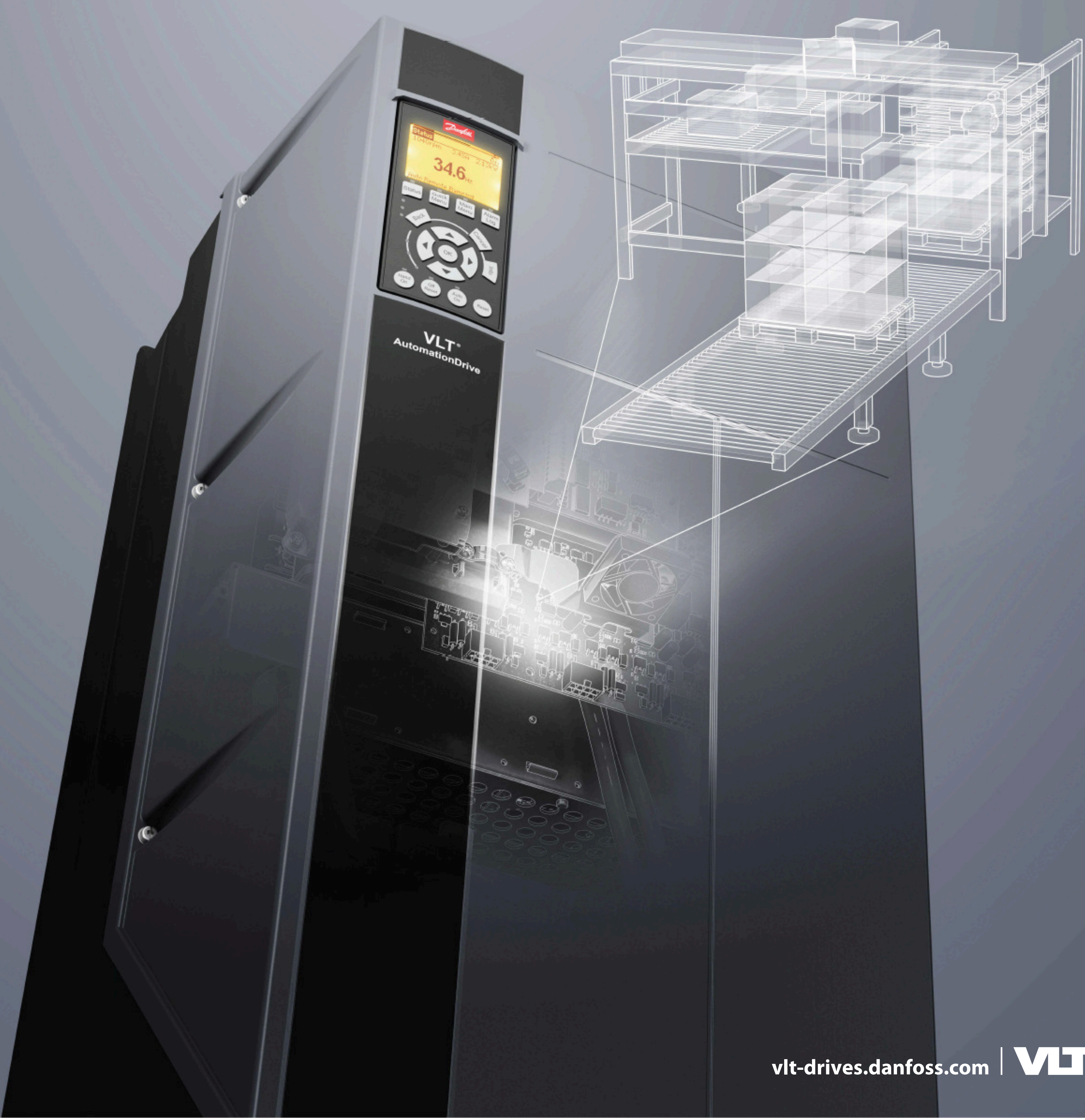
ENGINEERING
TOMORROW

Danfoss

Programming Guide

VLT® AutomationDrive EZ FC 321



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Contents

1 Introduction

1.1 Purpose of this Programming Guide

This Programming Guide provides information on how to program the drive. The guide also contains full parameter descriptions.

1.2 Supported Software Versions

Supported software versions: 8.43

The software version number can be read from *parameter 15-43 Software Version*.

1.3 Approvals and Certifications

Table 1: Approvals and Certifications

More approvals and certifications are available. For more information, contact a local partner.

1.4 Wiring Schematic

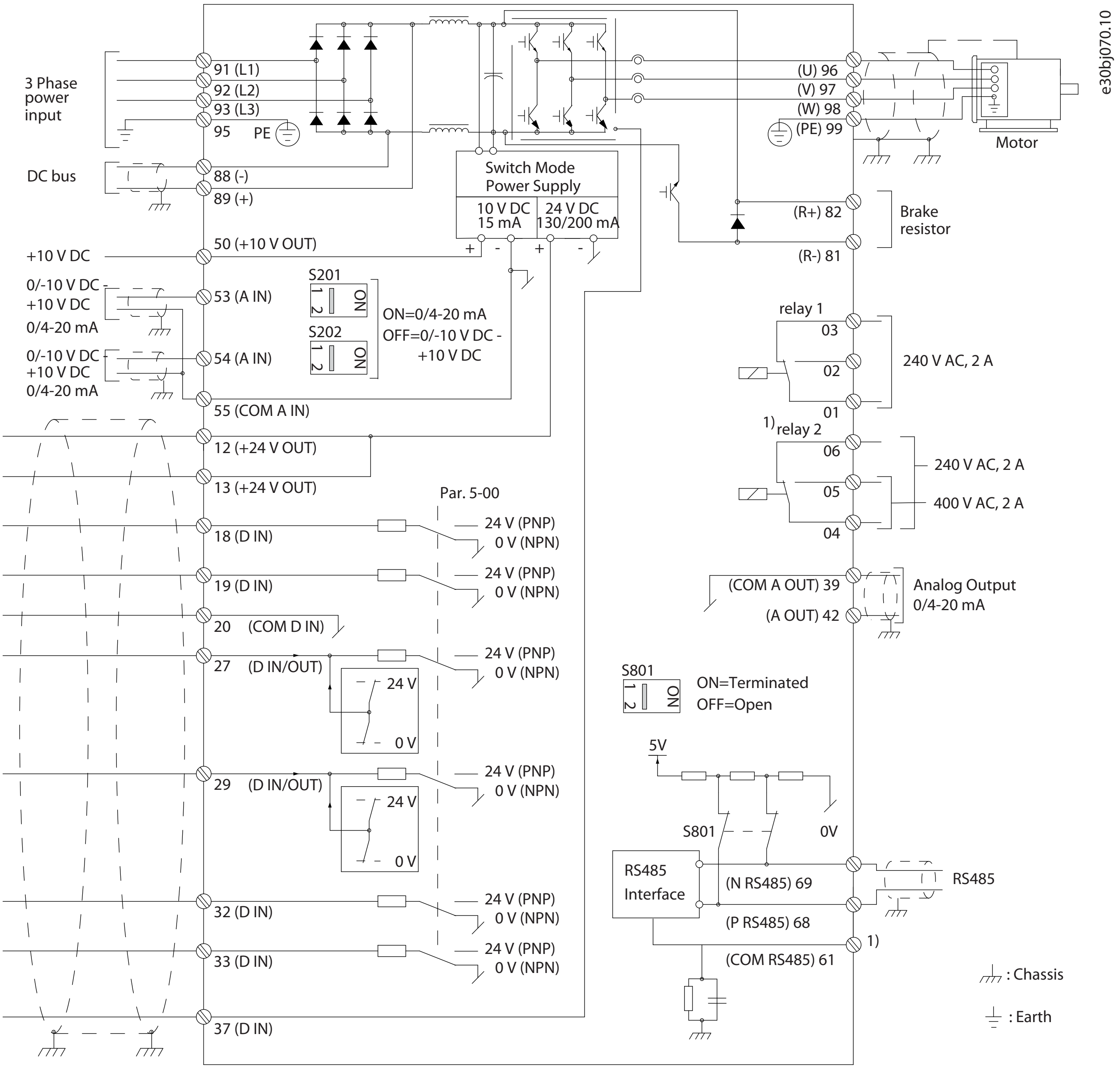

Illustration 1: Wiring Schematic

A=Analog, D=Digital

1) Do not connect cable shield.

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

Long control cables and analog signals may in rare cases, depending on installation, result in 50/60 Hz ground loops due to noise from mains supply cables. If 50/60 Hz ground loops occur, consider breaking the shield or insert a 100 nF capacitor between shield and enclosure.

To avoid ground currents from both groups to affect other groups, connect the digital and analog inputs and outputs separately to the common inputs (terminals 20, 55, and 39) of the drive. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals

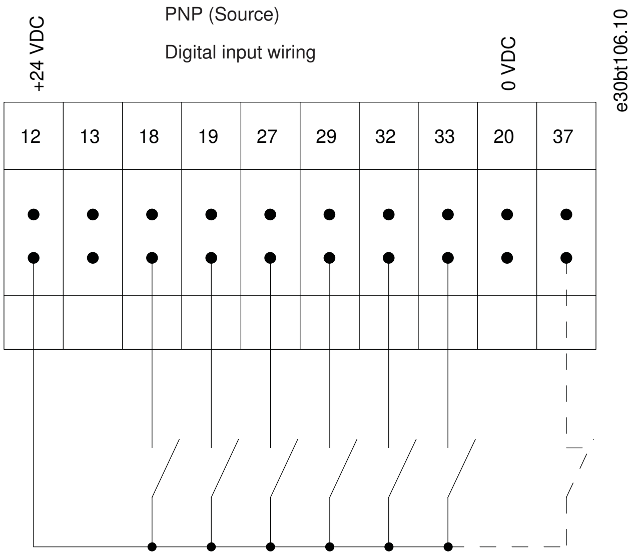

Illustration 2: PNP (Source)

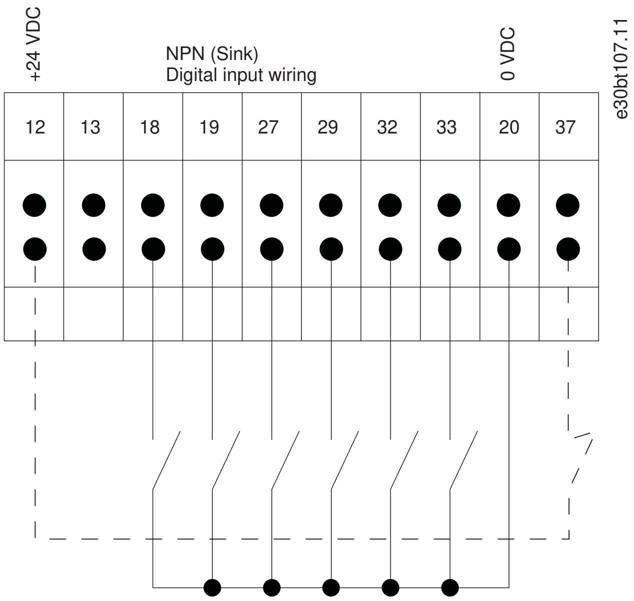

Illustration 3: NPN (Sink)

NOTICE
Control cables must be shielded/armored.

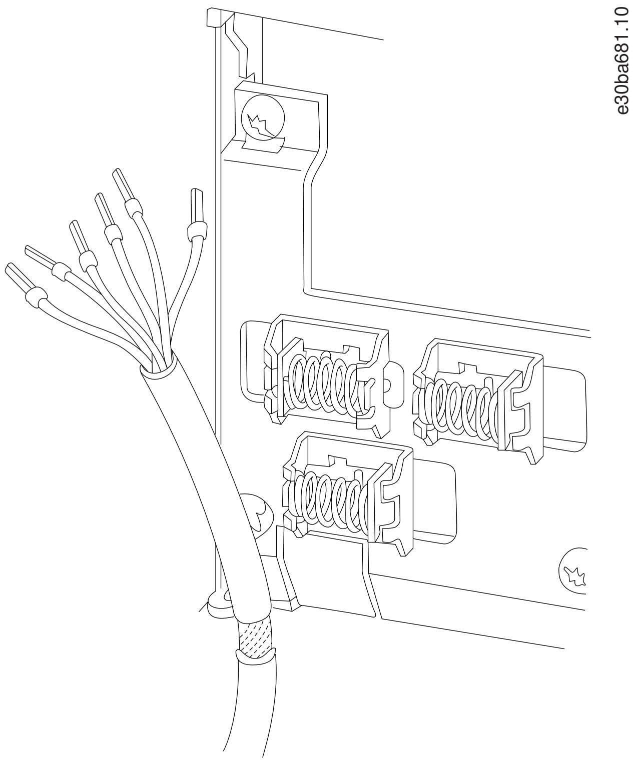

Illustration 4: Grounding of Shielded/Armored Control Cables

1.4.1 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.

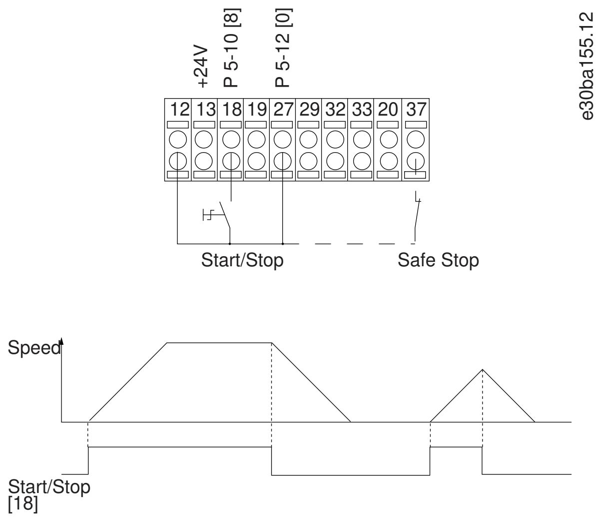

Illustration 5: Start/Stop

1.4.2 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.

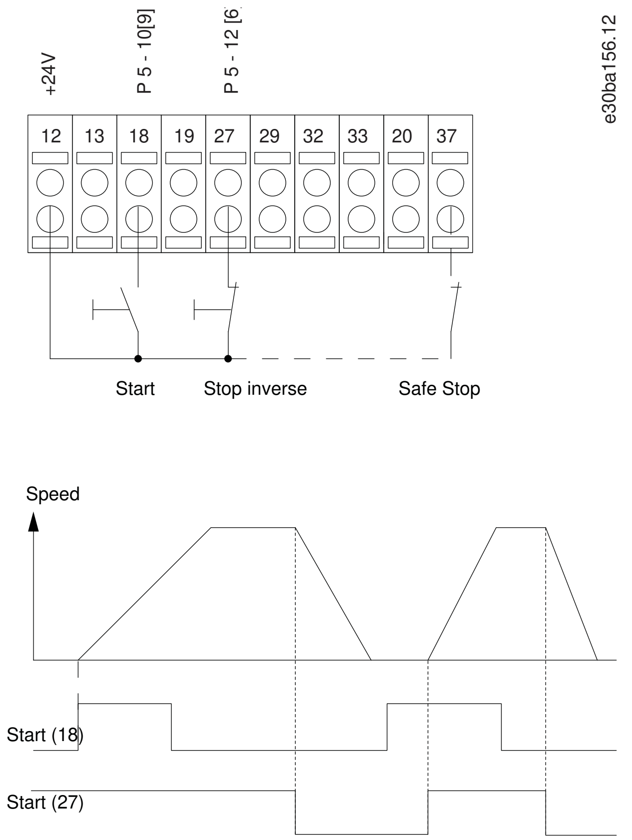

Illustration 6: Pulse Start/Stop

1.4.3 Speed Up/Speed Down

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

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

Terminal 37 = Safe Torque Off.

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

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

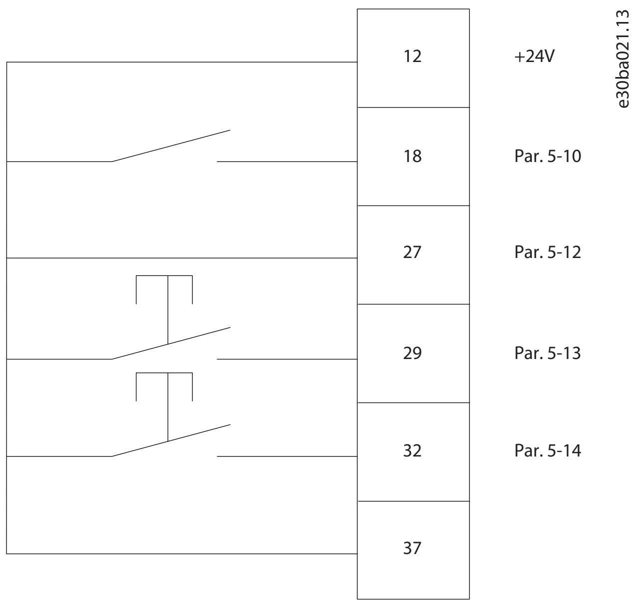

Illustration 7: Speed Up/Speed Down

1.4.4 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 reference/feedback = 0 RPM.

Terminal 53, high reference/feedback = 1500 RPM.

Switch S201 = OFF (U)

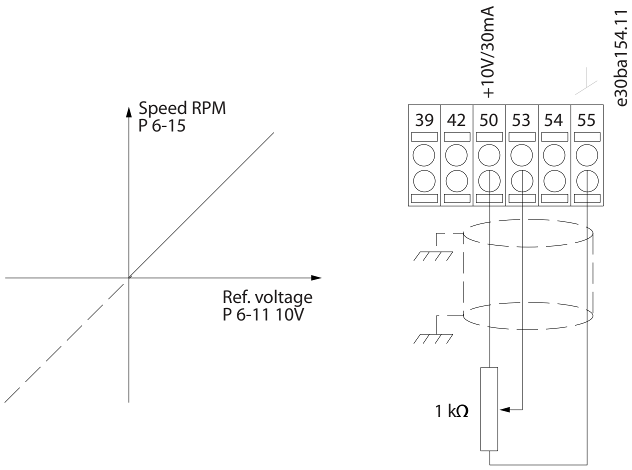

Illustration 8: Potentiometer Reference

2 Safety Instructions

2.1 Overview

This Safety chapter only relates to programming the drive. When installing or operating the drive, refer to the Installation Guide applicable safety instructions. To programming this product safely:

- Never program damaged units.
- Follow the instructions provided in this Programming Guide.
- Make sure that all personnel working on or with the drive have read and understood this guide and any additional product manuals. Contact if you are unclear of the given information, or if you lack information.

2.2 Target Group and Necessary Qualifications

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the drive. Only **skilled personnel** are allowed to perform all related activities for these tasks. Skilled personnel are defined as properly trained staff, who are familiar with and authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the skilled personnel must be familiar with the instructions and safety measures described in this manual and the other product-specific manuals. If you are not a skilled electrician, do not perform any electrical installation and troubleshooting activities.

2.3 Safety Symbols

The following symbols are used in this manual:

D A N G E R
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

W A R N I N G
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

C A U T I O N
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

N O T I C E
Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

2.4 General Safety Precautions

⚠ 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 skilled personnel can result in death or serious injury.

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

⚠ 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 can result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other drives.
- Wait for the time specified in the *Discharge Time tables* for the capacitors to discharge fully before performing any service or repair work.
- Measure the voltage level to verify full discharge.

Table 2: Discharge Time

Voltage [V]	Minimum waiting time (minutes)		
	4	15	20
	[hp]		
200–240	0.34–5.0	7.5–50	60–100
380–500	1.0–10	15–100	125–200
525–600	1.0–10	15–100	–
525–690	–	–	125–200

⚠ CAUTION ⚠

HOT SURFACES

The drive contains metal components that are still hot even after the drive has been powered off. Failure to observe the high temperature symbol (yellow triangle) on the drive can result in serious burns.

- Be aware that internal components, such as busbars, may be extremely hot even after the drive has been powered off.
- Do not touch exterior areas that are marked by the high temperature symbol (yellow triangle). These areas are hot while the drive is in use and immediately after being powered off.

2.5 Lifting the Drive

NOTICE

LIFTING HEAVY LOAD

The weight of the drive is heavy and failure to follow local safety regulations for lifting heavy weights may cause death, personal injury, or property damage.

- Ensure that the lifting equipment is in proper working condition.
- Check the weight of the drive and verify that the lifting equipment can safely lift the weight.
- Always lift the drive using a lifting bar inserted into the lifting eyes. Maximum diameter for the lifting bar: 20 mm (0.8 in).
- The angle from the top of the drive to the lifting cable: 60° or greater.
- Test lift the unit approximately 610 mm (24 in) to verify the proper center of gravity lift point. Reposition the lifting point if the unit is not level.

Table 3: Drive Weights and Dimensions

Enclosure size	Protection rating	Dimensions (HxWxD) [in]	Weight [lb]
A2	IP20/Chassis	10.6x3.6x8.7	10.8
A3	IP20/Chassis	10.6x5.2x8.7	14.6
A5	IP66 - Type 4X	16.6x9.6x7.9	31.5
B1	IP66 - Type 4X	18.9x9.6x10.3	51
B2	IP66 - Type 4X	25.6x9.6x10x3	60
B3	IP20/Chassis	15.8x6.5x9.8	26.5
B4	IP20/Chassis	20.5x9.1x9.6	52
C1	IP66 - Type 4X	26.8x12.2x12.3	99
C2	IP66 - Type 4X	30.4x14.6x13.2	143
C3	IP20/Chassis	21.7x12.2x13	77
C4	IP20/Chassis	26x14.6x13	110
D1h	Type 12	35.5x12.8x14.9	136.7
D2h	Type 12	43.6x12.8x14.9	275.6
D3h	IP20/Chassis	35.8x19.8x14.8	136.7
D4h	IP20/Chassis	44.2x14.8x14.8	238.1

2.6 Mechanical Installation Precautions

WARNING

EXPLOSIVE ATMOSPHERE

Installing the drive in a potentially explosive atmosphere can lead to death, personal injury, or property damage.

- Install the unit in a cabinet outside of the potentially explosive area.
- Use a motor with an appropriate ATEX protection class.
- Install a PTC temperature sensor on an ATEX PTC-Thermistor device to monitor the motor temperature.
- Install short motor cables.
- Use sine-wave output filters when shielded motor cables are not used.

2.7 Safe Operation

When operating the unit, refer to the Programming Guide and Application Guide for guidance and all applicable safety instructions.

- The drive is not suitable as the only safety device in the system. Make sure that additional monitoring and protection devices on drives, motors, and accessories are installed according to the regional safety guidelines and accident prevention regulations.
- Keep all doors, covers, and terminal boxes closed and securely fastened during operation.

3 How to Program

3.1 Local Control Panel

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

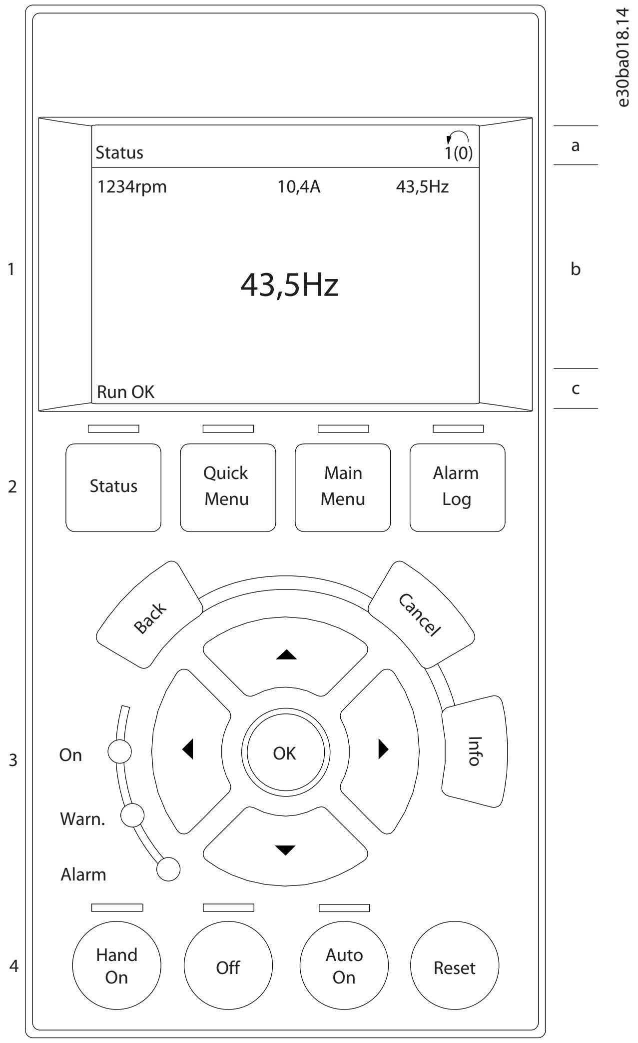

Illustration 9: LCP

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

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

N O T I C E

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

3.1.1 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 set-up, and the programming set-up. The display is divided into 3 sections.

Top section

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

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.

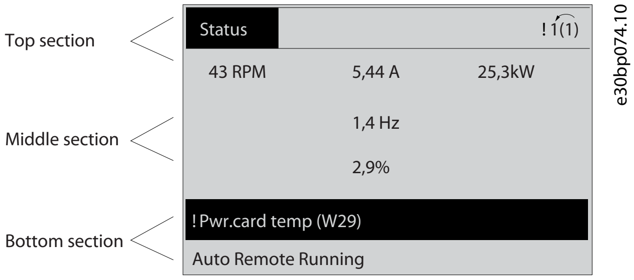

Illustration 10: Display

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

Display contrast adjustment

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

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

Most parameter set-ups 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 or 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.

