarm	
[10067]	Option config changed alarm	
[10068]	Safe stop alarm	
[10069]	Power card temp alarm	
[10073]	Safestop auto restart alarm	
[10074]	PTC thermistor alarm	
[10079]	Illegal PS config alarm	
[10081]	CSIV corrupt alarm	
[10082]	CSIV param error alarm	
[10090]	Feedback monitor alarm	
[10091]	AI54 settings alarm	
[10164]	ATEX ETR current lim alarm	
[10166]	ATEX ETR freq limit alarm	

8-19 Product Code

Default value:	Size related	**Parameter type:**	Range, 0 - 2147483647, Array [2]
Setup:	1 setup	**Conversion index:**	0

Data type:	Uint32	**Change during operation:**	True

Select 0 to read out the actual fieldbus product code according to the mounted fieldbus option. Select 1 to read out the actual vendor ID.

5.10.3 8-2* Counters

8-20 Invalid Memory Write Counter

Default value:	0 N/A	**Parameter type:**	Range (0 - 65535)
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

The error counter is incremented each time the Ethernet-based fieldbus options writes to an invalid memory.

5.10.4 8-3* FC Port Settings

8-30 Protocol

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the protocol to be used. Changing protocol is not effective until after powering off the drive.

Option	Name	Description
[0]	FC	Communication according to the FC Protocol as described in the product-specific design guide.
[1]	FC MC	Same as [0] FC but to be used when downloading SW to the drive or uploading a DLL file (covering information regarding parameters available in the drive and their inter-dependencies) to MCT 10 Setup software.
[2]	Modbus RTU	Communication according to the Modbus RTU protocol as described in the product-specific design guide.
[3]	Metasys N2	Communication protocol. The N2 software protocol is general in nature to accommodate the unique properties each device may have.
[9]	FC option	To be used when a gateway is connected to the integrated RS485 port.
[23]	Modbus multi master	

8-31 Address

Default value:	Size related	**Parameter type:**	Range, 1 - 255
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the address for the drive (standard) port. Valid range: Depends on the selected protocol.

8-32 FC Port Baud Rate

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	2400 Baud	Baud rate selection for the FC (standard) port.
[1]	4800 Baud	
[2]	9600 Baud	
[3]	19200 Baud	
[4]	38400 Baud	
[5]	57600 Baud	
[6]	76800 Baud	
[7]	115200 Baud	

8-33 Parity/Stop Bits

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Even parity, 1 stop bit	
[1]	Odd parity, 1 stop bit	
[2]	No parity, 1 stop bit	
[3]	No parity, 2 stop bits	

8-34 Estimated Cycle Time

Default value:	0 ms	**Parameter type:**	Range, 0 - 1000000 ms
Setup:	2 setups	**Conversion:**	-3
Data type:	Uint32	**Change during operation:**	True

In noisy environments, the interface may be blocked due to overload or bad frames. This parameter specifies the time between 2 consecutive frames on the network. If the interface does not detect valid frames in that time, it flushes the receive buffer.

8-35 Minimum Response Delay

Default value:	10 ms	**Parameter type:**	Range, 5 - 10000 ms
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Max Response Delay

Default value:	Size related	**Parameter type:**	Range, 11 - 10001 ms
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Specify the maximum allowed delay time between transmitting a request and receiving a response. If a response from the drive exceeds the time setting, then it is discarded.

8-37 Max Inter-Char Delay

Default value:	Size related	**Parameter type:**	Range, 0.00 - 35.00 ms
Setup:	1 setup	**Conversion index:**	-5
Data type:	Uint16	**Change during operation:**	True

Specify the maximum allowed time interval between receipt of 2 bytes. This parameter activates timeout if transmission is interrupted. This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[1] FC MC protocol***.

8-39 Protocol/Profile Firmware Version

Default value:	0	**Parameter type:**	Range, 0 - 10, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr [10]	**Change during operation:**	False

This parameter shows the firmware revision as follows:

- Index [0] = FC
- Index [1] = Modbus
- Index [2] = Metasys N2
- Index [3] = FLN
- Index [4] = BACnet
- Index [5] = Future native protocol
- Index [6] = PROFIdrive profile
- Index [7] = DS402 profile

5.10.5 8-4* Telegram Selection

8-40 Telegram Selection

Default value:	[1] Standard telegram 1	**Parameter type:**	Option

Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[1]*	Standard telegram 1	Enables use of freely configurable telegrams or standard telegrams for the FC port.
[100]	None	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	
[109]	PPO 9	
[200]	Custom telegram 1	Enables use of freely configurable telegrams or standard telegrams for the FC port.
[202]	Custom telegram 3	

8-42 PCD Write Configuration

Default value:	Size related	**Parameter type:**	Range, 0 - 9999, Array [64]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to the telegrams of the PCD. The number of available PCDs depends on the telegram type. The values in the PCDs are then written to the selected parameters as data values.

8-43 PCD Read Configuration

Default value:	Size related	**Parameter type:**	Range, 0 - 9999, Array [64]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to the PCDs of the telegrams. The number of available PCDs depends on the telegram type. PCDs contain the actual data values of the selected parameters.

8-45 BTM Transaction Command

Default value.	[0] Off	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	Off	
[1]	Write to active setup	
[2]	Commit transaction	Commit all parameters that have been sent during BTM mode.
[3]	Clear error	When ***parameter 8-46 BTM Transaction Status*** shows an error (3–8), the parameter must be cleared by setting this value.
[4]	Write to setup 1	
[5]	Write to setup 2	
[6]	Write to setup 3	
[7]	Write to setup 4	
[8]	Cancel BTM transaction	Abort any BTM activity. Parameters are not committed.

8-46 BTM Transaction Status

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Off	
[1]	Transaction started	
[2]	Transaction committing	
[3]	Transaction timeout	
[4]	Err. non-existing par.	
[5]	Err. par. out of range	
[6]	Transaction failed	

8-47 BTM Timeout

Default value:	60 s	**Parameter type:**	Range, 1 - 360 s
Setup:	1 setup	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	False

Select the BTM timeout after a BTM transaction has been started. Timeout is between each acyclic write of parameters.

8-48 BTM Maximum Errors

Default value:	21	**Parameter type:**	Range, 0 - 21
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Select the maximum allowed number of bulk transfer mode errors before aborting. If it is set to maximum, there is no abort.

8-49 BTM Error Log

Defaul value:	Size related	**Parameter type:**	Range, 0.000 - 9999.255, Array [22]
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

List of parameters that failed during bulk transfer mode. The value after the decimal break is the fault code (255 stands for no error).

5.10.6 8-5* Digital/Bus

Parameters for configuring the control word merging.

NOTICE

These parameters are only active when ***parameter 8-01 Control Site*** is set to ***[0] Digital and control word***.

8-50 Coasting Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the coasting function.

Option	Name	Description
[0]	Digital input	A digital input triggers the coasting function.
[1]	Bus	A serial communication port or the fieldbus triggers the coasting function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the coasting function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the coasting function.

8-51 Quick Stop Select

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the control of the quick stop function via the terminals and/or via the bus.

Option	Name	Description
[4]	Disabled	The quick stop function is disabled.

8-52 DC Brake Select

Default value:	–	**Parameter type:**	Option
Setup:	All seutps	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.

NOTICE

When ***parameter 1-10 Motor Construction*** is set to ***[1] PM non-salient SPM***, only selection ***[0] Digital input*** is available.

Option	Name	Description
[0]	Digital input	Activate a start command via a digital input.
[1]	Bus	Activate a start command via a serial communication port or fieldbus option.
[2]	Logic AND	Activate a start command via the fieldbus/serial communication port and also via 1 of the digital inputs.
[3]	Logic OR	Activate a start command via the fieldbus/serial communication port or via 1 of the digital inputs.

8-53 Start Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the start function.

Option	Name	Description
[0]	Digital input	A digital input triggers the start function.
[1]	Bus	A serial communication port or the fieldbus triggers the start function.

Option	Name	Description
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the start function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the start function.

8-54 Reversing Select

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the reversing function.

Option	Name	Description
[0]	Digital input	A digital input triggers the reversing function.
[1]	Bus	A serial communication port or the fieldbus triggers the reversing function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the reversing function.

8-55 Set-up Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the setup selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the setup selection.
[1]	Bus	A serial communication port or the fieldbus triggers the setup selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the setup selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the setup selection.

8-56 Preset Reference Select

Default value:	[3] Logic OR	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the preset reference selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the fieldbus triggers the preset reference selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the preset reference selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the preset reference selection.

5.10.7 **8-7* BACnet**

8-70 BACnet Device Instance

Default value:	1	**Parameter type:**	Range, 0 - 4194302
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

NOTICE

This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters

Default value:	127	**Parameter type:**	Range, 1 - 127
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

Define the address of the master which holds the highest address in this network. Decreasing this value optimizes polling for the token.

8-73 MS/TP Max Info Frames

Default value:	1	**Parameter type:**	Range, 1 - 65534
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE
This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

Define how many info/data frames the device is allowed to send while holding the token.

8-74 I-AM Service

Default value:	[0] Send at power-up	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE
This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[5] BACnet [9] FC Option***.

Choose whether the device should send the "I-Am" service message only at power-up or continuously with an interval of approximatley 1 minute.

Option	Name	Description
*[0]	Send at power-up	
[1]	Continuously	

8-75 Initialisation Password

Default value:	Size related	**Parameter type:**	Range, 1 - 20
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr [20]	**Change during operation:**	True

NOTICE
This parameter is active only when ***parameter 8-30 Protocol*** is set to ***[5] BACnet [9] FC Option***.

Enter the password needed for execution of Drive Re-initialisation from BACnet.

5.10.8 8-8* FC Port Diagnostics

These parameters are used for monitoring the bus communication via the FC port.

8-80 Bus Message Count

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the number of valid telegrams detected on the bus.

8-81 Bus Error Count

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [6]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the number of telegrams with faults (for example, CRC fault) detected on the bus.

Parameter 8-82 Slave Messages Rcvd

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the number of valid telegrams addressed to the slave sent by the drive.

8-83 Slave Error Count

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the number of error telegrams which are not executed by the drive.

5.10.9 8-9* Bus Jog

8-94 Bus Feedback 1

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	1 setup	**Conversion index:**	0
Data type:	N2	**Change during operation:**	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-95 Bus Feedback 2

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	1 setup	**Conversion index:**	0
Data type:	N2	**Change during operation:**	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-96 Bus Feedback 3

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	1 setup	**Conversion index:**	0

Data type:	N2	**Change during operation:**	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-97 Response Error Codes

Default value:	0	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is a 40-bytes buffer that contains the error words.

5.11 Parameter Group 9-** PROFIdrive

9-00 Setpoint

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter receives cyclic references from a master class 2. If the control priority is set to master class 2, the reference for the drive is taken from this parameter, whereas the cyclic reference is ignored.

9-07 Actual Value

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter delivers the MAV for a master class 2. The parameter is valid if the control priority is set to master class 2.

9-15 PCD Write Configuration

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see ***parameter 9-22 Telegram Selection***.

Option	Name	Description
[0]	None	
[302]	Minimum reference	
[303]	Maximum reference	
[341]	Ramp 1 ramp up time	

Option	Name	Description
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Terminal 42 output bus control	
[663]	Terminal X30/8 output bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

9-16 PCD Read Configuration

Default value:	–	Parameter type:	Option, Array [20]

Setup:	2 setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see ***parameter 9-22 Telegram Selection***.

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	

Option	Name	Description
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[Unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	

Option	Name	Description
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Warning word	
[1693]	Warning word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2 [mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	

Option	Name	Description
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog input X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	

9-18 Node Address

Default value:	126	**Parameter type:**	Range, 1 - 126
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the station address in this parameter or, alternatively, in the hardware switch. To adjust the station address in this parameter, set the hardware switch to 126 or 127 (that is all switches set to ON). Otherwise, this parameter shows the actual setting of the switch.

9-22 Telegram Selection

Default value:	[100] None	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select a standard PROFIBUS telegram configuration for the drive as an alternative to the freely configurable telegrams in ***parameter 9-15 PCD Write Configuration*** and ***parameter 9-16 PCD Read Configuration***.

Option	Name	Description
[1]	Standard telegram 1	
[100]*	None	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	

Option	Name	Description
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	

9-23 Parameters for Signals

Default value:	[0] None	**Parameter type:**	Option, Array [1000]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

This parameter contains a list of signals available for selection in ***parameter 9-15 PCD Write Configuration*** and ***parameter 9-16 PCD Read Configuration***.

Option	Name	Description
[0]*	None	
[15]	Readout: actual setup	
[302]	Minimum reference	
[303]	Maximum reference	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog/homing ramp time jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	

Option	Name	Description
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Term 42 output bus ctrl	
[663]	Terminal X30/8 bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	

Option	Name	Description
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	

Option	Name	Description
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1684]	Comm. option STW	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	

Option	Name	Description
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[2021]	Setpoint 1	
[2022]	Setpoint 2	
[2023]	Setpoint 3	
[2643]	Terminal X42/7 bus control	
[2653]	Terminal X42/9 bus control	
[2663]	Terminal X42/11 bus control	
[2792]	% of total capacity	
[2795]	Advanced cascade relay output [bin]	
[2796]	Extended cascade relay output [bin]	
[2969]	Flow	
[3401]	PCD 1 write to MCO	
[3402]	PCD 2 write to MCO	
[3403]	PCD 3 write to MCO	
[3404]	PCD 4 write to MCO	
[3405]	PCD 5 write to MCO	
[3406]	PCD 6 write to MCO	
[3407]	PCD 7 write to MCO	
[3408]	PCD 8 write to MCO	

Option	Name	Description
[3409]	PCD 9 write to MCO	
[3410]	PCD 10 write to MCO	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	
[3430]	PCD 10 read from MCO	
[3644]	Terminal X49/7 bus control	
[3654]	Terminal X49/9 bus control	
[3664]	Terminal X49/11 bus control	
[4520]	Type	
[4521]	Status	
[4523]	Baseline failure	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	
[4594]	Sensor 2 [%]	
[4595]	Sensor 3 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	

9-27 Parameter Edit

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	False

Parameters can be edited via:

- PROFIBUS
- The standard RS485 interface
- The LCP

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

9-28 Process Control

Default value:	[1] Enable cyclic master	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Process control (setting of control word, speed reference, and process data) is possible via either PROFIBUS or standard fieldbus, but not both simultaneously. Local control is always possible via the LCP. Control via process control is possible via either terminals or fieldbus depending on the settings in ***parameter 8-50 Coasting Select*** to ***parameter 8-56 Preset Reference Select***.

Option	Name	Description
[0]	Disable	
[1]*	Enable cyclic master	

9-31 Safe Address

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the safe address in this parameter.

9-44 Fault Message Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Indicates the number of fault events presently stored in ***parameter 9-45 Fault Code***. The buffer capacity is maximum 8 error events. The buffer and counter are set to 0 by reset or power-up.

9-45 Fault Code

Default value:	0	**Parameter type:**	Range, 0 - 0 N/A
Setup:	All setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-47 Fault Number

Default value:	0	**Parameter type:**	Range, 0 - 0 N/A
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-52 Fault Situation Counter

Default value:	0	**Parameter type:**	Range, 0 - 1000
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Indicates the number of fault events that have occurred since the last reset or power-up.

9-53 PROFIBUS Warning Word

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	True

This parameter shows PROFIBUS communication warnings.

Table 35: PROFIBUS Warning Word

Bit	Description
0	Connection with DP-master is not OK.
1	Not used.
2	FDL (fieldbus data link layer) is not OK.
3	Clear data command received.
4	Actual value is not updated.
5	Baud rate search.
6	PROFIBUS ASIC is not transmitting.
7	Initializing of PROFIBUS is not OK.
8	Drive is tripped.
9	Internal CAN error.
10	Wrong configuration data from PLC.

Table 35: PROFIBUS Warning Word (continued)

Bit	Description
11	Wrong ID sent by PLC.
12	Internal fault occurred.
13	Not configured.
14	Timeout active.
15	Warning 34, Fieldbus Fault is active.

9-63 Actual Baud Rate

Default value:	[255] No baud rate found	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter shows the actual PROFIBUS baud rate. The PROFIBUS master automatically sets the baud rate.

Option	Name	Description
[0]	9,6 kbit/s	
[1]	19,2 kbit/s	
[2]	93,75 kbit/s	
[3]	187,5 kbit/s	
[4]	500 kbit/s	
[6]	1500 kbit/s	
[7]	3000 kbit/s	
[8]	6000 kbit/s	
[9]	12000 kbit/s	
[10]	31,25 kbit/s	
[11]	45,45 kbit/s	
[255]*	No baud rate found	

9-64 Device Identification

Default value:	0	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is not visible via LCP.

The device identification parameter. The data type is array [n] of unsigned16. The assignment of the 1st subindexes is defined and shown in the following table.

Index	Content	Value
[0]	Manufacturer	128 (for)
[1]	Device type	1
[2]	Version	xxyy
[3]	Firmware date year	yyyy
[4]	Firmware date month	ddmm
[5]	No. of axes	Variable
[6]	Vendor specific: PB version	xxyy
[7]	Vendor specific: Database version	xxyy
[8]	Vendor specific: AOC version	xxyy
[9]	Vendor specific: MOC version	xxyy

9-65 Profile Number

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	OctStr[2]	**Change during operation:**	True

NOTICE

This parameter is not visible via LCP.

This parameter contains the profile identification. Byte 1 contains the profile number. Byte 2 contains the number of the profile.

9-67 Control Word 1

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

This parameter accepts the control word from a master class 2 in the same format as PCD 1.

9-68 Status Word 1

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	True

This parameter delivers the status word for a master class 2 in the same format as PCD 2.

9-70 Programming Set-up

Default value:	[9] Active set-up 1	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the setup to be programmed during operation.

Option	Name	Description
[0]	Factory setup	
[1]	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]*	Active set-up	

9-71 PROFIBUS Save Data Value

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Parameter values changed via RS485 are not automatically stored in a non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down.

Option	Name	Description
[0]*	Off	
[1]	Store all setups	
[2]	Store all setups	

9-72 PROFIBUSDriveReset

Default value:	[0] No action	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

Resets the VLT® PROFIBUS DP-V1 MCA 101 option only.

Option	Name	Description
[0]*	No action	
[1]	Power-on reset	
[2]	Power-on reset prep	
[3]	Comm option reset	

9-80 Defined Parameters (1)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-81 Defined Parameters (2)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-82 Defined Parameters (3)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-83 Defined Parameters (4)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-84 Defined Parameters (5)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-85 Defined Parameters (6)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-90 Changed Parameters (1)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-91 Changed Parameters (2)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-92 Changed Parameters (3)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Change during operation:	False		

This parameters shows a list of all the drive parameters deviating from default setting.

9-93 Changed Parameters (4)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-94 Changed Parameters (5)

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-99 PROFIBUS Revision Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Readout of revision count.

5.12 Parameter Group 10-** CAN Fieldbus

5.12.1 10-0* Common Settings

10-00 CAN Protocol

Default value:	[1] DeviceNet	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

View the active CAN protocol.

Option	Name	Description
[1]*	DeviceNet	

10-01 Baud Rate Select

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the fieldbus transmission speed. The selection must correspond to the transmission speed of the master and of the other fieldbus nodes.

Option	Name	Description
[16]	10 Kbps	
[17]	20 Kbps	
[18]	50 Kbps	
[19]	100 Kbps	
[20]	125 Kbps	
[21]	250 Kbps	
[22]	500 Kbps	

10-02 MAC ID

Default value:	Size related	**Parameter type:**	Range, 1 - 127 N/A

Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Select the station address. Every station connected to the same network must have an unambiguous address.

10-05 Readout Transmit Error Counter

Default value:	0	**Parameter type:**	Range, 0 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the number of CAN control transmission errors since the last power-up.

10-06 Readout Receive Error Counter

Default value:	0	**Parameter type:**	Range, 0 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the number of CAN control receipt errors since the last power-up.

10-07 Readout Bus Off Counter

Default value:	0	**Parameter type:**	Range, 0 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the number of fieldbus off events since the last power-up.

5.12.2 10-1* DeviceNet

10-10 Process Data Type Selection

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the instance (telegram) for data transmission. The instances available depend on the setting of ***parameter 8-10 Control Word Profile***. When ***parameter 8-10 Control Word Profile*** is set to ***[0] FC Profile***, options ***[0] INSTANCE 100/150*** and ***[1] INSTANCE 101/151*** in this parameter are available. When ***parameter 8-10 Control Word Profile*** is set to ***[5] ODVA***, options ***[2] INSTANCE 20/70*** and ***[3] INSTANCE 21/71*** in this parameter are available. Instances 100/150 and 101/151 are specific. Instances 20/70 and 21/71 are ODVA-specific AC motor profiles. For guidelines in telegram selection, refer to the VLT® DeciveNet MCA 104 Installation Guide.

NOTICE
A change to this parameter is executed immediately.

Option	Name	Description
[0]	Instance 100/150	
[1]	Instance 101/151	
[2]	Instance 20/70	
[3]	Instance 21/71	
[6]	Instance 102/152	

10-11 Process Data Config Write

Default value:	–	**Parameter type:**	Option, Array [4]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the process write data for I/O Assembly Instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option	Name	Description
[0]	None	
[302]	Minimum reference	
[303]	Maximum reference	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	

Option	Name	Description
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Terminal 42 output bus control	
[663]	Terminal X30/8 output bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

10-12 Process Data Config Read

Default value:	–	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the process read data for I/O Assembly Instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1500]	Operating hours	

Option	Name	Description
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	

Option	Name	Description
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1685]	FC port CTW 1	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	

Option	Name	Description
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[2792]	% of total capacity	
[2795]	Advanced cascade relay output [bin]	

Option	Name	Description
[2796]	Extended cascade relay output [bin]	
[2969]	Flow	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	
[3430]	PCD 10 read from MCO	
[4521]	Status	
[4523]	Baseline failure	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	
[4594]	Sensor 2 [%]	
[4595]	Sensor 3 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	

10-13 Warning Parameter

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View a DeviceNet-specific warning word. One bit is assigned to every warning. Refer to the VLT® DeviceNet MCA 104 Installation Guide for further information.

Table 36: Warning Bits

Bit	Description
0	Bus not active
1	Explicit connection timeout
2	I/O connection
3	Retry limit reached
4	Actual is not updated
5	CAN bus off
6	I/O send error
7	Initialization error
8	No bus supply
9	Bus off
10	Error passive
11	Error warning
12	Duplicate MAC ID error
13	RX queue overrun
14	TX queue overrun
15	CAN overrun

10-14 Net Reference

Default value:	[0] Off	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the reference source in instances 21/71 and 20/70.

Option	Name	Description
[0]*	Off	
[1]	On	

10-15 Net Control

Default value:	[0] Off	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the control source in instances 21/71 and 20/70.

Option	Name	Description
[0]*	Off	
[1]	On	

5.12.3 10-2* COS Filters

10-20 COS Filter 1

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Sets up the filter mask for the status word. When operating in COS (change-of-state), it is possible to filter out bits in the status word that should not be sent if they change.

10-21 COS Filter 2

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Sets up the filter mask for the main actual value. When operating in COS (change-of-state), it is possible to filter out bits in the main actual value that should not be sent if they change.

10-22 COS Filter 3

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Sets up the filter mask for PCD 3. When operating in COS (change-of-state), it is possible to filter out bits in PCD 3 that should not be sent if they change.

10-23 COS Filter 4

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Sets up the filter mask for PCD 4. When operating in COS (change-of-state), it is possible to filter out bits in PCD 4 that should not be sent if they change.

5.12.4 10-3* Parameter Access

This parameter group provides access to indexed parameters and defines programming setup.

10-30 Array Index

Default value:	0	**Parameter type:**	Range, 0 - 255

Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View array parameters. This parameter is only valid when a VLT® DeviceNet MCA 104 is installed.

10-31 Store Data Value

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is used to activate a function that stores all parameter values in the non-volatile memory, this retaining changed parameter values at power-down.

Option	Name	Description
[0]*	Off	Deactivates the non-volatile storage function.
[1]	Store edit setup	Stores all parameter values from the active setups in the non-volatile memory. The selection returns to ***[0] Off*** when all values have been stored.
[2]	Store all setups	Stores all parameter values for all setups in the non-volatile memory. The selection returns to ***[0] Off*** when all parameter values have been stored.

10-32 Devicenet Revision

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array 2
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The DeviceNet revision number. This parameter is used for EDS file creation.

10-33 Store Always

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data value:	Uint8	**Change during operation:**	True

This parameter is used to select whether parameter data received via the DeviceNet option should always be stored in non-volatile memory.

Option	Name	Description
[0]*	Off	Deactivates non-volatile storage of data.
[1]	On	Stores parameter data received via VLT® DeviceNet MCA 104 in EEPROM non-volatile memory as default.

10-34 DeviceNet Product Code

Default value:	Size related	**Parameter type:**	Range, 0 - 65535
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Use this parameter for reading out the actual DeviceNet product code.

10-39 Devicenet F Parameters

Default value:	0	**Parameter type:**	Range, 0 - 0, Array [1000]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Use this parameter to configure the drive via DeviceNet and build the EDS file.

5.13 Parameter Group 12-** Ethernet

5.13.1 12-0* IP Settings

12-00 IP Address Assignment

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type: Uint8	Change during operation: True		

Select the method for assigning the IP address.

Option	Name	Description
[0]	Manual	Set the IP address in ***parameter 12-01 IP Address***.
[1]	DHCP	Assign the IP address via DHCP server.
[2]	BOOTP	Assign the IP address via BOOTP server.
[3]	Disable	
[10]	DCP	Assign the IP address via DCP server.
[20]	From node ID	

12-01 IP Address

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Configure the IP address of the option. Read-only if ***parameter 12-00 IP Address Assignment*** is set to ***[1] DHCP***, ***[2] BOOTP***, or via DIP switches.

12-02 Subnet Mask

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Configure the IP subnet mask of the option. Read-only if ***parameter 12-00 IP Address Assignment*** is set to ***[1] DHCP*** or ***[2] BOOTP***.

12-03 Default Gateway

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Configure the IP default gateway of the option. Read-only if ***parameter 12-00 IP Address Assignment*** set to ***[1] DHCP*** or ***[2] BOOTP***. In a non-routed network, this address is set to the IP address of the I/O device.

12-05 Lease Expires

Default value:	Size related	**Parameter type:**	Range, Size related
Setup:	All setups	**Conversion index:**	0
Data type:	TimeDifferenceWithDateIndication	**Change during operation:**	True

This parameter is read-only. It shows the lease time for the current DHCP-assigned IP address.

12-06 Name Servers

Default value:	0	**Parameter type:**	Range, 0 -4294967295, Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

IP addresses of the domain name servers. Can be automatically assigned when using DHCP.

12-07 Domain Name

Default value:	0	**Parameter type:**	Range, 0 - 48
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[48]	**Change during operation:**	True

Domain name of the attached network. Can be automatically assigned when using DHCP network.

12-09 Physical Address

Default value:	0	**Parameter type:**	Range, 0 - 17
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[17]	**Change during operation:**	True

This parameter is read-only. It shows the physical (MAC) address of the option.

5.13.2 12-1* Ethernet Link Parameters

12-10 Link Status

Default value:	[0] No link	**Parameter type:**	Option, Array [2]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is read-only. It shows the link status of the Ethernet ports. Index [0] is used for port 1, and index [1] is used for port 2. For EtherCAT, index [0] is for the in-port, and index [1] is for the out-port.

Option	Name	Description
[0]*	No link	
[1]	Link	

12-11 Link Duration

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeDifferenceWithDateIndication	**Change during operation:**	True

Shows the duration of the present link on each port in dd:hh:mm:ss.

12-12 Auto Negotiation

Default value:	[1] On	**Parameter type:**	Option, Array [2]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Configures auto negotiation of Ethernet link parameters, for each port: ON or OFF. Link Speed and Link Duplex can be configured in ***parameter 12-13 Link Speed*** and ***parameter 12-14 Link Duplex***.

Option	Name	Description
[0]	Off	
[1]*	On	

12-13 Link Speed

Default value:	[0] None	**Parameter type:**	Option, Array [2]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Forces the link speed for each prot in 10 Mbps or 100 Mbps. If ***parameter 12-12 Auto Negotiation*** is set to ***[0] On***, this parameter is read-only and shows the actual link speed. If no link is present, None is shown.

Option	Name	Description
[0]*	None	
[1]	10 Mbps	
[2]	100 Mbps	

12-18 Supervisor MAC

Default value:	0	**Parameter type:**	Range, 0 - 2147483647, Array [2]
Setup:	2 setups	**Conversion index:**	0
Data type:	OctStr[6]	**Change during operation:**	True

MAC addresses of currently active supervisors.

12-19 Supervisor IP Addr.

Default value:	0	**Parameter type:**	Range, 0 - 2147483647, Array [2]
Setup:	2 setups	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

IP addresses of currently active supervisors.

5.13.3 12-2* Process Data

12-20 Control Instance

Default value:	Size related	**Parameter type:**	Range, 0 - 255
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter is read-only. It shows the connection to the master.

- In Ethernet/IP: If no CIP connection is present, None is shown.
- In EtherCAT: If no connection is active, None is shown, otherwise it shows the active PDO.

12-21 Process Data Config Write

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Option	Name	Description
[0]	None	
[302]	Minimum reference	

Option	Name	Description
[303]	Maximum reference	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog/homing ramp time jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Term 42 output bus ctrl	
[663]	Terminal X30/8 bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

12-22 Process Data Config Read

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	

Option	Name	Description
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	

Option	Name	Description
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	

Option	Name	Description
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	

12-27 Primary Master

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	False

This parameter contains the valid IP addresses for the masters allowed to control this slave. If both indexes are set to 0.0.0.0, all masters have access.

12-28 Store Data Values

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter activates a function that stores all parameter values in the non-volatile memory (EEPROM) thus retaining parameter values at power-down. The parameter returns to ***[0] Off***.

Option	Name	Description
[0]*	Off	
[1]	Store all setups	
[2]	Store all setups	

12-29 Store Always

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Activates a function that always stores received parameter data in the non-volatile memory (EEPROM).

Option	Name	Description
[0]*	Off	
[1]	On	

5.13.4 12-3* EtherNet/IP

12-30 Warning Parameter

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type	Uint32	**Change during operation:**	True

This parameter is read-only. It shows the EthetNet/IP-specific 16-bit status word.

Table 37: 16-Bit Status Word, EtherNet/IP

Bit	Description
0	Owned
1	Not used
2	Configured
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used
8	Minor recoverable fault
9	Minor unrecoverable fault
10	Major recoverable fault
11	Major unrecoverable fault
12	Not used
13	Not used
14	Not used
15	Not used

12-31 Net Reference

Default value:	[0] Off	**Parameter type:**	Option

Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Shows the reference source in instance 21/71.

Option	Name	Description
[0]*	Off	
[1]	On	

12-32 Net Control

Default value:	[0] Off	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uin8	**Change during operation:**	True

Shows the control source in instance 21/71.

Option	Name	Description
[0]*	Off	
[1]	On	

12-33 CIP Revision

Default value:	Size related	**Parameter type:**	Range, 0 - 65535, Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the CIP version of the option software.

12-34 CIP Product Code

Default value:	Size related	**Parameter type:**	Range, 0 - 65535
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the CIP product code.

12-35 EDS Parameter

Default value:	0	**Parameter type:**	Range, 0 - 0, Array [1000]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is used to configure the drive via DeviceNet and build the EDS-file.

12-37 COS Inhibit Timer

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Read-only change-of-state inhibit timer. If the option is configured for COS operation, this inhibit timer can be configured in the forward open telegram to prevent that continuously changing PCD data generates extensive network traffic. The inhibit time is in ms. 0 = disabled.

12-38 COS Filter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Change-of-state PCD filters. Sets up a filter mask for each word of process data when operating in COS mode. Single bits in the PCDs can be filtered in/out.

5.13.5 12-4* Modbus TCP

12-40 Status Parameter

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the Modbus TCP-specific 16-bit status word.

Table 38: 16-Bit Status Word, Modbus TCP

Bit	Description	Bit = [0]	Bit = [1]
0	Link status port 1	Disconnected	Connected
1	Link status port 2	Disconnected	Connected
2	Link speed	0/10 Mbps	100 Mbps
3	Link duplex	Half	Full
4	Port 502 communication	No	Yes
5	UNUSED	–	–
6	Valid IP address	No	Yes
7	Modbus timeout (30 s)	No	Yes
8	Duplicate IP	No	Yes
9	Register 7 error	No	Yes
10	FTP server	Disabled	Enabled
11	HTTP server	Disabled	Enabled

Table 38: 16-Bit Status Word, Modbus TCP (continued)

Bit	Description	Bit = [0]	Bit = [1]
12	SMTP server	Disabled	Enabled
13	Cable diagnosis	Disabled	Enabled
14	Auto crossover	Disabled	Enabled
15	IPMG	Disabled	Enabled

12-41 Slave Message Count

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the number of Modbus messages received and processed by the follower drive.

12-42 Slave Exception Message

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is read-only. It shows the number of Modbus messages for which the follower has sent an exception response.

5.13.6 12-4* Fieldbus Extension

12-49 Ethernet Extended Status

Default value:	0	**Parameter type:**	Range, 0 - 0xFFFFFFFF, Array [8]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter provides extra information from Ethernet-based communication.

5.13.7 12-7* BACnet

12-70 BACnet Status

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the status of the BACnet IP option.

12-71 BACnet Datalink

Default value:	[1] BACnet/IP	**Parameter type:**	Option

Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select which interface BACnet/IP should use. If ***[0] All datalinks*** is selected, the BACnet/IP automatically detects which BACnet layer to use.

Option	Name	Description
[0]	All datalinks	
[1]*	BACnet/IP	
[2]	BACnet Ethernet	

12-75 BBMD IP Address

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Set the IP address if the remote BBMD management device. If set to 0.0.0.0, the Foreign Device function is disabled.

12-76 BBMD Port

Default value:	47808	**Parameter type:**	Range, 1 - 65535
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the port number of the BBMD management device that handles the broadcast messages.

12-77 BBMD Reg. Interval

Default value:	10 s	**Parameter type:**	Range, 1 - 65535 s
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Sets the registration interval at which the drive re-registers itself in the remote BBMD. The interval is set in seconds.

12-78 Device ID Conflict

Default value:	0 min	**Parameter type:**	Range, 0 - 525600 min
Setup:	2 setups	**Conversion index:**	70
Data type:	Uint32	**Change during operation:**	True

Set the time in minutes that should pass between a device ID conflict and the logging of the conflict. If the parameter is set to 0, logging is disabled.

12-79 Message Counter

Default value:	0	**Parameter type:**	Range, 0 - 4294967294

Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows different message counters:

- Index 0: Total number of received and sent messages
- Index 1: Total number of received bus messages
- Index 2: Total number of sent messages
- Index 3: Total number of error messages
- Index 4: Total number of retired (timed out) messages
- Index 5: Total number of control word timeout error messages on object

5.13.8 12-8* Other Ethernet Services

12-80 FTP Server

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables/disables the built-in FTP server.

Option	Name	Description
[0]*	Disabled	Disable the built-in FTP server.
[1]	Enabled	Enable the built-in FTP server.
[2]	Enabled with TLS	

12-81 HTTP Server

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables/disables the built-in HTTP (web) server.

Option	Name	Description
[0]*	Disabled	Disable the built-in HTTP (web) server.
[1]	Enabled	Enable the built-in HTTP (web) server.

12-83 SNMP Agent

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to either enable or disable the SNMP agent.

Option	Name	Description
[0]	Disabled	Disable the SNMP agent.
[1]*	Enabled	Enable the SNMP agent.

12-84 Address Conflict Detection

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to detect and resolve IP address conflict.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

12-85 ACD Last Conflict

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	2 setups	**Comversion index:**	0
Data type:	OctStr[35]	**Change during operation:**	True

The name of the IP address causing the most recent address conflict.

12-86 NTP Host Server

Default value:	0	**Parameter type:**	Range, 0 - 48
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[48]	**Change during operation:**	True

Enter the IPv4/IPv6 address, the FQDN, or the hostname of the NTP server.

12-87 SNTP Time Sync

Default value:	60 min	**Parameter type:**	Range, 1 - 65535 min
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Synchronize the clock via NTP at a defined interval.

12-89 Transparent Socket Channel Port

Default value:	4000	**Parameter type:**	Range, 0 - 65535
Setup:	2 setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

Use this parameter for configuring the TCP port number for the transparent socket channel. Configuring the TCP port number enables transparent sending of FC telegrams on Ethernet via TCP. If the parameter is set to 0 (default value), the function is disabled.

5.13.9 12-9* Advanced Ethernet Services

12-90 Cable Diagnostics

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables/disables advanced cable diagnosis function. If enabled, the distance to cable errors can be read out in ***parameter 12-93 Cable Error Length***. The parameter resumes to the default setting ***[0] Disable*** after the diagnostics have finished.

NOTICE

The cable diagnostics function is only issued on ports where there is no link (see ***parameter 12-10 Link Status***).

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

12-91 MDI-X

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Disabling of the auto-crossover function requires crossed Ethernet cables for daisy-chaining the options.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

12-92 IGMP Snooping

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enabling the IGMP snooping function prevents flooding of the Ethernet protocol stack. Multicast packets are only forwarded to ports that are a member of the multicast group.

Option	Name	Description
[0]	Disabled	The IGMP snooping function is disabled.
[1]*	Enabled	The IGMP snooping function is enabled.

12-93 Cable Error Length

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

If cable diagnostics is enabled in ***parameter 12-90 Cable Diagnostic***, the built-in switch is possible via time domain reflectometry (TDR). This is a measurement technique which detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is shown in meters with an accuracy of ±2 m (6.6 ft). The value 0 means no errors detected.

12-94 Broadcast Storm Protection

Default value:	-1	**Parameter type:**	Range, -1 - 20%
Setup:	2 setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

The built-in switch is capable of protecting the switch system from receiving too many broadcast packages, which can use up network resources. The value indicates a percentage of the total bandwidth that is allowed for broadcast messages. Example: OFF means that the filter is disabled - all broadcast messages are passed through. The value 0% means that no broadcast messages are passed through. A value of 10% means that 10% of the total bandwidth is allowed for broadcast messages. If the amount of broadcast messages exceeds the 10% threshold, they are blocked.

12-95 Inactivity Timeout

Default value:	120	**Parameter type:**	Range, 0 - 3600
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Applies to ***parameter 12-94 Broadcast Storm Protection***, if the broadcast storm protection also includes multicast telegrams.

12-96 Port Config

Default value:	–	**Parameter type:**	Option
Setup:	2 seutps	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enable or disable the port-mirroring function. The function is used for troubleshooting with a network analyzer tool.

Option	Name	Description
[0]	Disable	
[1]	Mirror port 1 to 2	
[2]	Mirror port 2 to 1	
[10]	Port 1 disabled	
[11]	Port 2 disabled	
[254]	Mirror int. port to 1	
[255]	Mirror int. port to 2	

12-97 QoS Priority

Default value:	Size related	**Parameter type:**	Range, 0 - 63, Array [7]
Setup:	2 setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

Each index sets the DSCP value of different types of QoS prioritized messages.

12-98 Interface Counters

Default value:	4000	**Parameter type:**	Range, 0 - 4294967296, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

12-99 Media Counters

Default value:	0	**Parameter type:**	Range, 0 - 4294967296, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

5.14 Parameter Group 13-** Smart Logic

5.14.1 Introduction to Smart Logic Control

With SLC, it is possible to run up to 4 sequences in parallel. Link between the sequences to create customer- and application-specific behaviors by using logic rules.

Smart logic control (SLC) is a sequence of user-defined actions (see ***parameter 13-52 SL Controller 1 Action***) executed by the SLC when the associated user-defined event (see ***parameter 13-51 SL Controller 1 Event***) is evaluated as true by the SLC. The condition for an event can be a particular status, or that the output from a logic rule or a comparator operand becomes true. That leads to an associated action as illustrated:

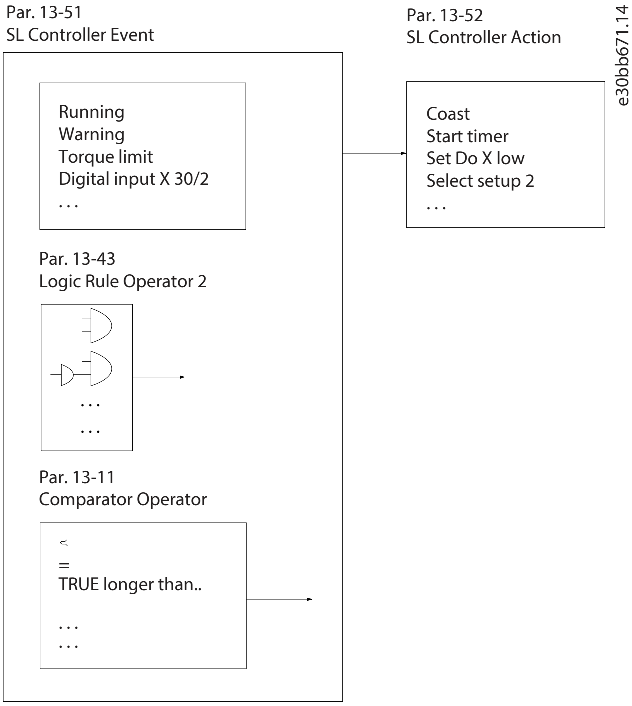


Figure 72: Smart Logic Control (SLC)

Events and actions are each numbered and linked in pairs (states). This means that when the 1st event is fulfilled (becomes true), the 1st action is executed. After this, the conditions of the 2nd event are evaluated and if evaluated true, the 2nd action is executed, and so on. Only 1 event is evaluated at any time. If an event is evaluated as false, nothing happens (in the SLC) during the current scan interval and no other events are evaluated. This means that when the SLC starts, it evaluates the 1st event (and only the 1st event) in each scan interval. Only when the 1st event is evaluated as true, the SLC executes the 1st action and starts evaluating the 2nd event. It is possible to program 1–20 events and actions. When the last event/action has been executed, the sequence starts over again from the 1st event/ action.

Four concurring sequences can be defined with each up to 20 event and action pairs. The sequences are executed at the same time but operate separately. For example, sequence 1 may have executed 3 actions, while sequence 2 still waits for its 1st event to occur. In this example, ***parameter 13-00 SL Controller Mode [0]***, ***parameter 13-01 Start Event [1]***, and ***parameter 13-02 Stop Event [2]*** correspond to sequence 1, sequence 2, sequence 3, and the like.

NOTICE

Comparators Flip-Flops, timers, and logic rules are shared between sequences.

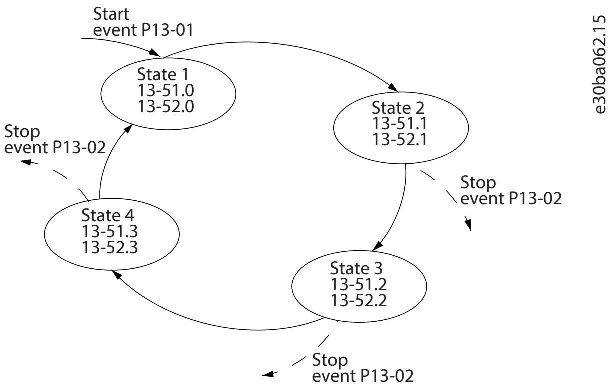


Figure 73: Example of Events and Actions

Starting and stopping the SLC

Start and stop the SLC by selecting ***[1] On*** or ***[0] Off*** in ***parameter 13-00 SL Controller Mode***. The SLC always starts in state 0 (where it evaluates event [0]). The SLC starts when the start event (defined in ***parameter 13-01 Start Event***) is evaluated as true (provided that ***[1] On*** is selected in ***parameter 13-00 SL Controller Mode***). The SLC stops when the stop event (***parameter 13-02 Stop Event***) is true. ***Parameter 13-03 Reset SLC***resets all SLC parameters and starts programming from scratch.

NOTICE
SLC is only active in auto-on mode, not hand-on mode.

5.14.2 13-0* SLC Settings

Use the SLC settings to activate, deactivate, and reset the smart logic control sequence. The logic functions and comparators are always running in the background, which opens for separate control of digital inputs and outputs.

13-00 SL Controller Mode

Default value:	–	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

An array with 4 elements [0]–[3] is shown in the display.

Option	Name	Description
[0]	Off	Disables the smart logic controller.
[1]	On	Enables the smart logic controller.

13-01 Start Event

Default value:	–	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the boolean (true or false) input to activate smart logic control.

Option	Name	Description
[0]	False	Select the boolean (true or false) input to activate smart logic control. Enters the fixed value *False*.
[1]	True	Enters the fixed value *True*.
[2]	Running	The motor runs.
[3]	In range	The motor runs within the programmed current and speed ranges set in ***parameter 4-50 Warning Current Low*** to ***parameter 4-53 Warning Speed High***.
[4]	On reference	The motor runs on reference.
[5]	Torque limit	The torque limit set in ***parameter 4-16 Torque Limit Motor Mode*** or ***parameter 4-17 Torque Limit Generator Mode*** is exceeded.
[6]	Current limit	The motor current limit set in ***parameter 4-18 Current Limit*** is exceeded.
[7]	Out of current range	The motor current is outside the range set in ***parameter 4-18 Current Limit***.
[8]	Below I_{low}	The motor current is lower than set in ***parameter 4-50 Warning Current Low***.
[9]	Above I_{high}	The motor current is higher than set in ***parameter 4-51 Warning Current High***.
[10]	Out of speed range	The speed is outside the range set in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[11]	Below speed low	The output speed is lower than the setting in ***parameter 4-52 Warning Speed Low***.
[12]	Above speed high	The output speed is higher than the setting in ***parameter 4-53 Warning Speed High***.
[13]	Out of feedb. range	The feedback is outside the range set in ***parameter 4-56 Warning Feedback Low*** and ***parameter 4-57 Warning Feedback High***.
[14]	Below feedb. low	The feedback is below the limit set in ***parameter 4-56 Warning Feedback Low***.
[15]	Above feedb. high	The feedback is above the limit set in ***parameter 4-57 Warning Feedback High***.
[16]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[17]	Mains out of range	The mains voltage is outside the specified voltage range.
[18]	Reversing	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[19]	Warning	A warning is active.
[20]	Alarm (trip)	A (trip) alarm is active.
[21]	Alarm (trip lock)	A (trip lock) alarm is active.

Option	Name	Description
[22]	Comparator 0	Use the result of comparator 0.
[23]	Comparator 1	Use the result of comparator 1.
[24]	Comparator 2	Use the result of comparator 2.
[25]	Comparator 3	Use the result of comparator 3.
[26]	Logic rule 0	Use the result of logic rule 0.
[27]	Logic rule 1	Use the result of logic rule 1.
[28]	Logic rule 2	Use the result of logic rule 2.
[29]	Logic rule 3	Use the result of logic rule 3.
[33]	Digital input DI18	Use the result of digital input 18.
[34]	Digital input DI19	Use the result of digital input 19.
[35]	Digital input DI27	Use the result of digital input 27.
[36]	Digital input DI29	Use the result of digital input 29.
[37]	Digital input DI32	Use the result of digital input 32.
[38]	Digital input DI33	Use the result of digital input 33.
[39]	Start command	A start command is issued. This is the default option.
[40]	Drive stopped	A stop command (jog, stop, quick stop, coast) is issued - and not from SLC itself.
[41]	Reset trip	A reset is issued.
[42]	Auto-reset trip	An auto reset is performed.
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[76]	Digital input X30/2	Use the value of X30/2 (VLT® General Purpose I/O MCB 101).
[77]	Digital input X30/3	Use the value of X30/3 (VLT® General Purpose I/O MCB 101).
[78]	Digital input X30/4	Use the value of X30/4 (VLT® General Purpose I/O MCB 101).
[90]	ECB drive mode	

Option	Name	Description
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[228]	Comparator 6	Use the result of comparator 6.
[229]	Comparator 7	Use the result of comparator 7.
[230]	Comparator 8	Use the result of comparator 8.
[231]	Comparator 9	Use the result of comparator 9.
[232]	Logic rule 6	Use the result of logic rule 6.
[233]	Logic rule 7	Use the result of logic rule 7.
[234]	Logic rule 8	Use the result of logic rule 8.
[235]	Logic rule 9	Use the result of logic rule 9.
[238]	RS flipflop 8	See *parameter group 13-1* Comparators*.
[239]	RS flipflop 9	See *parameter group 13-1* Comparators*.

13-02 Stop Event

Default value:	–	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–

Data type:	Uint8	Change during operation:	True

Select the boolean (true or false) input to deactivate smart logic control.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See *parameter group 5-3* Digital Outputs* for further description.
[3]	In range	See *parameter group 5-3* Digital Outputs* for further description.
[4]	On reference	See *parameter group 5-3* Digital Outputs* for further description.
[5]	Torque limit	See *parameter group 5-3* Digital Outputs* for further description.
[6]	Current limit	See *parameter group 5-3* Digital Outputs* for further description.
[7]	Out of current range	See *parameter group 5-3* Digital Outputs* for further description.
[8]	Below I_{low}	See *parameter group 5-3* Digital Outputs* for further description.
[9]	Above I_{high}	See *parameter group 5-3* Digital Outputs* for further description.
[10]	Out of speed range	
[11]	Below speed low	See *parameter group 5-3* Digital Outputs* for further description.
[12]	Above speed high	See *parameter group 5-3* Digital Outputs* for further description.
[13]	Out of feedb. range	See *parameter group 5-3* Digital Outputs* for further description.
[14]	Below feedb. low	See *parameter group 5-3* Digital Outputs* for further description.
[15]	Above feedb. high	See *parameter group 5-3* Digital Outputs* for further description.
[16]	Thermal warning	See *parameter group 5-3* Digital Outputs* for further description.
[17]	Mains out of range	See *parameter group 5-3* Digital Outputs* for further description.
[18]	Reversing	See *parameter group 5-3* Digital Outputs* for further description.
[19]	Warning	See *parameter group 5-3* Digital Outputs* for further description.
[20]	Alarm (trip)	See *parameter group 5-3* Digital Outputs* for further description.
[21]	Alarm (trip lock)	See *parameter group 5-3* Digital Outputs* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.

Option	Name	Description
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digial input, fieldbus, or other).
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true [◄]
[46]	Right key	[►]
[47]	Up key	[▲]
[48]	Down key	[▼]
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	

Option	Name	Description
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	

Option	Name	Description
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See *parameter group 13-1* Comparators* .
[239]	RS flipflop 9	See *parameter group 13-1* Comparators* .
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-03 Reset SLC

Default value:	[0] Do not reset SLC	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Do not reset SLC	Retain programmed settings in *parameter group 13-** Smart Logic*
[1]	Reset SLC	Reset all parameters in *parameter group 13-** Smart Logic*

5.14.3 13-1* Comparators

Comparators are used for comparing continuous variables (that is output frequency, output current, analog input, and so on) to fixed preset values.

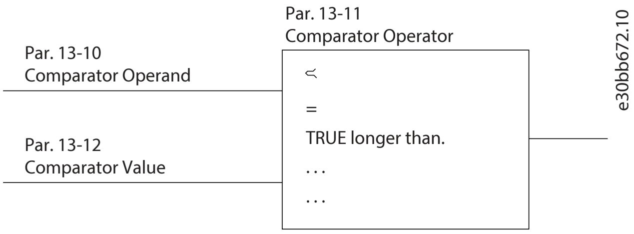


Figure 74: Comparators

There are digital values that are compared to fixed time values. See the explanation in ***parameter 13-10 Comparator Operand***. Comparators are evaluated once in each scan interval. Use the result (true or false) directly. All parameters in this parameter group are array parameters with index 0–9. Select index 0 to program comparator 0, select index 1 to program comparator 1, and so on.

13-10 Comparator Operand

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Options ***[1] Reference %*** to ***[31] Counter B*** are variables, which are compared based on their values. Options ***[50] FALSE*** to ***[186] Drive in auto mode*** are digital values (true/false) where the comparison is based on the amount of time during which they are set to true or false. See ***parameter 13-11 Comparator Operator***.

Option	Name	Description
[0]	DISABLED	The comparator is disabled.
[1]	Reference %	The resulting remote reference in %.
[2]	Feedback %	[RPM] or [Hz], as set in ***parameter 0-02 Motor Speed Unit***.
[3]	Motor speed	[RPM] or [Hz], as set in ***parameter 0-02 Motor Speed Unit***.
[4]	Motor current	
[5]	Motor torque	

Option	Name	Description
[6]	Motor power	
[7]	Motor voltage	
[8]	DC-link voltage	
[9]	Motor thermal	The value is in %.
[10]	Drive thermal	The value is in %.
[11]	Heat sink temp.	The value is in %.
[12]	Analog input AI53	The value is in %.
[13]	Analog input AI54	The value is in %.
[14]	Analog input AIFB10	AIFB10 is internal 10 V supply.
[15]	Analog input AIS24V	AIS24V is a 24 V switch mode power supply.
[17]	Analog input AICCT	Value is in [°]. AICCT is control card temperature.
[18]	Pulse input FI29	The value is in %.
[19]	Pulse input FI33	The value is in %.
[20]	Alarm number	Shows the actual alarm number. **NOTICE** With this selection, it is not possible to use < and > as comparator operators. **NOTICE** Several alarms/warnings can be present at the same time. As the alarm/warning numbers are nmot grouped in a predefined order, defining a range is not relevant.
[21]	Warning number	Shows the actual warning number. **NOTICE** With this selection, it is not possible to use < and > as comparator operators. **NOTICE** Several alarms/warnings can be present at the same time. As the alarm/warning numbers are nmot grouped in a predefined order, defining a range is not relevant.
[22]	Analog input X30/11	
[23]	Analog input X30/12	
[24]	Sensorless flow	
[25]	Sensorless pressure	

Option	Name	Description
[26]	Flow totalized volume	
[27]	Flow actual volume	
[28]	Flow	
[29]	Number of pump running	
[30]	Counter A	
[31]	Counter B	
[34]	Analog input X48/2	
[35]	Temp input X48/4	
[36]	Temp input X48/7	
[37]	Temp input X48/10	
[38]	Derag counter	
[40]	Analog input X42/1	
[41]	Analog input X42/3	
[42]	Analog input X42/5	
[43]	Analog input X49/1	
[44]	Analog input X49/3	
[45]	Analog input X49/5	
[46]	AI53 scaled	
[47]	AI54 scaled	
[48]	AI53 unit	
[49]	AI55 unit	
[50]	FALSE	Use to enter the fixed value *False* in the comparator.
[51]	TRUE	Use to enter *True* in the comparator.
[52]	Control ready	The control board receives supply voltage.
[53]	Drive ready	The drive is ready for operation and applies a signal on the control board.
[54]	Running	The motor runs.
[55]	Reversing	The output is active when the drive runs counterclockwise (the logical product of the status bits running AND reverse).
[56]	In range	The motor runs within the programmed current and speed ranges set in ***parameter 4-50 Warning Current Low*** to ***parameter 4-53 Warning Speed High***.
[60]	On reference	The motor runs on reference.

Option	Name	Description
[61]	Below reference, low	The motor runs at a reference which is less than the value in ***parameter 4-54 Warning Reference Low***.
[62]	Above ref, high	The motor runs at a reference which exceeds the value in ***parameter 4-55 Warning Reference High***.
[65]	Torque limit	The torque exceeds the value in ***parameter 4-16 Torque Limit Motor Mode*** or ***parameter 4-17 Torque Limit Generator Mode***.
[66]	Current limit	The motor current exceeds the value in ***parameter 4-18 Current Limit***.
[67]	Out of current range	The motor current is outside the range set in ***parameter 4-18 Current Limit***.
[68]	Below I low	The motor current is lower than the value in ***parameter 4-50 Warning Current Low***.
[69]	Above I high	The motor current is higher than the value in ***parameter 4-51 Warning Current High***.
[70]	Out of speed range	The speed is outside the range set in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[71]	Below speed low	The output speed is lower than the value in ***parameter 4-52 Warning Speed Low***.
[72]	Above speed high	The output speed is higher than the value in ***parameter 4-53 Warning Speed High***.
[75]	Out of feedack range	The feedback is outside the range set in ***parameter 4-56 Warning Feedback Low*** and ***parameter 4-57 Warning Feedback High***.
[76]	Below feedback low	The feedback is lower than the limit set in ***parameter 4-56 Warning Feedback Low***.
[77]	Above feedback high	The feedback exceeds the limit set in ***parameter 4-57 Warning Feedback High***.
[80]	Thermal warning	This operand becomes true when the drive detects any thermal warning, for instance when the temperature exceeds the limit in the motor, the drive, the brake resistor, or thermistor.
[82]	Mains out of range	The mains voltage is outside the specified voltage range.
[85]	Warning	If a warning is triggered, this operand gets the warning number.
[86]	Alarm (trip)	A trip alarm is active.
[87]	Alarm (trip lock)	A trip lock alarm is active.
[90]	Bus OK	Active communication (no timeout) via the serial communication port.
[91]	Torque limit and stop	If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[92]	Brake fault (IGBT)	The brake IGBT is short-circuited.
[94]	Safe stop active	

Option	Name	Description
[100]	Comparator 0	The result of comparator 0.
[101]	Comparator 1	The result of comparator 1.
[102]	Comparator 2	The result of comparator 2.
[103]	Comparator 3	The result of comparator 3.
[104]	Comparator 4	The result of comparator 4.
[105]	Comparator 5	The result of comparator 5.
[106]	Comparator 6	The result of comparator 6.
[107]	Comparator 7	The result of comparator 7.
[108]	Comparator 8	The result of comparator 8.
[109]	Comparator 9	The result of comparator 9.
[110]	Logic rule 0	The result of logic rule 0.
[111]	Logic rule 1	The result of logic rule 1.
[112]	Logic rule 2	The result of logic rule 2.
[113]	Logic rule 3	The result of logic rule 3.
[114]	Logic rule 4	The result of logic rule 4.
[115]	Logic rule 5	The result of logic rule 5.
[116]	Logic rule 6	The result of logic rule 6.
[117]	Logic rule 7	The result of logic rule 7.
[118]	Logic rule 8	The result of logic rule 8.
[119]	Logic rule 9	The result of logic rule 9.
[120]	SL time-out 0	The result of the SLC timer 0.
[121]	SL time-out 1	The result of the SLC timer 1.
[122]	SL time-out 2	The result of the SLC timer 2.
[123]	SL time-out 3	The result of the SLC timer 3.
[124]	SL time-out 4	The result of the SLC timer 4.
[125]	SL time-out 5	The result of the SLC timer 5.
[126]	SL time-out 6	The result of the SLC timer 6.
[127]	SL time-out 7	The result of the SLC timer 7.
[128]	SL time-out 8	The result of the SLC timer 8.
[129]	SL time-out 9	The result of the SLC timer 9.
[130]	Digital input DI18	Digital input 18 (high=true).
[131]	Digital input DI19	Digital input 19 (high=true).
[132]	Digital input DI27	Digital input 27 (high=true).

Option	Name	Description
[133]	Digital input DI29	Digital input 29 (high=true)
[134]	Digital input DI32	Digital input 32 (high=true).
[135]	Digital input DI33	Digital input 33 (high=true).
[136]	RS flipflop 0	
[137]	RS flipflop 1	
[138]	RS flipflop 2	
[139]	RS flipflop 3	
[140]	RS flipflop 4	
[141]	RS flipflop 5	
[142]	RS flipflop 6	
[143]	RS flipflop 7	
[144]	RS flipflop 8	
[145]	RS flipflop 9	
[150]	SL digital output A	Use the result of the SLC output A.
[151]	SL digital output B	Use the result of the SLC output B.
[152]	SL digital output C	Use the result of the SLC output C.
[153]	SL digital output D	Use the result of the SLC output D.
[154]	SL digital output E	Use the result of the SLC output E.
[155]	SL digital output F	Use the result of the SLC output F.
[160]	Relay 1	Relay 1 is active.
[161]	Relay 2	Relay 2 is active.
[162]	Relay 3	
[163]	Relay 4	
[164]	Relay 5	
[165]	Relay 6	
[166]	Relay 7	
[167]	Relay 8	
[168]	Relay 9	
[180]	Local reference active	Active when ***parameter 3-13 Reference Site*** is ***[2] Local*** or when ***parameter 3-13 Reference Site*** is ***[0] Linked to hand/auto*** , at the same time as the LCP is in hand-on mode.
[181]	Remote reference active	Active when ***parameter 3-13 Reference Site*** is ***[1] Remote*** or ***[0] Linked to hand/auto***, while the LCP is in auto-on mode.

Option	Name	Description
[182]	Start command	Active when there is an active start command and no stop command.
[183]	Drive stopped	A stop command (jog, stop, qstop, coast) is issued – and not from the SLC itself.
[185]	Drive in hand mode	Active when the drive is in hand-on mode.
[186]	Drive in auto mode	Active when the drive is in auto-on mode.
[187]	Start command given	
[190]	Digital input X30/2	
[191]	Digital input X30/3	
[192]	Digital input X30/4	
[193]	Digital input X46/1	
[194]	Digital input X46/3	
[195]	Digital input X46/5	
[196]	Digital input X46/7	
]197]	Digital input X46/9	
[198]	Digital input X46/11	
[199]	Digital input X46/13	
[204]	System on ref	
[205]	No flow	
[206]	Dry pump	
[207]	End of curve	
[208]	Broken belt	
[209]	ECB drive mode	
[210]	ECB bypass mode	
[211]	ECB test mode	
[212]	Emergency mode	
[240]	Totalized vol in thousands	
[241]	Totalized vol in millions	
[242]	Totalized vol in billions	
[243]	Totalized vol in trillions	
[245]	Actual vol in thousands	
[246]	Actual vol in millions	
[247]	Actual vol in billions	

Option	Name	Description
[248]	Actual vol in trillions	
[249]	Therm. sensor temp.	

13-11 Comparator Operator

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0–5.

Option	Name	Description
[0]	<	**NOTICE** If ***[20] Alarm number*** or ***[21] Warning number*** is selected in ***parameter 3-10 Comparator Operand***, ***[0]*** < cannot be selected in this parameter. The result of the evaluation is true when the variable selected in ***parameter 13-10 Comparator Operand*** is smaller than the fixed value in ***parameter 13-12 Comparator Value***. The result is false if the variable selected in ***parameter 13-10 Comparator Operand*** is greater than the fixed value in ***parameter 13-12 Comparator Value***.
[1]	≈ (equal)	The result of the evaluation is true when the variable selected in ***parameter 13-10 Comparator Operand*** is approximately equal to the fixed value in ***parameter 13-12 Comparator Value***.
[2]	>	**NOTICE** If ***[20] Alarm number*** or ***[21] Warning number*** is selected in ***parameter 3-10 Comparator Operand***, ***[2]*** > cannot be selected in this parameter. Inverse logic of option ***[0]*** <.
[5]	TRUE longer than..	
[6]	FALSE longerthan..	
[7]	TRUE shorter than..	
[8]	FALSE shorter than..	

13-12 Comparator Value

Default value:	Size related	**Parameter type:**	Range, -10000.000 - 100000, Array [10]

Setup:	2 setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the trigger level for the variable that is monitored by this comparator. This is an array parameter containing comparator values 0–9.

5.14.4 13-1* RS Flip Flops

The reset/set flip flops hold the signal until set/reset.

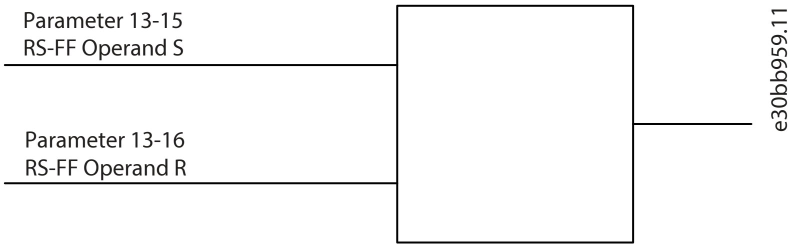


Figure 75: Reset/Set Flip Flops

Two parameters are used and the output can be used in the logic rules and as events.

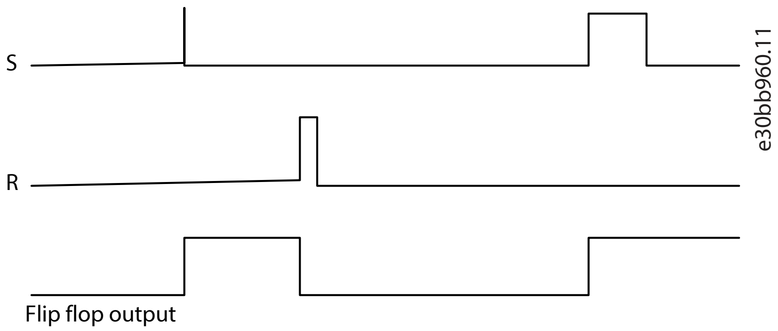


Figure 76: Flip Flop Outputs

The 2 operators can be selected from a long list. As a special case, the same digital input can be used as both set and reset, making it possible to use the same digital input as start/stop. The following settings can be used to set up the same digital input (for example, DI32) as start/stop.

Table 39: Operators

Parameter	Setting	Notes
Parameter 13-00 SL Controller Mode	***[1] On***	–
Parameter 13-01 Start Event [0]	*True*	–
Parameter 13-02 Stop Event [0]	*False*	–
Parameter 13-40 Logic Rule Boolean 1 [0]	***[37] Digital input DI32***	–
Parameter 13-42 Logic Rule Boolean 2 [0]	***[2] Running***	–
Parameter 13-41 Logic Rule Operator 1 [0]	***[3] AND NOT***	–

Table 39: Operators (continued)

Parameter	Setting	Notes
Parameter 13-40 Logic Rule Boolean 1 [1]	***[37] Digital input DI32***	–
Parameter 13-42 Logic Rule Boolean 2 [1]	***[2] Running***	–
Parameter 13-41 Logic Rule Operator 1 [1]	***[1] AND***	–
Parameter 13-15 RS-FF Operand S [0]	***[26] Logic rule 0***	Output from ***parameter 13-41 Logic Rule Operator 1*** [0].
Parameter 13-16 RS-FF Operand R [0]	***[27] Logic rule 1***	Output from ***parameter 13-41 Logic Rule Operator 1*** [1].
Parameter 13-51 SL Controller 1 Event [0]	***[94] RS Flipflop 0***	Output from ***parameter 13-15 RSFF Operand S*** and ***parameter 13-16 RSFF Operand R***.
Parameter 13-52 SL Controller 1 Action [0]	***[22] Run***	–
Parameter 13-51 SL Controller 1 Event [1]	***[27] Logic rule 1***	–
Parameter 13-52 SL Controller 1 Action [1]	***[24] Stop***	–

13-15 RS-FF Operand S

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the boolean (true or false) input to deactivate smart logic control.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See *parameter group 5-3* Digital Outputs* for further description.
[3]	In range	See *parameter group 5-3* Digital Outputs* for further description.
[4]	On reference	See *parameter group 5-3* Digital Outputs* for further description.
[5]	Torque limit	See *parameter group 5-3* Digital Outputs* for further description.
[6]	Current limit	See *parameter group 5-3* Digital Outputs* for further description.
[7]	Out of current range	See *parameter group 5-3* Digital Outputs* for further description.
[8]	Below I_{low}	See *parameter group 5-3* Digital Outputs* for further description.
[9]	Above I_{high}	See *parameter group 5-3* Digital Outputs* for further description.

Option	Name	Description
[10]	Out of speed range	
[11]	Below speed low	See *parameter group 5-3* Digital Outputs* for further description.
[12]	Above speed high	See *parameter group 5-3* Digital Outputs* for further description.
[13]	Out of feedb. range	See *parameter group 5-3* Digital Outputs* for further description.
[14]	Below feedb. low	See *parameter group 5-3* Digital Outputs* for further description.
[15]	Above feedb. high	See *parameter group 5-3* Digital Outputs* for further description.
[16]	Thermal warning	See *parameter group 5-3* Digital Outputs* for further description.
[17]	Mains out of range	See *parameter group 5-3* Digital Outputs* for further description.
[18]	Reversing	See *parameter group 5-3* Digital Outputs* for further description.
[19]	Warning	See *parameter group 5-3* Digital Outputs* for further description.
[20]	Alarm (trip)	See *parameter group 5-3* Digital Outputs* for further description.
[21]	Alarm (trip lock)	See *parameter group 5-3* Digital Outputs* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digial input, fieldbus, or other).

Option	Name	Description
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true if [◀] is pressed.
[46]	Right key	The event is true if [▶] is pressed.
[47]	Up key	The event is true if [▲] is pressed.
[48]	Down key	The event is true if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS flipflop 1	See *parameter group 13-1* Comparators*.

Option	Name	Description
[96]	RS flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input x46/1	
[126]	Digital input x46/3	
[127]	Digital input x46/5	
[128]	Digital input x46/7	
[129]	Digital input x46/9	
[130]	Digital input x46/11	
[131]	Digital input x46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If the *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.

Option	Name	Description
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See *parameter group 13-1* Comparators*.
[239]	RS flipflop 9	See *parameter group 13-1* Comparators*.
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-16 RS-FF Operand R

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the boolean (true or false) input to deactivate smart logic control. The Operand R inputs have priority over the Operand S inputs.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See *parameter group 5-3* Digital Outputs* for further description.
[3]	In range	See *parameter group 5-3* Digital Outputs* for further description.
[4]	On reference	See *parameter group 5-3* Digital Outputs* for further description.
[5]	Torque limit	See *parameter group 5-3* Digital Outputs* for further description.
[6]	Current limit	See *parameter group 5-3* Digital Outputs* for further description.

Option	Name	Description
[7]	Out of current range	See *parameter group 5-3* Digital Outputs* for further description.
[8]	Below I_{low}	See *parameter group 5-3* Digital Outputs* for further description.
[9]	Above I_{high}	See *parameter group 5-3* Digital Outputs* for further description.
[10]	Out of speed range	
[11]	Below speed low	See *parameter group 5-3* Digital Outputs* for further description.
[12]	Above speed high	See *parameter group 5-3* Digital Outputs* for further description.
[13]	Out of feedb. range	See *parameter group 5-3* Digital Outputs* for further description.
[14]	Below feedb. low	See *parameter group 5-3* Digital Outputs* for further description.
[15]	Above feedb. high	See *parameter group 5-3* Digital Outputs* for further description.
[16]	Thermal warning	See *parameter group 5-3* Digital Outputs* for further description.
[17]	Mains out of range	See *parameter group 5-3* Digital Outputs* for further description.
[18]	Reversing	See *parameter group 5-3* Digital Outputs* for further description.
[19]	Warning	See *parameter group 5-3* Digital Outputs* for further description.
[20]	Alarm (trip)	See *parameter group 5-3* Digital Outputs* for further description.
[21]	Alarm (trip lock)	See *parameter group 5-3* Digital Outputs* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).

Option	Name	Description
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digital input, fieldbus, or other).
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true if [◀] is pressed.
[46]	Right key	The event is true if [▶] is pressed.
[47]	Up key	The event is true if [▲] is pressed.
[48]	Down key	The event is true if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	

Option	Name	Description
[93]	Emergency mode	
[94]	RS flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input x46/1	
[126]	Digital input x46/3	
[127]	Digital input x46/5	
[128]	Digital input x46/7	
[129]	Digital input x46/9	
]130]	Digital input x46/11	
[131]	Digital input x46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If the *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.

Option	Name	Description
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See *parameter group 13-1* Comparators*.
[239]	RS flipflop 9	See *parameter group 13-1* Comparators*.
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.14.5 13-2* Timers

Use the result (true or false) form timers directly to define an event (see ***parameter 13-51 SL Controller Event***), or as boolean input in a logic rule (see ***parameter 13-40 Logic Rule Boolean 1***, ***parameter 13-42 Logic Rule Boolean 2***, or ***parameter 13-43 Logic Rule Boolean 3***). A timer is only false when started by an action, for example ***[29] Start timer 1***, until the timer value entered in this parameter has elapsed. Then the timer becomes true again. All parameters in this parameter group are array parameters with index 0–2. Each index programs the equivalent timer, for example, index 0 programs timer 0.

13-20 SL Controller Timer

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	1 setup	**Conversion index:**	-3
Data type:	Timediff w/o DateID	**Change during operation:**	True

Enter the value to define the duration of the false output from the programmed timer. A timer is only false if it is started by an action (that is *[29] Start timer 1*) and until the given timer value has elapsed.

5.14.6 13-4* Logic Rules

Combine up to 3 boolean inputs (true/false inputs) from timers, comparators, digital inputs, status bits, and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in ***parameter 13-40 Logic Rule Boolean 1***, ***parameter 13-42 Logic Rule Boolean 2***, and ***parameter 13-44 Logic Rule Boolean 3***. Define the operators used to logically combine the selected inputs in ***parameter 13-41 Logic Rule Operator 1*** and ***parameter 13-43 Logic Rule Operator 2***.

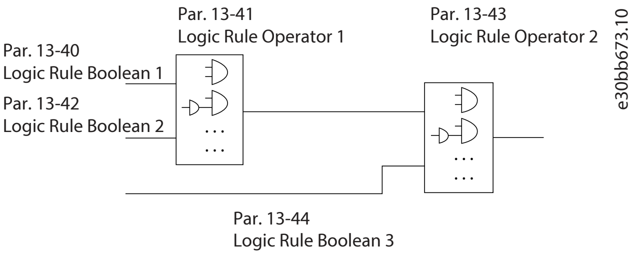


Figure 77: Logic Rules

Priority of calculation

The results of ***parameter 13-40 Logic Rule Boolean 1***, ***parameter 13-41 Logic Rule Operator 1***, and ***parameter 13-42 Logic Rule Boolean 2*** are calculated first. The outcome (true/false) of this calculation is combined with the settings of ***parameter 13-43 Logic Rule Operator 2*** and ***parameter 13-44 Logic Rule Boolean 3***, yielding the final result (true/false) of the logic rule.

13-40 Logic Rule Boolean 1

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the 1st boolean (true or false) input for the selected logic rule. See *parameter 13-01 Start Event* and *parameter 13-02 Stop Event* for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	

Option	Name	Description
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	

Option	Name	Description
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◄] is pressed. Only available on the graphical LCP.
[46]	Right key	[►] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.

Option	Name	Description
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	

Option	Name	Description
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-41 Logic Rule Operator 1

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 1st logical operator to use on the boolean inputs from ***parameter 13-40 Logic Rule Boolean 1*** and ***parameter 13-42 Logic Rule Boolean 2***. Parameter numbers in square brackets stand for the boolean inputs of parameters in *parameter group 13-** Smart Logic Control*.

Option	Name	Description
[0]	DISABLED	Ignores • ***Parameter 13-42 Logic Rule Boolean 2***. • ***Parameter 13-43 Logic Rule Operator 2***. • ***Parameter 13-44 Logic Rule Boolean 3***.
[1]	AND	Evaluates the expression [13-40] AND [13-42].
[2]	OR	Evaluates the expression [13-40] OR [13-42].
[3]	AND NOT	Evaluates the expression [13-40] AND NOT [13-42].
[4]	OR NOT	Evaluates the expression [13-40] OR NOT [13-42].
[5]	NOT AND	Evaluates the expression NOT [13-40] AND [13-42].
[6]	NOT OR	Evaluates the expression NOT [13-40] OR [13-42].

Option	Name	Description
[7]	NOT AND NOT	Evaluates the expression NOT [13-40] AND NOT [13-42].
[8]	NOT OR NOT	Evaluates the expression NOT [13-40] OR NOT [13-42].

13-42 Logic Rule Boolean 2

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the 2nd boolean (true or false) input for the selected logic rule. See *parameter 13-01 Start Event* and *parameter 13-02 Stop Event* for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	

Option	Name	Description
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	

Option	Name	Description
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	

Option	Name	Description
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	

Option	Name	Description
[244]	SL digital output E	
[245]	SL digital output F	

13-43 Logic Rule Operator 2

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 2nd logical operator to be used on the boolean input calculated in:

- ***Parameter 13-40 Logic Rule Boolean 1***.
- ***Parameter 13-41 Logic Rule Operator 1***.
- ***Parameter 13-42 Logic Rule Boolean 2***.

[13-44] signifies the boolean input of ***parameter 13-44 Logic Rule Boolean 3***. [13-40/13-42] signifies the boolean input calculated in:

- ***Parameter 13-40 Logic Rule Boolean 1***.
- ***Parameter 13-41 Logic Rule Operator 1***.
- ***Parameter 13-42 Logic Rule Boolean 2***.

Option	Name	Description
[0]	DISABLED	
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-44 Logic Rule Boolean 3

Default value:	–	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the 3rd boolean (true or false) input for the selected logic rule. See *parameter 13-01 Start Event* and *parameter 13-02 Stop Event* for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	

Option	Name	Description
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	

Option	Name	Description
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	

Option	Name	Description
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.14.7 13-5* States

13-51 SL Controller 1 Event

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See ***parameter 13-02 Stop Event*** for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	

Option	Name	Description
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	

Option	Name	Description
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	

Option	Name	Description
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-52 SL Controller 1 Action

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in ***parameter 13-51 SL Controller 1 Event***) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see ***parameter 13-20 SL Controller Timer*** for further description.
[30]	Start timer 1	Start timer 1, see ***parameter 13-20 SL Controller Timer*** for further description.
[31]	Start timer 2	Start timer 2, see ***parameter 13-20 SL Controller Timer*** for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)

Option	Name	Description
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in ***parameter 4-55 Warning Reference High***.
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see ***parameter 13-20 SL Controller Timer*** for further description.
[71]	Start timer 4	Starts timer 4, see ***parameter 13-20 SL Controller Timer*** for further description.
[72]	Start timer 5	Starts timer 5, see ***parameter 13-20 SL Controller Timer*** for further description.
[73]	Start timer 6	Starts timer 6, see ***parameter 13-20 SL Controller Timer*** for further description.
[74]	Start timer 7	Starts timer 7, see ***parameter 13-20 SL Controller Timer*** for further description.
[75]	Start timer 8	Starts timer 8, see ***parameter 13-20 SL Controller Timer*** for further description.
[76]	Start timer 9	Starts timer 9, see ***parameter 13-20 SL Controller Timer*** for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	

Option	Name	Description
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-53 SL Controller 2 Event

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See ***parameter 13-02 Stop Event*** for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	

Option	Name	Description
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	

Option	Name	Description
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	

Option	Name	Description
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	

Option	Name	Description
[244]	SL digital output E	
[245]	SL digital output F	

13-54 SL Controller 2 Action

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in ***parameter 13-53 SL Controller 2 Event***) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.

Option	Name	Description
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see ***parameter 13-20 SL Controller Timer*** for further description.
[30]	Start timer 1	Start timer 1, see ***parameter 13-20 SL Controller Timer*** for further description.
[31]	Start timer 2	Start timer 2, see ***parameter 13-20 SL Controller Timer*** for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in ***parameter 4-55 Warning Reference High***.
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see ***parameter 13-20 SL Controller Timer*** for further description.
[71]	Start timer 4	Starts timer 4, see ***parameter 13-20 SL Controller Timer*** for further description.
[72]	Start timer 5	Starts timer 5, see ***parameter 13-20 SL Controller Timer*** for further description.
[73]	Start timer 6	Starts timer 6, see ***parameter 13-20 SL Controller Timer*** for further description.

Option	Name	Description
[74]	Start timer 7	Starts timer 7, see ***parameter 13-20 SL Controller Timer*** for further description.
[75]	Start timer 8	Starts timer 8, see ***parameter 13-20 SL Controller Timer*** for further description.
[76]	Start timer 9	Starts timer 9, see ***parameter 13-20 SL Controller Timer*** for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-55 SL Controller 3 Event

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See ***parameter 13-02 Stop Event*** for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	

Option	Name	Description
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.

Option	Name	Description
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	

Option	Name	Description
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	

Option	Name	Description
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-56 SL Controller 3 Action

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in ***parameter 13-55 SL Controller 3 Event***) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.

Option	Name	Description
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see ***parameter 13-20 SL Controller Timer*** for further description.
[30]	Start timer 1	Start timer 1, see ***parameter 13-20 SL Controller Timer*** for further description.
[31]	Start timer 2	Start timer 2, see ***parameter 13-20 SL Controller Timer*** for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in ***parameter 4-55 Warning Reference High***.
[63]	Counter A (down)	

Option	Name	Description
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see ***parameter 13-20 SL Controller Timer*** for further description.
[71]	Start timer 4	Starts timer 4, see ***parameter 13-20 SL Controller Timer*** for further description.
[72]	Start timer 5	Starts timer 5, see ***parameter 13-20 SL Controller Timer*** for further description.
[73]	Start timer 6	Starts timer 6, see ***parameter 13-20 SL Controller Timer*** for further description.
[74]	Start timer 7	Starts timer 7, see ***parameter 13-20 SL Controller Timer*** for further description.
[75]	Start timer 8	Starts timer 8, see ***parameter 13-20 SL Controller Timer*** for further description.
[76]	Start timer 9	Starts timer 9, see ***parameter 13-20 SL Controller Timer*** for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-57 SL Controller 4 Event

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See ***parameter 13-02 Stop Event*** for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	

Option	Name	Description
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	

Option	Name	Description
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[95]	RS Flipflop 1	See *parameter group 13-1* Comparators*.

Option	Name	Description
[96]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[97]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[98]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[99]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[100]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.

Option	Name	Description
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-58 SL Controller 4 Action

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in ***parameter 13-57 SL Controller 4 Event***) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.

Option	Name	Description
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see ***parameter 13-20 SL Controller Timer*** for further description.
[30]	Start timer 1	Start timer 1, see ***parameter 13-20 SL Controller Timer*** for further description.
[31]	Start timer 2	Start timer 2, see ***parameter 13-20 SL Controller Timer*** for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).

Option	Name	Description
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in ***parameter 4-55 Warning Reference High***.
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see ***parameter 13-20 SL Controller Timer*** for further description.
[71]	Start timer 4	Starts timer 4, see ***parameter 13-20 SL Controller Timer*** for further description.
[72]	Start timer 5	Starts timer 5, see ***parameter 13-20 SL Controller Timer*** for further description.
[73]	Start timer 6	Starts timer 6, see ***parameter 13-20 SL Controller Timer*** for further description.
[74]	Start timer 7	Starts timer 7, see ***parameter 13-20 SL Controller Timer*** for further description.
[75]	Start timer 8	Starts timer 8, see ***parameter 13-20 SL Controller Timer*** for further description.
[76]	Start timer 9	Starts timer 9, see ***parameter 13-20 SL Controller Timer*** for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

5.14.8 13-9* User-defined Alerts and Readouts

Parameters in this group allow the configuration of application-specific triggers for triggering the drive to perform a certain action, show the status on the LCP, and represent it accordingly in ***parameter 13-97 Alert Alarm Word***, ***parameter 13-98 Alert Warning Word***, and ***parameter 13-99 Alert Status Word***. In ***parameter 13-91 Alert Action***, it is possible to select drive functionalities such as *info only*, *stop*, *running to max*, and *force drive to trip*.

Use the following parameters to configure the drive to show a message and perform an action when a specific event occurs:

- ***Parameter 13-90 Alert Trigger*** – the event that triggers the user-defined action and message.
- ***Parameter 13-91 Alert Action*** – the action that the drive performs when the event defined in ***parameter 13-90 Alert Trigger*** occurs.
- ***Parameter 13-92 Alert Text*** – the text that the drive shows in the display when the event defined in ***parameter 13-90 Alert Trigger*** occurs.

For example, consider the following use case: If there is an active signal on digital input 32, the drive shows the message *Valve 5 open* and ramps down to a stop. To achieve this configuration, make the following settings:

- ***Parameter 13-90 Alert Trigger*** = ***[37] Digital input DI32***.
- ***Parameter 13-91 Alert Action*** = ***[5] Stop & warning***.
- ***Parameter 13-92 Alert Text*** = *Valve 5 open*.

Actions reflected in *parameter 16-03 Status Word* and alert parameters

When an action containing trip is selected and triggered, the drive trips, bit 3 in the basic status word is set, and the corresponding hex value is shown in ***parameter 13-97 Alert Alarm Word***.

The alarm for *User Alert* is logged as alarm value = 124 in ***parameter 15-30 Fault Log: Error Code***, index [0]–[9].

When an action containing warning info is selected and triggered, bit 7 in the basic status word is set, and the corresponding hex value is shown in ***parameter 13-98 Alert Warning Word***.

Other actions selected are not indicated in the basic status word, but the corresponding hex value is shown in ***parameter 13-99 Alert Status Word***.

Example of setting up digital inputs as triggers, actions, and readouts

Refer to the following table to understand the 3 examples in this section.

Table 40: Example of Setting up Triggers, Actions, and Readouts

ID	Name	Setup 1
1390.0	Alert Trigger	[34] Digital input DI19
1390.1	Alert Trigger	[37] Digital input DI32
1390.2	Alert Trigger	[0] False
1390.3	Alert Trigger	[0] False
1390.4	Alert Trigger	[0] False
1390.5	Alert Trigger	[0] False
1390.6	Alert Trigger	[0] False
1390.7	Alert Trigger	[0] False
1390.8	Alert Trigger	[38] Digital input DI33
1390.9	Alert Trigger	[0] False
1391.0	Alert Action	[0] Info
1391.1	Alert Action	[1] Warning
1391.2	Alert Action	[0] Info
1391.3	Alert Action	[0] Info

Table 40: Example of Setting up Triggers, Actions, and Readouts (continued)

ID	Name	Setup 1
1391.4	Alert Action	[0] Info
1391.5	Alert Action	[0] Info
1391.6	Alert Action	[0] Info
1391.7	Alert Action	[0] Info
1391.8	Alert Action	[12] Trip
1391.9	Alert Action	[0] Info
1392.0	Alert Text	Dig In 19
1392.1	Alert Text	Dig In 32
1392.2	Alert Text	User Alert
1392.3	Alert Text	User Alert
1392.4	Alert Text	User Alert
1392.5	Alert Text	User Alert
1392.6	Alert Text	User Alert
1392.7	Alert Text	User Alert
1392.8	Alert Text	Dig In 33
1392.9	Alert Text	User Alert

Example 1: In ***parameter 13-90 Alert Trigger***, index [0], DI19 is selected as trigger. The digital value is 0000 0001. The corresponding action, Info, is set in ***parameter 13-91 Alert Action***, index [0] and is shown as 1 hex in ***parameter 13-99 Alert Status Word***.

Example 2: In ***parameter 13-90 Alert Trigger***, index [1], DI32 is selected as trigger. The digital value is 0000 0010. The corresponding action, Warning, is set in ***parameter 13-91 Alert Action***, index [1] and is shown as 2 hex in ***parameter 13-98 Alert Warning Word***.

Example 3: In ***parameter 13-90 Alert Trigger***, index [8], DI33 is selected as trigger. The digital value is 0001 0000 0000. The corresponding action, Trip, is set in ***parameter 13-91 Alert Action***, index [8] and is shown as 100 hex in ***parameter 13-97 Alert Alarm Word***.

When 1 of the 3 digital inputs shown in this example is activated, the text shown in the LCP is the one defined in ***parameter 13-92 Alert Text***, index [0], [1], and [8].

NOTICE

The action setting of an active trigger cannot be changed. For example, if DI19 is selected as trigger and the input is high, the action cannot be changed from *Stop* to *Jog*.

13-90 Alert Trigger

Default value:	[0] False	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the event that triggers the user-defined action and message.

Option	Name	Description
[0]*	False	
[1]	True	
[18]	Reversing	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[94]	RS flipflop 0	
[95]	RS flipflop 1	

Option	Name	Description
[96]	RS flipflop 2	
[97]	RS flipflop 3	
[98]	RS flipflop 4	
[99]	RS flipflop 5	
[100]	RS flipflop 6	
[101]	RS flipflop 7	
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	

13-91 Alert Action

Default value:	[0] Info	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

For safety reasons, this parameter cannot be changed when there is an active alarm.

Select the action that the drive performs when the event defined in ***parameter 13-90 Alert Trigger*** occurs.

Option	Name	Description
[0]*	Info	
[1]	Warning	
[2]	Freeze output	
[3]	Freeze output & warn	
[4]	Stop	

Option	Name	Description
[5]	Stop & warning	
[6]	Jogging	
[7]	Jogging & warning	
[8]	Max speed	
[9]	Max speed & warn	
[10]	Stop and trip	
[11]	Stop and trip w manual reset	
[12]	Trip	
[13]	Trip w manual reset	
[14]	Trip lock	

13-92 Alert Text

Default value:	Size related	**Parameter type:**	Range, 0 - 20, Array [10]
Setup:	2 setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	True

Enter the text that the drive shows in the display when the event defined in ***parameter 13-90 Alert Trigger*** occurs.

13-97 Alert Alarm Word

Default value:	0	**Parameter type:**	Range, 0 - 3FF hex
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the alarm word of a user-defined alarm in hex code.

13-99 Alert Status Word

Default value:	0	**Parameter type:**	Range, 0 - 3FF hex
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the status word of a user-defined alarm in hex code.

5.15 Parameter Group 14-** Special Functions

5.15.1 14-0* Inverter Switching

14-00 Switching Pattern

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Select the switching pattern: 60° AVM or SFAVM.

NOTICE

The drive may adjust the switching pattern automatically to avoid a trip.

Option	Name	Description
[0]	60 AVM	
[1]	SFAVM	

14-01 Switching Frequency

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the drive switching frequency. Changing the switching frequency reduces acoustic noise from the motor. Default values depend on power size.

NOTICE

The output frequency value of the drive must never exceed 10% of the switching frequency. When the motor is running, adjust the switching frequency in ***parameter 14-01 Switching Frequency*** to minimize motor noise.

NOTICE

To avoid a trip, the drive can adjust the switching frequency automatically.

Option	Name	Description
[0]	1.0 kHz	
[1]	1.5 kHz	
[2]	2.0 kHz	
[3]	2.5 kHz	
[4]	3.0 kHz	
[5]	3.5 kHz	
[6]	4.0 kHz	
[7]	5.0 kHz	
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	

Option	Name	Description
[12]	12.0 kHz	
[13]	14.0 kHz	
[14]	16.0 kHz	

14-02 Switching Pattern Shift Frequency

Default value:	Size related	**Parameter type:**	Range, 15 - 590 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Set the frequency where the switching pattern shifts between SFAVM and 60 AVM. Set a value to keep high-speed motors in SFAVM mode during ramp-up and during low-speed operation. The value to set is motor-dependent. The pattern shift frequency can be set when ***parameter 14-00 Switching Pattern*** is set to ***[0] 60 AVM***.

14-03 Overmodulation

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

Overmodulation leads to increased torque ripple as harmonics increase.

Option	Name	Description
[0]	Off	Select ***[0] Off*** for no overmodulation of the output voltage to avoid torque ripple on the motor shaft. This feature may be useful for applications such as grinding machines.
[1]	On	Select ***[1] On*** to enable the overmodulation function for the output voltage. This is the right option when it is required that the output voltage is higher than 95% of the input voltage (typically when running over-synchronously). The output voltage is increased according to the degree of overmodulation. Control in flux control principle provides an output current of up to 98% of the input current, regardless of ***parameter 14-03 Overmodulation***.
[2]	User defined	Modulation index refers to the relation between motor voltage and DC-link voltage. High overmodulation increases the motor voltage and optimizes the motor torque and efficiency by reducing the motor current. A high modulation index increases the risk of torque ripple on the motor shaft. In applications where the torque ripple occur, it can be beneficial to disable the overmodulation. It is possible to configure the setup in the range defined in ***parameter 40-55 Modulation Index***.

14-04 Acoustic Noise Reduction

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Off	No change of the acoustic motor switching noise.
[1]	On	Select to reduce the acoustic noise from the motor.

14-05 PWM Generation

Default value:	[0] Standard	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter in VVC+ and U/f mode only. When running with low ratio between switch frequency and output frequency (especially close to or <10:1), it is possible to improve the resolution of the PWM modulation and optimize the output voltage.

Option	Name	Description
[0]*	Standard	Use this setting for standard motors.
[1]	Double update	Updates the PWM pattern twice per switch period. Select this option to achieve a more optimal sinus-wave and slight increase of the output voltage.

5.15.2 14-1* Mains On/Off

These parameters are for configuring mains failure monitoring and handling.

14-10 Mains Failure

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

When ***parameter 1-00 Configuration Mode*** is set to ***[2] Torque***, the following options are inactive:

- ***[1] Ctrl. ramp-down***
- ***[5] Kinetic back-up, trip***
- ***[7] Kin. back-up, trip w recovery***

NOTICE

This parameter cannot be changed while the motor is running.

Parameter 14-10 Mains Failure is typically used where short mains interruptions (voltage dips) are present. At 100% load and a short voltage interruption, the DC voltage on the main capacitors drops quickly. For larger drives, it only takes a few milliseconds before the DC level drops to about 373 V DC, and the IGBTs cut off and lose the control of the motor. When mains is restored, and the IGBTs start again, the output frequency and voltage vector do not correspond to the speed/frequency of the motor, and the result is normally an overvoltage or overcurrent, mostly resulting in a trip lock. ***Parameter 14-10 Mains Failure*** can be programmed to avoid this situation. Select the function according to which the drive must act when the threshold in ***parameter 14-11 Mains Fault Voltage Level*** is reached.

Option	Name	Description
[0]*	No function	The drive does not compensate for a mains interruption. The voltage on the DC link drops quickly and motor control is lost within milliseconds to seconds. This situation results in a trip lock.
[1]	Ctrl. ramp-down	Control of the motor remains with the drive, and the drive performs a controlled ramp down from ***parameter 14-11 Mains Fault Voltage Level***. If ***parameter 2-10 Brake Function*** is ***[0] Off*** or ***[2] AC brake***, the ramp follows the overvoltage ramping. If ***parameter 2-10 Brake Function*** is***[1] Resistor Brake***, the ramp follows the setting in ***parameter 3-81 Quick Stop Ramp Time***. This selection is useful in pump applications, where the inertia is low and the friction is high. When mains is restored, the output frequency ramps the motor up to the reference speed. If the mains interruption is prolonged, the controlled ramp down may bring the output frequency down to 0 RPM, and when the mains is restored, the application is ramped up from 0 RPM to the previous reference speed via the normal ramp-up. If the energy in the DC link disappears before the motor is ramped to 0, the motor is coasted. **Limitation:** See the introduction text in this parameter.
[3]	Coasting	The inverter turns off and the capacitor bank backs up the control card. Backing up the control card ensures a faster restart when mains is reconnected (at short power zags).
[4]	Kinetick back-up	Kinetic back-up ensures that the drive keeps running as long as there is energy in the system due to the inertia from motor and load. This is done by converting the mechanical energy to the DC link and maintaining control of the drive and motor. This can extend the controlled operation, depending on the inertia in the system. For fans, it is typically several seconds; for pumps up to 2 s; and for compressors only for a fraction of a second. Many industry applications can extend controlled operation for many seconds, which is often enough time for the mains to return.

Option	Name	Description

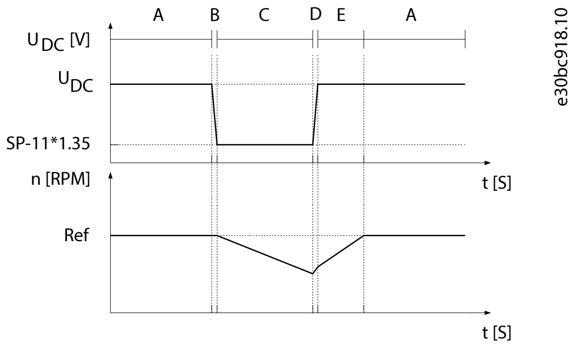


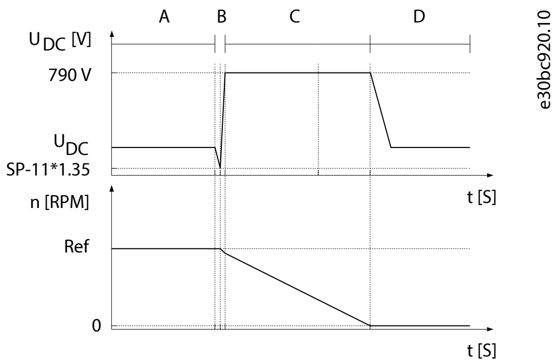
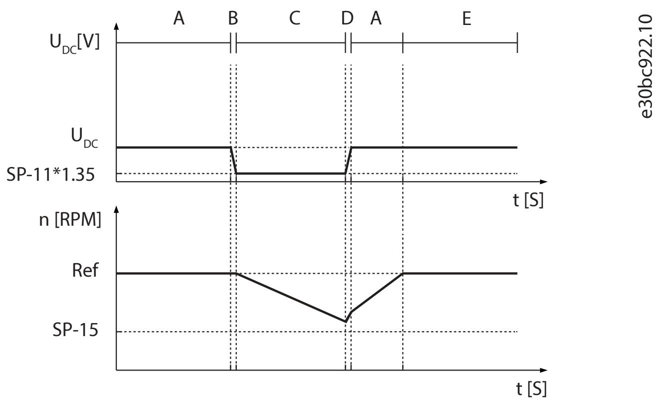
Figure 78: Kinetic Back-up

A	Normal operation	**B**	Mains failure
C	Kinetic backup	**D**	Mains return
E	Normal operation: Ramping		

The DC level during ***[4] Kinetic backup*** equals ***parameter 14-11 Mains Fault Voltage Level*** x 1.35. If the mains does not return, U_{DC} is maintained as long as possible by ramping the speed down towards 0 RPM. Finally, the drive coasts. If the mains returns while in kinetic back-up mode, U_{DC} increases above ***parameter 14-11 Mains Fault Voltage Level*** x 1.35. This is detected in 1 of the following ways:

- If U_{DC} > ***parameter 14-11 Mains Fault Voltage Level*** x 1.35 x 1.05.
- If the speed is above the reference. This is relevant if the mains comes back at a lower level than before, for example ***parameter 14-11 Mains Fault Voltage Level*** x 1.35 x 1.02. This does not fulfill the criterion in point 1, and the drive tries to reduce U_{DC} to ***parameter 14-11 Mains Fault Voltage Level*** x 1.35 by increasing the speed. This cannot be done as the mains cannot be lowered.
- If running mechanically. The same mechanism as in point 2 applies, but the inertia prevents the speed from going above the reference speed. This leads to the motor running mechanically until the speed is above the reference speed and the situation in point 2 occurs. Instead of waiting for that criterion, point 3 is introduced.

[5]	Kinetick back-up, trip	The difference between kinetic back-up with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains returns or not. The function does not detect if mains returns. This is the reason for the relatively high level on the DC link during ramp-down.

Option	Name	Description
		 **Figure 79: Kinetic Back-up Trip** **A** Normal operation; **B** Mains failure; **C** Kinetic backup; **D** Trip
[6]	Alarm	
[7]	Kin. back-up, trip w recovery	This option is valid in VVC+ only. Kinetic back-up with recovery combines the features of kinetic back-up and kinetic back-up with trip. This feature makes it possible to select between kinetic back-up and kinetic back-up with trip, based on a recovery speed, configurable in ***parameter 14-15 Kin. Back-up Trip Recovery Level***. If mains does not return, the drive ramps down to 0 RPM and trips. If mains returns while in kinetic back-up at a speed above the value in ***parameter 14-15 Kin. Back-up Trip Recovery Level***, normal operation is resumed. This is equal to ***[4] Kinetic Back-up***. The DC level during ***[7] Kin. back-up, trip w recovery*** is ***parameter 14-11 Mains Fault Voltage Level*** x 1.35.  **Figure 80: Kinetic Back-up Trip w/Recovery, Mains Returns Above *Parameter 14-15 Kin. Back-up Trip Recovery Level*** **A** Normal operation; **B** Mains Failure; **C** Kinetic backup; **D** Mains return; **E** Normal operation: Ramping

Option	Name	Description
		If mains returns while in kinetic back-up at a speed below ***parameter 14-15 Kin. Back-up Trip Recovery Level***, the drive ramps down to 0 RPM using the ramp and then trips. If the ramp is slower than the system ramping down on its own, the ramping is done mechanically and U_{DC} is at the normal level ($U_{DC,m}$ x 1.35).

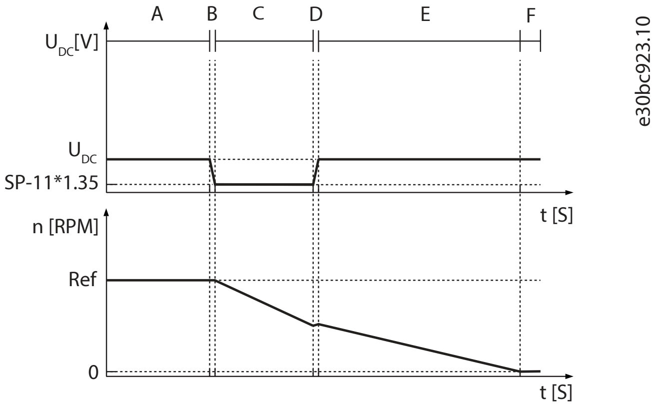


Figure 81: Kinetic Back-up Trip w/Recovery, Slow Ramp, Mains Returns Below *Parameter 14-15 Kin. Back-up Trip Recovery Level*

A	Normal operation	**B**	Mains failure
C	Kinetic backup	**D**	Mains return
E	Kinetic backup, ramping to trip	**F**	Trip

If the ramp is quicker than the ramp-down speed of the application, the ramping generates current. This results in a higher U_{DC}, which is limited using the brake chopper/resistor brake.

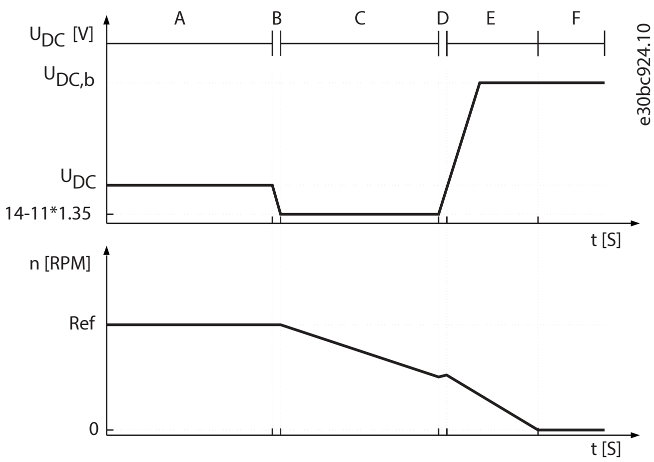


Figure 82: Kinetic Back-up Trip w/Recovery, Quick Ramp, Mains Returns Below *Parameter 14-15 Kin. Back-up Trip Recovery Level*

Option	Name	Description
		A Normal operation; B Mains failure; C Kinetic backup; D Mains return; E Kinetic backup ramping to trip; F Trip

NOTICE

For best performance of controlled ramp down and kinetic backup, set ***parameter 1-03 Torque Characteristics*** to ***[0] Compressor*** or ***[1] Variable torque***(no automatic energy optimization should be active).

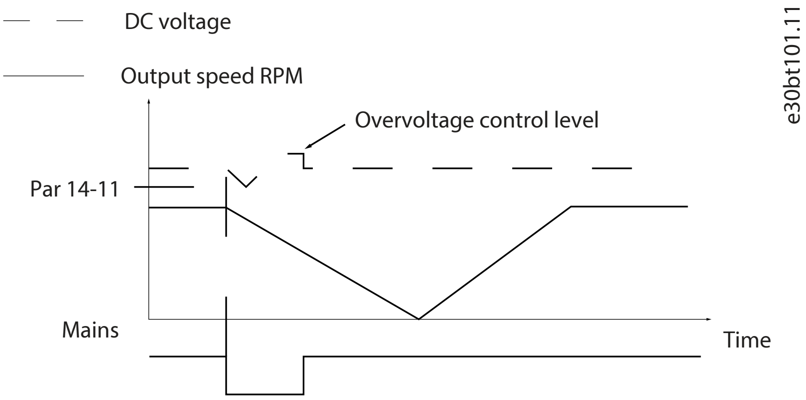


Figure 83: Controlled Ramp Down, Short Mains Failure

Figure 83 shows ramping down to a stop followed by rampin up to the reference.

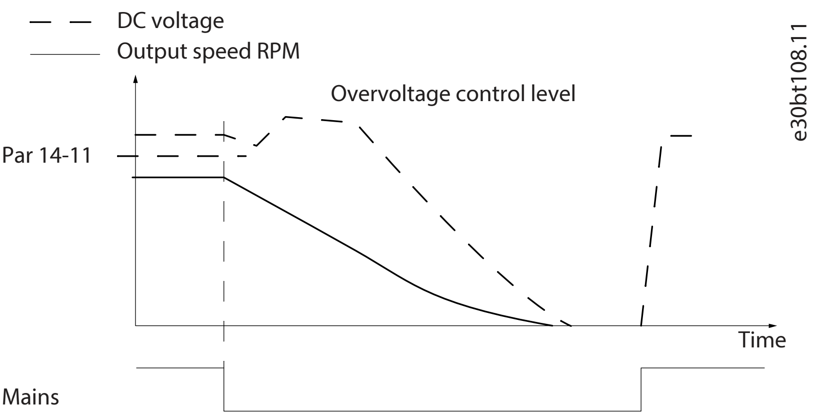


Figure 84: Controlled Ramp Down, Longer Mains Failure

Figure 84 shows ramping down as long as the energy in the system allows it, then the motor coasts.

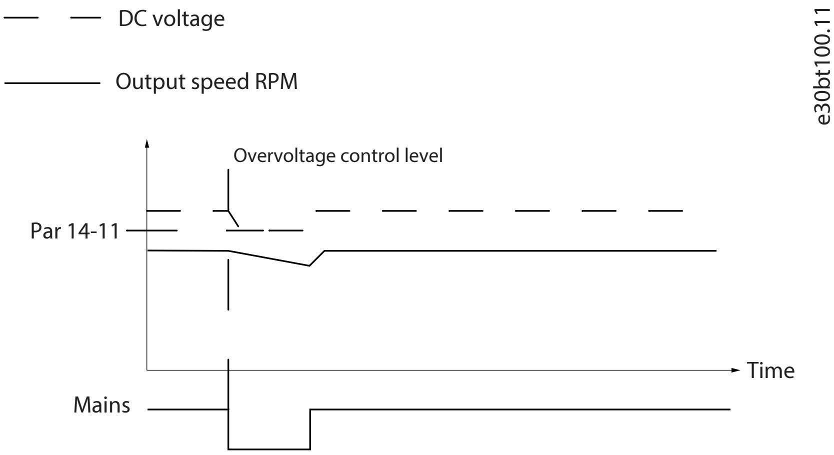


Figure 85: Kinetic Backup, Short Mains Failure

Figure 85 shows riding through as long as the energy in the system allows it.

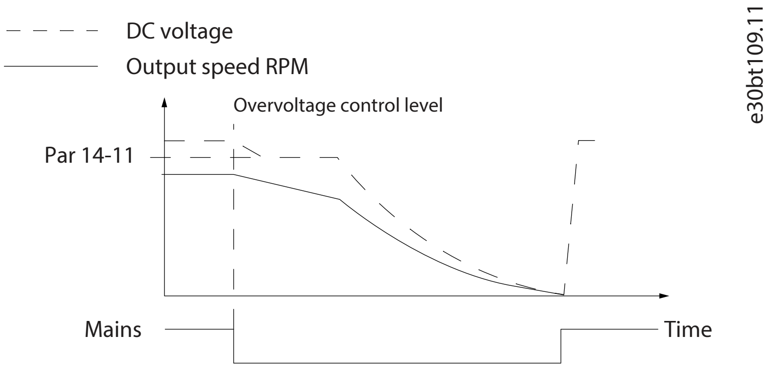


Figure 86: Kinetic Backup, Longer Mains Failure

Figure 86 shows the motor coasting when the energy in the system is too low.

14-11 Mains Fault Voltage Level

Default type:	Size related	**Parameter type:**	Range, 140 - 600 V
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter defines the threshold voltage at which the function in ***parameter 14-10 Mains Failure*** is activated. Select the detection level depending on the supply quality. For a supply of 380 V, set ***parameter 14-11 Mains Fault Voltage Level*** to 342 V. This results in a DC detection level of 462 V (***parameter 14-11 Mains Fault Voltage Level*** x 1.35).

14-12 Response to Mains Imbalance

Default value:	[3] Derate	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Make sure that the setting in ***parameter 0-03 Regional Setting*** matches the actual grid.

Operation under severe mains imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (for example, a pump or a fan running near full speed). Select the level of operation when mains imbalance conditions occur. Options ***[5] Fast trip lock*** to ***[7] Fast warning*** are based on a principle which enures detection of a missing mains phase within 2 s and responds according to the selection. See ***parameter 14-17 Fast Mains Phase Loss*** and ***parameter 14-18 Fast Mains Phase Loss Min Power***. A minimum load on the drive of 2% nominal power is required for detection of missing mains phase.

Option	Name	Description
[0]	Trip Lock	A trip lock is triggered upon a mains phase imbalance.
[1]	Warning	A warning is issued upon a mains phase imbalance.
[2]	Disabled	Mains failure detection is disabled.
[3]*	Derate	The drive derates upon a mains phase imbalance.
[4]	Trip	The drive trips.
[5]	Fast Trip Lock	A trip lock occurs when a mains input phase is missing.
[6]	Fast Trip	The drive trips when a mains input phase is missing.
[7]	Fast Warning	A warning occurs when a mains input phase is missing.

14-14 Kin. Back-up Time-up

Default value:	60 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter defines the kinetic back-up timeout in flux mode when running on low voltage grids. If the supply voltage does not exceed the value defined in ***parameter 14-11 Mains Fault Voltage Level*** +5% within the specified time, the drive automatically runs a controlled ramp-down profile before stop.

14-15 Kin. Back-up Trip Recovery Level

Default value:	Size related	**Parameter type:**	Range, 0 - 60000.000 Reference- FeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

This parameter specifies the kinetic back-up trip recovery level. The unit is defined in ***parameter 0-02 Motor Speed Unit***.

14-16 Kin. Back-up Gain

Default value:	100%	**Parameter type:**	Range, 0 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the kinetic back-up gain value in percent.

14-17 Fast Mains Phase Loss Level

Default value:	100%	**Parameter type:**	Range, 0 - 500%
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the level at which the functions Fast Mains Phase Loss Trip or Fast Mains Phase Loss Warning (see ***parameter 14-12 Response to Mains Imbalance***) should be activated.

NOTICE

A lower level than default might cause false alarms as it increases sensitivity.

14-18 Fast Mains Phase Loss Min Power

Default value:	2%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the minimum power level (% of nominal power) at which the functions Fast Mains Phase Loss Trip or Fast Mains Phase Loss Warning (see ***parameter 14-12 Response to Mains Imbalance***) should be activated.

NOTICE

A minimum power level of 2% is a prerequisite for the Fast Mains Phase Loss function to work.

5.15.3 14-2* Trip Reset

Parameters for configuring auto reset handling, special trip handling, and control card self-test or initialization.

14-20 Reset Mode

Default value:	[10] Automatic reset x 10	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the reset function after tripping. Once reset, the drive can be restarted.

NOTICE

The motor may start without warning. If the specified number of automatic resets is reached within 10 minutes, the drive enters ***[0] Manual reset*** mode. After the manual reset is performed, the setting of ***parameter 14-20 Reset Mode*** returns to the original selection. If the number of automatic resets are not reached within 10 minutes, or when a manual reset is performed, the internal automatic reset counter returns to 0.

Option	Name	Description
[0]	Manual reset	Select ***[0] Manual reset*** to perform a reset via [Reset] or via the digital inputs.
[1]	Automatic reset x 1	Select ***[1] - [12] Automatic reset*** x 1… x20 to perform 1–20 automatic resets after tripping.

Option	Name	Description
[2]	Automatic reset x 2	
[3]	Automatic reset x 3	
[4]	Automatic reset x 4	
[5]	Automatic reset x 5	
[6]	Automatic reset x 6	
[7]	Automatic reset x 7	
[8]	Automatic reset x 8	
[9]	Automatic reset x 9	
[10]*	Automatic reset x 10	
[11]	Automatic reset x 15	
[12]	Automatic reset x 20	
[13]	Infinite auto reset	Select this option for continuous resetting after tripping.

14-21 Automatic Restart Time

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the time interval from trip to start of the automatic reset function. This parameter is active when ***parameter 14-20 Reset Mode*** is set to ***[1]–[13] Automatic reset***.

14-22 Operation Mode

Default value:	[0] Normal operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

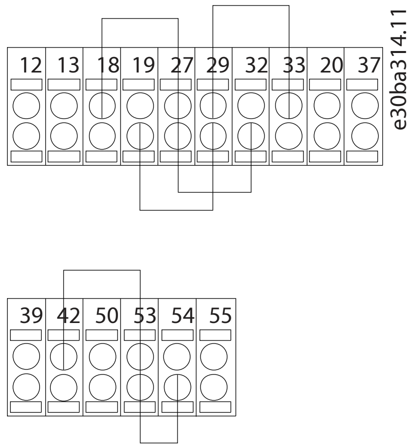
Use this parameter to specify normal operation, to perform tests, or to initialize all parameters except ***parameter 15-03 Power Up's***, ***parameter 15-04 Over Temp's***, and ***parameter 15-05 Over Volt's***. This function is active only when the power is cycled to the drive. Select ***[0] Normal operation*** for normal operation of the drive with the motor in the selected application. Select ***[1] Control card test*** to test the analog and digital inputs and outputs and the +10 V control voltage. The test requires a test connector with internal connections. Use the following procedure for the control card test:

- Select ***[1] Control card test***.
- Disconnect the mains supply and wait for the indicator light in the display to go out.
- Set switches S201 (A53) and S202 (A54) to ON/I.
- Insert the test plug.
- Connect to mains supply.
- Carry out various tests.
- The results are shown on the LCP and the drive moved into an infinite loop.

- ***Parameter 14-22 Operation Mode*** is automatically set to normal operation. Carry out a power cycle to start up in normal operation after a control card test.

If the test is OK	LCP readout: Control card OK. Disconnect the mains supply and remove the test plug. The green indicator light on the control card lights up.
If the test fails	LCP readout: Control card I/O failure. Replace the drive or control card. The red indicator light on the control card is turned on. Test plugs (connect the following terminals to each other): 18 - 27 - 32; 19 - 29 - 33; 42 - 53 - 54.

Figure 87: Test Plugs



Select ***[2] Initialisation*** to reset all parameter values to default settings, except for: ***Parameter 15-03 Power Up's***, ***parameter 15-04 Over Temp's***, and ***parameter 15-05 Over Volt's***. The drive resets during the next power-up. ***Parameter 14-22 Operation Mode*** also returns to the default setting ***[0] Normal operation***.

Option	Name	Description
[0]*	Normal operation	Normal operation of the drive with the motor in the selected application.
[1]	Control card test	Remember to set switches S201 (A53) and S202 (A54) as specified in the parameter description when performing a control card test. Otherwise, the test fails.
[2]	Initialisation	Select this option to perform initialization. The drive resets during the next power-up. This option does not clear the service logs.
[3]	Boot mode	
[4]	Initialize all parameters	Select this option to reset all parameters (including bus and motor parameters) to default values.

Option	Name	Description
[5]	Clear service logs	**NOTICE** Save the log information using MCT 10 Set-up Software before clearing the service logs. Select this option and perform a power cycle to clear the log.
[6]	Clear param. log	

14-24 Trip Delay at Current Limit

Default value:	60 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the current limit trip delay in s. When the output current reaches the current limit (***parameter 4-18 Current Limit***), a warning is triggered. When the current limit warning has been continuously present for the period specified in this parameter, the drive trips. To run continuously in current limit without tripping, set the parameter to 60 s. Thermal monitoring of the drive remains active.

14-25 Trip Delay at Torque Limit

Default value:	60 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the torque limit trip delay in s. When the output torque reaches the torque limits (***parameter 4-16 Torque Limit Motor Mode*** and ***parameter 4-17 Torque Limit Generator Mode***), a warning is triggered. When the torque limit warning has been continuously present for the period specified in this parameter, the drive trips. Disable the trip delay by setting the parameter to 60 s. Thermal monitoring of the drive remains active.

14-26 Trip Delay at Inverter Fault

Default value:	Size related	**Parameter type:**	Range, 0 - 35 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

When the drive detects an overvoltage in the set time, a trip is effected after the set time. If the value is 0, protection mode is disabled.

5.15.4 14-3* Current Limit Control

The drive features an integral current limit controller, which is activated when the motor current, and thus the torque, is higher than the torque limits set in ***parameter 4-16 Torque Limit Motor Mode*** and ***parameter 4-17 Torque Limit Generator Mode***. When the current limit is reached during motor operation or regenerative operation, the drive tries to reduce torque below the preset torque limits as quickly as possible without losing control of the motor. While the current control is active, the drive can only be stopped by setting a digital input to ***[2] Coast inverse*** or ***[3] Coast and reset inv***. Any signals on terminals 18â€“33 are not active until the drive is no longer near the current limit. By using a digital input set to ***[2] Coast inverse*** or ***[3] Coast and reset inv.***, the motor does not use the ramp-down time, since the drive is coasted. If a quick stop is necessary, use the mechanical brake control function along with an external electro-mechanical brake attached to the application.

14-30 Current Lim Ctrl, Proportional Gain

Default value:	100%	**Parameter type:**	Range, 5 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Enter the proportional gain value for the current limit controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability.

14-31 Current Lim Ctrl, Integration Time

Default value:	Size related	**Parameter type:**	Range, 0.002 - 2 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	False

Controls the current limit control integration time. Setting it to a lower value makes it react faster. A setting too low leads to controller instability.

14-32 Current Lim Ctrl, Filter Time

Default value:	Size related	**Parameter type:**	Range, 1 - 100 ms
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint16	**Change during operation:**	False

Controls the current limit control low-pass filter. This makes it possible to react to peak values or to average values. When selecting average values, it is sometimes possible to run with higher output current and instead trip on the hardware limit for current. However, the control reacts slower as it does not react on immediate values.

14-35 Stall Protection

Default value:	[1] Enabled	**Parmaeter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter is active in flux mode only.

Option	Name	Description
[0]	Disabled	Disables stall protection in field weakening flux mode and might cause the motor to be lost.
[1]*	Enabled	Enables stall protection in field weakening flux mode.

5.15.5 14-4* Energy Optimizing

Parameters for adjusting the energy optimization level in both variable torque (VT) and automatic energy optimization (AEO) mode.

Automatic energy optimization is only active if ***parameter 1-03 Torque Characteristics*** is set to either ***[2] Auto energy optim. CT*** or ***[3] Auto energy optim. VT***.

14-40 VT Level

Default value:	66%	**Parameter type:**	Range, 40 - 90%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

This parameter is not active when ***parameter 1-10 Motor Construction*** is set to ***[1] PM non-salient SPM***.

Enter the level of motor magnetization at low speed. Selection of a low value reduces energy loss in the motor but also reduces load capability.

14-41 AEO Minimum Magnetisation

Default value:	Size related	**Parameter type:**	Range, 30 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is not active when ***parameter 1-10 Motor Construction*** is set to ***[1] PM non-salient SPM***.

Enter the minimum allowable magnetization for AEO. Selection of a low value reduces energy loss in the motor but can also reduce resistance to sudden load changes.

14-42 Minimum AEO Frequency

Default value:	Size related	**Parameter type:**	Range, 0 - 255 Hz
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is not active when ***parameter 1-10 Motor Construction*** is set to ***[1] PM non-salient SPM***.

Enter the minimum frequency at which the automatic energy optimization (AEO) is to be active.

14-43 Motor Cosphi

Default value:	Size related	**Parameter type:**	Range, 0.40 - 0.95
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The Cos(phi) setpoint is automatically set for optimum AEO performance. This parameter should normally not be altered. However, in some situations it may be necessary to enter a new value to fine-tune.

14-44 d-axis Reference Gain

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Adjustment parameter for the d-axis current. 100% indicates maximum torque per ampere value based on motor parameters. Increasing the maximum torque can improve the power factor of the machine, which may increase the current consumption. The adjustment parameter allows to:

- Adjust minimum current consumption, allowing for tolerances in the motor parameters.
- Obtain the optimal balance between current consumption and power factor of the machine at a given point of operation.

5.15.6 14-5* Environment

NOTICE

Perform a power-cycle after changing any of the parameters in *parameter group 14-5* Environment*.

These parameters support the drive when operating under special environmental conditions.

14-50 RFI Filter

Default value:	[1] On	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Turn the RFI filter on or off. The RFI filter ensures that the drive complies with EMC standards. Select ***[0] Off*** only when the drive is connected to an isolated mains source (IT mains).

Option	Name	Description
[0]	Off	
[1]*	On	

14-51 DC-link Compensation

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The rectified AC-DC voltage in the DC link of the drive is associated with voltage ripples. These ripples can increase in magnitude with increased load. These ripples are undesirable because they can generate current and torque ripples. A compensation method is used to reduce these voltage ripples in the DC link. In general, DC-link compensation is recommended for most applications, but pay attention when operating in field weakening as it can generate speed oscillations at the motor shaft. In field weakening, turn off DC-link compensation.

Option	Name	Description
[0]	Off	Disables DC-link compensation.
[1]	On	Enables DC-link compensation.
[2]	Advanced	Improved compensation of DC-link ripple caused by mains frequency and phase imbalance. **NOTICE** ***Parameter 0-03 Regional Setting*** must be set correctly according to the actual mains grid.

14-52 Fan Control

Default value:	[0] Auto	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the minimum speed of the main fan.

Option	Name	Description
[0]*	Auto	Select ***[0] Auto*** to run fan only when internal temperature in the drive is in the range 35 °C (95 °F) to approximately 55 °C (131 °F). The fan runs at low speed below 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[1]	On 50%	The fan always runs at 50% speed or above. The fan runs at 50% speed at 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[2]	On 75%	The fan always runs at 75% speed or above. The fan runs at 75% speed at 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[3]	On 100%	The fan always runs at 100% speed.
[4]	Auto (Low temp env.)	This option is the same as ***[0] Auto***, but with special considerations around and below 0 °C (32 °F). In option ***[0] Auto*** there is a risk that the fan starts running around 0 °C as the drive detects a sensor fault and thus protects the drive while reporting *warning 66, Heat sink Temperature Low*. Option ***[4] Auto (Low temp env.)*** can be used in very cold environments and prevents the negative effects of this further cooling and avoids *warning 66, Heat sink Temperature Low*.

14-53 Fan Monitor

Default value:	[1] Warning	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the drive action if a fan fault is detected.

Option	Name	Description
[0]	Disabled	
[1]*	Warning	
[2]	Trip	

14-55 Output Filter

Default value:	[0] No filter	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

CAUTION

OVERHEATING OF FILTER OR AC DRIVE

Incorrect setting of ***parameter 14-55 Output Filter*** can lead to overheating and cause equipment damage and personal injury.

- Always set ***parameter 14-55 Output Filter*** to ***[2] Sine-wave fixed*** when using a sine-wave filter.

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Reset the drive after selecting ***[2] Sine-wave filter fixed***.

Select the type of output filter connected.

Option	Name	Description
[0]*	No filter	Set the parameter when VLT® MCC 102 dU/dt filters or VLT® MCC 105 high-frequency common-mode filters are connected to the drive.
[1]	Sine-wave filter	Use the setting for backward compatibility purposes. Set ***parameter 14-56 Capacitance Output Filter***and ***parameter 14-57 Inductance Output Filter***. Setting the parameter does not limit the range of the switching frequency.

<table>
<tr><th>Option</th><th>Name</th><th>Description</th></tr>
<tr><td>[2]</td><td>Sine-Wave Filter Fixed</td><td>NOTICE
SINE-WAVE FILTER FIXED SETTING
Ensures that the filter is operated within the safe range of switching frequencies.
• Use the setting only for VLT® MCC 101 Sine-wave Filters.

When setting the option for VLT® MCC 101 Sine-wave filters, the parameter sets a minimum allowed limit to the switching frequency and ensures the filter is operated within the safe range of switching frequencies. The option supports all control principle operations of the filter. Set parameter 14-56 Capacitance Output Filter and parameter 14-57 Inductance Output Filter. Setting the option allows the modulation pattern to be set to stator flux asynchronous vector modulation (SFAVM), which reduces the acoustic switching noise from the filter.</td></tr>
<tr><td>[5]</td><td>All-mode Filter</td><td>NOTICE
ALL-MODE FILTERING
Enables all-mode filter operating condition and ensures that the filter is operated within the safe range of switching frequencies.
• Use this setting only for VLT® MCC 201 All-Mode Filters.

When setting the option for VLT® MCC 201 All-mode Filter, the parameter enables all-mode filter operating conditions, which include settings for a minimum allowed limit to the switching frequency and ensure the filter is operated within the safe range of switching frequencies.
The option supports all control principle operations of the filter. Set Parameter 14-56 Capacitance Output Filter and parameter 14-57 Inductance Output Filter.
Setting the option allows the modulation pattern to be set to stator flux asynchronous vector modulation (SFAVM), which reduces the acoustic switching noise from the filter.</td></tr>
</table>

14-56 Capacitance Output Filter

Default value:	Size related	**Parametery type:**	Range, 0.1 - 6500 uF
Setup:	All setups	**Conversion index:**	-7
Data type:	Uint16	**Change during operation:**	False

Set the C_y (capacitance) value of the output filter in uF, when using VLT® MCC 101 Sine-wave filter and VLT® MCC 201 All-mode filter. See the filter product label for the capacitance value. The value is the equivalent star-connected capacitance of the filter. When the filters are installed in parallel, enter the combined capacitance value of the paralleled filter. The value is the equivalent star-connected capacitance (C_y) of the filter multiplied by the number of installed paralleled filters.

NOTICE

SETTING FOR VLT® MCC 101 SINE-WAVE FILTER AND VLT® MCC 201 ALL-MODE FILTER

Enables accurate flux compensation when option ***[2] Flux sensorless*** or option ***[3] Flux w/motor feedback*** is selected in ***parameter 1-01 Motor Control Principle***.

- Enter the correct capacitance value of the connected filter.

14-57 Inductance Output Filter

Default value:	Size related	**Parameter type:**	Range, 0.001 - 65 mH
Setup:	All setups	**Conversion index:**	-6
Data type:	Uint16	**Change during operation:**	False

Set the inductance of the output filter in mH, when using VLT® MCC 101 Sine-wave Filter and VLT® MCC 201 All-mode Filter. See the product label of the filter for the value of inductance. When filters are installed in parallel, enter the combined inductance value of the installed paralleled filters. The inductance value in the parameter is the inductance value of the filter divided by the number of paralleled filters.

NOTICE

SETTING FOR VLT® MCC 201 ALL-MODE AND VLT® MCC 101 SINE-WAVE FILTERS

Enables accurate flux control compensation when option ***[2] Flux Sensorless*** or option ***[3] Flux w/Motor Feedback*** is selected in ***parameter 1-01 Motor Control Principle***.

- Enter the correct inductance value of the connected filter.

14-59 Actual Number of Inverter Units

Default value:	Size related	**Parameter type:**	Range, 1 - 1
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set the actual number of power units.

5.15.7 14-6* Auto Derate

This parameter group contains parameters for derating the drive if there is a high temperature.

No trip at inverter overload

In some systems, the drive has not been sized properly to yield the current needed in all points of the operational flow-head characteristic. At these points, the motor needs a current higher than the rated current of the drive. The drive can yield 110% of the rated current continuously for 60 s. If still overloaded, the drive normally trips (causing the motor to stop by coasting) and issues an alarm.

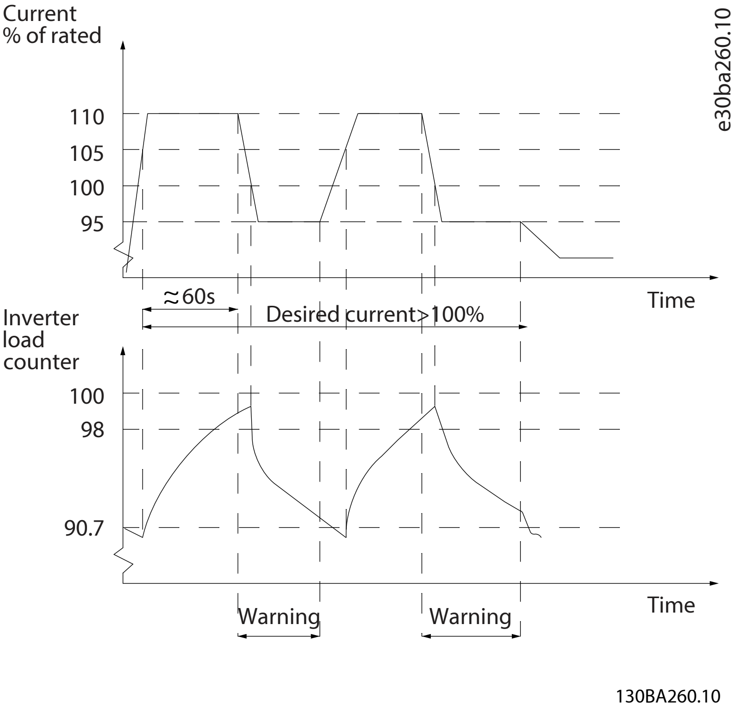


Figure 88: Output Current in Overload Condition

If the motor is unable to run continuously with the demanded capacity, run it at reduced speed for a while.

Select ***parameter 14-61 Function at Inverter Overload*** to automatically reduce motor speed until the output current is below 100% of the rated current (set in ***parameter 14-62 Inv. Overload Derate Current***). ***Parameter 14-61 Function at Inverter Overload*** is an alternative to letting the drive trip.

The drive estimates the load on the power section with an inverter load counter, which causes a warning at 98% and a reset of the warning at 90%. At the value 100%, the drive trips and issues an alarm. Status for the counter can be read in ***parameter 16-35 Inverter Thermal***.

If ***parameter 14-61 Function at Inverter Overload*** is set to ***[3] Derate***, the motor speed is reduced when the counter exceeds 98%, and stays reduced until the counter has dropped below 90.7%. If ***parameter 14-62 Inv. Overload Derate Current*** is set to for example 95%, a steady overload causes the pump speed to fluctuate between values corresponding to 110% and 95% of rated output current for the drive.

14-61 Function at Inverter Overload

Default value:	[1] Derate	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter if there is a steady overload beyond the thermal limits (110% for 60 s).

Option	Name	Description
[0]	Trip	Select ***[0] Trip*** to make the drive trip and issue an alarm.
[1]*	Derate	Reduces the motor speed to decrease the load on the power section and allowing it to cool down.

14-62 Inv. Overload Derate Current

Default value:	95%	**Parameter type:**	Range, 50 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the current level (in % of rated output current for the drive) when running with reduced motor speed after load on the drive has exceeded the allowable limit (110% for 60 s).

5.15.8 14-8* Options

14-80 Option Supplied by External 24VDC

Default value:	[0] No	**Parameter type:**	Option
Setup:	2 setups	**Conversion index**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

To make the parameter change function, perform a power cycle.

Option	Name	Description
[0]*	No	Select this option to use the 24 V DC supply of the drive.
[1]	Yes	Select this option if a 24 V DC external supply is used to power the option. Inputs/outputs are galvanically isolated from the drive when operated from an external supply.

14-88 Option Data Storage

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [24]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter stores information about options over a power cycle.

5.15.9 14-9* Fault Settings

14-90 Fault Level

Default value:	–	**Parameter type:**	Option, Array [28]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This is an array parameter with 26 elements. Each of the bits can be configured to any of the following options. Use this parameter to customize fault levels.

Option	Name	Description
[0]	Off	Use ***[0] Off*** with caution as it ignores all warnings and alarms for the selected source.
[1]	Warning	
[2]	Trip	Changing a fault level from default option ***[3] Trip Lock*** to ***[2] Trip*** leads to the automatic reset of the alarm. For alarms involving overcurrent, the drive has a hardware protection that issues a 3-minute recovery after 2 consecutive overcurrent incidents. This hardware protection cannot be overruled.
[3]	Trip lock	
[4]	Trip w. delayed reset	This option adds a delay between automatic resets, otherwise it is the same as option ***[2] Trip***. The delay prevents a situation where reset is attempted repeatedly for an overcurrent situation. Hardware protection of the drive forces the 3-minute recovery time after 2 consecutive overcurrents (within a short time window).

Table 41: Possible Actions when Selected Alarms Appear

Failure	Parameter	Alarm	Off	Warning	Trip	Trip lock	Trip with delayed reset
10 V low	1490.0	1	X(1)	D(2)	–	–	–
24 V low	1490.1	47	X	–	–	D	–
1.8 V low	1490.2	48	X	–	–	D	–
Voltage limit	1490.3	64	X	D	–	–	–
Ground fault	1490.4(3)	14	–	–	D	X	–
Ground fault 2	1490.5(3)	45	–	–	D	X	–
Torque limit	1490.6	12	X	D	–	–	–
Overcurrent	1490.7	13	–	–	–	D	X
Short circuit	1490.8	16	–	–	X	D	–
Heat sink temp.	1490.9	29	–	–	X	D	–
Heat sink sensor	1490.10	39	–	–	X	D	–
Control card temp.	1490.11	65	–	–	X	D	–
Power card temp.	1490.12	69	–	–	X	D	–
Heat sink temp.	1490.13(4)	244	–	–	X	D	–

Table 41: Possible Actions when Selected Alarms Appear (continued)

Failure	Parameter	Alarm	Off	Warning	Trip	Trip lock	Trip with delayed reset
Heat sink sensor	1490.14(4)	245	–	–	X	D	–
Power card temp.	1490.15(4)	247	–	–	X	D	–
Derag limit fault	1490.16(3), (5)	100	–	–	D	X	–

1) X = Possible selection

2) D = Default value

3) Only these faults are configurable on the FC 202. Due to a software limitation with array parameters, all other faults are shown in the VLT® Motion Control Tool MCT 10. For the other parameter indices, writing any other value than its current value (the default value) returns a value-out-of-range error. Thus, it is not allowed to cahnge the fault level for the non-configurable ones.

4) Alarm 244, Heat sink temp., alarm 245, Heat sink sensor, and alarm 247 Power card temp. are used for multiple power cards.

5) This parameter has been 1490.6 in all firmware versions up to 1.86.

5.16 Parameter Group 15-** Drive Information

5.16.1 15-0* Operating Data

15-00 Operating Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	False

View for how many hours the drive has run. The value is saved when the drive is turned off.

15-01 Running Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	False

View how many hours the motor has run. Reset the counter in ***parameter 15-07 Reset Running Hours Counter***. The value is saved when the drive is turned off.

15-02 kWh Counter

Default value:	0 kWh	**Parameter type:**	Range, 0 - 2147483647 kWh
Setup:	All setups	**Conversion index:**	75
Data type:	Uint32	**Change during operation:**	False

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in ***parameter 15-06 Reset kWh Counter***.

15-03 Power Up's

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the number of times the drive has been powered up.

15-04 Over Temp's

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the number of drive temperature faults.

15-05 Over Volt's

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the number of drive overvoltages.

15-06 Reset kWh Counter

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Do not reset	No reset of the kWh counter is required.
[1]	Reset counter	Press [OK] to reset the kWh counter to 0 (see ***parameter 15-02 kWh Counter***).

15-07 Reset Running Hours Counter

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Do not reset	No reset of running hours and number of starts counter is required.
[1]	Reset counter	To reset the running hours and numbers of starts counter to 0, select ***[1] Reset*** and press [OK] (see ***parameter 15-01 Running Hours*** and ***parameter 15-08 Number of starts***).

15-08 Number of Starts

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the number of times the motor has been started. The counter can be reset in ***parameter 15-07 Reset Running Hours Counter***. The value is saved when the drive is turned off.

5.16.2 15-1* Data Log Settings

The data log enables continuous logging of up to 4 data sources (***parameter 15-10 Logging Source***) at individual rates (***parameter 15-11 Logging Interval***). A trigger event (***parameter 15-12 Trigger Event***) and window (***parameter 15-14 Samples Before Trigger***) are used to start and stop the logging conditionally.

15-10 Logging Source

Default value:	[0] None	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the variables to be logged.

Option	Name	Description
[0]*	None	
[15]	Readout: Actual setup	
[17]	Active emergency mode setup	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1600]	Control word	
[1601]	Reference [Unit]	
[1602]	Reference [%]	
[1603]	Status word	
[1610]	Power [kW]	

Option	Name	Description
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1620]	Motor angle	
[1622]	Torque [%]	
[1624]	Calibrated Stator Resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1644]	Speed Error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback [Unit]	
[1654]	Feedback 1 [Unit]	
[1655]	Feedback 2 [Unit]	
[1656]	Feedback 3 [Unit]	
[1659]	Adjusted setpoint	
[1660]	Digital input	
[1662]	Analog input 53	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	

Option	Name	Description
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Warning word	
[1693]	Warning word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 digital output [bin]	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[2791]	Cascade reference	
[3110]	Bypass status word	

15-11 Logging Interval

Default value:	Size related	**Parameter type:**	Range, 0.000 - 0.000, Array [4]
Setup:	2 setups	**Conversion index:**	-3
Data type:	Time diff wo DateID[4]	**Change during operation:**	True

Enter the interval in ms between each sampling of the variables to be logged.

15-12 Trigger Event

Default value:	[0] False	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger event. When the trigger event occurs, a window is applied to freeze the log. The log then retains a specified percentage of samples before the occurrence of the trigger event (***parameter 15-14 Samples Before Trigger***).

Option	Name	Description
[0]*	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	

Option	Name	Description
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	

15-13 Logging Mode

Default value:	[0] Log always	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Log always	Select ***[0] Log always*** for continuous logging.
[1]	Log once on trigger	Select ***[1] Log once on trigger*** to start and stop logging conditionally using ***parameter 15-12 Trigger Event*** and ***parameter 15-14 Samples Before Trigger***.

15-14 Samples Before Trigger

Default value:	50	**Parameter type:**	Range, 0 - 100
Setup:	2 setups	**Conversion index:**	0

Data type:	Uint8	**Change during operation:**	True

Before a trigger event, enter the percentage of all samples which should be retained in the log. See also ***parameter 15-12 Trigger Event*** and ***parameter 15-13 Logging Mode***.

15-15 Info Message: "Service Log Full"

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

See Service log. By enabling this parameter, a text message is shown in the drive when the service log runs full: *Clear logs, Service log full: 28 [M26]*. The message recommends to clear the log.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	Enable message.

15-17 Service Log Trigger Alarm

Default value:	0	**Parameter type:**	Range, 0=Off - 9999
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter alarm number that triggers the Service Log write to flash. By default Service Log will log motor specific data during motor related alarms. Using Displayline parameters ***0-20 Display Line 1.1 Small***, ***0-21 Display Line 1.2 Small***, and ***0-22 Display Line 1.3 small*** with current parameter, the Service Log can be configured for custom data logging events.

15-18 Service Log Trigger SLC

Default value:	[0] False	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The service log can be used for troubleshooting. The SLC operands trigger the service log when an event occurs. The maximum numbers of service logs is 24. To clear the service logs, use ***parameter 14-22 Operation Mode*** followed by a power cycle.

Option	Name	Description
[0]*	False	
[18]	Reversing	
[19]	Warning	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	

Option	Name	Description
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[94]	RS flipflop 0	
[95]	RS flipflop 1	
[96]	RS flipflop 2	
[97]	RS flipflop 3	
[98]	RS flipflop 4	
[99]	RS flipflop 5	
[100]	RS flipflop 6	
[101]	RS flipflop 7	

Option	Name	Description
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.16.3 Service Log

The service log function saves detailed log information of a 5-second interval when alarms occur. Service technicians can analyze this information to troubleshoot and optimize the drive.

The drive can save up to 24 service log records in the flash memory. To receive a warning when the service log is full, set ***parameter 15-15 Info Message: "Service Log Full"*** to ***[1] Enable***. To read the current number of records in the memory, check ***parameter 16-42 Service Log Counter***.

Sampling rate

There are 2 periods with different sampling rates:

- Slow samples: 20 samples at a rate of 250 ms resulting in 5 s of history before the trip.
- Fast samples: 50 samples at a rate of 5 ms resulting in 250 ms of detailed history before the trip.

NOTICE

To enable the real-time clock (RTC) stamp, use the real-time clock module. If real-time clock is not available, the operating time in ***parameter 15-32 Fault Log: Time*** is recorded.

Table 42: Logged Channels

Polling	Color	Name
CH 1	Light gray	Frequency
CH 2	Dark gray	Speed [RPM]
CH 3	Red	Reference [%]
CH 4	Orange	DC-link voltage
CH 5	Yellow	Motor current
CH 6	Khaki	Motor voltage
CH 7	Light green	Control word
CH 8	Light blue	Status word
CH 9	Dark blue	[20] Operating hours
CH 10	Purple	[21] Running hours
CH 11	Magenta	[22] kWh counter

Channels 1–8 are fixed channels with unfiltered signals and cannot be changed. Channels 9–11 are filtered and refer to *parameters 0–20* to *0–22*, which are reflected in the 3 upper lines in the LCP.

5.16.4 Clearing the Service Log

The flash memory stores up to 24 records. To save new logs, clear the service log memory.

Save the service log records using the VLT® Motion Control Tool MCT 10 before clearing the service log.

The service log is stored in EEPROM in the control card and will be erased by initialization, that is when changing the power card. Before changing the power card:

- Click the Service Log icon to read the service log from the drive.
- Copy parameters to a project in MCT 10.
- Save the parameters including the service log in the project.
  - When loading the parameters back into the drive, the service log is not included.

Clear the service log after a commissioning to remove any alarms that occurred during testing.

Procedure

1. Select option ***[5] Clear Service Log*** in ***parameter 14-22 Operation Mode***.
2. Power cycle the drive. Clearing the service log extends the power-up time by approximately 1 s.

5.16.5 Service Log Indication

Parameter 16-42 Service Log Counter shows the number of service logs stored in the memory.

The drive indicates a full service log memory in 1 of the following ways:

- The LCP shows the message: *Clear logs Service log full: 28 [M26]*.
- Bit 25 is set high in ***parameter 16-96 Maintenance Word***(0x2000000).

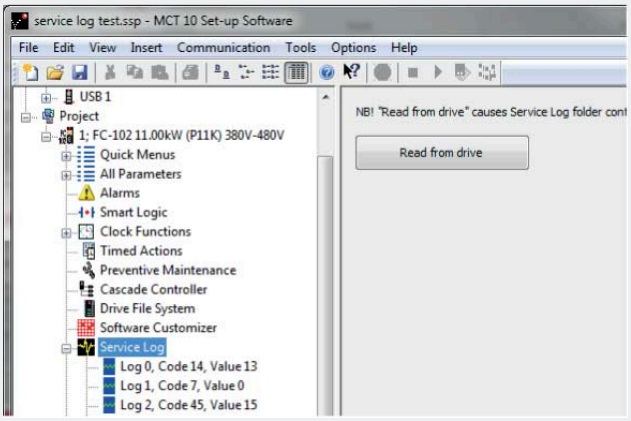
Performing the drive initialization does not clear the service log memory.

5.16.6 Reading the Service Log Information

See the VLT® Motion Control Tool MCT 10 to read the service log information.

Procedure

1. Open the MCT 10 software.
2. Select a drive.
3. Select the Service Log plug-in.
4. Click *Read from drive*.



e30bg260.1

Figure 89: MCT 10, Read From Drive

The service log view in MCT 10 looks as shown in Figure 90. Use the cursor to view the detailed readings at a specific time.

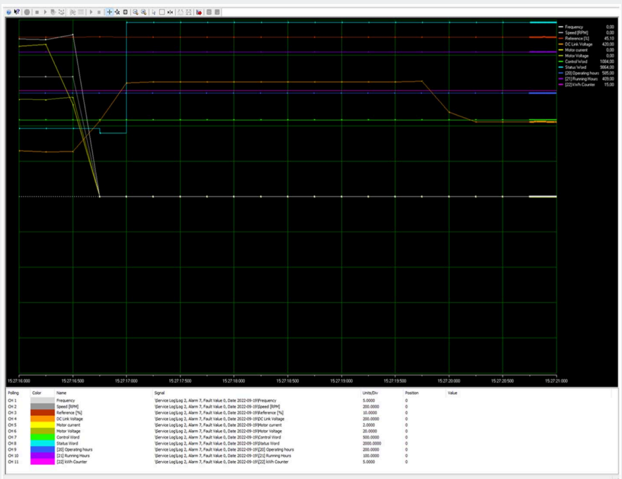


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Figure 90: Service Log View, 5 s

Use the zoom function to focus on the last 250 ms before the fault.

5.16.7 Alarms that Trigger a Service Log Record

Table 43: Alarms Triggering a Service Log Record

#	Alarm title
4	Mains phase loss
5	DC voltage high
6	DC voltage low
7	DC overvolt
8	DC undervolt
9	Inverter overld.
10	Motor ETR over
12	Torque limit
13	Over current
14	Earth (ground) fault
16	Short circuit
18	Start failed
25	Brake resistor
26	Brake overload
27	Brake IGBT
28	Brake check
30	U phase loss
31	V phase loss
32	W phase loss
36	Mains failure
37	Phase imbalance
44	Earth (ground) fault AL44
45	Earth (ground) fault 2
59	Current

NOTICE

If an alarm has 2 states (warning/alarm), it only triggers a service log record when going into the alarm state.

5.16.8 15-2* Historic Log

View up to 50 logged data items via the array parameters in this parameter group. Data is logged every time an event occurs (not to be confused with SLC events). Events in this context are defined as a change in 1 of the following areas:

- Digital inputs
- Digital outputs

- Warning word
- Alarm word
- Status word
- Control word
- Extended status word

Events are logged with value and time stamp in ms. The time interval between 2 events depends on how often events occur (maximum once every scan time). Data logging is continuous, but if an alarm occurs, the log is saved and the values can be viewed on the display. This feature is useful, for example when carrying out service following a trip. View the historic log contained in this parameter via the serial communication port or via the display.

15-20 Historic Log: Event

Default value:	0	**Parameter type:**	Range, 0 - 255, Array [50]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

View the event type of the logged events.

15-21 Historic Log: Value

Default value:	0	**Parameter type:**	Range, 0 - 2147483647, Array [50]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the value of the logged event. Interpret the event values as below:

Digital input	Decimal value. See ***parameter 16-60 Digital Input*** for a description after converting to binary value.
Digital output (not monitored in this SW release)	Decimal value. See ***parameter 16-66 Digital Output [bin]*** for a description after converting to binary value.
Warning word	Decimal value. See ***parameter 16-92 Warning Word*** for a description.
Alarm word	Decimal value. See ***parameter 16-90 Alarm Word*** for a description.
Status word	Decimal value. See ***parameter 16-03 Status Word*** for a description after converting to binary value.
Control word	Decimal value. See ***parameter 16-00 Control Word*** for a description.
Extended status word	Decimal value. See ***parameter 16-94 Ext. Status Word*** for a description.

15-22 Historic log: Time

Default value:	0 ms	**Parameter type:**	Range, 0 - 2147483647 ms, Array [50]

Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

View the time at which the logged event occurred. Time is measured in ms since drive start. This is an array parameter containing event times 0-49.

15-23 Historic Log: Date and Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [50]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	False

Array parameter; Date & Time 0 – 49. This parameter shows which time the logged event occurred.

5.16.9 15-3* Alarm Log

Parameters in this groups are array parameters where up to 10 fault logs can be viewed. 0 is the most recently logged data and 9 is the oldest. Fault codes, values, and time stamps can be viewed for all logged data.

15-30 Alarm Log: Error Code

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the error code and look up its meaning in the *table Alarm/Warning Code List* in the *chapter Troubleshooting*.

15-31 Alarm Log: Value

Default value:	0	**Parameter type:**	Range, -32767 - 32767, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

View an extra description of the error. This parameter is mostly used with *alarm 38, internal fault*.

15-32 Alarm Log: Time

Default value:	0 s	**Parameter type:**	Range, 0 - 2147483647, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the time when the logged event occurred. Time is measured in s from start-up of the drive.

15-33 Alarm Log: Date and Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	All setups	**Conversion index:**	0

Data type:	TimeOfDay	**Change during operation:**	False

Array parameter; Date & Time 0–9: This parameter shows when the logged event occurred.

15-34 Alarm Log: Setpoint

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit, Array [10]
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

This parameter shows the status of the alarm:

- 0 = Alarm inactive
- 1 = Alarm active

15-35 Alarm Log: Feedback

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit, Array [10]
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

This parameter shows at which time the logged event occurred. Time is measured in seconds since the drive was started.

15-36 Alarm Log: Current Demand

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

15-37 Alarm Log: Current Demand

Default value:	[0]	**Parameter type:**	Option, Array [10]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Option	Name	Description
[0]*		
[1]	%	
[5]	PPM	
[10]	l/min	
[11]	RPM	

Option	Name	Description
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm HG	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	

Option	Name	Description
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	HP	

15-38 Alarm Log: Speed

Default value:	0 RPM	**Parameter type:**	Range, -30000 - 30000 RPM, Array [10]
Setup:	All setups	**Conversion index:**	67
Data type:	Int32	**Change during operation:**	False

View the actual motor speed value when the logged event occurred.

5.16.10 15-4* Drive Identification

Parameters containing read-only information about the hardware and software configuration in the drive.

15-40 FC Type

Default value:	0	**Parameter type:**	Range, 0 - 6
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[6]	**Change during operation:**	False

View the drive type. The readout is identical to the drive power field of the type code definition, characters 1–6.

15-41 Power Section

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the power section. The readout is identical to the drive power field of the type code definition, characters 7–10.

15-42 Voltage

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the voltage. The readout is identical to the drive power field of the type code definition, characters 11-12.

15-43 Software Version

Default value:	0	**Parameter type:**	Range, 0 - 5
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[5]	**Change during operation:**	False

View the combined SW version (or package version) consisting of power SW and control SW.

15-44 Ordered Typecode String

Default value:	0	**Parameter type:**	Range, 0 - 40
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[40]	**Change during operation:**	False

View the type code string used for reordering the drive in its original configuration.

15-45 Actual Typecode String

Default value:	0	**Parameter type:**	Range, 0 - 40
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[40]	**Change during operation:**	False

View the actual type code string.

15-46 Frequency Converter Ordering No

Default value:	0	**Parameter type:**	Range, 0 - 8
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[8]	**Change during operation:**	False

View the 8-digit code number used for reordering the drive in its original configuration. To restore the order number after the power card exchange, see ***parameter 14-29 Service Code***.

15-47 Power Card Ordering No

Default value:	0	**Parameter type:**	Range, 0 - 8
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[8]	**Change during operation:**	False

View the power card code number.

15-48 LCP ID No

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the LCP ID number.

15-49 SW ID Control Card

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the control card software version number.

15-50 SW ID Power Card

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the power card software version number.

15-51 Frequency Converter Serial Number

Default value:	0	**Parameter type:**	Range, 0 - 10
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[10]	**Change during operation:**	False

View the drive serial number.

15-53 Power Card Serial Number

Default value:	0	**Parameter type:**	Range, 0 - 19
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[19]	**Change during operation:**	False

View the power card serial number.

15-54 Config File Name

Default value:	Size related	**Parameter type:**	Range, 0 - 16, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[16]	**Change during operation:**	False

Shows the special configuration file names.

15-58 Smart Setup Filename

Default value:	Size related	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[16]	**Change during operation:**	True

Shows the Smart Setup file name.

15-59 Filename

Default:	Size related	**Parameter type:**	Range, 0 - 16
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[16]	**Change during operation:**	False

Shows the currently used customer-specific initial values (CSIV) file name.

5.16.11 15-6* Option Ident.

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A, B, C0, and C1.

15-60 Option Mounted

Default value:	0	**Parameter type:**	Range, 0 - 30, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

Shows the type of installed option.

15-61 Option SW Version

Default value:	0	**Parameter type:**	Range, 0 - 20, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the installed option software version.

15-62 Option Ordering No

Default value:	0	**Parameter type:**	Range, 0 - 8, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[8]	**Change during operation:**	False

Shows the code number for the installed options.

15-63 Option Serial No

Default value:	0	**Parameter type:**	Range, 0 - 18, Array [8]
Setup:	All setups	**Conversion index:**	0

Data type:	VisStr[18]	**Change during operation:**	False

View the installed option serial number.