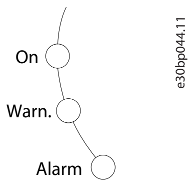

Illustration 11: Indicator Lights

3.1.1.1 LCP 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 4: 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.

LCP keys	Description
	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 • Changes made • Loggings 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]	Is used 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 an alarm list of the 5 latest alarms (numbered A1– A5). To obtain extra 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.
[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 5: 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 • Set-up select bit 0 - Set-up 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*.

LCP keys	Description
	If 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*. **Note:** 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*. The parameter shortcut can be carried out by pressing down the [Main Menu] key for 3 s. The parameter shortcut provides direct access to any parameter.

3.1.2 Quick Transfer of Parameter Settings between Multiple Drives

When the set-up 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.

3.1.2.1 Transferring Data from the Drive to the LCP

Procedure

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

3.1.2.2 Transferring Data from the LCP to the Drive

Procedure

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

3.1.3 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.

3.1.4 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, status view III).

The following table shows the measurements that can be linked to each of the operating variables. When options are mounted, additional measurements are available.

Define the links via:

- *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.*

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 a parameter is, the fewer digits are shown after the decimal point.

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

Table 6: 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 16-09 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 16-24 Calibrated Stator Resistance	
Parameter 16-30 DC Link Voltage	V
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	
Parameter 16-39 Control Card Temp.	°C
Parameter 16-40 Logging Buffer Full	
Parameter 16-45 Motor Phase U Current	
Parameter 16-46 Motor Phase V Current	
Parameter 16-47 Motor Phase W Current	
Parameter 16-48 Speed Ref. After Ramp [RPM]	
Parameter 16-49 Current Fault Source	

Operating variable	Unit
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]	
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]
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 16-75 Analog In X30/11	
Parameter 16-76 Analog In X30/12	
Parameter 16-77 Analog Out X30/8 [mA]	
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	
Parameter 16-90 Alarm Word	
Parameter 16-91 Alarm Word 2	
Parameter 16-92 Warning Word	
Parameter 16-93 Warning Word 2	

Operating variable	Unit
Parameter 16-94 Ext. Status Word	
Parameter 16-95 Ext. Status Word 2	
Parameter 16-97 Alarm Word 3	
Parameter 16-98 Warning Word 3	

3.1.4.1 Status View I

This 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 shown in the following illustration.

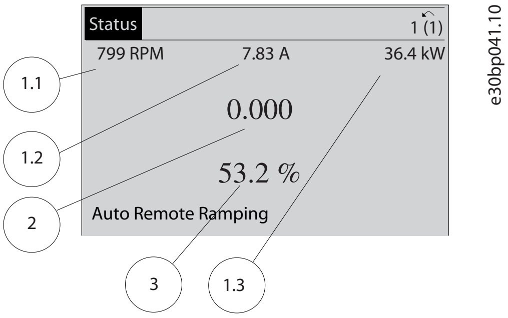

Illustration 12: Status View I

3.1.4.2 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 as variables in the 1st and 2nd lines.

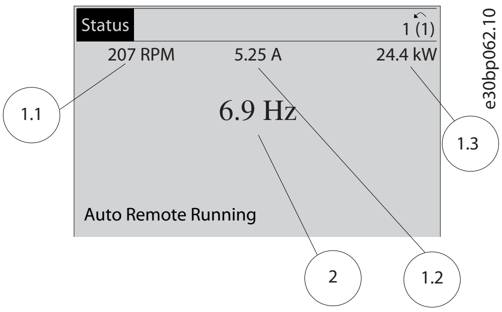

Illustration 13: Status View II

3.1.4.3 Status View III

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

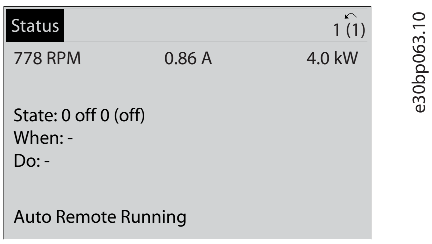

Illustration 14: Status View III

3.1.5 Parameter Set-up

The drive can be used for practically all assignments. The drive offers an option between 2 programming modes:

- Main menu mode
- Quick menu mode

Main menu provides access to all parameters.

Quick menu takes the user through a few parameters, making it possible to start operating the drive. Change a parameter in either main menu mode or quick menu mode.

3.1.6 Quick Menu Key Functions

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

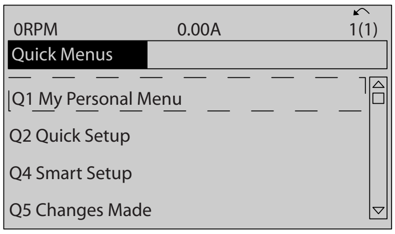

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Illustration 15: Quick Menus

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).

The parameter selection is effected with the navigation keys. The parameters in the following table are accessible.

Table 7: Selection of Parameter

Parameter	Setting
Parameter 0-01 Language	
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 3-02 Minimum Reference	[RPM]

Select *Changes made* to get 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.

3.1.7 Initial Commissioning

The easiest way of carrying out the initial commissioning is by pressing [Quick Menu] and following the quick set-up procedure using LCP 102 (read the following table from left to right). The example applies to open-loop applications.

Table 8: Quick Set-up Procedure

Press				
Quick Menu	↓	Q2 Quick Menu.	OK	↓
Parameter 0-01 Language	OK	Set language.	↓	
Parameter 1-20 Motor Power [kW]	OK	Set motor nameplate power.	↓	
Parameter 1-22 Motor Voltage	OK	Set nameplate voltage.	↓	
Parameter 1-23 Motor Frequency	OK	Set nameplate frequency.	↓	
Parameter 1-24 Motor Current	OK	Set nameplate current.	↓	
Parameter 1-25 Motor Nominal Speed	OK	Set nameplate speed in RPM.	↓	
Parameter 5-12 Terminal 27 Digital Input	OK	If terminal default is *[2] Coast inverse*, it is possible to change this setting to *[0] No function*. No connection to terminal 27 is then needed for running AMA.	↓	
Parameter 1-29 Automatic Motor Adaptation (AMA)	OK	Set desired AMA function. Enable complete AMA is recommended.	↓	

Parameter 3-02 Minimum Reference	OK	Set the minimum speed of the motor shaft.	↓	
Parameter 3-03 Maximum Reference	OK	Set the maximum speed of the motor shaft.	↓	
Parameter 3-41 Ramp 1 Ramp Up Time	OK	Set the ramp-up time with reference to synchronous motor speed, n_s.	↓	↓
Parameter 3-42 Ramp 1 Ramp Down Time	OK	Set the ramp-down time with reference to synchronous motor speed, n_s.	↓	
Parameter 3-13 Reference Site	OK	Set the site from where the reference must work.	↓	

Another easy way of commissioning the drive is by using the smart application set-up (SAS), which can also be found by pressing [Quick Menu]. To set up the applications listed, follow the instructions on the successive screens.

The [Info] key can be used throughout the SAS to see help information for various selections, settings, and messages. The following 3 applications are included:

- Mechanical brake.
- Conveyor.
- Pump/fan.

The following 4 fieldbusses can be selected:

- PROFIBUS.
- PROFINET.
- DeviceNet.
- EtherNet/IP.

NOTICE

The drive ignores the start conditions when SAS is active.

NOTICE

The smart set-up runs automatically on the first power-up of the drive or after a reset to factory settings. If no action is taken, the SAS screen automatically disappears after 10 minutes.

3.1.8 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.

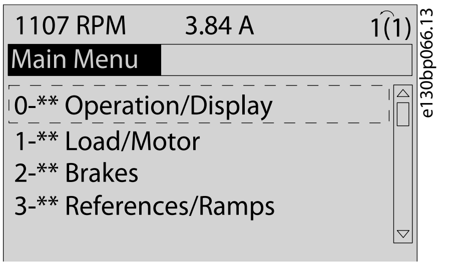


Illustration 16: Main Menu Mode

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.

3.1.9 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.

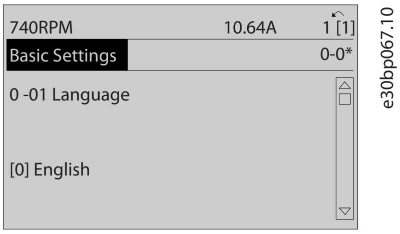


Illustration 17: Parameter Selection

3.1.10 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.

3.1.11 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].

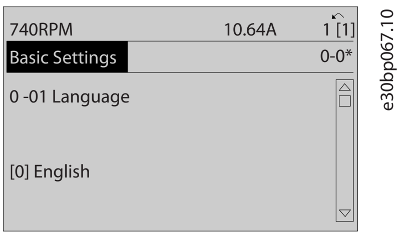
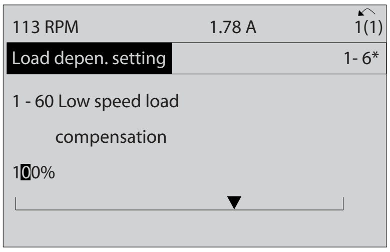


Illustration 18: Changing a Text Value

3.1.12 Changing a Data Value

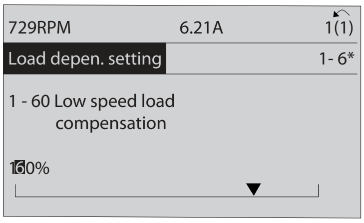
If the selected parameter shows a numeric data value, change the selected data value with the [◃] [▹] and the [▵] [▿] navigation keys. Press the [◃] [▹] keys to move the cursor horizontally.



e30bp069.10

Illustration 19: 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].

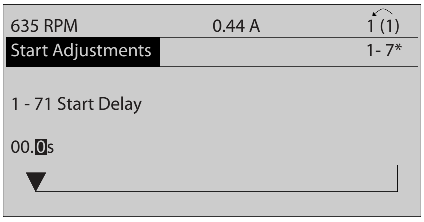


e30bp070.10

Illustration 20: Saving a Data Value

3.1.13 Infinitely Variable Change of Numeric Data Value

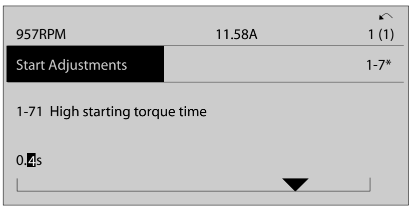
If the selected parameter shows a numeric data value, select a digit with [◃] [▹].



e30bp073.10

Illustration 21: 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].



e30bp072.10

Illustration 22: Saving

3.1.14 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.

3.1.15 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 Parameter Descriptions

4.1 Parameter Group 0-** Operation and Display

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

4.1.1 0-0* Basic Settings

Parameter 0-01 Language

Table 9: Parameter 0-01 Language

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 languages packages 1–4.
[1]	Deutsch	Part of languages 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.
[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.

Option	Name	Description
[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.

Parameter 0-02 Motor Speed Unit

Table 10: Parameter 0-02 Motor Speed Unit

0-02 Motor Speed Unit		
Default value: –	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).

Parameter 0-03 Regional Settings

Table 11: Parameter 0-03 Regioanl Settings

0-03 Regional Settings		
Default value: –	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.

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]	US	Activate *parameter 1-20 Motor Power [kW]* for setting the motor power in hp and set the default value of *parameter 1-23 Motor Frequency* to 60 Hz.

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

Table 12: Parameter 0-04 Operating State at Power-up (Hand)

0-04 Operating State at Power-up (Hand)		
Default value: [1] Forced stop, ref=old	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].
[2]	Forced stop, ref=0	Reset the local reference to 0 when restarting the drive.

4.1.2 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 very flexible and able to solve advanced control functionality problems, often saving the cost of external control equipment. Parameter setups can be used to program the drive to operate according to 1 control scheme in 1 setup (for example, motor 1 for horizontal movement) and another control scheme in another setup (for example, motor 2 for vertical movement). Alternatively, parameter setups can be used by an OEM machine builder to identically program all their factory-fitted drives for different machine types within a range to have the same parameters. During production/commissioning, simply select a specific setup depending on which machine the drive is installed on.

The active setup (that is the setup in which the drive is currently operating) can be selected in *parameter 0-10 Active Set-up* and is shown in the LCP. By using multi setup, it is possible to switch between setups with the drive running, or it can be stopped via digital input or serial communication commands. If it is necessary to change setups while the drive is running, ensure that *parameter 0-12 This Set-up Linked to* is programmed as required. By using *parameter 0-11 Edit Set-up*, it is possible to edit parameters within any of the setups while continuing the operation of the drive in its active setup, which can be a different setup to the one being edited. By using *parameter 0-51 Set-up Copy*, it is possible to copy parameter settings between the set-ups to enable quicker commissioning if similar parameter settings are required in different setups.

Use *parameter 0-51 Set-up Copy* to copy a setup to 1 or all other setups. Stop the drive before switching between setups where parameters marked not changeable during operation have different values. To avoid conflicting settings of the same parameter within 2 different setups, link the setups together using *parameter 0-12 This Set-up Linked to*. Parameters which are not changeable during operation are marked FALSE in the *Change during operation* field.

Parameter 0-10 Active Set-up

Table 13: Parameter 0-10 Active Set-up

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	

Option	Name	Description
[3]	Set-up 3	
[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 -012 This Set-up Linked to*. Stop the drive before making changes to open-loop and closed-loop functions.

Parameter 0-11 Edit Set-up

Table 14: Parameter 0-11 Edit Set-up

0-11 Edit Set-up		
Default value: [1] Set-up 1	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 set-up.
[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.

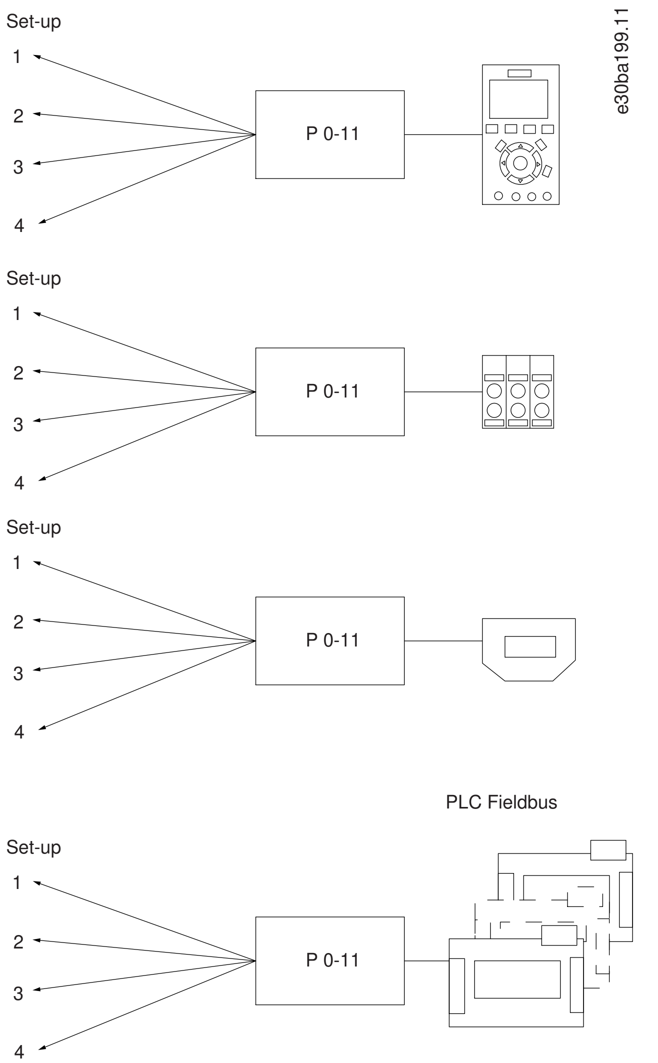


Illustration 23: Edit Setup

Parameter 0-12 This Set-up Linked to

Table 15: Parameter 0-12 This Set-up Linked to

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	

Example

Use multi set-up to shift from setup 1 to setup 2 while the motor is running. Program in setup 1 first, then ensure that setup 1 and setup 2 are synchronized (or linked). Synchronization can be performed in 2 ways:

- Select the following options:
  - *[2] Set-up 2* in *parameter 0-11 Edit Set-up*
  - Set *parameter 0-12 This Set-up Linked to* to *[1] Set-up 1*.

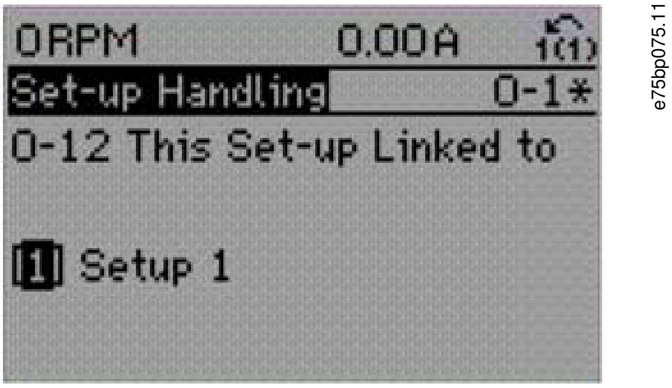


Illustration 24: Set-up 1

- While still in setup 1, copy setup 1 to setup 2. Then set *parameter 0-12 This Set-up Linked to* to *[2] Set-up 2*.

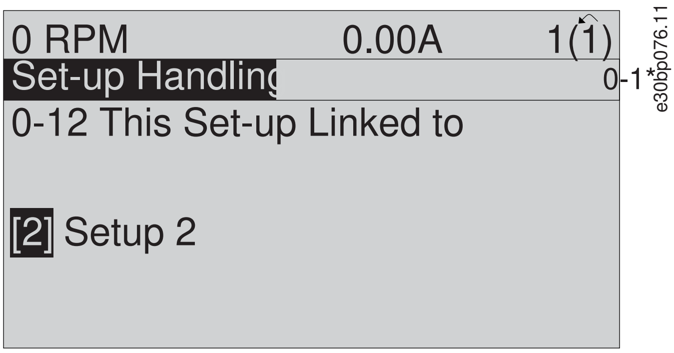


Illustration 25: Setup 2

Parameter 0-13 Readout: Linked Set-ups

Table 16: Parameter 0-13 Readout: Linked Set-ups

0-13 Readout: Linked Set-ups		
Default value: 0	Parameter type: Range [0–255]	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 17: Setup Link Example

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

Parameter 0-14 Readout: Edit Set-ups/Channel

Table 18: Parameter 0-14 Readout: Edit Set-ups/Channel

0-14 Readout: Edit Set-ups/Channel		
Default value: 0	Parameter type: Range [-2147483648–2147483648]	Setup: All setups
Conversion index: 0	Data type: Int32	Change during operation: True

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.

Example

The number AAAAAA21h means the following:

- The drive received the setting of setup 2 via a fieldbus channel. The selection is reflected in *parameter 0-11 Edit Set-up*.
- A user selected setup 1 via the LCP.
- All other channels are using the active setup.

Parameter 0-15 Readout: Actual Set-up

Table 19: Parameter 0-15 Readout: Actual Set-up

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*.

4.1.3 0-2* LCP Display

Define the variables shown in the LCP.

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.

Parameter 0-20 Display Line 1.1 Small

Table 20: Parameter 0-20 Display Line 1.1 Small

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.
[9]	Performance Monitor	
[15]	Readout: actual setup	
[37]	Display Text 1	
[38]	Display Text 2	
[39]	Display Text 3	
[89]	Date and Time Readout	
[748]	PCD Feed Forward	
[953]	PROFIBUS Warning Word	
[1005]	Readout Transmit Error Counter	
[1006]	Readout Receive Error Counter	
[1007]	Readout Bus Off Counter	
[1013]	Warning Parameter	
[1230]	Warning Parameter	
[1397]	Alert Alarm Word	
[1398]	Alert Warning Word	
[1399]	Alert Status Word	
[1472]	Legacy Alarm Word	
[1473]	Legacy Warning Word	
[1474]	Leg. Ext. Status Word	
[1500]	Operating Hours	
[1501]	Running Hours	
[1502]	kWh Counter	
[1580]	Fan Running Hours	
[1600]	Control Word	Present control word.
[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 [%]	Actual value as a percentage.
[1606]	Actual Position	Actual position in position units selected in *parameter 17-70 Position Unit*.
[1607]	Target Position	Active target position in position units selected in *parameter 17-70 Position Unit*.

Option	Name	Description
[1608]	Position Error	Actual position PI error in position units selected in *parameter 17-70 Position Unit*.
[1609]	Custom Readout	
[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.
[1619]	Thermistor Sensor Temperature	
[1620]	Motor Angle	
[1621]	Torque [%] High Res.	
[1622]	Torque [%]	Present motor load as a percentage of the rated motor torque.
[1623]	Motor Shaft Power [kW]	
[1624]	Calibrated Stator Resistance	
[1625]	Torque [Nm] High	
[1628]	Angle Error	
[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	
[1643]	Timed Actions Status	

Option	Name	Description
[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.
[1651]	Pulse Reference	Frequency in Hz connected to the digital inputs (18, 19 or 32, 33).
[1652]	Feedback[Unit]	Reference value from programmed digital inputs.
[1653]	Digi Pot Reference	
[1657]	Feedback [RPM]	
[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 log=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]	Freq. Input #29 [Hz]	Actual value of the frequency applied at terminal 29 as an impulse input.
[1668]	Freq. 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]	
[1672]	Counter A	Application-dependent (for example, SLC control).
[1673]	Counter B	Application-dependent(for example, SLC control).
[1674]	Prec. Stop Counter	Shows the actual value of the counter.
[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 se-lect the value to be shown.
[1678]	Analog Out X45/1 [mA]	
[1679]	Analog Out X45/3 [mA]	

Option	Name	Description
[1680]	Fieldbus CTW 1	Control word (CTW) received from the bus master.
[1681]	Fieldbus Sync. REF	
[1682]	Fieldbus REF 1	Mains reference value sent with control word from the bus master.
[1683]	Fielbus Pos. REF	
[1684]	Comm. Option STW	Extended fieldbus communication option status word.
[1685]	FC Port CTW 1	Control word (CTW) received from the bus master.
[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	
[1697]	Alarm Word 3	
[1698]	Warning Word 3	
[1804]	Mech Brake Count	
[1820]	Commanded Position	
[1821]	Master Position	
[1823]	Virtual Master Pos.	
[1827]	Safe Opt. Est. Speed	
[1828]	Safe Opt. Meas. Speed	
[1829]	Safe Opt. Speed Error	
[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	

Option	Name	Description
[1843]	Analog Out X49/7	
[1844]	Analog Out X49/9	
[1845]	Analog Out X49/11	
[1846]	X49 Digital Output [bin]	
[1860]	Digital Input 2	
[1870]	Mains Voltage	
[1871]	Mains Frequency	
[1872]	Mains Imbalance	
[1875]	Rectifier DC Volt.	
[1890]	Process PID Error	
[1891]	Process PID Output	
[1892]	Process PID Clamped Output	
[1893]	Process PID Gain Scaled Output	
[2316]	Maintenance Text	
[3019]	Wobble Delta Freq. Scaled	
[3110]	Bypass Status Word	
[3111]	Bypass Running Hours	
[3440]	Digital Inputs	
[3441]	Digital Outputs	
[3450]	Actual Position	
[3451]	Commanded Position	
[3452]	Actual Master Position	
[3453]	Slave Index Position	
[3454]	Master Index Position	
[3455]	Curve Position	
[3456]	Track Error	
[3457]	Synchronizing Error	
[3458]	Actual Velocity	
[3459]	Actual Master Velocity	
[3460]	Synchronizing Status	
[3461]	Axis Status	
[3462]	Program Status	

Option	Name	Description
[3466]	SPI Error Counter	
[9913]	Idle Time	
[9914]	Paramdb requests in queue	
[9917]	tCon1 time	
[9918]	tCon2 time	
[9919]	Time Optimize Measure	
[9920]	Fan Ctrl deltaT	
[9921]	Fan Ctrl Tmean	
[9922]	Fan Ctrl NTC Cmd	
[9923]	Fan Ctrl I-term	
[9924]	Rectifier Current	
[9952]	PC Debug 0	
[9953]	PC Debug 1	
[9954]	PC Debug 2	
[9961]	FPC Debug 0	
[9962]	FPC Debug 1	
[9963]	FPC Debug 2	
[9964]	FPC Debug 3	
[9965]	FPC Debug 4	

Parameter 0-22 Display Line 1.3 Small

The options are the same as those listed for *parameter -20 Display Line 1.1 Small*.

Parameter 0-23 Display Line 2 Large

The options are the same as those listed for *parameter -20 Display Line 1.1 Small*.

Parameter 0-24 Display Line 3 Large

The options are the same as those listed for *parameter -20 Display Line 1.1 Small*.

Parameter 0-25 My Personal Menu

Table 21: Parameter 0-25 My Personal Menu

0-25 My Personal Menu		
Default value: Size related	Parameter type: Range [0–9999]	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.

4.1.4 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 reaout

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.