15-64 Application Version

Default value:	0	**Parameter type:**	Range, 0 - 30, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

View application version that is running in options installed in slots A, B, C0, and C1.

15-70 Option in Slot A

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

View the type code string for the option installed in slot A and a translation of the type code string. For example, for type code string *AX*, the translation is *No option*.

15-71 Slot A Option SW Version

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the software version for the option installed in slot A.

15-72 Option in Slot B

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

View the type code string for the option installed in slot B and a translation of the type code string. For example, for type code string *BX*, the translation is *No option*.

15-73 Slot B SW Version

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the software version for the option installed in slot B.

15-74 Option in Slot C0/E0

Default value:	0	**Parameter type:**	Range, 0 - 30

Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

View the type code string for the option installed in slot C and a translation of the type code string. For example, for type code string *CXXXX*, the translation is *No option*.

15-75 Slot C0/E0 Option SW Version

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

View the software version for the option installed in slot C.

15-76 Option in Slot C1/E1

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

View the type code string for the option installed in slot C1 and a translation of the type code string. For example, for type code string CXXXX, the translation is *No option*.

15-77 Slot C1/E1 Option SW Version

Default value:	0	**Parameter type:**	Range, 0 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	False

Shows the software version for the installed option in option slot C.

15-80 Fan Running Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

View for how many hours the heat sink fan has run (increments for every hour). The value is saved when the drive is turned off.

15-81 Preset Fan Running Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 99999 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

Enter the preset fan running hours counter, see ***parameter 15-80 Fan Running Hours***. This parameter cannot be selected via the serial port RS485.

15-87 kWh Counter Hires

Default value:	0 kWh	**Parameter type:**	Range, 0 - 2147483647 kWh
Setup:	All setups	**Conversion index:**	75
Data type:	Uint32	**Change during operation:**	False

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in ***parameter 15-06 Reset kWh Counter***. The decimal places are reset at power-up.

5.16.12 15-9* Parameter Info

15-92 Defined Parameters

Default value:	0	**Parameter typa:**	Range, 0 - 9999, Array [2000]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View a list of all defined parameters in the drive. The list ends with 0.

15-93 Modified Parameters

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [1000]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View a list of the parameters that have been changed from their default setting. The list ends with 0. Changes may not be visible until up to 30 s after implementation.

15-94 Extended Version

Default value:	Size related	**Parameter type:**	Range, 0 - 65, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[65]	**Change during operation:**	True

View a list of SW build IDs in the drive. In a service case, Hotline can ask for SW build IDs.

15-98 Drive Identification

Default value:	0	**Parameter type:**	Range, 0 - 40
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[40]	**Change during operation:**	False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

15-99 Parameter Metadata

Default value:	0	**Parameter type:**	Range, 0 - 9999, Array [30]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

5.17 Parameter Group 16-** Data Readouts

5.17.1 16-0* General Status

16-00 Control Word

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the control word sent to the drive via the serial communication port in hex code.

16-01 Reference [Unit]

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999 ReferenceFeedbackUnit - 999999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the present reference value applied on impulse or analog basis in the unit resulting from the configuration selected in ***parameter 1-00 Configuration Mode*** (Hz, Nm, or RPM).

16-02 Reference %

Default value:	0%	**Parameter type:**	Range, -200 - 200%
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references plus catch up and slow down.

16-03 Status Word

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the status word sent from the drive via the serial communication port in hex code.

16-05 Main Actual Value [%]

Default value:	0%	**Parameter type:**	Range, -100 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	False

View the 2-byte word sent with the status word to the fieldbus master reporting the main actual value.

16-09 Customer Readout

Default value:	0 CustomReadoutUnit	**Parameter type:**	Range, -999999.99 CustomReadoutUnit - 999999.99
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the value of custom readout from ***parameter 0-30 Unit for Userdefined Readout*** to ***parameter 0-32 Custom Readout Max Value***.

5.17.2 16-1* Motor Status

16-10 Power [kW]

Default value:	0 kW	**Parameter type:**	Range, 0 - 10000 kW
Conversion index:	1	**Data type:**	Int32
Change during operation:	False		

Shows motor power in kW. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 s may pass from when an input value changes to when the data readout values change. The resolution of readout value on fieldbus is in 10-W steps. The base unit is in W.

16-11 Power [hp]

Default value:	0 hp	**Parameter type:**	Range, 0 - 10000 hp
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

Shows motor power in hp. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 ms may pass from when an input value changes to when the data readout values change.

16-12 Motor Voltage

Default value:	0 V	**Parameter type:**	Range, 0 - 6000 V
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

View the motor voltage, a calculated value used for controlling the motor.

16-13 Frequency

Default value:	0 Hz	**Parameter type:**	Range, 0 - 6500 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

View the motor frequency without resonance damping.

16-14 Motor Current

Default value:	0 A	**Parameter type:**	Range, 0 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the motor current measured as an average value, I_{RMS}. The value is filtered, and thus approximately 1.3 s may pass from when an input value changes to when the data readout values change.

16-15 Frequency [%]

Default value:	0%	**Parameter type:**	Range, -100 - 100%
Setup:	All seutps	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	False

View a 2-byte word reporting the actual motor frequency (without resonance damping) as a percentage (scale 0000–4000 hex) of ***parameter 4-19 Max Output Frequency***. Set ***parameter 9-16 PCD Read Configuration*** index 1 to send it with the status word instead of the MAV.

16-16 Torque [Nm]

Default value:	0 Nm	**Parameter type:**	Range, -30000 - 30000 Nm
Setup:	All setups	**Conversion index:**	-1
Data type:	Int32	**Change during operation:**	False

View the torque value with sign, applied to the motor shaft. Linearity is not exact between 160% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Therefore, the minimum value and the maximum value depend on the maximum motor current and the motor used. The value is filtered, and thus approximately 30 ms may pass from when an input changes value to when the data readout values change. In flux control principle, this readout is compensated for in ***parameter 1-68 Motor Inertia*** for improved accuracy.

16-17 Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range, -30000 - 30000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Int32	**Change during operation:**	False

View the actual motor RPM. In open-loop or closed-loop process control, the motor RPM is estimated. In speed closed-loop modes, the motor RPM is measured.

16-18 Motor Thermal

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

View the calculated thermal load on the motor. The cutout limit is 100%. The basis for calculation is the ETR function selected in ***parameter 1-90 Motor Thermal Protection***.

16-19 Thermistor Sensor Temperature

Default value:	0 °C	**Parameter type:**	Range, 0 - 0 °C
Setup:	All setups	**Conversion index:**	100
Data type:	Int16	**Change during operation:**	False

Returning the actual temperature on KTY sensor built into the motor. See *parameter group 1-9* Motor Temperature*.

16-20 Motor Angle

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the current encoder/resolver angle offset relative to the index position. The value range of 0–65535 corresponds to 0–2xpi (radian).

16-22 Torque [%]

Default value:	0%	**Parameter type:**	Range, -200 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

The value shown is the torque in percent of nominal torque, with sign, applied to the motor shaft.

16-23 Motor Shaft Power [kW]

Default value:	0 kW	**Parameter type:**	Range, 0 - 10000 kW
Setup:	All setups	**Conversion index:**	1
Data type:	Int32	**Change during operation:**	True

Readout of the mechanical power applied to the motor shaft. The base unit is in W.

16-24 Calibrated Stator Resistance

Default value:	0.0000 Ohm	**Parameter type:**	Range, 0.0000 - 100.0000 Ohm
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	True

Shows the calibrated stator resistance.

16-26 Power Filtered [kW]

Default value:	0 kW	**Parameter type:**	Range, 0 - 10000 kW
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Shows the calibrated stator resistance.

16-27 Power Filtered [hp]

Default value:	0 hp	**Parameter type:**	Range, 0 - 10000 hp
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

Shows the calibrated stator resistance.

5.17.3 16-3* Drive Status

16-30 DC Link Voltage

Default value:	0 V	**Parameter type:**	Range, 0 - 10000 V
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View a measured value. The value is filtered with a 30 ms time constant.

16-32 Brake Energy/s

Default value:	0 kW	**Parameter type:**	Range, 0 - 10000 kW
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the brake power transmitted to an external brake resistor, stated as an instant value.

16-33 Brake Energy Average

Default value:	0 kW	**Parameter type:**	Range, 0 - 10000 kW
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

View the brake power transmitted to an external brake resistor. The mean power is calculated on an average level based on the selected time period within ***parameter 2-13 Brake Power Monitoring***.

16-34 Heatsink Temp.

Default value:	0 °C	**Parameter type:**	Range, 0 - 255 °C
Setup:	All setups	**Conversion index:**	100
Data type:	Uint8	**Change during operation:**	False

View the drive heat sink temperature. The cutout limit is 90 ±5 °C (194 ±9 °F), and the motor cuts back in at 60 ±5 °C (140 ±9 °F).

16-35 Inverter Thermal

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Conversion index:**	False

View the percentage load on the inverter.

16-36 Inv. Nom. Current

Default value:	Size related	**Parameter type:**	Range, 0.01 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	False

View the inverter nominal current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

16-37 Inv. Max. Current

Default value:	Size related	**Parameter type:**	Range, 0.01 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	False

View the inverter maximum current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

16-38 SL Controller State

Default value:	0	**Parameter type:**	Range, 0 - 100, Array [4]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

View the state of the event under execution by the SL controller.

16-39 Control Card Temp.

Default value:	0 °C	**Parameter type:**	Range, 0 - 100 °C
Setup:	All setups	**Conversion index:**	100
Data type:	Uint8	**Change during operation:**	False

View the temperature on the control card, stated in °C.

16-40 Logging Buffer Full

Default value:	[0] No	**Parameter Type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

View whether the logging buffer is full (see *parameter group 15-1* Data Log Settings*). The logging buffer is never full when ***parameter 15-13 Logging Mode*** is set to ***[0] Log always***.

Option	Name	Description
[0]*	No	
[1]	Yes	

16-42 Service Log Counter

Default value:	0	**Parameter type:**	Range, 0 - 24
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Shows the number of service logs stored in the ServiceLog file. If the ServiceLog file is full, clear the logged data by selecting option ***[5] Clear*** service logs in ***parameter 14-22 Operation Mode***. The logged data is deleted on the next power-up.

16-44 Speed Error [RPM]

Default value:	0 RPM	**Parameter type:**	Range, -30000 - 30000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Int32	**Change during operation:**	True

Shows the difference between the speed reference and the actual speed.

16-45 Motor Phase U Current

Default value:	0 A	**Parameter type:**	Range, 0 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation.**	True

Shows the motor phase U_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings.

16-46 Motor Phase V Current

Default value:	0 A	**Parameter type:**	Range, 0 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

Shows the motor phase V_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings.

16-47 Motor Phase W Current

Default value:	0 A	**Parameter type:**	Range, 0 - 10000 A
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

Shows the motor phase W_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings.

16-48 Speed Ref. After Ramp [RPM]

Default value:	0 RPM	**Parameter type:**	Range, -30000 - 30000 RPM
Setup:	All setups	**Conversion index:**	67

Data type:	Int32	**Change during operation:**	False

This parameter specifies the reference given to the drive after the speed ramp.

16-49 Current Fault Source

Default value:	0	**Parameter type:**	Range, 0 - 8
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Value indicates source of current faults including short circuit, overcurrent, and imbalance of supply voltage (from left):

- 1–4 Inverter
- 5–8 Rectifier
- 0 No fault recorded

5.17.4 16-5* Ref. & Feedb.

16-50 External Reference

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

View the total reference, the sum of digital, analog, preset, fieldbus, and freeze references, plus catch up and slow down.

16-52 Feedback[Unit]

Default value:	0 ProcessCtrlUnit	**Parameter type:**	-999999.999 ProcessCtrlUnit - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View value of resulting feedback value after processing of feedback 1-3 in ***parameter 3-00 Reference Range***, ***parameter 16-54 Feedback 1 [Unit]***, ***parameter 16-55 Feedback 2 [Unit]***, and ***parameter 16-56 Feedback 3 [Unit]*** in the feedback manager. See *parameter group 20-0* Feedback*. The value is limited by settings in ***parameter 3-02 Minimum Reference*** and ***parameter 3-03 Maximum Reference***. Units are set in ***parameter 20-12 Reference/Feedback Unit***.

16-53 Digi Pot Reference

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	False

View the contribution of the digital potentiometer to the actual reference.

16-54 Feedback 1 [Unit]

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 ProcessCtrlUnit - 999999.999 ProcessCtrlUnit
Setup:	All	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the value of feedback 1, see *parameter group 20-0* Feedback*. The value is limited by the settings in ***parameter 20-13 Minimum Reference/Feedb.*** and ***parameter 20-14 Maximum Reference/Feedb.*** Units are as set in ***parameter 20-12 Reference/Feedback Unit***.

16-55 Feedback 2 [Unit]

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 ProcessCtrlUnit - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the value of feedback 2, see *parameter group 20-0* Feedback*. The value is limited by the settings in ***parameter 20-13 Minimum Reference/Feedb.*** and ***parameter 20-14 Maximum Reference/Feedb***. Units are as set in ***parameter 20-12 Reference/Feedback Unit***.

16-56 Feedback 3 [Unit]

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 ProcessCtrlUnit - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the value of feedback 3, see *parameter group 20-0* Feedback*. The value is limited by the settings in ***parameter 20-13 Minimum Reference/Feedb.*** and ***parameter 20-14 Maximum Reference/Feedb***. Units are as set in ***parameter 20-12 Reference/Feedback Unit***.

16-58 PID Output [%]

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

This parameter returns the drive closed-looop PID controller output value in %.

16-59 Adjusted Setpoint

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 ProcessCtrlUnit - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter shows the actual operating setpoint after it has been modified by flow compensation.

5.17.5 16-6* Inputs and Outputs

16-60 Digital Input

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the signal states from the active digital inputs. Example: Input 18 corresponds to bit number 5, 0 = no signal, 1 = connected signal. Bit 6 works in the opposite way, on = 0, off = 1 (Safe Torque Off input).

Table 44: Active Digital Inputs

Bit	Input
0	Digital input terminal 33.
1	Digital input terminal 32.
2	Digital input terminal 29.
3	Digital input terminal 27.
4	Digital input terminal 19.
5	Digital input terminal 18.
6	Digital input terminal 37.
7	Digital input VLT® General Purpose I/O MCB 101 terminal X30/4.
8	Digital input VLT® General Purpose I/O MCB 101 terminal X30/3.
9	Digital input VLT® General Purpose I/O MCB 101 terminal X30/2.
Bit 10–63	Reserved for future terminals.

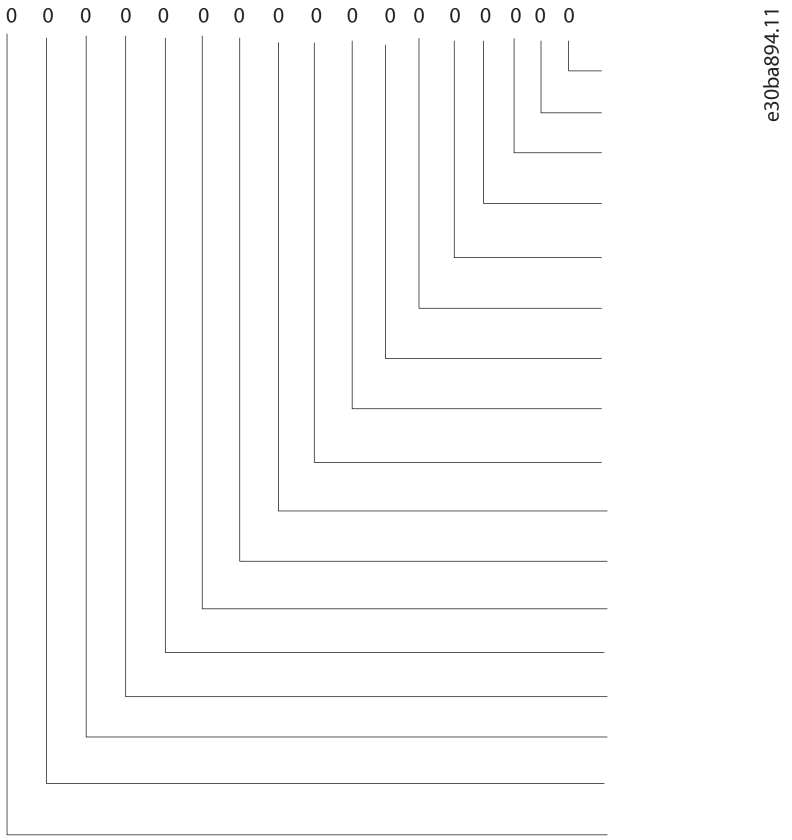


Figure 91: Relay Settings

16-61 Terminal 53 Switch Setting

Default value:	[0] Current	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

View the setting of input terminal 53.

Option	Name	Description
[0]*	Current	
[1]	Voltage	

16-62 Analog Input 53

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input 53.

16-63 Terminal 54 Switch Setting

Default value:	[0] Current	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

View the setting of terminal 54.

Option	Name	Description
[0]*	Current	
[1]	Voltage	

16-64 Analog Input 54

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Changes during operation:**	False

View the actual value at input 54.

16-65 Analog Output 42 [mA]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

View the actual value at output 42 in mA. The value shown reflects the selection in ***parameter 6-50 Terminal 42 Output***.

16-66 Digital Output [bin]

Default value:	0	**Parameter type:**	Range, 0 - 15
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

View the binary value of all digital outputs.

16-67 Freq. Input #29 [Hz]

Default value:	0	**Parameter type:**	Range, 0 - 130000
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual frequency rate on terminal 29.

16-68 Freq. Input #33 [Hz]

Default value:	0	**Parameter type:**	Range, 0 - 130000

Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual value of the frequency applied at terminal 33 as an impulse input.

16-69 Pulse Output #27 [Hz]

Default value:	0	**Parameter type:**	Range, 0 - 40000
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual value of pulses applied to terminal 27 in digital output mode.

16-70 Pulse Output #29 [Hz]

Default value:	0	**Parameter type:**	Range, 0 - 40000
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual value of pulses at terminal 29 in digital output mode.

16-71 Relay Output [bin]

Default value:	0	**Parameter type:**	0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the settings of all relays.

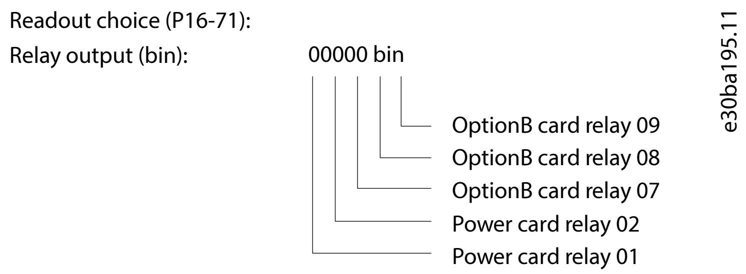


Figure 92: Relay Settings

16-72 Counter A

Default value:	0	**Parameter type:**	Range, -2147483648 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

View the present value of counter A. Counters are useful as comparator operands, see ***parameter 13-10 Comparator Operand***. Reset or change the value either via digital inputs (*parameter group 5-1* Digital Inputs*) or by using an SLC action (***parameter 13-52 SL Controller Action***).

16-73 Counter B

Default value:	0	**Parameter type:**	Range, -2147483648 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

View the present value of counter B. Counters are useful as comparator operands, see ***parameter 13-10 Comparator Operand***. Reset or change the value either via digital inputs (*parameter group 5-1* Digital Inputs*) or by using an SLC action (***parameter 13-52 SL Controller Action***).

16-75 Analog In X30/11

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input X30/11 of VLT® General Purpose I/O MCB 101.

16-76 Analog In X30/12

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input X30/12 of VLT® General Purpose I/O MCB 101.

16-77 Analog Out X30/8 [mA]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

View the actual value at input X30/8 in mA.

16-78 Analog Out X45/1 [mA]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Shows the actual output value at terminal X45/1. The value shown reflects the selection in ***parameter 6-70 Terminal X45/1 Output***.

16-79 Analog Out X45/3 [mA]

Default value:	0	**Parameter type:**	Range, 0 - 30

Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Shows the actual output value at terminal X45/3. The value shown reflects the selection in ***parameter 6-80 Terminal X45/3 Output***.

5.17.6 16-8* Fieldbus & FC Port

Parameters for reporting the bus references and control words.

16-80 Fieldbus CTW 1

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the 2-byte control word (CTW) received from the bus-master. Interpretation of the CTW depends on the fieldbus option installed and the CTW profile selected in ***parameter 8-10 Control Word Profile***. For more information, refer to the relevant fieldbus manual.

16-82 Fieldbus REF 1

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	All setups	**Conversion index:**	0
Data type:	N2	**Change during operation:**	False

View the 2-byte word sent with the control word form the bus-master to set the reference value. For more information, refer to the relevant fieldbus manual.

16-84 Comm. Option STW

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

Shows the status word of the extended fieldbus communication option. For more information, refer to the relevant fieldbus manual.

16-85 FC Port CTW 1

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the 2-byte control word (CTW) received from the fieldbus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in ***parameter 8-10 Control Word Profile***.

16-86 FC Port REF 1

Default value:	0	**Parameter type:**	Range, -200 - 200
Setup:	All setups	**Conversion index:**	0
Data type:	N2	**Change during operation:**	False

View the 2-byte status word (STW) sent to the fieldbus master. Interpretation of the status word depends on the fieldbus option installed and the control word profile selected in ***parameter 8-10 Control Word Profile***.

16-87 Bus Readout Alarm/Warning

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [3]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Alarm and warning numbers in hex as shown in the alarm log. The high byte contains the alarm, the low byte contains the warning. The alarm number is the 1st that occurred after the last reset.

16-89 Configurable Alarm/Warning Word

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This alarm/warning word is configured in parameter ***8-17 Configurable Alarm and Warningword*** to match the actual requirements.

5.17.7 16-9* Diagnosis Readouts

NOTICE

When using VLT® Motion Control Tool MCT 10, the readout parameters can only be read online, that is as the actual status. This means that the status is not stored in the MCT 10 setup software file.

16-90 Alarm Word

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Show the alarm word sent via the serial communication port in hex code.

16-91 Alarm Word 2

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the alarm word sent via the serial communication port in hex code.

16-92 Warning Word

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the warning word sent via the serial communication port in hex code.

16-93 Warning Word 2

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Show the warning word sent via the serial communication port in hex code.

16-94 Ext. Status Word

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Returns the extended warning word sent via the serial communication port in hex code.

16-95 Ext. Status Word 2

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Returns the extended warning word sent via the serial communication port in hex code.

16-96 Maintenane Word

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Readout of the preventive maintenance word. The bits reflect the status for the programmed preventive maintenance events in *parameter group 23-1* Maintenance*. 13 bits show combinations of all the possible items:

- Bit 0: Motor bearings
- Bit 1: Pump bearings
- Bit 2: Fan bearings
- Bit 3: Valve
- Bit 4: Pressure transmitter
- Bit 5: Flow transmitter
- Bit 6: Temperature transmitter
- Bit 7: Pump seals
- Bit 8: Fan belt
- Bit 9: Filter
- Bit 10: Drive cooling fan
- Bit 11: Drive system health check
- Bit 12: Warranty
- Bit 13: Maintenance text 0
- Bit 14: Maintenance text 1
- Bit 15: Maintenance text 2

- Bit 16: Maintenance text 3
- Bit 17: Maintenance text 4

The following table details the display of the maintenance word.

Table 45: Maintenance Word

Position 4⇒	Valve	Fan bearings	Pump bearings	Motor bearings
Position 3⇒	**Pump seals**	**Temperature transmitter**	**Flow transmitter**	**Pressure transmitter**
Position 2⇒	**Drive system health check**	**Drive cooling fan**	**Filter**	**Fan belt**
Position 1⇒	–	–	–	**Warranty**
0_{hex}	–	–	–	–
1_{hex}	–	–	–	+
2_{hex}	–	–	+	–
3_{hex}	–	–	+	+
4_{hex}	–	+	–	–
5_{hex}	–	+	–	+
6_{hex}	–	+	+	–
7_{hex}	–	+	+	+
8_{hex}	+	–	–	–
9_{hex}	+	–	–	+
A_{hex}	+	–	+	–
B_{hex}	+	–	+	+
C_{hex}	+	+	–	–
D_{hex}	+	+	–	+
E_{hex}	+	+	+	–
F_{hex}	+	+	+	+

Example: The preventive maintenace word shows 040Ahex:

Position	1	2	3	4
Hex value	0	4	0	A

- The 1st digit 0 indicates that no items from the 4th row require maintenance.
- The 2nd digit 4 refers to the 3rd row indicating that the drive cooling fan requires maintenance.
- The 3rd digit 0 indicates that no items for the 2nd row require maintenance.
- The 4th digit A refers to the top row indicating that the valve and the pump bearings require maintenance.

16-97 Alarm Word 3

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the alarm word sent via the serial communication port in hex code.

16-98 Warning Word 3

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the warning word sent via the serial communication port in hex code.

16-99 Ext. Status Word 3

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the extended status word sent via the serial communication port in hex code.

5.18 Parameter Group 18-** Data Readouts 2

5.18.1 18-0* Maintenance Log

This group contains the last 10 preventive maintenance events. Maintenance log 0 is the latest and maintenance log 9 is the oldest.

By selecting 1 of the logs and pressing [OK], the maintenance item, action, and time of the occurrence are shown in ***parameter 18-0 Maintenance Log: Item*** to ***parameter 18-03 Maintenance Log: Date and Time***.

The alarm log key allows access to both alarm log and maintenance log.

18-00 Maintenance Log: Item

Default value:	0	**Parameter type:**	Range, 0 - 255, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Shows the fault code. See the different maintenance items in ***parameter 23-10 Maintenance Item***.

18-01 Maintenance Log: Action

Default value:	0	**Parameter type:**	Range, 0 - 255, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Shows the fault code. See the different maintenance actions in ***parameter 23-11 Maintenance Action***.

18-02 Maintenance Log: Time

Default value:	0 s	**Parameter type:**	Range, 0 - 2147483647 s, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows when the logged event occurred. Time is measured in s since last power-up.

18-03 Maintenance Log: Date and Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	False

Shows when the logged event occurred.

NOTICE

This requires that the date and time is programmed in ***parameter 0-70 Date and Time***.

Date format depends on the setting in ***parameter 0-71 Date Format***, while the time format depends on the setting in ***parameter 0-72 Time Format***.

NOTICE

The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. In ***parameter 0-79 Clock Fault***, it is possible to program a warning in case the clock has not been set properly, for example after a power-down. Incorrect setting of the clock affects the time stamps for the maintenance events.

NOTICE

When mounting a VLT® Analog I/O MCB 109 option card, a battery back-up of date and time is included.

5.18.2 18-1* Emergency Mode Log

The log covers the latest 10 faults which have been suppressed by the emergency mode function. See *parameter group 24-0* Emergency Mode*. The log can be viewed either via the following parameters or by pressing [Alarm Log] on the LCP and selecting *Emergency mode log*. It is not possible to reset the emergency mode log.

18-10 Emergency Mode Log: Event

Default value:	0	**Parameter type:**	Range, 0 - 255, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter contains an array with 10 elements. The number read represents a fault code, which corresponds to a specific alarm. Refer to *Alarm/Warning Code List*in *chapter Troubleshooting*.

18-11 Emergency Mode Log: Time

Default value:	0 s	**Parameter type:**	Range, 0 - 2147483647 s, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

This parameter shows at which time the logged event occurred. Time is measured in seconds since the drive was started.

18-12 Emergency Mode Log: Date and Time

Default value:	Size related	**Parameter type:**	Range, Size related, Array [10]
Setup:	All seutps	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	False

This parameter shows at which date and time the logged event occurred. The date and time rely on the internal clock in *parameter group 0-7* Clock Settings*.

5.18.3 18-1* Parameter Log

18-13 Parameter Number

Default value:	0 N/A	**Parameter type:**	Range, 0 - 0xFFFF N/A, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Shows the parameter which is most recently changed. Index 0 shows the latest change in the parameter.

18-14 Parameter Index

Default value:	0 N/A	**Parameter type:**	Range, 0 - 0xFFFF N/A, Array [10]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	False

This parameter shows the index of the parameter which was changed.

18-15 Change Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	False

Shows the date and time stamp when a parameter was most recently changed. It is recommended to set the time and date in the drive to ensure the right time is logged.

18-16 Operating Hours

Default value:	0	**Parameter type:**	Range, 0 - 2147483647, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows operating hours of the drive at the instance when the parameter was changed.

18-17 Running Hours

Default value:	0	**Parameter type:**	Range, 0 - 2147483647, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows running hours of the motor when the parameter is changed.

18-18 Value Before Change as Integer

Default value:	0	**Parameter type:**	Range, -2147483648 - 2147483647, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Shows the previous value of the parameter as integer, without scaling or unit conversion. The parameter only shows integer data.

18-19 Value Before Change

Default value:	Size related	**Parameter type:**	Range, 0-30, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

Shows the previous value of the parameter with units. Only applicable for integer values.

5.18.4 18-3* Analog Readouts

18-30 Analog Input X42/1

Default value:	-3	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Readout of the value of the signal applied to terminal X42/1 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in ***parameter 26-00 Terminal X42/1 Mode***.

18-31 Analog Input X42/3

Default value:	0	**Parameter type:**	Range, -20 - 20

Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

Readout of the value of the signal applied to terminal X42/3 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in ***parameter 26-01 Terminal X42/3 Mode***.

18-32 Analog Input X42/5

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

Readout of the value of the signal applied to terminal X42/5 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in ***parameter 26-02 Terminal X42/5 Mode***.

18-33 Analog Input X42/7 [V]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	Int16
Data type:	Int16	**Change during operation:**	False

Readout of the value of the signal applied to terminal X42/7 on the analog I/O card. The value shown reflects the selection in ***parameter 26-40 Terminal X42/7 Output***.

18-34 Analog Input X42/9 [V]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Readout of the value of the signal applied to terminal X42/9 on the analog I/O card. The value reflects the selection in ***parameter 26-50 Terminal X42/9 Output***.

18-35 Analog Input X42/11 [V]

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation.**	False

Readout of the value of the signal applied to terminal X42/11 on the analog I/O card. The value shown reflects the selection in ***parameter 26-60 Terminal X42/11 Output***.

18-36 Analog Input X48/2 [mA]

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

View the actual current measured at input X48/2.

18-37 Temp. Input X48/4

Default value:	0	**Parameter type:**	Range, -500 - 500
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the actual temperature measured at input X48/4. The temperature unit is based on the selection in ***parameter 35-00 Term. X48/4 Temperature Unit***.

18-38 Temp. Input X48/7

Default value:	0	**Parameter type:**	Range, -500 - 500
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the actual temperature measured at input X48/7. The temperature unit is based on the selection in ***parameter 35-02 Term. X48/7 Temperature Unit***.

18-39 Temp. Input X48/10

Default value:	0	**Parameter type:**	Range, -500 - 500
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the actual temperature measured at input X48/10. The temperature unit is based on the selection in ***parameter 35-04 Term. X48/10 Temperature Unit***.

5.18.5 18-4* PGIO Data Readouts

Parameters for configuring the readout of VLT® Programmable I/O MCB 115.

18-40 Analog Input X49/1

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input X49/1 either as a voltage, current or a temperature value.

18-41 Analog Input X49/3

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input X49/3 either as a voltage, current, or a temperature value.

18-42 Analog Input X49/5

Default value:	0	**Parameter type:**	Range, -20 - 20
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

View the actual value at input X49/5 either as a voltage, current, or a temperature value.

18-43 Analog Input X49/7

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Shows the actual value at output of terminal X49/7 in V or mA. The value reflects the selection in ***parameter 36-40 Terminal X49/7 Analog Output***.

18-44 Analog Input X49/9

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Shows the actual value at output of terminal X49/9 in V or mA. The value reflects the selection in ***parameter 36-50 Terminal X49/9 Analog Output***.

18-45 Analog Input X49/11

Default value:	0	**Parameter type:**	Range, 0 - 30
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	False

Shows the actual value at output of terminal X49/11 in V or mA. The value reflects the selection in ***parameter 36-60 Terminal X49/11 Analog Output***.

18-46 X49 Digital Output [bin]

Default value:	0	**Parameter type:**	Range, 0 - 15
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

Shows the binary value of all programmable I/O digital outputs.

5.18.6 18-4* Last Warning

18-47 Last Warning

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

This parameter shows the last warning.

18-48 Last Warning Count

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows how many times the last warning has been active.

5.18.7 18-5* Ref. & Feedb.

Parameters in this group report the reference and feedback inputs.

18-50 Sensorless Readout [Unit]

Default value:	0 SensorlessUnit	**Parameter type:**	Range, -999999.999 - 999999.999 SensorlessUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

This parameter shows a readout of the pressure or flow based on the sensorless calculations. This value is not used for control and will only be updated if sensorless data supports both flow and pressure.

18-55 Active Alarm Numbers

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter contains an array of up to 20 alarms that are currently active. The value 0 means no alarm.

18-56 Active Warning Numbers

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter contains an array of up to 20 warnings that are currently active. The value 0 means no warning.

5.18.8 18-6* Inputs & Outputs 2

18-60 Digital Input 2

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Shows the signal states from the active digital inputs.

- 0 = No signal
- 1 = Connected signal

5.18.9 18-7* Rectifier Status

18-70 Mains Voltage

Default value:	0 V	**Parameter type:**	Range, 0 - 1000 V, Array [4]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows the mains line-to-line voltage.

18-71 Mains Frequency

Default value:	0 Hz	**Parameter type:**	Range, -100 - 100 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

Shows the mains frequency.

18-72 Mains Imbalance

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Shows the maximum imbalance for the 3 mains line-to-line measurements.

18-73 Worst Inrush

Default value:	0	**Parameter type:**	Range, 0 - 10000
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter identifies which active inrush produces the data shown in ***parameter 18-70 Mains Voltage***, ***parameter 18-71 Mains Frequency***, ***parameter 18-72 Mains Imbalance***, and ***parameter 18-75 Rectifier DC Volt***. 1 = inrush 1, 2 = inrush 2, and so on.

18-74 Inrush Mode

Default value:	0	**Parameter type:**	Range, 0 - 1000, Array [4]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows the reported mode of each inrush board. The values are:

- 0 = unknown
- 1 = inrush
- 2 = running

The indices are as follows:

- 0 = inrush1
- 1 = inrush2
- 2 = inrush3
- 3 = inrush4

18-75 Rectifier DC Volt

Default value:	0 V	**Parameter type:**	Range, 0 - 10000 V
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the DC voltage measured on the rectifier module.

18-76 Mains Voltage 2

Default value:	0 V	**Parameter type:**	Range, 0 - 1000 V, Array [16]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the mains line-to-line measurements. The values are RMS. The indices are as follows:

- 0 = inrush1 average
- 1 = inrush2 average
- 4 = inrush1 L1
- 5 = inrush2 L1
- 8 = inrush1 L2
- 9 = inrush2 L2
- = inrush1 L3
- = inrush2 L3

18-77 Mains Frequency 2

Default value:	0 Hz	**Parameter type:**	Range, -100 - 100 Hz, Array [4]
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the mains frequency measurement. The indices are as follows:

- 0 = inrush1
- 1 = inrush2

18-78 Mains Imbalance 2

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [4]
Setup:	All seutps	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the maximum measured imbalance for the 3 mains line-to-line measurements. The indices are as follows:

- 0 = inrush1
- 1 = inrush2

18-79 Rectifier DC Volt. 2

Default value:	0 V	**Parameter type:**	Range, 0 - 1000 V, Array [4]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the DC voltage measurement from the rectifier module. The indices are as follows:

- 0 = inrush1
- 1 = inrush2

5.19 Parameter Group 20-** FC Closed Loop

5.19.1 Introduction to FC Closed Loop Parameters

Closed-loop PID

This parameter group is used for configuring the closed-loop PID controller that controls the output frequency of the drive.

Closed-loop DRC

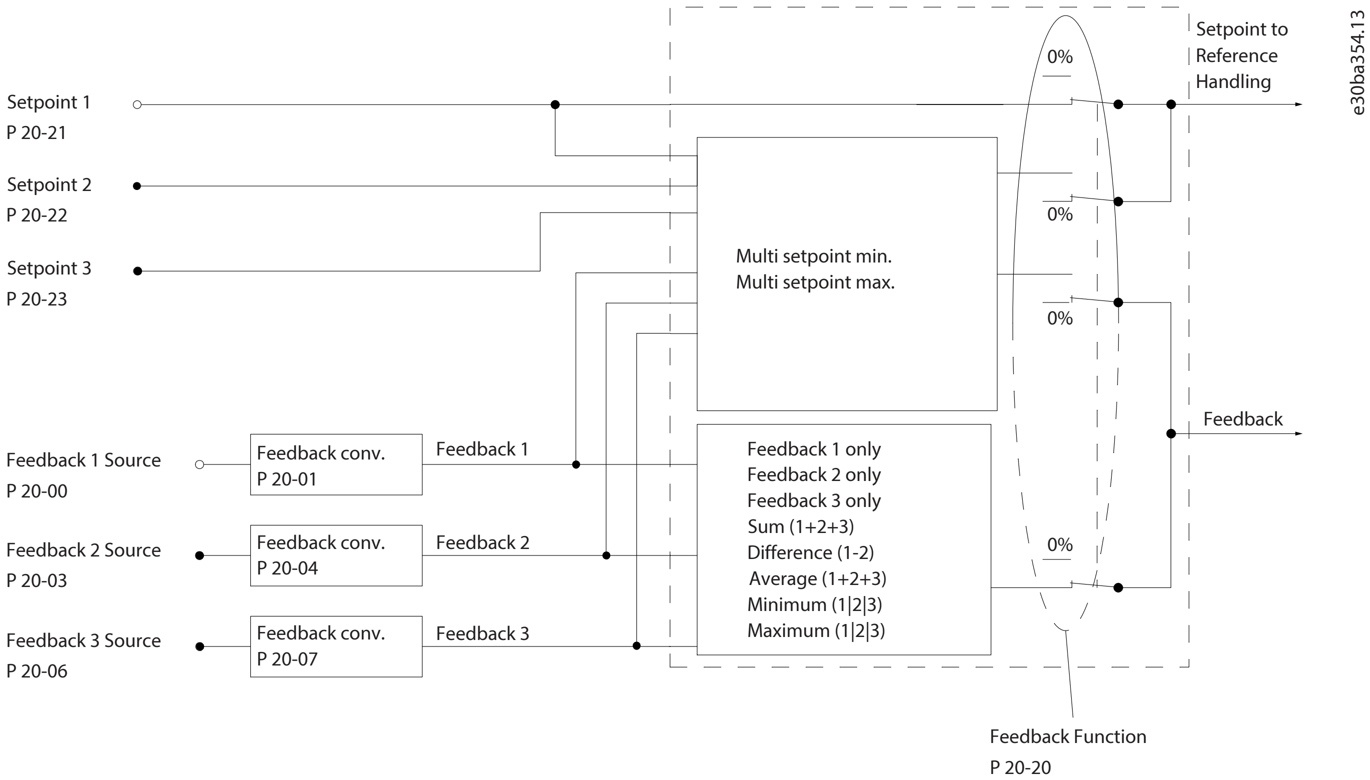
DRC (disturbance rejection control) improves adherence to the wanted process control setpoint (for example, wanted water pressure) by responding more rapidly to both incidental load disturbances and changes in the setpoint. DRC reacts rapidly to ensure that the system quickly returns to the required pressurization. This improved regulation ensures process consistency and reduces oscillations that may harm the mechanical infrastructure. DRC relies on a proprietary control algorithm that compensates for any behavior that deviates from the expected behavior based on the basic physical model generated by DRC Identify. Basically, DRC Control depends on the system characteristics measured by ***parameter 20-79 Autotuning*** when it is set to *SPC*. The DRC controller is then engaged based on the measured system information retrieved during the auto-tuning process. DRC responsiveness is initially set to a value that depends on whether the relevant system is defined as *Normal* (default) or *Fast*, which can be modified in ***parameter 20-71 Controller Performance***. An example of a fast system is an irrigation system with short ramp times which requires rapid responses when there are changes to the wanted water pressure or opened valves.

NOTICE

DRC is not yet recommended for usage in systems that uses cascade controller functionality (for example, municipal water distribution systems).

5.19.2 20-0* Feedback

This parameter group is used to configure the feedback signal for the closed-loop PID controller. Whether the drive is in closed-loop mode or open-loop mode, the feedback signals can be shown on the LCP display. It can also be used to control an analog output of a drive, and it can be sent over various serial communication protocols.



20-00 Feedback 1 Source

Default value:	[2] Analog input 54	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. *Parameter 20-20 Feedback Function* determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 1st feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]*	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	

Option	Name	Description
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-01 Feedback 1 Conversion

Default value:	[0] Linear	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

This parameter allows a conversion function to be applied to feedback 1.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback. $flow a \sqrt{pressure}$

20-02 Feedback 1 Source Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is only available when using pressure to temperature feedback conversion. If option ***[0] Linear*** is selected in ***parameter 20-01 Feedback 1 Conversion***, the setting of any option in ***parameter 20-02 Feedback 1 Source Unit*** does not matter as a conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of ***parameter 20-01 Feedback 1 Conversion***. This unit is not used by the PID controller.

Option	Name	Description
[0]	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	

Option	Name	Description
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-03 Feedback 2 Source

Default value:	[2] Analog input 54	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. *Parameter 20-20 Feedback Function* determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 2nd feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]*	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-04 Feedback 2 Conversion

Default value:	[0] Linear	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

This parameter allows a conversion function to be applied to feedback 2.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback. $flow \alpha \sqrt{pressure}$

20-05 Feedback 2 Source Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is only available when using pressure to temperature feedback conversion. If option ***[0] Linear*** is selected in ***parameter 20-04 Feedback 2 Conversion***, the setting of any option in ***parameter 20-05 Feedback 2 Source Unit*** does not matter as a conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of ***parameter 20-04 Feedback 2 Conversion***. This unit is not used by the PID controller.

Option	Name	Description
[0]	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	

Option	Name	Description
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-06 Feedback 3 Source

Default value:	[2] Analog input 54	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. *Parameter 20-20 Feedback Function* determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 3rd feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]*	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	

Option	Name	Description
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-07 Feedback 3 Conversion

Default value:	[0] Linear	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

This parameter allows a conversion function to be applied to feedback 3.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback. $\text{flow}a\sqrt{\text{pressure}}$

20-08 Feedback 3 Source Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is only available when using pressure to temperature feedback conversion. If option ***[0] Linear*** is selected in ***parameter 20-07 Feedback 3 Conversion***, the setting of any option in ***parameter 20-08 Feedback 3 Source Unit*** does not matter as a conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of ***parameter 20-07 Feedback 3 Conversion***. This unit is not used by the PID controller.

Option	Name	Description
[0]	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	

Option	Name	Description
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	

Option	Name	Description
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-12 Reference/Feedback Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter determines the unit that is used for references and feedback in closed-loop operation.

Option	Name	Description
[0]	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	

Option	Name	Description
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	

Option	Name	Description
[174]	in HG	
[180]	hp	

5.19.3 20-2* Feedback/Setpoint

This parameter group is used to determine how the PID controller uses the 3 possible feedback signals to control the output frequency of the drive. This group is also used to store the 3 internal setpoint references.

Parameter 20-20 Feedback Function

Default value:	[4] Maximum	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter determines how the 3 possible forms of feedback are used to control the output frequency of the drive.

Option	Name	Description
[0]	Sum	Sets up the PID controller to use the sum of feedback 1, feedback 2, and feedback 3 as the feedback. **NOTICE** Set any unused feedback to ***[0] No function*** in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** The sum of setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the setpoint reference of the PID controller.
[1]	Difference	Sets up the PID controller to use the difference between feedback 1 and feedback 2 as the feedback. Feedback 3 is not used with this selection. Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.

Option	Name	Description
[2]	Average	Sets up the PID controller to use the average of feedback 1, feedback 2, and feedback 3 as the feedback. **NOTICE** Set any unused feedback to *[0] No function* in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.
[3]	Minimum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3. The PID controller uses the lowest value as the feedback. **NOTICE** Set any unused feedback to *[0] No function* in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the PID controller's reference.
[4]*	Maximum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3. The PID controller uses the highest value as the feedback. **NOTICE** Set any unused feedback to *[0] No function* in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.

Option	Name	Description
[5]	Multi setpoint min	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2. **NOTICE** Set any unused feedback to ***[0] No function*** in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** Each setpoint reference is the sum of its respective parameter value and any other references that are enabled.
[6]	Multi setpoint max	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2. **NOTICE** Set any unused feedback to ***[0] No function*** in: • ***Parameter 20-00 Feedback 1 Source*** • ***Parameter 20-02 Feedback 2 Source*** • ***Parameter 20-06 Feedback 3 Source*** Each setpoint reference is the sum of its respective parameter value and any other references that are enabled.

The PID controller uses the feedback resulting from the function selected in ***parameter 20-20 Feedback Function*** to control the output frequency of the drive. This feedback can also be:

- Shown on the display of the drive.
- Used to control an analog output of a drive.
- Transmitted over various serial communication protocols.

The drive can be configured to handle multi-zone applications. 2 different multi-zone applications are supported:

- Multi-zone, single setpoint
- Multi-zone, multi-setpoint

Examples 1 and 2 show the difference between the 2 applications.

Example 1 - Multi-zone, single setpoint

In an office building, a VAV (variable air volume) VLT® HVAC Drive system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting ***parameter 20-20 Feedback Function*** to ***[3] Minimum*** and entering the desired pressure in ***parameter 20-21 Setpoint 1***. If any feedback is below the setpoint, the PID controller increases the fan speed. If all feedbacks are above the setpoint, the PID controller decreases the fan speed.

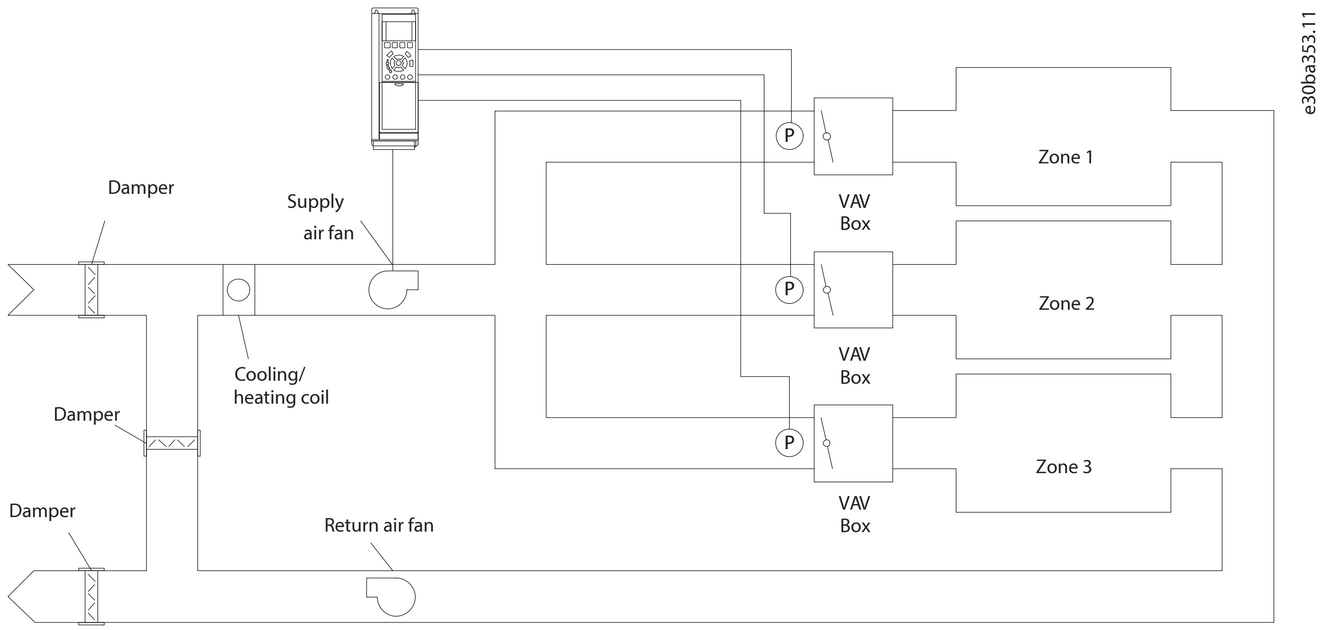


Figure 93: Example, Multi-zone, Single Setpoint

Example 2, multi-zone, multi-setpoint

The previous example illustrates the use of multi-zone, single-setpoint control. If the zones require different pressures for each VAV box, each setpoint may be specified in

- ***parameter 20-21 Setpoint 1***
- ***parameter 20-22 Setpoint 2***
- ***parameter 20-23 Setpoint 3***

By selecting ***[5] Multi-setpoint minimum*** in ***parameter 20-20 Feedback Function***, the PID controller increases the fan speed if any of the feedbacks are below their setpoints. If all feedbacks are above their individual setpoints, the PID controller decreases the fan speed.

20-21 Setpoint 1

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

20-22 Setpoint 2

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 2 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

20-23 Setpoint 3

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 3 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

5.19.4 20-5* DRC

20-50 Controller Selection

Default value:	[0] PID	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the PCL control principle. For extended PCL, the control principle is always PID.

Option	Name	Description
[0]*	PID	
[1]	DRC	

20-52 Gain Estimate

Default value:	1.00	**Parameter type:**	Range, 0.00 - 100.00
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Use this parameter for estimating the system gain.

20-53 Time Constant Estimate

Default value:	1.000 s	**Parameter type:**	Range, 0.000 - 100.000 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

Use this parameter for estimating the system time constant.

20-54 Deadtime Estimate

Default value:	10.000 s	**Parameter type:**	Range, 0.000 - 100.000 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

Use this parameter for estimating the system deadtime.

20-55 Controller Gain

Default value:	Size related	**Parameter type:**	Range, 0.0 - 1.0
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

This parameter determines the dynamic response of the DRC controller. To achieve a fast response, increase the parameter value. To prioritize stability over fast responses, decrease the parameter value.

20-56 Tuned Cascade Capacity

Default value:	100%	**Parameter type:**	Range, 100 - 800%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the combined capacity of the motors that were part of the last successful tuning experiment.

5.19.5 20-6* Sensorless

Parameters for sensorless function. See also:

- ***Parameter 20-20 Feedback 1 Source***
- ***Parameter 18-50 Sensorless Readout [Unit]***
- ***Parameter 16-26 Power Filtered [kW]***
- ***Parameter 16-27 Power Filtered [hp]***

NOTICE
Sensorless unit and sensorless information require setup by VLT® Motion Control Tool MCT 10 with sensorless-specific plug-in.

20-60 Sensorless Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Select the unit to be used with ***parameter 18-50 Sensorless Readout [Unit]***.

Option	Name	Description
[20]	l/s	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[71]	bar	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	

20-69 Sensorless Information

Default value:	0	**Parameter type:**	0 - 25, Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

View the information about the sensorless data.

5.19.6 20-7* Autotuning

PID autotuning

The closed-loop controller of the drive (*parameter group 20-** FC Closed Loop*) can be autotuned, which simplifies and saves time during commissioning, while ensuring accurate control adjustment. To use autotuning, configure the drive for closed loop in ***parameter 1-00 Configuration Mode***.

Use a graphical local control panel (GLCP) to react to messages during the autotuning sequence.

Selecting either PID or SPC in ***parameter 20-79 PID Autotuning*** puts the drive in autotuning mode. The LCP then shows on-screen instructions.

To start the fan/pump, press [Auto On] and apply a start signal. The default control settings ensure that the setpoint is eventually reached. For PID autotuning, it is possible to adjust the speed manually by pressing [▲] or [▼] to a level where the feedback is around the system setpoint.

NOTICE
If the feedback goes outside the specified limits (2073 and 2074) defined during autotune setup, the autotuning is discarded. The limits also serve as application protection during autotuning execution.

NOTICE
It is not possible to run the motor at maximum or minimum speed when manually adjusting the motor speed due to the need of increasing or decreasing the motor speed during autotuning.

Autotuning introduces step changes while operating at a steady state and then monitors the feedback. For PID control, the autotuning feedback response defines the required values for ***parameter 20-93 PID Proportional Gain***, and ***parameter 20-94 PID Integral Time*** is calculated. ***Parameter 20-95 PID Differentiation Time*** is set to value 0. ***Parameter 20-81 PID Normal/Inverse Control*** is determined during the tuning process.

These calculated values are presented in the LCP and can be either accepted or rejected. Once accepted, the values are written to the relevant parameters and autotuning mode is disabled in ***parameter 20-79 PID Autotuning***. Depending on the system, the time required to carry out autotuning could be several minutes.

Before carrying out the autotuning, set the following parameters according to the load inertia:

- ***Parameter 3-41 Ramp 1 Ramp Up Time***
- ***Parameter 3-42 Ramp 1 Ramp Down Time***

or

- ***Parameter 3-51 Ramp 2 Ramp Up Time***
- ***Parameter 3-52 Ramp 2 Ramp Down Time***

If PID autotuning is carried out with slow ramp times, the autotuned parameters typically result in slow control. Before activating PID autotuning, remove excessive feedback sensor noise using the input filter (*parameter groups 6-** Analog In/Out*, *5-** Pulse Input*, and *26-** Analog I/O Option MCB 109*, ***parameter 6-16 Terminal 53 Filter Time Constant***, ***parameter 6-26 Terminal 54 Filter Time Constant***, ***parameter 5-54 Pulse Filter Time Constant #29***, ***parameter 5-59 Pulse Filter Time Constant #33***). To obtain the most accurate controller parameters, carry out PID autotuning when the application runs in typical operation with a typical load.

SPC autotuning

SPC initiates a tuning of DRC. If feedback from the system determines the system to be 2nd order, autotuning proceeds automatically with tuning of PID parameters. If SPC discards the DRC, it is shown by the process bar going to step 4.

DCR assumes that the target applications of the drive can be generically modeled as 1st order plus dead-time systems. DRC autotuning is providing the feedback for calculation.

- τ = time constant of process system K_p (process system gain).
- θ = time delay between input and output. DRC can only be set up by using SPC.

20-70 Closed Loop Type

Default value:	[0] Auto	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the application response speed if it is known. The default setting is sufficient for most applications. A more precise value decreases the time needed for carrying out PID adaptation. The setting has no impact on values of parameters and only affects the auto-tuning speed.

Option	Name	Description
[0]*	Auto	Takes 30–120 s to complete.
[1]	Fast pressure	Takes 10–60 s to complete.
[2]	Slow pressure	Takes 30–120 s to complete
[3]	Fast temperature	Takes 10–20 minutes to complete.
[4]	Slow temperature	Takes 30–60 minutes to complete.

20-71 PID Performance

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the application response speed if it is known. The default setting is sufficient for most applications. A more precise value decreases the time needed for carrying out PID adaptation. The setting has no impact on values of parameters and only affects the auto-tuning speed.

Option	Name	Description
[0]*	Normal	Normal setting of this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting is used in pumping systems where a faster control response is wanted.

20-72 PID Output Change

Default value:	0.10	**Parameter type:**	Range, 0.01 - 0.5
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full speed. That is, if maximum output frequency in ***parameter 4-13 Motor Speed High Limit [RPM]***/***parameter 4-14 Motor Speed High Limit [Hz]*** is set to 40 Hz, 0.10 is 10% of 50 Hz, which is 5 Hz. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

20-73 Minimum Feedback Level

Default value:	-999999 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	2 setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

Enter the minimum allowable feedback level in user units as defined in ***parameter 20-12 Reference/Feedback Unit***. If the level drops below ***parameter 20-73 Minimum Feedback Level***, auto tuning is aborted and an error message appears in the LCP.

20-74 Maximum Feedback Level

Default value:	999999 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	2 setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the maximum allowable feedback level in user units as defined in ***parameter 20-12 Reference/Feedback Unit***. If the level rises above ***parameter 20-74 Maximum Feedback Level***, auto tuning is aborted and an error message appears in the LCP.

20-79 Autotuning

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the controller which should be autotuned. Once the auto tuning has successfully completed and the settings have been accepted or rejected via [OK] or [Cancel] at the end of tuning, this parameter resets to ***[0] Disabled***.

Option	Name	Description
[0]*	Disabled	Auto tuning is disabled.
[1]	PID	
[2]	Smart process	
[3]	DRC	

5.19.7 20-8* PID Basic Settings

This parameter group is used to configure the basic operation of the PID controller, including:

- Response to the feedback above or below the setpoint.
- The speed at which it first starts functioning.
- When it indicates that the system has reached the setpoint.

20-81 PID Normal/Inverse Control

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Normal	The output frequency of the drive decreases when the feedback is greater than the setpoint reference. This behavior is common for pressure-controlled supply fan and pump applications.
[1]	Inverse	The output frequency of the drive increases when the feedback is greater than the setpoint reference. This behavior is common for temperature-controlled cooling applications, such as cooling towers.

20-82 PID Start Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - Par. 4-13 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is only visible if ***parameter 0-02 Motor Speed Unit*** is set to ***[0] RPM***.

When the drive is first started, it initially ramps up to this output speed in open-loop mode, following the active ramp-up time. When the output speed programmed is reached, the drive automatically switches to closed-loop mode, and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

20-83 PID Start Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - Par. 4-14 [Hz]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is only visible if ***parameter 0-02 Motor Speed Unit*** is set to ***[1] Hz***.

When the drive is first started, it initially ramps up to this output frequency in open-loop mode, following the active ramp-up time. When the output frequency programmed is reached, the drive automatically switches to closed-loop mode, and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

20-84 On Reference Bandwidth

Default value:	5%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0

Data type:	Uint8	**Change during operation:**	True

When the difference between the feedback and the setpoint reference is less than the value of this parameter, the display of the drive shows *Run on reference*. This status can be communicated externally by programming the function of a digital output for ***[8] Run on reference/no warning***. Also, for serial communication, the On Reference status bit of the drive status word is high (value = 1). The *On reference bandwidth* is calculated as a percentage of the setpoint reference.

5.19.8 20-9* PID Controller

Use these parameters to adjust the PID controller manually. By adjusting the PID controller parameters, the control performance may be improved.

20-91 PID Anti Windup

Default value:	[1] On	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Option ***[1] On*** is activated automatically if 1 of the following options is selected in parameters in *parameter group 21-** Ext. Closed Loop*: ***[0] Normal***, *[X] Enabled Ext CLX PID*.

Option	Name	Description
[0]	Off	The integrator continues to change value also after output has reached 1 of the extremes. This can afterwards cause a delay of change of the output of the controller.
[1]*	On	The integrator is locked if the output of the built-in PID controller has reached 1 of the extremes (minimum or maximum value) and therefore is not able to add further changes to the value of the process parameter controlled. This allows the controller to respond more quickly when it can control the system again.

20-93 PID Proportional Gain

Default value:	2	**Parameter type:**	Range, 0=Off - 10
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

NOTICE

Always set the required value for ***parameter 20-14 Maximum Reference/Feedb.*** before setting the values for the PID controller in *parameter group 20-9* PID Controller*.

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (error x gain) jumps with a value equal to what is set in ***parameter 20-14 Maximum Reference/Feedb.***, the PID controller tries to change the output speed equal to what is set in ***parameter 4-13 Motor Speed High Limit [RPM]***/***parameter 4-14 Motor Speed High Limit [Hz]***. However, the output speed is limited by this setting.

Calculate the proportional band (error causing output to change from 0–100%) with this formula:

$$\left(\frac{1}{\text{Proportional gain}}\right) \times (\text{Max reference})$$

20-94 PID Integral Time

Default value:	8 s	**Parameter type:**	Range, 0.01 - 10000 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

The integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in ***parameter 20-93 PID Proportional Gain***. When no deviation is present, the output from the proportional controller is 0.

20-95 PID Differentiation Time

Default value:	0 s	**Parameter type:**	Range, 0=Off - 10 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The differentiator monitors the rate of change of the feedback. If the feedback is changing quickly, it adjusts the output of the PID controller to reduce the rate of change of the feedback. Quick PID controller response is obtained when this value is large. However, if too large a value is used, the output frequency of the drive may become unstable. Differentiation time is useful in situations where extremely fast drive response and precise speed control are required. It can be difficult to adjust this for proper system control. Differentiation time is not commonly used in HVAC applications. Therefore, it is best to leave this parameter at 0 or OFF.

20-96 PID Diff. Gain Limit

Default value:	5	**Parameter type:**	Range, 1 - 50
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

The differential function of a PID controller responds to the rate of change of the feedback. As a result, an abrupt change in the feedback can cause the differential function to make a large change in the PID controller output. This parameter limits the maximum effect that the PID controller differential function can produce. A smaller value reduces the maximum effect of the PID controller differential function. This parameter is only active when ***parameter 20-95 PID Differentiation Time*** is not set to OFF (0 s).

5.20 Parameter Group 21-** Extended Closed Loop

5.20.1 Introduction to Extended Closed Loop

The FC 202 offers 3 extended closed-loop PID controllers in addition to the PID controller. These can be configured independently to control either external actuators (valves, dampers, and so on) or be used with the internal PID controller to improve the dynamic responses to setpoint changes or load disturbances.

The extended closed-loop PID controllers may be interconnected or connected to the PID closed-loop controller to form a dual-loop configuration.

To control a modulating device, for example a valve motor, this device must be a positioning servo motor with built-in electronics accepting either a 0–10 V (signal from VLT® Analog I/O Option MCB 109) or a 0/4–20 mA (signal from control card and/or VLT® General Purpose I/O MCB 101) control signal. The output function can be programmed in the following parameters:

- Control card, terminal 42: ***Parameter 6-50 Terminal 42 Output*** (settings [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3)
- VLT® General Purpose I/O MCB 101, terminal X30/8: ***Parameter 6-60 Terminal X30/8 Output*** (settings [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3)
- VLT® Analog I/O Option MCB 109, terminal X42/7....11: ***Parameter 26-40 Terminal X42/7 Output***, ***parameter 26-50 Terminal X42/9 Output***, ***parameter 26-60 Terminal X42/11 Output*** (settings [113]...[115], Ext. Closed Loop 1/2/3)

VLT® General Purpose I/O MCB 101 and VLT® Analog I/O Option MCB 109 are optional cards.

5.20.2 21-0* Extended CL Autotuning

The extended closed-loop PID controllers can each be autotuned, which simplifies and saves time during commissioning, while ensuring accurate PID control adjustment.

To use PID autotuning, configure the relevant extended PID controller for the application.

Use a graphical LCP to react to messages during the autotuning sequence.

When enabling autotuning, ***parameter 21-09 PID Autotuning*** puts the relevant PID controller into PID autotuning mode. The LCP then provides on-screen instructions.

PID autotuning introduces step changes and then monitors the feedback. Based on the feedback response, the following required values are calculated:

- PID proportional gain
  - ***Parameter 21-21 Ext. 1 Proportional Gain*** for EXT CL 1.
  - ***Parameter 21-41 Ext. 2 Proportional Gain*** for EXT CL 2.
  - ***Parameter 21-61 Ext. 3 Proportional Gain*** for EXT CL 3.
- Integral time
  - ***Parameter 21-22 Ext. 1 Integral Time*** for EXT CL 1.
  - ***Parameter 21-42 Ext. 2 Integral Time*** for EXT CL 2.
  - ***Parameter 21-62 Ext. 3 Integral Time*** for EXT CL 3.

The PID differentiation time is set to 0 in the following parameters:

- ***Parameter 21-23 Ext. 1 Differentiation Time*** for EXT CL 1.
- ***Parameter 21-43 Ext. 2 Differentiation Time*** for EXT CL 2.
- ***Parameter 21-63 Ext. 3 Differentiation Time*** for EXT CL 3.
- ***Parameter 21-20 Ext. 1 Normal/Inverse Control*** for EXT CL 1.
- ***Parameter 21-40 Ext. 2 Normal/Inverse Control*** for EXT CL 2.
- ***Parameter 21-60 Ext. 3 Normal/Inverse Control*** for EXT CL 3.

These calculated values are presented on the LCP and can either be accepted or rejected. Once accepted, the values are written to the relevant parameters, and PID autotuning mode is disabled in ***parameter 21-09 PID Autotuning***.

Depending on the system being controlled, the time required to carry out PID autotuning could be several minutes.

Before activating the PID autotuning, remove excessive feedback sensor noise using the input filter (*parameter groups 5-5* Pulse Input*, *6-** Analog In/Out*, and *26-** Analog I/O Option MCB 109*, terminal 53/54 filter time constant, and pulse filter time constant #29/33).

21-00 Closed Loop Type

Default value:	[0] Auto	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter defines the application response. The default mode should be sufficient for most applications. If the relative application speed is known, it can be selected here. This decreases the time needed for carrying out PID autotuning.

Option	Name	Description
[0*]	Auto	
[1]	Fast pressure	
[2]	Slow pressure	
[3]	Fast temperature	
[4]	Slow temperature	

21-01 PID Performance

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	2 setups	**Convertion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Normal	Normal setting for this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting would generally be used in pumping systems where a faster control response is desirable.

21-02 PID Output Change

Default value:	0.10	**Parameter type:**	Range, 0.01 - 0.50
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full operating range. That is, if the maximum analog output voltage is set to 10 V, 0.10 is 10% of 10 V, which is 1 V. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

21-03 Minimum Feedback Level

Default value:	-999999.999	**Parameter type:**	Range, -999999.999 - par. 21-04
Setup:	2 setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

Enter the minimum allowable feedback level in user units as defined:

- ***Parameter 21-10 Ext. 1 Ref./Feedback Unit*** for EXT CL 1.
- ***Parameter 21-30 Ext. 2 Ref./Feedback Unit*** for EXT CL 2.
- ***Parameter 21-50 Ext. Ref./Feedback Unit*** EXT CL.

If the level drops below ***parameter 21-03 Minimum Feedback Level***, PID auto tuning is aborted, and an error message appears in the display.

21-04 Maximum Feedback Level

Default value:	999999.999	**Parameter type:**	Range, Par. 21-04 - 999999.999
Setup:	2 setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the maximum allowable feedback level in user units as defined:

- ***Parameter 21-10 Ext. 1 Ref./Feedback Unit*** for EXT CL 1.
- ***Parameter 21-30 Ext. 2 Ref./Feedback Unit*** for EXT CL 2.
- ***Parameter 21-50 Ext. Ref./Feedback Unit*** EXT CL.

If the level rises above ***parameter 21-04 Maximum Feedback Level***, PID autotuning is aborted, and an error message appears in the display.

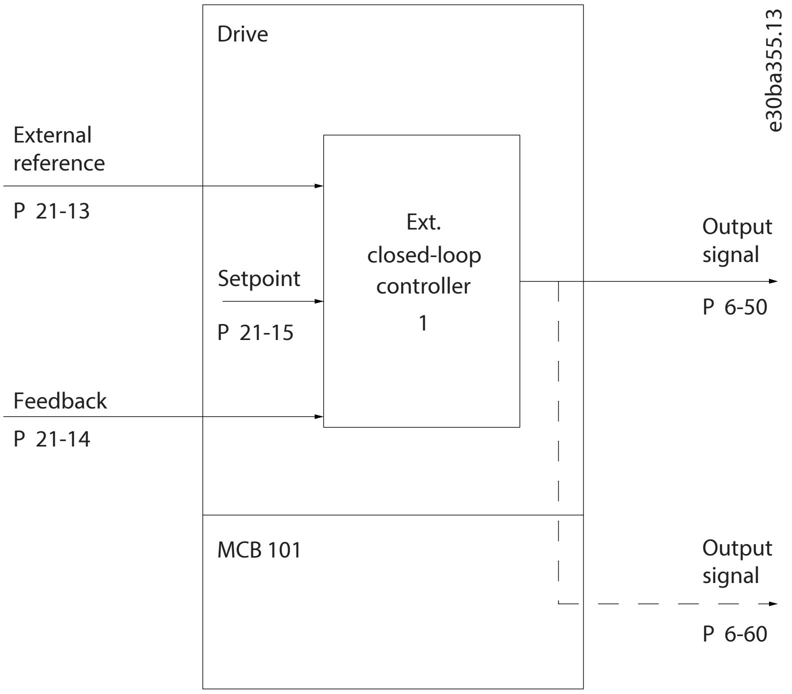
21-09 PID Autotuning

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter enables selection of the extended PID controller to be autotuned and starts the PID autotuning for that controller. Once the autotuning has successfully completed, and the settings have been accepted or rejected with [OK] or [Cancel] when autotuning has ended, this parameter resets to ***[0] Disabled***.

Option	Name	Description
[0*]	Disabled	
[1]	Enabled EXT CL 1 PID	
[2]	Enabled EXT CL 2 PID	
[3]	Enabled EXT CL 3 PID	

5.20.3 21-1* Closed Loop Ref/Feedback



21-10 Ext. 1 Ref./Feedback Unit

Default value:	[0]	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	

Option	Name	Description
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	

Option	Name	Description
[171]	lb/in ^{2}	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

21-11 Ext. 1 Minimum Reference

Default value:	0 ExtPID1Unit	**Parameter type:**	Range, -999999.999 - par. 21-12 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Select the minimum reference for the closed-loop 1 controller.

21-12 Ext. Maximum Reference

Default value:	100 ExtPID1Unit	**Parameter type:**	Range, par. 21-11 - 999999.999 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

Set the value for ***parameter 21-12 Ext. 1 Maximum Reference*** before setting the values for the PID controller in *parameter group 20-9* PID Controller*.

Select the maximum reference for the closed-loop 1 controller. The dynamics of the PID controller depend on the value set in this parameter. See also ***parameter 21-21 Ext. 1 Proportional Gain***.

21-13 Ext. 1 Reference Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. ***Parameter 20-20 Feedback Function*** determines how the PID controller uses the 3 possible feedbacks.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	
[35]	Digital input select	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-14 Ext. 1 Feedback Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	

Option	Name	Description
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-15 Ext. 1 Setpoint

Default value:	0 ExtPID1Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

The setpoint reference is used in extended 1 closed loop. Ext. 1 setpoint is added to the value from the Ext. 1 reference source selected in ***parameter 21-13 Ext. 1 Reference Source***.

21-17 Ext. Reference [Unit]

Default value:	0 ExtPID1Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID1Unit

Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the reference value for the closed-loop 1 controller.

21-18 Ext. 1 Feedback [Unit]

Default value:	0 ExtPID1Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the feedback value for the closed-loop 1 controller.

21-19 Ext. 1 Output [%]

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Readout of the output value for the closed-loop 1 controller.

5.20.4 21-2* Closed Loop 1 PID

21-20 Ext. 1 Normal/Inverse Control

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-21 Ext. 1 Proportional Gain

Default value:	0.50	**Parameter type:**	Range, 0=Off - 10
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (error x gain) jumps with a value equal to what is set in *parameter 20-14 Maximum Reference/Feedb.*, the PID controller tries to change the output speed equal to what is set in *parameter 4-13 Motor Speed High Limit [RPM]*/*parameter 4-14 Motor Speed High Limit [Hz]*. However, the output speed is limited by this setting. The proportional band (error causing output to change from 0–100%) can be calculated with this formula:

$$\left(\frac{1}{\text{Proportional gain}}\right) \times (\text{Maximum reference})$$

21-22 Ext. 1 Integral Time

Default value:	20 s	**Parameter type:**	0.01 - 10000=Off s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in ***parameter 20-93 PID Proportional Gain***. When no deviation is present, the output from the proportional controller is 0.

21-23 Ext. 1 Differentiation Time

Default value:	0 s	**Parameter type:**	Range, 0=Off - 10 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

21-24 Ext. 1 Dif. Gain Limit

Default value:	5	**Parameter type:**	Range, 1 - 50
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain when changes are slow and a constant differentiator gain when quick changes occur.

21-26 Ext. 1 On Reference Bandwidth

Default value:	5%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.20.5 21-3* Closed Loop 2 Ref/Fb

21-30 Ext. 2 Ref./Feedback Unit

Default value:	[0] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	Change during operation:	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	

Option	Name	Description
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

21-31 Ext. 2 Minimum Reference

Default value:	0 ExtPID2Unit	**Parameter type:**	Range, -999999.999 - par. 21-32 Ext.PID2Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Select the minimum reference for the closed-loop 2 controller.

21-32 Ext. 2 Maximum Reference

Default value:	100 ExtPID2Unit	**Parameter type:**	Range, par. 21-31 - 999999.999 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

Set the value for ***parameter 21-32 Ext. 2 Maximum Reference*** before setting the values for the PID controller in *parameter group 20-9* PID Controller*.

Select the maximum reference for the closed-loop 1 controller. The dynamics of the PID controller depend on the value set in this parameter. See also ***parameter 21-41 Ext. 2 Proportional Gain***.

21-33 Ext. 2 Reference Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. ***Parameter 20-20 Feedback Function*** determines how the PID controller uses the 3 possible feedbacks.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 2 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	
[35]	Digital input select	

Option	Name	Description
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-34 Ext. 2 Feedback Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.

Option	Name	Description
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-35 Ext. 2 Setpoint

Default value:	0 ExtPID2Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setpoint:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

The setpoint reference is used in extended 2 closed loop. Ext. 1 setpoint is added to the value from the Ext. 1 reference source selected in ***parameter 21-33 Ext. 2 Reference Source***.

21-37 Ext. 2 Reference [Unit]

Default value:	0 ExtPID2Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID2Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the reference value for the closed-loop 2 controller.

21-38 Ext. 2 Feedback [Unit]

Default value:	0 ExtPID2Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the feedback value for the closed-loop 2 controller.

21-39 Ext. 2 Output [%]

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Readout of the output value for the closed-loop 2 controller.

5.20.6 21-4* Closed Loop 2 PID

21-40 Ext. 2 Normal/Inverse Control

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-41 Ext. 2 Proportional Gain

Default value:	0.50	**Parameter type:**	Range, 0=Off - 10
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

21-42 Ext. 2 Integral Time

Default value:	20 s	**Parameter type:**	0.01 - 10000=Off s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in ***parameter 20-93 PID Proportional Gain***. When no deviation is present, the output from the proportional controller is 0.

21-43 Ext. 2 Differentiation Time

Default value:	0 s	**Parameter type:**	Range, 0=Off - 10 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

21-44 Ext. 2 Dif. Gain Limit

Default value:	5	**Parameter type:**	Range, 1 - 50

Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain when changes are slow and a constant differentiator gain when quick changes occur.

21-46 Ext. 2 On Reference Bandwidth

Default value:	5%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.20.7 21-5* Closed Loop 3 Ref/Fb

21-50 Ext. 3 Ref./Feedback Unit

Default value:	[0] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	

Option	Name	Description
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	

Option	Name	Description
[174]	in HG	
[180]	hp	

21-51 Ext. 3 Minimum Reference

Default value:	0 ExtPID3Unit	**Parameter type:**	Range, -999999.999 - par. 21-52 Ext.PID3Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Select the minimum reference for the closed-loop 3 controller.

21-52 Ext. 3 Maximum Reference

Default value:	100 ExtPID3Unit	**Parameter type:**	Range, par. 21-51 - 999999.999 Ext.PID3Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

NOTICE

Set the value for ***parameter 21-52 Ext. 3 Maximum Reference*** before setting the values for the PID controller in *parameter group 20-9* PID Controller*.

Select the maximum reference for the closed-loop 3 controller. The dynamics of the PID controller depend on the value set in this parameter. See also ***parameter 21-61 Ext. 3 Proportional Gain***.

21-53 Ext. 3 Reference Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If feedback is not used, set its source to ***[0] No function***. ***Parameter 20-20 Feedback Function*** determines how the PID controller uses the 3 possible feedbacks.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	

Option	Name	Description
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	
[35]	Digital input select	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-54 Ext. 3 Feedback Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	

Option	Name	Description
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-55 Ext. 3 Setpoint

Default value:	0 ExtPID3Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID3Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

The setpoint reference is used in extended 1 closed loop. Ext. 1 setpoint is added to the value from the Ext. 3 reference source selected in ***parameter 21-53 Ext. 3 Reference Source***.

21-57 Ext. 3 Reference [Unit]

Default value:	0 ExtPID3Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID3Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the reference value for the closed-loop 3 controller.