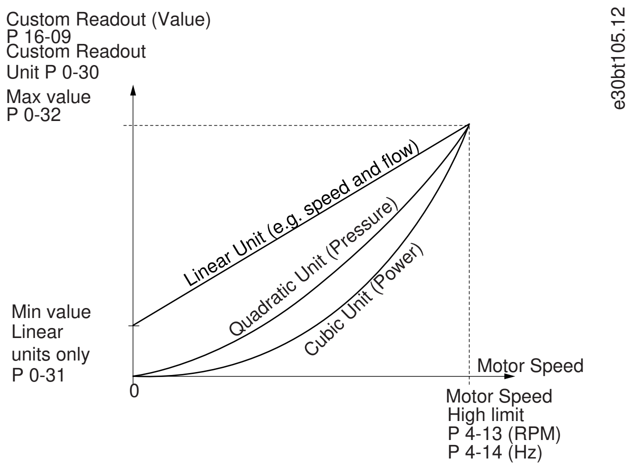


Illustration 26: Custom Readout

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

Table 22: Speed Relations for Different Unit Types

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

Parameter 0-30 Unit for User-defined Readout

Table 23: Parameter 0-30 Unit for User-defined Readout

0-30 Unit for User-defined Readout		
Default value: [0] None	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	

Option	Name	Description
[74]	m WG	
[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	
[176]	kpsi	
[177]	MPa	
[178]	kBar	
[180]	hp	

Parameter 0-31 Min Value of User-defined Readout

Table 24: Parameter 0-31 Min Value of User-defined Readout

0-31 Min Value of User-defined Readout		
Default value: 0 CustomReadoutUnit	Parameter type: Range [-999999.99 CustomReadoutUnit - par. 0-32]	Setup: All setups
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.

Parameter 0-32 Max Value of User-defined Readout

Table 25: Parameter 0-32 Max Value of User-defined Readout

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 0-33 Source for User-defined Redaout

Table 26: Parameter 0-33 Source of User-defined Readout

0-33 Source of User-defined Readout		
Default value: [240] Default Source	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Enter the source of the user-defined readout.

Option	Name	Description
[105]	Torque relate to rated	
[143]	PID Clamped Output 4–20mA	
[240]*	Default Source	

Parameter 0-37 Display Text 1

Table 27: Parameter 0-37 Display Text 1

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*

Parameter 0-38 Display Text 2

Table 28: Parameter 0-38 Display Text 2

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*

Parameter 0-39 Display Text 3

Table 29: Parameter 0-39 Display Text 3

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*

4.1.5 0-4* LCP Keypad

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

Parameter 0-40 [Hand On] Key on LCP

Table 30: Parameter 0-40 [Hand On] Key on LCP

0-40 [Hand On] Key on LCP		
Default value: Size related	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]	Hand Off/On	When [Hand On] is pressed once, the LCP switches to Off mode. When pressed again, the LCP switches to hand-on mode.
[4]	Hand Off/On w. Passw.	Same as option *[3] Hand Off/On* but a password is required (see option *[2] Password*).
[9]	Enabled, ref=0	

Parameter 0-41 [Off] Key on LCP

Table 31: Parameter 0-41 [Off] Key on LCP

0-41 [Off] Key on LCP		
Default value: Size related	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*.

Parameter 0-42 [Auto On] Key on LCP

Table 32: Parameter 0-42 [Auto On] Key on LCP

0-42 [Auto On] Key on LCP		
Default value: Size related	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*.

Parameter 0-43 [Reset] Key on LCP

Table 33: Parameter 0-43 [Reset] Key on LCP

0-43 [Reset] Key on LCP		
Default value: Size related	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*.
[7]	Enabled without OFF	Resets the drive without setting it in Off mode.
[8]	Password without OFF	Resets the drive without setting it in Off mode. A password is required when pressing [Reset] (see option *[2] Password*).

Parameter 0-44 [Off/Reset] Key on LCP

Table 34: Parameter 0-44 [Off/Reset] Key on LCP

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

Enable or disable the [Off/Reset] key.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	
[2]	Password	

Parameter 0-45 [Drive Bypass] Key on LCP

Table 35: Parameter 0-45 [Drive Bypass] Key on LCP

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

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	

4.1.6 0-5* Copy/Save

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

Parameter 0-50 LCP Copy

Table 36: Parameter 0-50 LCP Copy

0-50 LCP Copy		
Default value: [0] No copy	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

N O T I C E

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 set-ups from the drive memory to the LCP memory.
[2]	All from LCP	Copies all parameters in all set-ups 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.
[6]	Data from DYN to LCP	
[7]	Data from LCP to DYN	
[10]	Delete LCP copy data	Use to delete the copy after the transfer is complete.

Parameter 0-51 Set-up Copy

Table 37: Parameter 0-51 Set-up Copy

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 set-up (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 set-up (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 set-up (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 set-up (defined in *parameter 0-11 Edit Set-up*) to set-up 4.
[9]	Copy to all	Copies the parameters in the present set-up to each of the setups 1 to 4.

4.1.7 0-6* Password

Parameter 0-60 Main Menu Password

Table 38: Parameter 0-60 Main Menu 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.

Parameter 0-61 Access to Main Menu w/o Password

Table 39: Parameter 0-61 Access to Main Menu w/o Password

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.

Option	Name	Description
[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.

If *[0] Full access* is selected, *parameter 0-60 Main Menu Password*, *parameter 0-65 Personal Menu Password*, and *parameter 0-66 Access to Personal Menu w/o Password* are ignored.

NOTICE

A more complex password protection is available for OEMs upon request.

Parameter 0-65 Personal Menu Password

Table 40: Parameter 0-65 Personal Menu Password

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.

Parameter 0-66 Access to Personal Menu w/o Password

Table 41: Parameter 0-66 Access to Personal Menu w/o Password

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*, then 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.

Parameter 0-67 Bus Password Access

Table 42: Parameter 0-67 Bus Password Access

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.

Parameter 0-68 Safety Parameter Password

Table 43: Parameter 0-68 Safety Parameters Password

0-68 Safety Parameters Password		
Default value: 300	Parameter type: Range [0 - 9999]	Setup: 1 setup
Conversion index: 0	Data type: Uint16	Change during operation: True

Enter the password for the safety parameters access. If *parameter 0-69 Password Protection of Safety Parameters* is set to *[0] Disabled*, this parameter is ignored.

Parameter 0-69 Password Protection of Safety Parameters

Table 44: Parameter 0-69 Password Protection of Safety Parameters

0-69 Password Protection of Safety Parameters		
Default value: [0] Disabled	Parameter type: Option	Setup: 1 setup
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

4.1.8 0-7* Clock Settings

Parameter 0-70 Date and Time

Table 45: Parameter 0-70 Date and Time

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.

Parameter 0-71 Date Format

Table 46: Parameter 0-71 Date Format

0-71 Date Format		
Default value: Size related	Parameter type: Option	Setup: 1 setup
Conversion index: –	Data type: Uint8	Change during operation: True

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

Parameter 0-72 Time Format

Table 47: Parameter 0-72 Time Format

0-72 Time Format		
Default value: Size related	Parameter type: Option	Setup: 1 setup
Conversion index: –	Data type: Uint8	Change during operation: True

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

Parameter 0-73 Time Zone Offset

Table 48: Parameter 0-73 Time Zone Offset

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.

Parameter 0-74

Table 49: Parameter 0-74 DST/Summertime

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	

Parameter 0-76 DST/Summertime Start

Table 50: Parameter 0-76 DST/Summertime Start

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*.

Parameter 0-77 DST/Summertime End

Table 51: Parameter 0-77 DST/Summertime End

0-77 DST/Summertime End		
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 ends. The date is programmed in the format selected in *parameter 0-71 Date Format*.

Parameter 0-79 Clock Fault

Table 52: Parameter 0-79 Clock Fault

0-79 Clock Fault		
Default value: Size related	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	

Parameter 0-81 Working Days

Table 53: Parameter 0-81 Working Days

0-81 Working Days		
Default value: Size related	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	

Parameter 0-82 Additional Working Days

Table 54: Parameter 0-82 Additional Working Days

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 nonworking days according to *parameter 0-81 Working Days*.

Parameter 0-83 Additional Non-working Days

Table 55: Parameter 0-83 Additional Non-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 nonworking days according to *parameter 0-81 Working Days*.

Parameter 0-84 Time for Fieldbus

Table 56: Parameter 0-84 Time for Fieldbus

0-84 Time for Fieldbus		
Default value: 0	Parameter type: Range, 0 - 4294967295	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Shows the time fieldbus.

Parameter 0-85 Summer Time Start for Fieldbus

Table 57: Parameter 0-85 Summer Time Start for Fieldbus

0-85 Summer Time Start for Fieldbus		
Default value: 0	Parameter type: Range, 0 - 4294967295	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Shows the summer time start for fieldbus.

Parameter 0-86 Summer Time End for Fieldbus

Table 58: Parameter 0-86 Summer Time End for Fieldbus

0-86 Summer Time End for Fieldbus		
Default value: 0	Parameter type: Range, 0 - 4294967295	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Shows the summer time end for fieldbus.

Parameter 0-89 Date and Time Readout

Table 59: Parameter 0-89 Date and Time Readout

0-89 Date and Time Readout		
Default value: 0	Parameter type: Range, 0 - 25	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*.

4.2 Parameter Group 1-** Load and Motor

4.2.1 1-0* General Settings

Define whether the drive operates in speed mode or torque mode, and whether the internal PID control should be active or not.

Parameter 1-00 Configuration Mode

Table 60: Parameter 1-00 Configuration Mode

1-00 Configuration Mode		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

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]	Speed open loop	Enables speed control (without feedback signal from motor) with automatic slip compensation for almost constant speed at varying loads. Compensations are active, but can be disabled in *parameter group 1-** Load and Motor*. Set the speed control parameters in *parameter group 7-0* Speed PID Ctrl*.
[1]	Speed closed loop	Enables speed closed-loop control with feedback. Obtain full holding torque at 0 RPM. For increased speed accuracy, provide a feedback signal and set the speed PID control. Set the speed control parameters in *parameter group 7-0* Speed PID Ctrl*.
[2]	Torque	Enables torque closed-loop control with feedback. Only possible when *parameter 1-01 Motor Control Principle* is set to *[3] Flux w/motor feedb*.
[3]	Process	Enables the use of process control in the drive. Set the process control parameters in *parameter groups 7-2* Process Ctrl. Feedb.* and *7-3* Process PID Ctrl*.
[4]	Torque open loop	Enables the use of torque open-loop mode (*parameter 1-01 Motor Control Principle*). Set the torque PID parameters in *parameter group 7-1* Torque PI Control*.
[5]	Wobble	Enables the wobble functionality in *parameter 30-00 Wobble Mode* to *parameter 30-19 Wobble Delta Freq. Scaled*.
[6]	Surface winder	Enables the surface winder control-specific parameters in *parameter groups 7-2* Process Ctrl. Feedb.* and *7-3* Process PID Ctrl.*
[7]	Extended PID speed OL	Specific parameters in *parameter groups 7-2* Process Ctrl. Feedb.* to *7-5* Ext. Process PID Ctrl.*
[8]	Extended PID speed CL	Specific parameters in *parameter groups 7-2* Process Ctrl. Feedb.* to *7-5* Ext. Process PID Ctrl.*

Parameter 1-01 Motor Control Principle

Table 61: Parameter 1-01 Motor Control Principle

1-01 Motor Control Principle		
Default value: Size related	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	Special motor mode, for parallel-connected motors in special motor applications. When U/f is selected, the characteristic of the control principle can be edited in *parameter 1-55 U/f Characteristic - U* and *parameter 1-56 U/f Characteristic - 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.
[3]	Flux w/ motor	High accuracy speed and torque control, suitable for the most demanding applications.

The best shaft performance is normally achieved using either of the 2 flux vector control modes *[2] Flux sensorless* and *[3] Flux with encoder feedback*.

Parameter 1-02 Flux Motor Feedback Source

Table 62: Parameter 1-02 Flux Motor Feedback Source

1-02 Flux Motor Feedback Source		
Default value: 24V encoder	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

N O T I C E

This parameter cannot be adjusted while the motor is running.

Select the source of the feedback for flux closed-loop motor control. Set *parameter 1-01 Motor Control Principle* to *[3] Flux with motor feedback option*. The feedback device is typically mounted directly on the motor shaft. The feedback device can also be mounted in the application, provided that the gear ratio between motor and encoder is fixed and accurate. Configure the rear ratio between motor and encoder in *parameter 7-94 Position PI Feedback Scale Numerator* and *parameter 7-95 Position PI Feedback Scale Denominator* without any rounding error.

Option	Name	Description
[1]	24V encoder 32/33	Single signal generated from 24 V High Threshold Logic (HTL) encoder connected to terminals 32 and 33. Configure the 24 V encoder interface in *parameter group 5.7* 24 V Encoder Input*. Program terminals 32/33 to *[0] No operation*.
[13]	24V encoder 27/29	Single-signal HTL encoder connected to digital inputs 27 and 29. 24 V encoder is configured in *parameter group 5.7* 24V Encoder Input*. Program terminals 27/29 to *[0] No operation*.

Parameter 1-03 Torque Characteristics

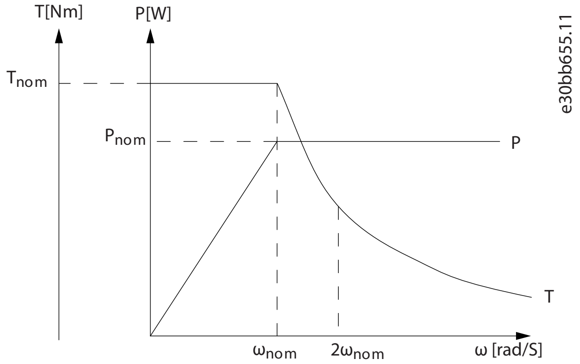
Table 63: Parameter 1-03 Torque Characteristics

1-03 Torque Characteristics		
Default value: [0] Constant torque	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

N O T I C E

This parameter cannot be adjusted while the motor is running.

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

Op-tion	Name	Description
[0]*	Constant torque	Motor shaft output provides constant torque under variable speed control.
[1]	Variable torque	Motor shaft output provides variable torque under variable speed control. Set the variable torque level in *parameter 14-40 VT Level*.
[2]	Auto energy optim.	Automatically optimizes energy consumption by minimizing magnetization and frequency via *parameter 14-41 AEO Minimum Magnetisation* and *parameter 14-42 Minimum AEO Frequency*.
[5]	Costant power	The function provides a constant power in the field weakening area. The torque shape of motor mode is used as a limit in the generator mode. This is done to limit the power in generator mode that otherwise becomes considerably larger than in motor mode, due to the high DC-link voltage available in generator mode. $P\text{shaft}[W] = \omega\text{mech}[\text{rad}/s] \times T[\text{Nm}]$  **Illustration 27: Relationship with Constant Power**

Parameter 1-04 Overload Mode

Table 64: Parameter 1-04 Overload Mode

1-04 Overload Mode		
Default value: Size related	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.

Parameter 1-05 Local Mode Configuration

Table 65: Parameter 1-05 Local Mode Configuration

1-05 Local Mode Configuration		
Default value: [2] As mode par. 1-00	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select which application configuration mode (*parameter 1-00 Configuration Mode*), that is application control principle, to use when a local (LCP) reference is active. A local reference can be active only when *parameter 3-13 Reference Site* is set to *[0] Linked to Hand/ Auto* or *[2] Local*. By default the local reference is active in hand-on mode only.

Option	Name	Description
[0]	Speed open loop	Allows up to 160% overtorque.
[1]	Speed closed loop	
[2]*	As mode par. 1-00	
[4]	Positioning	

Parameter 1-06 Clockwise Direction

Table 66: Parameter 1-06 Clockwise Direction

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 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	

Parameter 1-07 Motor Angle Offset Adjust

Table 67: Parameter 1-07 Motor Angle Offset Adjust

1-07 Motor Angle Offset Adjust		
Default value: [0] Manual	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

Option	Name	Description
[0]*	Manual	The functionality of this option depends on the type of the feedback device. This option sets the drive to use the motor angle offset entered in *parameter 1-41 Motor Angle Offset*, if an absolute feedback device is

Op-tion	Name	Description
		used. If an incremental feedback device is selected, the drive automatically adjusts the motor angle offset on the 1st start after power-up, or when the motor data is changed.
[1]	Auto	The drive adjusts the motor angle offset automatically on the 1st start after power-up, or when the motor data is changed no matter what feedback device is selected. This means that the options *[1] Manual* and *[2] Auto* are identical for the incremental encoder.
[2]	Auto every start	The drive adjusts the motor angle offset automatically on every start, or when the motor data is changed.
[3]	Off	Selecting this option turns the automatic offset adjustment off.
[4]	Once with store	This option updates *parameter 1-41 Motor Angle Offset* automatically when the angle value is 0. This option is valid only for absolute feedback devices. The function uses rotor detection and then applies DC hold to make the offset adjustment more accurate.

4.2.2 Motor Set-ups

4.2.2.1 Asynchronous Motor Set-up

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.

Application-specific adjustment when running flux

Flux control principle is the preferred control principle for optimum shaft performance in dynamic applications. Perform an AMA since this control mode requires precise motor data. Depending on the application, further adjustments may be required.

See Table 3.3 for application-related recommendations.

Table 68: Recommendations for Flux Applications

Application	Settings
Low-inertia applications	Keep calculated values.
High-inertia applications	*Parameter 1-66 Min. Current at Low Speed*. Increase current to a value between default and maximum depending on the application. Set ramp times matching the application. Too fast ramp up causes an overcurrent or overtorque. Too fast ramp down causes an overvoltage trip.

Application	Settings
High load at low speed	*Parameter 1-66 Min. Current at Low Speed*. Increase current to a value between default and maximum depending on the application
No-load application	Adjust *parameter 1-18 Min. Current at No Load* to achieve smoother motor operation by reducing torque ripple and vibration.
Flux sensorless control principle only	Adjust *parameter 1-53 Model Shift Frequency*. Example 1: If the motor oscillates at 5 Hz, and dynamics performance is required at 15 Hz, set *parameter 1-53 Model Shift Frequency* to 10 Hz. Example 2: If the application involves dynamic load changes at low speed, reduce *parameter 1-53 Model Shift Frequency*. Observe the motor behavior to make sure that the model shift frequency is not reduced too much. Symptoms of inappropriate model shift frequency are motor oscillations or drive tripping.

4.2.2.2 PM Motor Set-up

This section describes how to set up a PM motor.

Initial programming steps

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

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.

Program the following parameters in the order listed:

1. *Parameter 1-24 Motor Current*.
2. *Parameter 1-25 Motor Nominal Speed*.
3. *Parameter 1-26 Motor Cont. Rated Torque*.
4. *Parameter 1-39 Motor Poles*.

Run a complete AMA using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA*.

If a complete AMA is not performed, configure the following parameters manually:

1. *Parameter 1-30 Stator Resistance (Rs)* Enter the line-to-common stator winding resistance (Rs). If only line-line data is available, divide the line-line value by 2 to get the line-common value.
2. *Parameter 1-37 d-axis Inductance (Ld)* Enter the line-to-common direct axis inductance of the PM motor. If only line-line data is available, divide the line-line value by 2 to get the line-common value.
3. *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.

Test 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.

4.2.2.2.1 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.

4.2.2.2.2 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.

4.2.2.2.3 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+ PM settings. Table 3.4 contains recommendations for various applications.

Table 69: 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.

Application-specific adjustment when running flux

Flux control principle is the preferred control principle for optimum shaft performance in dynamic applications. Perform an AMA because this control mode requires precise motor data. Depending on the application, further adjustments may be required.

See 4.2.2.1 Asynchronous Motor Set-up for application-specific recommendations.

4.2.2.3 SynRM Motor Set-up with VVC+

This section describes how to set up a SynRM motor with VVC$^+$.

NOTICE

The SmartStart wizardcovers the basic configuration of SynRM motors.

4.2.2.3.1 Initial Programming

Procedure

1. Select *[5] Sync. Reluctance* in *parameter 1-10 Motor Construction* to activate SynRM motor operation.

4.2.2.3.2 Programming Motor Data

After performing the initial programming steps, the SynRM motor-related parameters in *parameter groups 1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active. Find the required motor data on the motor nameplate and in the motor data sheet.

Procedure

1. Program in the following order:
   a. *Parameter 1-23 Motor Frequency*.
   b. *Parameter 1-24 Motor Current*.
   c. *Parameter 1-25 Motor Nominal Speed*.
   d. *Parameter 1-26 Motor Cont. Rated Torque*.
2. Run a complete AMA.
   - Select *[1] Enable Complete AMA* in *parameter 1-29 Automatic Motor Adaptation (AMA)*, or
   - Enter the following manually:

     Parameter 1-30 Stator Resistance (Rs).

     Parameter 1-37 d-axis Inductance (Ld).

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

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

Parameter 1-48 Inductance Sat. Point.

4.2.2.3.3 Application-specific Adjustments

Start the motor at nominal speed. If the application does not run well, check the VVC+ SynRM settings.

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. Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.
Dynamic applications	Increase *parameter 14-41 AEO Minimum Magnetisation* for highly dynamic applications. Adjusting *parameter 14-41 AEO Minimum Magnetisation* ensures a good balance between energy efficiency and dynamics. Adjust *parameter 14-42 Minimum AEO Frequency* to specify the minimum frequency at which the drive should use minimum magnetization.
Motor sizes less than 18 kW (24 hp)	Avoid short ramp-down times.

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

4.2.3 1-1* Special Settings

N O T I C E

The parameters within this parameter group cannot be adjusted while the motor is running.

Parameter 1-10 Motor Construction

Table 70: Parameter 1-10 Motor Construction

1-10 Motor Construction		
Default value: [0] Asynchron	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.

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

Parameter 1-11 Motor Model

Table 71: Parameter 1-11 Motor Model

1-11 Motor Model		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

Automatically sets the factory values for the selected motor. If the default value *[1] Std. Asynchron* is used, determine settings manually according to the selection in *parameter 1-10 Motor Construction*.

Option	Name	Description
[1]	Std. asynchron	Default motor model when *[0] Asynchron* is selected in *parameter 1-10 Motor Construction*.
[2]	Std. PM, non salient	Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*.
[3]	Std. PM salient	
[10]	Danfoss OGD LA10	Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*. Only available for T5 in 1.5–3 kW. Settings are loaded automatically for this specific motor.
[11]	Danfoss OGD V210	Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*. Only available for T5 in 0.75–3 kW. Settings are loaded automatically for this specific motor.

Parameter 1-14 Damping Gain

Table 72: Parameter 1-14 Damping Gain

1-14 Damping Gain		
Default value: 140%	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.

Parameter 1-15 Low Speed Filter Time Const.

Table 73: Parameter 1-15 Low Speed Filter Time Const.

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.

Parameter 1-16 High Speed Filter Time Const.

Table 74: Parameter 1-16 High Speed Filter Time Const.

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.
Parameter 1-17 Voltage Filter Time Const.

Table 75: Parameter 1-17 Voltage Filter Time Const.

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.
Parameter 1-18 Min. Current at No Load

Table 76: Parameter 1-18 Min. Current at No Load

1-18 Min. Current at No Load		
Default value: 0%	Parameter type: Range, 0 - 50%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

Adjust this parameter to achieve a smoother motor operation.

4.2.4 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 effectwhen *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*

Parameter 1-20 Motor Power [kW]

Table 77: Parameter 1-20 Motor Power [kW]

1-20 Motor Power [kW]		
Default value: Size related	Parameter type: Range, 0.09 - 3000.00 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*.
Parameter 1-21 Motor Power [HP]

Table 78: Parameter 1-21 Motor Power [HP]

1-21 Motor Power [HP]		
Default value: Size related	Parameter type: Range, 0.09 - 3000.00 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] US*.
Parameter 1-22 Motor Voltage

Table 79: Parameter 1-22 Motor Voltage

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

Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.
Parameter 1-23 Motor Frequency

Table 80: Parameter 1-23 Motor Frequency

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

From software version 6.72 onwards, the output frequency of the drive is limited to 590 Hz.

Select the motor frequency value from the motor nameplate data. If a value other than 50 Hz or 60 Hz is selected, adapt the load-independent settings in *parameter 1-50 Motor Magnetisation at Zero Speed* to *parameter 1-53 Model Shift Frequency*. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. To run at 87 Hz, adapt *parameter 4-13 Motor Speed High Limit [RPM]* and *parameter 3-03 Maximum Reference*.
Parameter 1-24 Motor Current

Table 81: Parameter 1-24 Motor Current

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

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

Parameter 1-25 Motor Nominal Speed

Table 82: Parameter 1-25 Motor Nominal Speed

1-25 Motor Nominal Speed		
Default value: Size related	Parameter type: Range, 10 - 60000 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: False

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

$nm, n = ns - n\text{slip}$

Parameter 1-26 Motor Cont. Rated Torque

Table 83: Parameter 1-26 Motor Cont. Rated Torque

1-26 Motor Cont. Rated Torque		
Default value: Size related	Parameter type: Range, 0.1 - 100000.0 Nm	Setup: All setups
Conversion index: -1	Data type: Uint32	Change during operation: False

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*, that is, the parameter is valid for PM and non-salient SPM motors only.

Parameter 1-29 Automatic Motor Adaptation

Table 84: Parameter 1-29 Automatic Motor Adaptation (AMA)

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

N O T I C E

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.

N O T I C E

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

Option	Name	Description
		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.
[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.
[5]	Enable rotating AMA II	Performs rotation with 60% of nominal speed in Flux Sensorless with soft PID independent of selection in *parameter 1-01 Motor Control Principle*. Measures Back EMF on PM motors and re-measures main reactance (X_h) on induction motors. Ensure that the motor poles specified in *parameter 1-39 Motor Poles* are correct for accurate back EMF measurement.
[6]	Enable 360° turn OL	**Sensorless:** Performs a 360 degree test run in sensorless mode to verify the number of motor poles specified in *parameter 1-39 Motor Poles*. **Closed loop:** Performs a 360 degree test run in sensorless mode to test the encoder before running in closed loop. The speed is set in *parameter 3-19 Jog Speed [RPM]*. During the test run, the direction of rotation is verified and the number of pulses per revolution is verified to match the configuration in *parameter group 17-** Motor Feedb. Option* or *parameter group 5-** Digital In/Out* based on the selected encoder. After completing the 360 degree test run, either of the following messages are shown: • Encoder/Resolver OK • Encoder/Resolver Fail • Encoder/Resolver Inverted • Encoder/Resolver resolution/poles low • Encoder/Resolver resolution/poles high The *parameter 1-41 Motor Angle Offset* is automatically set when using PM motor and absolute encoder or resolver.
[7]	Enable inertia run	Use this option to ramp up in the mode as specified in *parameter 1-01 Motor Control Principle*. Measured inertia is set in *parameter 1-69 System Inertia* and *parameter 7-08 Speed PID Feed Forward Factor* is set to 90%.

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 1-2* Motor Data* is changed, *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-39 Motor Poles* return to default setting.

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.

4.2.5 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.

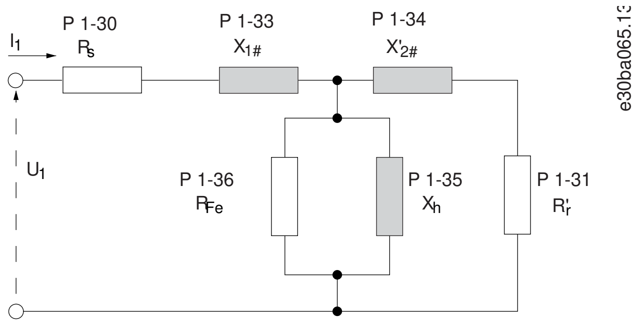


Illustration 28: Motor Equivalent Diagram of an Asynchronous Motor

Parameter 1-30 Stator Resistance (Rs)

Table 85: Parameter 1-30 Stator Resistance (Rs)

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

For salient PM motors: AMA is not available. If only line-line data is available, divide the line-line value by 2 to achieve the line-to-common (star point) value. Alternatively, measure the value with an ohmmeter. This also takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.

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*.

Parameter 1-31 Rotor Resistance (Rr)

Table 86: Parameter 1-31 Rotor Resistance (Rr)

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*, *[5] Sync. Reluctance*.

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.

Parameter 1-33 Stator Leakage Reactance (X1)

Table 87: Parameter 1-33 Stator Leakage Reactance (X1)

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*.

Parameter 1-34 Rotor Leakage Reactance (X2)

Table 88: Parameter 1-34 Rotor Leakage Reactance (X2)

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 asynchronous 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.

N O T I C E

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*.

Parameter 1-35 Main Reactance (Xh)

Table 89: Parameter 1-35 Main Reactance (X2)

1-35 Main Reactance (X2)		
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

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.

N O T I C E

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*.

Parameter 1-36 Iron Loss Resistance (Rfe)

Table 90: Parameter 1-36 Iron Loss Resistance (Rfe)

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

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.

Parameter 1-37 d-axis Inductance (Ld)

Table 91: Parameter 1-37 d-axis Inductance (Ld)

1-37 d-axis Inductance (Ld)		
Default value: 0.0 mH	Parameter type: Range, 0.0 - 1000.0 mH]	Setup: All setups
Conversion index: -4	Data type: Uint32	Change during operation: False

Enter line-to-common direct axis inductance of the PM motor. Obtain the value from the permanent magnet motor datasheet. If only line-line data is available, divide the line-line value by 2 to achieve the line-common (star point) value. Alternatively, measure the value with an inductance meter. This also takes the inductance of the cable into account. Divide the measured value by 2 and enter the result. This parameter is only active when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM* (Permanent Magnet Motor) or *[5] Sync. Reluctance*. For a selection with 1 decimal, use this parameter. For a selection with 3 decimals, use *parameter 30-80 daxis Inductance (Ld)*.

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*.

Parameter 1-38 q-axis Inductance (Lq)

Table 92: Parameter 1-38 q-axis Inductance (Lq)

1-38 q-axis Inductance (Lq)		
Default value: Size related	Parameter type: Range, 0.000 - 1000 mH]	Setup: All setups
Conversion index: -6	Data type: Uint32	Change during operation: False

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

Parameter 1-39 Motor Poles

Table 93: Parameter 1-39 Motor Poles

1-39 Motor Poles		
Default value: Size related	Parameter type: Range, 2 - 132	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: False

Enter the number of motor poles. Make sure not to enter pairs of motor poles.

Table 94: Pole Number for Normal Speed Ranges

Poles	$\sim n_n$@ 50 Hz	$\sim n_n$@ 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 in 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*.

Parameter 1-40 Back EMF at 1000 RPM

Table 95: Parameter 1-40 Back EMF at 1000 RPM

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	Change during operation: 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:

$$\text{Back EMF} = (\text{Voltage} \div \text{RPM}) \times 1000$$

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

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

N O T I C E

When using PM motors, it is recommended to use brake resistors.

Parameter 1-41 Motor Angle Offset

Table 96: Parameter 1-41 Motor Angle Offset

1-41 Motor Angle Offset		
Default value: 0	Parameter type: Range, -32768 - 32767	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

N O T I C E

This parameter is only active when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM* (permanent magnet motor).

Enter the correct offset angle between the PM motor and the index position (single-turn) of the attached encoder or resolver. The value range of 0-32768 corresponds to 0–2 x pi (radians). To obtain the offset angle value: After drive start-up, apply DC hold and enter the value of *parameter 16-20 Motor Angle* into this parameter.

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

Table 97: Parameter 1-44 d-axis Inductance Sat. (LdSat)

1-44 d-axis Inductance Sat. (LdSat)		
Default value: Size related	Parameter type: Range, 0 - 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.

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

Table 98: Parameter 1-45 q-axis Inductance Sat. (LqSat)

1-45 q-axis Inductance Sat. (LqSat)		
Default value: Size related	Parameter type: Range, 0 - 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.

Parameter 1-46 Position Detection Gain

Table 99: Parameter 1-46 Position Detection Gain

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 measure-ment.

Parameter 1-47 Torque Calibration

Table 100: Parameter 1-47 Torque Calibration

1-47 Torque Calibration		
Default value: Size related	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).*
[5]	Enable rotating AMA II	Performs rotation with 60% of nominal speed in Flux Sensorless with soft PID independent of selection in *parameter 1-01 Motor Control Principle*. Measures Back EMF on PM motors and re-measures main reactance (X_h) on induction motors. Ensure that the motor poles specified in *parameter 1-39 Motor Poles* are correct for accurate back EMF measurement.
[6]	Enable 360° turn OL	**Sensorless:** Performs a 360 degree test run in sensorless mode to verify the number of motor poles specified in *parameter 1-39 Motor Poles*. **Closed loop:** Performs a 360 degree test run in sensorless mode to test the encoder before running in closed loop. The speed is set in *parameter 3-19 Jog Speed [RPM]*. During the test run, the direction of rotation is verified and the number of pulses per revolution is verified to match the configuration in *parameter group 17-** Motor Feedb. Option* or *parameter group 5-** Digital In/Out* based on the selected encoder. After completing the 360 degree test run, either of the following messages are shown: • Encoder/Resolver OK • Encoder/Resolver Fail • Encoder/Resolver Inverted

Option	Name	Description
		• Encoder/Resolver resolution/poles low • Encoder/Resolver resolution/poles high *Parameter 1-41 Motor Angle Offset* is automatically set when using PM motor and absolute encoder or resolver.
[7]	Enable inertia run	Use this option to ramp up in the mode as specified in *parameter 1-01 Motor Control Principle*. Measured inertia is set in *parameter 1-69 System Inertia* and *parameter 7-08 Speed PID Feed Forward Factor* is set to 90%.

Parameter 1-48 d-axis Inductance Sat. Point

Table 101: Parameter 1-48 d-axis Inductance Sat. Point

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: True

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.

Parameter 1-49 q-axis Inductance Sat. Point

Table 102: Parameter 1-49 q-axis Inductance Sat. Point

1-49 q-axis Inductance Sat. Point		
Default value: Size related	Parameter type: Range, 0 - 200%	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.

4.2.6 1-5* Load Indep. Setting

Parameter 1-50 Motor Magnetization at Zero Speed

Table 103: Parameter 1-50 Motor Magnetization at Zero Speed

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

N O T I C E

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.

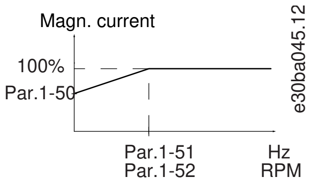


Illustration 29: Motor Magnetization

Parameter 1-51 Min Speed Normal Magnetising [RPM]

Table 104: Parameter 1-51 Min Speed Normal Magnetising [RPM]

1-51 Min Speed Normal Magnetising [RPM]		
Default value: Size related	Parameter type: Range, 10 - 600 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

N O T I C E

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*.

Parameter 1-52 Min Speed Normal Magnetising [Hz]

Table 105: Parameter 1-52 Min Speed Normal Magnetising [Hz]

1-52 Min Speed Normal Magnetising [Hz]		
Default value: Size Related	Parameter type: Range, 0 - 250.0 Hz	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

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*.

Parameter 1-53 Model Shift Frequency

Table 106: Parameter 1-53 Model Shift Frequency

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

N O T I C E

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 flux model 1 and flux model 2.
- 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*.

Flux model 1 - flux model 2: This model is used when *parameter 1-00 Configuration Mode* is set to *[1] Speed closed loop* or *[2] Torque*, and *parameter 1-01 Motor Control Principle* is set to *[3] Flux w/motor feedback*. With this parameter, it is possible to make an adjustment of the shifting point where the drive changes between flux model 1 and flux model 2, which is useful in some sensitive speed and torque control applications.

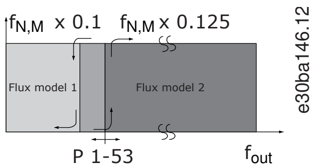


Illustration 30: Example of Parameter 1-00 Configuration Mode = [1] Speed closed loop or [2] Torque and parameter 1-01 Motor Control Principle = [3] Flux w/motor feedback

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.

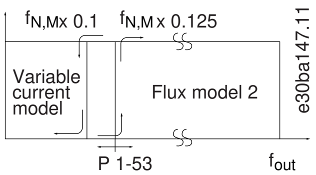


Illustration 31: Parameter 1-00 Configuration Mode = [0] Speed open loop, parameter 1-01 Motor Control Principle = [2] Flux sensorless

Parameter 1-54 Voltage Reduction in Fieldweakening

Table 107: Parameter 1-54 Voltage reduction in fieldweakening

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: False

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.

Parameter 1-55 U/f Characteristic - U

Table 108: Parameter 1-55 U/f Characteristic - U

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*.

Parameter 1-56 U/f Characteristic - F

Table 109: Parameter 1-56 U/f Characteristic - 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*.

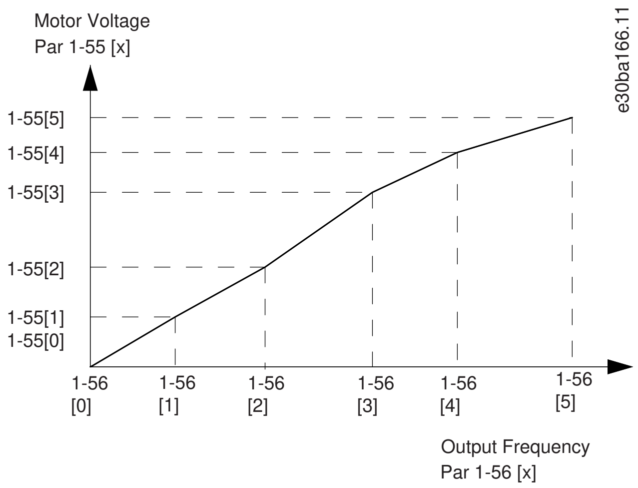


Illustration 32: U/f Characteristic

Parameter 1-58 Flying Start Test Pulses Current

Table 110: Parameter 1-58 Flying Start Test Pulses Current

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 has effect on PM motors only.

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, but may vary for PM motors. For adjusting PM motors, the value tunes for back EMF and d-axis inductance of the motor.

Parameter 1-59 Flying Start Test Pulses Frequency

Table 111: Parameter 1-59 Flying Start Test Pulses Frequency

1-59 Flying Start Test Pulses Frequency		
Default value: Size related	Parameter type: Range, 0 - 500%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: False

Asynchronous motor: Set the frequency of the flying start test pulses that are used to detect the motor direction. For asynchronous motors, the value 100% means that the slip is doubled. Increase this value to reduce the generated torque. For synchronous motors, this value is the percentage $n_{m,n}$ of the free-running motor. Above this value, flying start is always performed. Below this value, the start mode is selected in *parameter 1-70 Start Mode*.

4.2.7 1-6* Load Depend. Setting

Parameter 1-60 Low Speed Load Compensation

Table 112: Parameter 1-60 Low Speed Load Compensation

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

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	Changeover
0.25–7.5 kW	<10 Hz

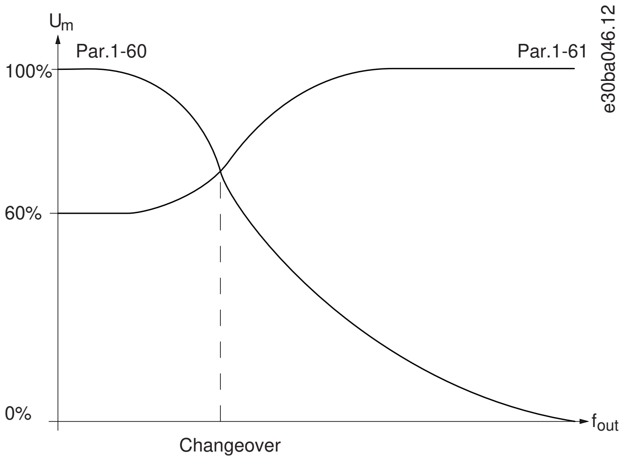


Illustration 33: Changeover

Parameter 1-61 High Speed Load Compensation

Table 113: Parameter 1-61 High 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

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

Parameter 1-62 Slip Compensation

Table 114: Parameter 1-62 Slip Compensation

1-62 Slip Compensation		
Default value: Size related	Parameter type: Range, -500 - 500%	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

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 $n_{M,N}$. This function is not active when *parameter 1-00 Configuration Mode* is set to *[1] Speed closed loop* or *[2] Torque* torque control with speed feedback or when *parameter 1-01 Motor Control Principle* is set to *[0] U/f*.

Parameter 1-63 Slip Compensation Time Constant

Table 115: Parameter 1-63 Slip Compensation Time Constant

1-63 Slip Compensation Time Constant		
Default value: Size related	Parameter type: Range, 0.05 - 5 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

N O T I C E

Parameter 1-63 Slip Compensation Time Constant has no effect when *parameter 1-10 Motor Construction = [1] PM, nonsalient SPM*.

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.

Parameter 1-64 Resonance Damping

Table 116: Parameter 1-64 Resonance Damping

1-64 Resonance Damping		
Default value: Size related	Parameter type: Range, 0 - 1000%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

N O T I C E

Parameter 1-64 Resonance Damping has no effect when *parameter 1-10 Motor Construction = [1] PM, nonsalient SPM*.

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*.

Parameter 1-65 Resonance Damping Time

Table 117: Parameter 1-65 Resonance Damping Time Constant

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

N O T I C E

Parameter 1-65 Resonance Damping Time Constant has no effect when *parameter 1-10 Motor Construction = [1] PM, non-salient SPM*.

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.

Parameter 1-66 Min. Current at Low Speed

Table 118: Parameter 1-66 Min. Current at Low Speed

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.

Parameter 1-67 Load Type

Table 119: Parameter 1-67 Load Type

1-67 Load Type		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint32	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.

Parameter 1-68 Motor Inertia

Table 120: Parameter 1-68 Motor Inertia

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.

Parameter 1-69 System Inertia

Table 121: Parameter 1-69 System Inertia

1-69 System Inertia		
Default value: Size related	Parameter type: Range, 0000 - 10000.0000 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* or *[3] Flux w/motor feedb*. 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.

4.2.8 1-7* Start Adjustments

Parameter 1-70 Start Mode

Table 122: Parameter 1-70 Start Mode

1-70 Start Mode		
Default value: [0] Rotor detection	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 VLT® AutomationDrive 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	

Parameter 1-71 Start Delay

Table 123: Parameter 1-71 Start Delay

1-71 Start Delay		
Default value: 0 s	Parameter type: Range, 0 - 25.5 s	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

This parameter refers to the start function selected in *parameter 1-72 Start Function*. Enter the time delay required before commencing acceleration.

Parameter 1-72 Start Function

Table 124: Parameter 1-72 Start Function

1-72 Start Function		
Default value: [2] Coast/delay time	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/ delay time	Energize the motor with a DC hold current (*parameter 2-00 DC Hold Current*) during the start delay time.
[1]	DC brake/ delay time	Energize the motor with a DC brake current (*parameter 2-01 DC Brake Current*) during the start delay time.
[2]*	Coast/delay time	Motor coasted during the start delay time (inverter off).
[3]	Start speed cw	Only possible with VVC$^+$. Connect the function described in *parameter 1-74 Start Speed [RPM]* and *parameter 1-76 Start Current* in the start delay time. Regardless of the value applied by the reference signal, the output speed applies the setting of the start speed in *parameter 1-74 Start Speed [RPM]* or *parameter 1-75 Start Speed [Hz]*, and the output current corresponds to the setting of the start current in *parameter 1-76*

Op-tion	Name	Description
		Start Current. This function is typically used in hoisting applications without counterweight and especially in applications with a cone-motor where the start is clockwise, followed by rotation in the reference direction.
[4]	Horizontal operation	Only possible with VVC⁺. For obtaining the function described in *parameter 1-74 Start Speed [RPM]* and *parameter 1-76 Start Current during the start delay time*. The motor rotates in the reference direction. If the reference signal equals 0, *parameter 1-74 Start Speed [RPM]* is ignored and the output speed equals 0. The output current corresponds to the setting of the start current in *parameter 1-76 Start Current*.
[5]	VVC⁺/flux clockwise	For the function described in *parameter 1-74 Start Speed [RPM]* only. The start current is calculated automatically. This function uses the start speed in the start delay time only. Regardless of the value set by the reference signal, the output speed equals the setting of the start speed in parameter 1-74 Start Speed [RPM]. *[3] Start speed/current clockwise* and *[5] VVC+/Flux clockwise* are typically used in hoisting applications. *[4] Start speed/current* in reference direction is particularly used in applications with counterweight and horizontal movement.
[6]	Hoist mech. brake rel	For utilizing mechanical brake control functions (*parameter 2-24 Stop Delay* to *parameter 2-28 Gain Boost Factor*). This parameter is only active in flux control principle, in a mode with motor feedback or sensorless mode.
[7]	VVC⁺/flux counter-cw	

Parameter 1-73 Flying Start

Table 125: Parameter 1-73 Flying Start

1-73 Flying Start		
Default value: Size related	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 flying start is enabled, *parameter 1-71 Start Delay* and *parameter 1-72 Start Function* have no function. When options *[1] Enable* and *[2] Enabled always* are enabled, *parameter 1-58 Flying Start Test Pulses Current* and *parameter 1-59 Flying Start Test Pulses Frequency* are used to specify conditions for flying start. For flying start version 1, options *[3] Enabled ref. dir.* and *[4] Enab. always ref. dir.* are set to search for the motor in the reference direction only, which allows a faster execution of the motor catch. For flying start version 2, options *[11]* to *[14]* are specific to asynchronous motor (induction motor) in VVC⁺ up to 132 Hz output frequency. These options provide a faster, more reliable, and robust flying start. 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 not finding the speed, it 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.

Parameter 1-74 Start Speed [RPM]

Table 126: Parameter 1-74 Start Speed [RPM]

1-74 Start Speed [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 a motor start speed. After the start signal, the output speed leaps to set value. Set the start function in *parameter 1-72 Start Function* to *[3] Start speed cw*, *[4] Horizontal operation*, or *[5] VVC+ /Flux clockwise*, and set a start delay time in *parameter 1-71 Start Delay*.

Parameter 1-75 Start Speed [Hz]

Table 127: Parameter 1-75 Start Speed [HZ]

1-75 Start Speed [HZ]		
Default value: Size related	Parameter type: Range, 0 - 500.0 Hz	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

This parameter can be used for hoist applications (cone rotor). Set a motor start speed. After the start signal, the output speed leaps to the set value. Set the start function in *parameter 1-72 Start Function* to *[3] Start speed cw*, *[4] Horizontal operation*, or *[5] VVC+/Flux clockwise*, and set a start delay time in *parameter 1-71 Start Delay*.

Parameter 1-76 Start Current

Table 128: Parameter 1-76 Start Current

1-76 Start Current		
Default value: 0 A	Parameter type: Range, 0 - par. 1-24 A	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Some motors, for example cone rotor motors, need extra current/starting speed to disengage the rotor. To obtain this boost, set the required current in *parameter 1-76 Start Current*. Set *parameter 1-74 Start Speed [RPM]*. Set *parameter 1-72 Start Function* to *[3] Start speed cw* or *[4] Horizontal operation*, and set a start delay time in *parameter 1-71 Start Delay*. This parameter can be used for hoist applications (cone rotor).

4.2.9 1-8* Stop Adjustments

Parameter 1-80 Function at Stop

Table 129: Parameter 1-80 Function at Stop

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]*.

Option	Name	Description
[0]*	Coast	Leaves motor in free mode. The motor is disconnected from the drive.
[1]	DC hold	Energizes the motor with a DC hold current (see *parameter 2-00 DC Hold Current*).
[2]	Motor check	Checks if a motor has been connected. The interval for checking the motor can be defined in *parameter 4-49 Motor Check Time Interval*.
[3]	Premagnetizing	Builds up a magnetic field while the motor is stopped. This allows the motor to produce torque quickly at subsequent start commands (asynchronous motors only). This premagnetizing function does not help the 1st start command. Two different solutions are available to premagnetize the machine for the 1st start command: • Start the drive with a 0 RPM reference and wait 2–4 rotor time constants before increasing the speed reference. • Use the start delay with DC hold: Set *parameter 1-71 Start Delay* to the required premagnetizing time (2–4 rotor time constants). See the time constants description further in this section. Set *parameter 1-72 Start Function* to either *[0] DC hold* or *[1] DC Brake*. Set the DC hold or DC brake current magnitude (*parameter 2-00 DC Hold Current* or *parameter 2-01 DC Brake Current*) to be equal to I_pre-mag = Unom/(1.73 x Xh). Sample rotor time constants = (Xh+X2)/(6.3*Freq_nom*Rr) • 1 kW = 0.2 s • 10 kW = 0.5 s • 100 kW = 1.7 s • 1000 kW = 2.5 s
[4]	DC voltage U0	When the motor is stopped, *parameter 1-55 U/f Characteristic - U [0]* defines the voltage at 0 Hz.

Option	Name	Description
[5]	Coast at low reference	When the reference is below *parameter 1-81 Min Speed for Function at Stop [RPM]*, the motor is disconnected from the drive.
[6]	Motor check, alarm	
[8]	Torque ramp to zero	

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

Table 130: Parameter 1-81 Min Speed for Function at Stop [RPM]

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*.

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

Table 131: Parameter 1-82 Min Speed for Function at Stop [Hz]

1-82 Min Speed for Function at Stop [Hz]		
Default value: Size related	Parameter type: Range, 0 - 500.0 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*.

Parameter 1-83 Precise Stop Function

Table 132: Parameter 1-83 Precise Stop Function

1-83 Precise Stop Function		
Default value: [0] Precise ramp stop	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

N O T I C E

This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	Precise ramp stop	Only optimal when the operational speed, for example, the operational speed of a conveyor belt, is constant. This is an open-loop control. Achieves high repetitive precision at the stop point.
[1]	Cnt stop with reset	Counts the number of pulses, typically from an encoder, and generates a stop signal after a preprogrammed number of pulses, defined in *parameter 1-84 Precise Stop Counter Value*, has been received at terminal 29 or terminal 33. This is direct feedback with one-way closed-loop control. The counter function is activated (starts timing) at the edge of the start signal (when it changes from stop to start). After each precise stop, the number of pulses counted during ramp-down to 0 RPM are reset.
[2]	Cnt stop w/o reset	Same as *[2] Cnt stop with reset* but the number of pulses counted during ramp down to 0 RPM are deducted from the counter value entered in *parameter 1-84 Precise Stop Counter Value*. This reset function can be used to compensate for the extra distance done during ramping down and to reduce the impacts of gradual wear of mechanical parts.

Op-tion	Name	Description
[3]	Speed comp stop	Stops at precisely the same point, regardless of the present speed. The stop signal is delayed internally when the present speed is lower than the maximum speed (set in *parameter 4-19 Max Output Frequency*). The delay is calculated on the basis of the reference speed of the drive and not on the basis of the actual speed. Make sure that the drive has ramped up before activating the speed–compensated stop.
[4]	Com cnt stop w/rst	Same as *[3] Speed comp stop* but after each precise stop, the number of pulses counted during ramp down to 0 RPM is reset.
[5]	Comp cnt stop w/o r	Same as *[3] Speed comp stop* but the number of pulses counted during ramp down to 0 RPM is deducted from the counter value entered in *parameter 1-84 Precise Stop Counter Value*. This reset function can be used to compensate for the extra distance done during ramping down and to reduce the impacts of gradual wear of mechanical parts.