21-58 Ext. 3 Feedback [Unit]

Default value:	0 ExtPID3Unit	**Parameter type:**	Range, -999999.999 - 999999.999 Ext.PID3Unit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Readout of the feedback value for the closed-loop 3 controller.

21-59 Ext. 3 Output [%]

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Readout of the output value for the closed-loop 3 controller.

5.20.8 21-6* Closed Loop 3 PID

21-60 Ext. 3 Normal/Inverse Control

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-61 Ext. 3 Proportional Gain

Default value:	0.50	**Parameter type:**	Range, 0=Off - 10
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

21-62 Ext. 3 Integral Time

Default value:	20 s	**Parameter type:**	0.01 - 10000=Off s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in ***parameter 20-93 PID Proportional Gain***. When no deviation is present, the output from the proportional controller is 0.

21-63 Ext. 3 Differentiation Time

Default value:	0 s	**Parameter type:**	Range, 0=Off - 10 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

21-64 Ext. 3 Dif. Gain Limit

Default value:	5	**Parameter type:**	Range, 1 - 50
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

21-66 Ext. 3 On Reference Bandwidth

Default value:	5%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.21 Parameter Group 22-** Application Functions

5.21.1 22-0* Miscellaneous

This parameter group contains parameters used for monitoring water/wastewater applications.

22-00 External Interlock Delay

Default value:	0 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the delay time for the external interlock command.

22-01 Power Filter Time

Default value:	0.50 s	**Parameter type:**	Range, 0.02 - 10 s
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the time constant for the filtered power readout. A higher value will give a more steady readout but a slower system response to changes.

5.21.2 22-2* No-flow Detection

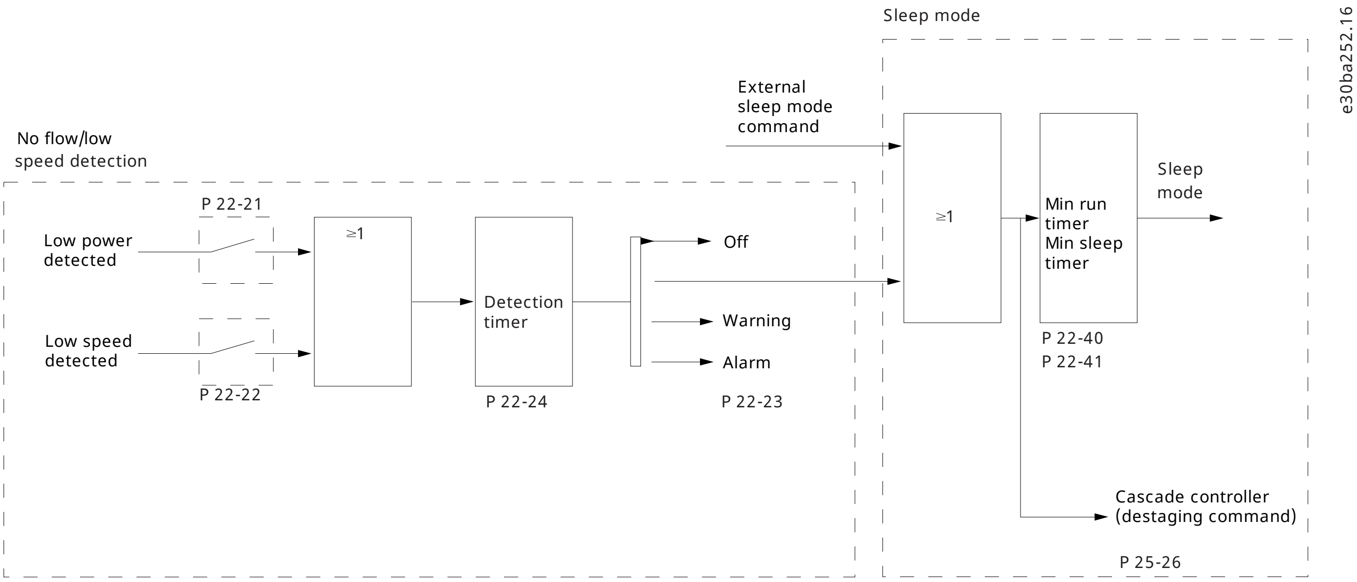


Figure 94: Signal Flow Chart

The VLT® AQUA Drive FC 202 includes functions that detect if the load conditions in the system allow the motor to be stopped:

- Low-power detection
- Low-speed detection

One of these 2 signals must be active for a set time (***parameter 22-24 No-Flow Delay***) before the selected action takes place. Possible actions to select (in ***parameter 22-23 No-Flow Function***) are:

- No action
- Warning
- Alarm
- Sleep mode

No-flow detection

This function is used to detect a no-flow situation in pump systems where all valves can be closed. It can be used both when controlled by the integrated PI controller in the drive or by an external PI controller. Program the actual configuration in ***parameter 1-00 Configuration Mode***. The configuration modes for the PI controllers are as follows:

- Integrated PI controller: Closed loop
- External PI controller: Open loop

NOTICE
Carry out no-flow tuning before setting the PI controller parameters.

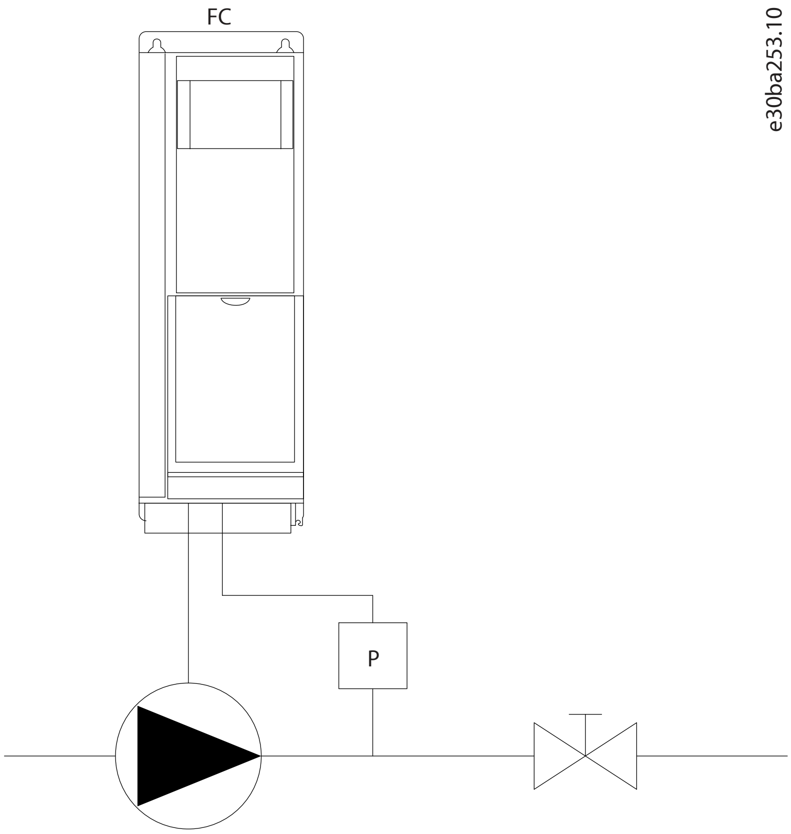


Figure 95: No-flow Detection Scheme

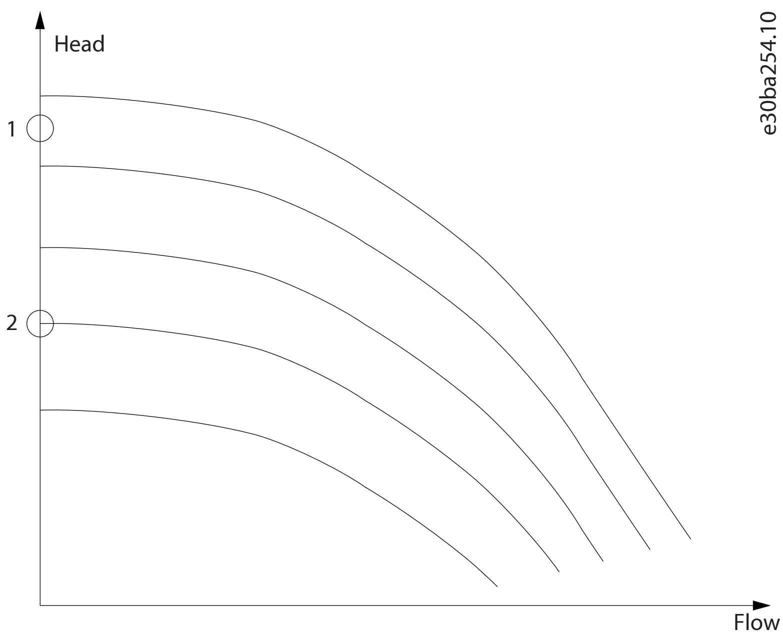


Figure 96: No-flow Detection Graph

No-flow detection is based on the measurement of speed and power. For a certain speed, the drive calculates the power at no flow. The coherence is based on the adjustment of 2 sets of speed and associated power at no flow. By monitoring the power, it is possible to detect no-flow conditions in systems with fluctuating suction pressure, or if the pump has a flat characteristic towards low speed. Base the 2 sets of data on measurement of power at approximately 50% and 85% of maximum speed with the valve closed. The data is programmed in *parameter group 22-3* No-flow Power Tuning*. It is also possible to run a ***parameter 22-20 Low Power Auto Set-up***, automatically stepping through the commissioning process, and also automatically storing the data measured. Set the drive for open loop in ***parameter 1-00 Configuration Mode*** when carrying out the auto setup (see *parameter group 22-3* No-flow Power Tuning*).

NOTICE

When using the integrated PI controller, carry out no-flow tuning before setting the PI controller parameters.

Low-speed detection

Low-speed detection gives a signal if the motor operates with minimum speed as set in ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***. Actions are common with no-flow detection (individual selection not possible). The use of low-speed detection is not limited to systems with a no-flow situation. It can be used in any system where operation at minimum speed allows for a stop of the motor until the load calls for a speed higher than minimum speed. An example is systems with fans and compressors.

NOTICE

In pump systems, ensure that the minimum speed in ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]*** has been set high enough for detection as the pump can run with a rather high speed, even with valves closed.

Dry-pump detection

No-flow detection can also be used to detect if the pump has run dry (low power consumption and high speed). It can be used with both the integrated PI controller and an external PI controller. The conditions for dry-pump signal are:

- Power consumption below no-flow level.
- Pump running at maximum speed or maximum reference open loop, whichever is lowest.

The signal must be active for a set time (***parameter 22-27 Dry Pump Delay***) before the selected action takes place. Possible actions to select (in ***parameter 22-26 Dry Pump Function***) are:

- Warning
- Alarm

Enable the low-power detection in ***parameter 22-21 Low Power Detection***. Perform the tuning using *parameter group 22-3* No-Flow Power Tuning*.

In a dry-pump detection setup, select ***[0] Off*** in ***parameter 22-23 No-Flow Function***. Otherwise, make sure that the options in that parameter do not prevent the dry-pump detection.

22-20 Low Power Auto Set-up

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Start of auto setup of power data for no-flow power tuning.

Option	Name	Description
[0*]	Off	
[1]	Enabled	**NOTICE** Do the auto setup when the system has reached normal operating temperature. **NOTICE** It is important that ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]*** is set to the maximum operational speed of the motor. **NOTICE** Do the auto setup before configuring the integrated PI controller as the settings are reset when changing from closed loop to open loop in ***parameter 1-00 Configuration Mode***. **NOTICE** Carry out the tuning with the same settings in ***parameter 1-03 Torque Characteristics*** as for operation after the tuning. An auto setup sequence is activated, automatically setting the speed to approximately 50% and 85% of nominal motor speed (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***). At those 2 speeds, the power consumption is automatically measured and stored. Before enabling auto setup: • Close valves to create a no-flow condition. • Set the drive to open loop (***parameter 1-00 Configuration Mode***). It is important also to set ***parameter 1-03 Torque Characteristics***.

22-21 Low Power Detection

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for enabling/disabling no-flow detection based on measured motor power.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	To set the parameters in *parameter group 22-3* No-flow Power Tuning* for proper operation, carry out the low-power detection commissioning.

22-22 Low Speed Detection

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for enabling/disabling no-flow detection based on operation at motor speed low limit.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	Detects when the motor operates at a speed as set in ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***.
[2]	Enabled with boost	This option is available when ***[3] Closed loop*** is selected in ***parameter 1-00 Configuration Mode***. Enable this option to improve the low-speed detection for applications with at least 1 of the following characteristics: • Varying inlet pressure. • A pressure drop at the outlet caused by closing a non-return valve. In such applications, the drive potentially does not reduce the speed to the minimum as required for the normal low-speed detection. When this option is selected, the drive creates a pressure pulse (boost of the pressure) when the feedback is within the range defined in ***parameter 7-39 On Reference Bandwidth*** for a period defined in ***parameter 22-40 Minimum Run Time*** or longer. ***Parameter 22-45 Setpoint Boost*** adjusts the height of the pulses. ***Parameter 22-46 Maximum Boost Time*** defines the maximum length of the pulse. **NOTICE** If selecting this option, ensure that the system can withstand the boost pressure.

Option	Name	Description
[3]	Enabled for multiple drives	For applications with multiple drives. Enable low-speed detection with the following features: • Minimum run time • Minimum sleet time • Boost
[4]	Enabled multidrive boost	For applications with multiple drives. This option is available when ***[3] Closed loop*** is selected in ***parameter 1-00 Configuration Mode***. Enable this option to improve low-speed detection for applications with at least 1 of the following characteristics: • Varying inlet pressure. • A pressure drop at the outlet caused by closing a non-return valve. In such applications, the drive potentially does not reduce the speed to the minimum as required for the normal low-speed detection. When this option is selected, the drive created a pressure pulse (boost of the pressure) when the feedback is within the range defined in ***parameter 7-39 On Reference Bandwidth*** for a period defined in ***parameter 22-40 Minimum Run Time*** or longer. ***Parameter 22-45 Setpoint Boost*** adjusts the height of the pulses. ***Parameter 22-46 Maximum Boost Time*** defines the maximum length of the pulse. **NOTICE** If selecting this option, ensure that the system can withstand the boost pressure. Refer to the Cascade Controller Options MCO 101/102 Operating Instructions for more information about the cascade controller.

22-23 No-flow Detection

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Common actions for low-power detection and low-speed detection (individual selections not possible).

Option	Name	Description
[0*]	Off	**NOTICE** Do not set ***parameter 14-20 Reset Mode*** to ***[13] Infinite auto reset*** when *parameter 22-23 No-flow Function* is set to ***[3] Alarm*** . Doing so causes the drive to continuously cycle between running and stopping when a no-flow condition is detected. **NOTICE** Disable the automatic bypass function of the bypass if • the drive has a constant-speed bypass with an automatic bypass function starting the bypass if a persistent alarm condition occurs, AND • ***[3] Alarm*** is selected as the no-flow function.
[1]	Sleep mode	The drive enters sleep mode and stops when a no-flow condition is detected. See *parameter group 22-4* Sleep Mode* for programming options for sleep mode.
[2]	Warning	The drive continues to run but activates a no-flow warning (*warning 92, NoFlow*). A digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The drive stops running and activates a no-flow alarm (*alarm 92, NoFlow*). A drive digital output or a serial communication bus can communicate an alarm to other equipment.

22-24 No-flow Delay

Default value:	10 s	**Parameter type:**	Range, 1 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the time that low power/low speed must stay detected to activate a signal for actions. If detection disappears before the time runs out, the timer is reset.

22-26 Dry Pump Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action for dry-pump operation. To use the dry-pump detection:

- Enable low-power detection in ***parameter 22-21 Low Power Detection***.

- Commission low-power detection using either *parameter group 22-3* No-flow Power Tuning* or ***parameter 22-20 Low Power Auto Set-up***.

NOTICE

Do not set ***parameter 14-20 Reset Mode*** to ***[13] Infinite auto reset*** when ***parameter 22-26 Dry Pump Function*** is set to ***[2] Trip***. Doing so causes the drive to continuously cycle between running and stopping when a dry-pump condition is detected.

NOTICE

For drives with constant-speed bypass: If an automatic bypass function starts the bypass at persistent alarm conditions, disable the automatic bypass function, if *[2] Trip* or *[3] Manuel reset trip* is selected as the dry-pump function.

Option	Name	Description
[0]*	Off	
[1]	Warning	The drive continues to run but activates a dry-pump warning (*warning 93, Dry pump*). A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The drive trips and activates a dry-pump alarm
[3]	Manuel reset trip	The drive trips and activates a no-flow alarm (*alarm 92, NoFlow*). A drive digital output or a serial communication bus can communicate an alarm to other equipment.
[4]	Stop and trip	

22-27 Dry Pump Delay

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter defines for how long the dry-pump condition must be active before activating a warning or an alarm. The drive waits for the no-flow delay time (***parameter 22-24 No-flow Delay***) to expire before the timer for the dry-pump delay starts.

22-28 No-flow Low Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, par. 4-11 - par. 4-13 [RPM]
Setup:	All setup	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the no-flow speed reference in RPM.

22-29 No-flow Low Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, par. 4-12 - par. 4-14 [Hz]
Setup:	All setups	**Conversion index:**	-1

Data type:	Uint16	**Change during operation:**	True

Set the no-flow speed reference in Hz.

5.21.3 22-4* Sleep Mode

If the load on the system allows for stop of the motor and the load is monitored, the motor can be stopped by activating the sleep-mode function. This is not a normal stop command, but ramps the motor down to 0 RPM and stops energizing the motor. When in sleep mode, certain conditions are monitored to find out when load has been applied to the system again.

Sleep mode can be activated either from the no-flow detection/minimum speed detection (must be programmed via parameters for no-flow detection, see the signal flow-diagram in *parameter group 22-2* No-flow Detection*) or via an external signal applied to 1 of the digital inputs (must be programmed via the parameters for configuration of the digital inputs, *parameter group 5-1* Digital Inputs* selecting ***[66] Sleep Mode***). Sleep mode is activated only when no wake-up conditions are present. To enable use of, for example, an electro-mechanical flow switch to detect a no-flow condition and activate sleep mode, the action takes place at the raising edge of the external signal applied (otherwise the drive would stay in sleep mode as the signal would be steadily connected).

NOTICE

If sleep mode is to be based on no-flow detection/minimum speed, select ***[1] Sleep Mode*** in ***parameter 22-23 No-flow Function***.

If ***parameter 25-26 Destage at No-flow*** is set to ***[1] Enabled***, activating sleep mode sends a command to the cascade controller (if enabled) to start de-staging of lag pumps (fixed speed) before stopping the lead pump (variable speed).

When entering sleep mode, the lower status line in the LCP shows *Sleep Mode*.

See also signal flow chart in *parameter group 22-2* No-flow Detection*. There are the following ways of using the sleep mode function.

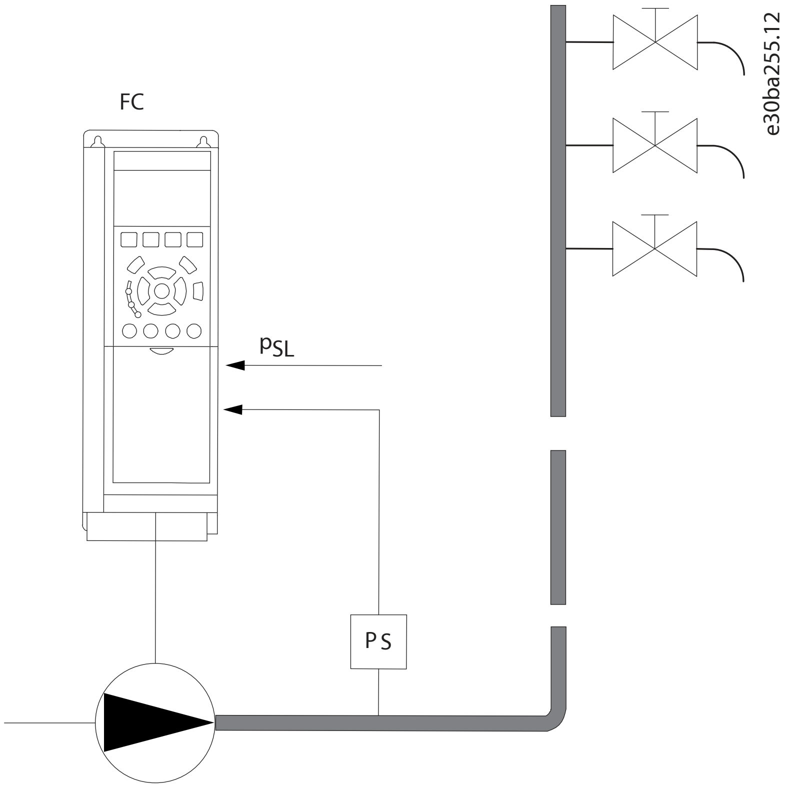


Figure 97: Sleep-mode Function

1. Systems where the integrated PI controller is used for controlling pressure or temperature, for example, boost systems with a pressure feedback signal applied to the drive from a pressure transducer. Set *parameter 1-00 Configuration Mode* to *[3] Closed Loop* and configure the PI controller configured for desired reference and feedback signals.

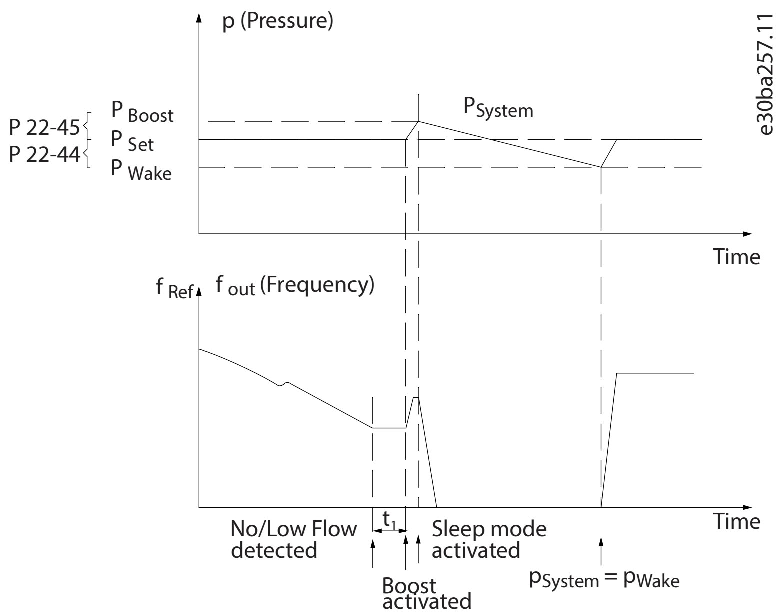


Figure 98: Example with Boost System

If no-flow is detected, the drive increases the setpoint for pressure to ensure a slight overpressure in the system (boost set in *parameter 22-45 Setpoint Boost*). The feedback from the pressure transducer is monitored, and then this pressure has dropped with a set percentage below the normal setpoint for pressure (P_{set}). The motor ramps up again and the pressure reached the set value (P_{set}).

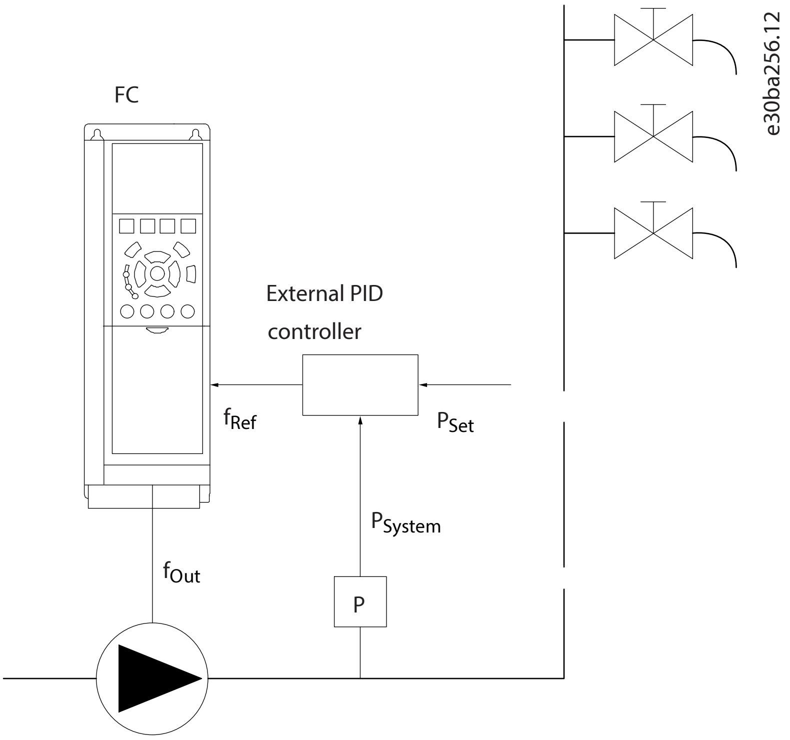


Figure 99: Boost System

2. In systems where the pressure or temperature is controlled by an external PI controller, the wake-up conditions cannot be based on feedback from the pressure/temperature transducer as the setpoint is not known. In the example with a boost system, the desired pressure, P_{set}, is not known. Set *parameter 1-00 Configuration Mode* to *[0] Open Loop*.

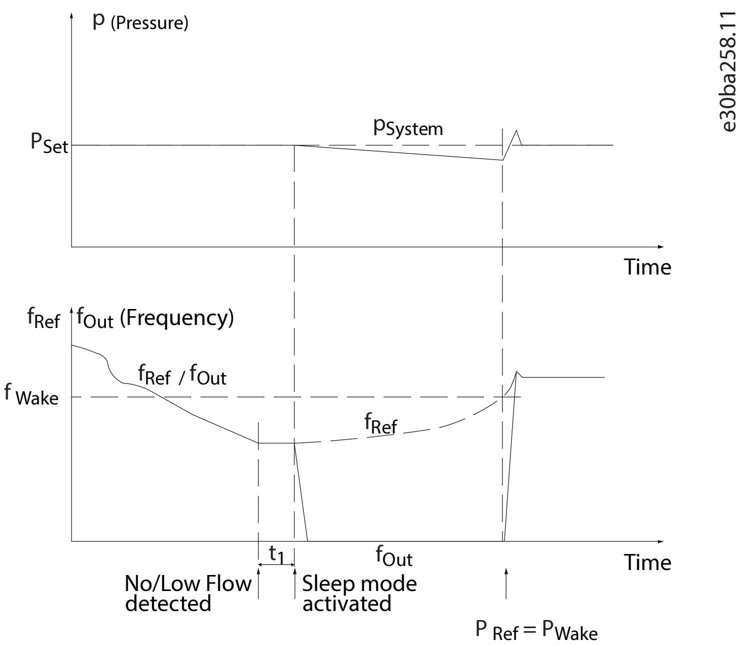


Figure 100: Example with Boost System

When low power or low speed is detected, the motor is stopped, but the reference signal (f_{ref}) from the external controller is still monitored. Because of the the low pressure created, the controller increases the reference signal to gain pressure. When the reference signal has reached a set value, f_{wake}, the motor restarts. The speed is set manually by an external reference signal (remote reference). Use default settings (*parameter group 22-3* No-flow Power Tuning*) for tuning of the no-flow function.

Table 46: Configuration overview

	Internal PI controller (*parameter 1-00 Configuration Mode: closed loop*)		External PI controller or manual control (*parameter 1-00 Configuration Mode: open loop*)	
	Sleep mode	**Wake up**	**Sleep mode**	**Wake up**
No-flow detection (pumps only)	Yes	–	Yes (except manual setting of speed)	–
Low-speed detection	Yes	–	Yes	–
External signal	Yes	–	Yes	–
Pressure/temperature (transmitted)	–	Yes	–	No
Output frequency	–	No	–	Yes

NOTICE

Sleep mode is not active when local reference is active (press the navigation keys to set speed manually). See ***parameter 3-13 Reference Site***. Sleep mode does not work in hand-on mode. Carry out auto setup in open loop before setting input/output in closed loop.

22-40 Minimum Run Time

Default value:	60 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the minimum running time for the motor after a start command (digital input or fieldbus) before entering sleep mode.

22-41 Minimum Sleep Time

Default value:	30 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

22-42 Wake-up Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4.13 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

To be used if ***parameter 0-02 Motor Speed Unit*** has been set to ***[0] RPM*** (parameter not visible if ***[1] Hz*** is selected). Only to be used if ***parameter 1-00 Configuration Mode*** is set to ***[0] Open loop*** and an external controller applies speed reference. Set the reference speed at which the sleep mode should be canceled.

22-43 Wake-up Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-14 [Hz]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

To be used if ***parameter 0-02 Motor Speed Unit*** has been set to ***[1] Hz*** (parameter not visible if ***[0] RPM*** is selected). Only to be used if ***parameter 1-00 Configuration Mode*** is set to ***[0] Open loop*** and speed reference is applied by an external controller controlling the pressure. Set the reference at which speed the sleep mode should be canceled.

22-44 Wake-up Ref./FB Difference

Default value:	10%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

To be used if ***parameter 1-00 Configuration Mode*** is set to ***[3] Process Closed Loop*** and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (P_{set}) before canceling the sleep mode.

22-45 Setpoint Boost

Default value:	0%	**Parameter type:**	Range, -100 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

To be used if ***parameter 1-00 Configuration Mode*** is set to ***[3] Process Closed Loop*** and the integrated PI controller is used. In a system with, for example, constant pressure control, it is advantageous to increase system pressure before the motor is stopped. This extends the time in which the motor is stopped and helps to avoid frequent start/stop. Set the overpressure/overtemperature in percentage of the setpoint for the pressure (P_{set})/temperature before entering sleep mode. If set to 5%, the boost pressure is P_{set} x 1.05. The negative values can be used, for example, in cooling tower control where a negative change is needed.

22-46 Maximum Boost Time

Default value:	60 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

To be used if ***parameter 1-00 Configuration Mode*** is set for ***[3] Process Closed Loop*** and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode is allowed. If the set time is exceeded, sleep mode is entered, not waiting for the set boost pressure to be reached.

5.21.4 22-5* End of Curve

The end-of-curve conditions occur when a pump is yielding a too large volume to ensure the set pressure. This situation can occur if a leakage occurs in the distribution pipe system after the pump. Such a leakage causes the pump to operate at the end of the pump characteristic valid for the maximum speed set in ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***. If the feedback is 2.5% of the programmed value in ***parameter 20-14 Maximum Reference/Feedb.*** (or numerical value of ***parameter 20-13 Minimum Reference/Feedb.***, whichever is highest) below the setpoint for the required pressure for a set time (***parameter 22-51 End of Curve Delay***), and the pump runs with maximum speed set in ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***, the function selected in ***parameter 22-50 End of Curve Function*** takes place. It is possible to get a signal on 1 of the digital outputs by selecting ***[192] End of Curve*** in *parameter group 5-3* Digital Outputs*and/or *parameter group 5-4* Relays*. The signal is present when an end-of-curve condition occurs and the selection in ***parameter 22-50 End of Curve Function*** is different from ***[0] Off***. The end-of-curve function can only be used when operating with the built-in PID controller (***[3] Closed loop*** in ***parameter 1-00 Configuration Mode***).

22-50 End of Curve Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Automatic restart resets the alarm and restarts the system.

NOTICE

Do not set ***parameter 14-20 Reset Mode*** to ***[13] Infinite auto reset*** when *parameter 22-50 End of Curve Function* is set to ***[2] Trip***. Doing so would cause the drive to cycle continuously between running and stopping when an end-of-curve condition is detected.

NOTICE

If the drive is equipped with a constant speed bypass with an automatic bypass function activating the bypass when persistent alarm conditions occur, disable the automatic bypass function if ***[2] Trip*** or ***[3] Man. reset trip*** is selected as the end-of-curve function.

Option	Name	Description
[0]*	Off	End-of-curve monitoring is not active.
[1]	Warning	The drive continues to run, but activates an end-of-curve warning (*warning 94, End of Curve*). A drive digital output or a fieldbus can communicate a warning to other equipment.
[2]	Trip	The drive stops running and activates an end-of-curve alarm (*alarm 94, End of Curve*). A drive digital output or a fieldbus can communicate an alarm to other equipment.

Option	Name	Description
[3]	Man. reset trip	The drive stops running and activates an end-of-curve alarm (*alarm 94, End of Curve*). A drive digital output or a fieldbus can communicate an alarm to other equipment.
[4]	Stop and Trip	

22-51 End of Curve Delay

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

When an end-of-curve condition is detected, a timer is activated. When the time set in this parameter expires, and the end-of-curve condition is steady during the entire period, the function set in ***parameter 22-50 End of Curve Function*** is activated. If the condition disappears before the timer expires, the timer is reset.

Parameter 22-52 End of Curve Tolerance

Default value:	2.5%	**Parameter type:**	Range, 0.5 - 20.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

Set the required tolerance of the end-of-curve function.

5.21.5 22-6* Broken Belt Detection

The broken-belt detection can be used in both closed-loop systems and open-loop systems for pumps and fans. If the estimated motor torque is below the broken belt torque value (***parameter 22-61 Broken Belt Torque***) and the drive output frequency is above or equal to 15 Hz, the broken-belt function (***parameter 22-60 Broken Belt Function***) is performed.

22-60 Broken Belt Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Do not set ***parameter 14-20 Reset Mode*** to ***[13] Infinite auto reset*** when ***parameter 22-60 Broken Belt Function*** is set to ***[2] Trip***. Doing so would cause the drive to cycle continuously between running and stopping when a broken-belt condition is detected.

NOTICE

If the drive is equipped with a constant speed bypass with an automatic bypass function activating the bypass when persistent alarm conditions occur, disable the automatic bypass function if ***[2] Trip*** or ***[3] Stop and trip*** is selected as the broken-belt function.

Option	Name	Description
[0]*	Off	End-of-curve monitoring is not active.
[1]	Warning	The drive continues to run, but activates a broken-belt warning (*warning 95, Broken Belt*). A drive digital output or a fieldbus can communicate a warning to other equipment.
[2]	Trip	The drive stops running and activates a broken-belt alarm (*alarm 95, Broken Belt*). A drive digital output or a fieldbus can communicate an alarm to other equipment.
[3]	Stop and Trip	

22-61 Broken Belt Torque

Default value:	10%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the broken-belt torque as a percentage of the rated motor torque.

22-62 Broken Belt Delay

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Sets the time for which the broken-belt conditions must be active before carrying out the action selected in ***parameter 22-60 Broken Belt Function***.

5.21.6 22-7* Short Cycle Protection

In some applications, a need for limiting the numbers of starts often exists. One way to do this is to ensure a minimum run time (between a start and a stop) and a minimum interval between starts. This means that any normal stop command can be overridden by ***parameter 22-77 Minimum Run Time*** and any normal start command (start/jog/freeze) can be overridden by ***parameter 22-76 Interval Between Starts***.

None of the 2 functions are active if hand-on mode or off mode has been activated via the LCP. If pressing [Hand On] or [Off], the 2 timers are reset to 0. The timers do not start counting until [Auto On] is pressed, and an active start command is applied.

22-75 Short Cycle Protection

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Disabled	The timer set in ***parameter 22-76 Interval between Starts*** is disabled.
[1]	Enabled	The timer set in ***parameter 22-76 Interval between Starts*** is enabled.

22-76 Interval between Starts

Default value:	Setting in par. 22-77	**Parameter type:**	Range, par. 22-77 - 3600 s
Setup:	All setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Sets the minimum time between 2 starts. Any normal start command (start/jog/freeze) is disregarded until the timer has expired.

22-77 Minimum Run Time

Default value:	0 s	**Parameter type:**	Range, 0 - par. 22-76 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter does not work in casacde mode.

Sets the minimum run time after a normal start command (start/jog/freeze). Any normal stop command is disregarded until the set time has expired. The timer starts counting following a normal start command (start/jog/freeze). A coast (inverse) or an external interlock command overrides the timer.

22-78 Minimum Run Time Override

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

This parameter only works in systems with inverse PID control.

Option	Name	Description
[0]*	Disabled	Feedback does not override the minimum run time.
[1]	Enabled	Feedback overrides the minimum run time.

22-79 Minimum Run Time Override Value

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit

Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Set the feedback value at which the minimum-run-time timer must be overridden. When the feedback drops below this value, the motor is destaged even if the minimum-run-time timer has not expired.

5.21.7 22-8* Flow Compensation

Sometimes it is not possible for a pressure transducer to be placed at a remote point in the system, and it can only be placed close to the fan/pump outlet. Flow compensation operates by adjusting the setpoint according to the output frequency, which is almost proportional to flow, thus compensating for higher losses at higher flow rates.

H_{DESIGN} (required pressure) is the setpoint for closed-loop (PI) operation of the drive and is set for closed-loop operation without flow compensation.

It is recommended to use slip compensation and RPM unit.

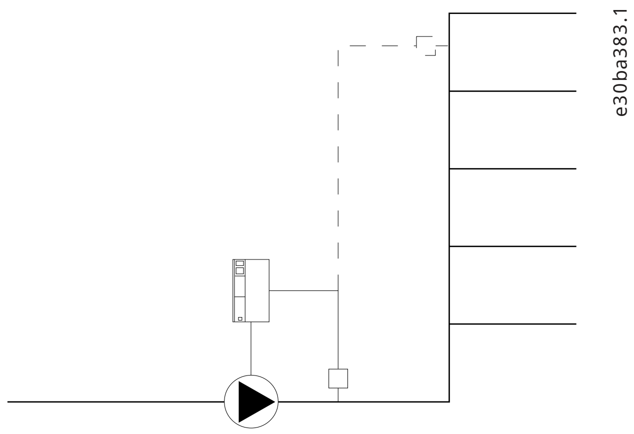


Figure 101: Flow Compensation

> **NOTICE**
>
> When flow compensation is used with the cascade controller (*parameter group 25-** Cascade Controller*), the actual setpoint does not depend on speed (flow), but on the number of pumps cut in.

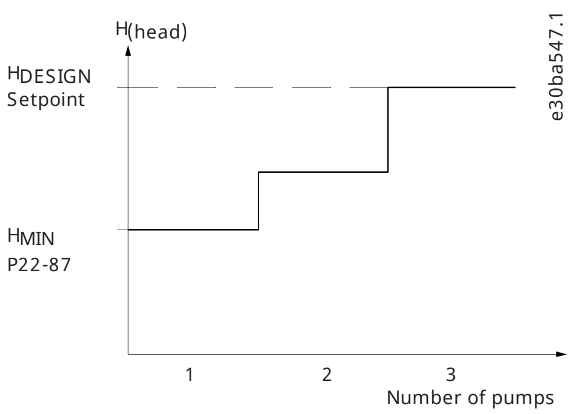


Figure 102: Flow Compensation with Cascade Controller

There are 2 methods which can be employed, depending on whether or not the speed at system design working point is known.

Table 47: Setpoint Defined by Number of Pumps

Parameter used	Speed at design point KNOWN	Speed at design point UNKNOWN	Cascade controller
Parameter 22-80 Flow Compensation	+	+	+
Parameter 22-81 Square-linear Curve Approximation	+	+	–
Parameter 22-82 Work Point Calculation	+	+	–
Parameter 22-83 Speed at No Flow [RPM]/parameter 22-84 Speed at No Flow [Hz]	+	+	–
Parameter 22-85 Speed at Design Point [RPM]/Parameter 22-86 Speed at Design Point [Hz]	+	–	–
Parameter 22-87 Pressure at No-Flow Speed	+	+	+
Parameter 22-88 Pressure at Rated Speed	–	+	–
Parameter 22-89 Flow at Design Point	–	+	–
Parameter 22-90 Flow at Rated Speed	–	+	–

22-80 Flow Compensation

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0*]	Disabled	Setpoint compensation is not active.
[1]	Enabled	Setpoint compensation is active and allows flow-compensated setpoint operation.

22-81 Square-Linear Curve Approximation

Default value:	100%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

This parameter is invisible in casacde mode.

Example 1: Adjustment of this parameter allows the shape of the control curve to be adjusted.

- 0% = Linear
- 100% = Ideal shape (theoretical)

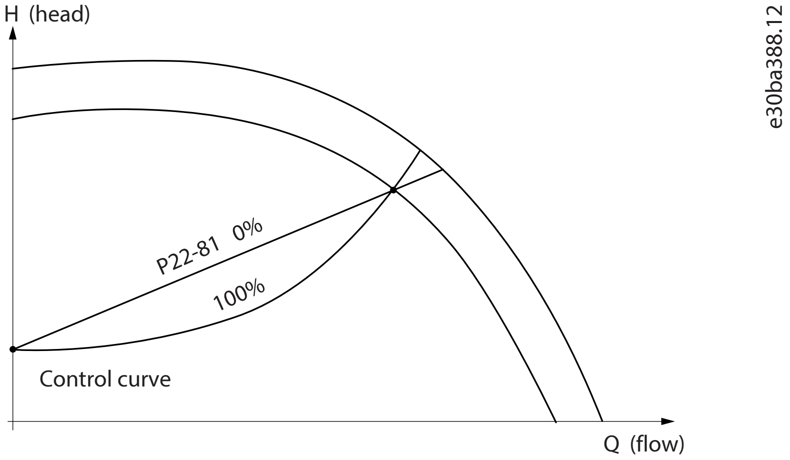


Figure 103: Square-Linear Curve Approximation

22-82 Work Point Calculation

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

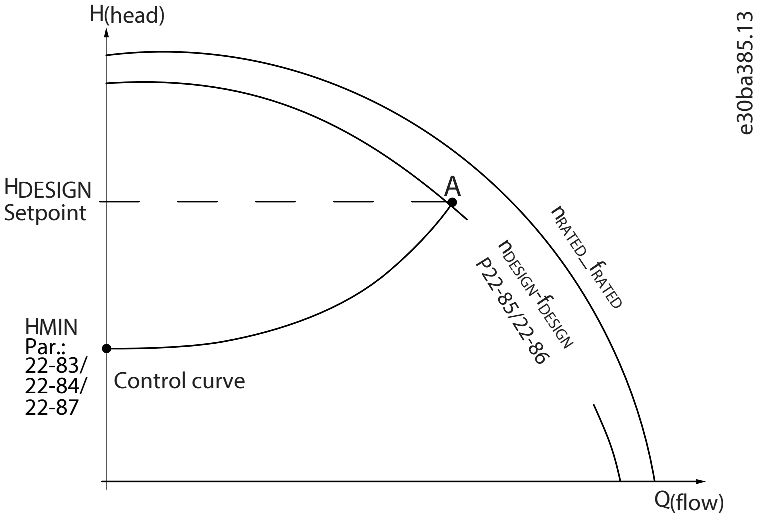


Figure 104: Example 1: Speed at Known System Design Working Point

From the datasheet showing characteristics for the specific equipment at different speeds, reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows finding point A, which is the system design working point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no-flow point to be identified. Adjustment of ***parameter 22-81 Square-linear Curve Approximation*** then allows the shape of the control curve to be adjusted infinitely.

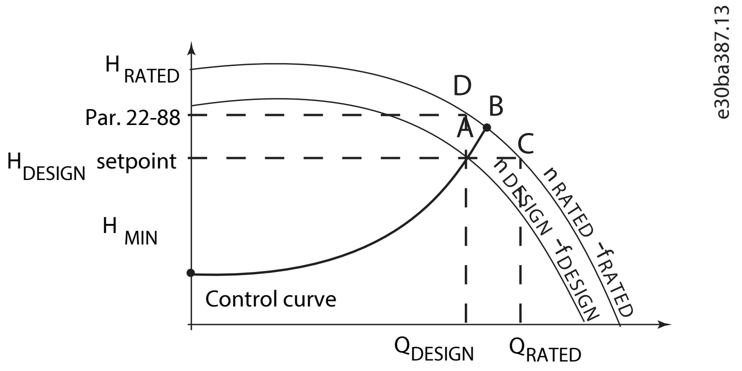


Figure 105: Example 2: Speed at Unknown System Design Working Point

Speed at system design working point is not known: Where the speed at system design working point is unknown, another reference point on the control curve has to be determined based on the datasheet. Looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN}, Point C), the flow at that pressure, Q_{RATED}, can be determined. Similarly, by plotting the design flow (Q_{DESIGN}, Point D), the pressure H_{DESIGN} at that flow can be determined. Knowing these 2 points on the pump curve, along with H_{MIN} as described, allows the drive to calculate the reference point B and thus to plot the control curve, which also includes the system design working point A.

Option	Name	Description
[0]*	Disabled	Work point calculation is not active. To be used if speed at design point is known.
[1]	Enabled	Work point calculation is active. Enabling this parameter allows the calculation of the unknown system design working point at 50/60 Hz speed, from the input data set in: • ***Parameter 22-83 Speed at No-Flow [RPM]*** • ***Parameter 22-84 Speed at No-Flow [Hz]*** • ***Parameter 22-87 Pressure at No-Flow Speed*** • ***Parameter 22-88 Pressure at Rated Speed*** • ***Parameter 22-89 Flow at Design Point*** • ***Parameter 22-90 Flow at Rated Speed***

22-83 Speed at No-Flow [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 22-85 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Changes during operation:**	True

Resolution 1 RPM. Enter the speed of the motor in RPM at which flow is 0, and minimum pressure, H_{MIN}, is achieved. Alternatively, enter the speed in Hz in ***parameter 22-84 Speed at No-Flow [Hz]***. If ***parameter 0-02 Motor Speed Unit*** is set to RPM, ***parameter 22-85 Speed at Design Point [RPM]*** should also be used. Closing the valves and reducing the speed until minimum pressure, H_{MIN}, is achieved determines this value.

22-84 Speed at No-Flow [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 22-86 [Hz]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Resolution 0.033 Hz. Enter the motor speed in Hz at which flow has effectively stopped and minimum pressure, H_{MIN}, is achieved Alternatively, enter the speed in RPM in ***parameter 22-83 Speed at No-Flow [RPM]***. If ***parameter 0-02 Motor Speed Unit*** is set to Hz, ***parameter 22-86 Speed at Design Point [Hz]*** should also be used. Closing the valves and reducing the speed until minimum pressure, H_{MIN}, is achieved determines this value.

22-85 Speed at Design Point [RPM]

Default value:	Size related	**Parameter type:**	Range, par. 22-83 - 60000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Resolution 1 RPM. Only visible when ***parameter 22-82 Work Point Calculation*** is set to ***[0] Disabled***. Enter the motor speed in RPM at which the system design working point is achieved. Alternatively, enter the speed in Hz in ***parameter 22-86 Speed at Design Point [Hz]***. If ***parameter 0-02 Motor Speed Unit*** is set to RPM, ***parameter 22-83 Speed at No-Flow [RPM]*** should also be used.

22-86 Speed at Design Point [Hz]

Default value:	Size related	**Parameter type:**	Range, 0.0 - par. 4-19 [Hz]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Resolution 0.033 Hz. Only visible when ***parameter 22-82 Work Point Calculation*** is set to ***[0] Disabled***. Enter the motor speed in Hz at which the system design working point is achieved. Alternatively, enter the speed in RPM in ***parameter 22-85 Speed at Design Point [RPM]***. If ***parameter 0-02 Motor Speed Unit*** is set to Hz, ***parameter 22-83 Speed at No-Flow [RPM]*** should also be used.

22-87 Pressure at No-Flow Speed

Default value	0	**Parameter type:**	Range, 0 - par. 22-88
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the pressure H_{MIN} corresponding to speed at no-flow in reference/feedback units.

22-88 Pressure at Rated Speed

Default value:	999999.999	**Parameter type:**	Range, par. 22-87 - 999999.999
Setup:	All setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

Enter the value corresponding to the pressure at rated speed in reference/feedback units. This value can be defined using the pump datasheet.

22-89 Flow at Design Point

Default value:	0	**Parameter type:**	Range, 0 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the value corresponding to the flow at design point. No units are required.

22-90 Flow at Rated Speed

Default value:	Size related	**Parameter type:**	Range, 0 - 999999999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the value corresponding to the flow at rated speed. This value can be defined using the pump datasheet.

5.22 Parameter Group 23-** Time-based Functions

5.22.1 23-0* Timed Actions

Use timed actions for actions performed on a daily or weekly basis, for example different references for working hours/non-working hours. Up to 10 timed actions can be programmed in the drive. Select the timed action number from the list when entering *parameter group 23-** Time-based Functions* from the LCP. ***Parameter 23-00 ON Time*** and ***parameter 23-04 Occurrence*** then refer to the selected timed action number. Each timed action is divided into an ON time and an OFF time, in which 2 different actions may be performed.

Display lines 2 and 3 in the LCP show the status for timed actions mode (***parameter 0-23 Display Line 2 Large*** and ***parameter 0-24 Display Line 3 Large***, setting ***[1643] Timed Actions Status***).

NOTICE

A change in mode via the digital inputs can only take place if ***parameter 23-08 Timed Actions Mode*** is set to ***[0] Times Actions Auto***. If commands are applied simultaneously to the digital inputs for constant OFF and constant ON, the timed actions mode changes to timed actions auto and the 2 commands are disregarded. If ***parameter 0-70 Date and Time*** is not set or the drive is set to hand-on mode or OFF mode (for example via the LCP), the timed actions mode is changed to ***[0] Disabled***. The timed actions have a higher priority than the same actions/commands activated by the digital inputs or the smart logic controller.

The actions programmed in timed actions are merged with corresponding actions from digital inputs, control word via bus, and smart logic controller, according to merge rules set up in *parameter group 8-5* Digital/Bus*.

NOTICE

Program the clock (*parameter group 0-7* Clock Settings*) correctly for timed actions to function.

NOTICE

When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

NOTICE
The PC-based configuration tool VLT® Motion Control Tool MCT 10 comprises a special guide for easy programming of timed actions.

23-00 ON Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	2 setups	**Conversion index:**	0
Data type:	TimeOfDayWoDate	**Change during operation:**	True

Sets the ON time for the desired action.

NOTICE
The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clockmodule with back-up is installed. In ***parameter 0-79 Clock Fault***, it is possible to program a warning if the clock has not been set properly, for example after a power-down.

23-01 ON Action

Default value:	[0] Disabled	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE
For options ***[32] Set digital out A low*** – ***[43] Set digital out F high*** , see also *parameter group 5-3* Digital Outputs* and *parameter group 5-4* Relays* .

Select the action during ON time. See ***parameter 13-52 SL Controller Action*** for descriptions of the options.

Option	Name	Description
[0]*	Disabled	
[1]	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	

Option	Name	Description
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	Dc brake	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset counter A	
[61]	Reset counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	

Option	Name	Description
[71]	Start timer 4	
[72]	Start timer 5	
[73]	Start timer 6	
[74]	Start timer 7	
[75]	Start timer 8	
[76]	Start timer 9	
[80]	Sleep mode	
[81]	Derag	
[82]	Reset derag counter	
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

23-02 OFF Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [10]
Setup:	2 setups	**Conversion index:**	0
Data type:	TimeOfDayWoDate	**Change during operation:**	True

Sets the OFF time for the desired action.

NOTICE

The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clockmodule with back-up is installed. In ***parameter 0-79 Clock Fault***, it is possible to program a warning if the clock has not been set properly, for example after a power-down.

23-03 OFF Action

Default value:	[1] No action	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action during OFF time. See ***parameter 13-52 SL Controller Action*** for descriptions of the options.

Option	Name	Description
[1]*	No action	
[2]	Select set-up 1	

Option	Name	Description
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	DC brake	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	

Option	Name	Description
[43]	Set digital out F high	
[60]	Reset counter A	
[61]	Reset counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	
[71]	Start timer 4	
[72]	Start timer 5	
[73]	Start timer 6	
[74]	Start timer 7	
[75]	Start timer 8	
[76]	Start timer 9	
[80]	Sleep mode	
[81]	Derag	
[82]	Reset derag counter	
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual colume counter	

23-04 Occurrence

Default value:	[0] All days	**Parameter type:**	Option, Array [10]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select which days the timed action applies to. Specify working/non-working days in:

- ***Parameter 0-81 Working Days***.
- ***Parameter 0-82 Additional Working Days***.
- ***Parameter 0-83 Additional Non-Working Days***.

Option	Name	Description
[0]*	All days	
[1]	Working days	
[2]	Non-working days	
[3]	Monday	
[4]	Tuesday	
[5]	Wednesday	
[6]	Thursday	
[7]	Friday	
[8]	Saturday	
[9]	Sunday	
[10]	Day 1 of month	
[11]	Day 2 of month	
[12]	Day 3 of month	
[13]	Day 4 of month	
[14]	Day 5 of month	
[15]	Day 6 of month	
[16]	Day 7 of month	
[17]	Day 8 of month	
[18]	Day 9 of month	
[19]	Day 10 of month	
[20]	Day 11 of month	
[21]	Day 12 of month	
[22]	Day 13 of month	
[23]	Day 14 of month	
[24]	Day 15 of month	
[25]	Day 16 of month	
[26]	Day 17 of month	
[27]	Day 18 of month	
[28]	Day 19 of month	
[29]	Day 20 of month	
[30]	Day 21 of month	
[31]	Day 22 of month	
[32]	Day 23 of month	

Option	Name	Description
[33]	Day 24 of month	
[34]	Day 25 of month	
[35]	Day 26 of month	
[36]	Day 27 of month	
[37]	Day 28 of month	
[38]	Day 29 of month	
[39]	Day 30 of month	
[40]	Day 31 of month	

5.22.2 23-1* Maintenance

Wear and tear calls for periodic inspection and service of elements in the application, for example motor bearings, feedback sensors, seals, and filters. With preventive maintenance, the service intervals may be programmed into the drive. The drive gives a message when maintenance is required. 20 preventive maintenance events can be programmed into the drive.

Specify the following for each event:

- Maintenance item (for example, motor bearings).
- Maintenance action (for example, replacement).
- Maintenance time base (for example, running hours, or a specific date and time).
- Maintenance time interval or the date and time of next maintenance.

NOTICE

To disable a preventive maintenance event, set the associated ***parameter 23-12 Maintenance Base*** to ***[0] Disabled***.

Preventive maintenance can be programmed from the LCP, but use of the PC-based VLT® Motion Control Tool MCT 10 is recommended.

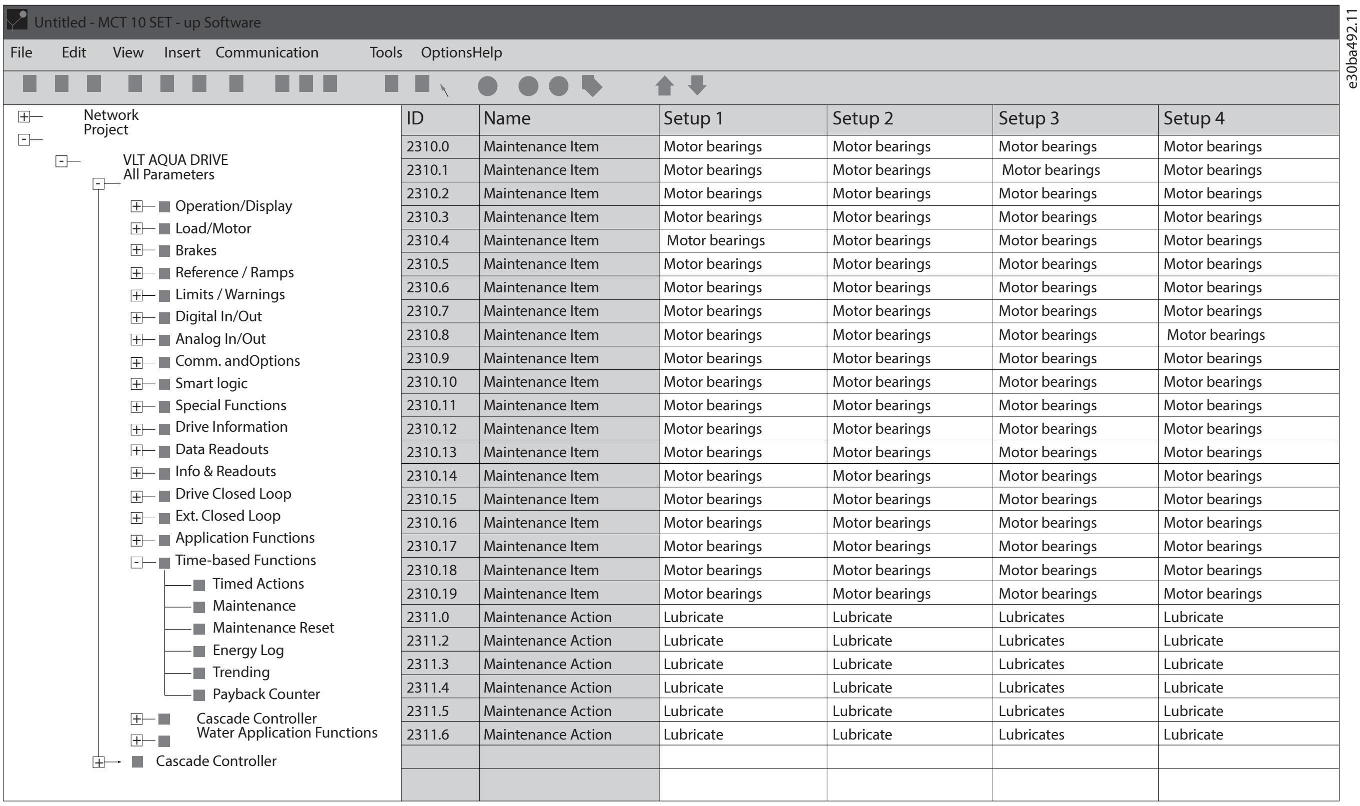


Figure 106: Maintenance Menu, MCT 10

The LCP indicates (with a wrench icon and letter M) when it is time for a preventive maintenance action and can be programmed to be indicated on a digital output in *parameter group 5-3* Digital Outputs*. The preventive maintenance status is shown in ***parameter 16-96 Maintenance Word***. A preventive maintenance indication can be reset from a digital input, the FC bus, or manually from the LCP through ***parameter 23-15 Reset Maintenance Word***.

NOTICE

The preventive maintenance events are defined in a 20-element array. Hence, each preventive maintenance event must use the same array element index in ***parameter 23-10 Maintenance Item*** to ***parameter 23-14 Maintenance Date and Time***.

23-10 Maintenance Item

Default value:	[1] Motor Bearings	**Parameter type:**	Option, Array [20]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Array with 20 elements shown below the parameter number in the display. Press [OK] and step between elements with [◀], [▶], [▲], and [▼]. Select the item to be associated with the preventive maintenance event.

Option	Name	Description
[1]*	Motor bearings	
[2]	Fan bearings	
[3]	Pump bearings	

Option	Name	Description
[4]	Valve	
[5]	Pressure transmitter	
[6]	Flow transmitter	
[7]	Temperature transm.	
[8]	Pump seals	
[9]	Fan belt	
[10]	Filter	
[11]	Drive cooling fan	
[12]	System health check	
[13]	Warranty	
[20]	Maintenance text 0	
[21]	Maintenance text 1	
[22]	Maintenace text 2	
[23]	Maintenance text 3	
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[26]	Service log full	

23-11 Maintenance Action

Default value:	[1] Lubricate	**Parameter type:**	Option, Array [20]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the action to be associated with the preventive maintenance event.

Option	Name	Description
[1]*	Lubricate	
[2]	Clean	
[3]	Replace	
[4]	Inspect/check	
[5]	Overhaul	
[6]	Renew	
[7]	Check	
[20]	Maintenance text 0	

Option	Name	Description
[21]	Maintenance text 1	
[22]	Maintenance text 2	
[23]	Maintenance text 3	
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[28]	Clear logs	

23-12 Maintenance Base

Default value:	[0] Disabled	**Parameter type:**	Option, Array [20]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the time base to be associated with the preventive maintenance event.

Option	Name	Description
[0]*	Disabled	Disables the preventive maintenance event.
[1]	Running hours	The number of hours the motor has run. Running hours are not reset at power-on. Specify the maintenance time interval in ***parameter 23-13 Maintenance Interval***.
[2]	Operating hours	The number of hours the drive has run. Operating hours are not reset at power-on. Specify the maintenance time interval in ***parameter 23-13 Maintenance Interval***.
[3]	Date & time	Uses the internal clock. Specify the date and time of the next maintenance occurrence in ***parameter 23-14 Maintenance Date and Time***.

23-13 Maintenance Interval

Default value:	1	**Parameter type:**	Range, 1 - 2147483647, Array [20]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set the interval associated with the current preventive maintenance event. This parameter is only used if ***[1] Running Hours*** or ***[2] Operating Hours*** is selected in ***parameter 23-12 Maintenance Base***. The timer is reset in ***parameter 23-15 Reset Maintenance Word***.

23-14 Maintenance Date and Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [20]
Setup:	1 setup	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

Set the date and time for the next maintenance occurrence if the preventive maintenance event is based on date/time. Date format depends on the setting in ***parameter 0-71 Date Format*** while the time format depends on the setting in ***parameter 0-72 Time Format***.

NOTICE

The drive has no back-up of the clock function. The set date/time is reset to default (2000-01-01 00:00) after a power-down. In ***parameter 0-79 Clock Fault***, it is possible to program a warning if the clock has not been set properly, for example after a power-down. Set the time at least 1 hour later than actual time.

NOTICE

When mounting a VLT® Analog I/O option MCB 109 option card, a battery back-up of the date and time is included.

23-15 Reset Maintenance Word

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion inde:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

When messages are reset, maintenance item, action, and maintenance date/time are not canceled. ***Parameter 23-12 Maintenance Time Base*** is set to ***[0] Disabled***.

Set this parameter to ***[1] Do reset*** to reset the maintenance word in ***parameter 16-96 Maintenance Word*** and reset the message shown in the LCP. This parameter changes back to ***[0] Do not reset*** when pressing [OK].

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

23-16 Maintenance Text

Default value:	0	**Parameter type:**	Range, 0 - 20, Array [6]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[20]	**Change during operation:**	True

6 individual texts (Maintenance Text 0...Maintenance Text 5) can be written for use in either ***parameter 23-10 Maintenance Item*** or ***parameter 23-11 Maintenance Action***. The text is written according to the guidelines in ***parameter 0-37 Display Text 1***.

5.22.3 23-5* Energy Log

The drive is continuously accumulating the consumption of the controlled motor, based on the actual power yielded by the drive.

This data can be used for an energy log function allowing to compare and structure the information about the energy consumption related to time.

There are 2 functions:

- Data related to a preprogrammed period defined by a set date and time for start.
- Data related to a predefined period back in time, for example, last 7 days within the preprogrammed period.

For each of the above 2 functions, the data is stored in several counters allowing for selection time frame and a split on hours, days, or weeks.

The period/split (resolution) can be set in ***parameter 23-50 Energy Log Resolution***.

The data is based on the value registered by the kWh counter in the drive. This counter value can be read in ***parameter 15-02 kWh Counter*** containing the accumulated value since the 1st power-up or latest reset of the counter (***parameter 15-06 Reset kWh Counter***).

All data for the energy log is stored in counters, which can be read from ***parameter 23-53 Energy Log***.

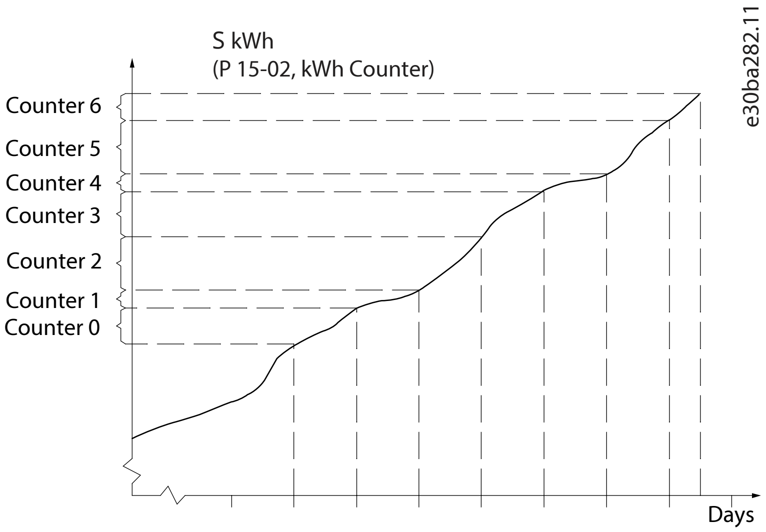


Figure 107: Energy Log Graph

Counter 00 always contains the oldest data. A counter covers a period from XX:00 to XX:59 if hours, or 00:00 to 23:59 if days. If logging either the last hours or last days, the counters shift contents at XX:00 every hour, or at 00:00 every day. The counter with the highest index is always subject to update (containing data for the actual hour since XX:00 or the actual day since 00:00).

The contents of counters can be shown as bars on the LCP. Select *Quick Menu*, *Loggings*, *Energy Log: Trending Continued Bin/Trending Timed Bin/Trending Comparison*.

23-50 Energy Log Resolution

Default value:	[5] Last 24 hours	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

The drive has no backup of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with backup is installed. Therefore, the logging is stopped until date/time is readjusted in ***parameter -70 Date and Time***. In ***parameter 0-79 Clock Fault***, it is possible to program a warning if the clock has not been set properly, for example, after a power-down.

Select the type of period for logging consumption: ***[0] Hour of day***, ***[1] Day of week***, or ***[2] Day of month***. The counters contain the logging data from the preprogrammed date/time for start (*parameter 23-51 Period Start*) and the numbers of hours/days as programmed for ***parameter 23-50 Energy Log Resolution***. The logging starts on the date programmed in ***parameter 23-51 Period Start*** and continues until 1 day/week/month has passed. The counters contain data for 1 day, 1 week, or 5 weeks back in time and up to the actual time. The logging starts at the date programmed in ***parameter 23-51 Period Start***. In all cases, the period split refers to operating hours (time where the drive is powered up).

Option	Name	Description
[0]	Hour of day	
[1]	Day of week	
[2]	Day of month	
[5]*	Last 24 hours	
[6]	Last 7 days	
[7]	Last 5 weeks	

23-51 Period Start

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	2 setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

NOTICE

When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the energy log starts updating the counters. First, data is stored in counter [00] and starts at the time/date programmed in this parameter. Date format depends on the setting in ***parameter 0-71 Date Format*** and time format on the setting in ***parameter 0-72 Time Format***.

23-53 Energy Log

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [31]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

NOTICE

All counters are automatically reset when changing the setting in ***parameter 23-50 Energy Log Resolution***. At overflow, the update of the counters stops at maximum value.

NOTICE

When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Array with several elements equal to the number of counters ([00]-[xx] below parameter numbers in display). Press [OK] and step between elements with [▲] [▼]. Array elements:

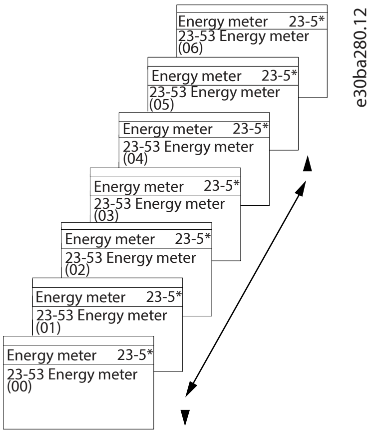


Figure 108: Energy Log

Data from the latest period is stored in the counter with the highest index. At power-down, all counter values are stored and resumed at next power-up.

23-54 Reset Energy Log

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select ***[1] Do reset*** to reset all values in the energy log counters shown in ***parameter 23-53 Energy Log***. After pressing [OK], the setting of the parameter value automatically changes to ***[0] Do not reset***.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.22.4 23-6* Trending

Trending is used to monitor a process variable over time and record how often the data falls into each of 10 user-defined data ranges. This is a convenient tool to obtain a quick overview indicating where to focus on improvement of operation.

Two sets of data for trending can be created to make it possible to compare current values for a selected operating variable with data for a certain reference period for the same variable. This reference period can be preprogrammed (***parameter 23-63 Timed Period Start*** and ***23-64 Timed Period Stop***). The 2 sets of data can be read from ***parameter 23-61 Continuous Bin Data*** (current) and ***parameter 23-62 Timed Bin Data*** (reference).

It is possible to create trending for the following operation variables:

- Power
- Current
- Output frequency
- Motor speed

The trending function includes 10 counters (forming a bin) for each set of data containing the numbers of registrations reflecting how often the operating variable is within each of 10 predefined intervals. The sorting is based on a relative value of the variable.

The relative value for the operating variable is determined as:

- Actual/rated x 100% - for power and current.
- Actual/max x 100% - for output frequency and motor speed.

The size of each interval can be adjusted individually, but is 10% for each as default. Power and current can exceed rated value, but those registrations are included in 90–100% (MAX) counter.

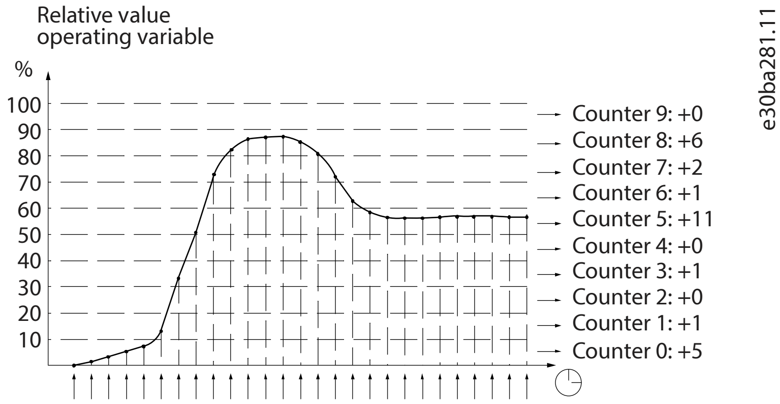


Figure 109: Time and Relative Values

Once per second, the value of the operating variable selected is registered. If a value has been registered to equal 13%, the counter 10 to <20% is updated with the value 1. If the value stays at 13% for 10 s, 10 is added to the counter value.

The contents of counters can be shown as bars on the LCP. Select *Quick Menu⇒Loggings: Trending Continued Bin/Trending Timed Bin/ Trending Comparison*.

NOTICE

The counters start counting whenever the drive is powered up. A power cycle shortly after a reset resets the counters. EEPROM data is updated once per hour.

23-60 Trend Variable

Default value:	[2] Frequency [Hz]	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the required operating variable to be monitored for trending.

Option	Name	Description
[0]	Power [kW]	Power yielded to the motor. Reference for the relative value is the rated motor power programmed in ***parameter 1-20 Motor Power [kW]*** or ***parameter 1-21 Motor Power [hp]***. The actual value can be read in ***parameter 16-10 Power [kW]*** or ***parameter 16-11 Power [hp]***.
[1]	Current [A]	Output current to the motor. Reference for the relative value is the rated motor current in ***parameter 1-24 Motor Current***. The actual value can be read in ***parameter 16-14 Motor Current***.

Option	Name	Description
[2]*	Frequency [Hz]	Output frequency to the motor. Reference for the relative value is the maximum output frequency programmed in ***parameter 4-14 Motor Speed High Limit [Hz]***. The actual value can be read in ***parameter 16-13 Frequency***.
[3]	Motor speed [RPM]	Reference for the relative value is the maximum motor speed programmed in ***parameter 4-13 Motor Speed High Limit [RPM]***.

23-61 Continuous Bin Data

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating variable monitored, sorted according to the following intervals:

- Counter [0]: 0%...<10%
- Counter [1]: 10%...<20%
- Counter [2]: 20%...<30%
- Counter [3]: 30%...<40%
- Counter [4]: 40%...<50%
- Counter [5]: 50%...<60%
- Counter [6]: 60%...<70%
- Counter [7]: 70%...<80%
- Counter [8]: 80%...<90%
- Counter [9]: 90%...100% or maximum

The above minimum limits for the intervals are the default limits. These can be changed in ***parameter 23-65 Minimum Bin Value***. Starts to count when the drive is powered up for the 1st time. All counters can be reset to 0 in ***parameter 23-66 Reset Continuous Bin Data***.

23-62 Timed Bin Data

Default value:	0	**Parameter type:**	Range, 0 - 4294967295, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating variable monitored, sorted according to the following intervals:

- Counter [0]: 0–<10%
- Counter [1]: 10–<20%
- Counter [2]: 20–<30%
- Counter [3]: 30–<40%
- Counter [4]: 40–<50%
- Counter [5]: 50–<60%

- Counter [6]: 60–<70%
- Counter [7]: 70–<80%
- Counter [8]: 80–<90%
- Counter [9]: 90–100% or maximum

Starts to count at the date/time programmed in ***parameter 23-63 Timed Period Start***, and stops at the date/time programmed in ***parameter 23-64 Timed Period Stop***. All counters can be reset to 0 in ***parameter 23-67 Reset Timed Bin Data***.

23-63 Timed Period Start

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	2 setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

NOTICE

The drive has no backup of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with backup is installed. Therefore, the logging is stopped until date/time is readjusted in ***parameter 0-70 Date and Time***. In ***parameter 0-79 Clock Fault***, it is possible to program a warning if the clock has not been set properly, for example, after a power-down.

NOTICE

When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the trending starts the update of the timed bin counters. Date format depends on the setting in ***parameter 0-71 Date Format***, and time format depends on the setting in ***parameter 0-72 Time Format***.

23-64 Timed Period Stop

Default value:	0	**Parameter type:**	Range, 0 - 0
Setup:	2 setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

NOTICE

When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the trend analyses must stop updating the timed bin counters. Date format depends on the setting in ***parameter 0-71 Date Format***, and time format depends on the setting in ***parameter 0-72 Time Format***.

23-65 Minimum Bin Value

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [10]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. Set the minimum limit for each interval in ***parameter 23-61 Continuous Bin Data*** and ***parameter 23-62 Timed Bin Data***. Example: If selecting ***[1] counter*** and changing setting from 10% to 12%, ***[0] counter*** is based on the interval 0 to <12% and ***[1] counter*** on interval 12 to <20%.

23-66 Reset Continuous Bin Data

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uin8	**Change during operation:**	True

Select ***[1] Do reset*** to reset all values in the energy log counters shown in ***parameter 23-61 Continuous Bin Data***. After pressing [OK], the setting of the parameter value automatically changes to ***[0] Do not reset***.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

23-67 Reset Timed Bin Data

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select ***[1] Do reset*** to reset all values in the energy log counters shown in ***parameter 23-62 Timed Bin Data***. After pressing [OK], the setting of the parameter value automatically changes to ***[0] Do not reset***.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.22.5 23-8* Payback Counter

The drive includes a feature which can give a rough calculation on payback in cases where the drive has been installed in an existing plant to ensure energy savings. Reference for the savings is a set value representing the average power yielded before the upgrade with variable-speed control.

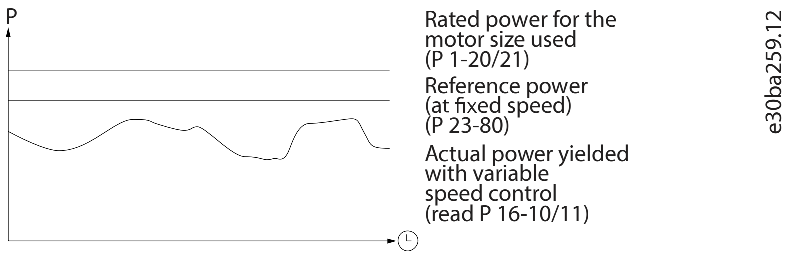


Figure 110: Comparison of Reference Power and Actual Power

The difference between the reference power at fixed speed and the actual power yielded with speed control represents the actual saving.

As value for the fixed speed case, the rated motor size (kW) is multiplied with a factor (set in %) representing the power produced at fixed speed. The difference between this reference power and the actual power is accumulated and stored. The difference in energy can be read in ***parameter 23-83 Energy Savings***. The accumulated value for the difference in power consumption is multiplied with the energy cost in local currency and the investment is subtracted. This calculation for cost savings can also be read in ***parameter 23-84 Cost Savings***. Breakeven (payback) occurs when the value read in the parameter turns from negative to positive.

$$\mathrm{Costsavings} = \left\{\sum_{t=0}^{t}\left[(\mathrm{motorratedpower} \times \mathrm{powerreferencefactor}) - \mathrm{actualpowerconsumption}\right] \times \mathrm{energycost}\right\} - \mathrm{investmentcost}$$

It is not possible to reset the energy savings counter, but the counter can be stopped any time by setting ***parameter 23-80 Power Reference Factor*** to 0.