The precise stop functions are advantageous in applications where high precision is required. If using a standard stop command, the accuracy is determined by the internal task time. That is not the case when using the precise stop function. It eliminates the task time dependence and increases the accuracy substantially. The drive tolerance is normally given by its task time. However, by using its special precise stop function, the tolerance is independent of the task time because the stop signal immediately interrupts the execution of the drive program. The precise stop function gives a highly reproducible delay from the stop signal is given until the ramping down starts. Run a test to find this delay as it is a sum of sensor, PLC, drive, and mechanical parts.

To ensure optimum accuracy, there should be at least 10 cycles during ramping down, see:

- *Parameter 3-42 Ramp 1 Ramp Down Time*
- *Parameter 3-52 Ramp 2 Ramp Down Time*
- *Parameter 3-62 Ramp 3 Ramp down Time*
- *Parameter 3-72 Ramp 4 Ramp Down Time*

The precise stop function is set up here and enabled from DI at terminal 29 or terminal 33.

Parameter 1-84 Precise Stop Counter Value

Table 133: Parameter 1-84 Precise Stop Counter Value

1-84 Precise Stop Counter Value		
Default value: 100000	Parameter type: Range, 0 - 999999999	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Enter the counter value to be used in the integrated precise stop function, *parameter 1-83 Precise Stop Function*. The maximum permissible frequency at terminal 29 or 33 is 110 kHz.

N O T I C E

Not used for selections *[0] Precise ramp stop* and *[3] Speed comp stop* in *parameter 1-83 Precise Stop Function*.

Parameter 1-85 Precise Stop Speed Compensation Delay

Table 134: Parameter 1-85 Precise Stop Speed Compensation Delay

1-85 Precise Stop Speed Compensation Delay		
Default value: 10 ms	Parameter type: Range, 0 - 100 ms	Setup: All setups
Conversion index: -3	Data type: Uint8	Change during operation: True

Enter the delay time for sensors, PLCs, and so on for use in *parameter 1-83 Precise Stop Function*. In speed–compensated stop mode, the delay time at different frequencies has a major influence on the stop function.

N O T I C E

Not used for selections *[0] Precise ramp stop*, *[1] Cnt stop with reset*, and *[2] Cnt stop w/o reset* in *parameter 1-83 Precise Stop Function*.

Parameter 1-89 Stop Func Torque Ramp Time

Table 135: Parameter 1-89 Stop Func Torque Ramp Time

1-89 Stop Func Torque Ramp Time		
Default value: 0.01 s	Parameter type: Range, 0.01 - 3600.00 s	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Configure the time in seconds during which the torque is ramped to 0, after the motor speed is ramped down to the minimum speed as specified in *parameter 1-81 Min Speed for Function at Stop [RPM]*.

4.2.10 1-9* Motor Temperature

Parameter 1-90 Motor Thermal Protection

Table 136: Parameter 1-90 Motor Thermal Protection

1-90 Motor Thermal Protection		
Default value: Size related	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 chapter 3.2.13 PTC Thermistor Connection.
- Via a KTY sensor in the motor winding connected to an analog input (*parameter 1-96 Thermistor Sensor Resource*). See chapter 3.2.14 KTY Sensor 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 chapter 3.2.15 ETR.
- Via a mechanical thermal switch (Klixon type). See chapter 3.2.17 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 or KTY sensor in the motor reacts in the event of motor overtemperature.
[2]	Thermistor trip	Stops (trips) the drive when connected thermistor or KTY sensor in the motor reacts in the event of motor overtemperature. The thermistor cutout value must be more than 3 kΩ. Integrate a thermistor (PTC sensor) in the motor for winding protection.
[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 set-up 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	
[6]	ETR trip 2	
[7]	ETR warning 3	

Option	Name	Description
[8]	ETR trip 3	
[9]	ETR warning 4	
[10]	ETR trip 4	
[21]	Advanced ETR	

Parameter 1-91 Motor External Fan

Table 137: Parameter 1-91 Motor External Fan

1-91 Motor External Fan		
Default value: Size related	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 Illustration 38 (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.

Parameter 1-93 Thermistor Resource

Table 138: Parameter 1-93 Thermistor Resource

1-93 Thermistor Resource		
Default value: [0] None	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

N O T I C E

This parameter cannot be adjusted while the motor is running.

N O T I C E

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

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	

Option	Name	Description
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	

Parameter 1-95 Thermistor Sensor Type

Table 139: Parameter 1-95 Thermistor Sensor Type

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).
[3]	Pt1000	
[4]	Ni1000 (6178 ppm/K)	
[5]	Ni1000-LG (TC5)	Examples: • Siemens LG-Ni1000 • Tasseron RTD Ni1000-TC5 1000 Ohm

Parameter 1-96 Thermistor Sensor Resource

Table 140: Parameter 1-96 Thermistor Sensor Resource

1-96 Thermistor Sensor Resource		
Default value: [0] None	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Selecting analog input terminal 54 to be used as thermistor sensor input. 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	

Parameter 1-97 Thermistor Threshold Level

Table 141: Parameter 1-97 Thermistor Threshold Level

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.

4.2.10.1 PTC Thermistor Connection

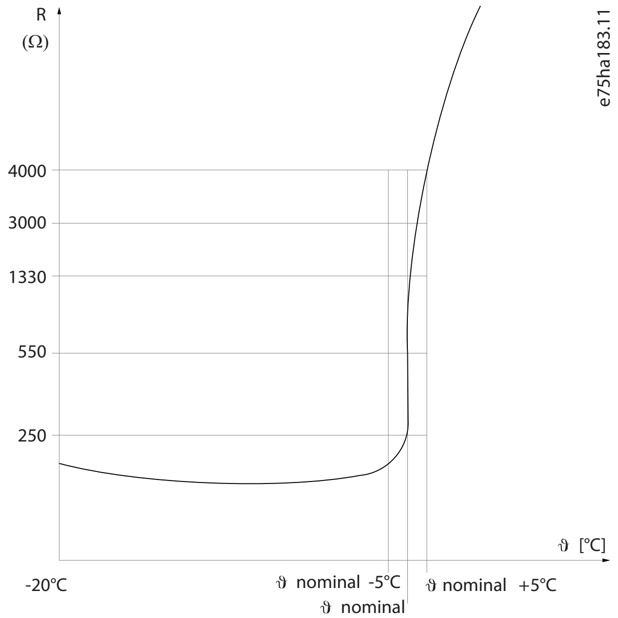


Illustration 34: PTC Profile

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

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

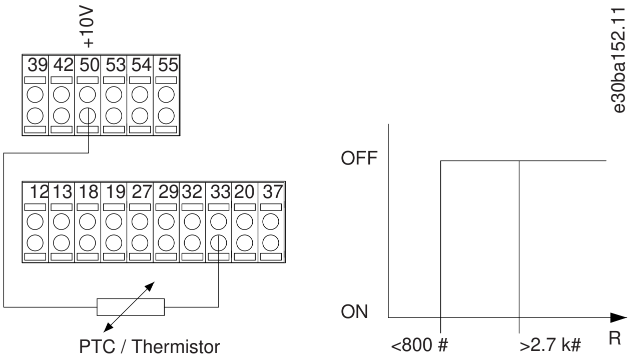


Illustration 35: PTC Thermistor Connection - Digital Input

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

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

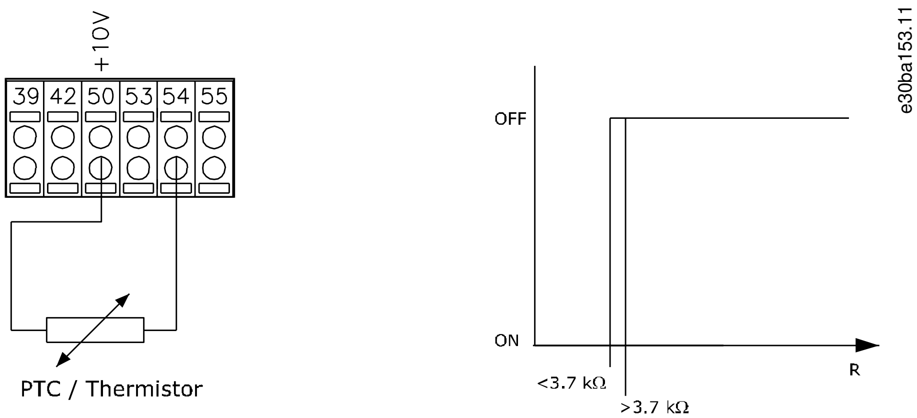


Illustration 36: PTC Thermistor Connection - Analog Input

Table 142: 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.

4.2.10.2 KTY Sensor Connection

KTY sensors are used especially in permanent magnet servo motors (PM motors) for dynamic adjusting of motor parameters as stator resistance (*parameter 1-30 Stator Resistance (Rs)*) for PM motors and also rotor resistance (*parameter 1-31 Rotor Resistance (Rr)*) for asynchronous motors, depending on winding temperature. The calculation is:

$Rs = Rs_{20^\circ C} \times (1 + \alpha_{cu} \times \Delta T)\ \Omega$ where $\alpha_{cu} = 0 . 00393$

KTY sensors can be used for motor protecting (*parameter 1-97 KTY Threshold level*). can handle 3 types of KTY sensors, defined in *parameter 1-95 KTY Sensor Type*. The actual sensor temperature can be read out from *parameter 16-19 KTY sensor temperature*.

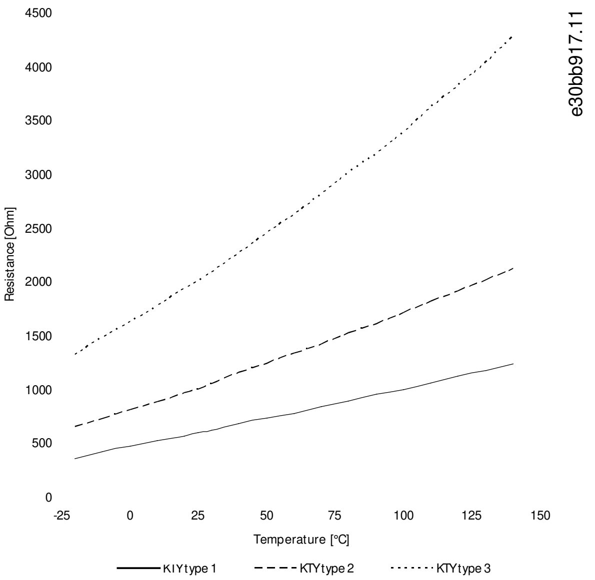


Illustration 37: KTY Type Selection

KTY Sensor 1: 1 kΩ at 100 °C (212 °F) (for example Philips KTY 84-1)

KTY Sensor 2: 1 kΩ at 25 °C (77 °F) (for example Philips KTY 83-1)

KTY Sensor 3: 2 kΩ at 25 °C (77 °F) (for example Infineon KTY-10)

N O T I C E

If the temperature of the motor is utilized through a thermistor or KTY sensor, the PELV is not complied with if there are short circuits between motor windings and the sensor. Put extra isolation on the sensor to comply with PELV.

4.2.10.3 ETR

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

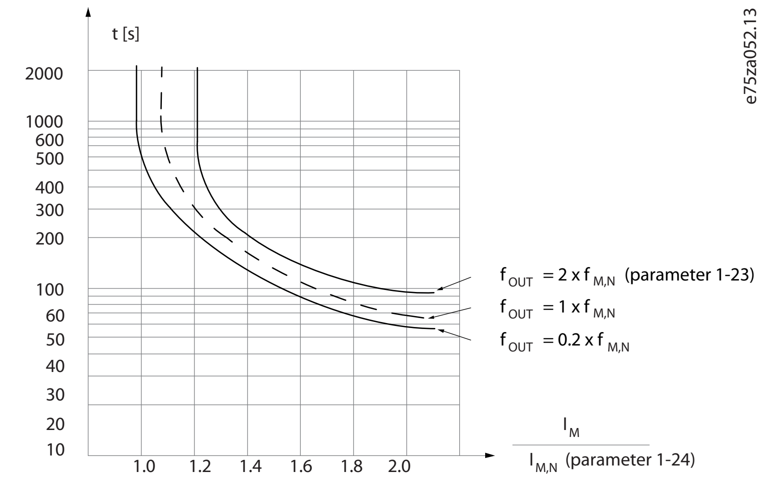


Illustration 38: ETR Profile

4.2.10.4 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*.

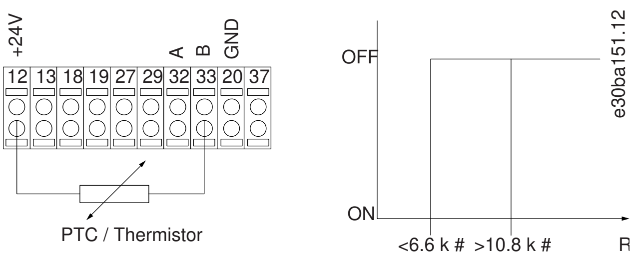


Illustration 39: Thermistor Connection

4.2.11 PM Settings

If *[2] Std. PM, non-salient* is selected in *parameter 1-10 Motor Construction*, enter the motor parameters manually in the following order:

- *Parameter 1-24 Motor Current*.
- *Parameter 1-26 Motor Cont. Rated Torque*.
- *Parameter 1-25 Motor Nominal Speed*.
- *Parameter 1-39 Motor Poles*.
- *Parameter 1-30 Stator Resistance (Rs)*.
- *Parameter 1-37 d-axis Inductance (Ld)*.
- *Parameter 1-40 Back EMF at 1000 RPM*.

The following parameters have been added for PM motors.

- *Parameter 1-41 Motor Angle Offset*.
- *Parameter 1-07 Motor Angle Offset Adjust*.
- *Parameter 1-14 Damping Gain*.

- *Parameter 1-47 Torque Calibration*.
- *Parameter 1-58 Flying Start Test Pulses Current*.
- *Parameter 1-59 Flying Start Test Pulses Frequency*.
- *Parameter 1-70 Start Mode*.
- *Parameter 30-20 High Starting Torque Time [s]*.
- *Parameter 30-21 High Starting Torque Current [%]*.

N O T I C E

Standard parameters still need configuration (for example *parameter 4-19 Max Output Frequency*).

Table 143: Recommendations for VVC+ 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 calculated 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* (>100% for longer time can overheat the motor).

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, a good value for this parameter can be 10% or 100% higher than the default value.

Adjust starting torque in *parameter 1-66 Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

Table 144: Recommendations for Flux Applications

Application	Settings
Low inertia applications	Keep calculated values.
High inertia applications	*Parameter 1-66 Min. Current at Low Speed*. Increase speed to a value between default and maximum depending on application. Set ramp times matching the application. Too fast ramp-up causes an overcurrent/overtorque. Too fast ramp-down causes an overvoltage trip.
High load at low speed	*Parameter 1-66 Min. Current at Low Speed.* Increase speed to a value between default and maximum depending on application.

Adjust starting torque in *parameter 1-66 Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

4.3 Parameter Group 2-** Brakes

4.3.1 2-0* DC Brakes

Parameter group for configuring the DC brake and DC hold functions.

Parameter 2-00 DC Hold Current

Table 145: Parameter 2-00 DC Hold Current

2-00 DC Hold Current		
Default value: 50%	Parameter type: Range, -40 - 160%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

N O T I C E

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 is 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 [0]* or *parameter 1-80 Function at Stop [1]*.

Parameter 2-01 DC Brake Current

Table 146: Parameter 2-01 DC Brake Current

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

N O T I C E

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*.

Parameter 2-02 DC Braking Time

Table 147: 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.

Parameter 2-03 DC Brake Cut In Speed [RPM]

Table 148: Parameter 2-03 DC Brake Cut In Speed [RPM]

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.

Parameter 2-04 DC Brake Cut In Speed [Hz]

Table 149: Parameter 2-04 DC Brake Cut In Speed [Hz]

2-04 DC Brake Cut In Speed [Hz]		
Default value: Size related	Parameter type: Range, 0 - par. 4-14 RPM	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

NOTICE

Parameter 2-04 DC Brake Cut In Speed [Hz] is not effective when *parameter 1-10 Motor Construction = [1] PM, nonsalient SPM*.

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.

Parameter 2-05 Maximum Reference

Table 150: Parameter 2-05 Maximum Reference

2-05 Maximum Reference		
Default value: Size related	Parameter type: Range, par. 3-02 - 999999.999 Reference- FeedbackUnit	Setup: All setups
Conversion index: -3	Data type: Int32	Change during operation: True

This is an access parameter to *parameter 3-03 Maximum Reference* for legacy products. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the option selected in *parameter 1-00 Configuration Mode* and the unit in *parameter 3-01 Reference/Feedback Unit*.

Parameter 2-06 Parking Current

Table 151: Parameter 2-06 Parking Current

2-06 Parking Current		
Default value: 50%	Parameter type: Range, 0 - 1000%	Setup: All setups
Conversion index: 0	Data type: Uint32	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*.

Parameter 2-07 Parking Time

Table 152: Parameter 2-07 Parking Time

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.

4.3.2 2-1* Brake Energy Funct.

Parameter group for selecting dynamic brake parameters. Only valid for drives with brake choppers.

Parameter 2-10 Brake Function

Table 153: Parameter 2-10 Brake Function

2-10 Brake Function		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Op-tion	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.

Parameter 2-11 Brake Resistor (ohm)

Table 154: Parameter 2-11 Brake Resistor (ohm)

2-11 Brake Resistor (ohm)		
Default value: Size related	Parameter type: Range, 0 - 65535 Ohm	Setup: All setups
Conversion index: 0	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)*.

Parameter 2-12 Brake Power Limit (kW)

Table 155: Parameter 2-12 Brake Power Limit (kW)

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.

$$P\text{br, avg}[W] = \frac{U^2\text{br}[V] \times t\text{br}[s]}{R\text{br}[\Omega] \times T\text{br}[s]}$$

$P_{br,avg}$ 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:

- T2 units: 390 V
- T5 units: 810 V
- T6 units: 943 V/1099 V for D 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)*.

Parameter 2-13 Brake Power Monitoring

Table 156: Parameter 2-13 Brake Power Monitoring

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, trip, and alarm.
[4]	Warning 30s	
[5]	Trip 30s	
[6]	Warning & trip 30s	
[7]	Warning 60s	
[8]	Trip 60s	
[9]	Warning & trip 60s	
[10]	Warning 300s	
[11]	Trip 300s	
[12]	Warning & trip 300s	
[13]	Warning 600s	
[14]	Trip 600s	
[15]	Warning & trip 600s	

Parameter 2-15 Brake Check

Table 157: Parameter 2-15 Brake Check

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.
[5]	Trip lock	

Parameter 2-16 AC Brake Max. Current

Table 158: Parameter 2-16 AC Brake Max. Current

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*.

Parameter 2-17 Over-voltage Control

Table 159: Parameter 2-17 Over-voltage Control

2-17 Over-voltage Control		
Default value: [0] Disabled	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.
[1]	Enabled (not at stop)	Activates OVC except when using a stop signal to stop the drive.
[2]	Enabled	Activates OVC.

Parameter 2-18 Brake Check Condition

Table 160: Parameter 2-18 Brake Check Condition

2-18 Brake Check Condition		
Default value: [0] At power up	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]*	At power up	Brake check at power up.
[1]	After coast situations	Brake check is performed after cost situations.

Parameter 2-19 Over-voltage Gain

Table 161: Parameter 2-19 Over-voltage Gain

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

Select overvoltage gain.

4.3.3 2-2* Mechanical Brake

Parameters for controlling operation of an electro-magnetic (mechanical) brake, typically required in hoisting applications.

To control a mechanical braking, a relay output (relay 01 or relay 02) or a programmed digital output (terminal 27 or 29) is required. Normally, this output must be closed during periods when the drive is unable to hold the motor, for example due to an excessive load. Select *[32] Mechanical Brake Control* for applications with an electro-magnetic brake in *parameter 5-40 Function Relay*, *parameter 5-30 Terminal 27 Digital Output*, or *parameter 5-31 Terminal 29 Digital Output*. When selecting *[32] Mechanical brake control*, the mechanical brake is closed from start-up until the output current is above the level selected in *parameter 2-20 Release Brake Current*. During stop, the mechanical braking activates when the speed drops below the level specified in *parameter 2-21 Activate Brake Speed [RPM]*. If the drive enters an alarm condition, an overcurrent, or overvoltage situation, the mechanical braking immediately cuts in. This is also the case during Safe Torque Off.

NOTICE

Protection mode and trip delay features (*parameter 14-25 Trip Delay at Torque Limit* and *parameter 14-26 Trip Delay at Inverter Fault*) may delay the activation of the mechanical braking in an alarm condition. These features must be disabled in hoisting applications.

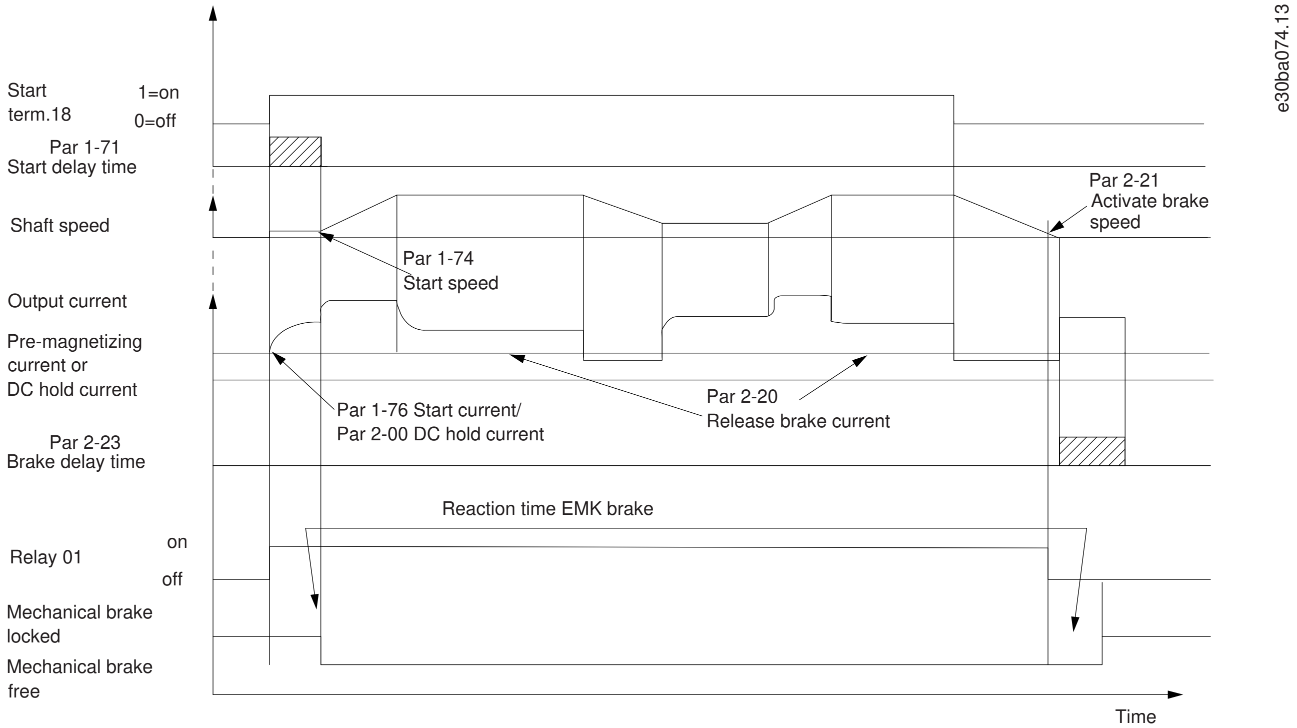


Illustration 40: Mechanical Braking

Parameter 2-20 Release Brake Current

Table 162: Parameter 2-20 Release Brake Current

2-20 Release Brake Current		
Default value: Size related	Parameter type: Range, 10 - par. 16-37 A	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Set the motor current for release of the mechanical braking when a start condition is present. The default value is the maximum current the inverter can provide for the particular power size. The upper limit is specified in *parameter 16-37 Inv. Max. Current*.

NOTICE

When mechanical brake control output is selected, but no mechanical braking is connected, the function does not work by default setting due to too low motor current.

Parameter 2-21 Activate Brake Speed [RPM]

Table 163: Parameter 2-21 Activate Brake Speed [RPM]

2-21 Activate Brake Speed [RPM]		
Default value: Size related	Parameter type: Range, 0 - par. 4-53 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Set the motor speed for activation of the mechanical braking when a stop condition is present. The upper speed limit is specified in *parameter 4-53 Warning Speed High*.

Parameter 2-22 Activate Brake Speed [Hz]

Table 164: Parameter 2-22 Activate Brake Speed [Hz]

2-22 Activate Brake Speed [Hz]		
Default value: Size related	Parameter type: Range, 0 - 5000.0 Hz	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Set the motor frequency for activation of the mechanical braking when a stop condition is present.

Parameter 2-23 Activate Brake Delay

Table 165: Parameter 2-23 Activate Brake Delay

2-23 Activate Brake Delay		
Default value: 0 s	Parameter type: Range, 0 - 5 s	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

Enter the brake delay time of the coast after ramp-down time. The shaft is held at 0 speed with full holding torque. Ensure that the mechanical braking has locked the load before the motor enters coast mode. To adjust transition of the load to the mechanical braking, set *parameter 2-23 Activate Brake Delay* and *parameter 2-24 Stop Delay*. Setting of brake delay parameters does not affect the torque. The drive does not register that mechanical braking is holding the load. After setting *parameter 2-23 Activate Brake Delay*, the torque drops to 0 after a few minutes. The sudden torque change leads to movement and noise.

Parameter 2-24 Stop Delay

Table 166: Parameter 2-24 Stop Delay

2-24 Stop Delay		
Default value: 0 s	Parameter type: Range, 0 - 5 s	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

Set the time interval from the moment when the motor is stopped until the brake closes. To adjust transition of the load to the mechanical braking, set *parameter 2-23 Activate Brake Delay* and *parameter 2-24 Stop Delay*. This parameter is a part of the stop function.

Parameter 2-25 Brake Release Time

Table 167: Parameter 2-25 Brake Release Time

2-25 Brake Release Time		
Default value: 0.20 s	Parameter type: Range, 0 - 5 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

This value defines the time it takes for the mechanical brake to open. This parameter must act as a timeout when brake feedback is activated.

Parameter 2-26 Torque Ref

Table 168: Parameter 2-26 Torque Ref

2-26 Torque Ref		
Default value: 0%	Parameter type: Range, -300 - 300%	Setup: All setups
Conversion index: -2	Data type: Int16	Change during operation: True

The value defines the torque applied against the closed mechanical brake before release. The torque/load on a crane is positive and is 10–160%. To obtain the best starting point, set *parameter 2-26 Torque Ref* to approximately 70%. The torque/load on a lift can be both positive and negative and between -160% and +160%. To obtain the best starting point, set *parameter 2-26 Torque Ref* to 0%. The higher the torque error is (*parameter 2-26 Torque Ref* vs. actual torque), the more movement during load takeover.

Parameter 2-27 Torque Ramp Up Time

Table 169: Parameter 2-27 Torque Ramp Up Time

2-27 Torque Ramp Up Time		
Default value:0.2 s	Parameter type: Range, 0 - 5 s	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

The value defines the duration of the torque ramp in clockwise direction. Value 0 enables very fast magnetization in flux control principle.

Parameter 2-28 Gain Boost Factor

Table 170: Parameter 2-28 Gain Boost Factor

2-28 Gain Boost Factor		
Default value:1	Parameter type: Range, 0 - 4	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Only active in flux closed loop. The function ensures a smooth transition from torque control mode to speed control mode when the motor takes over the load from the brake. Increase to minimize the movement. Activate the advanced mechanical braking (*parameter group 2-3* Adv. Mech Brake*) by setting *parameter 2-28 Gain Boost Factor* to 0.

Parameter 2-29 Torque Ramp Down Time

Table 171: Parameter 2-29 Torque Ramp Down Time

2-29 Torque Ramp Down Time		
Default value:0 s	Parameter type: Range, 0 - 5 s	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

Torque ramp-down time.

4.3.3.1 Hoist Mechanical Brake

The hoist mechanical brake control supports the following functions:

- 2 channels for mechanical braking feedback to offer further protection against unintended behavior resulting from broken cable.
- Monitoring of mechanical braking feedback throughout the complete cycle. This helps protect the mechanical brake, especially if more drives are connected to the same shaft.
- No ramp-up until feedback confirms that mechanical brake is open.
- Improved load control at stop. If the value of *parameter 2-23 Activate Brake Delay* is too low, Warning 22 Hoist mech. brake is activated and the torque is not allowed to ramp down.
- The transition when motor takes over the load from the brake can be configured. *Parameter 2-28 Gain Boost Factor* can be increased to minimize the movement. To achieve smooth transition, change the setting from the speed control to the position control during the changeover.
- Set *parameter 2-28 Gain Boost Factor* to 0 to enable position control during *parameter 2-02 DC Braking Time*. This enables *parameter 2-30 Position P Start Proportional Gain* to *parameter 2-33 Speed PID Start Lowpass Filter Time*, which are PID parameters for the position control.

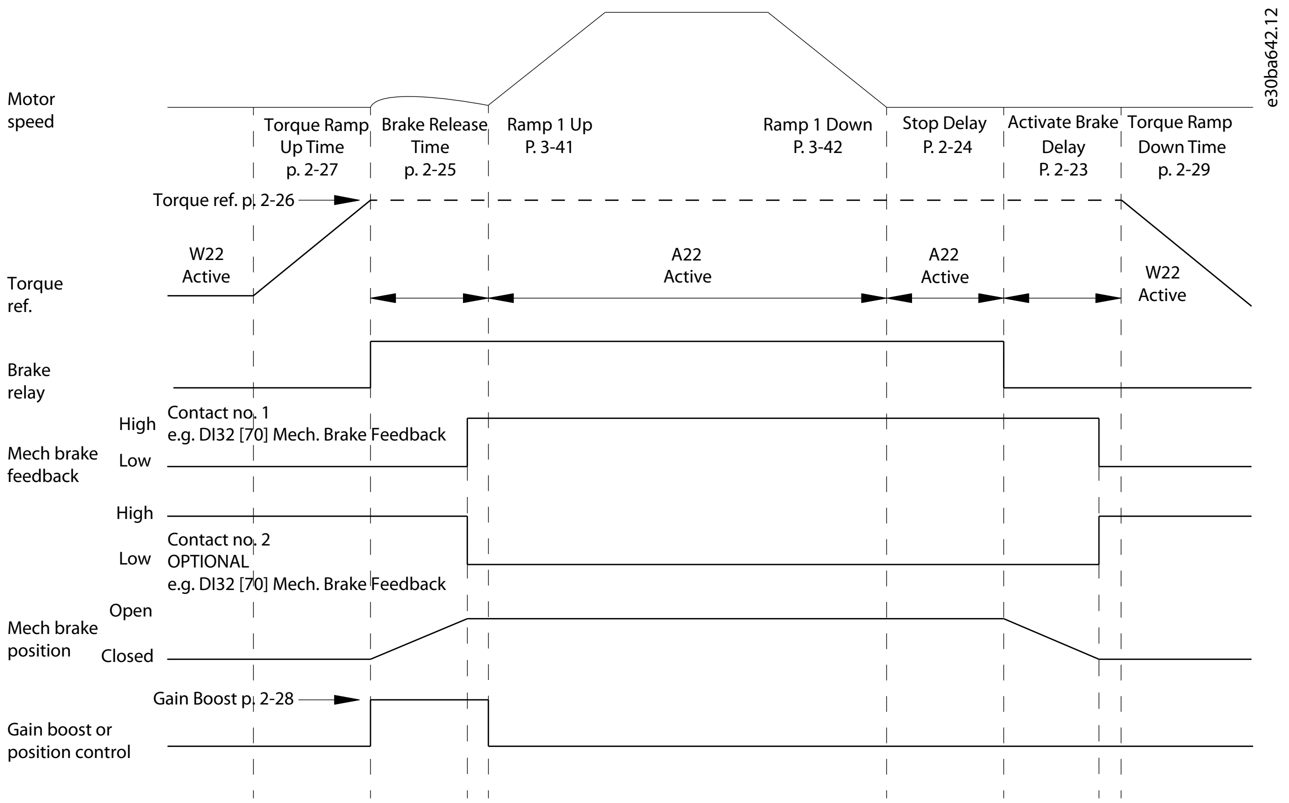


Illustration 41: Brake Release Sequence for Hoist Mechanical Brake Control

Parameter 2-26 Torque Ref to *parameter 2-33 Speed PID Start Lowpass Filter Time* are only available for the hoist mechanical brake control (flux with motor feedback).

4.3.4 2-3* Adv. Mech Brake

Parameter 2-30 Position P Start Proportional Gain to *parameter 2-33 Speed PID Start Lowpass Filter Time* can be set up for very smooth transition change from speed control to position control during *parameter 2-25 Brake Release Time* - the time when the load is transferred from the mechanical brake to the drive. *Parameter 2-30 Position P Start Proportional Gain* to *parameter 2-33 Speed PID Start Lowpass Filter Time* are activated when *parameter 2-28 Gain Boost Factor* is set to 0.

Parameter 2-30 Position P Start Proportional Gain

Table 172: Parameter 2-30 Position P Start Proportional Gain

2-30 Position P Start Proportional Gain		
Default value:0.0000	Parameter type: Range, 0.0000 - 1.0000	Setup: All setups
Conversion index: -4	Data type: Uint32	Change during operation: True

Enter the position controller during start proportional gain. Quick control is obtained at high amplification. However, if the amplification is too high, the process may become unstable.

Parameter 2-31 Speed PID Start Proportional Gain

Table 173: Parameter 2-31 Speed PID Start Proportional Gain

2-31 Speed PID Start Proportional Gain		
Default value: 0.0150	Parameter type: Range, 0.0000 - 1.0000	Setup: All setups
Conversion index: -4	Data type: Uint32	Change during operation: True

Enter the speed controller proportional gain during start. Quick control is obtained at high amplification. However, if amplification is too high, the process may become unstable.

Parameter 2-32 Speed PID Start Integral Time

Table 174: Parameter 2-32 Speed PID Start Integral Time

2-32 Speed PID Start Integral Time		
Default value: 200.0 ms	Parameter type: Range, 1.0 - 20000.0 ms	Setup: All setups
Conversion index: -4	Data type: Uint32	Change during operation: True

Enter the speed controller integral time. 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.

Parameter 2-33 Speed PID Start Lowpass Filter Time

Table 175: Parameter 2-33 Speed PID Start Lowpass Filter Time

2-33 Speed PID Start Lowpass Filter Time		
Default value: 10.0 ms	Parameter type: Range, 0.1 - 100.0 ms	Setup: All setups
Conversion index: -4	Data type: Uint16	Change during operation: True

Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. However, severe filtering can be detrimental to dynamic performance.

4.4 Parameter Group 3-** Reference/Ramps

Parameters for handling of reference, definition of limitations, and configuration of the reaction of the drive to changes.

4.4.1 3-0* Reference Limits

Parameter 3-00 Reference Range

Table 176: Parameter 3-00 Reference Range

3-00 Reference Range		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. The minimum limit may have a negative value, unless *[1] Speed closed loop control* or *[3] Process* is selected in *parameter 1-00 Configuration Mode*.

Option	Name	Description
[0]	Min - Max	Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. The minimum limit may have a negative value, unless *[1] Speed closed loop control* or *[3] Process* is selected in *parameter 1-00 Configuration Mode*.
[1]	-Max - +Max	For both positive and negative values (both directions, relative to *parameter 4-10 Motor Speed Direction*).

Parameter 3-01 Reference/Feedback Unit

Table 177: Parameter 3-01 Reference/Feedback Unit

3-01 Reference/Feedback Unit		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the unit to be used in process PID control references and feedbacks. *Parameter 1-00 Configuration Mode* must be either *[3] Process* or *[8] Extended PID Control*.

Option	Name	Description
[0]	None	
[1]	%	
[2]	RPM	
[3]	Hz	
[4]	Nm	
[5]	PPM	
[10]	l/min	
[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	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	

Option	Name	Description
[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	
[150]	lb ft	
[160]	°F	
[170]	psi	
[171]	lb/in^3	
[172]	in WG	
[173]	ft WG	
[180]	HP	

4.4.2 3-1* References

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

Parameter 3-10 Preset Reference

Table 178: Parameter 3-10 Preset Reference

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*.

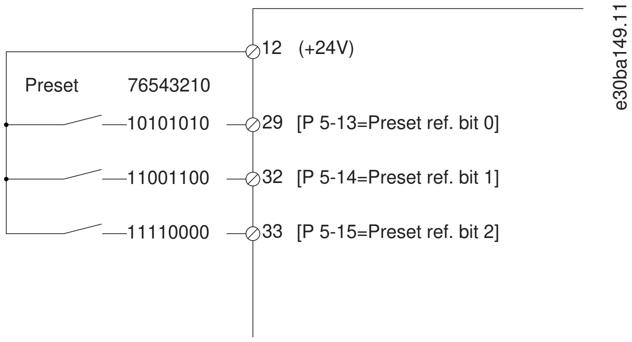


Illustration 42: Preset Reference

Table 179: 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
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

Parameter 3-11 Jog Speed [Hz]

Table 180: Parameter 3-11 Jog Speed [Hz]

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*.

Parameter 3-12 Catch Up/Slow Down Value

Table 181: Parameter 3-12 Catch Up/Slow Down Value

3-12 Catch Up/Slow Down Value		
Default value: 0%	Parameter type: Range, 0 - 100%	Setup: All setups
Conversion index: -2	Data type: Int16	Change during operation: True

Enter a percentage (relative) value to be either added to or deducted from the actual reference for catch up or slow down. If catch up is selected via 1 of the digital inputs (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-15 Terminal 33 Digital Input*), the percentage (relative) value is added to the total reference. If slow down is selected via 1 of the digital inputs (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-15 Terminal 33 Digital Input*), the percentage (relative) value is deducted from the total reference. Obtain extended functionality with the DigiPot function. See *parameter group 3-9* Digital Potentiometer*.

Parameter 3-13 Reference Site

Table 182: Parameter 3-13 Reference Site

3-13 Reference Site		
Default value: Size related	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.

4.4.3 3-4* Ramp 1

For each of the 4 ramps (*parameter groups 3-4* Ramp 1*, *3-5* Ramp 2*, *3-6* Ramp 3*, and *3-7* Ramp 4*) configure the ramp parameters:

- 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 Illustration 43 and Illustration 44.

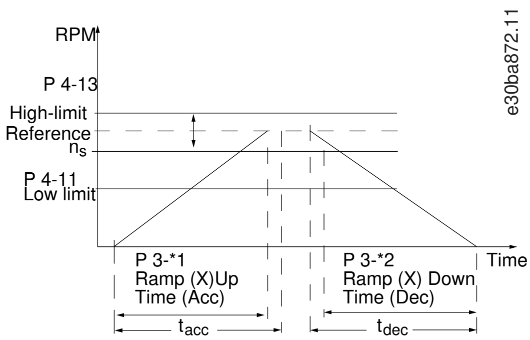


Illustration 43: Linear Ramping Times

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.

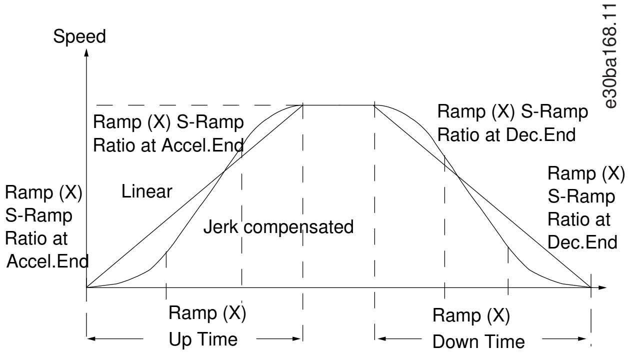


Illustration 44: Linear Ramping Times

Parameter 3-40 Ramp 1 Type

Table 183: Parameter 3-40 Ramp 1 Type

3-40 Ramp 1 Type		
Default value: [1] Linear	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

NOTICE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realize a jerk-free movement, which may result in a longer start or stop time. Extra adjustment of the S-ramp ratios or switching initiators may be necessary.

Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application.

Option	Name	Description
[0]*	Linear	
[1]	S-ramp Const Jerk	Acceleration with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *parameter 3-41 Ramp 1 Ramp Up Time* and *parameter 3-42 Ramp 1 Ramp Down Time*.

Parameter 3-41 Ramp 1 Ramp Up Time

Table 184: Parameter 3-41 Ramp 1 Ramp Up Time

3-41 Ramp 1 Ramp Up Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the synchronous motor speed n_S. Select a ramp-up time which prevents the output current from exceeding the current limit in *parameter 4-18 Current Limit during ramping*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*.

$$\text{Par. } 3-41 = \frac{tacc\,[s] \times ns\,[\text{RPM}]}{\text{ref}\,[\text{RPM}]}$$

Parameter 3-42 Ramp 1 Ramp Down Time

Table 185: Parameter 3-42 Ramp 1 Ramp Down Time

3-42 Ramp 1 Ramp Down Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the synchronous motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time*.

$$\text{Par. } 3-42 = \frac{t\text{dec } [s] \times ns \text{ [RPM]}}{\text{ref [RPM]}}$$

Parameter 3-45 Ramp 1 S-ramp Ratio at Accel. Start

Table 186: Parameter 3-45 Ramp 1 S-ramp Ratio at Accel. Start

3-45 Ramp 1 S-ramp Ratio at Accel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-41 Ramp 1 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks occurring in the application.

Parameter 3-46 Ramp 1 S-ramp Ratio Accel. End

Table 187: Parameter 3-46 Ramp 1 S-ramp Ratio at Accel. End

3-46 Ramp 1 S-ramp Ratio at Accel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-41 Ramp 1 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-47 Ramp 1 S-ramp Ratio at Decel. Start

Table 188: Parameter 3-47 Ramp 1 S-ramp Ratio at Decel. Start

3-47 Ramp 1 S-ramp Ratio at Decel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-48 Ramp 1 S-ramp Ratio at Decel. End

Table 189: Parameter 3-48 Ramp 1 S-ramp Ratio at Decel. End

3-48 Ramp 1 S-ramp Ratio at Decel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

4.4.4 3-5* Ramp 2

Parameter 3-50 Ramp 2 Type

Table 190: Parameter 3-50 Ramp 2 Type

3-50 Ramp 2 Type		
Default value: [1] Linear	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

N O T I C E

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realize a jerk-free movement, which may result in a longer start or stop time. Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application.

Option	Name	Description
[0]*	Linear	
[1]	S-ramp Const Jerk	Acceleration with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *parameter 3-51 Ramp 2 Ramp Up Time* and *parameter 3-52 Ramp 2 Ramp Down Time*.

Parameter 3-51 Ramp 2 Ramp Up Time

Table 191: Parameter 3-51 Ramp 2 Ramp Up Time

3-51 Ramp 2 Ramp Up Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed ns. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-52 Ramp 2 Ramp Down Time*.

$$\text{Par. } 3-51 = \frac{t\text{acc}\,[s] \times ns\,[\text{RPM}]}{\text{ref}\,[\text{RPM}]}$$

Parameter 3-52 Ramp 2 Ramp Down Time

Table 192: Parameter 3-52 Ramp 2 Ramp Down Time

3-52 Ramp 2 Ramp Down Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage occurs in the drive due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-51 Ramp 2 Ramp Up Time*.

$$\text{Par. } 3-52 = \frac{t\text{dec }[s] \times ns\text{ [RPM]}}{\text{ref [RPM]}}$$

Parameter 3-55 Ramp 2 S-ramp Ratio at Accel. Start

Table 193: Parameter 3-55 Ramp 2 S-ramp Ratio at Accel. Start

3-55 Ramp 2 S-ramp Ratio at Accel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-51 Ramp 2 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks occurring in the application.

Parameter 3-56 Ramp 2 S-ramp Taio at Accel. End

Table 194: Parameter 3-56 Ramp 2 S-ramp Ratio at Accel. End

3-56 Ramp 2 S-ramp Ratio at Accel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-51 Ramp 2 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-57 Ramp 2 S-ramp Ratio Decel. Start

Table 195: Parameter 3-57 Ramp 2 S-ramp Ratio at Decel. Start

3-57 Ramp 2 S-ramp Ratio at Decel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-52 Ramp 1 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-58 Ramp 2 S-ramp Ratio at Decel. End

Table 196: Parameter 3-58 Ramp 2 S-ramp Ratio at Decel. End

3-58 Ramp 2 S-ramp Ratio at Decel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-52 Ramp 2 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

4.4.5 3-6* Ramp 3

Parameter 3-60 Ramp 3 Type

Table 197: Parameter 3-60 Ramp 3 Type

3-60 Ramp 3 Type		
Default value: [1] Linear	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

NOTICE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realize a jerk-free movement, which may result in a longer start or stop time. Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application.

Option	Name	Description
[0]*	Linear	
[1]	S-ramp Const Jerk	Acceleration with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *parameter 3-61 Ramp 3 Ramp Up Time* and *parameter 3-62 Ramp 3 Ramp Down Time*.

Parameter 3-61 Ramp 3 Ramp Up Time

Table 198: Parameter 3-61 Ramp 3 Ramp Up Time

3-61 Ramp 3 Ramp Up Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed ns. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-62 Ramp 3 Ramp Down Time*.

$$\text{Par. } 3-61 = \frac{tacc\ [s] \times ns\ [\text{RPM}]}{\text{ref [RPM]}}$$

Parameter 3-62 Ramp 3 Ramp Down Time

Table 199: Parameter 3-62 Ramp 3 Ramp Down Time

3-62 Ramp 3 Ramp Down Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage occurs in the drive due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-61 Ramp 3 Ramp Up Time*.

$$\text{Par. } 3-62 = \frac{tdec\ [s] \times ns\ [\text{RPM}]}{\text{ref [RPM]}}$$

Parameter 3-65 Ramp 3 S-ramp Ratio at Accel. Start

Table 200: Parameter 3-65 Ramp 3 S-ramp Ratio at Accel. Start

3-65 Ramp 3 S-ramp Ratio at Accel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-61 Ramp 3 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks occurring in the application.

Parameter 3-66 Ramp 3 S-ramp Ratio at Accel. End

Table 201: Parameter 3-66 Ramp 3 S-ramp Ratio at Accel. End

3-66 Ramp 3 S-ramp Ratio at Accel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-61 Ramp 3 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-67 Ramp 3 S-ramp Ratio at Decel. Start

Table 202: Parameter 3-67 Ramp 3 S-ramp Ratio at Decel. Start

3-67 Ramp 3 S-ramp Ratio at Decel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-52 Ramp 1 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-68 Ramp 3 S-ramp Ratio at Decel. End

Table 203: Parameter 3-68 Ramp 3 S-ramp Ratio at Decel. End

3-68 Ramp 3 S-ramp Ratio at Decel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-62 Ramp 3 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

4.4.6 3-7* Ramp 4

Parameter 3-70 Ramp 4 Type

Table 204: Parameter 3-70 Ramp 4 Type

3-70 Ramp 4 Type		
Default value: [1] Linear	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

NOTICE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realize a jerk-free movement, which may result in a longer start or stop time. Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application.

Option	Name	Description
[0]*	Linear	
[1]	S-ramp Const Jerk	Acceleration with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *parameter 3-71 Ramp 3 Ramp Up Time* and *parameter 3-72 Ramp 3 Ramp Down Time*.

Parameter 3-71 Ramp 4 Ramp Up Time

Table 205: Parameter 3-71 Ramp 4 Ramp Up Time

3-71 Ramp 4 Ramp Up Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed ns. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-72 Ramp 4 Ramp Down Time*.

$$\text{Par. } 3-71 = \frac{tacc\,[s] \times ns\,[\text{RPM}]}{\text{ref [RPM]}}$$

Parameter 3-72 Ramp 4 Ramp Down Time

Table 206: Parameter 3-72 Ramp 4 Ramp Down Time

3-72 Ramp 4 Ramp Down Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 the nominal motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage occurs in the drive due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-71 Ramp 4 Ramp Up Time*.

$$\text{Par. } 3-72 = \frac{tdec\,[s] \times ns\,[\text{RPM}]}{\text{ref [RPM]}}$$

Parameter 3-75 Ramp 4 S-ramp Ratio Accel. Start

Table 207: Parameter 3-75 Ramp 4 S-ramp Ratio at Accel. Start

3-75 Ramp 4 S-ramp Ratio at Accel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-71 Ramp 4 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks occurring in the application.

Parameter 3-76 Ramp 4 S-ramp Ratio at Accel. End

Table 208: Parameter 3-76 Ramp 4 S-ramp Ratio at Accel. End

3-76 Ramp 4 S-ramp Ratio at Accel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-71 Ramp 4 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-77 Ramp 4 S-ramp Ratio at Decel. Start

Table 209: Parameter 3-77 Ramp 4 S-ramp Ratio at Decel. Start

3-77 Ramp 4 S-ramp Ratio at Decel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-72 Ramp 4 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-78 Ramp 4 S-ramp Ratio at Decel. End

Table 210: Parameter 3-78 Ramp 4 S-ramp Ratio at Decel. End

3-78 Ramp 4 S-ramp Ratio at Decel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-72 Ramp 4 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

4.4.7 3-8* Other Ramps

Parameter 3-80 Jog/Homing Ramp Time

Table 211: Parameter 3-80 Jog/Homing Ramp Time

3-80 Jog/Homing Ramp Time		
Default value: Size related	Parameter type: Range, 0.01 - 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 rated motor frequency n_s. 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 activation of a jog signal via the LCP, a selected digital input, or the serial communication port. When jog state is disabled, then the normal ramping times are valid.

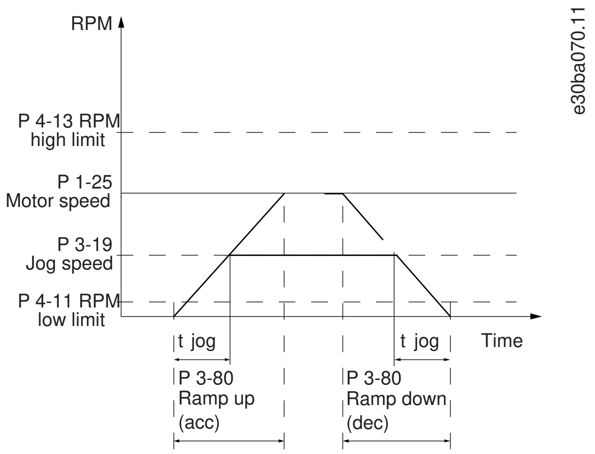


Illustration 45: Jog Ramp Time

$$\text{Par. } 3-80 = \frac{t\text{jog }[s] \times ns\,[\text{RPM}]}{\Delta \text{ jog speed (par. } 3-19)\,[\text{RPM}]}$$

Parameter 3-81 Quick Stop Ramp Time

Table 212: Parameter 3-81 Quick Stop Ramp Time

3-81 Quick Stop Ramp Time		
Default value: Size related	Parameter type: Range, 0.01 - 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.