Table 48: Parameter Overview

Parameter for settings		Parameters for readout	
Rated motor power	***Parameter 1-20 Motor Power [kW]/1-21 Motor Power [hp]***	Energy savings	***Parameter 23-83 Energy Savings***
Power reference factor in %	***Parameter 23-80 Power Reference Factor***	Actual power	***Parameter 16-10 Power [kW]/Parameter 16-11 Power [hp]***
Energy cost per kWh	***Parameter 23-81 Energy Cost***	Cost savings	***Parameter 23-84 Cost Savings***
Investment	***Parameter 23-82 Investment***	–	–

23-80 Power Reference Factor

Default value:	100%	**Parameter type:**	Range, 0 - 100%
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the percentage of the rated motor size (set in ***parameter 1-20 Motor Power [kW]*** or ***parameter 1-21 Motor Power [HP]***), which shows the average power yielded at the time running with fixed speed (before upgrade with variable-speed control). Set a value different from 0 to start counting.

23-81 Energy Cost

Default value:	1	**Parameter type:**	Range, 0 - 999999.99
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the actual cost for a kWh in local currency. If the energy cost is changed later on, it impacts the calculation for the entire period.

23-82 Investment

Default value:	0	**Parameter type:**	Range, 0 - 999999999
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set the value of the investment spent on upgrading the plant with speed control. Use the same currency as in ***parameter 23-81 Energy Cost***.

23-83 Energy Savings

Default value:	0 kWh	**Parameter type:**	Range, 0 - 0 kWh
Setup:	All setups	**Conversion index:**	75
Data type:	Int32	**Change during operation:**	True

This parameter allows a readout of the accumulated difference between the reference power and the actual output power. If motor size is set in hp (***parameter 1-21 Motor Power [hp]***), the equivalent kW value is used for the energy savings.

23-84 Cost Savings

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

This parameter allows a readout of the calculation based on the above formula (in local currency).

23-85 CO2 Conversion Factor

Default value:	500g	**Parameter type:**	Range, 0 - 1000 g
Setup:	2 setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter the CO_2 emission in grams per 1 kWh of electrical energy produced. Typical life-cycle greenhouse-gas emission values for different power sources are:

- Renewable: 25 g.
- Nuclear: 70 g.
- Natural gas: 350 g.
- Oil: 800 g.
- Coal: 1000 g

For more precise emission values in local regions, contact the regional environment agency.

23-86 CO2 Reduction

Default value:	0 kg	**Parameter type:**	Range, 0 - 0 kg
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Shows the CO_2 depletion in kg based on the CO_2 conversion factor (***parameter 23-85 CO2 Conversion Factor***) and saved energy (***parameter 23-83 Energy Savings***).

5.23 Parameter Group 24-** Application Functions 2

5.23.1 24-0* Emergency Mode

NOTICE

The drive is only 1 component of an entire application system. Correct function of emergency mode depends on the correct design and selection of system components. Non-interruption of the drive due to emergency-mode operation could cause overpressure and damage the system and components. The drive itself could be damaged, or may cause damage or fire. Danfoss accepts no responsibility for errors, malfunctions, personal injury, or any damage to the drive itself or the components herein, application systems and components herein, or other property when the drive has been programmed for emergency mode. In no event shall Danfoss be liable to the end user or any other party for any direct or indirect, special, or consequential damage, or loss suffered by such party, which has occurred due to the drive being programmed and operated in emergency mode. Danfoss warranty is only affected or reduced if a critical alarm occurs during emergency-mode operation, and the drive is programmed to continue even though the application system would be damaged eventually.

If critical alarms have been activated during emergency mode operation, the drive informs the user that its performance and expected lifetime may be affected (*W280*), where an inspection of the drive may be needed to secure maximum operation in a new critical situation.

Background

Emergency mode is for use in critical situations where it is imperative for the motor to keep running, regardless of the normal protective functions of the drive. These situations could be ventilation fans in tunnels or stairwells, for instance, where continued operation of fan facilitates safe evacuation of personnel and protection of inventory if a fire occurs. Some selections of the emergency-mode function cause alarms and trip conditions to be disregarded, enabling the motor to run without interruption.

Activation

Emergency mode can be activated via digital input and/or over the fieldbus network. In digital activation, normal or inverse signals levels can be selected as continual fixed signals or as trigger pulse activation to fit the overall fire control system. It can operate in open loop with up to 8 different preset speeds or in closed loop with an external signal reference and feedback source. See *parameter group 5-1* Digital Inputs* and ***parameter 24-43 Emergency Mode Signal Operation***.

Messages in display

When emergency mode is activated, the display shows a status message *Emergency Mode* and a warning *Emergency Mode*. Once the emergency mode is deactivated, the status messages disappear and the warning is replaced by the warning *Emergency M Was Active*.

Digital and relay outputs can be configured for the status emergency mode messages, see *parameter group 5-3* Digital Outputs* and *parameter group 5-4* Relays*. Emergency mode messages can also be accessed in the warning word via serial communication (see relevant documentation). Access the status messages *Emergency Mode* via the extended status word.

Table 49: Messages in Display

Messages	Type	LCP	Messages in display	Alarm word 1–3	Warning word 2	Warning word 3	Ext. status word 2
W200 Emergency Mode	Warning	+	+	–	–	+ (bit 7)	+ (bit 25)
W201 Emerg. M Was Active	Warning	+	+	–	+ (bit 3)	+ (bit 8)	–

Table 49: Messages in Display (continued)

Messages	Type	LCP	Messages in display	Alarm word 1–3	Warning word 2	Warning word 3	Ext. status word 2
W202 Emerg. M Limits Exceeded	Alarm (log)	+	+	–	–	+ (bit 9)	+ (bit 27)
W280 Emcy M Service Warning	Alarm (log)	+	+	–	–	+ (bit 10)	–
W281 Emcy OPR unexpected	Warning	+	+	–	–	+ (bit 11)	–

Log

To see an overview of the emergency mode-related events, view the emergency mode log, *parameter group 18-1* Emergency Mode Log*, or press [Alarm Log] on the LCP. The log includes up to 10 of the latest events. Warranty-affecting alarms have a higher priority than the other 2 types of events.

The emergency mode alarm log can only be reset by a Danfoss authorized service partner. To secure the emergency mode operation documentation, the 1st critical alarms can never be removed.

The following events are logged:

- W200 - Emergency mode.
- W201 - Emerg. M mode was act. (deactivated).
- W202 - Emerg. M limits exceeded covered by the activated critical alarm number.
- (W280) - Emcy M service warning - service is needed.
- (W281) - Emcy OPR unexpected - emergency mode does not work as expected.

All alarms are logged as usual, and critical emergency mode alarms are logged in the emergency mode log in *parameter group 18-1* Emergency Mode Log*.

NOTICE

During emergency-mode operation, all stop commands to the drive are ignored, including coast/coast inverse and external interlock. The keypad is also locked during emergency mode to prevent user interference during operation of the safety system. However, if Safe Torque Off is available in the drive, this function is still active.

NOTICE

Emergency mode has a special live zero function for handling lost analog signal inputs used for emergency mode setpoint/feedback, for example, for handling a burnt cable. How emergency mode should continue in these live zero situations is configured in ***parameter 6-02 Emergency Mode Live Zero Timeout Function***. If live zero is activated, *Emergency mode not working as expected* is activated so that a redundant system can take over or a setup change can be activated. A warning for live zero has a higher priority than the warning *Emergency mode* and will replace that information in the display.

NOTICE

If setting the command *[11] Start Reversing* on a digital input terminal in ***parameter 5-10 Terminal 18 Digital Input***, the drive understands this as a reversing command.

24-00 Emergency Mode Function

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Alarms are produced or ignored in accordance with the selection in ***parameter 24-09 Emergency Mode Alarm Handling***.

Option	Name	Description
[0]*	Disabled	The emergency-mode function is not active.
[1]	Enabled-run forward	In this mode, the motor continues to operate in a clockwise direction. Works only in open loop. Set ***parameter 24-01 Emergency Mode Configuration*** to ***[0] Open Loop***.
[2]	Enable-run reverse	In this mode, the motor continues to operate in a counterclockwise direction. Works only in open loop. Set ***parameter 24-01 Emergency Mode Configuration*** to ***[0] Open Loop***.
[3]	Enabled-coast	In this mode, the output is disabled, and the motor is allowed to coast to stop.
[4]	Enable-run Fwd/Rev	
[8]	Alarm suppression	In this mode, the drive continues operation as normal, meaning on standard parameters and control operation, but where the alarms are suppressed as in normal emergency mode. The emcy LCP information and status word is updated as the emergency mode operation is logged in the emergency mode log.

24-01 Emergency Mode Configuration

Default value:	[0] Open loop	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Before adjusting the PID controller, set ***parameter 24-09 Emergency Mode Alarm Handling*** to ***[9] Trip, all alarms/test***.

NOTICE

If ***[2] Enable-run reverse*** is selected in ***parameter 24-00 Emergency Mode Function***, ***[3] Closed loop*** cannot be selected in ***parameter 24-01 Emergency Mode Configuration***.

The emergency mode can be controlled in open loop with up to 8 different preset values (zones), or in closed loop by a reference and feedback signal. The reference and feedback signal can come via drive input signals or over the fieldbus.

Option	Name	Description
[0]*	Open loop	When emergency mode is active, the motor runs with a fixed speed based on a reference set. The unit is the same as selected in ***parameter 0-02 Motor Speed Unit***.
[3]	Closed loop	When emergency mode is active, the built-in PID controller controls the speed based on the setpoint and a feedback signal selected in ***parameter 24-07 Emergency Mode Feedback Source***. Select the unit in ***parameter 24-02 Emergency Mode Unit***. For PID controller settings, use *parameter group 20-** FC Closed Loop* as for normal operation. The same PID configuration can be selected for both normal and emergency mode, and the operation can be continued as setup 1–4.

24-02 Emergency Mode Unit

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

By default, emergency mode is configured for open-loop control where only the motor unit is selected in ***parameter 0-02 Motor Speed Unit***. For closed-loop operation, select any of the following options.

Option	Name	Description
[0]	None	
[1]	%	
[2]	RPM	
[3]	Hz	
[4]	Nm	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	

Option	Name	Description
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm HG	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	

Option	Name	Description
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	HP	

24-03 Emergency Mode Min Reference

Default value:	Size related	**Parameter type:**	Range, -999999.999 - par. 24-04 EmergencyModeMaxReference
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Minimum value to the reference/setpoint (limiting the sum of values in ***parameter 24-05 Emergency Mode Preset Reference*** and value of signal on input selected in ***parameter 24-06 Emergency Mode Reference Source***). If running in open loop when emergency mode is active, the unit is selected by the setting ***parameter 0-02 Motor Speed Unit***. For closed loop, select the unit in ***parameter 24-02 Emergency Mode Unit***.

24-04 Emergency Mode Max Reference

Default value:	Size related	**Parameter type:**	Range, par. 24-03 - 999999.999 EmergencyModeMinReference
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter defines the maximum speed reference which the emergency mode can operate to, although the motor limits in ***parameter 4-10 Motor Speed Direction*** have the highest priority. This maximum value is also used as reference value for the 8 preset values calculations in %. If running in open loop when emergency mode is active, the unit is selected by setting ***parameter 0-02 Motor Speed Unit***. For closed loop, select the unit in ***parameter 24-02 Emergency Mode Unit***.

24-05 Emergency Mode Preset Reference

Default value:	0%	**Parameter type:**	Range, -100 - 100%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

A parameter array with 8 elements (0–7). The 8 present values (zones) are for open-loop control. Index [0] is used for basic emergency mode control. Indexes 1–7 are used to enhance emergency mode control, which also overwrites the basic control. More reference value can be added via *parameter group 24-** Application Functions 2*.

24-06 Emergency Mode Reference Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

Data type:	Uint8	**Change during operation:**	True

Select the external reference input to be used for emergency mode. In open-loop mode, this signal value is added to the preset values in ***parameter 24-05 Emergency Mode Preset Reference***. There may be a different units scaling between preset and external values.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[11]	Local bus reference	Serial inputs from internal COM interfaces.
[20]	Digital pot.meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[33]	PCD bus	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	A reference value can also come via selected fieldbus.

24-07 Emergency Mode Feedback Source

Default value:	[0] No function	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

In emergency mode closed-loop operation, feedback is requested for the internal PID controller. Select the feedback input to be used for the feedback signal.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	

Option	Name	Description
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	Different feedback channels can be selected via fieldbus network.
[101]	Bus feedback 2	Different feedback channels can be selected via fieldbus network.
[102]	Bus feedback 3	Different feedback channels can be selected via fieldbus network.

24-09 Emergency Mode Alarm Handling

Default value:	[0] Trip+reset, critical alarms	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

NOTICE

Warranty-affecting alarms. Certain alarms can affect the lifetime of the drive. Should 1 of these ignored alarms occur while in emergency mode, the alarms are logged and stored in the emergency-mode log.

NOTICE

The setting in ***parameter 14-20 Reset Mode*** is disregarded if emergency mode is active (see *parameter group 24-0* Emergency Mode*).

Select an option to define the response to alarms when emergency mode is active and an alarm is issued.

Option	Name	Description
[0]*	Trip+reset, critical alarms	Alarms are ignored even though damage may be caused, except for the critical alarms mentioned in the following table. When these alarms occur, the drive trips immediately, followed by an automatic reset and restarts even if the operation leads to an infinite loop of trip and restart.
[1]	Trip, critical alarms	Alarms are ignored even though damage may be caused, except for the critical alarms mentioned in the following table. For the critical alarms, a trip is caused. A manual reset is required before restart. A manual restart requires disabling emergency mode and enabling emergency mode again.
[2]	Trip, all alarms/test	Option for testing emergency mode operation without compromising the normal handling of warnings and alarms. All alarms are handled as normally defined in the Warning/Alarm Code List in the chapter *Troubleshooting*.

Table 50: Emergency Mode Alarm Handling

Alarm number	Description	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip.			Warranty-affecting alarms in emergency mode
		[0] Trip+reset	[1] Trip	[2] Test	
4	Mains phase loss	Ignore	Ignore	(Warning/trip)	X
7	DC voltage high	Trip+reset	Trip	Warning/trip	
8	DC voltage low	Trip+reset	Trip	Warning/trip	
9	Inverter overld.	Ignore	Ignore	(Warning/trip)	X
13	Over current	Trip+reset	Trip	(Warning/trip/trip lock)	
14	Ground fault	Trip+reset	Trip	(Warning/trip/trip lock)	
16	Short circuit	Trip+reset	Trip	(Trip/trip lock)	
29	Power module temp	Ignore	Ignore	(Warning/trip/trip lock	X
33	Inrush fault	Ignore	Ignore	Trip/trip lock	X
38	Internal fault	Ignore	Ignore	Trip/trip lock	X
39	Heatsink sensor	Ignore	Ignore	(Trip/trip lock)	X
45	Ground fault 2	Ignore	Ignore		
65	Ctrl. card temp	Ignore	Ignore	Warning/trip/(trip lock)	X
68	Safe stop	Trip	Trip	Trip	
69	Pwr card temp.	Ignore	Ignore	Trip/(trip lock)	X

Table 50: Emergency Mode Alarm Handling (continued)

Alarm number	Description	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip.			Warranty-affecting alarms in emergency mode
79	Illegal PS config	Ignore	Ignore		
101	Speed monitor (FC 302)	Ignore	Ignore		
200	Emergency mode	Ignore	Ignore		
201	Emerg. M was active	Ignore	Ignore		
202	Emerg. M limits exceeded	Ignore	Ignore		
244	Heatsink temp	Ignore	Ignore	(Trip/trip lock)	X
245	Heatsink sensor	Ignore	Ignore	(Trip/trip lock)	X
247	Pwr.card temp	Ignore	Ignore	(Trip/trip lock)	X
280	Emergency m service warning	Ignore	Ignore		
281	Emcy OPR unexpected	Ignore	Ignore		

5.23.2 24-1* Drive Bypass

The drive includes a feature which can be used to automatically activate an external electro-mechanical bypass if the drive trips or if there is an emergency-mode coast (see ***parameter 24-00 Emergency Mode Function***).

The bypass switches the motor top operation direct on line. The external bypass is activated by 1 of the digital outputs or relays in the drive when programmed in *parameter group 5-3* Digital Outputs* or *parameter group 5-4* Relays*.

NOTICE

After enabling the drive bypass function, the drive is no longer safety certified (for using the Safe Torque Off in versions, where included).

To deactivate the drive bypass at normal operation (emergency mode not activated), carry out 1 of the following actions:

- Press [Off] on the LCP, or program 2 of the digital inputs for Hand On-Off-Auto.
- Activate external interlock via digital input.
- Carry out a power cycle.

NOTICE

The drive bypass cannot be deactivated if in emergency mode. It can be deactivated only by either removing the emergency mode command signal or the power supply to the drive.

When the drive bypass function is activated, the display on the LCP shows the status message *Drive Bypass*. This message has a higher priority than the emergency mode status messages. When the automatic drive bypass function is enabled, it cuts in the external bypass according to the sequence shown in Figure 111.

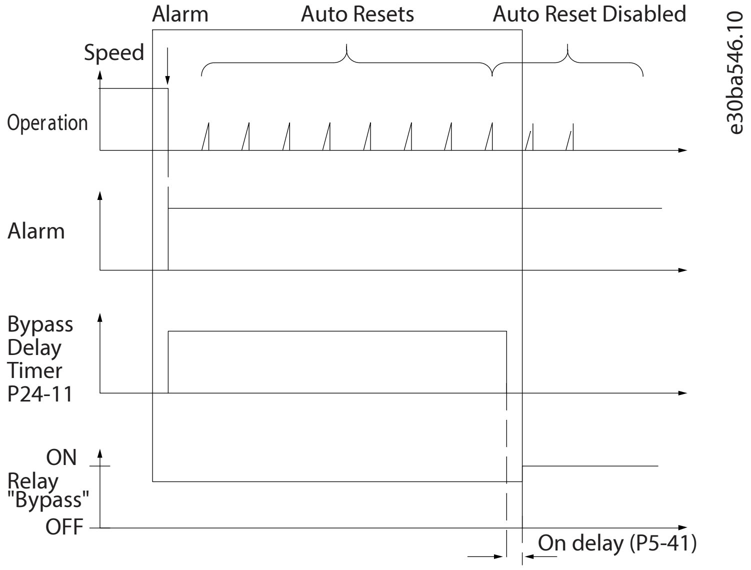


Figure 111: Drive Bypass

The status can be read in the extended status word 2, bit number 24.

24-10 Drive Bypass Function

Default value:	[0] Disabled	**Parameter type:**	option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

After enabling the drive bypass function, the Safe Torque Off function (where included) does not comply with standard EN 954-1, Cat. 3 installations.

This parameter determines the circumstances that activate the drive bypass function.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	If in normal operation, the drive bypass function is activated under the following conditions: • If there is a trip lock or a trip. • After the number of reset attempts programmed in ***parameter 14-20 Reset Mode***. • If the bypass delay timer (***parameter 24-11 Drive Bypass Delay***) expires before reset attempts have been completed.
[2]	Enabled (Emergency M Only)	

24-11 Drive Bypass Delay Time

Default value:	0 s	**Parameter type:**	Range, 0 - 600 s

Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Programmable in 1 s increments. Once the bypass function is activated in accordance with the setting in ***parameter 24-10 Drive Bypass Function***, the bypass delay timer begins to operate. If the drive has been set for several restart attempts, the timer continues to run while the drive tries to restart. Should the motor have restarted within the time period of the bypass delay timer, the timer is reset. Should the motor fail to restart at the end of the bypass delay time, the drive bypass relay programmed for bypass in ***parameter 5-40 Function Relay*** is activated. If a relay delay has also been programmed in ***parameter 5-41 On Delay, Relay***, [Relay] or ***parameter 5-42 Off Delay, Relay*** [Relay], this time must also elapse before the relay action is performed. Where no restart attempts are programmed, the timer runs for the delay period set in this parameter and activates the drive bypass relay, which has been programmed for bypass in ***parameter 5-40 Function Relay***. If a relay delay has also been programmed in ***parameter 5-41 On Delay, Relay*** or ***parameter 5-42 Off Delay, Relay*** [Relay], this time must also elapse before the relay action is performed.

5.23.3 24-4* Emergency Mode 2

Configure the ramp parameters for emergency mode:

- Ramp type
- Ramping times (duration of acceleration and deceleration)
- Level of jerk compensation for S-ramps

Start by setting the linear ramping times corresponding to Figure 112 and Figure 113.

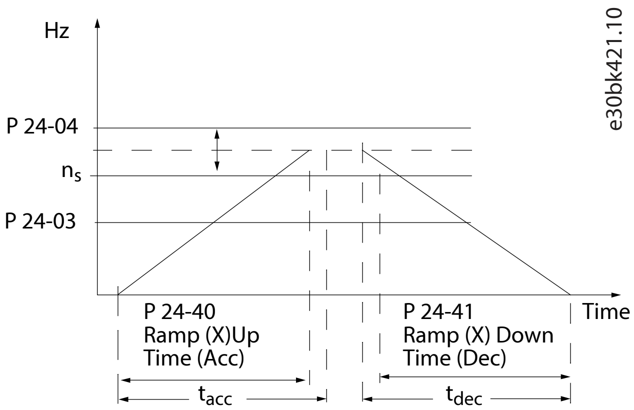


Figure 112: Linear Ramping Times

If S-ramps are selected, set the level of non-linear jerk compensation required. Set jerk compensation by defining the proportion of ramp-up and ramp-down times where acceleration and deceleration are variable (that is, increasing or decreasing). The S-ramp acceleration and deceleration settings are defined as a percentage of the actual ramp time.

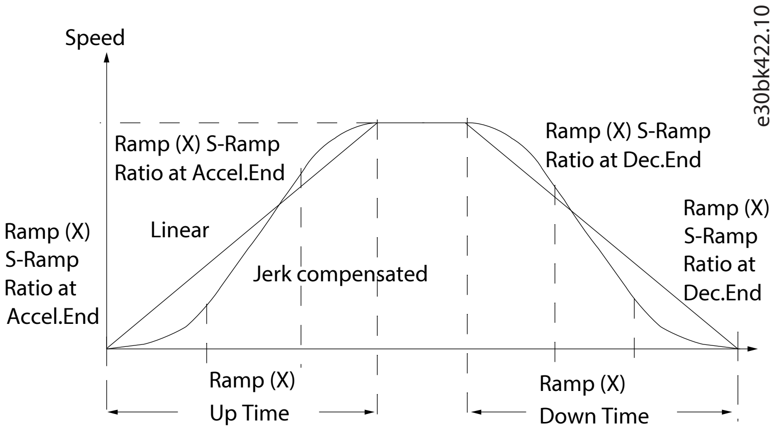


Figure 113: Non-linear Ramping Times

24-40 Emergency Mode Ramp Up Time

Default value:	3 s	**Parameter type:**	Range, 1.0 - 3600 s, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

This ramp time is used for acceleration while emergency mode is active.

24-41 Emergency Mode Ramp Down Time

Default value:	3 s	**Parameter type:**	Range, 1.0 - 3600 s, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Changes during operation:**	True

This ramp time is used for deceleration while emergency mode is active.

24-41 Emergency Mode Ramp Down Time

Default value:	3 s	**Parameter type:**	Range, 1.0 - 3600 s, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Changes during operation:**	True

This ramp time is used for deceleration while emergency mode is active.

24-42 Timeout for Emergency Mode Test

Default value:	10 min	**Parameter type:**	Range, 1 - 60 min
Setup:	All setups	**Conversion index:**	70
Data type:	Uint8	**Change during operation:**	True

A digital impulse triggers the emergency mode operation with stop on all alarms as option ***[2] Trip, all alarms/test*** in ***parameter 24-09 Emergency Mode Alarms Handling***. This test impulse signal can only activate 1 test time period and the normal emergency mode operation takes over as soon as the test time ends, or it stops the test period if the emergency mode signal disappears. Only "normal high impulse" signals can trigger the test timer and test information is included in the LCP and status word, as emergency mode output "not operating as expected" is activated.

24-43 Emergency Mode Signal Operation

Default value:	–	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint	**Change during operation:**	True

NOTICE

Ensure that the correct input selections and connections are in place as it is not possible to operation the LCP while emergency mode is activated.

NOTICE

If signal handling is set to inverse, a low ***[196] EM active*** and a low ***[197] EM was active*** indicate that the drive is off or power cycling, which can be used to activate a redundant system.

Select how emergency mode input and output signals are handled. Before changing this parameter, disable ***parameter 24-00 Emergency Mode Function***.

Option	Name	Description
[0]	Standard, active-high	Normal high input and output signals operate the emergency mode function as long as they are active (high).
[1]	Inverse, active-low	This option adds safety rules to ensure that emergency mode still operates if a signal is lost.
[2]	Impulse, set-reset	This option activates and stops the emergency mode operation on high signal impulse. Operation mode is defined and activated by selected input signals and is frozen 2 s after the 1st signal activation. Reset signal has the highest priority and is required to stop operation or switch to a new operation configuration. A valid signal impulse has to be active for minimum 2 s. **NOTICE** LCP copy and software download only accept parameter changes if ***parameter 24-00 Emergency Mode*** is set to ***[0] Disabled***.

5.24 Parameter Group 25-** Cascade Controller

5.24.1 Introduction to Cascade Controller Parameters

Parameters for configuring the basic cascade controller for sequence control of multiple pumps. For a more application-oriented description and wiring examples, see the section *Application Examples, Cascade Controller*in the design guide. For more information on using the advanced cascade controller options, refer to *Parameter Group 27-** Cascade CTL Option*.

To configure the cascade controller to the actual system and the required control strategy, follow the sequence starting with *parameter group 25-0* System Settings* and next *parameter group 25-5* Alternation Settings*. These parameters can normally be set in advance. Parameters in *parameter groups 25-2* Bandwidth Settings* and *25-4* Staging Settings* often depend on the dynamic of the system and final adjustment to be done at the commissioning of the plant.

NOTICE

The cascade controller is supposed to operate in closed loop controlled by the built-in PI controller (***[3] Closed loop*** selected in ***parameter 1-00 Configuration Mode***). If ***[0] Open loop*** is selected in ***parameter 1-00 Configuration Mode***, all fixed-speed pumps are destaged, but the variable-speed pump is still controlled by the drive, now as an open-loop configuration.

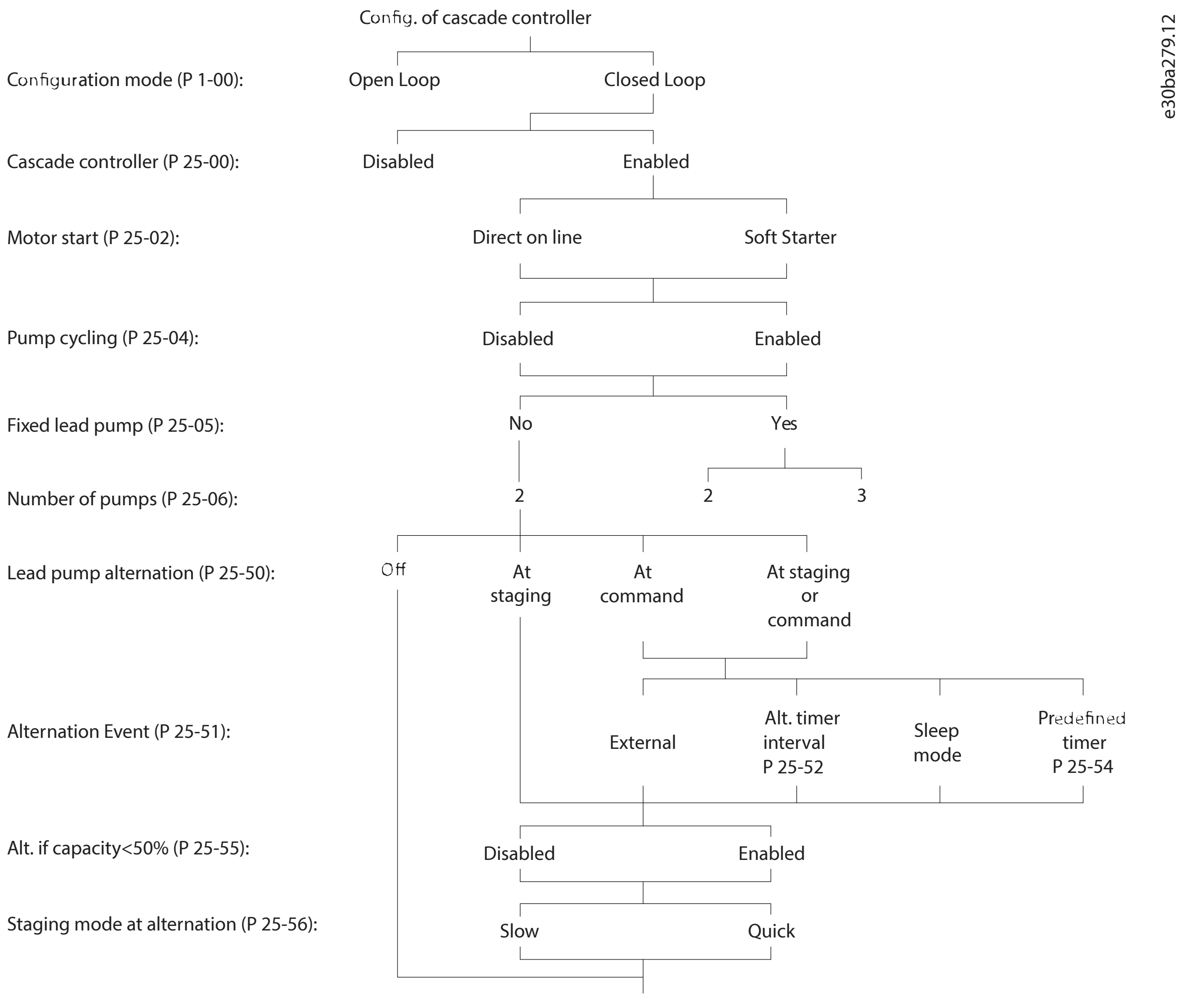


Figure 114: Cascade Controller Sample Setup

5.24.2 25-0* System Settings

The parameters in this parameter group are related to control principles and configuration of the system.

25-00 Cascade Controller

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

For operation of multiple devices (pump/fan) systems where capacity is adapted to actual load with speed control combined with on/off control of the devices. For simplicity, only pump systems are described. To enable the cascade controller functionality, set ***parameter 1-00 Configuration Mode*** to ***[3] Closed loop***.

Option	Name	Description
[0]*	Disabled	The cascade controller is not active. All built-in relays assigned to pump motors in the cascade function are de-energized. If a variable-speed pump is connected to the drive directly (not controlled by a built-in relay), this pump/fan is controlled as a single-pump system.
[1]	Basic cascade ctrl	The cascade controller is active and stages/destages the pump according to the load on the system.
[2]	Motor alternation only	

25-02 Motor Start

Default value:	[0] Direct on line	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Motors are connected to mains directly with a contactor or with a soft starter. When the value of ***parameter 25-02 Motor Start*** is set to an option other than ***[0] Direct on line***, ***parameter 25-50 Lead Pump Alternation*** is automatically set to the default of ***[0] Direct on line***.

Option	Name	Description
[0]*	Direct on line	Each fixed-speed pump is connected to mains directly via a contactor.
[1]	Soft starter	Each fixed-speed pump is connected to mains via a soft starter.
[2]	Star-Delta	Fixed pumps connected with star-delta starters are staged in the same way as pumps connected with soft starters. They are destaged in the same way as pumps connected directly to mains.

25-04 Pump Cycling

Default value:	–	**Parameter type:**	Option
Size related:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

To provide equal hours of operation with fixed-speed pumps, the pump used can be cycled. The selection of pump cycling is either first in-last out or equal running hours for each pump.

Option	Name	Description
[0]	Disabled	The fixed-speed pumps are connected in the order 1–2 and disconnected in the order 2–1 (last in-first out).
[1]	Enabled	The fixed-speed pumps are connected/disconnected to have equal running hours for each pump.

25-05 Fixed Lead Pump

Default value:	[1] Yes	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Fixed lead pump is a configuration when the variable-speed pump is connected directly to the drive. If a contactor is applied between the drive and the pump, this contactor is not controlled by the drive. If operating with ***parameter 25-50 Lead Pump Alternation*** set to other than ***[0] Off***, set this parameter to ***[0] No***.

Option	Name	Description
[0]	No	The lead-pump function can alternate between the pumps controlled by the 2 built-in relays. Connect 1 pump to the built-in relay 1 and the other pump to relay 2. The pump function (cascade pump1 and cascade pump2) is automatically assigned to the relays (maximum 2 pumps can be controlled by the drive in this case).
[1]*	Yes	The lead pump is fixed (no alternation) and connected directly to the drive. ***Parameter 25-50 Lead Pump Alternation*** is automatically set to ***[0] Off***. Built-in relays, relay 1 and relay 2, can be assigned to separate fixed-speed pumps. In total, the drive can control 3 pumps.

25-06 Number of Pumps

Default value:	2	**Parameter type:**	Range, 2 - 9
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

The number of pumps connected to the cascade controller including the variable-speed pump. If the variable-speed pump is connected directly to the drive, and the other fixed-speed pumps (lag pumps) are controlled by the 2 built-in relays, 3 pumps can be controlled. If both the variable-speed and fixed-speed pumps are to be controlled by built-in relays, only 2 pumps can be connected. If ***parameter 25-05 Fixed Lead Pump*** is set to ***[0] No***: 1 variable-speed pump and 1 fixed-speed pump, both controlled by built-in relay. If ***parameter 25-05 Fixed Lead Pump*** is set to ***[1] Yes***: 1 variable-speed pump and 1 fixed-speed pump controlled by built-in relays. 1 lead pump, see ***parameter 25-05 Fixed Lead Pump***. 2 fixed-speed pumps controlled by built-in relays.

5.24.3 25-2* Bandwidth Settings

Parameters for setting the bandwidth within which the pressure is allowed to operate before staging/destaging fixed speed pumps. These parameters also include various timers to stabilize the control.

25-20 Staging Bandwidth

Default value:	Size related	**Parameter type:**	Range, 1 - par. 25-21 [%]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the staging bandwidth (SBW) percentage to accommodate normal system pressure fluctuation. In cascade control systems, to avoid frequent switching of fixed speed pumps, the desired system pressure is typically kept within a bandwidth rather than at a constant level. The SBW is programmed as a percentage of ***parameter 20-13 Minimum Reference/ Feedb.*** and ***parameter 20-14 Maximum Reference/ Feedb***. For example, if the setpoint is 5 bar and the SBW is set to 10%, a system pressure between 4.5 and 5.5 bar is tolerated. No staging or destaging occurs within this bandwidth.

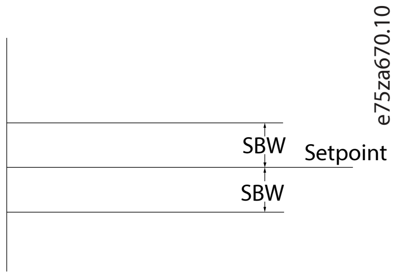
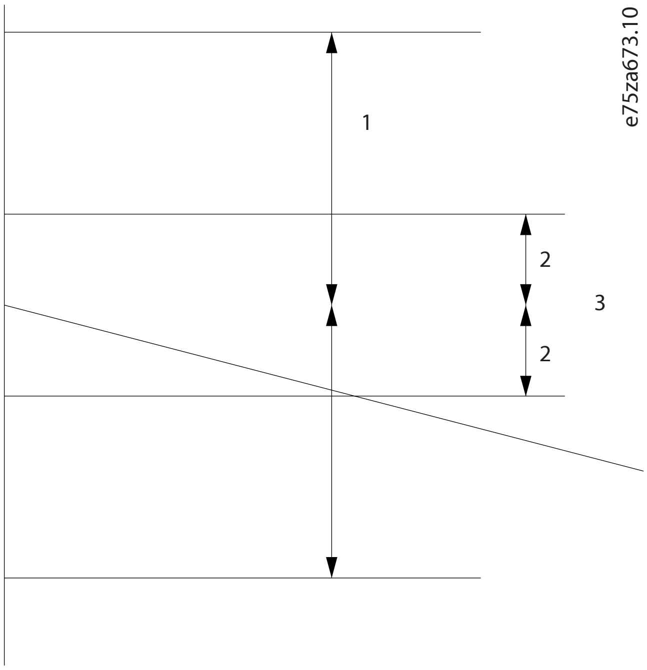


Figure 115: Staging Bandwidth

25-21 Override Bandwidth

Default value:	100%	**Parameter type:**	Range, par. 25-20 - 100 %
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

When a large and quick change in the system demand occurs (such as a sudden water demand), the system pressure rapidly changes and an immediate staging or destaging of a fixed-speed pump becomes necessary to match the requirement. The override bandwidth (OBW) is programmed to override the staging/destaging timer (***parameter 25-23 SBW Staging Delay*** and ***parameter 25-24 SBW Destaging Delay***) for immediate response. Always program the OBW to a higher value than the value set in ***parameter 25-20 Staging Bandwidth***. The OBW is a percentage of ***parameter 3-02 Minimum Reference*** and ***parameter 3-03 Maximum Reference***.



1	Override bandwidth	**2**	SBW
3	Setpoint		

Figure 116: Override Bandwidth

Setting the OBW too close to the SBW could defeat the purpose with frequent staging at momentary pressure changes. Setting the OBW too high might lead to unacceptably high or low pressure in the system while the SBW timers are running. The value can be optimized with increased familiarity with the system. See ***parameter 25-25 OBW Time***. To avoid unintended staging during the commissioning phase and fine-tuning of the controller, initially leave the OBW at the factory setting of 100% (Off). When the fine-tuning is completed, set the OBW to the required value. Initial value of 10% is suggested.

25-22 Fixed Speed Bandwidth

Default value:	Size related	**Parameter type:**	Range, par. 25-20 - par. 25-21 %
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

When the cascade control system runs normally and the drive issues a trip alarm, it is important to maintain the system head. The cascade controller does this by continuing to stage/destage the fixed-speed pump on and off. As keeping the head at the setpoint would require frequent staging and destaging when only a fixed-speed pump is running, a wider fixed-speed bandwidth (FSBW) is used instead of SBW. In alarm situations, or if the start signal on the digital input goes low, it is possible to stop the fixed-speed pumps by pressing [Off] or [Hand On]. If the issued alarm is a trip lock alarm, the cascade controller stops the system immediately by cutting out all the fixed-speed pumps. This is basically the same as emergency stop (coast/coast inverse command) for the cascade controller.

25-23 SBW Stagind Delay

Default value:	15 s	**Parameter type:**	Range, 0 - 3000 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Immediate staging of a fixed-speed pump is not desirable when a momentary pressure drop in the system exceeds the staging bandwidth (SBW). Staging is delayed by the length of the time programmed. If the pressure increases within the SBW before the timer has elapsed, the timer is reset.

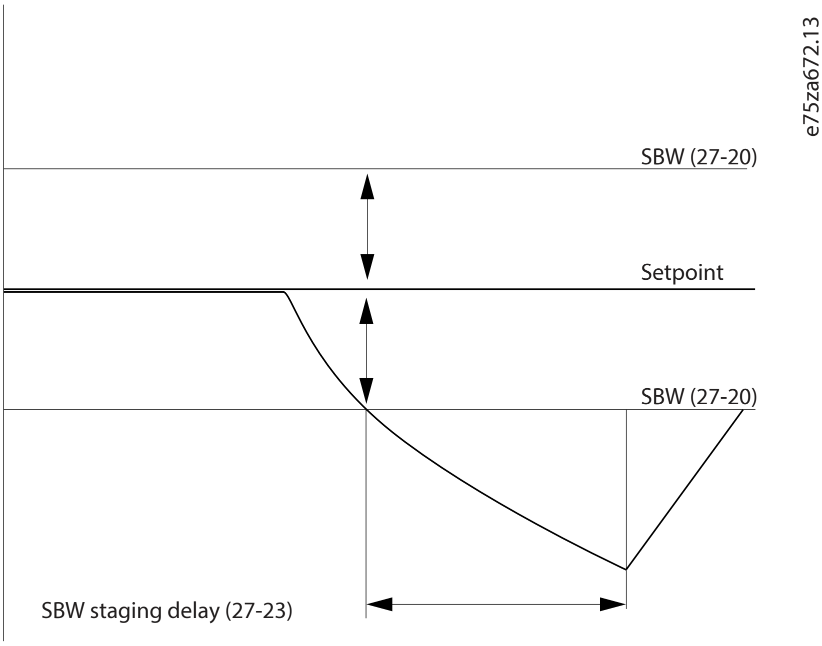


Figure 117: SBW Staging Delay

25-24 SBW Destaging Delay

Default value:	15 s	**Parameter type:**	Range, 0 - 3000 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Immediate destaging of a fixed-speed pump is not recommended when a momentary pressure increases in the system that exceeds the staging bandwidth (SBW). Destaging is delayed by the length of time programmed. If the pressure decreases within the SBW before the timer has elapsed, the timer is reset.

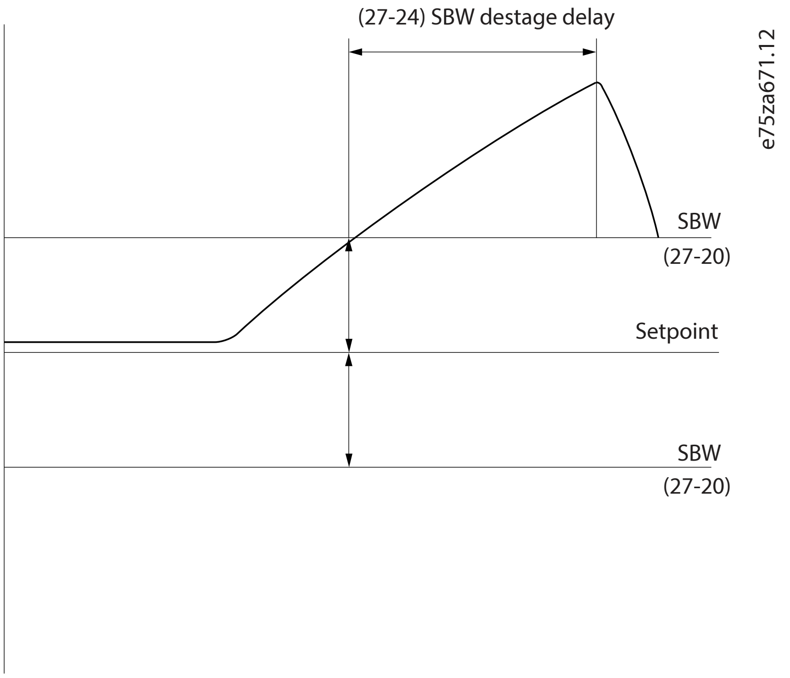


Figure 118: SBW Destaging Delay

25-25 OBW Time

Default value:	10 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Staging a fixed-speed pump creates a momentary pressure peak in the system, which might exceed the override bandwidth (OBW). It is not recommended to destage a pump in response to a staging pressure peak. The OBW time can be programmed to prevent staging until the system pressure has stabilized and normal control established. Set the timer to a value that allows the system to stabilize after staging. The 10 s factory setting is appropriate in most applications. In highly dynamic systems, a shorter time may be wanted.

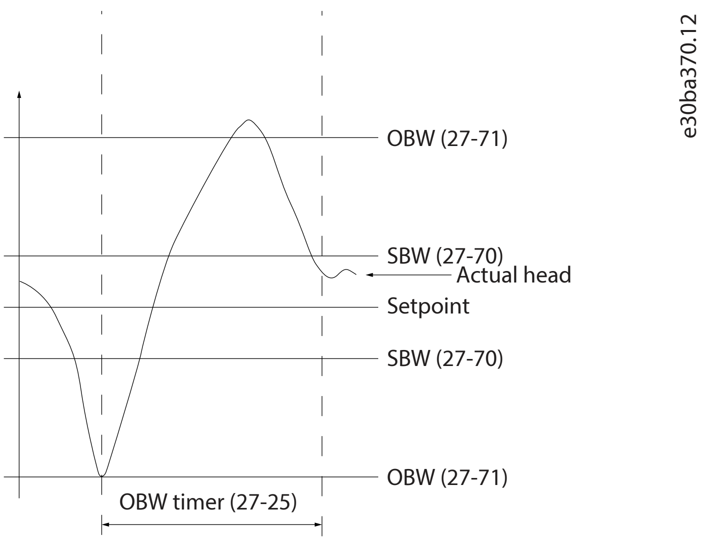


Figure 119: Override Bandwidth Time

25-26 Destage at No-Flow

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter ensures that when a no-flow situation occurs, the fixed-speed pumps are destaged 1 by 1 until the no-flow signal disappears. This requires that no-flow detection is active. See *parameter group 22-2* No-Flow Detection*. If ***[0] Disabled*** is selected, the cascade controller does not change the normal behavior of the system.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

25-27 Stage Function

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

If the stage function is set to ***[0] Disabled***, ***parameter 25-28 Stage Function Time*** is not activated.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

25-28 Stage Function Time

Default value:	15 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The stage function time is programmed to avoid frequent staging of the fixed-speed pumps. The stage function time starts if ***[1] Enabled*** is selected in ***parameter 25-27 Stage Function***, and the variable-speed pump runs at motor speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***) with at least 1 fixed-speed pump in the stop position. When the programmed value of the timer expires, a fixed-speed pump is staged.

25-29 Destage Function

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The destage function ensures that the lowest numbers of pumps are running to save energy and to avoid dead-head water circulation in the variable-speed pump. If the destage function is set to ***[0] Disabled***, ***parameter 25-30 Destage Function Time*** is not activated.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

25-30 Destage Function Time

Default value:	15 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The destage function timer is programmable to avoid frequent staging/destaging of the fixed-speed pumps. The destage function time starts when the adjustable-speed pump is running at ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***, with 1 or more fixed-speed pumps in operation and system requirements satisfied. In this situation, the adjustable-speed pump contributes a little to the system. When the programmed value of the timer expires, a stage is removed, avoiding dead-head water circulation in the adjustable-speed pump.

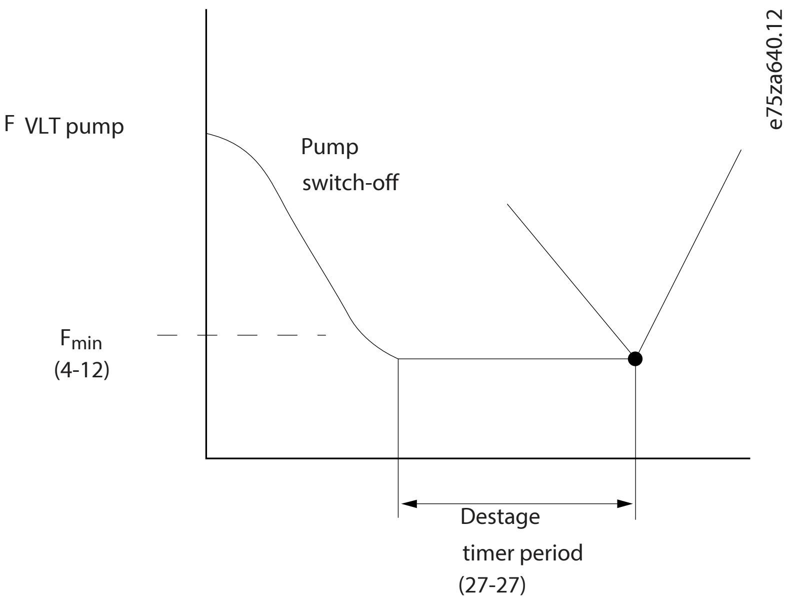


Figure 120: Destage Function Time

5.24.4 25-4* Staging Settings

Parameters determining the conditions for staging/destaging of the pumps.

25-40 Ramp Down Delay

Default value:	10 s	**Parameter type:**	Range, 0 - 120 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

Use this option only if *[1] Soft starter* or *[2] Star-Delta* is selected in ***parameter 25-02 Motor Start***.

When adding a fixed-speed pump controlled by a soft starter or a star-delta starter, it is possible to delay the ramp down of the lead pump until a preset time after the start of the fixed-speed pump. This delay eliminates pressure surges or water hammer in the system.

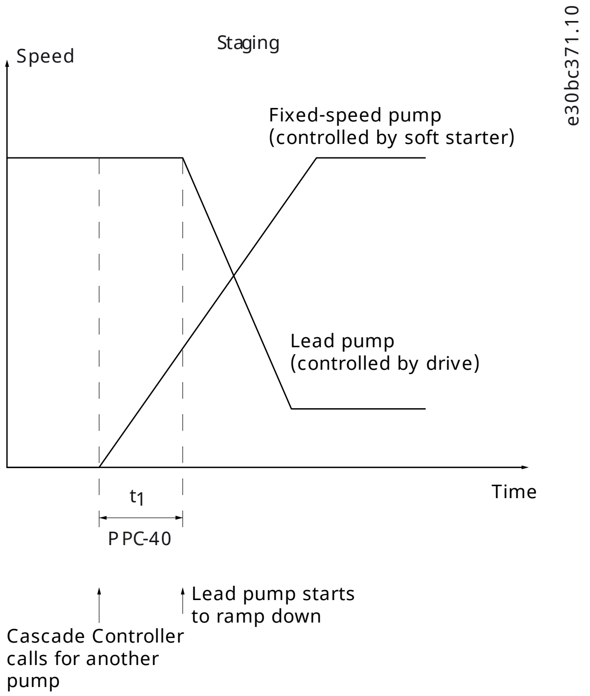


Figure 121: Staging with Ramp-down Delay

25-41 Ramp Up Delay

Default value:	2 s	**Parameter type:**	Range, 0 - 12 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

Use this option only if *[1] Soft starter* is selected in ***parameter 25-02 Motor Start***.

When removing a fixed-speed pump controlled by a soft starter, it is possible to delay the ramp up of the lead pump until a preset time after the stop of the fixed-speed pump. This delay eliminates pressure surges or water hammer in the system.

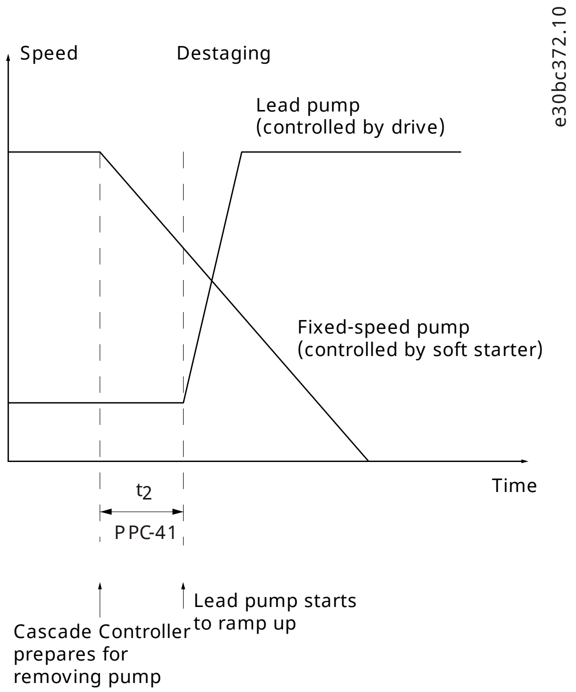


Figure 122: Destaging with Ramp-up Delay

25-42 Staging Threshold

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. The staging threshold is used to calculate the speed of the variable-speed pump when the “cut-in point” of the fixed-speed pump occurs. The calculation of the staging threshold is the ratio of ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***, to ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***, expressed in percent. Staging threshold must range from $\text{Stage}\,\% = \frac{\text{LOW}}{\text{HIGH}} \times 100\%$ to 100%, where n_{HIGH} is motor speed high limit.

NOTICE

If the setpoint is reached after staging before the variable speed pump reaches its minimum speed, the system enters the state closed loop when the feedback pressure is crossing the setpoint.

25-43 Destaging Threshold

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

When removing a fixed-speed pump to prevent an undershoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. The destaging threshold is used to calculate the speed of the variable-speed pump when the destaging of the fixed-speed pump occurs. The calculation of the destaging threshold is the ratio of ***parameter 4-11 Motor Speed Low Limit [RPM]*** or ***parameter 4-12 Motor Speed Low Limit [Hz]***, to ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***, expressed in percent. Destaging threshold must range from $\text{Stage}\,\% = \frac{\text{LOW}}{\text{HIGH}} \times 100\%$ to 100%, where n_{LOW} is motor speed low limit and n_{HIGH} is motor speed high limit.

25-44 Staging Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range, 000 - 0 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Readout of the calculated value for staging speed. When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. Staging speed calculation is based on ***parameter 25-42 Staging Threshold*** and ***parameter 4-13 Motor Speed High Limit [RPM]***. Staging speed is calculated with the following formula:

$\eta\text{STAGE} = \eta\text{HIGH}\frac{\eta\text{STAGE}\,\%}{100}$ where n_{HIGH} is motor speed high limit and $n_{STAGE100\%}$ is the value of the staging threshold.

25-45 Staging Speed [Hz]

Default value:	0 Hz	**Parameter type:**	Range, 0 - 6500 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Readout of the calculated value for staging speed. When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. Staging speed calculation is based on ***parameter 25-42 Staging Threshold*** and ***parameter 4-14 Motor Speed High Limit [Hz]***.

The staging speed is calculated with the following formula:

$\text{STAGE} = \text{HIGH}\frac{\text{STAGE}\,\%}{100}$ where n_{HIGH} is motor speed high limit, and $n_{STAGE100\%}$ is the value of the staging threshold.

25-46 Destaging Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range, 000 - 30000 RPM
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Readout of the calculated value for destaging speed. When removing a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. Destaging speed calculation is based on ***parameter 25-43 Destaging Threshold*** and ***parameter 4-13 Motor Speed High Limit [RPM]***.

The staging speed is calculated with the following formula:

$\text{DESTAGE} = \text{HIGH}\frac{\text{DESTAGE}\,\%}{100}$ where n_{HIGH} is motor speed high limit, and $n_{DESTAGE100\%}$ is the value of the destaging threshold.

25-47 Destaging Speed [Hz]

Default value:	0 Hz	**Parameter type:**	Range, 0 - 6500 Hz
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Readout of the calculated value for destaging speed. When removing a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. Destaging speed calculation is based on ***parameter 25-43 Destaging Threshold*** and ***parameter 4-14 Motor Speed High Limit [Hz]***.

The staging speed is calculated with the following formula:

$DESTAGE = HIGH\frac{DESTAGE\,\%}{100}$ where n_{HIGH} is motor speed high limit, and $n_{DESTAGE100\%}$ is the value of the destaging threshold.

25-49 Staging Principle

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the staging principle for the staging of fixed-speed pumps (direct online models). To configure the drive to return to closed-loop operation immediately after a pump was staged or destaged, select ***[1] Rapid staging***. Use ***[1] Rapid staging*** in systems with rapid demand changes.

Option	Name	Description
[0]*	Normal	
[1]	Rapid staging	

5.24.5 25-5* Alternation Settings

Parameters for defining the conditions for alternation of variable-speed pump (lead) if selected as control strategy.

25-50 Lead Pump Alternation

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

If ***parameter 25-05 Fixed Lead Pump*** is set to ***[1] Yes***, it is only possible to select ***[0] Off***.

Lead pump alternation equalizes the use of pumps by periodically changing the pump that is speed-controlled. This ensures that pumps are equally used over time. Alternation equalizes the usage of pumps by always selecting the pump with the lowest number of hours run to stage on next.

Option	Name	Description
[0]	Off	No alternation of lead-pump function takes place. If ***parameter 25-02 Motor Start*** is set to other than ***[0] Direct on line***, it is not possible to set this parameter to options other than ***[0] Off***.
[1]	At staging	Alternation of the lead-pump function takes place when staging another pump.

Option	Name	Description
[2]	At command	Alternation of the lead-pump function takes place at an external command signal or a preprogrammed event. See ***parameter 25-51 Alternation Event*** for available options.
[3]	At staging or command	Alternation of the lead pump takes place at staging or according to ***[2] At command***.

25-51 Alternation Event

Default value:	[0] External	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is only active if the options ***[2] At command*** or ***[3] At staging or command*** have been selected in ***parameter 25-50 Lead Pump Alternation***. If an alternation event is selected, the alternation of lead pump takes place every time the event occurs.

Option	Name	Description
[0]*	External	Alternation takes place when a signal is applied to 1 of the digital inputs on the terminal strip and this input has been assigned to ***[121] Lead Pump Alternation*** in *parameter group 5-1*, Digital Inputs*.
[1]	Alternation time interval	Alternation takes place every time ***parameter 25-52 Alternation Time Interval*** expires.
[2]	Sleep mode	Alternation takes place each time the lead pump goes into sleep mode. Set ***parameter 20-23 Setpoint 3*** to ***[1] Sleep Mode*** or apply an external signal for this function.
[3]	Predefined time	Alternation takes place at a defined time of the day. If ***parameter 25-54 Alternation Predefined Time*** is set, the alternation is carried out every day at the specified time. Default time is midnight (00:00 or 12:00AM depending on the time format).

25-52 Alternation Time Interval

Default value:	24 h	**Parameter type:**	Range, 1 - 999 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint16	**Change during operation:**	True

If selecting ***[1] Alternation time interval*** in ***parameter 25-21 Alternation Event***, the alternation of the variable-speed pump takes place every time the alternation time interval expires (can be checked in ***parameter 25-53 Alternation Time Value***). The timer pauses when the drive is not running.

25-53 Alternation Time Value

Default value:	0	**Parameter type:**	Range, 0 - 7
Setup:	All setups	**Conversion index:**	0

Data type:	VisStr[7]	**Change during operation:**	True

Readout parameter for the alternation time interval value set in ***parameter 25-52 Alternation Time Interval***.

25-54 Alternation Predefined Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDaywoDate	**Change during operation:**	True

If selecting ***[3] Predefined Time*** in ***parameter 25-51 Alternation Event***, the variable-speed pump alternation is carried out every day at the specified time set in alternation predefined time. Default time is midnight (00:00 or 12:00AM depending on the time format).

25-55 Alternation if Load <50%

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Only valid if ***parameter 25-50 Lead Pump Alternation*** is different from ***[0] Off***.

If selecting ***[1] Enabled***, the pump alternation can only occur if the capacity is equal to or below 50%. The capacity calculation is the ratio of running pumps (including the variable-speed pump) to the total number of available pumps (including variable-speed pump, but not those that are interlocked). For the basic cascade controller, all pumps are of equal size.

$$\text{Capacity} = \frac{N_{\text{RUNNING}}}{N_{\text{TOTAL}}} \times 100\%$$

Option	Name	Description
[0]	Disabled	The lead-pump alternation takes place at any pump capacity.
[1]*	Enabled	The lead-pump function is alternated only if the number of pumps running are providing less than 50% of total pump capacity.

25-56 Staging Mode at Alternation

Default value:	[0] Slow	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

NOTICE

Only valid if ***parameter 25-50 Lead Pump Alternation*** is different from ***[0] Off***.

This parameter is only active if the option selected in ***parameter 25-50 Lead Pump Alternation*** is different from ***[0] Off***. 2 types of staging and destaging of pumps are possible. Slow transfer makes staging and destaging smooth. Quick transfer makes staging and destaging as fast as possible; the variable-speed pump is just cut out (coasted).

The following illustration is an example of the slow transfer-staging. The variable-speed pump (top graph) and 1 fixed-speed pump (bottom graph) run before the staging command. When the *[0] Slow transfer command* is activated, an alternation is carried out by ramping the variable-speed pump to *parameter 4-13 Motor Speed High Limit [RPM]* or *parameter 4-14 Motor Speed High Limit [Hz]*, and then decelerated to zero speed. After a delay before starting the next pump (*parameter 25-58 Run Next Pump Delay*), the next lead pump (middle graph) is accelerated and another original lead pump (top graph) is added after the delay before running on mains (*parameter 25-59 Run on Mains Delay*) as a fixed-speed pump. The next lead pump (middle graph) is decelerated to motor speed low limit and then allowed to vary speed to maintain system pressure.

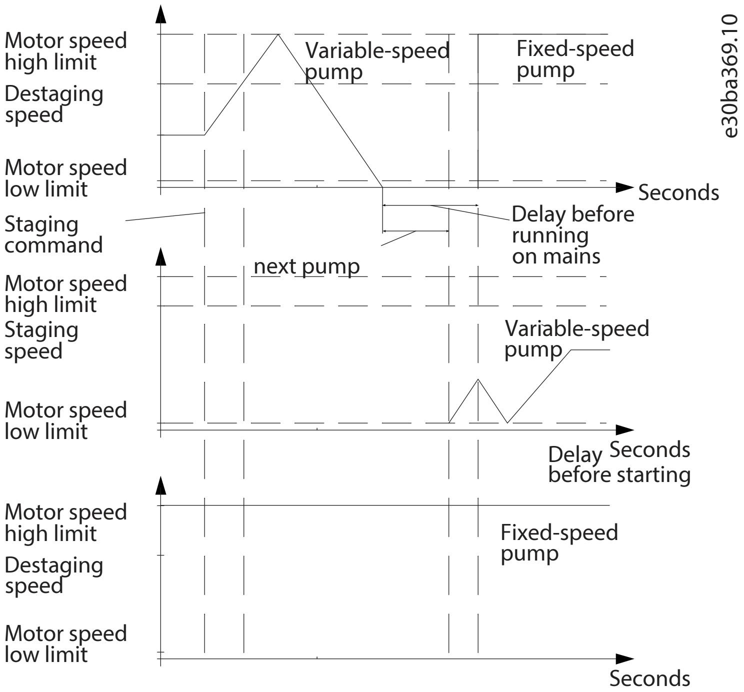


Figure 123: Staging Mode at Alternation

Option	Name	Description
[0]*	Slow	At alternation, the variable-speed pump is ramped up to maximum speed and then ramped down to a standstill.
[1]	Quick	At alternation, the variable-speed pump is ramped up to maximum speed and then coasted to a standstill.
[2]	Slow down	At alternation, the variable-speed pump is ramped down to a standstill.

25-58 Run Next Pump Delay

Default value:	0.1 s	**Parmaeter type:**	Range, 0.1 - 5 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This parameter is only active if the option selected in ***parameter 25-50 Lead Pump Alternation*** is different from ***[0] Off***. This parameter sets the time between stopping the old variable-speed pump and starting another pump as a new variable-speed pump. Refer to ***parameter 25-56 Staging Mode at Alternation*** for a description of staging and alternation.

25-59 Run on Mains Delay

Default value:	0.5 s	**Parameter type:**	Range, Par. 25-58 - 5 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter is only active if the option selected in ***parameter 25-50 Lead Pump Alternation*** is different from ***[0] Off***.

This parameter sets the time between stopping the old variable-speed pump and starting this pump as a new fixed-speed pump. Refer to ***parameter 25-56 Staging Mode at Alternation*** for a description of staging and alternation.

5.24.6 25-8* Status

This parameter group contains readout parameters providing information about the operating status of the cascade controller and the pumps installed.

25-80 Cascade Status

Default value:	0	**Parameter type:**	Range, 0 - 25
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

Readout of the status of the cascade controller.

25-81 Pump Status

Default value:	0	**Parameter type:**	Range, 0 - 25
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

Pump status shows the status for the number of pumps selected in ***parameter 25-06 Number of Pumps***. It is a readout of the status for each of the pumps showing a string, which consists of the pump number and the status of the pump. Example: Readout is with the abbreviation like "1:D 2:O" This means that pump 1 is running and the speed is controlled by the drive, and pump 2 is stopped.

25-82 Lead Pump

Default value:	0	**Parameter type:**	Range, 0 - par. 25-06
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Readout parameter for the actual variable-speed pump in the system. The lead-pump parameter is updated to reflect the current variable-speed pump in the system when an alternation takes place. If no lead pump is selected (cascade controller disabled or all pumps interlocked), the display shows N1.

25-83 Relay Status

Default value:	0	**Parameter type:**	Range, 0 - 4, Array [9]
Setup:	All setups	**Conversion index:**	0

Data type:	VisStr[4]	**Change during operation:**	True

Readout of the status for each of the relays assigned to control the pumps. Every element in the array shows a relay. If a relay is activated, the corresponding element is set to On. If a relay is deactivated, the corresponding element is set to Off.

25-84 Pump ON Time

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h, Array [10]
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

Readout of the value for pump ON time. The cascade controller has separate counters for the pumps and for the relays that control the pumps. Pump ON time monitors the operating hours of each pump. The value of each pump ON time counter can be reset to 0 by writing in the parameter, for example, if the pump is replaced at a service.

25-85 Relay ON Time

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h, Array [9]
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

Readout of the value for relay ON time. The cascade controller has separate counters for the pumps and for the relays that control the pumps. Pump cycling is always done based on the relay counters, otherwise it would always use the new pump if a pump is replaced and its value in ***parameter 25-84 Pump ON Time*** is reset. To use ***parameter 25-04 Pump Cycling***, the cascade controller is monitoring the relay ON time.

25-86 Reset Relay Counters

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Resets all elements in ***parameter 25-85 Relay ON Time*** counters.

Option	Name	Description
[0]*	Do not reset	
[1]	Reset	

25-87 Inverse Interlock

Default value:	0	**Parameter type:**	Range, 0 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the interlock status of the connected compressors.

5.24.7 25-9* Service

The parameters in this group are used if there is a service on 1 or more of the pumps controlled.

25-90 Pump Interlock

Default value:	[0] Off	**Parameter type:**	Option, Array [10]
Setup:	All setups	**Conversion index:**	–
Data type:	Uin8	**Change during operation:**	True

In this parameter, it is possible to disable 1 or more of the fixed lead pumps. For example, the pump is not selected for staging on even if it is the next pump in the operation sequence. It is not possible to disable the lead pump with the pump interlock command. The digital input interlocks are selected as ***[130] Pump 1 interlock* – *[132] Pump 3 interlock*** in *parameter group 5-1* Digital In/Out*.

Option	Name	Description
[0]*	Off	The pump is active for staging/destaging.
[1]	On	The pump interlock command is given. If a pump runs, it is immediately destaged. If the pump does not run, it is not allowed to stage on.

25-91 Manual Alternation

Default value:	0	**Parameter type:**	Range, 0 - par. 25-06
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Readout parameter for the actual variable-speed pump in the system. When an alternation takes place, the lead pump parameter is updated to reflect the current variable-speed pump in the system. If no lead pump is selected (cascade controller disabled or all pumps interlocked), the display shows N1.

5.25 Parameter Group 26-** Analog I/O Option MCB 109

5.25.1 Introduction to Parameters Related to the VLT® Analog I/O Option MCB 109

VLT® Analog I/O Option MCB 109 extends the functionality of VLT® drives by adding some more, programmable analog inputs and outputs. This could be especially useful in building management system installations where the drive may be used as decentral I/O, obviating the need for an outstation and thus reducing cost.

NOTICE

The maximum current for the analog outputs 0–10 V is 1 mA.

NOTICE

Where live zero monitoring is used, it is important that any analog inputs not being used for the drive, that is, being used as part of the building management system decentral I/O, should have their live zero-function disabled.

Table 51: Relevant Parameters for Analog Inputs, Outputs, and Relays

Terminal	Parameters
Analog inputs	
X42/1	***Parameter 26-00 terminal X42/1 Mode, parameter 26-10 Terminal X42/1 Low Voltage***.
X42/3	***Parameter 26-01 terminal X42/3 Mode, parameter 26-20 Terminal X42/3 Low Voltage***.
X42/5	***Parameter 26-02 terminal X42/5 Mode, parameter 26-30 Terminal X42/5 Low Voltage***.
Analog outputs	
X42/7	***Parameter 26-40 Terminal X42/7 Output***.
X42/9	***Parameter 26-50 Terminal X42/9 Output***.
X42/11	***Parameter 26-60 Terminal X42/11 Output***.
Analog inputs	
53	*Parameter group 6-1* Analog Input 1*.
54	*Parameter group 6-2* Analog Input 2*.
Analog outputs	
42	*Parameter group 6-5* Analog Output 1*.
Relays	
Relay 1, terminals 1, 2, 3	*Parameter group 5-4* Relays*.
Relay 2, terminals 4, 5, 6	*Parameter group 5-4* Relays*.

It is also possible to read the analog inputs, write to the analog outputs, and control the relays, using communication via the fieldbus. See the relevant parameters in Table 52.

NOTICE

Enable the relay outputs via control word bit 11 (relay 1) and bit 12 (relay 2).

Table 52: Relevant Parameters for Analog Inputs, Outputs, and Relays When Using Fieldbus

Terminal	Parameters
Analog inputs (read)	
X42/1	***Parameter 18-30 Analog Input X42/1***.
X42/3	***Parameter 18-31 Analog Input X42/3***.
X42/5	***Parameter 18-32 Analog Input X42/5***.
Analog outputs (write)	
X42/7	***Parameter 18-33 Analog Out X42/7 [V]***.
X42/9	***Parameter 18-34 Analog Out X42/9 [V]***.

Table 52: Relevant Parameters for Analog Inputs, Outputs, and Relays When Using Fieldbus (continued)

Terminal	Parameters
X42/99	***Parameter 18-35 analog Out X42/11 [V]***.
Analog inputs (read)	
53	***Parameter 16-62 Analog Input 53***.
54	***Parameter 16-64 Analog Input 54***
Analog output	
42	***Parameter 6-63 Terminal X30/8 Output Bus Control***.
Relays	
Relay 1, terminals 1, 2, 3	***Parameter 16-71 Relay Output [bin]***.
Relay 2, terminals 4, 5, 6	***Parameter 16-71 Relay Output [bin]***.

Setting of on-board real-time clock

The analog I/O option incorporates a real-time clock with battery backup. This can be used as backup of the clock function included in the drive as standard. See *parameter group 0-7* Clock Settings*.

The analog I/O option can be used for the control of devices such as actuators or valves, using the extended closed-loop facility, thus removing control from the building management system. See *parameter group 21-** Extended Closed Loop*. There are 3 independent closed-loop PID controllers.

5.25.2 26-0* Analog I/O Mode

Parameter group for setting up the analog I/O configuration. The option is equipped with 3 analog inputs. These analog inputs can be freely allocated to either voltage (0–10 V), pt 1000, or Ni 1000 temperature sensor input.

26-00 Terminal X42/1 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Terminal X42/1 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode. ***[2] Pt 1000 [°C]*** and ***[4] Ni 1000 [°C]*** if operating in Celsius, or ***[3] Pt 1000 [°F]*** and ***[5] Ni 1000 [°F]*** if operating in Fahrenheit.

NOTICE

If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- ***Parameter 20-12 Reference/ Feedback Unit.***
- ***Parameter 21-10 Ext. 1 Ref./ Feedback Unit.***
- ***Parameter 21-30 Ext. 2 Ref./ Feedback Unit.***
- ***Parameter 21-50 Ext. 3 Ref./ Feedback Unit.***

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

26-01 Terminal X42/3 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Terminal X42/3 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode. ***[2] Pt 1000 [°C]*** and ***[4] Ni 1000 [°C]*** if operating in Celsius, or ***[3] Pt 1000 [°F]*** and ***[5] Ni 1000 [°F]*** if operating in Fahrenheit.

NOTICE

If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- ***Parameter 20-12 Reference/ Feedback Unit.***
- ***Parameter 21-10 Ext. 1 Ref./ Feedback Unit.***
- ***Parameter 21-30 Ext. 2 Ref./ Feedback Unit.***
- ***Parameter 21-50 Ext. 3 Ref./ Feedback Unit.***

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

26-02 Terminal X42/5 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Terminal X42/5 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode. ***[2] Pt 1000 [°C]*** and ***[4] Ni 1000 [°C]*** if operating in Celsius, or ***[3] Pt 1000 [°F]*** and ***[5] Ni 1000 [°F]*** if operating in Fahrenheit.

NOTICE

If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- ***Parameter 20-12 Reference/Feedback Unit.***
- ***Parameter 21-10 Ext. 1 Ref./Feedback Unit.***
- ***Parameter 21-30 Ext. 2 Ref./Feedback Unit.***
- ***Parameter 21-50 Ext. 3 Ref./Feedback Unit.***

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

5.25.3 26-1* Analog Input X42/1

Parameters for configuring the scaling and limits for analog input terminal X42/1.

26-10 Terminal X42/1 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 26-11
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in ***parameter 26-14 Term. X42/1 Low Ref./Feedb. Value***.

26-11 Terminal X42/1 High Voltage

Default value:	10 V	**Parameter type:**	Range, Par. 26-10 - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/ feedback value set in ***parameter 26-15 Term. X42/1 High Ref./Feedb. Value***.

26-14 Term. X42/1 Low Ref./Feedb. Value

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the low-voltage value set in ***parameter 26-10 Terminal X42/1 Low Voltage***.

26-15 Term. X42/1 High Ref./Feedb. Value

Default value:	100	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the high-voltage value set in ***parameter 26-11 Terminal X42/1 High Voltage***.

26-16 Term. X42/1 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/1. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-17 Term. X42/1 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.4 26-2* Analog Input X42/3

Parameters for configuring the scaling and limits for analog input terminal X42/3.

26-20 Terminal X42/3 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - par. 26-21
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in ***parameter 26-24 Term. X42/3 Low Ref./Feedb. Value***.

26-21 Terminal X42/3 High Voltage

Default value:	10 V	**Parameter type:**	Range, Par. 26-20 - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/ feedback value set in ***parameter 26-25 Term. X42/3 High Ref./Feedb. Value***.

26-24 Term. X42/3 Low Ref./Feedb. Value

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the low-voltage value set in ***parameter 26-20 Terminal X42/3 Low Voltage***.

26-25 Term. X42/3 High Ref./Feedb. Value

Default value:	100	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the high-voltage value set in ***parameter 26-21 Terminal X42/3 High Voltage***.

26-26 Term. X42/3 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/3. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-27 Term. X42/3 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.5 26-3* Analog Input X42/5

Parameters for configuring the scaling and limits for analog input terminal X42/5.

26-30 Terminal X42/5 Low Voltage

Default value:	0.007 V	**Parameter type:**	Range, 0 - par. 26-31
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in ***parameter 26-34 Term. X42/5 Low Ref./Feedb. Value***.

26-31 Terminal X42/5 High Voltage

Default value:	10 V	**Parameter type:**	Range, Par. 26-30 - 10 V
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in ***parameter 26-35 Term. X42/5 High Ref./Feedb. Value***.

26-34 Term. X42/5 Low Ref./Feedb. Value

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the analog input scaling value that corresponds to the low-voltage value set in ***parameter 26-30 Terminal X42/5 Low Voltage***.

26-36 Term. X42/5 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

NOTICE

This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/5. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-37 Term. X42/5 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.6 26-4* Analog Out X42/7

Parameters for configuring the scaling and output function for analog output terminal X42/7.

26-40 Terminal X42/7 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the function of terminal X42/7 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +-200%	-200%...+200% of ***parameter 3-03 Maximum Reference*** (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***), (0–10 V).
[108]	Torque +-160%	

Option	Name	Description
[109]	Out frq 0-Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-41 Terminal X42/7 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the minimum output of the selected analog signal at terminal X42/7 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in ***parameter 26-42 Terminal X42/7 Max. Scale***.

26-42 Terminal X42/7 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal X42/7. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$\left(\frac{10V}{\mathrm{Desired maximum voltage}}\right)\times 100\%$ that is $5V : \frac{10V}{5V}\times 100\,\% = 200\,\%$

26-43 Terminal X42/7 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of terminal X42/7 if controlled by bus.

26-44 Terminal X42/7 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of terminal X42/7. If a fieldbus and a timeout function are selected in ***parameter 26-50 Terminal X42/9 Output***, the output presets to this level.

5.25.7 26-5* Analog Out X42/9

Parameters for configuring the scaling and output function for analog output X42/9.

26-50 Terminal X42/9 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the function of terminal X42/9 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +-200%	-200%...+200% of ***parameter 3-03 Maximum Reference*** (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***), (0–10 V).
[108]	Torque +-160%	
[109]	Out frq 0-Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	

Option	Name	Description
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-51 Terminal X42/9 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the minimum output of the selected analog signal at terminal X42/9 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in ***parameter 26-52 Terminal X42/9 Max. Scale***.

26-52 Terminal X42/9 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal X42/9. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$\left(\frac{10V}{Desiredmaximumvoltage}\right)\times 100\%$ that is $5V:\frac{10V}{5V}\times 100\,\% = 200\,\%$

26-53 Terminal X42/9 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of terminal X42/9 if controlled by bus.

26-54 Terminal X42/9 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of terminal X42/9. If a fieldbus and a timeout function are selected in ***parameter 26-60 Terminal X42/11 Output***, the output presets to this level.

5.25.8 26-6* Analog Out X42/11

Parameter for configuring the scaling and output function for analog output terminal X42/11.

26-60 Terminal X42/11 Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the function of terminal X42/11 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +-200%	-200%...+200% of ***parameter 3-03 Maximum Reference*** (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (***parameter 16-37 Inv. Max. Current***), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (***parameter 4-16 Torque Limit Motor Mode***), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (***parameter 4-13 Motor Speed High Limit [RPM]*** and ***parameter Motor Speed High Limit [Hz]***), (0–10 V).
[108]	Torque +-160%	
[109]	Out frq 0-Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-61 Terminal X42/11 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the minimum output of the selected analog signal at terminal X42/11 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in ***parameter 26-62 Terminal X42/11 Max. Scale***.

26-62 Terminal X42/11 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of the selected analog signal at terminal X42/11. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$\left(\frac{10V}{Desiredmaximumvoltage}\right) \times 100\%$ that is $5V : \frac{10V}{5V} \times 100\,\% = 200\,\%$

26-63 Terminal X42/11 Bus Control

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	N2	**Change during operation:**	True

Holds the level of terminal X42/11 if controlled by bus.

26-64 Terminal X42/11 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Holds the preset level of terminal X42/11. If a fieldbus and a timeout function are selected, the output presets to this level.

5.26 Parameter Group 27-** Cascade CTL Option

5.26.1 Introduction to Cascade Controller Option Parameters

Parameter group 27-** Cascade CTL Option is available if 1 of the following conditions is met:

- VLT® Extended Cascade Controller MCO 101 is installed.
- VLT® Advanced Cascade Controller MCO 102 is installed.
- The drive was ordered with type code LXX1.

Relay wiring configuration using MCO 101 or MCO 102

For a detailed description of commissioning for mixed pump and master/follower applications (using relay operation), refer to VLT® Cascade Controller Options MCO 101/102 Operating Instructions.

Serial communication wiring configuration

The serial communication wiring configuration supports the master/follower cascade controller setup controlling up to 8 pumps in total. Basic functionality and staging principles are programmed via *parameter group 27-** Cascade CTL Option* supporting configurations of up to 8 drives/pumps.

In water distributions systems, it is usually a requirement that the cascade system has s redundant master functionality. This functionality can be achieved by having a cascade controller enabled in multiple drives in the same system.

At least 1 of the drives in the setup must have *parameter group 27-** Cascade CTL Option* enabled. When this parameter group is available, ***[23] Modbus multi master*** is enabled in ***parameter 8-30 Protocol***.

When master functionality is used with ***[23] Modbus multi master*** in ***parameter 8-30 Protocol***, this will take up setup 1 and setup 2. The remaining setups can be used for other purposes. All drives capable of being assigned as master power up as being a follower. The drive with the lowest address in the system will be the first to be assigned as master, and thereby keeping the remaining drives in follower setup. If an assigned master fails, or is powered off due to maintenance, the next lowest address is assigned automatically as master. If the drive with a lower address is reinserted into the system, the lowest address will be reinserted as a follower. Assignment of master functionality to the lowest address in the system, does NOT happen automatically. When appropriate, for example during night time, the assigned master drive must be power-cycled. The lowest address will then be assigned master of the system.

NOTICE

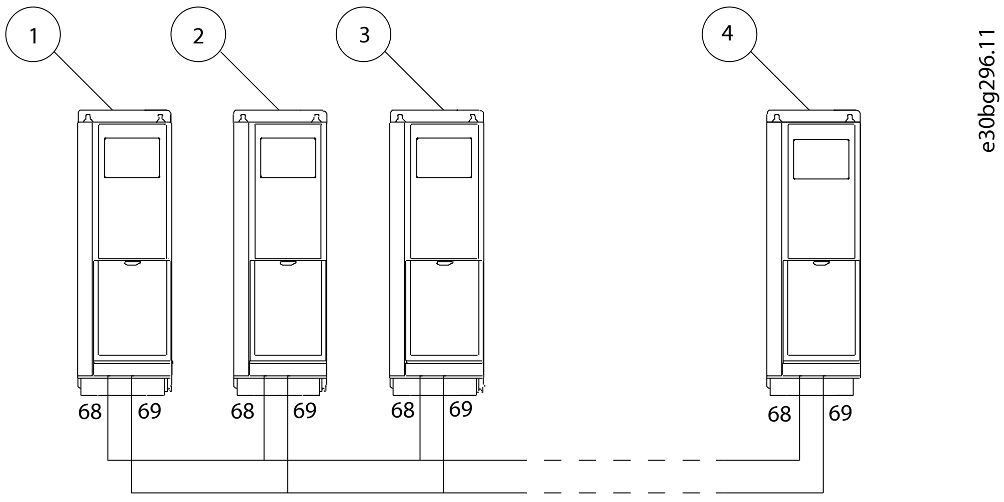
Each possible master must have its own feedback signal.

If a drive must act differently when being assigned as master compared to being assigned as follower, this difference can be programmed as parameter differences between setup 1 (master closed loop) and setup 2 (follower open loop).

Drives must be addressed with a unique address or forward-running number. For follower drives, set ***[2] Modbus RTU*** in ***parameter 8-30 Protocol***. Reaction at communication loss can be set in ***parameter 8-03 Control Timeout Time*** and ***parameter 8-04 Control Timeout Function***. Apply this setting to all drives in the system. This configuration only supports the master/follower mode.

NOTICE

Terminate the RS485 bus with a resistor at both ends. For this purpose, set switch S801 on the control card to ON.



1	Primary master 1	**2**	Follower 1
3	Follower 2	**4**	Follower X (up to 7 followers)

Figure 124: Serial Communication Wiring

5.26.2 Master/Follower Configuration

The master/follower cascade control mode offers the best performance, the most precise control, and maximum energy savings. This mode controls multiple equally sized pumps in parallel runs all pumps at the same speed, and stages the pumps on an off according to system requirements.

Compared to the closed-loop cascade control using feedback, the master drive uses the speed values from the follower drives for controlling when to either stage or destage pumps.

Set the stage-on and stage-off speed according to the system requirements to obtain the highest energy saving. In the master/follower configuration, the master drive runs in closed loop, while the follower drives run in open loop. All follower drives are connected to mains and the motor in the same way as the master drive. In this configuration, each pump is controlled by a drive. All pumps and drives must be of the same size.

5.26.3 Mixed-pump Configuration

This configuration combines some of the benefits of the master/follower configuration with some of the initial cost savings of the fixed-speed configuration. Use this configuration when the extra capacity of the fixed pump is rarely needed.

The mixed-pump configuration supports a mix of variable-speed pumps connected to the drives with extra fixed-speed pumps. First, the variable-speed pumps are staged on and destaged based on the drive speed. After that, the fixed-speed pumps are staged on and destaged based on the feedback pressure.

NOTICE

All drives must have the same power range. All variable-speed pumps must be of the same size. Fixed-speed pumps can be of different sizes.

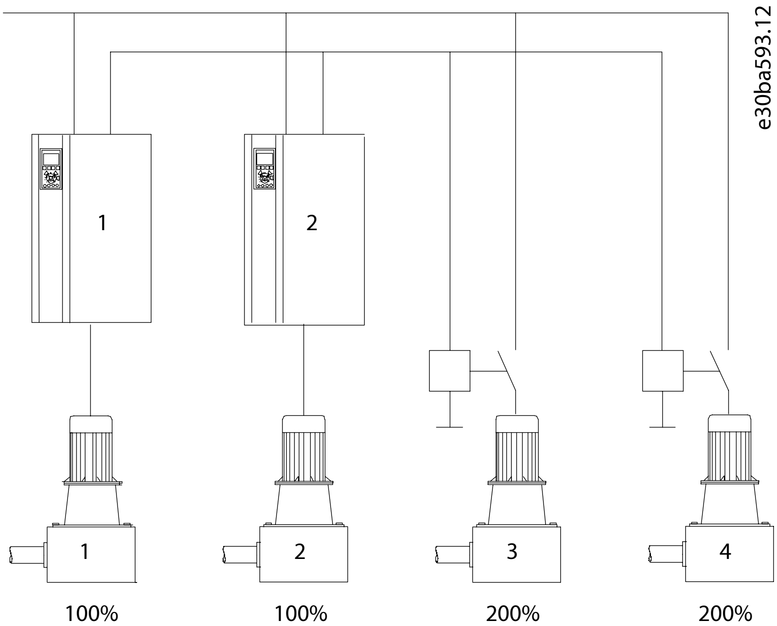


Figure 125: Mixed-pump Configuration

5.26.4 Unequal Pump Size Configuration

The unequal pump size configuration supports a limited mix of fixed-speed pumps in different sizes. This configuration provides the larges range of system output with the smallest number of pumps.

5.26.5 Using Soft Starters for Fixed-speed Pumps

In a mixed-pump configuration, contactors can be replaced with soft starters.

NOTICE
Mixing soft starters and contactors hinders the control of output pressure during the staging and destaging transitions. The use of soft starters delays staging due to the ramp time of a fixed-speed pump.

5.26.6 27-0* Control & Status

The parameters in this parameter group are used for monitoring and controlling pumps.

27-01 Pump Status

Default value:	[0] Ready	**Parameter type:**	Option, Array [9]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter shows the status of each pump in the system.

Option	Name	Description
[0]*	Ready	The pump is available for use by the Cascade Controller.
[1]	On drive	The pump is: • running. • connected to the drive. • controlled by the Cascade Controller.
[2]	On mains	The pump is: • running. • connected to mains. • controlled by the Cascade Controller.
[3]	Offline - off	The pump is off and not available for use by the Cascade Controller.
[4]	Offline - on mains	The pump is: • running. • connected to mains. • not available for use by the Cascade Controller.
[5]	Offline - on drive	The pump is: • running. • connected to the drive. • Not available for use by the Cascade Controller.
[6]	Offline - fault	The pump is: • running. • connected to mains. • not available for use by the Cascade Controller.
[7]	Offline - hand	The pump is: • running. • connected to mains. • Not available for use by the Cascade Controller.
[8]	Offline - external interlock	The pump is off and is externally interlocked.
[9]	Spinning	The Cascade Controller is off and is externally interlocked.
[10]	No relay connection	The pump is not directly connected to the drive, and a relay is not assigned to the pump.

27-02 Manual Pump Control

Default value:	[0] No operation	**Parameter type:**	Option, Array [9]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter is a command parameter that allows manual control of individual pump states. Selecting 1 of the options executes the command in the option and then returns to option ***[0] No operation***.

Option	Name	Description
[0]*	No operation	The drive does not issue any commands.
[1]	Online	The pump is available to the Cascade Controller.
[2]	Alternate - on	The drive forces the selected pump to be the lead pump.
[3]	Offline - off	The drive turns off the pump and makes it unavailable for cascading.
[4]	Offline - on	The drive turns on the pump and makes it unavailable for cascading.
[5]	Offline - spin	The drive initiates a pump spin.

27-03 Current Runtime Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h, Array [9]
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

This parameter shows the total number of hours that each pump has run since the last reset. This value is used to balance the running hours between pumps. To reset the value to 0, use ***parameter 27-91 Cascade Reference***.

27-04 Pump Total Lifetime Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h, Array [9]
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	True

NOTICE

Do not use this parameter to set a certain value for maintenance purposes.

This parameter shows the total hours run for each connected pump.

5.26.7 27-1* Configuration

Use the parameters in this group for configuring the Cascade Controller option.

27-10 Cascade Controller

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the operating mode for the Cascade Controller. To enable the cascade controller functionality, set ***parameter 1-00 Configuration Mode*** to ***[3] Closed loop***.

Option	Name	Description
[0]	Disabled	Turns off the Cascade Controller option.
[1]	Master/follower	Select this option to use only variable-speed pumps connected to drives. Selecting this option sets ***parameter 8-30 Protocol*** to ***[23] Modbus multi master***.
[2]	Mixed pumps	Select this option to use both variable and fixed-speed pumps.
[3]	Basic cascade control	Turns off the Cascade Controller option and reverts to basic cascade operation (see *parameter group 25-** Cascade Controller* for more information). Selecting this option increases the number of pumps that the basic Cascade Controller can control. The extra relays on the option can be used to extend the basic Cascade Controller with 3 relays.

27-11 Number of Drives

Default value:	Size related	**Parameter type:**	Range, 1 - 8
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

This parameter shows how many drives the Cascade Controller controls. Depending on the option installed, the Cascade Controller can control the following number of drives:

- VLT® Extended Cascade Controller MCO 101: 1–6
- VLT® Advanced Cascade Controller MCO 102: 1–8
- Cascade CTL License software (type code LXX1): 1–8

27-12 Number of Pumps

Default value:	Size related	**Parameter type:**	Range, 2 - 8
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

This parameter shows how many pumps the Cascade Controller controls. Depending on the configuration, the Cascade Controller can control the following number of pumps:

- VLT® Extended Cascade Controller MCO 101: 0–6
- VLT® Advanced Cascade Controller MCO 102: 0–8
- Cascade CTL License software (type code LXX1): 1–8

27-13 Max Number of Pumps Running

Default value:	Size related	**Parameter type:**	Range, 1 - 8
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter shows the number of pumps that are currently running.

27-14 Pump Capacity

Default value:	Size related	**Parameter type:**	Range, 10 - 800%, Array [9]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Enter the capacity of each pump in the system relative to the 1st pump. This is an indexed parameter with 1 entry per pump. The capacity of the 1st pump is 100%.

27-16 Runtime Balancing

Default value:	[0] Balanced priority 1	**Parameter type:**	Option, Array [9]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during configuration:**	True

Set the priority of each pump for balancing its running hours. Pumps with the same priority are staged/destaged based on the running hours.

Option	Name	Description
[0]*	Balanced priority 1	Turned on first, turned off last.
[1]	Balanced priority 2	Turned on if no priority 1 pumps are available. Turned off before priority 1 pumps are turned off.
[2]	Spare pump	Turned on last, turned off first.

27-17 Motor Starters

Default value:	[0] Direct online	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the type of the mains starter for the fixed-speed pumps. All fixed-speed pumps must have the same starter type.

Option	Name	Description
[0]*	Direct online	
[1]	Soft starter	This option adds a delay when staging and destaging pumps. The delay is defined in ***parameter 27-41 Ramp Down Delay*** and ***parameter 27-42 Ramp Up Delay***.
[2]	Star/delta	This option adds a delay when staging pumps. The delay is defined in ***parameter 27-42 Ramp Up Delay***.

27-18 Spin Time for Unused Pumps

Default value:	Size related	**Parameter type:**	Range, 0=Off - 99 s
Setup:	All setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

NOTICE

Ensure that the value in this parameter does not cause overpressure in the system.

Enter the time to spin unused pumps. If a fixed-speed pump has not run in the last 72 hours, it is turned on for this time. This function prevents the damage caused by leaving the pump off for too long. To disable the function, set the value of this parameter to 0.

27-19 Reset Current Runtime Hours

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select ***[1] Do reset*** to reset all current run-time hours to 0. The run-time hours value is used for run-time balancing.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.26.8 27-2* Bandwidth Settings

Parameters for configuring the control response.

27-20 Normal Operating Range

Default value:	Size related	**Parameter type:**	Range, 1 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the maximum offset from the setpoint before a pump may be added or removed. The value is a percentage of ***parameter 21-12 Ext. 1 Maximum Reference***. The system must be outside the normal operating range for the time specified in ***parameter 27-23 Staging Delay*** or ***parameter 27-24 Destaging Delay*** before a cascade operation takes place. Normal operation is operation with at least 1 variable-speed pump available.

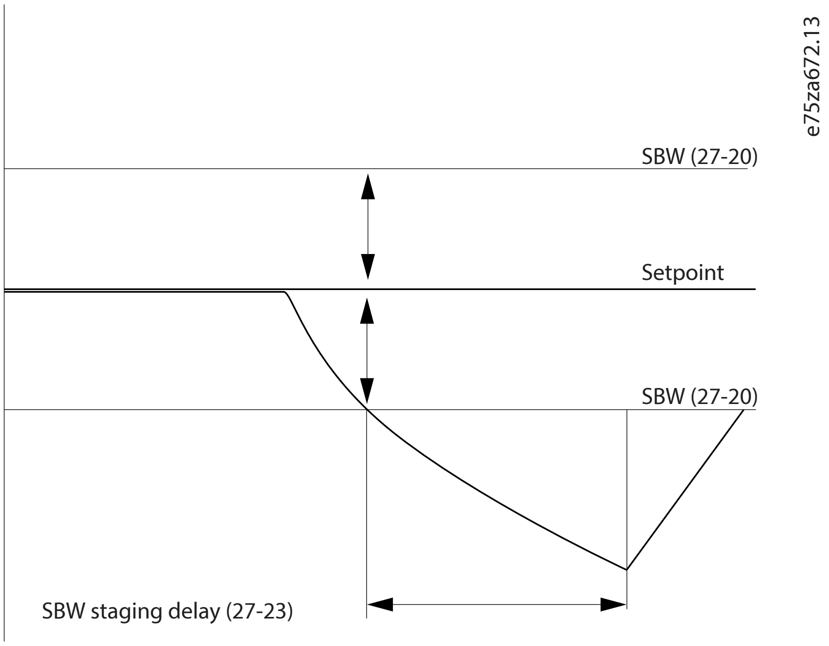


Figure 126: SBW Staging Delay

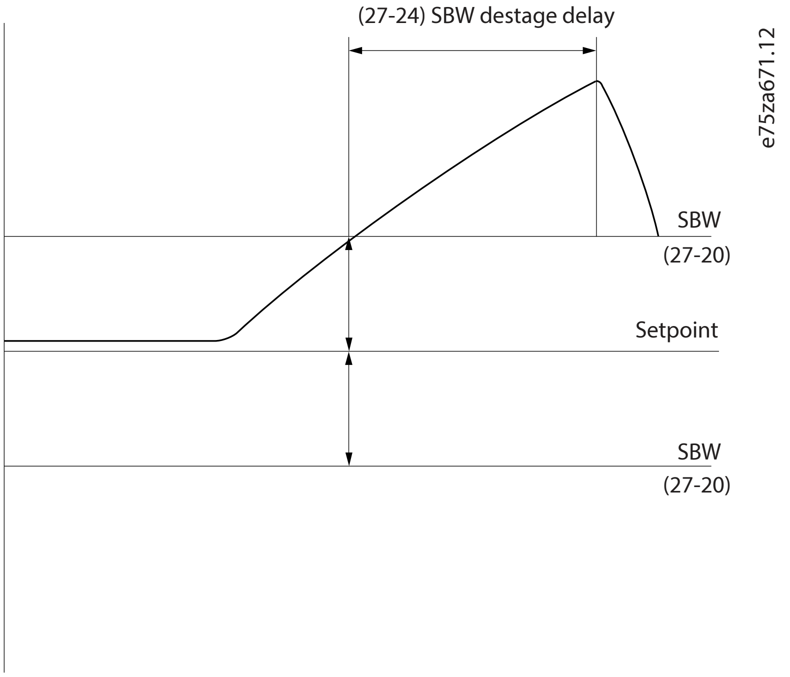


Figure 127: SBW Destaging Delay

27-21 Override Limit

Default value:	100%	**Parameter type:**	Range, 0 - 100=Disabled %
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the maximum offset from the setpoint before a pump is added or removed immediately, for example, if there was a sudden water demand. The value is a percentage of ***parameter 21-12 Ext. 1 Maximum Reference***. This parameter allows responding to sudden changes in demand without a delay. The override functionality can be disabled by setting this parameter to 100%.

NOTICE

In master/follower applications, the override limit is used as the wake-up condition.

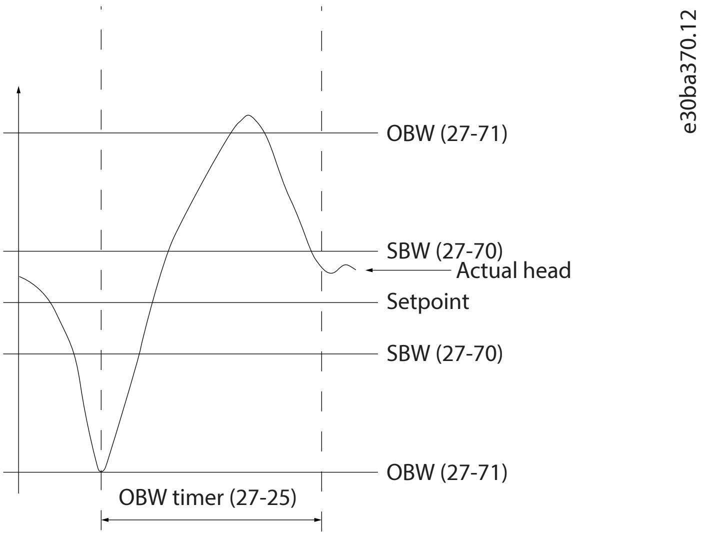


Figure 128: OBW Time

27-22 Fixed Speed Only Operating Range

Default value:	Size related	**Parameter type:**	Range, 0 - par. 27-21
Conversion index:	0	**Data type:**	Uint8
Change during operation:	True		

Enter the allowed offset from the setpoint at which a fixed-speed pump is added or removed when there are no operational variable-speed pumps. The value is a percentage of ***parameter 21-12 Ext. 1 Maximum Reference***. The system must be outside this limit for the time specified in ***parameter 27-23 Staging Delay*** or ***parameter 27-24 Destaging Delay*** before a cascade operation takes place.

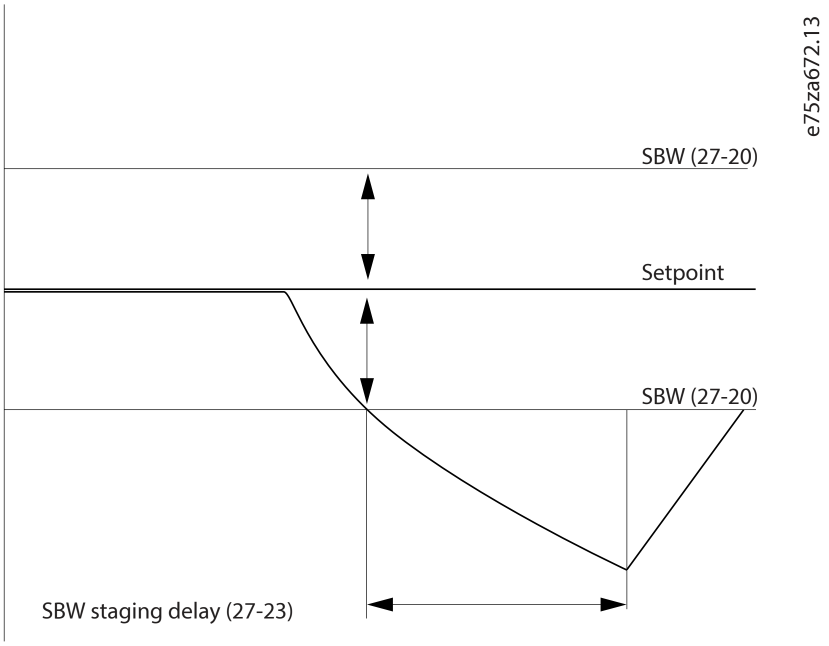


Figure 129: SBW Staging Delay

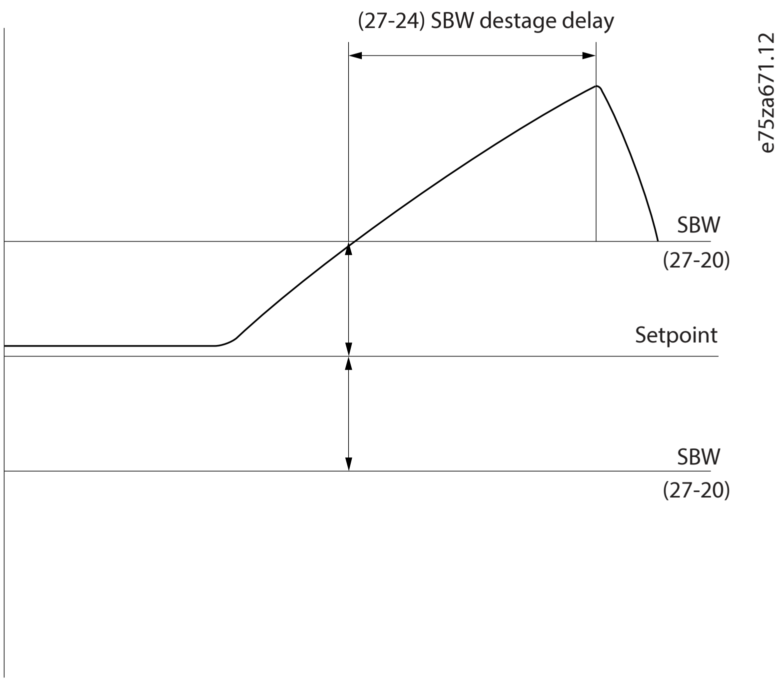


Figure 130: SBW Destaging Delay

27-23 Staging Delay

Default value:	15 s	**Parameter type:**	Range, 0 - 3000 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the time during which the system feedback must remain below the operating range before a fixed-speed pump is turned on. If the system is operating with at least 1 variable-speed pump available, ***parameter 27-20 Normal Operating Range*** is used. If no variable-speed pumps are available, ***parameter 27-22 Fixed Speed Only Operating Range*** is used.

27-24 Destaging Delay

Default value:	15 s	**Parameter type:**	Range, 0 - 3000 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the time during which the system feedback must remain above the operating range before a pump is turned off. If the system is operating with at least 1 variable-speed pump available, ***parameter 27-20 Normal Operating Range*** is used. If no variable-speed pumps are available, ***parameter 27-22 Fixed Speed Only Operating Range*** is used.

27-25 Override Hold Time

Default value:	10 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the minimum time that must elapse after staging or destaging before another staging or destaging may take place due to the system exceeding the value in ***parameter 27-21 Override Limit***. This value allows the system to stabilize after a pump is turned on or off. If this delay is not long enough, the transients caused by turning a pump on or off may cause the system to add or remove another pump unnecessarily.

27-27 Min Speed Destage Delay

Default value:	Size related	**Parameter type:**	Range, 0 - 300=Disabled s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the time that the lead pump must run at minimum speed while the system feedback is still inside the normal operating band before a pump is turned off to save energy. Energy savings are achieved by turning off a pump if all variable-speed pumps are operating at minimum speed, but the feedback is still within the specified band. Under these conditions, a pump may be turned off and the system is still able to maintain control. The pumps that remain on operate more efficiently.

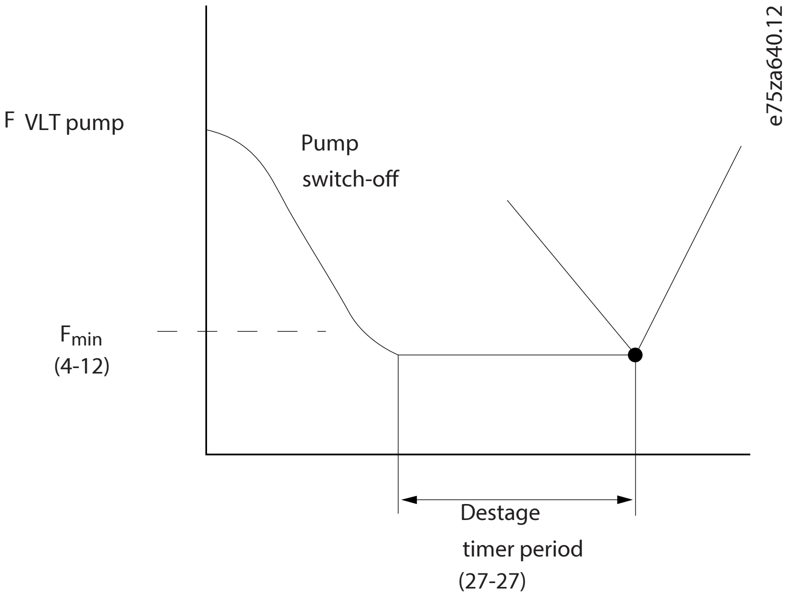


Figure 131: Destage Function Time

5.26.9 27-3* Staging Speed

The parameters in this group are used for configuring the master/follower control response.

27-30 Auto Tune Staging Speeds

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	When this option is selected, the drive calculates and keeps ***parameters 27-31*** to ***27-34*** up to date. If any of these4 parameters are modified via fieldbus or LCP, the new values are used but are continuously tuned automatically. The drive recalculates and updates the parameters when staging occurs and optimizes the settings to ensure high performance and low energy consumption.

27-31 Stage On Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-13, Array [11]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

To be used if RPM is selected. If the lead pump is operating above Stage On Speed for the time specified in ***parameter 27-23 Staging Delay*** and a variable-speed pump is available, it is turned on.

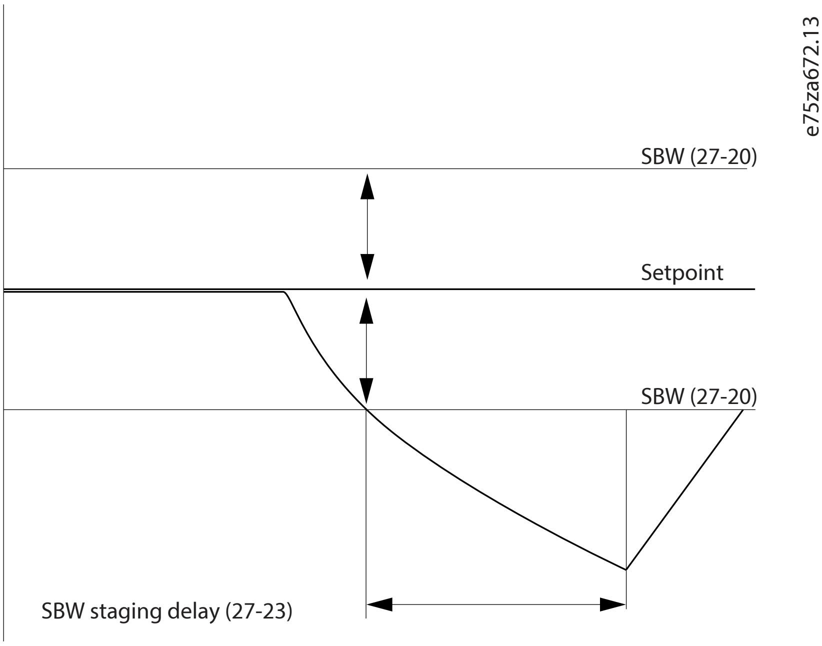


Figure 132: SBW Staging Delay

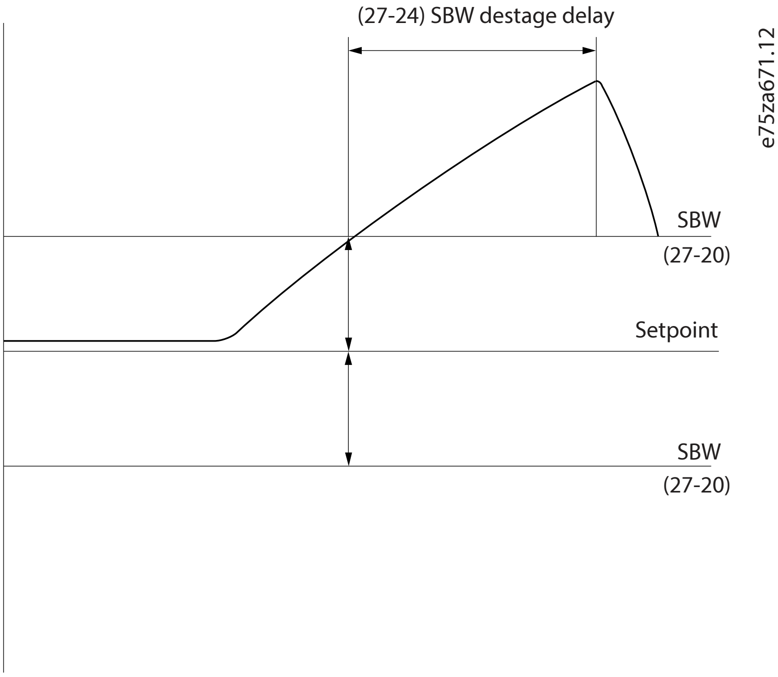


Figure 133: SBW Destaging Delay

27-32 Stage On Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-14, Array [11]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

If the lead pump speed is exceeding the value in this parameter for the time specified in ***parameter 27-23 Staging Delay***, and a variable-speed pump is available, the variable-speed pump is turned on.

27-33 Stage Off Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - 1500 [RPM], Array [11]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

If the lead pump speed is lower than the value in this parameter for the time specified in ***parameter 27-24 Destaging Delay***, and more than 1 variable-speed pump is on, a variable-speed pump is turned off.

27-34 Stage Off Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - 50 [Hz], Array [11]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

If the lead pump speed is lower than the value in this parameter for the time specified in ***parameter 27-24 Destaging Delay***, and more than 1 variable-speed pump is on, a variable-speed pump is turned off.

5.26.10 27-4* Staging Settings

Parameters in this group are used for configuring the staging transition.

27-40 Auto Tune Staging Settings

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

When this parameter is enabled, the staging and destaging thresholds are auto tuned during operation. The settings are optimized to prevent the pressure from overshooting or undershooting when staging and destaging pumps.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

27-41 Ramp Down Delay

Default value:	10 s	**Parameter type:**	0 - 120 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the delay between turning on a pump controlled by a soft starter and ramping down a pump controlled by the drive. This parameter is only used for soft starter and start/delta-controlled pumps.

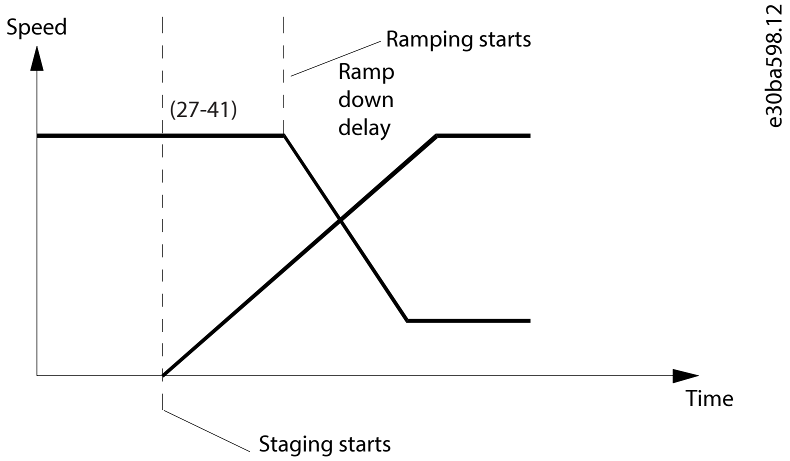


Figure 134: Ramp Down Delay

27-42 Ramp Up Delay

Default value:	2 s	**Parameter type:**	Range, 0 - 12 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the delay between turning off a pump controlled by a soft starter and ramping up a soft starter and ramping up a pump controlled by the drive. This parameter is only used for soft starter-controlled pumps, and not for star/delta-controlled pumps.

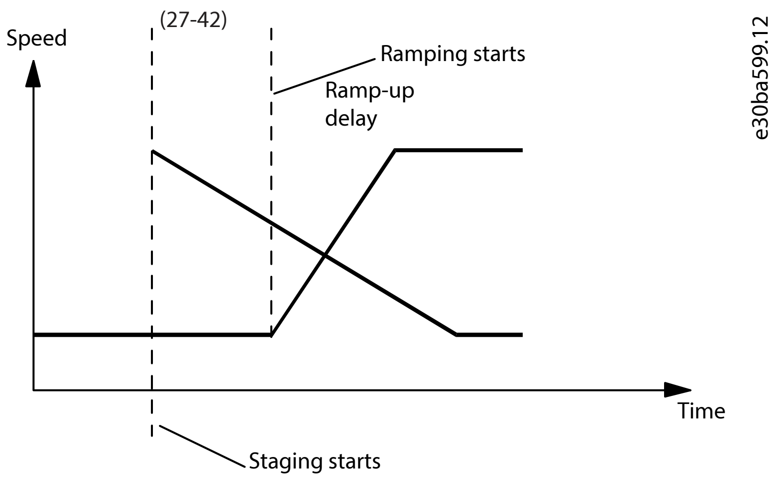


Figure 135: Ramp-up Delay

27-43 Staging Threshold

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the speed in the staging ramp at which the fixed-speed pump is turned on. The value is a percentage of the maximum pump speed. If ***parameter 27-0 Auto Tune Staging Settings*** is set to ***[1] Enabled***, ***parameter 27-43 Staging Threshold*** and ***parameter 27-44 Destaging Threshold*** are kept up to date with the new calculated values. If ***parameters 27-43*** and ***27-44*** are modified via the fieldbus or the LCP, the new values are used but are continuously tuned automatically.

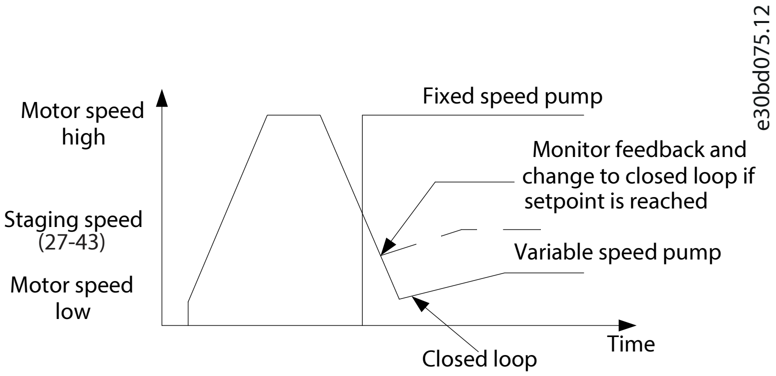


Figure 136: Staging Threshold

27-44 Destaging Threshold

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the speed in the staging ramp at which the fixed-speed pump is turned off. The value is a percentage of the maximum pump speed. If ***parameter 27-40 Auto Tune Staging Settings*** is set to ***[1] Enabled***, ***parameter 27-43 Staging Threshold*** and ***27-44 Destaging Threshold*** are kept up to date with the new calculated values. If ***parameters 27-43*** and ***27-44*** are modified via the fieldbus or the LCP, the new values are used but are continuously tuned automatically.

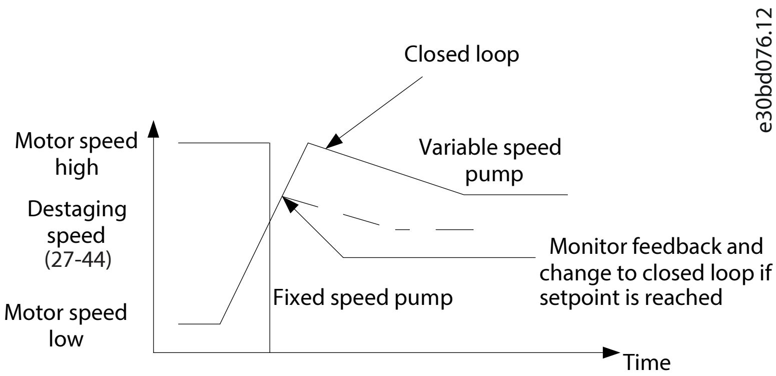


Figure 137: Destaging Threshold

27-45 Staging Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range, 0 - 0 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the actual staging speed based on the staging threshold.

27-46 Staging Speed [Hz]

Default value:	0 Hz	**Parameter type:**	Range, 0 - 0 [Hz]
Setup:	All setups	**Conversion index:**	-1

Data type:	Uint16	**Change during operation:**	True

Shows the actual staging speed based on the staging threshold.

27-47 Destaging Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range, 0 - 0 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the actual destaging speed based on the destaging threshold.

27-48 Destaging Speed [Hz]

Default value:	0 Hz	**Parameter type:**	Range, 0 - 0 [Hz]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the actual destaging speed based on the destaging threshold.

27-49 Staging Principle

Default value:	[0] Normal	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Using the Rapid Staging function is convenient in systems with rapid demand changes. When ***[1] Rapid staging*** is selected, the drive returns to closed-loop operation immediately after a pump was either staged or destaged.

Option	Name	Description
[0]*	Normal	
[1]	Rapid staging	The drive returns to closed-loop operation immediately after staging or destaging a pump.

5.26.11 27-5* Alternate Settings

The parameters in this group are for configuring alternation.

27-50 Automatic Alternation

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

When this parameter is enabled, the Cascade Controller selects the best time to alternate the lead pump.

Option	Name	Description
[0]*	Disabled	The Cascade Controller is not allowed to select the best time to alternate the lead pump.

27-51 Alternation Event

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select if alternation at destaging should be allowed.

Option	Name	Description
[0]	Off	Alternation at destaging is not possible.
[1]	At destage	Alternation at destaging is possible.

27-52 Alternation Time Interval

Default value:	0 min	**Parameter type:**	Range, 0=Disabled - 10080 min
Setup:	All setups	**Conversion index:**	70
Data type:	Uint16	**Change during operation:**	True

Enter the time between alternations. Disable the alternation by entering the value 0. ***Parameter 27-53 Alternation Timer Value*** shows the time remaining until the next alternation occurs.

27-53 Alternation Time Value

Default value:	0 min	**Parameter type:**	Range, 0 - 10080 min
Setup:	All setups	**Conversion index:**	70
Data type:	Uint16	**Change during operation:**	True

Shows the time remaining before an interval-based alternation occurs. ***Parameter 27-52 Alternation Time Interval*** defines the time interval.

27-54 Alternation At Time of Day

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enable alternating pumps at a specific time of day. The time is set in ***parameter 27-55 Alternation Predefined Time***. This parameter requires a real-time clock.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

27-55 Alternation Predefined Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDayWoDate	**Change during operation:**	True

Enter the time of day for pump alternation. This parameter is only available if ***parameter 27-54 Alternation At Time of Day*** is set to ***[1] Enabled***.

27-56 Alternate Capacity is <

Default value:	0%	**Parameter type:**	Range, 0=Off - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter ensures that the lead pump is operating at a speed lower than a certain value before the time-based alternation takes place. This behavior ensures that alternation only takes place when the interruption in operation does not affect the quality of the process and minimizes the system disturbance caused by alternations. The value is a percentage of the capacity of pump 1. Setting this parameter to 0% disables it.

27-58 Run Next Pump Delay

Default value:	0.1 s	**Parameter type:**	Range, 0.1 - 5 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the delay between stopping the current lead pump and starting the next lead pump during alternation. This parameter gives the contactors time to switch while both pumps are stopped.

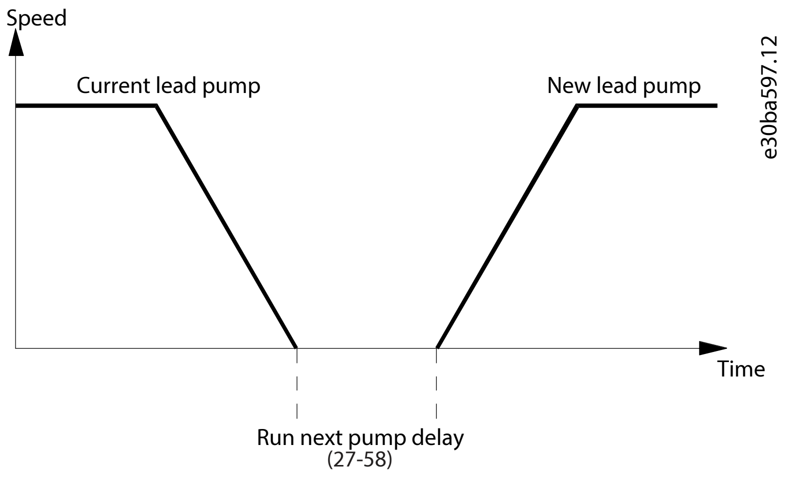


Figure 138: Run Next Pump Delay

5.26.12 27-6* Digital Inputs

The parameters in this group are for configuring digital inputs. The parameters are only available if VLT® Advanced Cascade Controller MCO 102 is installed.

27-60 Terminal X66/1 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function for this digital input.

Option	Name	Description
[0]	No function	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	

Option	Name	Description
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	hand/auto start	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	
[75]	MCO specific	
[78]	Preset preventive maintenance word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	

Option	Name	Description
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency setup bit 0	
[194]	Emergency setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

27-61 Terminal X66/3 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

27-62 Terminal X66/5 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

27-63 Terminal X66/7 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

27-64 Terminal X66/9 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

27-65 Terminal X66/11 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

27-66 Terminal X66/13 Digital Input

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

The options for this parameter are the same as those listed for ***parameter 27-60 Terminal X66/1 Digital Input***.

5.26.13 27-7* Connections

The parameters in this group are for configuring relay connections.

27-70 Relay

Default value:	[0] Standard relay	**Parameter type:**	Option, Array [20]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

This parameter is only relevant for a relay wiring configuration. Use this parameter to set up the function of the option relays. This parameter is an array. The visibility of options depends on the MCO option installed in the drive.

- VLT® Extended Cascade Controller MCO 101: Relays 10–12 are available.
- VLT® Advanced Cascade Controller MCO 102: Relays 13–20 are available.

In any case, the standard relays (Relay 1 and relay 2), and the relays in the VLT® Relay Option MCB 105 are available. To set the function of a specific relay, select the relay and then select the function. If the option ***[0] Standard relay*** is selected, the relay can be used as a general-purpose relay and the function can be set in *parameter group 5-4* Relays*.

Option	Navn	Description
[0]*	Standard relay	Enable follower drive X.
[1]	Drive 2 enable	
[2]	Drive 3 enable	

Option	Navn	Description
[3]	Drive 4 enable	
[4]	Drive 5 enable	
[5]	Drive 6 enable	
[6]	Drive 7 enable	
[7]	Drive 8 enable	
[8]	Pump 1 to drive 1	
[9]	Pump 1 to drive 2	
[10]	Pump 1 to drive 3	
[11]	Pump 1 to drive 4	
[12]	Pump 1 to drive 5	
[13]	Pump 1 to drive 6	
[14]	Pump 1 to drive 7	
[15]	Pump 1 to drive 8	
[16]	Pump 2 to drive 1	
[17]	Pump 2 to drive 2	
[18]	Pump 2 to drive 3	
[19]	Pump 2 to drive 4	
[20]	Pump 2 to drive 5	
[21]	Pump 2 to drive 6	
[22]	Pump 2 to drive 7	
[23]	Pump 2 to drive 8	
[24]	Pump 3 to drive 1	
[25]	Pump 3 to drive 2	
[26]	Pump 3 to drive 3	
[27]	Pump 3 to drive 4	
[28]	Pump 3 to drive 5	
[29]	Pump 3 to drive 6	
[30]	Pump 3 to drive 7	
[31]	Pump 3 to drive 8	
[32]	Pump 4 to drive 1	
[33]	Pump 4 to drive 2	
[34]	Pump 4 to drive 3	
[35]	Pump 4 to drive 4	

Option	Navn	Description
[36]	Pump 4 to drive 5	
[37]	Pump 4 to drive 6	
[38]	Pump 4 to drive 7	
[39]	Pump 4 to drive 8	
[40]	Pump 5 to drive 1	
[41]	Pump 5 to drive 2	
[42]	Pump 5 to drive 3	
[43]	Pump 5 to drive 4	
[44]	Pump 5 to drive 5	
[45]	Pump 5 to drive 6	
[46]	Pump 5 to drive 7	
[47]	Pump 5 to drive 8	
[48]	Pump 6 to drive 1	
[49]	Pump 6 to drive 2	
[50]	Pump 6 to drive 3	
[51]	Pump 6 to drive 4	
[52]	Pump 6 to drive 5	
[53]	Pump 6 to drive 6	
[54]	Pump 6 to drive 7	
[55]	Pump 6 to drive 8	
[56]	Pump 7 to drive 1	
[57]	Pump 7 to drive 2	
[58]	Pump 7 to drive 3	
[59]	Pump 7 to drive 4	
[60]	Pump 7 to drive 5	
[61]	Pump 7 to drive 6	
[62]	Pump 7 to drive 7	
[63]	Pump 7 to drive 8	
[64]	Pump 8 to drive 1	
[65]	Pump 8 to drive 2	
[66]	Pump 8 to drive 3	
[67]	Pump 8 to drive 4	
[68]	Pump 8 to drive 5	

Option	Navn	Description
[69]	Pump 8 to drive 6	
[70]	Pump 8 to drive 7	
[71]	Pump 8 to drive 8	
[72]	Pump 1 to mains	
[73]	Pump 2 to mains	
[74]	Pump 3 to mains	
[75]	Pump 4 to mains	
[76]	Pump 5 to mains	
[77]	Pump 6 to mains	
[78]	Pump 7 to mains	
[79]	Pump 8 to mains	

5.26.14 27-8* Advanced Settings

The parameters in this group contain the advanced settings for the Cascade Controller.

27-80 MultiMaster Primary Restore

Default value:	[0] Resume	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Option	Name	Description
[0]*	Resume	With this option selected, the mastership returns to the primary master.
[1]	Hold	This option retains the backup master even when a response from the primary master is received.

27-81 Master Setup

Default value:	[0] Set-up 1	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Use this parameter for configuring the setup to be used by the master when working in a multi-master system.

Option	Name	Description
[1]*	Set-up 1	
[2]	Set-up 2	

Option	Name	Description
[3]	Set-up 3	
[4]	Set-up 4	

5.26.15 27-9* Readouts

This parameter group contains readout parameters for the Cascade CTL Option.

27-91 Cascade Reference

Default value:	0%	**Parameter type:**	Range, -200 - 200%
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

This parameter shows the reference output for the follower drives. This reference is available even when the master drive is stopped. This is the speed that the drive operates at or would be operating at if it was on. The value is a percentage of ***parameter 4-13 Motor Speed High Limit [RPM]*** or ***parameter 4-14 Motor Speed High Limit [Hz]***.

27-92 % Of Total Capacity

Default value:	0%	**Parameter type:**	Range, 0 - 0%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows the operating point as a percentage of the total system capacity. 100% means that all pumps are on at full speed.

27-93 Cascade Option Status

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter shows the status of the cascade system.

Option	Name	Description
[0]*	Disabled	The cascade option is not used.
[1]	Off	The cascade function is turned off.
[2]	Running	The cascade function is running normally.
[3]	Running at FSBW	The cascade function is running in the fixed-speed mode. No variable-speed pumps are available.
[4]	Jogging	The system is running at the jog speed set in ***parameter 3-11 Jog Speed [HZ]***.
[5]	In open loop	The control principle is set to open loop.
[6]	Freezed	The system is frozen in the current state. No changes take place.

Option	Name	Description
[7]	Coast	The system is stopped due to coasting.
[8]	Alarm	The system is operating with an alarm.
[9]	Staging	A staging operation is in progress.
[10]	Destaging	A destaging operation is in progress.
[11]	Alternating	An alternation operation is in progress.
[12]	All offline	
[13]	Cascade CTL sleep	

27-94 Cascade System Status

Default value:	0	**Parameter type:**	Range, 0 - 25
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[25]	**Change during operation:**	True

This parameter shows the status of each individual pump. The value depends on the wiring configuration.

- Relay wiring configuration:
  - The parameter shows the status of all relays configured in the system. The value has the format PUMP_NUMBER:PUMP_STATUS. PUMP_STATUS can have 1 of the following values: 0, R, D, X. For example, 1:D 2:R 3:0 4:X
    D: Variable-speed pump. R: Fixed-speed pump. 0: Not running. X: Interlock
- Serial communication wiring configuration:
  - The parameter shows the system status. The value has the format MASTER/FOLLOWER:PUMP_STATUS. PUMP_STATUS can have 1 of the following values: 0, D, X. For example, M:D F:0 F:X
    D: Variable-speed pump. 0: Not running. X: Interlock or OFF mode. x: Tripped or no communication.

27-95 Advanced Cascade Relay Output [bin]

Default value:	0	**Parameter type:**	Range, 0 - 255
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows the status of each individual relay. From left to right, the bits correspond to 13, 14, 15, 16, 17, 18, 19, 20.

27-96 Extended Cascade Relay Output [bin]

Default value:	0	**Parameter type:**	Range, 0 - 7
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter shows the status of the relay outputs. From left to right, the bits correspond to relay outputs 12, 11, and 10.

5.27 Parameter Group 29-** Water Application Functions

5.27.1 29-0* Pipe Fill Function

In water supply systems, water hammering can occur when filling the pipes too fast. It is therefore recommended to limit the filling rate. Pipe fill mode eliminates the occurrence of water hammering associated with the rapid exhausting of air from the piping system by filling the pipes at a low rate.

This function is used in horizontal, vertical, and mixed piping systems. As the pressure in horizontal pipe systems does not climb as the system fills, filling horizontal pipe systems requires a user-specified speed to fill for a user-specified time and/or until a user-specified pressure setpoint is reached.

The best way to fill a vertical pipe system is to use the PID function to ramp the pressure at a user-specified rate between the motor speed low limit and a user-specified pressure.

The pipe fill function uses a combination of the above to ensure a safe filling of any system.

No matter which system, the pipe fill mode starts using the constant speed set in ***parameter 29-01 Pipe Fill Speed [RPM]*** until the pipe fill time in ***parameter 29-03 Pipe Fill Time*** has expired. Filling then continues with the filling ramp set in ***parameter 29-04 Pipe Fill Rate*** until the filling setpoint specified in ***parameter 29-05 Filled Setpoint*** is reached.

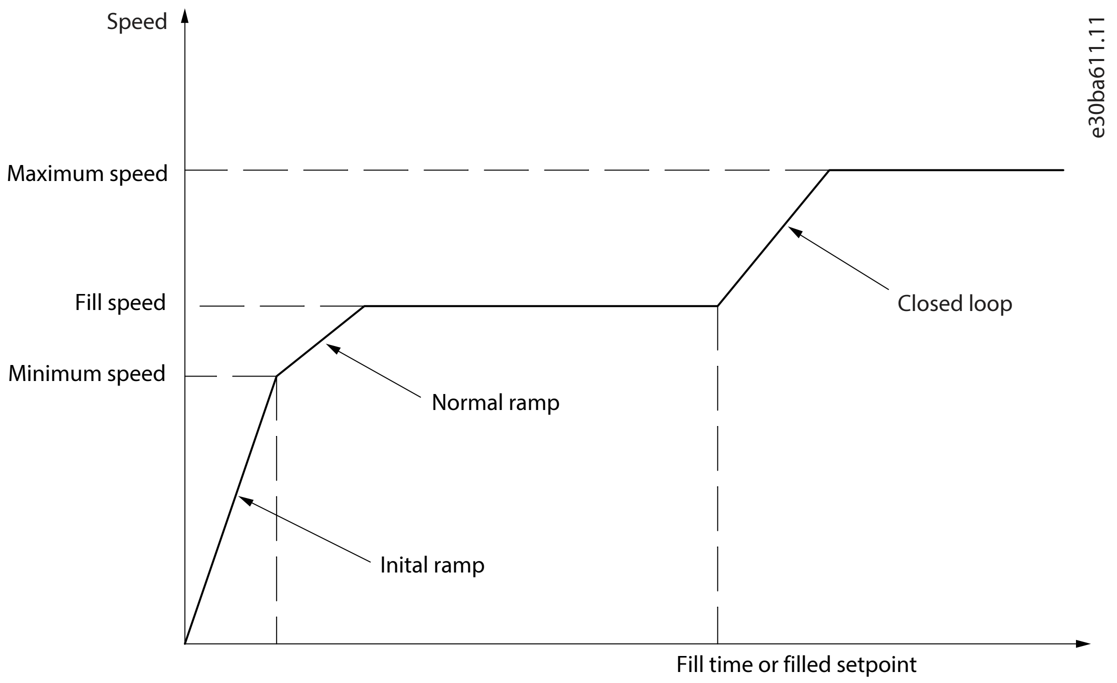


Figure 139: Horizontal Pipe System

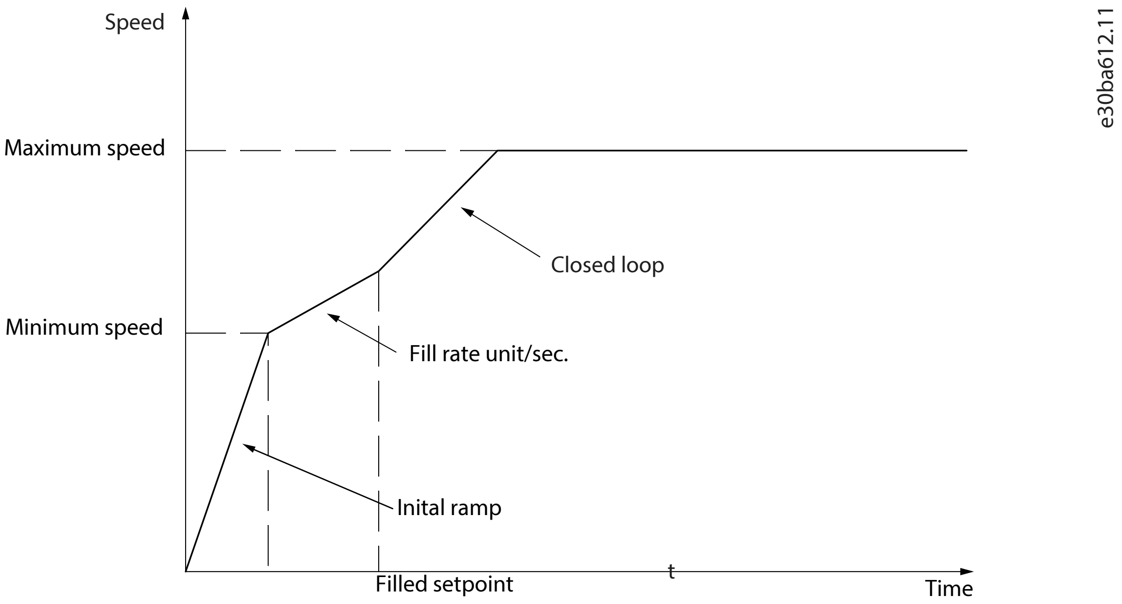


Figure 140: Vertical Pipe System

29-00 Pipe Fill Enable

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Option	Name	Description
[0]*	Disabled	The pipes are not filled at a user-specified rate.
[1]	Enabled	The pipes are filled at a user-specified rate.

29-01 Pipe Fill Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, par. 4-11 - par. 4-13 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the selection made in ***parameter 4-11 Motor Speed Low Limit [RPM]***/***parameter 4-13 Motor Speed High Limit [RPM]*** or in ***parameter 4-12 Motor Speed Low Limit [Hz]***/***parameter 4-13 Motor Speed High Limit [Hz]***.

29-02 Pipe Fill Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, par. 4-12 - par. 4-14
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the selection made in ***parameter 4-11 Motor Speed Low Limit [RPM]***/***parameter 4-13 Motor Speed High Limit [RPM]*** or in ***parameter 4-12 Motor Speed Low Limit [Hz]***/***parameter 4-13 Motor Speed High Limit [Hz]***.

29-03 Pipe Fill Time

Default value:	0 s	**Parameter type:**	Range, 0 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the specified time for pipe filling of horizontal pipe systems.

29-04 Pipe Fill Rate

Default value:	0.001 ProcessCtrlUnit	**Parameter type:**	Range, 0.001 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter specifies the fill rate in units using the PI controller. Fill-rate units use feedback functionality. This function is used for filling up vertical pipe systems. The function is active when the filling time has expired, until the pipe fill setpoint set in ***parameter 29-05 Filled Setpoint*** is reached.

29-05 Filled Setpoint

Default value:	0 ProcessCtrlUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Specifies the filled setpoint at which the pipe fill function is disabled, and then PID controller takes control. This function can be used both for horizontal and vertical pipe systems.

29-06 No-flow Disable Timer

Default value:	0 s	**Parameter type:**	Range, 0 - 3600 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the timer for detection of no flow during pipe fill. The timer defines for how long the low power no-flow detection must be disabled after pipe filling starts. When the timer expires, the delay timer in ***parameter 22-24 No-Flow Delay*** activates the no-flow function.

29-07 Filled Setpoint Delay

Default value:	0 s	**Parameter type:**	Range, 0 - 10 s
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Select the delay before the drive considers the filled setpoint to be reached if a fill rate in units per second is used.

5.27.2 29-1* Deragging Function

The purpose of the deragging feature is to free the pump blade of debris in wastewater applications so that the pump operates normally.

A deragging event is defined as the time when the drive starts to drag to when the deragging finishes. When a derag is started, the drive first ramps to a stop and then an off-delay expires before the 1st cycle begins.

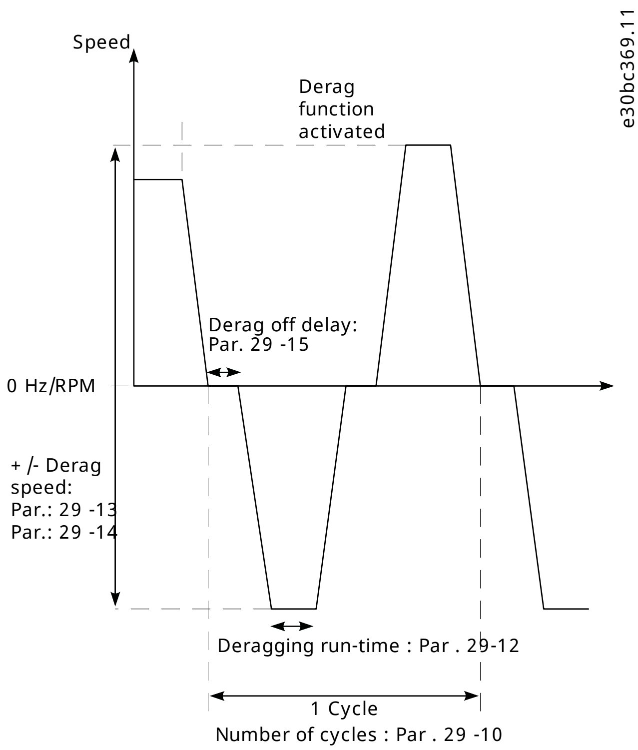


Figure 141: Derag Function

If a derag is triggered from a drive-stopped state, the 1st off delay is skipped. The deragging event may consist of several cycles: one cycle consisting of 1 pulse in the reverse direction followed by 1 pulse in the forward direction. Deragging is considered finished after the specified number of cycles have been completed. More specifically, on the last pulse (it is always forward) of the last cycle, the deragging is considered finished after the deragging run-time expires (the drive is running at derag speed). In between the pulses, the drive output coasts for a specified off-delay time to let debris in the pump settle.

NOTICE
Do not enable deragging if the pump cannot operate in reverse direction.

There are 3 different notifications for an ongoing deragging event:

- Status in the LCP: *Auto Remote Derag*.
- A bit in the extended status word (bit 23, 80 0000 hex).
- A digital output can be configured to reflect the active deragging status.

Depending on the application and the purpose of using it, this feature can be used as a preventive or reactive measure and can be triggered/started in the following ways:

- On each start command (***parameter 29-11 Derag at Start/Stop***).
- On each stop command (***parameter 29-11 Derag at Start/Stop***).
- On each start/stop command (***parameter 29-11 Derag at Start/Stop***).
- On digital input (*parameter group 5-1* Digital Inputs*).
- On drive action with the smart logic controller (***parameter 13-52 SL Controller Action***).

- As timed action (*parameter group 23-** TIme-based Functions*).
- On high power (*parameter group 29-2* Derag Power Tuning*.

29-10 Derag Cycles

Default value:	Size related	**Parameter type:**	Range, 0=Off - 10
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

The number of cycles the drive derags.

29-11 Derag at Start/Stop

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select when to use the derag function.

Option	Name	Description
[0]*	Off	The derag function is not used.
[1]	Start	The drive derags at start.
[2]	Stop	The drive derags at stop.
[3]	Start and stop	The drive derags at start and stop.

29-12 Deragging Run Time

Default value:	0 s	**Parameter type:**	Range, 0 - 3600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The time that the drive dwells at the derag speed.

29-13 Derag Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-13 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

The speed at which the drive derags measured in RPM.

29-14 Derag Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 4-13
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

The speed at which the drive derags measured in Hz.

29-15 Derag Off Delay

Default value:	10 s	**Parameter type:**	Range, 1 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

The time that the drive remains off before starting another derag pulse. Allows contents of the pump to settle.

29-16 Derag Counter

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Shows the number of deragging events.

29-17 Reset Derag Counter

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Do not reset	This option does not reset deragging counter.
[1]	Reset counter	This option resets the deragging counter.

5.27.3 29-2* Derag Power Tuning

The derag feature monitors drive power in a similar was as no flow. Based on 2 user-defined setpoints and an offset value, the monitor calculates a derag power curve. It uses the exact same calculations as no flow with the difference being that the derag monitors for high power and not lower power.

Commissioning the no-flow user points via the no-flow auto setup also sets the points of the derag curve to the same value.

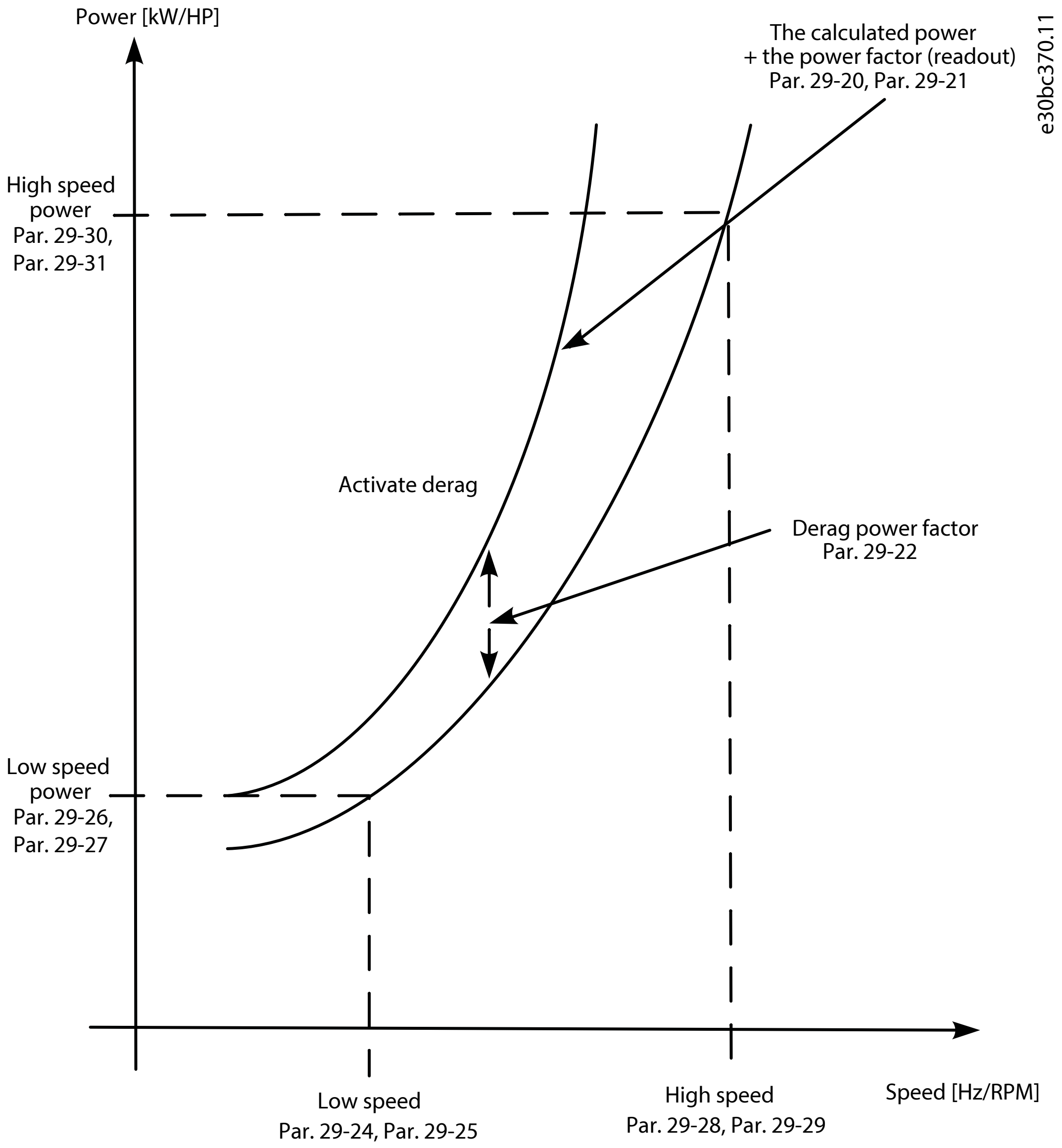


Figure 142: Derag Power Tuning

29-20 Derag Power [kW]

Default value:	0 kW	**Parameter type:**	Range, 0 - 0 [kW]
Setup:	All setups	**Conversion index:**	1
Data type:	Uint32	**Change during operation:**	True

Readout of calculated derag power at actual speed.

29-21 Derag Power [HP]

Default value:	0 hp	**Parameter type:**	Range, 0 - 0 [hp]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Readout of calculated derag power at actual speed.

29-22 Derag Power Factor

Default value:	200%	**Parameter type:**	Range, 1 - 400%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set a correction if derag detection reacts on a power value that is too low.

29-23 Derag Power Delay

Default value:	601 s	**Parameter type:**	Range, 1 - 601=Off s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the time that the drive must remain on reference and a high-power condition for a derag to occur.

29-24 Low Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0 - par. 29-28
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the output speed used for registration of derag power at low speed in RPM.

29-25 Low Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0 - Par. 29-29
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the output speed used for registration of derag power at low speed in Hz.

29-26 Low Speed Power [kW]

Default value:	Size related	**Parameter type:**	Range, 0 - 5.50 [kW]
Setup:	All setups	**Conversion index:**	1
Data type:	Uint32	**Change during operation:**	True

Set the derag power at low speed in kW.

29-27 Low Speed Power [HP]

Default value:	Size related	**Parameter type:**	Range, 0 - 7.5 [hp]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the derag power at low speed in hp.

29-28 High Speed [RPM]

Default value:	Size related	**Parameter type:**	Range, 0.0 - par. 4-13
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Set the output speed used for registration of derag power at high speed in RPM.

29-29 High Speed [Hz]

Default value:	Size related	**Parameter type:**	Range, 0.0 - par. 4-14
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the output speed used for registration of derag power at high speed in Hz.

29-30 High Speed Power [kW]

Default value:	Size related	**Parameter type:**	Range, 0 - 5.50 [kW]
Setup:	All setups	**Conversion index:**	1
Data type:	Uint32	**Change during operation:**	True

Set derag power at high speed in kW.

29-31 High Speed Power [HP]

Default value:	Size related	**Parameter type:**	Range, 0 - 7.50 [hp]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the derag power at high speed in hp.

29-32 Derag On Ref Bandwidth

Default value:	5%	**Parameter type:**	Range, 1 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the bandwidth percentage of motor speed high limit to accommodate system pressure fluctuation.

29-33 Power Derag Limit

Default value:	3	**Parameter type:**	Range, 0 - 10
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set the number of time the power monitor can trigger consecutive derags before a fault is reported.

29-34 Consecutive Derag Interval

Default value:	Size related	**Parameter type:**	Range, 0 - 3600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Derags are considered to be consecutive if they happen within the interval specified in this parameter.

29-35 Derag at Locked Rotor

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for selecting whether or not the derag should be triggered at high power if there is a locked rotor condition.

Option	Name	Description
[0]*	Disabled	A derag is not triggered at a locked rotor condition at high power.
[1]	Enabled	A derag is triggered at a locked rotor condition at high power.

5.27.4 29-4* Pre/Post-Lube Function

Use the pre/post-lube function in the following applications:

- To avoid damage and wear, a motor requires lubrication of its mechanical parts before and while it runs. This is especially the case when the motor has not been running for a long time.
- An application requires external fans to run.

The function makes the drive signal an external device for a user-defined period. A start delay can be configured in ***parameter 1-71 Start Delay***. With this delay, the pre-lube function runs while the motor is stopped.

For information about the pre/post-lube function options, see the following parameters:

- ***Parameter 29-40 Pre/Post Lube Function***
- ***Parameter 29-41 Pre Lube Time***
- ***Parameter 29-42 Post Lube Time***

Consider the following use case:

- A lubricating device starts the lubrication at the time when the drive receives the start command.
- The drive starts the motor. The lubrication device is still running.
- After a certain time, the drive stops the lubrication device.

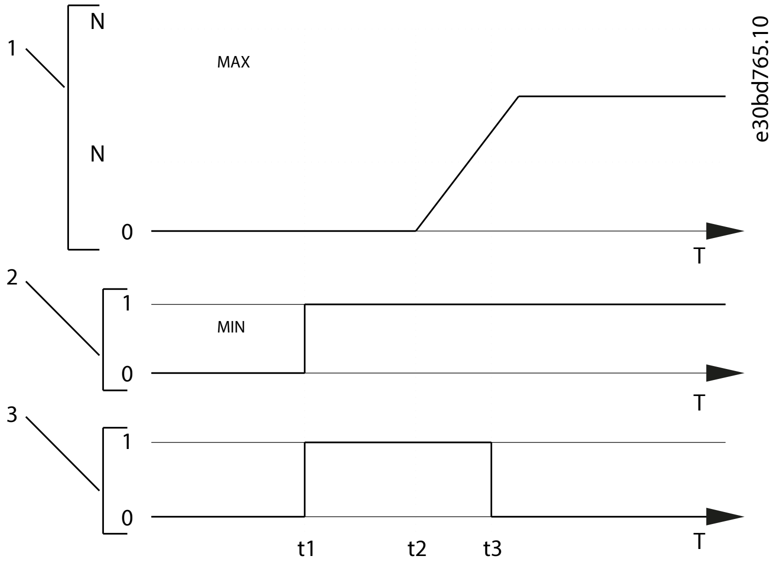


Figure 143: Pre/Post-Lube Function, Example

1	Speed curve.	**2**	Start command (for example, terminal 18).
3	Pre-lube output signal.	t_1	Start command issued (for example, terminal 18 activated). The start delay timer (***parameter 1-71 Start Delay***) and the pre-lube timer (***parameter 29-41 Pre Lube Time***) start running.
t_2	The start delay timer expires. The drive starts to ramp up.	t_3	The pre-lube timer expires.

29-40 Pre/Post Lube Function

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select when the pre/post-lube function is to be active. Use ***parameter 1-71 Start Delay*** to set the delay before the drive starts to ramp up.

Option	Name	Description
[0]*	Disabled	The pre/post-lube function is disabled.
[1]	Pre lube only	The pre-lube function is active before the drive ramps up.
[2]	Pre & running	The pre-lube function is active before the drive starts up and while the drive is running.
[3]	Pre & running & post	The pre/post-lube function is active before the drive starts up, while the drive is running, and when the drive has stopped.

29-41 Pre Lube Time

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All seutps	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

Enter for how long the pre-lube function is to be active. Only use this parameter, when ***[1] Pre Lube Only*** is selected in ***parameter 29-40 Pre/Post Lube Function***.

29-42 Post Lube Time

Default value:	10 s	**Parameter type:**	Range, 0 - 600 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter for how long the post-lube function is to be on after the motor stops. Only use this parameter, when ***[3] Pre & running & post*** is selected in ***parameter 29-40 Pre/Post Lube Function***.

5.27.5 29-5* Flow Confirmation

The flow confirmation feature is designed for applications where there is a need for the motor/pump to run while waiting for an external event. The flow confirmation monitor expects to receive a digital input from a sensor on a gate valve, flow switch, or a similar device, indicating that the device is in the open position and flow is possible. In ***parameter 29-50 Validation Time***, define for how long the VLT® AQUA Drive FC 202 waits for the digital input signal from the external device to confirm the flow. After the flow is confirmed, the drive checks the signal again after the flow verification time and then runs normally. The LCP status reads *Verifying flow* while the flow monitor is active.