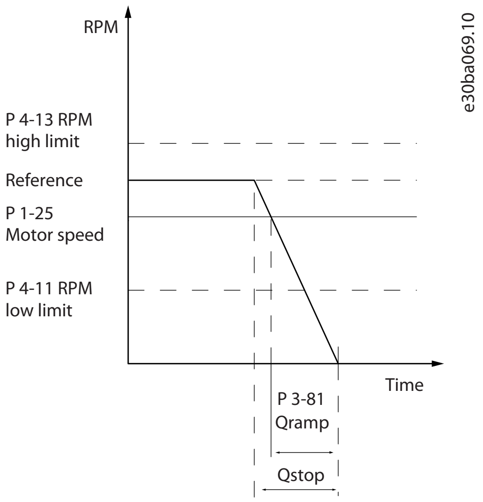


Illustration 46: Quick Stop Ramp Time

Parameter 3-82 Quick Stop Ramp Type

Table 213: Parameter 3-82 Quick Stop Ramp Type

3-82 Quick Stop Ramp Type		
Default value: [1] Linear	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application.

Option	Name	Description
[0]*	Linear	
[1]	S-ramp Const Jerk	
[2]	S-ramp Const Time	

Parameter 3-83 Quick Stop S-ramp Ratio at Decel. Start

Table 214: Parameter 3-83 Quick Stop S-ramp Ratio at Decel. Start

3-83 Quick Stop S-ramp Ratio at Decel. Start		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-up time (*parameter 3-41 Ramp 1 Ramp Up Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-84 Quick Stop S-ramp at Decel. End

Table 215: Parameter 3-84 Quick Stop S-ramp at Decel. End

3-84 Quick Stop S-ramp at Decel. End		
Default value: 50%	Parameter type: Range, 1 - 99%	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: True

Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application.

Parameter 3-89 Ramp Lowpass Filter Time

Table 216: Parameter 3-89 Ramp Lowpass Filter Time

3-89 Ramp Lowpass Filter Time		
Default value: 1 ms	Parameter type: Range, 1 - 2000 ms	Setup: All setups
Conversion index: -4	Data type: Uint16	Change during operation: True

Use this parameter to set how smoothly the speed changes.

4.4.8 3-9* Digital Pot.Meter

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

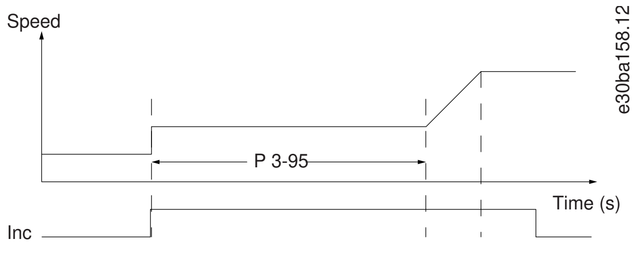


Illustration 47: Increase Actual Reference

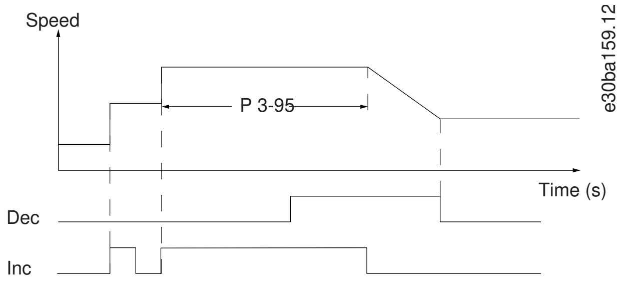


Illustration 48: Increase/Decrease Actual Reference

Parameter 3-90 Step Size

Table 217: Parameter 3-90 Step Size

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.

Parameter 3-91 Ramp Time

Table 218: Parameter 3-91 Ramp Time

3-91 Ramp Time		
Default value: 0 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*.

Parameter 3-92 Power Restore

Table 219: Parameter 3-92 Power Restore

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.

Parameter 3-93 Maximum Limit

Table 220: Parameter 3-93 Maximum Limit

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.

Parameter 3-94 Minimum Limit

Table 221: Parameter 3-94 Minimum Limit

3-94 Minimum Limit		
Default value: 100%	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.

Parameter 3-95 Ramp Delay

Table 222: Parameter 3-95 Ramp Delay

3-95 Ramp Delay		
Default value: Size related	Parameter type: Range, 0 - 0	Setup: All setups
Conversion index: -3	Data type: TimeDiff w/o DateIdent.	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*.

4.5 Parameter Group 4-** Limits/Warnings

4.5.1 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.

Parameter 4-10 Motor Speed Direction

Table 223: Parameter 4-10 Motor Speed Direction

4-10 Motor Speed Direction		
Default value: Size related	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.
[1]	Counterclockwise	The reference is set to CCW rotation. Reversing input (default terminal 19) must be closed. If reversing is required with reverse input open, the motor direction can be changed by *parameter 1-06 Clockwise Direction*.
[2]	Both directions	Allows the motor to rotate in both directions.

Parameter 4-11 Motor Speed Low Limit [RPM]

Table 224: Parameter 4-11 Motor Speed Low Limit [RPM]

4-11 Motor Speed Low Limit [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 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]*.

Parameter 4-12 Motor Speed Low Limit [Hz]

Table 225: Parameter 4-12 Motor Speed Low Limit [Hz]

4-12 Motor Speed Low Limit [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

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]*.

Parameter 4-13 Motor Speed High Limit [RPM]

Table 226: Parameter 4-13 Motor Speed High Limit [RPM]

4-13 Motor Speed High Limit [RPM]		
Default value: Size related	Parameter type: Range, 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]*.

Parameter 4-14 Motor Speed High Limit [Hz]

Table 227: Parameter 4-14 Motor Speed High Limit [Hz]

4-14 Motor Speed High Limit [Hz]		
Default value: Size related	Parameter type: Range, Par. 4-12 - 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*).

Parameter 4-16 Torque Limit Motor Mode

Table 228: Parameter 4-16 Torque Limit Motor Mode

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

N O T I C E

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.

N O T I C E

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.

Parameter 4-17 Torque Limit Generator Mode

Table 229: Parameter 4-17 Torque Limit Generator Mode

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.

Parameter 4-18 Current Limit

Table 230: Parameter 4-18 Current Limit

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

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.

Parameter 4-19 Max Output Frequency

Table 231: Parameter 4-19 Max Output Frequency

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*).

4.5.2 4-2* Limit Factors

Parameter 4-20 Torque Limit Factor Source

Table 232: Parameter 4-20 Torque Limit Factor Source

4-20 Torque Limit Factor Source		
Default value: [1] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select an analog input for scaling the settings in *parameter 4-16 Torque Limit Motor Mode* and *parameter 4-17 Torque Limit Generator Mode* 0–100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, for example *parameter group 6-1* Analog Input 1*. This parameter is only active when *parameter 1-00 Configuration Mode* is in *[0] Speed Open Loop* or *[1] Speed Closed Loop*.

Option	Name	Description
[0]*	No function	
[2]	Analog in 53	
[4]	Analog in 53 inv	
[6]	Analog in 54	
[8]	Analog in 54 inv	
[10]	Analog in X30-11	
[12]	Analog in X30-11 inv	
[14]	Analog in X30-12	
[16]	Analog in X30-12 inv	

Parameter 4-21 Speed Limit Factor Source

Table 233: Parameter 4-21 Speed Limit Factor Source

4-21 Speed Limit Factor Source		
Default value: [1] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select an analog input for scaling the settings in *parameter 4-19 Max Output Frequency* 0–100% (or the other way around). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, for example *parameter group 6-1* Analog Input 1*. This parameter is only active when *parameter 1-00 Configuration Mode* is in *[4] Torque Open Loop*.

Option	Name	Description
[0]*	No function	
[2]	Analog in 53	
[4]	Analog in 53 inv	
[6]	Analog in 54	
[8]	Analog in 54 inv	
[10]	Analog in X30-11	
[12]	Analog in X30-11 inv	
[14]	Analog in X30-12	
[16]	Analog in X30-12 inv	

Parameter 4-23 Brake Check Limit Factor Source

Table 234: Parameter 4-23 Brake Check Limit Factor Source

4-23 Brake Check Limit Factor Source		
Default value: [0] DC-link Voltage	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the input source for the function in *parameter 2-15 Brake Check*. If several drives are carrying out a brake check simultaneously, the resistance in the grid leads to a voltage drop on the mains or DC-link and a false brake check can occur. Use an external current sensor on every brake resistor. If an application requires a 100% valid brake check, connect the sensor to an analog input.

Option	Name	Description
[0]*	DC-link voltage	The drive performs the brake check by monitoring the DC-link voltage. The drive injects current in the brake resistor which lowers the DC-link voltage.
[1]	Analog input 53	Select to use an external current sensor for brake monitoring.
[2]	Analog input 54	Select to use an external current sensor for brake monitoring

Parameter 4-24 Brake Check Limit Factor

Table 235: Parameter 4-24 Brake Check Limit Factor

4-24 Brake Check Limit Factor		
Default value: 98%	Parameter type: Range, 0 - 100%	Setup: All setups
Conversion index: -1	Data type: Uint8	Change during operation: True

Enter the limit factor that *parameter 2-15 Brake Check* uses when performing the brake check. The drive uses the limit factor depending on the selection in *parameter 4-23 Brake Check Limit Factor Source*: *[0] DC-link voltage* - the drive applies the factor to the EEPROM data in the DC-link. *[1] Analog Input 53* or *[2] Analog Input 54* - the brake check fails if the input current on the analog input is lower than the maximum input current multiplied by the limit factor. For example, in the following configuration the brake check fails if the input current is lower than 16 mA:

- A current transducer with a range of 4-20 mA is connected to analog input 53.
- *Parameter 4-24 Brake Check Limit Factor* is set to 80%.

Parameter 4-25 Power Limit Motor Factor Source

Table 236: Parameter 4-25 Power Limit Motor Factor Source

4-25 Power Limit Motor Factor Source		
Default value: [0] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the input that scales the value in *parameter 4-82 Power Limit Motor Mode* from 0% to 100%.

Option	Name	Description
[0]*	No function	
[2]	Analog in 53	
[4]	Analog in 53 inv	
[6]	Analog in 54	
[8]	Analog in 54 inv	
[10]	Analog in X30-11	
[12]	Analog in X30-11 inv	
[14]	Analog in X30-12	
[16]	Analog in X30-12 inv	

Parameter 4-26 Power Limit Gener. Factor Source

Table 237: Parameter 4-26 Power Limit Gener. Factor Source

4-26 Power Limit Gener. Factor Source		
Default value: [0] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the input that scales the value in *parameter 4-83 Power Limit Generator Mode* from 0% to 100%.

Option	Name	Description
[0]*	No function	
[2]	Analog in 53	
[4]	Analog in 53 inv	
[6]	Analog in 54	
[8]	Analog in 54 inv	
[10]	Analog in X30-11	
[12]	Analog in X30-11 inv	
[14]	Analog in X30-12	
[16]	Analog in X30-12 inv	

4.5.3 4-3* Motor Feedback Monitoring

This parameter group includes monitoring and handling of motor feedback devices, such as encoders and resolvers.

Parameter 4-30 Motor Feedback Monitoring Loss Function

Table 238: Parameter 4-30 Motor Feedback Loss Function

4-30 Motor Feedback Loss Function		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

This function is used to monitor consistency in the feedback signal, that is if the feedback signal is available. Select which action the drive should take if a feedback fault is detected. The selected action is to take place when the feedback signal differs from the output speed by the value set in *parameter 4-31 Motor Feedback Speed Error* for longer than the value set in *parameter 4-32 Motor Feedback Loss Timeout*.

Option	Name	Description
[0]	Disabled	
[1]	Warning	
[2]	Trip	
[3]	Jog	
[4]	Freeze output	
[5]	Max speed	
[6]	Switch to open loop	
[7]	Select setup 1	

Option	Name	Description
[8]	Select setup 2	
[9]	Select setup 3	
[10]	Select setup 4	
[11]	Stop & trip	

Warning 90, Feedback monitor is active as soon as the value in *parameter 4-31 Motor Feedback Speed Error* is exceeded, regardless of the setting in *parameter 4-32 Motor Feedback Loss Timeout*. *Warning/Alarm 61, Feedback Error* is related to the motor feedback loss function.

Parameter 4-31 Motor Feedback Speed Error

Table 239: Parameter 4-31 Motor Feedback Speed Error

4-31 Motor Feedback Speed Error		
Default value: 300 RPM	Parameter type: Range, 1 - 600 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Select the minimum allowed error in speed (output speed vs. feedback).

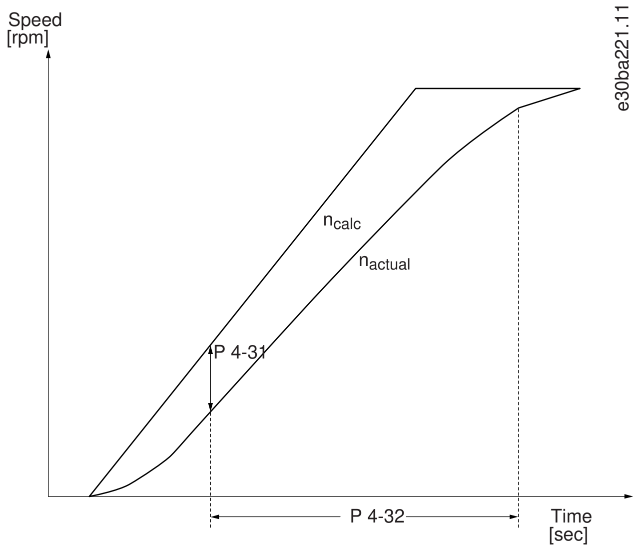


Illustration 49: Motor Feedback Speed Error

Parameter 4-32 Motor Feedback Loss Timeout

Table 240: Parameter 4-32 Motor Feedback Loss Timeout

4-32 Motor Feedback Loss Timeout		
Default value: Size related	Parameter type: Range, 0 - 60 RPM	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Set the timeout value allowing the speed error set in *parameter 4-31 Motor Feedback Speed Error* to be exceeded before enabling the function selected in *parameter 4-30 Motor Feedback Loss Function*.

Parameter 4-34 Tracking Error Function

Table 241: Parameter 4-34 Tracking Error Function

4-34 Tracking Error Function		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

This function is used to monitor that the application follows the expected speed profile. In closed loop, the speed reference to the PID is compared to the encoder feedback (filtered). In open loop, the speed reference to the PID is compensated for slip and compared to the frequency that is sent to the motor (*parameter 16-13 Frequency*). The reaction is activated if the measured difference is more than the value specified in *parameter 4-35 Tracking Error* for the time specified in *parameter 4-36 Tracking Error Timeout*. A tracking error in closed loop does not imply that there is a problem with the feedback signal. A tracking error can be the result of torque limit at too heavy loads.

Option	Name	Description
[0]	Disable	
[1]	Warning	
[2]	Trip	
[3]	Trip after stop	

Warning/Alarm 78, Tracking Error is related to the tracking error function.

Parameter 4-35 Tracking Error

Table 242: Parameter 4-35 Tracking Error

4-35 Tracking Error		
Default value: 10 RPM	Parameter type: Range, 1 - 600 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the maximum allowed speed error between the motor speed and the output of the ramp when not ramping. In open loop, the motor speed is estimated and in closed loop, it is the feedback from encoder/resolver.

Parameter 4-36 Tracking Error Timeout

Table 243: Parameter 4-36 Tracking Error Timeout

4-36 Tracking Error Timeout		
Default value: 1 s	Parameter type: Range, 0 - 60 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Enter the timeout period during which an error greater than the value set in *parameter 4-35 Tracking Error* is allowed.

Parameter 4-37 Tracking Error Ramping

Table 244: Parameter 4-37 Tracking Error Ramping

4-37 Tracking Error Ramping		
Default value: 100 RPM	Parameter type: Range, 1 - 600 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the maximum allowed speed error between the motor speed and the output of the ramp when ramping. In open loop, the motor speed is estimated and in closed loop, the encoder measures the speed.

Parameter 4-38 Tracking Error Ramping Timeout

Table 245: Parameter 4-38 Tracking Error Ramping Timeout

4-38 Tracking Error Ramping Timeout		
Default value: 1 s	Parameter type: Range, 0 - 60 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Enter the timeout period during which an error greater than the value set in *parameter 4-37 Tracking Error Ramping* while ramping is allowed.

Parameter 4-39 Tracking Error After Ramping Timeout

Table 246: Parameter 4-39 Tracking Error After Ramping Timeout

4-39 Tracking Error After Ramping Timeout		
Default value: 5 s	Parameter type: Range, 0 - 60 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Enter the timeout period after ramping where *parameter 4-37 Tracking Error Ramping* and *parameter 4-38 Tracking Error Ramping Timeout* are still active.

4.5.4 4-4* Speed Monitor

Parameter 4-43 Motor Speed Monitor Function

Table 247: Parameter 4-43 Motor Speed Monitor Function

4-43 Motor Speed Monitor Function		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

N O T I C E
This parameter is only available in the flux control principle.

Select how the drive reacts when the motor speed monitor-function detects overspeed or wrong rotation direction. When the motor speed monitor is active, the drive detects an error if the following conditions are true for a time period specified in *parameter 4-45 Motor Speed Monitor Timeout*:

- The actual speed differs from the reference speed in *parameter 16-48 Speed Ref. After Ramp [RPM]*.
- The difference between the speeds exceeds the value in *parameter 4-44 Motor Speed Monitor Max*.

In speed closed loop, the actual speed is the feedback from the encoder measured during the time defined in *parameter 7-06 Speed PID Lowpass Filter Time*. In open loop, the actual speed is the estimated motor speed.

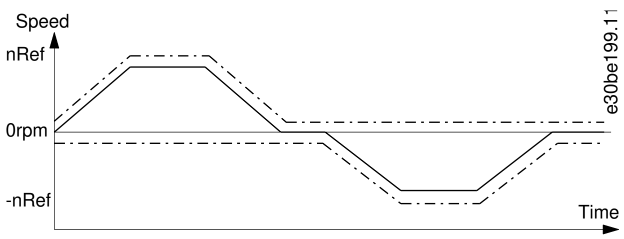


Illustration 50: Speed Reference and Maximum Allowed Speed Difference

Option	Name	Description
[0]	Disabled	
[1]	Warning	The drive reports *warning 101, Speed monitor* when the speed is outside the limit.
[2]	Trip	The drive trips and reports *alarm 101, Speed monitor*.
[3]	Jog	
[4]	Freeze output	
[5]	Max speed	
[6]	Switch to open loop	
[7]	Select setup 1	
[8]	Select setup 2	
[9]	Select setup 3	
[10]	Select setup 4	
[11]	Stop & trip	
[12]	Trip/warning	The drive reports *alarm 101, Speed monitor* in running mode and *warning 101, Speed monitor* in stop or coast mode. This option is only available in closed-loop operation.
[13]	Trip/catch	Select when there is a need to catch a load, for example when mechanical braking fails. This option is available in closed loop only. The drive trips and reports *alarm 101, Speed monitor* in running mode. In stop mode, the drive catches the flying load and reports *warning 101, Speed monitor*. In catch mode, the drive applies holding torque to control the 0 speed on a potentially malfunctioning brake (closed loop). To exit this mode, send a new start signal to the drive. A coast or Safe Torque Off also terminates the function.

Parameter 4-44 Motor Speed Monitor Max

Table 248: Parameter 4-44 Motor Speed Monitor Max

4-44 Motor Speed Monitor Max		
Default value: 300 RPM	Parameter type: Range, 10 - 500 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

NOTICE

Only available in flux control principle.

Enter the maximum allowable speed deviation between the actual mechanical shaft speed and the value in *parameter 16-48 Speed Ref. After Ramp [RPM]*.

Parameter 4-45 Motor Speed Monitor Timeout

Table 249: Parameter 4-45 Motor Speed Monitor Timeout

4-45 Motor Speed Monitor Timeout		
Default value: 0.1 s	Parameter type: Range, 0 - 60 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

NOTICE
Only available in flux control principle.

Enter the timeout period during which a deviation defined in *parameter 4-44 Motor Speed Monitor Max* is allowable. The timer for this parameter is reset if the deviation stops exceeding the value in *parameter 4-44 Motor Speed Monitor Max*.

Parameter 4-49 Motor Check Time Interval

Table 250: Parameter 4-49 Motor Check Time Interval

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	

4.5.5 4-5* Adjustable Warnings

Use these parameters for adjusting 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.

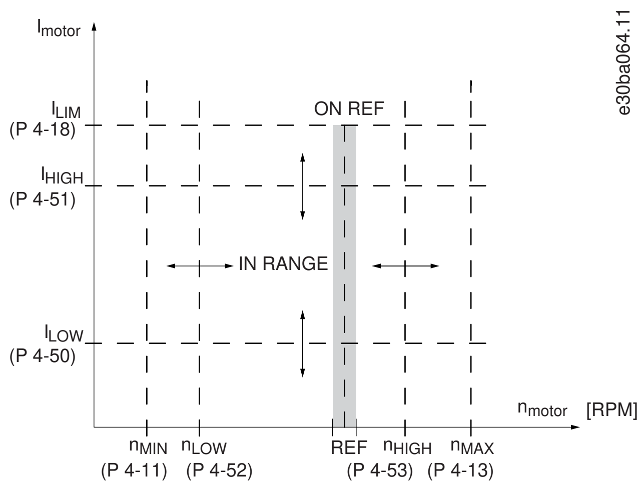


Illustration 51: Adjustable Warnings

Parameter 4-50 Warning Current Low

Table 251: Parameter 4-50 Warning Current Low

4-50 Warning Current Low		
Default value: 0 A	Parameter type: Range, 0 - 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. Refer to Illustration 51.

Parameter 4-51 Warning Current High

Table 252: Parameter 4-51 Warning Current High

4-51 Warning Current High		
Default value: Size related	Parameter type: Range, par. 4-50 - 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 and on relay output 01 or 02. Refer to Illustration 51.

Parameter 4-52 Warning Speed Low

Table 253: Parameter 4-52 Warning Speed Low

4-52 Warning Speed Low		
Default value: 0 RPM	Parameter type: Range, 0 - par. 16-37	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.

Parameter 4-53 Warning Speed High

Table 254: Parameter 4-53 Warning Speed High

4-53 Warning Speed High		
Default value: Size related	Parameter type: Range, 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. Refer to Illustration 51.

Parameter 4-54 Warning Reference Low

Table 255: Parameter 4-54 Warning Reference Low

4-54 Warning Reference Low		
Default value: -999999.999	Parameter type: Range, -999999.999 - 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.

Parameter 4-55 Warning Reference High

Table 256: Parameter 4-55 Warning Reference High

4-55 Warning Reference High		
Default value: 999999.999	Parameter type: Range, 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.

Parameter 4-56 Warning Feedback Low

Table 257: Parameter 4-56 Warning Feedback Low

4-56 Warning Feedback Low		
Default value: Size related	Parameter type: Range, par 4-57 - -999999.999 ReferenceFeedback-Unit	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.

Parameter 4-57 Warning Feedback High

Table 258: Parameter 4-57 Warning Feedback High

4-57 Warning Feedback High		
Default value: Size related	Parameter type: Range, par 4-56 - 999999.999 ReferenceFeedback-Unit	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.

Parameter 4-58 Missing Motor Phase Function

Table 259: Parameter 4-58 Missing Motor Phase Function

4-58 Missing Motor Phase Function		
Default value: Size related	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.

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 ranging from 1–10 Hz.
[3]	Trip 100 ms 3ph detec.	**NOTICE** Only available in flux closed loop.

Op-tion	Name	Description
		This option is relevant for applications where the motor load and motor currents are very low, such as lowering a lift. Selecting this option allows to prevent false motor phase detection due to low currents. The drive performs a scan for 100 ms to detect missing motor phases.
[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.

The following table details the detection of missing motor phase function for different motor types:

Table 260: Missing Motor Phase for Different Motor Types

Op-tion	Missing motor phase function	U/f	VVC+	Flux open loop	Flux closed loop
[0]	Disabled	No function			
[1]	Trip 100 ms	Detects missing 1 phase(1)	Detects missing 1 phase(1)	Detects 1–3 phase(1)	Detects 1–3 phase(1)
[2]	Trip 1000 ms	Detects missing 1 phase(1)	Detects missing 1 phase(1)	Detects missing 1 phase(1)	N/A
[3]	Trip 100 ms 3 phase limit	N/A			Detects 1–3 phase
[5]	Motor check (service switch)	Coasts if motor is disconnected or auto started when the motor is reconnected.			

1 When *parameter 4-58 Missing Motor Phase Function* is set to *[1] Trip 100 ms* or *[3] Trip 100 ms 3ph detec.*, phase detection is enabled for U/f and VVC+ motor types.

Parameter 4-59 Motor Check at Start

Table 261: Parameter 4-59 Motor Check at Start

4-59 Motor Check at Start		
Default value: [0] Off	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.

This function detects missing motor phase before each start. Shows *alarm 30*, *alarm 31*, *alarm 32* if motor phases are missing. In these cases, the drive trips and an alarm is issued. The function has been developed to avoid disengaging a mechanical brake if motor phases are missing, for example, in lift applications.