The drive trips with the alarm ***Flow Not Confirmed*** if the expected digital input signal becomes inactive before either the flow validation time or the flow verification time expires.

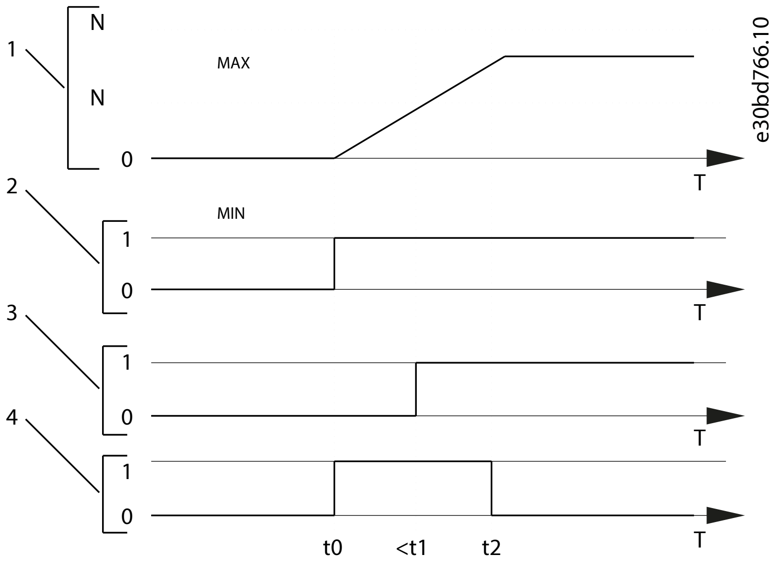


Figure 144: Flow Confirmation

1	Speed curve.	**2**	Start command (for example, terminal 18).
3	Digital signal from an external device that confirms that the flow is possible.	**4**	Flow verification

t_0	Start command issued (for example, terminal 18 is set to active).
t_1	Digital signal from an external device becomes active before ***parameter 29-50 Validation Time***expires.
t_2	When ***parameter 29-51 Verification Time*** passes, the drive checks the signal from the external device again and then runs normally.

29-50 Validation Time

Default value:	Size related	**Parameter type:**	Range, 0 - 999 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

NOTICE

Parameter 29-50 Validation Time is only visible in the LCP if a digital input is set to ***[86] Flow Confirmation*** in *parameter group 5-1* Digital Inputs*.

The digital input from an external device must be active during the validation time.

29-51 Verification Time

Default value:	15 s	**Parameter type:**	Range, 0.10 - 255 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

NOTICE

Parameter 29-51 Verification Time is only visible in the LCP if a digital input is set to ***[86] Flow confirmation*** in *parameter group 5-1* Digital Inputs*.

When the time set in this parameter has passed, the drive checks the signal from the external device. If the signal is active, the drive runs normally.

29-52 Signal Lost Verification Time

Default value:	1 s	**Parameter type:**	Range, 0.01 - 255 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the length of the delay after which the signal is considered to be lost. This parameter is ignored if ***parameter 29-53 Flow Confirmation Mode*** is set to ***[0] Confirmation only***.

29-53 Flow Confirmation Mode

Default value:	[0] Confirmation only	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the operating mode of the flow monitor function.

Option	Name	Description
[0]*	Confirmation only	The flow confirmation function is only active during the start-up of the pump.
[1]	Monitor and stop	The flow confirmation function is active during and after the pump start-up. If the input signal is lost, the drive ramps down to stop.
[2]	Monitor and coast	The flow confirmation is active during and after the pump start-up. If the input signal is lost, the drive coasts.

5.27.6 29-6* Flow Meter

VLT® AQUA Drive FC 202 can measure the flow in the system. Irrigation applications are the most common use case for parameters in this parameter group. The functionality allows to:

- Measure the flow in the system.
- Calculate the water volume pumped for a certain time period.
- React on flow conditions, for example, low flow rate.
- Control the system using the pumped water volume calculated by the drive, for example, stop pumping when a certain amount of water is pumped, cyclic pumping of water volumes.
- Use the output signal of an external flow meter that is connected to an input of the drive.

Inputs and supported signal types

The flow meter feature can use and scale the output signals of commonly used flow meters. The feature supports the following signal types:

- Current: 0/4–20 mA
- Voltage: 0–10 V
- Pulse signal, for example, paddle-wheel flow meters.

Configure the scaling of the flow meter signal received as input via the available parameters for the input configuration (parameters in *parameter groups 6-** Analog In/Out* or *5-5* Pulse Input*). The flow meter feature also supports inputs of hardware options.

Volume counters

The flow meter feature uses 2 different counters for storing calculated volume of pumped water:

- ***Parameter 29-66 Actual Volume***: See the volume of water pumped since the last counter reset.
- ***Parameter 29-65: Totalized Volume:*** See the volume of water pumped since the last counter reset. Use this parameter for the total volume of water pumped.

The 2 counters can have different units. Use ***parameter 29-66 Actual Volume*** for shorter periods of time.

Each parameter can be reset individually in 1 of the following ways:

- Using ***parameter 29-67 Reset Totalized Volume*** or ***parameter 29-68 Reset Actual Volume***.
- Using a digital input.
- Using an action of the smart logic controller.

Reading the data

The measured data is available via readout parameters:

- ***Parameter 29-65 Totalized Volume***.
- ***Parameter 29-66 Actual Volume***.
- ***Parameter 29-69 Flow***.

To show the readout parameters on the LCP, configure the display lines. Comparator operands can use the data from readout parameters as conditions for SLC and as triggers for actions. The measured flow can also be used as input for the feedback.

> **NOTICE**
>
> This software feature has not been designed as being a part of a calibrated measurement system. The overall accuracy also depends on external factors such as flow conditions and used flow meter. See the VLT® AQUA Drive FC 202 Design Guide for details about analog and digital inputs of the drive.

Examples

- A sequence of SLC is triggered (or stopped) after a specific amount of water is pumped.
- The drive performs 1 or more actions and resets the volume counters within a sequence of SLC.
- An alert shows up after a specific amount of water is pumped.

29-60 Flow Meter Monitor

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select if the flow meter monitor should be disabled or enabled.

Option	Name	Description
[0]*	Disabled	The flow meter monitor is disabled.
[1]	Enabled	The flow meter monitor is enabled.
[2]	Enabled while running	The flow meter monitor is only enabled when the connected pump is running.

29-61 Flow Meter Source

Default value:	[0] Analog input 53	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the source for the flow meter signal. Available options depend on the hardware configuration.

Option	Name	Description
[0]*	Analog input 53	
[1]	Analog input 54	

Option	Name	Description
[2]	Analog input X30/11	
[3]	Analog input X30/12	
[4]	Analog input X42/1	
[5]	Analog input X42/3	
[6]	Analog input X42/5	
[7]	Analog input X48/2	
[8]	Pulse input 29	
[9]	Pulse input 33	
[10]	Bus feedback 1	
[11]	Bus feedback 2	
[12]	Bus feedback 3	

29-62 Flow Meter Unit

Default value:	[0] l/s	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit for the flow meter output.

Option	Name	Description
[0]*	l/s	
[1]	l/min	
[2]	l/h	
[3]	m^3/s	
[4]	m^3/min	
[5]	m^3//h	
[6]	gal/s	
[7]	gal/min	
[8]	gal/h	
[9]	in^3/s	
[10]	in^3/min	
[11]	in^3/h	
[12]	ft^3/s	

Option	Name	Description
[13]	ft^3/min	
[14]	ft^3/h	

29-63 Totalized Volume Unit

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit for ***parameter 29-65 Totalized Volume***.

Option	Name	Description
[0]*	Disabled	
[1]	l	
[2]	m^3	
[3]	gal	
[4]	in^3	
[5]	ft^3	
[6]	acre-in	
[7]	acre-ft	

29-64 Actual Volume Unit

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit for ***parameter 29-66 Actual Volume***.

Option	Name	Description
[0]*	Disabled	
[1]	l	
[2]	m^3	
[3]	gal	
[4]	in^3	
[5]	ft^3	

Option	Name	Description
[6]	acre-in	
[7]	acre-ft	

29-65 Totalized Volume

Default value:	0 TotalizedVolumeUnit	**Parameter type:**	Range, 0 - 2147483647, Array [5]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the total volume of pumped water.

29-66 Actual Volume

Default value:	0.00 ActualVolumeUnit	**Parameter type:**	Range, 0.00 - 21474836.47, Array [5]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	False

Shows the volume of pumped water for a certain time period.

29-67 Reset Totalized Volume

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to set ***parameter 29-65 Totalized Volume*** to 0.

Option	Name	Description
[0]*	Do not reset	***Parameter 29-65 Totalized Volume*** is not reset.
[1]	Do reset	***Parameter 29-65 Totalized Volume*** is reset to 0.

29-68 Reset Actual Volume

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to set ***parameter 29-66 Actual Volume*** to 0.

Option	Name	Description
[0]*	Do not reset	***Parameter 29-66 Actual Volume*** is not reset.
[1]	Do reset	***Parameter 29-66 Actual Volume*** is reset to 0.

29-69 Flow

Default value:	0 FlowMeterUnit	**Parameter type:**	Range, 0 - 2147483647 FlowMeterUnit
Setup:	All seutps	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows the actual flow rate.

5.28 Parameter Group 30-** Special Features

5.28.1 30-2* Adv. Start Adjust

30-20 High Starting Torque Time [s]

Default value:	0 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Define for how long the increased high starting torque current defined in ***parameter 30-21 High Starting Torque Current*** should be applied.

30-21 High Starting Torque Current [%]

Default value:	Size related	**Parameter type:**	Range, 0 - 200.0%
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Set the high starting current that should be applied for the time specified in ***parameter 30-20 High Starting Torque Time***. The increased current will improve the starting torque and starting performance in demanding applications. The high starting torque current is valid for VVC+ and flux in speed open loop. The parameter can be used with the following motors:

- SPM
- IPM
- SynRM
- PMaSynRM

30-22 Locked Rotor Protection

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Available for PM motors only, in flux sensorless mode and VVC+ open-loop mode.

Option	Name	Description
[0]*	Off	
[1]	On	Protects the motor from the locked rotor condition. The control algorithm detects a possible locked rotor condition in the motor and trips the drive to protect the motor.

30-23 Locked Rotor Detection Time [s]

Default value:	0.10 s	**Parameter type:**	Range, 0.05 - 1 s
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint8	**Change during operation:**	True

Time period for detecting the locked rotor condition. A low parameter value leads to faster detection.

5.28.2 30-5* Unit Configuration

30-50 Heat Sink Fan Mode

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select how the heat sink fan responds to operating conditions. Use ***parameter 14-52 Fan Control*** to control the minimum fan speed.

Option	Name	Description
[0]	Simple profile	The simple profile is a passive fan control based on the current temperature state of the drive. This option represents the classic operating behavior of fans.
[1]	Reduced acoustics	
[2]	Standard	
[3]	Cooler operation	

5.28.3 30-8* Compatibility (I)

30-81 Brake Resistor (ohm)

Default value:	Size related	**Parameter type:**	Range, 5 - 65535.00 Ohm
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor in ***parameter 2-13 Brake Power Monitoring***. This parameter is only active in drives with an integral dynamic brake.

30-85 Motor Frequency

Default value:	Size related	**Parameter type:**	Range, 20.0 - 1000.0 Hz

Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	False

NOTICE

Changing this parameter affects the settings of other parameters.

Select the motor frequency from the motor nameplate data.

5.28.4 30-9* Wifi LCP

Use the parameters in this group for configuring the wireless LCP 103.

30-90 SSID

Default value:	Size related	**Parameter type:**	Range, 1 - 32
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[32]	**Change during operation:**	True

Enter the wireless network name (SSID). The default value is: Danfoss_<Serial number of the drive>. The serial number is in ***parameter 15-51 Frequency Converter Serial Number***.

30-91 Channel

Default value:	5	**Parameter type:**	Range, 1 - 11
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the wireless channel number. The default channel number is 5. Change the channel number, if there is an interference from other wireless networks. Recommended channels: USA territory: 1, 6, 11. Europe: 1, 7, 13.

30-92 Password

Default value:	Size related	**Parameter type:**	Range, 8 - 48
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[48]	**Change during operation:**	True

Enter the wireless network password. Password length: 8–48 characters.

Parameter 30-93 Security Type

Default value:	[2] WPA_WPA2	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the wireless network security type.

Option	Name	Description
[2]*	WPA_WPA2	

30-94 IP Address

Default value:	Size related	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Enter the IP address to connect to.

30-95 Submask

Default value:	Size related	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Enter the subnet mask.

30-96 Port

Default value:	5001	**Parameter type:**	Range, 1024 - 65535
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the TCP port to connect to.

30-97 Wifi Timeout Action

Default value:	[0] Do nothing	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select which action to execute if a local reference (hand-on mode) or a remote reference (auto-on mode) is set via the wireless connection and the connection is lost.

Option	Name	Description
[0]*	Do nothing	The drive does not do any extra actions.
[1]	Stop motor	The drive stops the motor (if the motor was started via a wireless connection).

30-98 Remote SSID

Default value:	Size related	**Parameter type:**	Range, 1 - 32
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[32]	**Change during operation:**	True

Minimum length of the SSID is 1 character. Maximum length is 32 characters.

30-99 Wifi Network Mode

Default value:	[0] Access point	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Access point	
[1]	Client	

5.29 Parameter Group 31-** Bypass Option

Parameter group for configuring the electronically controlled bypass option board, VLT® Bypass Option MCO 104.

31-00 Bypass Mode

Default value:	[0] Drive	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the bypass operating mode.

Option	Name	Description
[0]*	Drive	The drive operates the motor.
[1]	Bypass	The motor is operated at full speed during bypass mode.

31-01 Bypass Start Time Delay

Default value:	30 s	**Parameter type:**	Range, 0 - 60 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Setting the time delay to pass from the bypass receives a run command until it starts the motor at full speed. A countdown timer shows the remaining time.

31-02 Bypass Trip Time Delay

Default value:	0 s	**Parameter type:**	Range, 0 - 300 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Setting the time delay to pass from the drive experiences an alarm that stops it and until the motor is automatically switched to bypass control. If the delay is set to 0, a drive alarm does not automatically switch the motor to bypass control.

31-03 Test Mode Activation

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Disabled	Test mode is disabled.
[1]	Enabled	The motor runs in bypass while the drive can be tested into an open circuit. In this mode, keypad does not control start/stop of bypass.

31-10 Bypass Status Word

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	74
Data type:	V2	**Change during operation:**	False

View the status of the bypass as a hexadecimal value.

31-11 Bypass Running Hours

Default value:	0 h	**Parameter type:**	Range, 0 - 2147483647 h
Setup:	All setups	**Conversion index:**	74
Data type:	Uint32	**Change during operation:**	False

View the number of hours in which the motor has run in bypass mode. The counter can be reset in ***parameter 15-07 Reset Running Hours Counter***. The value is saved when the drive is turned off.

31-19 Remote Bypass Activation

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

5.30 Parameter Group 34-** MCO Data Readouts

5.30.1 34-0* PCD Write Par.

34-01 PCD 1 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD1 of the fieldbus telegram.

34-02 PCD 2 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD2 of the fieldbus telegram.

34-03 PCD 3 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD3 of the fieldbus telegram.

34-04 PCD 4 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD4 of the fieldbus telegram.

34-05 PCD 5 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD5 of the fieldbus telegram.

34-06 PCD 6 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD6 of the fieldbus telegram.

34-07 PCD 7 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD7 of the fieldbus telegram.

34-08 PCD 8 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD8 of the fieldbus telegram.

34-09 PCD 9 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD9 of the fieldbus telegram.

34-10 PCD 10 Write to MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value received in PCD10 of the fieldbus telegram.

5.30.2 34-2* PCD Read Par.

34-21 PCD 1 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD1 of the fieldbus telegram.

34-22 PCD 2 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Data type:**	Uint16

Change during operation:	True

Shows the value sent in PCD2 of the fieldbus telegram.

34-23 PCD 3 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Shows the value sent in PCD2 of the fieldbus telegram.

34-24 PCD 4 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD4 of the fieldbus telegram.

34-25 PCD 5 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD5 of the fieldbus telegram.

34-26 PCD 6 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD6 of the fieldbus telegram.

34-27 PCD 7 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD7 of the fieldbus telegram.

34-28 PCD 8 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD8 of the fieldbus telegram.

34-29 PCD 9 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD9 of the fieldbus telegram.

34-30 PCD 10 Read from MCO

Default value:	0	**Parameter type:**	Range, 0 - 65535
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Shows the value sent in PCD10 of the fieldbus telegram.

5.31 Parameter Group 35-** Sensor Input Option

5.31.1 35-0* Temp. Input Mode (MCB 114)

35-00 Term. X48/4 Temperature Unit

Default value:	[60] °C	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit to be used with temperature input X48/4 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-01 Term. X48/4 Input Type

Default value:	[0] Not connected	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

View the temperature sensor type detected at input X48/4.

Option	Name	Description
[0]*	Not connected	
[1]	PT100 2-wire	
[3]	PT1000 2-wire	
[5]	PT100 3-wire	
[7]	PT1000 3-wire	

35-02 Term. X48/7 Temperature Unit

Default value:	[60] °C	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit to be used with temperature input X48/7 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-03 Term. X48/7 Input Type

Default value:	[0] Not connected	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

View the temperature sensor type detected at input X48/7.

Option	Name	Description
[0]*	Not connected	
[1]	PT100 2-wire	
[3]	PT1000 2-wire	
[5]	PT100 3-wire	
[7]	PT1000 3-wire	

35-04 Term. X48/10 Temperature Unit

Default value:	[60] °C	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the unit to be used with temperature input X48/10 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-05 Term. X48/10 Input Type

Default value:	[0] Not connected	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

View the temperature sensor type detected at input X48/10.

Option	Name	Description
[0]*	Not connected	
[1]	PT100 2-wire	
[3]	PT1000 2-wire	
[5]	PT100 3-wire	
[7]	PT1000 3-wire	

35-06 Temperature Sensor Alarm Function

Default value:	[5] Stop and trip	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the alarm function.

Option	Name	Description
[0]	Off	
[2]	Stop	
[5]*	Stop and trip	
[27]	Forced stop and trip	

5.31.2 35-1* Temp. Input X48/4 (MCB 114)

35-14 Term. X48/4 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0

Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/4. A high time constant value improves dampening but also increases the time delay through the filter.

35-15 Term. X48/4 Temp. Monitor

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in ***parameter 35-16 Term. X48/4 Low Temp. Limit*** and ***parameter 35-17 Term. X48/4 High Temp. Limit***.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-16 Term. X48/4 Low Temp. Limit

Default value:	Size related	**Parameter type:**	Range, -50 - par. 35-17
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

35-17 Term. X48/4 High Temp. Limit

Default value:	Size related	**Parameter type:**	Range, par. 35-16 - 204
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

5.31.3 35-2* Temp. Input X48/7 (MCB 114)

35-24 Term. X48/7 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/7. A high time constant value improves dampening but also increases the time delay through the filter.

35-25 Term. X48/7 Temp. Monitor

Default value:	[0] Disabled	**Parameter type:**	Option

Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in ***parameter 35-26 Term. X48/7 Low Temp. Limit*** and ***parameter 35-27 Term. X48/7 High Temp. Limit***.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-26 Term. X48/7 Low Temp. Limit

Default value:	Size related	**Parameter type:**	Range, -50 - par. 35-27
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

35-27 Term. X48/7 High Temp. Limit

Default value:	Size related	**Parameter type:**	Range, Par. 35-26 - 204
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

5.31.4 35-3* Temp. Input X48/10 (MCB 114)

35-34 Term. X48/10 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/10. A high time constant value improves dampening but also increases the time delay through the filter.

35-35 Term. X48/10 Temp. Monitor

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in ***parameter 35-36 Term. X48/10 Low Temp. Limit*** and ***parameter 35-37 Term. X48/10 High Temp. Limit***.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-36 Term. X48/10 Low Temp. Limit

Default value:	Size related	**Parameter type:**	Range, -50 - par. 35-37
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

35-37 Term. X48/10 High Temp. Limit

Default value:	Size related	**Parameter type:**	Range, par. 35-36 - 204
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

5.31.5 35-4* Analog Input X48/2 (MCB 114)

35-42 Term. X48/2 Low Current

Default value:	4 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the current (mA) that corresponds to the low reference value set in ***parameter 35-44 Term. X48/2 Low Ref./Feedb. Value***. The value must be more than 2 mA to activate the live zero timeout function in ***parameter 6-01 Live Zero Timeout Function***.

35-43 Term. X48/2 High Current

Default value:	20 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) that corresponds to the high reference value set in ***parameter 35-45 Term. X48/2 High Ref./Feedb. Value***.

35-44 Term. 48/2 Low Ref./Feedb. Value

Defaul value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) that corresponds to the voltage or current set in ***parameter 35-42 Term. X48/2 Low Current***.

35-45 Term. 48/2 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) that corresponds to the voltage or current set in ***parameter 35-43 Term. X48/2 High Current***.

35-46 Term. X48/2 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/2. A high time constant value improves dampening but also increases the time delay through the filter.

35-47 Term. X48/2 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter makes it possible to enable the live zero monitoring.

Option	Name	Description
[0]	Disabled	Live zero monitoring is disabled.
[1]*	Enabled	Live zero monitoring is enabled.

5.32 Parameter Group 36-** Programmable I/O Option

5.32.1 36-0* I/O Mode

36-00 Term. X49/1 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/1.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-01 Term. X49/3 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/3.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-02 Term. X49/5 Mode

Default value:	[1] Voltage	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/5.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	

Option	Name	Description
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-03 Term. X49/7 Mode

Default value:	[0] Voltage 0–10V	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/7.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

36-04 Term. X49/9 Mode

Default value:	[0] Voltage 0–10V	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/9.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

36-05 Term. X49/11 Mode

Default value:	[0] Voltage 0–10V	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the output mode of analog terminal X49/11.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

5.32.2 36-1* Analog Input X49/1

36-10 Terminal X49/1 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - 10 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the voltage corresponding to the low reference value set in ***parameter 36-14 Term. X49/1 Low Ref./Feedb. Value***.

36-11 Terminal X49/1 Low Current

Default value:	4 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the low reference value set in ***parameter 36-14 Term. X49/1 Low Ref./Feedb. Value***.

36-12 Terminal X49/1 High Voltage

Default value:	10 V	**Parameter type:**	Range, 0 - 10 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the voltage corrsponding to the high reference value set in ***parameter 36-15 Term. X49/1 High Ref./Feedb. Value***.

36-13 Terminal X49/1 High Current

Default value:	20 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the high reference value set in ***parameter 36-15 Term- X49/1 High Ref./Feedb. Value***.

36-14 Terminal X49/1 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-10 Terminal X49/1 Low Voltage*** or ***parameter 36-11 Terminal X49/1 Low Current***.

36-15 Terminal X49/1 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-12 Terminal X49/1 High Voltage*** or ***parameter X49/1 High Current***.

36-16 Term. X49/1 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/1. A high time constant value improves dampening but also increases the time delay through the filter.

36-17 Term. X49/1 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.3 36-2* Analog Input X49/3

36-20 Terminal X49/3 Low Voltage

Default value:	0.007 V	**Parameter type:**	Range, 0 - 10 V

Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the voltage corresponding to the low reference value set in ***parameter 36-24 Term. X49/3 Low Ref./Feedb. Value***.

36-21 Terminal X49/3 Low Current

Default value:	4 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the low reference value set in ***parameter 36-24 Term. X49/3 Low Ref./Feedb. Value***.

36-22 Terminal X49/3 High Voltage

Default value:	10 V	**Parameter type:**	Range, 0 - 10 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the voltage corresponding to the high reference value set in ***parameter 36-25 Term. X49/3 High Ref./Feedb. Value***.

36-23 Terminal X49/3 High Current

Default value:	20 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the high reference value set in ***parameter 36-25 Term. X49/3 High Ref./Feedb. Value***.

36-24 Terminal X49/3 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-20 Terminal X49/1 Low Voltage*** or ***parameter 36-21 Terminal X49/1 Low Current***.

36-25 Terminal X49/3 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-22 Terminal X49/3 High Voltage*** or ***parameter 36-23 Terminal X49/3 High Current***.

36-26 Term. X49/3 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/3. A high time constant value improves dampening but also increases the time delay through the filter.

36-27 Term. X49/3 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.4 36-3* Analog Input X49/5

36-30 Terminal X49/5 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range, 0 - 10 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the voltage corresponding to the low reference value set in ***parameter 36-34 Term. X49/5 Low Ref./Feedb. Value***.

36-31 Terminal X49/3 Low Current

Default value:	4 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the low reference value set in ***parameter 36-34 Term. X49/5 Low Ref./Feedb. Value***.

36-32 Terminal X49/5 High Voltage

Default value:	10 V	**Parameter type:**	Range, 0 - 10 V
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the voltage corresponding to the high reference value set in ***parameter 36-35 Term. X49/5 High Ref./Feedb. Value***.

36-33 Terminal X49/5 High Current

Default value:	20 mA	**Parameter type:**	Range, 0 - 20 mA
Setup:	All setups	**Conversion index:**	-3
Data type:	Int16	**Change during operation:**	True

Enter the current (mA) corresponding to the high reference value set in ***parameter 36-35 Term. X49/5 High Ref./Feedb. Value***.

36-34 Terminal X49/5 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-30 Terminal X49/5 Low Voltage*** or ***parameter 36-31 Terminal X49/4 Low Current***.

36-35 Terminal X49/5 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in ***parameter 36-32 Terminal X49/5 High Voltage*** or ***parameter 36-33 Terminal X49/5 High Current***.

36-36 Term. X49/5 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range, 0.005 - 10 s
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/3. A high time constant value improves dampening but also increases the time delay through the filter.

36-37 Term. X49/5 Live Zero

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.5 36-4* Output X49/7

36-40 Terminal X49/7 Analogue Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the functionality of terminal X49/7.

Option	Name	Description
[0]*	No description	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output freq. 0–100	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference Min–Max	***Parameter 3-00 Reference Range [Min - Max]*** 0% = 0 mA; 100% = 20 mA ***Parameter 3-00 Reference Range [-Max - Max]*** -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback ±200%	-200% to +200% of ***parameter 3-03 Maximum reference***, (0–100 V)
[103]	Motor cur. 0–Imax	The value is taken from ***parameter 16-37 Inv. Max. Current***. The inverter maximum current (160% current) is equal to 20 mA. **Example:** Inverter normal current (11 kW) is 24 A. 160 %=38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20\ \text{mA} \times 22\ \text{A}}{38.4\ \text{A}} = 11.46\text{mA}$ When the normal motor current is equal to 20 mA, the output setting of ***parameter 6-52 Terminal 42 Output Max Scale*** is: $\frac{I_{\text{VLT, MAX}} \times 100}{I_{\text{Motor, Nom}}} = \frac{38.4 \times 100}{22} = 175\,\%$
[104]	Torque 0–Tlim	The torque setting is related to the setting in ***parameter 4-16 Torque Limit Motor Mode***.
[105]	Torque 0–Tnom	The torque is related to the motor torque setting.
[106]	Power 0–Pnom	Taken from ***parameter 1-20 Motor Power [kW]***.
[107]	Speed 0–HighLim	Taken from ***parameter 3-03 Maximum Reference***. 20 mA equals the value in ***parameter 3-03 Maximum Reference***.
[108]	Torque ±160%	Torque reference related to 160% torque.
[109]	Out frq 0–Fmax	0 Hz = 0 mA, ***parameter 4-19 Max Output Frequency*** = 20 mA.

Option	Name	Description
[113]	Ext. closed loop 1	0–100%, (0–10 V)
[114]	Ext. closed loop 2	0–100%, (0–10 V)
[115]	Ext. closed loop 3	0–100%, (0–10 V)
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	***Parameter 4-54 Warning Reference Low*** defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

36-41 Terminal X49/7 Digital Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function of terminal X49/7 as a digital output.

Option	Name	Description
[0]*	No operation	All digital and relay outputs are by default set to No Operation.
[1]	Control ready	The control card is ready.
[2]	Drive ready	The drive is ready to operate. Mains and control supplies are OK.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command is given (start/disable). There are no warnings.
[5]	Running	The motor is running, and shaft torque is present.
[6]	Running/no warning	Output speed is higher than the speed set in ***parameter 1-81 Min Speed for Function at Stop [RPM]*** . The motor runs and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output. No warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in ***parameter 4-16 Torque Limit Motor Mode*** or ***parameter 4-17 Torque Limit Generator Mode*** has been exceeded.
[12]	Out of current range	The motor current is outside the range set in ***parameter 4-18 Current Limit***.

Option	Name	Description
[13]	Below current, low	The motor current is lower than set in ***parameter 4-50 Warning Current Low***.
[14]	Above current, high	The motor current is higher than set in ***parameter 4-51 Warning Current High***.
[15]	Out of speed range	Output speed/frequency is outside the frequency range set in ***parameter 4-52 Warning Speed Low*** and ***parameter 4-53 Warning Speed High***.
[16]	Below speed, low	Output speed is lower than the setting in ***parameter 4-52 Warning Speed Low***.
[17]	Above speed, high	Output speed is higher than the setting in ***parameter 4-53 Warning Speed High***.
[18]	Out of feedb. range	Feedback is outside the range set in ***parameter 4-56 Warning Feedback Low*** and ***parameter 4-57 Warning Feedback High***.
[19]	Below feedback, low	Feedback is below the limit set in ***parameter 4-56 Warning Feedback Low***.
[20]	Above feedback, high	Feedback is above the limit set in ***parameter 4-57 Warning Feedback High***.
[21]	Thermal warning	Thermal warning turns on when the temperature exceeds the limit either in motor, drive, brake resistor, or connected thermistor.
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and counterclockwise when logic = 1. The output changes as soon as the reversing signal is applied.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Use for performing a coasted stop in a torque limit condition. If the drive has received a stop signal and is in torque limit, the signal is logic 0.
[28]	Brake, no brake war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake module. Use the digital output/relay to cut out the main voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[40]	Out of ref range	Active when the actual speed is outside the settings in ***parameter 4-52 Warning Speed Low*** to ***parameter 4-55 Warning Reference High***.

Option	Name	Description
[41]	Below reference, low	Active when the actual speed is below speed reference setting.
[42]	Above ref, high	Active when actual speed is above speed reference setting.
[45]	Bus ctrl.	Controls digital output/relay via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. The output state is retained in the event of a bus timeout.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in ***parameter 5-90 Digital & Relay Bus Control***. If a bus timeout occurs, the output state is set low (off).
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	See *parameter group 13-1* Comparators*. If comparator 0 in SLC is true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See *parameter group 13-1* Comparators*. If comparator 1 in SLC is true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See *parameter group 13-1* Comparators*. If comparator 2 in SLC is true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See *parameter group 13-1* Comparators*. If comparator 3 in SLC is true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See *parameter group 13-1* Comparators*. If comparator 4 in SLC is true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See *parameter group 13-1* Comparators*. If comparator 5 in SLC is true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See *parameter group 13-1* Comparators*. If comparator 6 in SLC is true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See *parameter group 13-1* Comparators*. If comparator 7 in SLC is true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See *parameter group 13-1* Comparators*. If comparator 8 in SLC is true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See *parameter group 13-1* Comparators*. If comparator 9 in SLC is true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See *parameter group 13-4* Logic Rules*. If logic rule 0 in SLC is true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See *parameter group 13-4* Logic Rules*. If logic rule 1 in SLC is true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See *parameter group 13-4* Logic Rules*. If logic rule 2 in SLC is true, the output goes high. Otherwise, it is low.

Option	Name	Description
[73]	Logic rule 3	See *parameter group 13-4* Logic Rules*. If logic rule 3 in SLC is true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See *parameter group 13-4* Logic Rules*. If logic rule 4 in SLC is true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See *parameter group 13-4* Logic Rules*. If logic rule 5 in SLC is true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See *parameter group 13-4* Logic Rules*. If logic rule 6 in SLC is true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See *parameter group 13-4* Logic Rules*. If logic rule 7 in SLC is true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See *parameter group 13-4* Logic Rules*. If logic rule 8 in SLC is true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See *parameter group 13-4* Logic Rules*. If logic rule 9 in SLC is true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See ***parameter 13-52 SL Controller Action***. Output A is low on smart logic action ***[32] Set digital out A low***. Output A is high on smart logic action ***[38]***.
[81]	SL digital output B	See ***parameter 13-52 SL Controller Action***. Output B is low on smart logic action ***[33] Set digital out B low***. Output B is high on smart logic action ***[39]***.
[82]	SL digital output C	See ***parameter 13-52 SL Controller Action***. Output C is low on smart logic action ***[34] Set digital out C low***. Output C is high on smart logic action ***[40]***.
[83]	SL digital output D	See ***parameter 13-52 SL Controller 1 Action***. Output D is low on smart logic action ***[35] Set digital out D low*** . Output D is high on smart logic action ***[41]***.
[84]	SL digital output E	See ***parameter 13-52 SL Controller Action***. Output E is low on smart logic action ***[36] Set digital out E low***. Output E is high on smart logic action ***[42]***.
[85]	SL digital output F	See ***parameter 13-52 SL Controller Action***. Output F is low on smart logic action ***[37] Set digital out F low***. Output F is high on smart logic action ***[43]***.
[90]	kWh counter pulse	
[120]	System on ref	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *alarm 164, ATEX ETR cur.lim.alarm* is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR*** . If *alarm 166, ATEX ETR freq.lim.alarm* is active, the output is 1.

Option	Name	Description
[153]	ATEX ETR cur. warning	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR*** . If *alarm 163, ATEX ETR cur.lim.warning* is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if ***parameter 1-90 Motor Thermal Protection*** is set to ***[20] ATEX ETR*** or ***[21] Advanced ETR***. If *warning 165, ATEX ETR freq.lim.warning* is active, the output is 1.
[155]	Verifying flow	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	
[165]	Local ref active	The output is high when ***parameter 3-13 Reference Site*** is set to ***[2] Local*** or when ***parameter 3-13 Reference Site*** is set to ***[0] Linked to hand/auto*** at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when ***parameter 3-13 Reference Site*** is set to ***[1] Remote*** or ***[0] Linked to hand/auto*** while the LCP is in auto-on mode.
[167]	Start command activ	The output is high when there is an active start command (via digital input, bus connection, [Hand On], or [Auto On]), and no stop command is active.
[168]	Hand/Off	The output is high when the drive is in hand-on mode (as indicated by the LED light above [Hand On]).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the LED light above [Auto On]).
[173]	10Wh counter pulse	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. maintenance	One or more of the preventive maintenance events programmed in ***parameter 23-10 Maintenance Item*** has passed the time for the specified action in ***parameter 23-22 Maintenance Action***.
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF capacitor connect	
[189]	External fan control	The internal logics for internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	

Option	Name	Description
[193]	Sleep mode	The drive/system has entered sleep mode. See *parameter group 22-4* Sleep Mode*.
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in ***parameter 22-60 Broken Belt Function***.
[195]	Bypass valve control	
[196]	Emergency mode	The drive operates in emergency mode. See *parameter group 24-0* Emergency Mode*.
[197]	Emcy mode was act.	The drive has been operating in emergency mode. In software version 5.4X, this output is only active 1 minute after emergency mode is stopped. See *parameter group 24-0* Emergency Mode*.
[198]	Drive bypass	To be used as signal for activating an external electro-mechanical bypass, switching the motor direct on line. See *parameter group 24-1* Drive Bypass*. **NOTICE** **LOSS OF CERTIFICATION** If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See *parameter group 13-1* Comparators*.
[241]	RS flipflop 1	See *parameter group 13-1* Comparators*.
[242]	RS flipflop 2	See *parameter group 13-1* Comparators*.

Option	Name	Description
[243]	RS flipflop 3	See *parameter group 13-1* Comparators*.
[244]	RS flipflop 4	See *parameter group 13-1* Comparators*.
[245]	RS flipflop 5	See *parameter group 13-1* Comparators*.
[246]	RS flipflop 6	See *parameter group 13-1* Comparators*.
[247]	RS flipflop 7	See *parameter group 13-1* Comparators*.
[249]	Emcy m OPR unexpected	Emergency mode input or safe stop is not operating as expected, for example, live zero monitoring on an analog input is activated.
[250]	Emcy mode limits	During emergency mode operation, 1 of the critical alarms has been activated and suppressed by emergency mode. This may lead to reduced drive performance and expected operation lifetime before service is required.
[254]	Testing emcy mode	Emergency mode is activated in a special test mode where the drive stops on all alarms.

36-42 Terminal X49/7 Min Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Match the minimum output of terminal X49/7 with a required value. The required value is defined as a percentage of the value selected in ***parameter 36-40 Terminal X49/7 Analogue Output***. To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***. The following example describes how the drive uses this parameter.

Example:

- ***Parameter 36-03 Terminal X49/7 Mode = [0] Voltage 0–10 V***.
- ***Parameter 36-40 Terminal X49/7 Analogue Output = [100] Output frequency***.
- ***Parameter 4-19 Max Output Frequency*** = 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/7 should be 0 V. To fulfil the example requirement, enter 10% in ***parameter 36-42 Terminal X49/7 Min. Scale***.

36-43 Terminal X49/7 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of terminal X49/7. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***. **Example:**

- ***Parameter 36-03 Terminal X49/7 Mode = [0] Voltage 0–10 V***

- ***Parameter 36-40 Terminal X49/7 Analogue Output*** = ***[100] Output Frequency***.
- ***Parameter 4-19 Max Output Frequency*** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. ***Parameter 36-43 Terminal X49/7 Max. Scale*** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). ***Parameter 36-43 Terminal X49/7 Max. Scale*** = 75%.

36-44 Terminal X49/7 Bus Ctrl

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	N2	**Change during operation:**	True

This parameter contains the output level of terminal X49/7 if the terminal is controlled by bus.

36-45 Terminal X49/7 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.32.6 36-5* Output X49/9

36-50 Terminal X49/9 Analogue Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the functionality of terminal X49/9.

Option	Name	Description
[0]*	No operation	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output frequency	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference	***Parameter 3-00 Reference Range [Min - Max]*** 0% = 0 mA; 100% = 20 mA ***Parameter 3-00 Reference Range [-Max - Max]*** -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback	

Option	Name	Description
[103]	Motor current	The value is taken from ***parameter 16-37 Inv. Max. Current***. The inverter maximum current (160% current) is equal to 20 mA. **Example:** Inverter normal current (11 kW) is 24 A. 160 %=38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20mA \times 22A}{38.4A} = 11.46mA$ When the normal motor current is equal to 20 mA, the output setting of ***parameter 6-52 Terminal 42 Output Max Scale*** is: $\frac{I_{VLT, MAX} \times 100}{I_{Motor, Nom}} = \frac{38.4 \times 100}{22} = 175\,\%$
[104]	Torque rel to limit	The torque setting is related to the setting in ***parameter 4-16 Torque Limit Motor Mode***.
[105]	Torque relate to rated	The torque is related to the motor torque setting.
[106]	Power	Taken from ***parameter 1-20 Motor Power [kW]***.
[107]	Speed	Taken from ***parameter 3-03 Maximum Reference***. 20 mA equals the value in ***parameter 3-03 Maximum Reference***.
[108]	Torque	Torque reference related to 160% torque.
[109]	Max out freq	0 Hz = 0 mA, ***parameter 4-19 Max Output Frequency*** = 20 mA.
[113]	PID clamped output	
[117]	Shaft power	
[119]	Torque % lim	
[123]	Speed both dir	
[135]	Torq.% nom 4–20mA	The torque setting is related to the motor torque setting.
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	***Parameter 4-54 Warning Reference Low*** defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[158]	Motor Volt.	

36-51 Terminal X49/9 Digital Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No operation	
[1]	Control ready	

Option	Name	Description
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Stand-by/no warning	
[5]	Running	
[6]	Running/no warning	
[8]	Run on ref/no warn	
[9]	Alarm	
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[33]	Safe stop active	
[35]	External interlock	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	

Option	Name	Description
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[66]	Comparator 6	
[67]	Comparator 7	
[68]	Comparator 8	
[69]	Comparator 9	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[76]	Logic rule 6	
[77]	Logic rule 7	
[78]	Logic rule 8	
[79]	Logic rule 9	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[90]	kWh counter pulse	
[120]	Local ref active	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	
[152]	ATEX ETR freq. alarm	

Option	Name	Description
[153]	ATEX ETR cur. warning	
[154]	ATEX ETR freq. warning	
[155]	Verifying flow	
[160]	No alarm	
[161]	Running reverse	
[164]	Local ref active, not OFF	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command activ	
[168]	Hand mode	
[169]	Auto mode	
[173]	10Wh counter pulse	
[180]	Clock fault	
[181]	Prev. Maintenance	
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	
[194]	Broken belt	
[195]	Bypass valve control	
[196]	Emergency mode	
[197]	Emcy mode was act.	
[198]	Drive bypass	
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	

Option	Name	Description
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	
[241]	RS flipflop 1	
[242]	RS flipflop 2	
[243]	RS flipflop 3	
[244]	RS flipflop 4	
[245]	RS flipflop 5	
[246]	RS flipflop 6	
[247]	RS flipflop 7	
[249]	Emcy m OPR unexpected	
[250]	Emcy mode limits	
[254]	Testing emcy mode	

36-52 Terminal X49/9 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Match the minimum output of terminal X49/9 with a required value. The required value is defined as a percentage of the value selected in ***parameter 36-50 Terminal X49/9 Analogue Output***. To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***. The following example describes how the drive uses this parameter.

Example:

- ***Parameter 36-04 Terminal X49/9 Mode = [0] Voltage 0–10 V***.
- ***Parameter 36-50 Terminal X49/9 Analogue Output = [100] Output frequency***.
- ***Parameter 4-19 Max Output Frequency***= 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/9 should be 0 V. To fulfil the example requirement, enter 10% in ***parameter 36-52 Terminal X49/9 Min. Scale***.

36-53 Terminal X49/9 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of terminal X49/9. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***.

Example:

- ***Parameter 36-04 Terminal X49/9 Mode = [0] Voltage 0–10 V***
- ***Parameter 36-50 Terminal X49/9 Analogue Output = [100] Output Frequency***.
- ***Parameter 4-19 Max Output Frequency*** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. ***Parameter 36-53 Terminal X49/9 Max. Scale*** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). ***Parameter 36-53 Terminal X49/9 Max. Scale*** = 75%.

36-54 Terminal X49/9 Bus Ctrl

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	N2	**Change during operation:**	True

This parameter contains the output level of terminal X49/9 if the terminal is controlled by bus.

36-55 Terminal X49/9 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.32.7 36-6* Output X49/11

36-60 Terminal X49/11 Analogue Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the functionality of terminal X49/11.

Option	Name	Description
[0]*	No operation	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output freq. 0–100	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference	***Parameter 3-00 Reference Range [Min - Max]*** 0% = 0 mA; 100% = 20 mA ***Parameter 3-00 Reference Range [-Max - Max]*** -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback ±200%	
[103]	Motor cur. 0–Imax	The value is taken from ***parameter 16-37 Inv. Max. Current***. The inverter maximum current (160% current) is equal to 20 mA. **Example:** Inverter normal current (11 kW) is 24 A. 160 %=38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20\text{mA} \times 22A}{38.4A} = 11.46\text{mA}$ When the normal motor current is equal to 20 mA, the output setting of ***parameter 6-52 Terminal 42 Output Max Scale*** is: $\frac{I_{\text{VLT, MAX}} \times 100}{I_{\text{Motor, Nom}}} = \frac{38.4 \times 100}{22} = 175\,\%$
[104]	Torque 0–Tlim	The torque setting is related to the setting in ***parameter 4-16 Torque Limit Motor Mode***.
[105]	Torque 0–Tnom	The torque is related to the motor torque setting.
[106]	Power 0–Pnom	Taken from ***parameter 1-20 Motor Power [kW]***.
[107]	Speed 0–HighLim	Taken from ***parameter 3-03 Maximum Reference***. 20 mA equals the value in ***parameter 3-03 Maximum Reference***.
[108]	Torque ±160%	Torque reference related to 160% torque.
[109]	Out frq 0–Fmax	0 Hz = 0 mA, ***parameter 4-19 Max Output Frequency*** = 20 mA.
[113]	Ext. closed lopp 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[117]	Shaft power	
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	***Parameter 4-54 Warning Reference Low*** defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

36-61 Terminal X49/11 Digital Output

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Stand-by/no warning	
[5]	Running	
[6]	Running/no warning	
[8]	Run on ref/no warn	
[9]	Alarm	
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[33]	Safe stop active	

Option	Name	Description
[35]	External interlock	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[66]	Comparator 6	
[67]	Comparator 7	
[68]	Comparator 8	
[69]	Comparator 9	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[76]	Logic rule 6	
[77]	Logic rule 7	
[78]	Logic rule 8	
[79]	Logic rule 9	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	

Option	Name	Description
[84]	SL digital output E	
[85]	SL digital output F	
[90]	kWh counter pulse	
[120]	Local ref active	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	
[152]	ATEX ETR freq. alarm	
[153]	ATEX ETR cur. warning	
[154]	ATEX ETR freq. warning	
[155]	Verifying flow	
[160]	No alarm	
[161]	Running reverse	
[164]	Local ref active, not OFF	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command activ	
[168]	Hand mode	
[169]	Auto mode	
[173]	10Wh counter pulse	
[180]	Clock fault	
[181]	Prev. Maintenance	
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	
[194]	Broken belt	
[195]	Bypass valve control	
[196]	Emergency mode	
[197]	Emcy mode was act.	

Option	Name	Description
[198]	Drive bypass	
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	
[241]	RS flipflop 1	
[242]	RS flipflop 2	
[243]	RS flipflop 3	
[244]	RS flipflop 4	
[245]	RS flipflop 5	
[246]	RS flipflop 6	
[247]	RS flipflop 7	
[249]	Emcy m OPR unexpected	
[250]	Emcy mode limits	
[254]	Testing emcy mode	

36-62 Terminal X49/11 Min. Scale

Default value:	0%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Match the minimum output of terminal X49/11 with a required value. The required value is defined as a percentage of the value selected in ***parameter 36-60 Terminal X49/11 Analogue Output***. To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***. The following example describes how the drive uses this parameter.

Example:

- ***Parameter 36-05 Terminal X49/16 Mode = [0] Voltage 0–10 V***.
- ***Parameter 36-50 Terminal X49/11 Analogue Output = [100] Output frequency***.
- ***Parameter 4-19 Max Output Frequency*** = 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/9 should be 0 V. To fulfil the example requirement, enter 10% in ***parameter 36-62 Terminal X49/11 Min. Scale***.

36-63 Terminal X49/11 Max. Scale

Default value:	100%	**Parameter type:**	Range, 0 - 200%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Scale the maximum output of terminal X49/11. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see ***parameter 6-52 Terminal 42 Output Max Scale***.

Example:

- ***Parameter 36-05 Terminal X49/11 Mode = [0] Voltage 0–10 V***
- ***Parameter 36-60 Terminal X49/11 Analogue Output = [100] Output Frequency***.
- ***Parameter 4-19 Max Output Frequency*** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. ***Parameter 36-63 Terminal X49/11 Max. Scale*** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). ***Parameter 36-63 Terminal X49/11 Max. Scale*** = 75%.

36-64 Terminal X49/11 Bus Ctrl

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	N2	**Change during operation:**	True

This parameter contains the output level of terminal X49/11 if the terminal is controlled by bus.

36-65 Terminal X49/11 Timeout Preset

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.33 Parameter Group 40-** Special Settings

5.33.1 40-2* PM Motor Specific

40-26 Individual Currents

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select whether or not to use individual axis currents for induction calculations.

Option	Name	Description
[0]*	Off	
[1]	On	

5.33.2 40-4* Extend. Alarm Log

40-40 Fault Log: Ext. Reference

Default value:	0%	**Parameter type:**	Range, -200 - 200%, Array [10]
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

View the present reference value applied on impulse or analog basis when the logged event occurred.

40-41 Alarm Log: Frequency

Default value:	0 Hz	**Parameter type:**	Range, -3276.8 - 3276.7 [Hz], Array [10]
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

View the actual motor frequency when the logged event occurred.

40-42 Fault Log: Current

Default value:	0 A	**Parameter type:**	Range, 0 - 10000 A, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the motor current measured when the logged event occurred.

40-43 Fault Log: Voltage

Default value:	0 V	**Parameter type:**	Range, 0 - 6000 V, Array [10]

Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the motor voltage when the logged event occurred.

40-44 Fault Log: DC Link Voltage

Default value:	0 V	**Parameter type:**	Range, 0 - 10000 V, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the DC-link voltage when the logged event occurred.

40-45 Fault Log: Control Word

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the control word sent from the drive when the logged event occurred.

40-46 Fault Log: Status Word

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	False

View the status word sent from the drive when the logged event occurred.

40-47 Alarm Log: Torque

Default value:	0 Nm	**Parameter type:**	Range, -30000 - 30000 [Nm], Array [10]
Setup:	All setups	**Conversion index:**	-1
Data type:	Int32	**Change during operation:**	False

View the actual motor torque when the logged event occurred.

40-48 Alarm Log: CBM Value

Default value:	0%	**Parameter type:**	Range, 0 - 300%, Array [10]
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the actual CBM value for this alarm.

40-49 Alarm Log: CBM Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 300%, Array [10]

Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the CBM threshold for this alarm.

5.33.3 40-5* Advanced Control Settings

40-50 Flux Sensorless Model Shift

Default value:	Size related	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to enable or disable the shifting between flux model 1 and flux model 2 at low speed. See also ***parameter 1-66 Min. Current at Low Speed***.

Option	Name	Description
[0]	Off	
[1]	On	

40-51 Flux Sensorless Corr. Gain

Default value:	Size related	**Parameter type:**	Range, 0.1 - 200.0
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Adjust the flux correction gain used at low speed.

40-52 Speed PID Anti Windup Gain

Default value:	Size related	**Parameter type:**	Range, 0 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

This Flux parameter is active in the drive when the following parameters are set to 1 of the values listed here:

- ***Parameter 1-00 Configuration Mode***
  - ***[0] Speed open loop*** or
  - ***[1] Speed closed loop*** or
  - ***[4] Torque open loop***
- ***Parameter 1-01 Motor Control Principle***
  - ***[2] Flux sensorless*** or
  - ***[3] Flux w/motor feedback***
- ***Parameter 1-10 Motor Construction***
  - ***[0] Asynchron*** or
  - ***[1] PM, non-salient SPM*** or

- *[2] PM, salient IPM*

40-53 Current PID Anti Windup Gain

Default value:	Size related	**Paramter type:**	Range, 0 - 500%
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

This Flux parameter is active in the drive when the following parameters are set to 1 of the values listed here:

- ***Parameter 1-00 Configuration Mode***
-
  - *[0] Speed open loop* or
  - *[1] Speed closed loop* or
  - *[4] Torque open loop*
- ***Parameter 1-01 Motor Control Principle***
  - *[2] Flux sensorless* or
  - *[3] Flux w/motor feedback*
- ***Parameter 1-10 Motor Construction***
  - *[0] Asynchron* or
  - *[1] PM, non-salient SPM* or
  - *[2] PM, salient IPM*

40-55 Modulation Index

Default value:	100%	**Parameter type:**	Range, 80 - 106%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE
This parameter is for IPM and SPM motors in VVC+ control principle only.

Activate this parameter by setting ***parameter 14-03 Overmodulation*** to ***[2] User Defined***. Use this parameter to set the maximum modulation index and thus trim the application, especially if running with high-power motors without sine-wave filters. Increasing the maximum modulation index increases the motor voltage and improves efficiency and stability. Setting the modulation index too high may lead to torque ripples on the motor shaft.

40-56 Rotor Position Estimation Gain

Default value:	100%	**Parameter type:**	Range, 10 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

When running IPM with high speed, high load, and low mains voltage, there is an increased risk of nuisance alarms. To reduce the risk of alarms, decrease the value, which then increases control stability.

5.33.4 40-6* IPv6 Settings

40-60 IPv6 Address Assignment

Default value:	[3] Disable	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the method for assigning the IP address. If selecting ***[0] Manual***, the IP address can be set in ***parameter 40-61 IPv6 Address***. To stop communication via IPv6, select ***[3] Disable***.

Option	Name	Description
[0]	Manual	
[1]	Auto configuration	
[2]	DHCPv6	
[3]*	Disable	

40-61 IPv6 Address

Default value:	Size related	**Parameter type:**	Range, 3 - 39, Array [4]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[39]	**Change during operation:**	True

Use this parameter for configuring the IP address of the option in IPv6 format.

40-62 Prefix Length

Default value:	0	**Parameter type:**	Range, 0 - 128, Array [4]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

NOTICE

If ***parameter 40-60 IPv6 Address*** is set to ***[1] Auto Configuration*** or ***[2] DHCPv6***, this parameter is read-only.

Use this parameter for configuring the submask of the option.

40-63 Default Gateway

Default value:	Size related	**Parameter type:**	Range, 3 - 39
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[39]	**Change during operation:**	True

Use this parameter for setting the default gateway for IPv6.

40-64 DHCPv6 Server

Default value:	Size related	**Parameter type:**	Range, 3 - 39
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[39]	**Change during operation:**	True

This parameter shows the IP address of the detected DHCPv6 server.

40-65 Lease Expires IPv6

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimD	**Change during operation:**	True

This parameter shows the remaining time for the currently assigned IP address by the DHCPv6 server in the format DD:HH:MM:SS.

40-66 Name Servers IPv6

Default value:	Size related	**Parameter type:**	Range, 3 - 39, Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[39]	**Change during operation:**	True

This parameter shows the IP address found on the DHCPv6 server.

5.33.5 40-8* IoT Settings

40-80 IoT Profile

Default value:	[0] Disable	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the profile to publish data on the selected IoT protocol.

Option	Name	Description
[0]*	Disable	
[1]	Profile 1	
[2]	Profile 2	
[3]	Profile 3	

40-81 IoT Connection Info

Default value:	0	**Parameter type:**	Range, 0 - 64, Array [8]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[64]	**Change during operation:**	True

Shows status and configuration information of the current IoT protocol.

5.33.6 40-9* Security

40-90 UUID

Default value:	Size related	**Parameter type:**	Range, 36 - 36
Setup:	1setup	**Conversion index:**	0
Data type:	VisStr[36]	**Change during operation:**	True

The Universal Unique Identifier (UUID) identifies this device within the network.

40-92 802.1X Port-Based Network Access Control

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter for setting the protocol used for network port access control using 802.1X.

Option	Name	Description
[0]*	Disable	
[1]	Enable EAP-TLS	

40-99 Protocol Status Word

Default value:	0	**Parameter type:**	Range, 0 - 0xFFFFFFFF, Array [10]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter shows the protocol status word for the drive in hex code.

5.34 Parameter Group 43-** Unit Readouts

5.34.1 43-0* Component Status

43-00 Component Temp.

Default value:	0 °C	**Parameter type:**	Range, -128 - 127 °C, Array [18]
Setup:	All setups	**Conversion index:**	100
Data type:	Int8	**Change during operation:**	True

Shows the temperature of a system component. The elements of the array reference local PCB temperature sensor measurements. ***Parameter 16-31 System Temp*** uses all elements in this array to calculate the system temperature.

43-01 Auxiliary Temp.

Default value:	0 °C	**Parameter type:**	Range, -128 - 127 °C, Array [18]

Setup:	All setups	**Conversion index:**	100
Data type:	Int8	**Change during operation:**	True

Shows the temperature of an auxiliary component. The elements of the array reference the temperature measurements from the NTC temperature sensors connected to hardware components in the drive. Refer to the Operating Guide for specifications of temperature sensor placement.

43-02 Component SW ID

Default value:	0	**Parameter type:**	Range, 0 - 20, Array [18]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[18]	**Change during operation:**	True

Shows the software version of the installed option.

5.34.2 43-1* Power Card Status

43-10 HS Temp. ph.U

Default value:	0 °C	**Parameter type:**	Range, -128 - 127, Array [8]
Setup:	All setups	**Conversion index:**	100
Data type:	Int8	**Change during operation:**	True

Shows the heat sink temperature at the location of the phase U IGBT power module. This measurement is not available in all enclosure sizes. ***Parameter 16-34 Heatsink Temp.*** uses the value in this parameter.

43-11 HS Temp. ph.V

Default value:	0 °C	**Parameter type:**	Range, -128 - 127, Array [8]
Setup:	All setups	**Conversion index:**	100
Data type:	Int8	**Change during operation:**	True

Shows the heat sink temperature at the location of the phase V IGBT power module. This measurement is not available in all enclosure sizes. ***Parameter 16-34 Heatsink Temp.*** uses the value in this parameter.

43-12 HS Temp. ph.W

Default value:	0 °C	**Parameter type:**	Range, -128 - 127, Array [8]
Setup:	All setups	**Conversion index:**	100
Data type:	Int8	**Change during operation:**	True

Shows the heat sink temperature at the location of the phase W IGBT power module. This measurement is not available in all enclosure sizes. ***Parameter 16-34 Heatsink Temp.*** uses the value in this parameter.

43-13 PC Fan A Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [8]
Setup:	All setups	**Conversion index:**	67

Data type:	Uint16	**Change during operation:**	True

Shows the measured speed of fan A on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the Operating Guide. A typical placement for fan A is in the backchannel (the external fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

43-14 PC Fan B Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [8]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the measured speed of fan B on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the Operating Guide. A typical placement for fan B is on the enclosure door (the internal fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

43-15 PC Fan C Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [8]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Changing during operation:**	True

Shows the measured speed of fan C on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the Operating Guide. A typical placement for fan C is inside the enclosure (the mixing fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

5.34.3 43-2* Fan Pow.Card Status

43-20 FPC Fan A Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan A.

43-21 FPC Fan B Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan B.

43-22 FPC Fan C Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [2]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan C.

43-23 FPC Fan D Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan D.

43-24 FPC Fan E Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan E.

43-25 FPC Fan F Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535, Array [4]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Shows the speed of the power card fan F.

5.34.4 43-3* Warning Log

43-48 Warning Log: CBM Value

Default value:	0%	**Parameter type:**	Range, 0 - 300%, Array [30]
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the actual CBM value for this warning.

43-49 Warning Log: CBM Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 300%, Array [30]
Setup:	All setups	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	False

View the CBM threshold for this warning.

5.35 Parameter Group 45-** Condition Based Monitoring

5.35.1 45-0* Cockpit: Monitor

Use this parameter group to enable condition-based monitoring, define units, baseline computation, input sources, view baseline status, and progress.

45-00 Function

Default value:	[0] Off	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Set type of notification level and to enable monitoring of the drive.

Option	Name	Description
[0]*	Off	Notification is disabled.
[1]	Warning	Warning notifications are triggered.
[2]	Alarm & warning	Both alarm and warning notifications are triggered.

Table 53: Parameter Index

Parameter ID	Description
45-00.0	Select the required option to enable stator winding monitoring.
45-00.1	Select the required option to enable load envelope
45-00.2	Select the required option to enable sensor 1 vibration.
45-00.3	Select the required option to enable sensor 2 vibration.

45-01 Status

Default value:	[0] Off	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Set the parameter to view current monitoring status.

Option	Name	Description
[0]*	Off	Status is disabled.
[1]	On	Shows current monitoring status.
[2]	Waiting for baseline	Baseline computation is in progress.

45-02 Start Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [6]

Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows at which date and time the monitoring function was started.

45-03 Stop Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [6]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows at which date and time the monitoring function was stopped.

45-09 Readout Setting

Default value:	[0] Actual	**Paramete type:**	Option, Array [6]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the readout setting.

Option	Name	Description
[0]*	Actual	
[1]	Actual rel. To S1 High	
[2]	Actual rel. To S2 High	
[3]	Actual rel. To Alarm High	
[4]	Actual rel. To S1 Low (Only For Load)	
[5]	Actual rel. To S2 Low (Only For Load)	
[6]	Actual rel. To Alarm Low (Only For Load)	

Table 54: Parameter Index

Parameter ID	Description
45-00.0	Select the required option to enable stator winding monitoring.
45-00.1	Select the required option to enable load envelope
45-00.2	Select the required option to enable sensor 1 vibration.
45-00.3	Select the required option to enable sensor 2 vibration.

5.35.2 45-1* Cockpit: Actl Status

Use the parameters in this group to compare the actual monitor values to all thresholds at the current motor output speed.

45-10 Alarm High Threshold

Default value:	0%	**Parameter type:**	Range 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the maximum threshold limit. The drive triggers a notification when threshold limit is exceeded.

Table 55: Options

Parameter ID	Description
45-10.0	Stator Winding
45-10.1	Stator Winding Active
45-10.2	Stator Winding Load
45-10.3	Load Envelope
45-10.4	Sensor 1 Vibration
45-10.5	Sensor 2 Vibration

45-11 Warning S2 High Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the maximum threshold limit for warning stage 2 for the index. The drive triggers a warning notification when threshold limit is exceeded.

Table 56: Parameter Index

Parameter ID	Description
45-11.0	Stator Winding
45-11.1	Stator Winding Active
45-11.2	Stator Winding Load
45-11.3	Load Envelope
45-11.4	Sensor 1 Vibration
45-11.5	Sensor 2 Vibration

45-12 Warning S1 High Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the maximum threshold limit for warning stage 1, in the parameter index. The drive triggers a warning notification when threshold limit is exceeded. Entering a value in the parameter indicates a user specified threshold limit.

Table 57: Parameter Index

Parameter ID	Description
45-12.0	Stator Winding
45-12.1	Stator Winding Active
45-12.2	Stator Winding Load
45-12.3	Load Envelope
45-12.4	Sensor 1 Vibration
45-12.5	Sensor 2 Vibration

45-13 Actual Monitor Value

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the current value of selected signal.

Table 58: Parameter Index

Parameter ID	Description
45-13.0	Stator Winding
45-13.1	Stator Winding Active
45-13.2	Stator Winding Load
45-13.3	Load Envelope
45-13.4	Sensor 1 Vibration
45-13.5	Sensor 2 Vibration

45-14 Warning S1 Low Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the minimum threshold limit for warning stage 1 notification in the parameter index. The drive triggers a notification when the actual monitoring value falls below the minimum threshold limit.

Table 59: Parameter Index

Parameter ID	Description
45-14.0	Stator Winding
45-14.1	Stator Winding Active
45-14.2	Stator Winding Load
45-14.3	Load Envelope
45-14.4	Sensor 1 Vibration
45-14.5	Sensor 2 Vibration

45-15 Warning S2 Low Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the minimum threshold limit for warning stage 2 notification, in the parameter index. The drive triggers a warning stage 2 notification when the actual monitoring value falls below the threshold limit specified in the parameter.

Table 60: Parameter Index

Parameter ID	Description
45-15.0	Stator Winding
45-15.1	Stator Winding Active
45-15.2	Stator Winding Load
45-15.3	Load Envelope
45-15.4	Sensor 1 Vibration
45-15.5	Sensor 2 Vibration

45-16 Alarm Low Threshold

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [8]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the minimum threshold limit, in the parameter index. The drive triggers an alarm notification when the actual falls below the minimum threshold limit.

Table 61: Parameter Index

Parameter ID	Description
45-16.0	Stator Winding

Table 61: Parameter Index (continued)

45-16.1	Stator Winding Active
45-16.2	Stator Winding Load
45-16.3	Load Envelope
45-16.4	Sensor 1 Vibration
45-16.5	Sensor 2 Vibration

5.35.3 45-2* Baseline Settings

Use the parameters in this group to configure how to capture baseline data.

45-20 Type

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use the parameter to select type of baseline computation.

Option	Name	Description
[0]*	Off	Baseline computation type is not set.
[1]	Baseline Run	Select the option when the application can operate from minimum to maximum speed in one sweep. On enabling this option, the condition-based monitoring function sets speed points. On completion of baseline computation, the motor is ramped down to 0. The option can only operate when Hand On mode is set via control panel.
[2]	Online Baseline	Select the option in applications where baseline run cannot be utilized. In this type of baseline computation, the drive is controlled by the application baseline and speed points are recorded and saved during the duration specified in ***Parameter 45-24 Duration***. The option can only operate when Auto On mode is set via control panel.

45-21 Status

Default value:	[0] Not started	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter shows the current status of baseline computation.

Option	Name	Description
[0]*	Not started	
[1]	Baseline run running	
[2]	Online baseline running	
[3]	Baseline completed	
[4]	Baseline failed	
[5]	Online inadequate data	

45-22 Progress

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Shows the progress of baseline computation. 0% indicates that the baseline computation is not started, and 100% indicates that baseline computation is completed.

45-23 Baseline Result Info

Default value:	[0] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the required selection for baseline during both baseline run and online baseline.

Option	Name	Description
[0]*	None	
[1]	Baseline run OFF	
[2]	Reverse direction	
[3]	Speed limit exceeded	
[4]	Speed diff low	
[5]	Step ramp timeout	
[6]	Stator supply imbalance	
[7]	Online baseline OFF	
[8]	Online baseline count limit	
[9]	Not allowed - motor running	

45-24 Duration

Default value:	–	**Parameter type:**	Option

Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select a suitable duration for baseline computation. If a value is not selected, by default, the system considers 2 minutes for baseline run and 1 hour for online baseline.

Option	Name	Description
[0]	1 min	
[1]	2 mins	
[3]	4 mins	
[6]	10 mins	
[9]	30 mins	
[13]	1 hour	
[16]	2 hours	
[19]	4 hours	
[23]	8 hours	
[27]	1 day	
[30]	2 days	
[33]	5 days	
[36]	1 week	
[40]	2 weeks	
[43]	1 month	
[46]	2 months	
[49]	4 months	
[52]	6 months	

45-25 Online Speed Band

Default value:	5%	**Parameter type:**	Range, 0 - 5%
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Use this parameter to define a window to capture the baseline data for different speed points when the speed of drive is within the specified band percentage. Setting the parameter increases a chance to capture all speed points in online baseline mode.

45-26 Min. Speed

Default value:	Size related	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	2 setups	**Conversion index:**	67

Data type:	Uint16	**Change during operation:**	True

Use this parameter to set the minimum speed of the drive to begin condition-based monitoring functions. Ensure to set a value which exceeds the minimum speed limit of motor. The minimum limit of motor speed corresponds to the setting in ***parameter 4-11 Motor Speed Low Limit [RPM]***. For more information, refer to the drive-specific programming guide.

45-27 Max. Speed

Default value:	Size related	**Parameter type:**	Range, 100 - 35700 [RPM]
Setup:	2 setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

Use this parameter to set the maximum speed of the drive for condition-based monitoring functions. Setting the minimum and maximum speed defines the speed range for condition-based monitoring functions to perform effectively. Ensure to set a value which does not exceed the maximum limit of motor speed. The maximum limit of motor speed corresponds to the setting in ***parameter 4-13 Motor Speed High Limit [RPM]***. For more information, refer to the drive-specific programming guide.

45-28 Speed Points

Default value:	Size related	**Parameter type:**	Range, par. 45-26 - par. 45-27, Array [20]
Setup:	2 setups	**Conversion index:**	67
Data type:	Uint32	**Change during operation:**	True

Shows the baseline speed points calculated within the range defined in ***parameter 45-26 Min. Speed*** and ***parameter 45-27 Max. speed***.

5.35.4 45-3* Threshold Config.

45-30 Baseline Statistics

Default value:	[3] Mean ± 3 standard deviation	**Parameter type:**	Option, Array [6]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the type of baseline statistical data for visualizing calculated threshold limits for each parameter index. The calculated threshold is used for monitoring purposes.

Option	Name	Description
[1]	Mean	Average of the baseline data is shown.
[2]	Maximum/minimum	Maximum and minimum of the baseline data is shown.
[3]*	Mean +/- 3 standard deviation	Mean and +/-3 standard deviations of the baseline data is shown.

Table 62: Parameter Index

Parameter ID	Description
45-30.0	Stator Winding

Table 62: Parameter Index (continued)

45-30.1	Load Envelope
45-30.2	Sensor 1 Vibration
45-30.3	Sensor 2 Vibration

45-31 Warning Mode

Default value:	[0] Absolute	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select a mode to define threshold limit for warnings.

Option	Name	Description
[0]*	Absolute	Absolute value is considered as threshold limit.
[1]	Offset	Calculates threshold as a sum of the computed baseline data and the offset values.
[2]	Factor	Calculates threshold as baseline data x factor.

The values can be specified in ***parameter 45-34 Warning S2 High***, ***parameter 45-35 Warning S1 High***, ***Parameter 45-36 Warning S1 Low***, and ***parameter 45-37 Warning S2 Low***. For example, if selecting ***[0] Absolute***, a warning S2 low value of 200, and a warning S1 high value of 300, the threshold limit for warning stage 2 ranges from 200–300.

Table 63: Parameter Index

Parameter ID	Description
45-31.0	Stator Winding
45-31.1	Load Envelope
45-31.2	Sensor 1 Vibration
45-31.3	Sensor 2 Vibration

45-32 Alarm Mode

Default value:	[0] Absolute	**Parameter type:**	Option, Array [6]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select a mode to define the threshold limits for alarms.

Option	Name	Description
[0]*	Absolute	Absolute value is considered as threshold.
[1]	Offset	Calculates threshold as a sum of the computed baseline data and the offset values.
[2]	Factor	Calculates threshold as baseline data * factor.

The values can be specified in ***parameter 45-33 Alarm High*** and ***parameter 45-38 Alarm Low***. For example, if selecting ***[0] Absolute***, setting an alarm low value of 200, and an alarm high value of 300, the threshold limit for alarms ranges from 200 to 300.

Table 64: Parameter Index

Parameter ID	Description
45-32.0	Stator Winding
45-32.1	Load Envelope
45-32.2	Sensor 1 Vibration
45-32.3	Sensor 2 Vibration

45-33 Alarm High

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [6]
Setup:	2 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Type the threshold value for high alarm notification. Based on the type of alarm mode selected by the user, a high alarm threshold is calculated.

Table 65: Options

Parameter ID	Description
45-33.0	Stator Winding
45-33.1	Load Envelope
45-33.2	Sensor 1 Vibration
45-33.3	Sensor 2 Vibration

45-34 Warning S2 High

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during option:**	True

Type the threshold value for computing a warning S2 high notification. Based on the type of warning mode selected by the user, a warning S2 high threshold is calculated.

Table 66: Options

Parameter ID	Description
45-34.0	Stator Winding
45-34.1	Load Envelope
45-34.2	Sensor 1 Vibration
45-34.3	Sensor 2 Vibration

45-35 Warning S1 High

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Type the threshold value for computing a warning S1 high notification. Based on the type of warning mode selected by the user, a warning S1 high threshold is calculated.

Table 67: Options

Parameter ID	Description
45-35.0	Stator Winding
45-35.1	Load Envelope
45-35.2	Sensor 1 Vibration
45-35.3	Sensor 2 Vibration

45-36 Warning S1 Low

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Type the threshold value for computing a warning S1 low notification. Based on the type of warning mode selected by the user, a warning S1 low threshold is calculated.

Table 68: Options

Parameter ID	Description
45-36.0	Stator Winding
45-36.1	Load Envelope
45-36.2	Sensor 1 Vibration
45-36.3	Sensor 2 Vibration

45-37 Warning S2 Low

Default value:	Size related	**Parameter type:**	Range, 0 - 100%, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Type the threshold value for computing a warning S2 low notification. Based on the type of warning mode selected by the user, a warning S2 low threshold is calculated.

Table 69: Options

Parameter ID	Description
45-37.0	Stator Winding
45-37.1	Load Envelope
45-37.2	Sensor 1 Vibration
45-37.3	Sensor 2 Vibration

45-38 Alarm Low

Default value:	Size related	**Parameter type:**	Range, 0 - 100%
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Type the threshold value for computing a low alarm notification. Based on the type of alarm mode selected, a low alarm threshold is calculated.

Table 70: Options

Parameter ID	Description
45-38.0	Stator Winding
45-38.1	Load Envelope
45-38.2	Sensor 1 Vibration
45-38.3	Sensor 2 Vibration

45-39 Online Baseline Counter

Default value:	2	**Parameter type:**	Range, 0 - 65535, Array [6]
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Type the minutes during which monitoring values are captured for a speed point during baseline generation. Speed points are captured for different types of condition-based monitoring during the minutes specified in this parameter.

Table 71: Options

Parameter ID	Description
45-39.0	Stator Winding
45-39.1	Load Envelope
45-39.2	Sensor 1 Vibration
45-39.3	Sensor 2 Vibration

45-40 Extend Factor

Default value:	1.00f	**Parameter type:**	Range, 0.05 - 5.00f, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

In this parameter, consider the extended factor required for setting the extended threshold generation via ***parameter 45-45 Threshold Generation***

5.35.5 45-4* Threshold Generation

The parameters in this parameter group support the generation of the CBM thresholds.

45-45 Threshold Generation

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Off	Not applicable.
[1]	Generate now	Based on the selections, threshold for all functions is generated from actual baseline data.
[2]	Auto generate	Not applicable.
[3]	Generate now - previous	Based on the selections, threshold for all functions is generated from previous baseline data.
[4]	Gen. now - stator	Based on the selections, threshold for stator is generated from actual baseline data.
[5]	Gen. now - load	Based on the selections, threshold for load is generated from actual baseline data.
[6]	Gen. now - sensor 1	Based on the selections, threshold for sensor 1 is generated from actual baseline data.
[7]	Gen. now - sensor 2	Based on the selections, threshold for sensor 2 is generated from actual baseline data.

Option	Name	Description
[8]	Gen. now - sensor 3	Based on the selections, threshold for sensor 3 is generated from actual baseline data.
[9]	Gen. now - sensor 4	Based on the selections, threshold for sensor 4 is generated from actual baseline data.
[10]	Extended auto gen.	

45-46 Threshold Limits

Default value:	[0] Limits OK	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Clear the threshold limit warning when the threshold is at an acceptable level.

Option	Name	Description
[0]*	Limits OK	
[1]	Limits Exceeded	

5.35.6 45-5* Sensor Config.

Select the analog input for sensor and unit configuration.

45-50 Source

Default value:	[0] None	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select an analog input source for receiving sensor signals. Scaling of analog inputs is performed as defined in *parameter group 6-** Analog In/Out*. For more information on *parameter group 6-** Analog In/Out*, refer to the drive-specific programming guide.

Option	Name	Description
[0]*	None	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Analog Input X30/11	
[4]	Analog Input X30/12	
[5]	Analog Input X42/1	
[6]	Analog Input X42/3	
[7]	Analog Input X42/5	

Option	Name	Description
[8]	Analog Input X48/2	
[9]	Analog Input X49/1	
[10]	Analog Input X49/3	
[11]	Analog Input X49/5	

Table 72: Option

Parameter ID	Description
45-50.0	Sensor 1 Vibration
45-50.1	Sensor 2 Vibration

45-51 Sensor 1 Unit

Default value:	[0] None	**Parameter type:**	Option, Array [4]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use the parameter to set unit of monitoring signals from the sensor. The unit is specified on the vibration sensor.

Option	Name	Description
[0]*	None	
[1]	mm/s	
[2]	inch/s	
[3]	m/s2	
[4]	g	
[5]	bar	
[6]	psi	
[7]	Pa	
[8]	kPa	
[9]	MPa	
[10]	kg/cm2	
[11]	inHg	
[12]	m3/h	
[13]	US gpm	
[14]	l/h	
[15]	cfm	

5.35.7 45-6* Stator Res. Setting

45-60 Active Threshold

Default value:	2%	**Parameter type:**	0 - 100%
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Use this parameter to activate the resonance region supply imbalance control. Enter the threshold offset value from the baseline data.

45-61 Load Mode

Default value:	[0] Absolute	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Option	Name	Description
[0]*	Absolute	Absolute value specified in ***parameter 45-33 Alarm High*** is considered as notification threshold.
[1]	Offset	Notification threshold is a sum of the computed baseline data and the offset values specified in ***parameter 45-33*** through ***parameter 45-38***.
[2]	Factor	Threshold limits is calculated as baseline data * factor value specified in ***parameter 45-33*** through ***parameter 45-38***.

45-62 Load Threshold

Default value:	Size related	**Parameter type:**	Range, 0 - 200%
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

45-63 Imbalance Limit

Default value:	0.50%	**Parameter type:**	Range, 0.05 - 10%
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

45-64 Imbalance Value

Default value:	0%	**Parameter type:**	Range, 0 - 100%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual value of the supply imbalance.

5.35.8 45-9* Actual Readouts

The parameters in this group are readout parameters showing the actual monitoring values.

45-90 Stator [%]

Default value:	0%	**Parameter type:**	0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual stator monitor value at motor output speed.

45-91 Load [%]

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual load monitor value at motor output speed.

45-92 Sensor 1 [%]

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual sensor 1 monitor value in % at motor output speed.

45-93 Sensor 1 [Unit]

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter shows the actual sensor 1 monitor value in the selected unit at motor output speed.

45-94 Sensor 2 [%]

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual sensor 2 monitor value in % at motor output speed.

45-95 Sensor 2 [Unit]

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

This parameter shows the actual sensor 2 monitor value in the selected unit at motor output speed.

45-96 Sensor 3 [%]

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual sensor 3 value in % at motor output speed.

45-97 Sensor 3 [Unit]

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter shows the actual sensor 3 monitor value in the selected unit at motor output speed.

45-98 Sensor 4 [%]

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the actual sensor 4 monitor value in % at motor output speed.

45-99 Sensor 4 [Unit]

Default value:	0	**Parameter type:**	Range, -999999.999 - 999999.999
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

This parameter shows the actual sensor 4 monitor value in the selected unit at motor output speed.

5.36 Parameter Group 46-** CBM Adv. Thresholds

5.36.1 46-0* History

The parameters in this group hold threshold history, such as timestamps of the last modification.

46-00 Last Change Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0, Array [6]
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows the time stamp of the latest modification to a notification threshold.

5.36.2 46-0* General

46-07 Monitoring Min Speed

This parameter monitors the minimum speed as defined in ***parameter 45-45 Threshold Generation***.

46-08 Monitoring Max Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter monitors the maximum speed as defined in ***parameter 45-45 Threshold Generation***.

46-09 Monitoring Speeds

Default value:	0 RPM	**Parameter type:**	Range, 0 - 37500 [RPM], Array [20]
Setup:	All setups	**Conversion index:**	67
Data type:	Int32	**Change during operation:**	True

This parameter shows the 20 speed points in RPM. By default, the baseline minimum speed is considered.

5.36.3 46-1* Timing

46-10 Alarm Time

Default value:	10 s	**Parameter type:**	Range, 0 - 60000 s, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the time in seconds to define duration during which the alarm is not triggered. When the value which is monitored exceeds or falls below the alarm threshold for more than the time specified in the parameter, an alarm is triggered. Alarm time is the amount of time in seconds a monitoring state should be over alarm threshold before triggering an alarm.

Table 73: Parameter Index

Parameter ID	Description
46-10.0	Stator Winding
46-10.1	Load Envelope
46-10.2	Sensor 1 Vibration
46-10.3	Sensor 2 Vibration

46-11 Warning S2 Time

Default value:	10 s	**Parameter type:**	Range, 0 - 60000 s, Array [6]
Setup:	2 setups	**Conversion index:**	-2

Data type:	Uint32	**Change during operation:**	True

Set the time in seconds to define duration during which the warning S2 is not triggered. When the value which is monitored exceeds or falls below the warning S2 threshold for more than the time specified in the parameter, a warning S2 is triggered.

Table 74: Parameter Index

Parameter ID	Description
46-11.0	Stator Winding
46-11.1	Load Envelope
46-11.2	Sensor 1 Vibration
46-11.3	Sensor 2 Vibration

46-12 Warning S1 Time

Default value:	10 s	**Parameter type:**	Range, 0 - 60000 s, Array [6]
Setup:	2 setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the time in seconds to define duration during which the warning S1 is not triggered. When the value which is monitored exceeds or falls below the warning S1 threshold for more than the time specified in the parameter, a warning S1 is triggered.

Table 75: Parameter Index

Parameter ID	Description
46-12.0	Stator Winding
46-12.1	Load Envelope
46-12.2	Sensor 1 Vibration
46-12.3	Sensor 2 Vibration

46-13 Interpolation Type

Default value:	[0] Linear	**Parameter type:**	Option, Array [6]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set the type of interpolation parameter to construct accurate speed points.

Option	Name	Description
[0]*	Linear	Select this option for stator and load monitoring.
[1]	Staircase	Select this option for vibration monitoring.

Table 76: Index Array

Parameter ID	Description
46-13.0	Stator Winding
46-13.1	Load Envelope
46-13.2	Sensor 1 Vibration
46-13.3	Sensor 2 Vibration

5.36.4 46-2* Stator

46-20 Alarm High

	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a high alarm for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values to manually configure Stator Winding Monitoring Alarm High Threshold for each individual speed point.

46-21 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a warning S2 alarm for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a high warning S2 is triggered. The parameter contains 20 index values to manually configure Stator Winding Monitoring Warning S2 High Threshold for each individual speed point.

46-22 Stator Warning S1

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a high warning S1 for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a high warning S1 is triggered. The parameter contains 20 index values which can be used to manually configure Stator Winding Monitoring Warning S1 High Threshold for each individual speed point.

46-23 Resonance Active

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

46-24 Resonance Load

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

5.36.5 46-3* Load

Use the parameters in this group to enter, adjust, and display threshold values for load envelope monitoring function.

46-30 Alarm High

Default value:	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a high alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values which can be used to manually configure Load Alarm High Threshold for each individual speed point.

46-31 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a high warning S2 for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a warning S2 high is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S2 High Threshold for each individual speed point.

46-32 Warning S1 High

Default value:	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a high warning S1 for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a high warning S1 is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S1 High Threshold for each individual speed point.

46-33 Warning S1 Low

Default value	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low S1 warning for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a low S1 warning is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S1 Low Threshold for each individual speed point.

46-34 Warning S2 Low

Default value:	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low S2 warning for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a low S2 warning is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S2 Low Threshold for each individual speed point.

46-35 Alarm Low

Default value:	0%	**Parameter type:**	Range, 0 - 200%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Load Alarm Low Threshold for each individual speed point.

5.36.6 46-4* Sensor 1

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 1 monitoring function.

46-40 Alarm High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Alarm High Threshold for each individual speed point.

46-41 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Warning S2 High Threshold for each individual speed point.

46-42 Warning S1 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Warning S2 High Threshold for each individual speed point.

5.36.7 46-5* Sensor 2

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 2 monitoring function.

46-50 Alarm High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

46-51 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Warning S2 High Threshold for each individual speed point.

46-52 Warning S1 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

5.36.8 46-6* Sensor 3

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 3 monitoring function.

46-60 Alarm High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]

Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

46-61 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a warning S2 notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a warning S2 high is triggered. The parameter contains 20 index values which can be used to manually configure warning S2 high threshold for each individual speed point.

46-62 Warning S1 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a warning stage 1 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure Warning S1 High Threshold for each individual speed point.

5.36.9 46-7* Sensor 4

Use the parameters in this group to enter, adjust and display threshold values for Sensor 4 monitoring function.

46-70 Alarm High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a alarm high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values which can be used to manually configure alarm high threshold for each individual speed point.

46-71 Warning S2 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a warning stage 2 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure Warning stage 2 high threshold for each individual speed point.

46-72 Warning S1 High

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the threshold value which defines a warning stage 1 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure warning stage 1 high threshold for each individual speed point.

5.37 Parameter Group 47-** CBM Baseline Data

5.37.1 47-0* History

The parameters in this group holds the baseline history of start and stop timestamps of the active and previous baseline.

47-00 Actual Start Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows a timestamp of when the actual baseline capturing was started.

47-01 Actual Time Stop

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows a timestamp of when the actual baseline capturing was stopped.

47-02 Previous Start Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0
Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows a timestamp of when the previous baseline capturing was started.

47-03 Previous Stop Time

Default value:	Size related	**Parameter type:**	Range, 0 - 0
Setup:	All setups	**Conversion index:**	0

Data type:	TimeOfDay	**Change during operation:**	True

This parameter shows a timestamp of when the previous baseline capturing was stopped.

5.37.2 47-0* Speeds

The parameters in this group show the baseline speed points of active and previous baseline data.

47-04 Actual Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535 [RPM], Array [20]
Setup:	All setups	**Conversion index:**	67
Change during operation:	True		

This parameter shows the baseline speed points of the actual baseline data captured.

47-05 Previous Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 65535 [RPM], Array [20]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter shows the baseline speed points of the previous baseline data captured.

5.37.3 47-0* Stator

47-06 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the maximum stator winding readings for the active baseline.

47-07 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the mean and 3 standard deviations of stator winding readings for the active baseline.

47-08 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the average of stator winding readings for the active baseline.

47-09 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The parameter shows the minimum value of motor stator windings for active baseline.

47-10 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for speed points.

47-11 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the maximum stator winding readings for the previous baseline.

47-12 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the mean and 3 standard deviations of stator winding readings for the previous baseline.

47-13 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

This parameter shows the average of stator winding readings for the previous baseline.

47-14 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The parameter shows the minimum value of motor stator windings for previous baseline.

47-15 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 0, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for speed points.

5.37.4 47-1* Stator Res. Active

47-16 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the active stator resistance.

47-17 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of stator resistance readings for the active baseline.

47-18 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Shows the mean of stator resistance recordings for active load in the active baseline.

47-19 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Shows the minimum of all stator resistance recordings for active load in the active baseline.

47-20 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum stator resistance readings for the previous baseline.

47-21 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of stator resistance readings for the previous baseline.

47-22 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of stator resistance readings for the previous baseline.

47-23 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [10]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of motor stator resistance for previous baseline.

5.37.5 47-2* Stator Res. Load

47-24 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [40]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum load dependent stator resonance. An indexed parameter with 20 pointers showing stator resonance load recordings from minimum to maximum.

47-25 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average and standard deviation of stator resonance load recordings for the active baseline.

47-26 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of stator resonance load recordings for the active baseline.

47-27 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of stator resonance load recordings for the active baseline.

47-28 Previous Max

Default value:	0%	**Parameter Type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum stator resonance readings for the previous baseline.

47-29 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of stator resonance readings for the previous baseline.

47-30 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of stator resonance readings for the previous baseline.

47-31 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of motor stator resonance for the previous baseline.

5.37.6 47-3* Load

47-32 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum positive load envelope recordings for the active baseline. An indexed parameter with 20 pointers of positive load envelope recordings with minimum to maximum.

47-33 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the active mean and 3 standard deviation of load envelope recordings for active baseline.

47-34 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the active mean of load envelope recordings for the active baseline.

47-35 Actual Mean - 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the active mean minus 3 standard deviation of load envelope recordings for the active baseline.

47-36 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of load envelope recordings for the active baseline.

47-37 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for load envelope.

47-38 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum value for load envelope readings for the previous baseline.

47-39 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Converison index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of load envelope readings for the previous baseline.

47-40 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of load envelope readings for the previous baseline.

47-41 Previous Mean - 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean minus 3 standard deviations of load envelope readings for the previous baseline.

47-42 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 655.35%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of load envelope for the previous baseline.

47-43 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for load envelope.

5.37.7 47-4* Sensor 1

47-44 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-45 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-46 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average value of recordings from vibration sensors for the active baseline.

47-47 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of recordings from vibration sensors for the active baseline.

47-48 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for Sensor 1.

47-49 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum value for Sensor 1 readings for the previous baseline.

47-50 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of Sensor 1 readings for the previous baseline.

47-51 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of Sensor 1 readings for the previous baseline.

47-52 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of Sensor 1 for the previous baseline.

47-53 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for Sensor 1.

5.37.8 47-5* Sensor 2

47-54 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [10]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-55 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-56 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Shows the average value of recordings from vibration sensors for active baseline.

47-57 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-58 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for Sensor 2.

47-59 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum value for Sensor 2 readings for the previous baseline.

47-60 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of Sensor 2 readings for the previous baseline.

47-61 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of Sensor 2 readings for the previous baseline.

47-62 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of Sensor 2 for the previous baseline.

47-63 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for Sensor 2.

5.37.9 47-6* Sensor 3

47-64 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-65 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-66 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Shows the average value of recordings from vibration sensors for active baseline.

47-67 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-68 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for Sensor 3.

47-69 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum value for Sensor 3 readings for the previous baseline.

47-70 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of Sensor 3 readings for the previous baseline.

47-71 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of Sensor 3 readings for the previous baseline.

47-72 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of Sensor 3 for the previous baseline.

47-73 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for Sensor 3.

5.37.10 47-7* Sensor 4

47-74 Actual Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-75 Actual Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-76 Actual Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Shows the average value of recordings from vibration sensors for active baseline.

47-77 Actual Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-78 Actual Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the active minutes to capture monitoring values for Sensor 4.

47-79 Previous Max

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the maximum value for Sensor 4 readings for the previous baseline.

47-80 Previous Mean + 3 Std. Dev.

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the mean and 3 standard deviations of Sensor 4 readings for the previous baseline.

47-81 Previous Mean

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

This parameter shows the average of Sensor 4 readings for the previous baseline.

47-82 Previous Min

Default value:	0%	**Parameter type:**	Range, 0 - 100%, Array [20]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

The parameter shows the minimum value of Sensor 4 for the previous baseline.

47-83 Previous Counter

Default value:	0	**Parameter type:**	Range, 0 - 65535, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

The parameter shows the previous minutes to capture monitoring values for Sensor 4.

5.37.11 47-9* Min Max Speed

47-95 Actual Min Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter shows the minimum speed of the actual baseline data.

47-96 Actual Max Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter shows the maximum speed of the actual baseline data.

47-97 Previous Min Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter shows the minimum speed of the previous baseline data.

47-98 Previous Max Speed

Default value:	0 RPM	**Parameter type:**	Range, 0 - 35700 [RPM]
Setup:	All setups	**Conversion index:**	67
Data type:	Uint16	**Change during operation:**	True

This parameter shows the maximum speed of the previous baseline data.

5.38 Parameter Group 50-** License

50-00 License Installed

Default value:	0	**Parameter type:**	Range, 0 - 40, Array [3]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[40]	**Change during operation:**	False

Shows all licenses activated in the drive.

50-01 License Code

Default value:	Size related	**Parameter type:**	Range, 0 - 19
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[19]	**Change during operation:**	True

Enter the license code provided by the sales representative to activate licensed features in the drive. The license code comprises 16 alphanumeric characters in the format (XXXX-XXXX-XXXX-XXXX). When the license is accepted by the drive, the parameter is shown as 0000-0000-0000-0000.

NOTICE

Restart the drive after entering the new license code. Parameters relevant for configuring the new feature(s) are now shown in the drive. The new type code is reflected in ***parameter 15-45 Actual Typecode String***. The original type code of the drive can be viewed in ***parameter 15-44 Ordered Typecode String***. The activated license is shown in ***parameter 50-00 License Installed***.

The license code can also be set from the factory.

5.39 Parameter Group 600-** PROFIsafe

600-00 Velocity Reference Value

Default value:	1500.000 ReferenceFeedbackUnit	**Parameter type:**	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

The velocity reference sets the speed value for 100% for N2/N4 normalized speed signals.

6 Troubleshooting

6.1 Status Messages

6.1.1 Warnings and Alarms

A warning or an alarm is signaled by the relevant indicator light on the front of the drive and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances, operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the drive trips. Reset the alarm to resume operation once the cause has been rectified.

3 ways to reset:

- Press [Reset].
- Via a digital input with the reset function.
- Via serial communication/optional fieldbus.

NOTICE

After a manual reset pressing [Reset], press [Auto On] to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip locked.

Alarms that are trip locked offer extra protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the drive is no longer blocked and can be reset once the cause has been rectified.

Alarms that are not trip locked can also be reset using the automatic reset function in ***parameter 14-20 Reset Mode*** (Warning: Automatic wake up is possible.)

If a warning or alarm is marked against a code in the alarm/warning code list, this means that either a warning occurs before an alarm, or it is possible to specify whether a warning or an alarm should be shown for a given fault.

This is possible, for instance, in ***parameter 1-90 Motor Thermal Protection***. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the drive is reset.

NOTICE

No missing motor phase detection (numbers 30-32) and no stall detection are active when ***parameter 1-10 Motor Construction*** is set to ***[1] PM non-salient SPM***.

6.1.2 Alarm/Warning Code List

NOTICE

If more selections are marked as default, it indicates that the warning changes to an alarm after a certain time.

- X = Default
- (X) = Possible selection
- – = Not relevant

Table 77: Alarm/Warning Code List

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
1	10 volts low	X	–	–	***Parameter 14-90.0 Fault Level***	Ignored	Ignored	Warning	–
2	Live zero error	(X)	(X)	–	***Parameter 6-01 Live Zero Timeout Function***, ***Parameter 6-02 Fire Mode Live Zero Timeout Function***	Ignored	Ignored	(Warning/Trip)	–
3	No motor	(X)	–	–	***Parameter 1-80 Function at Stop***	Ignored	Ignored	(Warning/Trip)	–
4	Mains ph. loss	(X)	(X)	(X)	***Parameter 14-12 Response to Mains Imbalance***	Ignored	Ignored	(Warning/Trip)	X
5	DC voltage high	X	–	–	–	Ignored	Ignored	Warning	–
6	DC voltage low	X	–	–	–	Ignored	Ignored	Warning	–
7	DC overvolt	X	X	–	–	Trip+Reset	Trip	Warning /Trip	–
8	DC undervolt	X	X	–	–	Trip+Reset	Trip	Warning /Trip	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
9	Inverter overld.	X	X	–	Alternatively, ***parameter 14-61 Function at Inverter Overload*** can be set to ***[0] Derate***	Ignored	Ignored	Warning /Trip	X
		X	–	–	Alternatively, ***parameter 14-90 Fault Settings*** can be set to ***[0] Off***				
10	Motor ETR over	(X)	(X)	–	***Parameter 1-90 Motor Thermal Protection***	Ignored	Ignored	(Warning/Trip)	–
11	Motor th over	(X)	(X)	–	***Parameter 1-90 Motor Thermal Protection***	Ignored	Ignored	(Warning/Trip)	–
12	Torque limit	X	X	–	***Parameter 14-90.6 Fault level*** and ***parameter 14-25 Trip Delay at Torque Limit***	Ignored	Ignored	Warning /Trip	–
13	Overcurrent	X	X	X	***Parameter 14-90 Fault Settings***	Trip+Reset	Trip	Trip lock	–
14	Ground fault	X	X	X	***Parameter 14-90.4 Fault Level***	Trip+Reset	Trip	Trip	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
15	Incomp. HW	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
16	Short circuit	–	X	X	***Parameter 14-90.8 Fault Level*** default is Trip Lock	Trip+Re-set	Trip	Trip lock	–
17	Ctrl. word TO	(X)	(X)	–	***Parameter 8-04 Control Word Timeout Function***, default ***[0] Off***	Ignored	Ignored	(Warn-ing/Trip)	–
18	Start failed	–	X	–	–	Ignored	Ignored	Trip	–
20	Temp. input error	–	–	–	–	–	–	–	–
21	Param error	–	–	–	–	–	–	–	–
23	Internal fans	X	–	–	***Parameter 14-53 Fan Monitor***	Ignored	Ignored	(Warn-ing/Trip)	–
24	External fans	X	–	–	***Parameter 14-53 Fan Monitor***	Ignored	Ignored	(Warn-ing/Trip)	–
25	Brake resis-tor	X	–	–	–	Ignored	Ignored		–
26	Brake over-load	(X)	(X)	–	***Parameter 2-13 Brake Power Monitoring***, default ***[0] Off***	Ignored	Ignored	(Warn-ing/Trip)	–
27	Brake IGBT	X	X	–	–	Ignored	Ignored	Warning /Trip	–
28	Brake check	(X)	(X)	–	***Parameter 2-15 Brake Check***	Ignored	Ignored	(Warn-ing/Trip lock)	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
29	Power module temp	–	–	X	***Parameter 14-90.9 Fault Level***	Ignored	Ignored	Trip lock	X
30	U phase loss	(X)	(X)	(X)	Alternatively, ***parameter 4-58 Missing Motor Phase Function*** can be set to ***[0] Disable***.	Ignored	Ignored	Trip lock	–
		–	–	X	***Parameter 14-90.16 Fault Level***				
31	V phase loss	(X)	(X)	(X)	Alternatively, ***parameter 4-58 Missing Motor Phase Function*** can be set to ***[0] Disable***.	Ignored	Ignored	Trip lock	–
		–	–	X	***Parameter 14-90.16 Fault Level***				
32	W phase loss	(X)	(X)	(X)	Alternatively, ***parameter 4-58 Missing Motor Phase Function*** can be set to ***[0] Disable***.	Ignored	Ignored	Trip lock	–
		–	–	X	***Parameter 14-90.16 Fault Level***				
33	Inrush fault	–	X	X	–	Ignored	Ignored	Trip lock	X

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
34	Fieldbus fault	X	X	–	***Parameter 14-90.27 Fault Level***	Ignored	Ignored	Warning /Trip	–
35	Option fault	–	–	–	–	Ignored	Ignored	Warning	–
36	Mains failure	X	X	–	***Parameter 14-10 Mains Failure***, default ***[0] Off***	Ignored	Ignored	(Warn-ing/Trip)	–
37	Phase imbal-ance	–	X	–					
38	Internal fault	–	X	X	–	Ignored	Ignored	Trip/Trip lock	X
39	Heat sink sensor	–	X	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	X
40	Overload T27	(X)	–	–	***Parameter 5-00 Digital I/O Mode***, ***parameter 5-01 Terminal 27 Mode***	Ignored	Ignored	(Warn-ing)	–
41	Overload T29	(X)	–	–	***Parameter 5-00 Digital I/O Mode***, ***parameter 5-02 Terminal 29 Mode***	Ignored	Ignored	(Warn-ing)	–
42	Ovrld X30/6-7	(X)	–	–	–	–	–	–	–
43	Ext. supply (option)	X	–	–	–	–	–	–	–
45	Ground fault 2	X	X(1)	X	***Parameter 14-90.5 Fault Level***	Ignored	Ignored	Trip	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
46	Pwr. card supply	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
47	24 V supply low	X	X	X	*Parameter 14-90 Fault Settings*	Ignored	Ignored	Trip lock	–
48	1.2 V supply low	–	X	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	–
49	Speed limit	–	X	–	***Parameter 1-86 Trip Low Speed [RPM]***	Ignored	Ignored	Warning /(Trip)	–
50	AMA calibra-tion	–	X	–	–	Ignored	Ignored	Trip	–
51	AMA U_{nom},I_{nom}	–	X	–	–	Ignored	Ignored	Trip	–
52	AMA low I_{nom}	–	X	–	–	Ignored	Ignored	Trip	–
53	AMA big mo-tor	–	X	–	–	Ignored	Ignored	Trip	–
54	AMA small mot	–	X	–	–	Ignored	Ignored	Trip	–
55	AMA par. range	–	X	–	–	Ignored	Ignored	Trip	–
56	AMA inter-rupt	–	X	–	–	Ignored	Ignored	Trip	–
57	AMA time-out	–	X	–	–	Ignored	Ignored	Trip	–
58	AMA internal	X	X	–	–	Ignored	Ignored	Trip	–
59	Current limit	X	–	–	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Warning	–
60	External in-terlock	–	X	–	–	Ignored	Ignored	Warning	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
61	Tracking error	(X)	(X)	–	–	–	–	–	––
62	Output freq. lim.	X	–	–	–	Ignored	Ignored	Warning	–
63	Mech. brake low	–	(X)	–	–	–	–	–	–
64	Voltage limit	X	–	–	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Warning	–
65	Ctrl. card temp	X	X	X	***Parameter 14-90.11 Fault Level***	Ignored	Ignored	Trip lock	X
66	Low temp.	X	–	–	–	Ignored	Ignored	Warning	–
67	Option change	–	X	–	–	Ignored	Ignored	Trip	–
68	Safe stop	(X)	(X)(1)	–	***Parameter 5-19 Terminal 37 Safe Stop***	Trip	Trip	Trip	–
69	Pwr. card temp	–	X	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	X
70	Illegal FC config	–	–	X	–	Ignored	Ignored	Trip lock	–
71	PTC 1 safe stop	X	X(1)	–	–	Ignored	Ignored	Warning /Trip	–
72	Dangerous failure	–	–	X(1)	–	Ignored	Ignored	Trip lock	–
73	Safe stop auto restart	(X)	(X)	–	***Parameter 5-19 Terminal 37 Safe Stop***	Ignored	Ignored	(Warning/Trip)	–
76	Power unit setup	X	–	–	–	Ignored	Ignored	Warning	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
77	Reduced power mode	X	–	–	***Parameter 14-59 Actual Number of Inverter Units***	–	–	–	–
79	Illegal PS config	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
80	Drive initial-ized	–	X	–	–	Ignored	Ignored	Trip	–
81	CSIV corrupt	–	X	–	–	–	–	–	–
82	CSIV para-meter error	–	X	–	–	–	–	–	–
90	Feedback mon.	(X)	(X)	–	–	–	–	–	–
91	AI54 set wrong	–	–	X	–	Ignored	Ignored	Trip lock	–
92	No-flow	(X)	(X)	–	***Parameter 22-23 No-flow Function***	Ignored	Ignored	(Warn-ing/Trip)	–
93	Dry pump	(X)	(X)	(X)	***Parameter 22-26 Dry Pump Function***	Ignored	Ignored	(Warn-ing/Trip)	–
94	End of curve	(X)	(X)	(X)	***Parameter 22-50 End of Curve Function***	Ignored	Ignored	(Warn-ing/Trip)	–
95	Broken belt	(X)	(X)	(X)	***Parameter 22-60 Broken Belt Function***	Ignored	Ignored	(Warn-ing/Trip)	–
96	Start delayed	X	–	–	–	Ignored	Ignored	Warning	–
97	Stop delayed	X	–	–	–	Ignored	Ignored	Warning	–
98	Clock fault	(X)	(X)	(X)	–	Ignored	Ignored	Warning	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
99	Locked rotor	–	(X)	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip/Trip lock	–
100	Derag limit fault	–	–	–		Ignored	Ignored	–	
104	Mixing fans	X	X	–	***Parameter 14-53 Fan Monitor***	Ignored	Ignored	(Warning/Trip)	–
124	User alert	(X)	(X)	(X)	*Parameter group 13-9* User Defined Alerts*	Ignored	Ignored	(Warning/Trip)	–
129	I2C comm. failure	X	–	–	–	–	–	–	–
144	Inrush supply	–	–	–	–	–	–	–	–
145	Ext. SCR disable	–	X	–	–	–	–	–	–
146	Mains voltage	X	X	–	–	–	–	–	–
147	Mains frequency	X	X	–	–	–	–	–	–
148	System temp	X	X	–	–	–	–	–	–
161	Feedback not ready	X	–	–	–	–	–	–	–
162	Memory error	–	–	–	–	–	–	–	–
163	ATEX ETR cur.lim.warning	X	–	–	–	–	–	–	–
164	ATEX ETR cur.lim.alarm	–	X	–	–	–	–	–	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
165	ATEX ETR freq.lim.warning	X	–	–	–	–	–	–	–
166	ATEX ETR freq.lim.alarm	–	X	–	–	–	–	–	–
200	Emergency mode	–	–	–	–	Ignored	Ignored	Warning	–
201	Emerg. m was active	–	–	–	–	Ignored	Ignored	Warning	–
202	Emerg. m limits exceeded	X	–	X	–	Ignored	Ignored	Warning	–
217	Protection mode	X	–	–	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Warning	–
219	Pump interlock	X	–	–	–	Ignored	Ignored	Warning	–
220	Overload trip	–	X	–	–	–	–	–	–
221	Bypass interlock	–	X	–	–	–	–	–	–
222	M2 open failed	–	–	X	–	–	–	–	–
223	M2 close failed	–	–	X	–	–	–	–	–
224	M3 open failed	–	–	X	–	–	–	–	–
225	Overload X59/3-6	X	–	–	–	–	–	–	–
226	M3 close failed	–	–	X	–	–	–	–	–
227	Bypass com error				–	–	–	–	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
228	APU low voltage	X	–	–	–	–	–	–	–
229	Motor dis-conn.	X	–	–	–	–	–	–	–
230	Read failed	–	X	–	–	–	–	–	–
231	Read com-plete	–	X	–	–	–	–	–	–
232	Read in progress	–	X	–	–	–	–	–	–
239	SAS file in-valid	–	X	–	–	–	–	–	–
240	Write failed	–	X	–	–	–	–	–	–
241	Write com-plete	–	X	–	–	–	–	–	–
242	Write in progress	–	X	–	–	–	–	–	–
243	Brake IGBT	(X)	(X)	(X)	***Parameter 2-13 Brake Power Monitoring***, default ***[0] Off***	Ignored	Ignored	Warning /Trip	–
244	Heat sink temp	–	–	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	X
245	Heat sink sensor	–	–	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	X
246	Pwr. card supply	–	–	X	–	Ignored	Ignored	Trip/Trip lock	–
247	Pwr. card temp	–	–	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	X
248	Illegal PS config	–	–	X	–	Ignored	Ignored	Trip/Trip lock	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
249	Rect. low temp.	X	–	–	–	–	–	–	––
250	New spare part	–	–	X	–	Ignored	Ignored	Trip lock	–
251	New type code	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
252	X49/7 overload	–	–	–	–	–	–	–	–
253	X49/9 overload	–	–	–	–	–	–	–	–
254	X49/11 overload	–	–	–	–	–	–	–	–
258	Missing motor	–	–	–	–	–	–	–	–
259	Pump failed	–	–	–	–	–	–	–	–
260	AMA complete	–	X	–	***Parameter 1-29 AMA*** configured via fieldbus and started via fieldbus control word.	Ignored	Ignored	–	–
273	BTM error	–	–	–	–	–	–	–	–
274	Flow not confirmed	–	–	–	–	–	–	–	–
275	Flow switch failure	–	–	–	–	–	–	–	–
276	Totalized vol. overflow	–	–	–	–	–	–	–	–
277	Actual vol. overflow	–	–	–	–	–	–	–	–
280	Emcy m service warning	X	–	–	–	–	–	–	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
281	Emcy OPR unexpected	X	–	–	–	–	–	–	–
290	Connection to one master is lost	X	–	–	–	–	–	–	–
300	Mains cont. fault	–	–	X	***Parameter 14-90 Fault Settings***	Ignored	Ignored	Trip lock	–
301	SC cont. fault	–	–	–	–	–	–	–	–
421	FPC temp	–	X	–	–	–	–	–	–
423	FPC updating	–	X	–	–	–	–	–	–
424	FPC update success	–	X	–	–	–	–	–	–
425	FPC update failure	–	–	X	–	–	–	–	–
426	FPC config	–	–	X	–	–	–	–	–
427	FPC supply	–	X	–	–	–	–	–	–
432	Inrush mode error	–	X	–	–	–	–	–	–
500[(2), (3)]	Stator S2	(X)	(X)	–	***Parameter 45-00.0 Function***	Ignored	Ignored	Ignored	–
501	Load S2	(X)	(X)	–	***Parameter 45-00.1 Function***	Ignored	Ignored	Ignored	–
502	Sensor 1 S2	(X)	(X)	–	***Parameter 45-00.2 Function***	Ignored	Ignored	Ignored	–
503	Sensor 2 S2	(X)	(X)	–	***Parameter 45-00.3 Function***	Ignored	Ignored	Ignored	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
504	Sensor 3 S2	(X)	(X)	–	***Parameter 45-00.4 Function***	Ignored	Ignored	Ignored	–
505	Sensor 4 S2	(X)	(X)	–	***Parameter 45-00.5 Function***	Ignored	Ignored	Ignored	–
506	Load low S2	(X)	(X)	–	***Parameter 45-00.1 Function***	Ignored	Ignored	Ignored	–
510	Stator	(X)	(X)	–	***Parameter 45-00.0 Function***	Ignored	Ignored	Ignored	–
511	Load	(X)	(X)	–	***Parameter 45-00.1 Function***	Ignored	Ignored	Ignored	–
512	Sensor 1	(X)	(X)	–	***Parameter 45-00.2 Function***	Ignored	Ignored	Ignored	–
513	Sensor 2	(X)	(X)	–	***Parameter 45-00.3 Function***	Ignored	Ignored	Ignored	–
514	Sensor 3	(X)	(X)	–	***Parameter 45-00.4 Function***	Ignored	Ignored	Ignored	–
515	Sensor 4	(X)	(X)	–	***Parameter 45-00.5 Function***	Ignored	Ignored	Ignored	–
516	Load low	(X)	(X)	–	***Parameter 45-00.1 Function***	Ignored	Ignored	Ignored	–
520	Stator thld at max/min	(X)	–	–	–	–	–	–	–
521	Load thld at max/min	(X)	–	–	–	–	–	–	–

Table 77: Alarm/Warning Code List (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in *parameter 24-09 Emergency Mode Alarm Handling*. Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
522	Sensor 1 thld at max/min	(X)	–	–	–	–	–	–	–
523	Sensor 2 thld at max/min	(X)	–	–	–	–	–	–	–
524	Sensor 3 thld at max/min	(X)	–	–	–	–	–	–	–
525	Sensor 4 thld at max/min	(X)	–	–	–	–	–	–	–
550	Sensor 1 low	(X)	(X)	–	***Parameter 45-00.2 Function***	Ignored	Ignored	Ignored	–
551	Sensor 2 low	(X)	(X)	–	***Parameter 45-00.3 Function***	Ignored	Ignored	Ignored	–
552	Sensor 3 low	(X)	(X)	–	***Parameter 45-00.4 Function***	Ignored	Ignored	Ignored	–
553	Sensor 4 low	(X)	(X)	–	***Parameter 45-00.5 Function***	Ignored	Ignored	Ignored	–
600	Thread tim-ing	–	–	–	–	–	–	–	–

*1) Cannot be auto reset via **parameter 14-20 Reset Mode**.*

2) All warnings and alarms from 500–525 require a CBM license.

3) All CBM warnings and alarms have warning and alarm/trip, where warning is default if the CBM license is installed and monitoring is enabled.

A trip is the action following an alarm. The trip coasts the motor and is reset by pressing [Reset] or by a digital input (*parameter group 5-1* Digital Inputs*). The original event that caused an alarm cannot damage the drive or cause dangerous conditions.

A trip lock is an action when an alarm occurs, which could damage the drive or connected parts. A trip lock situation can only be reset by cycling power.

6.1.3 Indicator Light

Table 78: Indicator Light

Warning	Yellow
Alarm	Flashing red
Trip locked	Yellow and red

6.1.4 Alarm Word, Warning Word, and Extended Status Word

Table 79: Description of Alarm Word

Bit	Hex	Dec	Alarm word	Alarm word 2	Alarm word 3
			Parameter 16-90 Alarm Word	*Parameter 16-91 Alarm Word 2*	*Parameter 16-97 Alarm Word 3*
0	00000001	1	Brake check (A28)	Servicetrip, read/ write	Temp. input error
1	00000002	2	Pwr.card temp (A69)	Servicetrip, (re- served)	Memory module fault
2	00000004	4	Ground fault (A14)	Servicetrip, typecode/spare part	Internal fan error
3	00000008	8	Ctrl.card temp (A65)	Servicetrip, (re- served)	Sync. fault
4	00000010	16	Ctrl. word TO (A17)	Servicetrip, (re- served)	OPM fault
5	00000020	32	Overcurrent (A13)	Reserved	–
6	00000040	64	Torque limit (A12)	Reserved	Profibus converter invalid
7	00000080	128	Motor th over (A11)	Reserved	–
8	00000100	256	Motor ETR over (A10)	Reserved	–
9	00000200	512	Inverter overld. (A9)	Reserved	–
10	00000400	1024	DC undervolt (A8)	Reserved	–
11	00000800	2048	DC overvolt (A7)	Reserved	–
12	00001000	4096	Short circuit (A16)	Reserved	–
13	00002000	8192	Inrush fault (A33)	Reserved	–
14	00004000	16384	Mains ph. loss (A4)	Reserved	–
15	00008000	32768	AMA not OK	Reserved	–
16	00010000	65536	Live zero error (A2)	Reserved	–

Table 79: Description of Alarm Word (continued)

Bit	Hex	Dec	Alarm word	Alarm word 2	Alarm word 3
			Parameter 16-90 Alarm Word	*Parameter 16-91 Alarm Word 2*	*Parameter 16-97 Alarm Word 3*
17	00020000	131072	Internal fault (A38)	KTY error	–
18	00040000	262144	Brake overload (A26)	Fans error	–
19	00080000	524288	U phase loss (A30)	ECB error	–
20	00100000	1048576	V phase loss (A31)	Reserved	–
21	00200000	2097152	W phase loss (A32)	Reserved	–
22	00400000	4194304	Fieldbus fault (A34)	Reserved	–
23	00800000	8388608	24 V supply low (A47)	Reserved	–
24	01000000	16777216	Mains failure (A36)	Reserved	–
25	02000000	33554432	1.8 V supply low (A48)	Reserved	Emergency mode
26	04000000	67108864	Brake resistor (A25)	Reserved	Sensor 4
27	08000000	134217728	Brake IGBT (A27)	Reserved	Sensor 3
28	10000000	268435456	Option change (A67)	Reserved	Sensor 2
29	20000000	536870912	Drive initialized (A80)	Feedback fault (A61, A90)	Sensor 1
30	40000000	1073741824	Safe stop (A68)	PTC 1 Safe Stop (A71)	Load
31	80000000	2147483648	Mech. brake low (A63	Dangerous failure (A72)	Stator

Table 80: Description of Warning Word

Bit	Hex	Dec	Warning word	Warning word 2	Warning word 3
			Parameter 16-92 Warning Word	*Parameter 16-93 Warning Word 2*	*Parameter 16-98 Warning Word 3*
0	00000001	1	Brake check (W28)	Start delayed	Temp. input error
1	00000002	2	Pwr.card temp (A69)	Stop delayed	–
2	00000004	4	Earth fault (W14)	Reserved	Internal fan warn-ing
3	00000008	8	Ctrl.card temp (W65)	Reserved	–

Table 80: Description of Warning Word (continued)

Bit	Hex	Dec	Warning word	Warning word 2	Warning word 3
			Parameter 16-92 Warning Word	*Parameter 16-93 Warning Word 2*	*Parameter 16-98 Warning Word 3*
4	00000010	16	Ctrl. word TO (W17)	–	–
5	00000020	32	Overcurrent (W13)	Reserved	Test MOC function
6	00000040	64	Torque limit (W12)	Reserved	Profibus converter time warning
7	00000080	128	Motor th over (W11)	Reserved	EmcymodeActive
8	00000100	256	Motor ETR over (W10)	Reserved	EmcymodeHas-BeenActive
9	00000200	512	Inverter Overld (W9)	Discharge high	EmcymodeLimits active
10	00000400	1024	DC under volt (W8)	Multi-motor under-load	EmcymodeSer-viceRequest due to limits
11	00000800	2048	DC over volt (W7)	Multi-motor over-load	Emcymode-NotRedyToOperate
12	00001000	4096	DC voltage low (W6)	Compressor inter-lock	CBM Reserved
13	00002000	8192	DC voltage high (W5)	Mechanical brake sliding	CBM Reserved
14	00004000	16384	Mains ph. loss (W4)	Safe option warn-ing	CBM Reserved
15	00008000	32768	No motor (W3)	Auto DC braking	CBM Reserved
16	00010000	65536	Live zero error (W2)		CBM Reserved
17	00020000	131072	10 V low (W1)	KTY warn	CBM Reserved
18	00040000	262144	Brake overload (W26)	Fans warn	Load low S2
19	00080000	524288	Brake resistor (W25)	ECB warn	Load low
20	00100000	1048576	Brake IGBT (W27)	Hoist mechanical brake (W22)	Sensor 4 S2
21	00200000	2097152	Speed limit (W49)	Reserved	Sensor 4
22	00400000	4194304	Fieldbus fault (W34)	Reserved	Sensor 3 S2
23	00800000	8388608	24 V supply low (W47)	Reserved	Sensor 3

Table 80: Description of Warning Word (continued)

Bit	Hex	Dec	Warning word	Warning word 2	Warning word 3
			Parameter 16-92 Warning Word	*Parameter 16-93 Warning Word 2*	*Parameter 16-98 Warning Word 3*
24	01000000	16777216	Mains failure (W36)	Reserved	Sensor 2 S2
25	02000000	33554432	Current limit (W59)	Power Limit Motor	Sensor 2
26	04000000	67108864	Low temp (W66)	Power Limit Gener-ator	Sensor 1 S2
27	08000000	134217728	Voltage limit (W64)	Reserved	Sensor 1
28	10000000	268435456	Encoder loss (W90)	Reserved	Load S2
29	20000000	536870912	Output freq. lim. (W62)	BackEMF too high	Load
30	40000000	1073741824	Safe stop (W68)	PTC thermistor (W74)	Stator S2
31	80000000	2147483648	Extended status word	–	Stator

Table 81: Description of Extended Status Word

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter 16-94 Ext. Status Word	*Parameter 16-95 Ext. Status Word 2*	*Parameter 16-99 Ext. Status Word 3*
Extended Status Word					
0	00000001	1	Ramping	Off	High pressure stop
1	00000002	2	AMA running	Hand/auto	Low pressure stop
2	00000004	4	Start CW/CCW start_possible is ac-tive, when the DI selections [12] OR [13] are active and the requested di-rection matches the reference sign	–	Defrost
3	00000008	8	Slow down slow down com-mand active, for ex-ample via CTW bit 11 or DI	–	Pre/post lube

Table 81: Description of Extended Status Word (continued)

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter 16-94 Ext. Status Word	*Parameter 16-95 Ext. Status Word 2*	*Parameter 16-99 Ext. Status Word 3*
4	00000010	16	Catch up catch up command active, for example via CTW bit 12 or DI	–	User-defined alerts
5	00000020	32	Feedback high feedback >***parameter 4-57 Warning Feedback High***	Relay 123 active	–
6	00000040	64	Feedback low feedback <***parameter 4-56 Warning Feedback Low***	Start prevented	–
7	00000080	128	Output current high current >***parameter 4-51 Warning Current High***	Control ready	–
8	00000100	256	Output current low current <***parameter 4-50 Warning Current Low***	Drive ready	–
9	00000200	512	Output freq high speed >***parameter 4-53 Warning Speed High***	Quick stop	–
10	00000400	1024	Output freq low speed <***parameter 4-52 Warning Speed Low***	DC brake	–
11	00000800	2048	Brake check OK Brake test NOT OK	Stop	–
12	00001000	4096	Braking max. BrakePower > ***parameter 2-12 Brake Power Limit [kW]***	Standby	–

Table 81: Description of Extended Status Word (continued)

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter 16-94 Ext. Status Word	*Parameter 16-95 Ext. Status Word 2*	*Parameter 16-99 Ext. Status Word 3*
13	00002000	8192	Braking	Freeze output request	–
14	00004000	16384	Out of speed range	Freeze output	–
15	00008000	32768	OVC active	Jog request	–
16	00010000	65536	AC brake	Jog	–
17	00020000	131072	Password timelock number of allowed password trials exceeded - timelock active	Start request	–
18	00040000	262144	Password protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY	Start	–
19	00080000	524288	Reference high reference >***parameter 4-55 Warning Reference High***	Start applied	–
20	00100000	1048576	Reference low Reference < ***parameter 4-54 Warning Reference Low***	Start delay	–
21	00200000	2097152	Local reference Reference site = REMOTE -> auto on pressed & active	Sleep	–
22	00400000	4194304	Protection mode	Sleep boost	–
23	00800000	8388608	Unused	Running/pipe filling	–
24	01000000	16777216	Unused	Drive bypass	–
25	02000000	33554432	Unused	Emergency mode	–
26	04000000	67108864	Unused	Reserved	–

Table 81: Description of Extended Status Word (continued)

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter 16-94 Ext. Status Word	*Parameter 16-95 Ext. Status Word 2*	*Parameter 16-99 Ext. Status Word 3*
27	08000000	134217728	Unused	Reserved	–
28	10000000	268435456	Unused	Reserved	–
29	20000000	536870912	Unused	Reserved	–
30	40000000	1073741824	Unused	Reserved	–
31	80000000	2147483648	Unused	Reserved	–

The alarm words, warning words and extended status words can be read out via a serial bus or optional fieldbus for diagnostics. See also ***parameter 16-94 Ext. Status Word***.

6.2 Descriptions of Warnings and Alarms

Warning 1, 10 Volts Low

Cause

The control card voltage is less than 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or incorrect wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50.
- If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live Zero Error

Cause

This warning or alarm only appears if programmed in ***parameter 6-01 Live Zero Timeout Function***. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform the input terminal signal test.

WARNING 3, No Motor

Cause

No motor is connected to the output of the drive.

Troubleshooting

- Check the cable connection between the drive and the motor.

WARNING/ALARM 4, Mains Phase Loss

Cause

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in ***parameter 14-12 Response to Mains Imbalance***.

Troubleshooting

- Check the supply voltage and supply currents to the drive.

Warning 5, DC Link Voltage High

Cause

The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

Warning 6, DC Link Voltage Low

Cause

The DC-link voltage (DC) is lower than the low-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

WARNING/ALARM 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.

WARNING/ALARM 8, DC Under Voltage

Cause

If the DC-link voltage (DC-link) drops below the under-voltage limit, the drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the drive voltage.
- Perform the input voltage test.
- Perform the soft charge circuit test.

WARNING/ALARM 9, Inverter Overload

Cause

The drive is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 90% and trips at 100%, while giving an alarm. The drive cannot be reset until the counter is below 90%.

The fault occurs when the drive has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the LCP with the drive rated current.
- Compare the output current shown on the LCP with the measured motor current.

- Show the thermal drive load on the LCP and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor ETR Overtemperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the drive issues a warning or an alarm when the counter reaches 100% in ***parameter 1-90 Motor Thermal Protection***. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in ***parameter 1-24 Motor Current*** is correct.
- Ensure that the motor data in ***parameter 1-20*** to ***parameter 1-25*** is set correctly.
- Running AMA in ***parameter 1-29 Automatic Motor Adaptation (AMA)*** tunes the drive to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor Thermistor Overtemperature

Cause

Check whether the thermistor is disconnected. Select whether the drive issues a warning or an alarm in ***parameter 1-90 Motor Thermal Protection***.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that ***parameter 1-93 Thermistor Resource*** selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in ***parameter 1-93 Thermistor Resource***.

WARNING/ALARM 12, Torque Limit

Cause

The torque has exceeded the value in ***parameter 4-16 Torque Limit Motor Mode*** or the value in ***parameter 4-17 Torque Limit Generator Mode***. ***Parameter 14-25 Trip Delay at Torque Limit*** can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 5 s, then the drive trips and issues an alarm. Shock loading or fast acceleration with high-inertia loads can cause this fault.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check ***parameters 1-20 to 1-25*** for correct motor data.

ALARM 14, Ground Fault

Cause

There is current from the output phases to ground, either in the cable between the drive and the motor or in the motor itself.

Troubleshooting

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a meg-ohmmeter.

Alarm 15, Hardware Mismatch

Cause

A fitted option is not operational with the present control card hardware or software.

Troubleshooting

- Record the values of the following parameters and contact Danfoss.
  - **a.** ***Parameter 15-40 FC Type***
  - **b.** ***Parameter 15-41 Power Section***
  - **c.** ***Parameter 15-42 Voltage***
  - **d.** ***Parameter 15-43 Software Version***
  - **e.** ***Parameter 15-45 Actual Typecode String***
  - **f.** ***Parameter 15-49 SW ID Control Card***
  - **g.** ***Parameter 15-50 SW ID Power Card***
  - **h.** ***Parameter 15-60 Option Mounted***
  - **i.** ***Parameter 15-61 Option SW Version*** (for each option slot).

ALARM 16, Short Circuit

Cause

There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove power to the drive and repair the short circuit.

WARNING/ALARM 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when ***parameter 8-04 Control Word Timeout Function*** is NOT set to ***[0] Off***. If ***parameter 8-04 Control Word Timeout Function*** is set to ***[5] Stop and Trip***, a warning appears. The drive then ramps down until it trips, while giving an alarm. ***Parameter 8-03 Control Timeout Time*** could possibly be increased.

Troubleshooting

- Check connections on the serial communication cable.
- Increase ***parameter 8-03 Control Word Timeout Time***.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 18, Start Failed

Cause

The speed cannot exceed the value set in ***parameter 1-78 Compressor Start Max Speed [Hz]*** during start within the allowed time, which is set in ***parameter 1-79 Compressor Start Max Time to Trip***. The alarm may be caused by a blocked motor.

Troubleshooting

- Check if the motor is blocked.
- Check if the start max speed is set higher than the working speed after ramp up.
- Check if the start max time to trip is set shorter than the normal ramp up time.

WARNING/ALARM 20, Temp. Input Error

Cause

The temperature detected by VLT® Sensor Input Option MCB 114 exceeds the limit.

This warning/alarm is only active when ***[5] Stop and trip*** is selected in ***parameter 35-06 Temperature Sensor Alarm Function***.

Troubleshooting

- Check the settings of the following parameters:
  - **a.** ***parameter group 35-1* Temp. Input X48/4***
  - **b.** ***parameter group 35-2* Temp. Input X48/7***
  - **c.** ***parameter group 35-3* Temp. Input X48/10***
- Check the feedback temperature from the following parameters:
  - **a.** ***parameter 18-37 Temp. Input X48/4***
  - **b.** ***parameter 18-38 Temp. Input X48/7***
  - **c.** ***parameter 18-39 Temp. Input X48/10***

Warning/Alarm 21, Parameter Error

Cause

The parameter is out of range. The parameter number is shown in the display.

Troubleshooting

- Set the affected parameter to a valid value.

Warning 23, Internal Fan Fault

Cause

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in ***parameter 14-53 Fan Monitor*** by selecting ***[0] Disabled***.

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this warning appears. For drives with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Cycle for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the control card.

Warning 24, External Fan Fault

Cause

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in ***parameter 14-53 Fan Monitor*** by selecting ***[0] Disabled***.

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this warning appears. For drives with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the heat sink.

WARNING 25, Brake Resistor Short-circuited

Cause

The brake resistor is monitored during start-up. If a short circuit occurs, the brake function is disabled and the alarm appears. The drive is tripped.

Troubleshooting

- Remove the power to the drive and check the connection of the brake resistor.

WARNING/ALARM 26, Brake Resistor Power Limit

Cause

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in ***parameter 2-11 Brake Resistor (ohm)***. The warning is active when the dissipated braking power is higher than the value set in ***parameter 2-12 Brake Power Limit (kW)***. The drive trips if the warning persists for 1200 s.

Troubleshooting

- Decrease brake energy via lower speed or longer ramp time.

ALARM 27, Brake IGBT/Brake Chopper Short-circuited

Cause

The brake transistor is monitored during start-up. If a short circuit occurs, the brake function is disabled, and an alarm is issued. The drive is tripped.

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

ALARM 28, Brake Check

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check if brake resistor is connected or it is too large for the drive.

ALARM 29, Power Module Temp

Cause

The maximum temperature of the heat sink is exceeded. The temperature fault is not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different, based on the drive power size.

Troubleshooting

Check for the following conditions:

- The ambient temperature is too high.
- The motor cables are too long.
- Incorrect airflow clearance above and below the drive.
- Blocked airflow around the drive.
- Damaged heat sink fan.
- Dirty heat sink.

ALARM 30, Motor Phase U Missing

Cause

Motor phase U between the drive and the motor is missing.

Troubleshooting

- Remove power from the drive and check motor phase U.

ALARM 31, Motor Phase V Missing

Cause

Motor phase V between the drive and the motor is missing.

Troubleshooting

- Remove power from the drive and check motor phase V.

ALARM 32, Motor Phase W Missing

Cause

Motor phase W between the drive and the motor is missing.

Troubleshooting

- Remove power from the drive and check motor phase W.

ALARM 33, Inrush Fault

Cause

Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.
- Check potential DC-link fault to ground.

WARNING/ALARM 34, Fieldbus Fault

Cause

The fieldbus on the communication option card is not working.

Troubleshooting

- Check the fieldbus communication option card.

ALARM 35, Option Fault

Cause

Fieldbus or option B detects internal faults.

Troubleshooting

- Contact the local supplier.

WARNING/ALARM 36, Mains Failure

Cause

This warning/alarm is only active if the supply voltage to the drive is lost and ***parameter 14-10 Mains Failure*** is not set to ***[0] No function***.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

ALARM 37, Phase Imbalance

Cause

There is a current imbalance between the power units.

ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number is shown.

Table 82: Internal Fault List

Fault number	Cause	Solution
140–142	Power board EEPROM data error	Upgrade the software in the drive to the latest version.
176	The firmware in the drive does not match the drive.	Upgrade the software in the drive to the latest version.
256	Flash ROM check-sum error.	Upgrade the software in the drive to the latest version.
2304	Firmware mismatch between the control card and the power card.	Upgrade the software in the drive to the latest version.
2560	Communication error between the control card and the power card.	Upgrade the software in the drive to the latest version. If the alarm occurs again, check the connection between the control card and the power card.
3840	Serial flash version error.	Upgrade the software in the drive to the latest version.
4608	Drive power size error.	Upgrade the software in the drive to the latest version. If the alarm occurs again, contact a Danfoss supplier.
5632	Option hardware version error.	The hardware version of the option or the fieldbus variant is not compatible with the drive software.
5888	Option software version error.	The software version of the option or the fieldbus variant is not compatible with the drive software. Change either the fieldbus software or the drive software.
6144	The option is not supported.	Check if the product supports this option.
6400	Option combination error.	Remove the option.
Other	Other internal faults.	Power cycle the drive. If the alarm occurs again, contact a Danfoss supplier.

Troubleshooting

- See the above table for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

ALARM 39, Heat Sink Sensor

Cause

There is no feedback from the heat sink temperature sensor. The signal from the IGBT thermal sensor is not available on the power card.

Troubleshooting

- Check the ribbon cable between the power card and the gate drive card.
- Check for a defective power card.
- Check for a defective gate drive card.

WARNING 40, Overload T27

Troubleshooting

- Check the load connected to terminal 27 or remove the short-circuit connection.
- Check ***parameter 5-00 Digital I/O Mode*** and ***parameter 5-01 Terminal 27 Mode***.

WARNING 41, Overload T29

Troubleshooting

- Check the load connected to terminal 29 or remove the short-circuit connection.
- Check ***parameter 5-00 Digital I/O Mode*** and ***parameter 5-02 Terminal 29 Mode***.

WARNING 42, Ovrld X30/6-7

Troubleshooting, X30/6

- Check the load connected to the terminal or remove the short-circuit connection.
- Check ***parameter 5-32 Term X30/6 Digi Out (MCB 101)***(VLT® General Purpose I/O MCB 101).

Troubleshooting, X30/7

- Check the load connected to the terminal or remove the short-circuit connection.
- Check ***parameter 5-33 Term X30/7 Digi Out (MCB 101)***(VLT® General Purpose I/O MCB 101).

WARNING 43, Ext. Supply

Cause

VLT® Extended Relay Option MCB 113 is mounted without 24 V DC. Select 1 of the options in the troubleshooting list.

Troubleshooting

- Connect a 24 V DC external supply.
- Specify that no external supply is used via ***parameter 14-80 Option Supplied by External 24VDC*** set to ***[0] No***. A change in ***parameter 14-80 Option Supplied by External 24VDC*** requires a power cycle.

ALARM 45, Earth (Ground) Fault 2

Cause

A ground fault has occurred.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

ALARM 46, Power Card Supply

Cause

The supply on the power card is out of range. Another reason can be a defective heat sink fan. There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ±18 V.

When powered with VLT® 24 V DC Supply MCB 107, only 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.

- Check for a defective option card.
- If 24 V DC is used, verify proper supply power.
- Check for a defective heat sink fan.

WARNING/ALARM 47, 24 V Supply Low

Cause

The 24 V DC is measured on the control card.

Troubleshooting

- Check for a defective control card.

ALARM 48, 1.8 V Supply Low

Cause

The 1.8 V DC supply used on the control card is outside of the allowed limits. The supply is measured on the control card.

Troubleshooting

- Check for a defective control card.
- If an option is installed, check for overvoltage.

WARNING 49, SPEED LIMIT

Cause

The warning is shown when the speed is outside of the specified range in ***parameter 4-12 Motor Speed Low Limit [Hz]*** and ***parameter 4-14 Motor Speed High Limit [Hz]***.

Troubleshooting

- Check if the system ran outside of the speed range.
- Check if ***parameter 4-12 Motor Speed Low Limit [Hz]*** and ***parameter 4-14 Motor Speed High Limit [Hz]*** are set correctly..

ALARM 50, AMA Calibration

Cause

A calibration error has occurred.

Troubleshooting

- Contact a Danfoss supplier or the Danfoss service department.

ALARM 51, AMA check U_{nom} and I_{nom}

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check the settings in ***parameter 1-20*** to ***parameter 1-25***.

ALARM 52, AMA Low I_{nom}

Cause

The motor current is too low.

Troubleshooting

- Check the setting in ***parameter 1-24 Motor Current***.

ALARM 53, AMA Big Motor

Cause

The power size of the motor is too large for the AMA to operate.

Troubleshooting

- Check the settings in ***parameter group 1-2* Motor Data***.

ALARM 54, AMA Small Motor

Cause

The power size of the motor is too small for the AMA to operate.

Troubleshooting

- Check the settings in ***parameter group 1-2* Motor Data***.

ALARM 55, AMA Parameter Range

Cause

The parameter values of the motor are outside of the acceptable range. The AMA does not run.

Troubleshooting

- Check the settings in ***parameter group 1-2* Motor Data***.

ALARM 56, AMA Interrupted

Cause

The AMA is manually interrupted.

Troubleshooting

- Re-run the AMA calibration.

ALARM 57, AMA Timeout

Cause

AMA timeout.

Troubleshooting

- Try to restart the AMA. Repeated restarts can overheat the motor.

ALARM 58, AMA Internal Fault

Cause

An AMA internal fault occurs.

Troubleshooting

- Contact a local Danfoss supplier.

WARNING/ALARM 59, Current Limit

Cause

The current is higher than the value in ***parameter 4-18 Current Limit***.

Troubleshooting

- Ensure that the motor data in ***parameter 1-20*** to ***parameter 1-25*** is set correctly.
- Possibly increase the current limit.
- Be sure that the system can operate safely at a higher limit.

ALARM 60, External Interlock

Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

WARNING/ALARM 61, Feedback Error

Cause

An error between calculated speed and speed measurement from feedback device.

Troubleshooting

- Check the settings for warning/alarm/disabling in ***parameter 4-30 Motor Feedback Loss Function***.
- Set the tolerable error in ***parameter 4-31 Motor Feedback Speed Error***.
- Set the tolerable feedback loss time in ***parameter 4-32 Motor Feedback Loss Timeout***.

WARNING/ALARM 62, Output Frequency Limit

Cause for Flux Mode

If the output frequency reaches the value set in ***parameter 4-19 Max Output Frequency***, the drive issues a warning. The warning ceases when the output drops below the maximum limit. If the drive is unable to limit the frequency, it trips and issues an alarm. The latter may happen in the Flux mode if the drive loses control of the motor.

Troubleshooting for Flux Mode

- Check the application for possible causes. The load torque could be too significant to drag the motor run to a high speed.
- Increase the output frequency limit. Ensure that the system can operate safely at a higher output frequency.

Cause for VVC TCL Mode

The output speed limit is reached, and the torque reference is derated. If the system is designed to reduce the speed by speed limit function, the warning only means that the speed limit is active.

Troubleshooting for VVC TCL Mode

- The system speed exceeds the speed limit, in this case, adjust the system speed or adjust the speed limit.
- If the speed limit function is used to control system speed, the warning can be ignored.

ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

WARNING 64, VOLTAGE LIMIT

Cause

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

Troubleshooting

- Check if the mains input is not high enough.
- Check if the output frequency is too high above motor nominal frequency.

WARNING/ALARM 65, Control Card Over Temperature

Cause

The cutout temperature of the control card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check the fan operation.
- Check the control card.

Warning 66, Heat Sink Temperature Low

Cause

The drive is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Troubleshooting

- Increase the ambient temperature of the unit.
- Supply a trickle amount of current to the drive whenever the motor is stopped by setting ***parameter 2-00 DC Hold/Preheat Current*** to 5% and ***parameter 1-80 Function at Stop***.

ALARM 67, Option Module Configuration Has Changed

Cause

One or more options have either been added or removed since the last power-down.

Troubleshooting

- Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop Activated

Cause

The Safe Torque Off (STO) has been activated.

Troubleshooting

- To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal via bus, digital I/O, or by pressing [Reset].

WARNING/ALARM 69, Power Card Temperature

Cause

The cutout temperature of the power card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check fan operation.
- Check the power card.

ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the Danfoss supplier with the type code from the unit nameplate and the part numbers on the cards.

ALARM 71, PTC 1 Safe Stop

Cause

Because the motor is too warm, the VLT® PTC Thermistor Card MCB 112 activated Safe Torque Off (STO).

Troubleshooting

- Once the motor temperature reaches an acceptable level, and the digital input from MCB 112 is deactivated, perform 1 of the following:
  - Send a reset signal via bus or digital I/O.
  - Press [Reset].

ALARM 72, Dangerous Failure

Cause

Safe Torque Off (STO) with trip lock. An unexpected combination of STO commands has occurred.

Troubleshooting

- VLT® PTC Thermistor Card MCB 112 enables X44/10, but STO is not enabled.
- MCB 112 is the only device using STO (specified via ***[4] PTC 1 alarm*** or ***[5] PTC 12 warning*** in ***parameter 5-19 Terminal 37 Safe Stop***). STO is activated, but X44/10 is not.

WARNING 73, Safe Stop Auto Restart

Cause

STO is activated.

Troubleshooting

- With automatic restart enabled, the motor can start when the fault is cleared.

WARNING 76, Power Unit Setup

Cause

The required number of power units does not match the detected number of active power units.

Troubleshooting

- When replacing a drive module, this warning can occur if the power-specific data in the module power card does not match the rest of the drive. Confirm that the spare part and its power card are the correct code number.

WARNING 77, Reduced Power Mode

Cause

The drive is operating in reduced power mode (less than allowed number of inverter sections). The warning is generated on power cycle when the drive is set to run with fewer inverters and remains on.

ALARM 79, Illegal Power Section Configuration

Cause

The scaling card has an incorrect code number or is not installed. The MK102 connector on the power card could not be installed.

ALARM 80, Drive Initialized to Default Value

Cause

Parameter settings are initialized to default settings after a manual reset.

Troubleshooting

- To clear the alarm, reset the unit.

ALARM 81, CSIV Corrupt

Cause

The CSIV file has syntax errors.

ALARM 82, CSIV Parameter Error

Cause

CSIV failed to initialize a parameter.

ALARM 90, Feedback Monitor

Troubleshooting

- Check the connection to the encoder/resolver option and, if necessary, replace the VLT® Encoder Input MCB 102 or VLT® Resolver Input MCB 103.

ALARM 91, Analog Input 54 Wrong Settings

Troubleshooting

- Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

WARNING/ALARM 92, No Flow

Cause

A no-flow condition has been detected in the system. ***Parameter 22-23 No-Flow Function*** is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the drive after the fault has been cleared.

WARNING/ALARM 93, Dry Pump

Cause

A no-flow condition in the system with the drive operating at high speed may indicate a dry pump. ***Parameter 22-26 Dry Pump Function*** is set for warning or alarm.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING/ALARM 94, End of Curve

Cause

Feedback is lower than the set point. This may indicate a leakage in the system. ***Parameter 22-50 End of Curve Function*** is set for warning or alarm.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING/ALARM 95, Broken Belt

Cause

Torque is below the torque level set for no load, indicating a broken belt. ***Parameter 22-60 Broken Belt Function*** is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the drive after clearing the fault.

WARNING 96, Start Delayed

Cause

Motor start has been delayed due to short-cycle protection. ***Parameter 22-76 Inverval between Starts*** is enabled.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING 97, Stop Delayed

Cause

Stopping the motor has been delayed due to short-cycle protection. ***Parameter 22-76 Interval between Starts*** is enabled.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING 98, Clock Fault

Cause

Time is not set or the RTC clock has failed.

Troubleshooting

- Reset the clock in ***parameter 0-70 Date and Time***.

ALARM 99, Locked Rotor

Cause

The rotor is blocked. It is only enabled for PM motor control.

Troubleshooting

- Check if the motor shaft is locked.
- Check if the start current triggers the current limit set in ***parameter 4-18 Current Limit***.
- Check if it increases the value in ***parameter 30-23 Locked Rotor Detection Time [s]***.

WARNING/ALARM 104, Mixing Fan Fault

Cause

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing fan fault can be configured as a warning or an alarm in ***parameter 14-53 Fan Monitor***.

Troubleshooting

- Cycle power to the drive to determine if the warning/alarm returns.

ALARM 144, Inrush Supply

Cause

A supply voltage on the inrush card is out of range.

Troubleshooting

- See the bit field result report value for more details.
  - **a.** Bit 2: Vcc high
  - **b.** Bit 3: Vcc low
  - **c.** Bit 4: Vdd high
  - **d.** Bit 5: Vdd low

ALARM 145, External SCR Disable

Cause

The alarm indicates a series DC-link capacitor voltage imbalance.

WARNING/ALARM 146, Mains Voltage

Cause

Mains voltage is outside valid operating range.

Troubleshooting

- See the following report values for details.
  - **a.** Voltage too low: 0=R-S, 1=S-T, 2=T-R
  - **b.** Voltage too high: 3=R-S, 4=S-T, 5=T-R

WARNING/ALARM 147, Mains Frequency

Cause

Mains frequency is outside valid operating range.

Troubleshooting

- The following report values provide more information:
  - **a.** 0: frequency too low
  - **b.** 1: frequency too high

WARNING/ALARM 148, System Temp

Cause

One or more of the system temperature measurements is too high.

WARNING 163, ATEX ETR Cur.Lim.Warning

Cause

The drive has run above the characteristic curve for more than 50 s. The warning is activated at 83% and deactivated at 65% of the allowed thermal overload.

Alarm 164, ATEX ETR Cur.Lim.Alarm

Cause

Running above the characteristic curve for more than 60 s within a period of 600 s activated the alarm, and the drive trips.

WARNING 165, ATEX ETR Freq.Lim.Warning

Cause

The drive has run for more than 50 s below the allowed minimum frequency as set in ***parameter 1-98 ATEX ETR Interpol. Points.Freq.).***

ALARM 166, ATEX ETR Freq.Lim.Alarm

Cause

The drive has run for more than 60 s in a period of 600 s below the allowed minimum frequency as set in ***parameter 1-98 ATEX ETR Interpol. Points. Freq.***).

Warning 200, Emergency Mode

Cause

Emergency mode is active.

Troubleshooting

- The warning clears when emergency mode is removed.
- See the emergency mode data in the alarm log.

Warning 201, Emerg. M Was Active

Cause

Emergency mode is no longer active.

Troubleshooting

- Cycle power to the unit to remove the warning. See the emergency mode data in the alarm log.

Warning 202, Emerg. M Limits Exceeded

Cause

While operating in emergency mode, 1 or more alarm conditions have been ignored, which would normally trip the unit. Operating in this condition voids the warranty of the unit.

Troubleshooting

- Cycle power to the unit to remove this warning. See the emergency mode data in the alarm log. See ***parameter 18-10 Emergency Mode Log*** for further details.

Warning 217, Protection Mode

Either motor current or DC voltage has reached the hardware limit.

Troubleshooting

- Check that the drive matches the motor requirements.
- Check that the motor is not overloaded.
- Check the input power supply and motor configurations.

Warning 218, Stall Limit

During torque limit, current limit, or field weakening, the drive runs in stall protection and is not able to follow the reference.

Troubleshooting

- Check that the motor is not overloaded.
- Tune the stall protection adjustment factor.

WARNING 220, Configuration File Version not Supported

Cause

The drive does not support the current configuration file version. Customization is aborted.

ALARM 243, Brake IGBT

Cause

This alarm is only for multi-drive systems. It is equivalent to ***alarm 27, Brake chopper fault***. The report value in thie alarm log indicates which drive module generated the alarm. This IGBT fault can be caused by any of the following:

- The DC fuse is blown.
- The brake jumper is not in position.
- The Klixon switch opened due to an overtemperature condition in the brake resistor.

Indication of the drive module generating the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 244, Heat Sink Temperature

Cause

The maximum temperature of the heat sink has been exceeded. The temperature fault cannot reset until the temperature drops below the defined heat sink temperature. The trip and reset points are different, based on the power size. This alarm is equivalent to ***Alarm 29, Power module temp***.

Troubleshooting

- Check for the following:
  - **a.** Ambient temperature too high.
  - **b.** Motor cables too long.
  - **c.** Incorrect airflow clearance above or below the AC drive.
  - **d.** Blocked airflow around the unit.
  - **e.** Damaged heat sink fan.
  - **f.** Dirty heat sink.

ALARM 245, Heat Sink Sensor

Cause

There is no feedback from the heat sink temperature sensor. This signal form the IGBT thermal sensor is not available on the power card. This alarm is equivalent to ***Alarm 39, Heat sink sensor***.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from the left.
- 3 = Third drive module from the left (in 4-module systems).
- 4 = Fourth drive module from the left (in 4-module systems).

Troubleshooting

- Check the power card.
- Check the gate drive card.
- Check the ribbon cable between the power card and the gate drive card.

ALARM 246, Power Card Supply

Cause

The supply on the power card is out of range. This alarm is only for multi-drive systems. It is equivalent to ***Alarm 46, Power card supply***.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 247, Power Card Temperature

Cause

This alarm is only for multi-drive systems. It is equivalent to ***Alarm 69, Power card temperature***.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 248, Illegal Power Section Configuration

Cause

This alarm is only for multi-drive systems. It is equivalent to ***Alarm 79, Illegal power section configuration***.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

Troubleshooting

- Check the current scaling cards on the MDCIC.

WARNING 249, Rect. Low Temperature

Cause

The temperature of the rectifier heat sink is too low, which indicates that the temperature sensor may be detect.

WARNING 250, New Spare Part

Cause

A component in the drive system has been replaced.

Troubleshooting

- Enter the serial number and type code for canceling the trip lock status after a power cycle.

WARNING 251, New Typecode

Cause

The power card or other components have been replaced, and the type code has changed.

Troubleshooting

- Reset the drive for normal operation.

Alarm 260, AMA Complete

An alarm has coasted the drive after AMA was executed via fieldbus.

Troubleshooting

- Ensure that AMA data is completed properly.
- Check the AMA status in ***parameter 18-65 AMA Status***.

Warning 280, Emcy M Service Warning

Cause

Emergency mode requires service.

Troubleshooting

- Contact a Danfoss supplier or the Danfoss service department.

Warning 281, Emcy OPR unexpected

Cause

Emergency mode critical alarm has occurred and impacts the drive performance in Emergency mode.

Troubleshooting

- Reset the drive.
- If resetting the drive does not solve the problem, contact Danfoss service department.

ALARM 421, FPC Temp

Cause

A fault caused by the on-board temperature sensor is detected on the fan power card. The report values identify which fan power card detected the fault.

Troubleshooting

- Check the wiring.
- Check the on-board temperature sensor.
- Replace the fan power card.

ALARM 423, FPC Updating

Cause

The alarm is generated when the fan power card reports that it has an invalid PUD. The control card attempts to update the PUD. A subsequent alarm can result depending on the update. See ***Alarm 424, FPC Update Successul*** and ***Alarm 425, FPC Update Failure***.

ALARM 424, FPC Update Successful

Cause

This alarm is generated when the control card has updated the fan power card PUD successfully.

Troubleshooting

- Press [Reset] to stop the alarm.

ALARM 425, FPC Update Failure

Cause

This alarm is generated after the control card failed to update the fan power card PUD.

Troubleshooting

- Check the fan power card wiring.
- Replace the fan power card.
- Contact supplier.

ALARM 426, FPC Config

Cause

The number of found fan power cards does not match the number of configured fan power cards. See *parameter group 15-6* Option Ident* for the number of configured fan power cards.

Troubleshooting

- Check fan power card wiring.
- Replace the fan power card.

ALARM 427, FPC Supply

Cause

Supply voltage faults (5 V, 24 V, or 48 V) on the fan power card is detected.

Troubleshooting

- Check fan power card wiring.
- Replace the fan power card.

ALARM 432, Inrush Mode Error

Cause

An active inrush card reported the wrong mode. The report value indicates which inrush card reported the alarm.

Troubleshooting

- Check inrush card wiring.
- Replace the inrush card.

Warning 500, Motor Stator Winding Warning 2

Cause

The stator winding reached condition orange. A severe fault might occur soon in the motor.

Troubleshooting

- Check the stator windings.

Warning 501, Load Envelope Warning 2

Cause

Application load has reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased motor load.

Warning 502, Vibration Monitoring Warning 2

Cause

A significant increase in motor vibration is detected. The vibration levels have reached condition orange.

Troubleshooting

- Investigate the root cause for severe vibration.

Warning 506, Load Envelope Low Warning 2

The application load has reached condition orange low limit.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application

ALARM 510, Motor Stator Winding Alarm

Cause

Stator winding has reached condition red. A severe fault is detected in the motor.

Troubleshooting

- Check motor stator winding.

WARNING 510, Motor Stator Winding Warning 1

Cause

Stator winding reached condition yellow. An early fault is detected in the motor.

Troubleshooting

- Check the motor stator winding.

ALARM 511, Load Envelope Alarm

Cause

Application load has reached condition red.

Troubleshooting

- Check root cause for excessive overload or underload.

WARNING 511, Load Envelope Warning 1

Troubleshooting for Warning 511, Load Envelope Warning 1

Cause

Application load has reached condition yellow.

Troubleshooting

- Check root cause for high motor load.

Alarm 512, Sensor 1 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 1. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 512, Sensor 1 Monitoring Warning 1

Cause

An increase in the Sensor 1 value is detected. The value levels in Sensor 1 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 513, Sensor 2 Monitoring Warning 1

Cause

There is an excessive amount of motor vibration on sensor 2. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Alarm 514, Sensor 3 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 3. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 514, Sensor 3 Monitoring Warning 1

Cause

An increase in the Sensor 3 value is detected. The value levels in Sensor 3 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 515, Sensor 4 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 4. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 515, Sensor 4 Monitoring Warning 1

Cause

An increase in the Sensor 4 value is detected. The value levels in Sensor 4 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 516, Load Envelope Low Alarm

The application load has reached low-level condition red.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application.

Warning 516, Load Envelope Low Warning 1

The application load has reached low-level condition yellow.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application.

Warning 520, Stator Thld At Max/Min

Cause

The stator in the condition-based monitoring is either at its minimum or maximum limit.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-2* Stator* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Warning 521, Load Thld At Max/Min

Cause

The load threshold in the condition-based monitoring is either at its minimum or maximum.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-3* Load* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Warning 522, Sensor 1 Thld At Max/Min

Cause

The sensor 1 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 1 function.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-4* Sensor 1* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Warning 523, Sensor 2 Thld At Max/Min

Cause

The sensor 2 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 2 function.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-5* Sensor 2* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Warning 524, Sensor 3 Thld At Max/Min

Cause

The sensor 3 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 3 function.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-6* Sensor 3* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Warning 525, Sensor 4 Thld At Max/Min

Cause

The sensor 4 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 4 function.

Troubleshooting

- Check the threshold values at maximum or minimum in *parameter group 46-** CBM Adv Thresholds* to *parameter group 46-7* Sensor 4* and adjust the values if needed.
- Acknowledge the generation by setting ***parameter 45-46 Threshold Limit*** to ***[0] Limit OK***.

Alarm 550, Sensor 1 Low Monitoring Alarm

The value measured on Sensor 1 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 550, Sensor 1 Low Monitoring Warning 1

The value measured on Sensor 1 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 551, Sensor 2 Low Monitoring Alarm

The value measured on Sensor 2 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 551, Sensor 2 Low Monitoring Warning 1

The value measured on Sensor 2 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 552, Sensor 3 Low Monitoring Alarm

The value measured on Sensor 3 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 552, Sensor 3 Low Monitoring Warning 1

The value measured on Sensor 3 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 553, Sensor 4 Low Monitoring Alarm

The value measured on Sensor 4 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 553, Sensor 4 Low Monitoring Warning 1

The value measured on Sensor 4 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

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