Option	Name	Description
[0]*	Off	**⚠ CAUTION ⚠** **RISK OF MOTOR DAMAGE** Using this option may lead to motor damage.

Option	Name	Description
		The drive does not issue a missing motor phase alarm.
[1]	On	Before each start, the drive checks if all 3 motor phases are present. The check is performed without any shaft movement. The function also enables 3-phase detection in U/f and VVC^+ mode. See description in *parameter 4-58 Missing Motor Phase Function*.

The table details the motor check at start for different motor modes.

Table 262: Motor Check at Start for Different Motor Types

Option	Motor Check at Start	U/f	VVC^+	Flux open loop	Flux closed loop
[0]	*Off*	No function.			
[1]	*On*[1]	Check for missing motor phase before start is executed or enables 3-phase detection for U/f and VVC^+ in *parameter 4-58 Missing Motor Phase Function*.			

[1] When the motor check is done at start and a missing motor phase is detected, the motor starts at trip 10 ms. This means that *parameter 4-58 Missing Motor Phase Function* is set to *[1] Trip 100 ms*.

When *parameter 4-59 Motor Check At Start* is set to *[1] On*, do not set *parameter 4-58 Missing Motor Phase Function* to the following options:

- *[0] Disabled*
- *[5] Motor check*

4.5.6 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.

Parameter 4-60 Bypass Speed From [RPM]

Table 263: Parameter 4-60 Bypass Speed From [RPM]

4-60 Bypass Speed From [RPM]		
Default value: Size related	Parameter type: Range, 0 - 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.

Parameter 4-61 Bypass Speed From [Hz]

Table 264: Parameter 4-61 Bypass Speed From [Hz]

4-61 Bypass Speed From [Hz]		
Default value: Size related	Parameter type: Range, 0 - 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.

Parameter 4-62 Bypass Speed To [RPM]

Table 265: Parameter 4-62 Bypass Speed To [RPM]

4-62 Bypass Speed To [RPM]		
Default value: Size related	Parameter type: Range, 0 - 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.

Parameter 4-63 Speed Bypass To [Hz]

Table 266: Parameter 4-63 Bypass Speed To [Hz]

4-63 Bypass Speed To [Hz]		
Default value: Size related	Parameter type: Range, 0 - 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.

4.5.7 4-8* Power Limit

Parameter 4-80 Power Limit Func. Motor Mode

Table 267: Parameter 4-80 Power Limit Func. Motor Mode

4-80 Power Limit Func. Motor Mode		
Default value: [0] Disabled	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select whether the power limit function is enabled. Define the power limit motor mode in *parameter 4-82 Power Limit Motor Mode*.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	
[2]	When activated	Activation via a digital input or a fieldbus.

Parameter 4-81 Power Limit Func. Generator Mode

Table 268: Parameter 4-81 Power Limit Func. Generator Mode

4-81 Power Limit Func. Generator Mode		
Default value: [0] Disabled	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select whether the power limit function is enabled in generating mode. Define the power limit motor mode in *parameter 4-83 Power Limit Generator Mode*.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	
[2]	When activated	Activation via a digital input or a fieldbus.

Parameter 4-82 Power Limit Motor Mode

Table 269: Parameter 4-82 Power Limit Motor Mode

4-82 Power Limit Motor Mode		
Default value: 100.0%	Parameter type: Range, 0.0 - 200.0%	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the maximum output power when the power limit function is active. Related parameters: *parameter 1-20 Motor Power [kW]*, *parameter 1-21 Motor Power [HP]*.

Parameter 4-83 Power Limit Generator Mode

Table 270: Parameter 4-83 Power Limit Generator Mode

4-83 Power Limit Generator Mode		
Default value: 100.0%	Parameter type: Range, 0.0 - 200.0%	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the maximum generating power when the power limit function is active. Related parameters: *Parameter 1-20 Motor Power [kW]*, *parameter 1-21 Motor Power [HP]*.

4.5.8 4-9* Directional Limits

The directional limits functionality allows to specify different torque and speed limits for different combinations of torque application direction and rotation direction. In Illustration 52, quadrants 1–4 show different combinations of rotation direction and torque application direction, and the parameters that act in different quadrants.

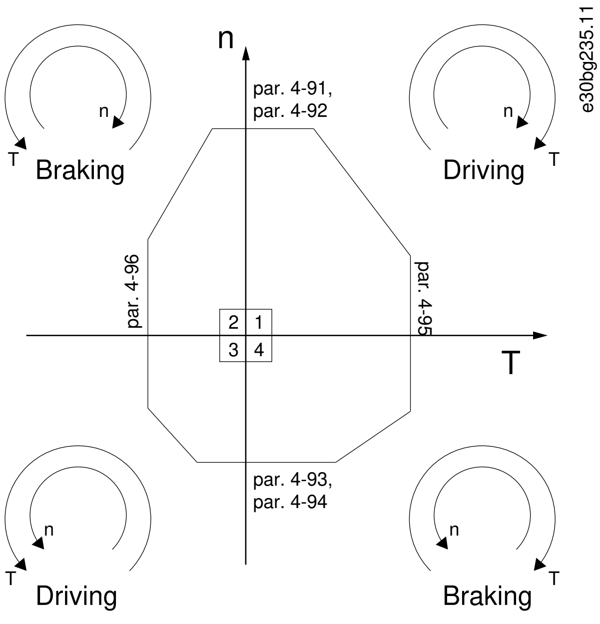


Illustration 52: Example of Directional Limits

A speed limit value cannot exceed the value of *parameter 4-13 Motor Speed High Limit [RPM]* or *parameter 4-14 Motor Speed High Limit [Hz]*. A torque limit value cannot exceed the value of *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode*.

Parameter 4-90 Directional Limit Mode

Table 271: Parameter 4-90 Directional Limit Mode

4-90 Directional Limit Mode		
Default value: [0] Disabled	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select whether the directional limits are enabled. With directional limits enabled, it is possible to specify different speed and torque limits for clockwise and counterclockwise rotation directions.

Option	Name	Description
[0]*	Disabled	Directional limits are disabled.
[1]	Enabled	Directional limits are active for the speed values.
[2]	Torque	Directional limits are active for the torque values.
[3]	Speed and torque	Directional limits are active for both torque and speed values.

Parameter 4-91 Positive Speed Limit [RPM]

Table 272: Parameter 4-91 Positive Speed Limit [RPM]

4-91 Positive Speed Limit [RPM]		
Default value: Size related	Parameter type: Range, 0.0 - par. 4-13 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the limit for the motor speed when the rotation direction is clockwise.

Parameter 4-92 Positive Speed Limit [Hz]

Table 273: Parameter 4-92 Positive Speed Limit [Hz]

4-92 Positive Speed Limit [Hz]		
Default value: Size related	Parameter type: Range, 0.0 - par. 4-14 RPM	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the limit for the motor speed when the rotation direction is clockwise.

Parameter 4-93 Negative Speed Limit [RPM]

Table 274: Parameter 4-93 Negative Speed Limit [RPM]

4-93 Negative Speed Limit [RPM]		
Default value: Size related	Parameter type: Range, 0.0 - par. 4-13 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the limit for the motor speed when the rotation direction is counterclockwise.

Parameter 4-94 Negative Speed Limit [Hz]

Table 275: Parameter 4-94 Negative Speed Limit [Hz]

4-94 Negative Speed Limit [Hz]		
Default value: Size related	Parameter type: Range, 0.0 - par. 4-14 RPM	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the limit for the motor speed when the rotation direction is counterclockwise.

Parameter 4-95 Positive Torque Limit

Table 276: Parameter 4-95 Positive Torque Limit

4-95 Positive Torque Limit		
Default value: Size related	Parameter type: Range, 1 - 160.0%	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the limit for the motor torque when the rotation direction is clockwise.

Parameter 4-96 Negative Torque Limit

Table 277: Parameter 4-96 Negative Torque Limit

4-96 Negative Torque Limit		
Default value: Size related	Parameter type: Range, 1 - 160.0%	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Enter the limit for the motor torque when the rotation direction is counterclockwise.

4.6 Parameter Group 5-** Digital I/O Mode

4.6.1 5-0* Digital I/O Mode

Parameters for configuring the input and output using NPN and PNP.

Parameter 5-00 Digital I/O Mode

Table 278: Parameter 5-00 Digital I/O Mode

5-00 Digital I/O Mode		
Default value: [0] PNP	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

N O T I C E

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	Action on positive directional pulses (↕). PNP systems are pulled down to GND.
[1]	NPN	Action on negative directional pulses (↕). NPN systems are pulled up to +24 V, internally in the drive.

Parameter 5-01 Terminal 27 Mode

Table 279: Parameter 5-01 Terminal 27 Mode

5-01 Terminal 27 Mode		
Default value: [0] Input	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

N O T I C E

This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

Parameter 5-02 Terminal 29 Mode

Table 280: Parameter 5-02 Terminal 29 Mode

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.

4.6.2 5-1* Digital Inputs

The digital inputs are used for selecting various functions in the drive. Refer to Table 282 for functions which can be assigned to digital inputs.

Functions in function group 1 have higher priority than functions in function group 2.

Table 281: 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 282: 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 inverse	[3]	All
Quick stop inverse	[4]	All
DC brake inverse	[5]	All
Stop inverse	[6]	All
Start	[8]	All, terminal 18
Latched start	[9]	All
Reversing	[10]	All, terminal 19
Start reversing	[11]	All
Enable start forward	[12]	All
Enable start reverse	[13]	All

Digital input function	Select	Terminal
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
Precise stop inverse	[26]	18, 19
Precise start, stop	[27]	18, 19
Catch up	[28]	All
Slow down	[29]	All
Counter input	[30]	29, 33
Pulse input edge triggered	[31]	29, 33
Pulse input time based	[32]	29, 33
Ramp bit 0	[34]	All
Ramp bit 1	[35]	All
Latched precise start	[40]	18, 19
Latched precise stop inverse	[41]	18, 19
External interlock	[51]	–
DigiPot increase	[55]	All
DigiPot decrease	[56]	All
DigiPot clear	[57]	All
DigiPot hoist	[58]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33

Digital input function	Select	Terminal
Reset Counter B	[65]	All
Mech. brake feedb.	[70]	All
Mech. brake feedb. inv.	[71]	All
PID error inv.	[72]	All
PID reset I-part	[73]	All
PID enable	[74]	All
PTC card 1	[80]	All
PROFIdrive OFF2	[91]	All
PROFIdrive OFF3	[92]	All
Light-load detection	[94]	All
Evacuation	[95]	All
Mains loss	[96]	32, 33
Mains loss inverse	[97]	32, 33
Start edge triggered	[98]	All
Power limit mot.	[231]	All
Power limit gen.	[232]	All
Power limit both	[233]	All
Light load + evacuation	[234]	All

standard terminals are 18, 19, 27, 29, 32, and 33.
Functions dedicated to only 1 digital input are stated in the associated parameter.
All digital inputs can be programmed to these functions:

Table 283: 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.
[4]	Quick stop inverse	Inverted input (NC). Generates a stop in accordance with quick stop ramp time set in *parameter 3-81 Quick Stop Ramp Time*. When the motor stops, the shaft is in free mode. Logic 0⇒quick stop.
[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.

Option		Function
		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*, • *Parameter 3-62 Ramp 3 Ramp down Time*, and • *Parameter 3-72 Ramp 4 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.
[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) 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*. The function is not active in process closed loop.
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[12]	Enable start forward	Disengages the counterclockwise movement and allows clockwise direction.
[13]	Enable start reverse	Disengages the clockwise movement and allows counterclockwise direction.
[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 284.
[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 284: 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

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 285: Digital Inputs, Function Descriptions - 2

Option		Function
[19]	Freeze ref	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*.
[20]	Freeze output	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*.
[21]	Speed up	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.

Table 286: 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 287: 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*.
[26]	Precise stop inv.	Sends an inverted stop signal when the precise stop function is activated in *parameter 1-83 Precise Stop Function*. Precise stop inverse function is available for terminals 18 or 19.

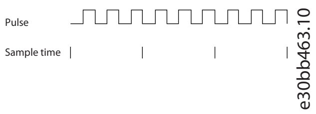
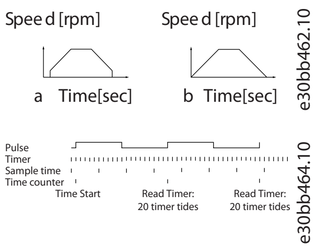
Option		Function
[27]	Precise start, stop	Use when *[0] Precise ramp stop* is selected in *parameter 1-83 Precise Stop Function*. Precise start, stop is available for terminals 18 and 19. Precise start ensures that the rotor turning angle from standing still to reference is the same for each start (for same ramp time, same setpoint). This function is the equivalent to the precise stop where the rotor turning angle from reference to standstill is the same for each stop. When using *parameter 1-83 Precise Stop Function* option *[1] Cnt stop with reset* or *[2] Cnt stop w/o reset*: The drive needs a precise stop signal before reaching the value of *parameter 1-84 Precise Stop Counter Value*. If this signal is not supplied, the drive does not stop when the value in *parameter 1-84 Precise Stop Counter Value* is reached. Trigger precise start, stop by a digital input. The function is available for terminals 18 and 19.
[28]	Catch up	Increases reference value by percentage (relative) set in *parameter 3-12 Catch up/slow Down Value*.
[29]	Slow down	Reduces reference value by percentage (relative) set in *parameter 3-12 Catch up/slow Down Value*.
[30]	Counter input	Precise stop function in *parameter 1-83 Precise Stop Function* acts as counter stop or speed compensated counter stop with or without reset. Set the counter value in *parameter 1-84 Precise Stop Counter Value*.
[31]	Pulse edge triggered	Counts the number of pulse flanks per sample time. This gives a higher resolution at high frequencies, but is not as precise at lower frequencies. Use this pulse principle for encoders with low resolution (for example 30 PPR).  **Illustration 53: Pulse Flanks per Sample Time**
[32]	Pulse time-based	Measures the duration between pulse flanks. This gives a higher resolution at lower frequencies, but is not as precise at higher frequencies. This principle has a cutoff frequency, which makes it unsuited for encoders with low resolutions (for example 30 PPR) at low speeds.  **Illustration 54: Duration Between Pulse Flanks**
[34]	Ramp bit 0	Enables a selection between 1 of the 4 ramps available, according to Table 288.
[35]	Ramp bit 1	Same as *[34] Ramp bit 0*.

Table 288: 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 289: Digital Inputs, Function Descriptions - 4

Option		Function
[40]	Latched precise start	A latched precise start only requires a pulse of 3 ms on terminals 18 or 19. When using for *parameter 1-83 Precise Stop Function[1] Cnt stop with reset* or *[2] Cnt stop w/o reset*: When the reference is reached, the drive internally enables the precise stop signal. This means that the drive does the precise stop when the counter value of *parameter 1-84 Precise Stop Counter Value* is reached.
[41]	Latched precise stop inverse	Sends a latched stop signal when the precise stop function is activated in *parameter 1-83 Precise Stop Function*. The latched precise stop inverse function is available for terminals 18 or 19.
[51]	External inter-lock	This function makes it possible to give an external fault to the drive. This fault is treated in the same way as an internally generated alarm.
[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.
[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.
[70]	Mech. Brake Feedback	Brake feedback for hoisting applications: Set *parameter 1-01 Motor Control Principle* to *[3] Flux w/ motor feedback*; set *parameter 1-72 Start Function* to *[6] Hoist mech brake Ref*.
[71]	Mech. Brake Feedback inv.	Inverted brake feedback for hoisting applications.
[72]	PID error inverse	When enabled, this option inverts the resulting error from the process PID controller. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL*, or *[8] Extended PID Speed CL*.
[73]	PID reset I-part	When enabled, this option resets the I-part of the process PID controller. Equivalent to *parameter 7-40 Process PID I-part Reset*. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL*, or *[8] Extended PID Speed CL*.
[74]	PID enable	Enables the extended process PID controller. Equivalent to *parameter 7-50 Process PID Extended PID*. Available only if *parameter 1-00 Configuration Mode* is set to *[7] Extended PID Speed OL* or *[8] Extended PID Speed CL*.
[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.
[91]	PROFIdrive OFF2	The functionality is the same as the corresponding control word bit of the PROFIBUS/PROFINET option.
[92]	PROFIdrive OFF3	The functionality is the same as the corresponding control word bit of the PROFIBUS/PROFINET option.
[94]	Light Load Detection	Light-load detection is a feature for lift application to ensure that the lift runs in the evacuation direction which requires the least energy (UPS capacity), during an emergency. See *parameter 30-25 Light*

Option		Function
		Load Delay [s], *parameter 30-26 Delay Before Measurements*, *parameter 30-27 Light Load Speed [%]*, *parameter 30-28 Evacuation Speed [%]*, and *parameter 30-29 Ramp Time* for light-load detection configurations. **NOTICE** Flying start overrules light load detection.
[95]	Evacuation	Evacuation Mode is a feature for lift application to enable drives to operate at reduced DC voltage for evacuation of people if there is power failure. When the feature is activated, undervoltage limits and enable voltage limits are reduced so that the drive can be operated with 230 V single-phase UPS-supply.
[96]	Mains loss	Select to improve kinetic back-up. When the mains voltage goes back to a level that is close to (but still lower than) the detection level, the output speed increases and kinetic back-up remains active. To avoid this situation, send a status signal to the drive. When the signal on the digital input is low (0), the drive forcibly turns off the kinetic back-up. **NOTICE** Only available for pulse inputs at terminals 32/33.
[97]	Mains loss inverse	When the signal on the digital input is high (1), the drive forcibly turns off the kinetic back-up. For more details, see the description of *[96] Mains loss*. **NOTICE** Only available for pulse inputs at terminals 32/33.
[98]	Start edge triggered	Edge-triggered start command. Keeps the start command alive. It can be used for a start push key.
[231]	Power limit mot.	Serves as input to activate the power limit function in the motor mode. See *parameter group 4-8* Power Limit*.
[232]	Power limit gen.	Serves as input to activate the power limit function in the generating mode. See *parameter group 4-8* Power Limit*.
[233]	Power limit both	Serves as input to activate the power limit function in both the motor and the generating mode. See *parameter group 4-8* Power Limit*.
[234]	Light load + evacuation	Use this option to activate both light-load detection and evacuation.

Parameter 5-10 Terminal 18 Digital Input

Table 290: Parameter 5-10 Terminal 18 Digital Input

5-10 Terminal 18 Digital Input		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the function from the available digital input range and the additional options *[60] Counter A (up)*, *[61] Counter A (down)*, *[63] Counter B (up)*, and *[64] Counter B (down)*. Counters are used in smart logic control functions. All functions are described in Table 283, Table 285, Table 287, and Table 289.

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[8]	Start	
[9]	Latched	
[10]	Reversing	
[11]	Start reversing	
[12]	Enable start forward	
[13]	Enable start reverse	
[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	
[26]	Precise stop inverse	
[27]	Precise start, stop	
[28]	Catch up	
[29]	Slow down	
[34]	Ramp bit 0	
[35]	Ramp bit 1	
[40]	Latched precise start	
[41]	Latch prec stop inv	

Option	Name	Description
[44]	Restart drive	
[51]	External interlock	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[58]	DigiPot hoist	
[62]	Reset counter A	
[65]	Reset counter B	
[70]	Mech. brake feedb.	
[71]	Mech. brake feedb. inv.	
[72]	PID error inverse	
[73]	PID reset 1 part	
[74]	PID enable	
[78]	Reset maint. word	
[80]	PTC card 1	
[91]	PROFIdrive OFF2	
[92]	PROFIdrive OFF3	
[94]	Light load detection	
[95]	Evacuation mode	
[96]	Mains loss	
[97]	Mains loss inverse	
[98]	Start edge triggered	
[100]	Safe option reset	
[231]	Power limit mot.	
[232]	Power limit gen.	
[233]	Power limit both	
[234]	Light load + evacuation	

Parameter 5-11 Terminal 19 Digital Input

Table 291: Parameter 5-11 Terminal 19 Digital Input

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*.
Parameter 5-12 Terminal 27 Digital Input

Table 292: Parameter 5-12 Terminal 27 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*.
Parameter 5-13 Terminal 29 Digital Input

Table 293: Parameter 5-13 Terminal 29 Digital Input

5-13 Terminal 29 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 5-14 Terminal 32 Digital Input

Table 294: Parameter 5-14 Terminal 32 Digital Input

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*.
Parameter 5-15 Terminal 33 Digital Inputs

Table 295: Parameter 5-15 Terminal 33 Digital Input

5-15 Terminal 33 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 5-16 Terminal X30/2 Digital Input

Table 296: Parameter 5-16 Terminal X30/2 Digital Input

5-16 Terminal X30/2 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 5-17 Terminal X30/3 Digital Input

Table 297: Parameter 5-17 Terminal X30/3 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*.

Parameter 5-18 Terminal X30/4 Digital Input

Table 298: Parameter 5-18 Terminal X30/4 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

Table 299: Parameter 5-19 Terminal 37 Safe Stop

5-19 Terminal 37 Safe Stop		
Default value: Size related	Parameter type: Option	Setup: 1 setup
Conversion index: –	Data type: Uint8	Change during operation: True

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).

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.

NOTICE

Selecting Auto Reset/Warning enables automatic restart of the drive.

Table 300: 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]]

[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

Table 301: Parameter 5-20 Terminal X46/1 Digital Input

5-20 Terminal X46/1 Digital Input		
Default value: [0] No operation	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

All functions are described in Table 283, Table 285, Table 287, and Table 289.

Option	Name	Description
[0]*	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[8]	Start	
[9]	Latched	
[10]	Reversing	
[11]	Start reversing	
[12]	Enable start forward	
[13]	Enable start reverse	
[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	
[26]	Precise stop inverse	
[27]	Precise start, stop	
[28]	Catch up	
[29]	Slow down	
[34]	Ramp bit 0	
[35]	Ramp bit 1	
[40]	Latched precise start	
[41]	Latch prec stop inv	

Option	Name	Description
[44]	Restart drive	
[51]	External interlock	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[58]	DigiPot hoist	
[62]	Reset counter A	
[65]	Reset counter B	
[70]	Mech. brake feedb.	
[71]	Mech. brake feedb. inv.	
[72]	PID error inverse	
[73]	PID reset 1 part	
[74]	PID enable	
[78]	Reset maint. word	
[80]	PTC card 1	
[91]	PROFIdrive OFF2	
[92]	PROFIdrive OFF3	
[94]	Light load detection	
[95]	Evacuation mode	
[96]	Mains loss	
[97]	Mains loss inverse	
[98]	Start edge triggered	
[100]	Safe option reset	
[106]	Set master home	
[107]	Target inverse	
[122]	Position vir. master	
[123]	Master marker	
[124]	Master marker inv	
[125]	Follower marker	
[126]	Follow. marker inv.	
[231]	Power limit mot.	

Option	Name	Description
[232]	Power limit gen.	
[233]	Power limit both	
[234]	Light load + evacuation	

Parameter 5-21 Terminal X46/3 Digital Input

Table 302: Parameter 5-21 Terminal X46/3 Digital Input

5-21 Terminal X46/3 Digital Input		
Default value: [0] No operation	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*.
Parameter 5-22 Terminal X46/5 Digital Input

Table 303: Parameter 5-22 Terminal X46/5 Digital Input

5-22 Terminal X46/5 Digital Input		
Default value: [0] No operation	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*.
Parameter 5-23 Terminal X46/7 Digital Input

Table 304: Parameter 5-23 Terminal X46/7 Digital Input

5-23 Terminal X46/7 Digital Input		
Default value: [0] No operation	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

The options for this parameter are the same as for those lited for *parameter 5-20 Terminal X46/1 Digital Input*.
Parameter 5-24 Terminal X46/9 Digital Input

Table 305: Parameter 5-24 Terminal X46/9 Digital Input

5-24 Terminal X46/9 Digital Input		
Default value: [0] No operation	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*.
Parameter 5-25 Terminal X46/11 Digital Input

Table 306: Parameter 5-25 Terminal X46/11 Digital Input

5-25 Terminal X46/11 Digital Input		
Default value: [0] No operation	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*.

Parameter 5-26 Terminal X46/13 Digital Input

Table 307: Parameter 5-26 Terminal X46/13 Digital Input

5-26 Terminal X46/13 Digital Input		
Default value: [0] No operation	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*.

4.6.3 5-3* Digital Outputs

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.

Table 308: Digital Outputs, Function Descriptions - 1

Option		Function
[0]	No operation	Default for all digital outputs and relay outputs.
[1]	Control ready	The control card is ready.
[2]	Drive ready	The drive is ready for operation and applies a supply signal on the control card.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Enable/no warning	Ready for operation. No start or stop command has been given (start/disable). No warnings are active.
[5]	Running	The motor runs, and shaft torque is present.
[6]	Running/no warning	The 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.
[7]	Run inrange/no warn	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*. There are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. There are no warnings.
[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* 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 Curent Low*.
[14]	Above current, high	The motor current is higher than set in *parameter 4-51 Warning Current High*.
[15]	Out of speed range	The output 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	The output speed is higher than the setting in *parameter 4-53 Warning Speed High*.

Option		Function
[18]	Out of feedb. range	Feedback is below the limit 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	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[22]	Ready, no thermal W	The drive is ready for operation, and there is no overtemperature warning.
[23]	Remote, ready, no TW	The drive is ready for operation and is in auto-on mode. There is no overtemperature warning.
[24]	Ready, voltage OK	The drive is ready for operation and the mains voltage is within the specified voltage range.
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and runs counterclockwise when logic = 1. The output changes when the reversing signal is applied.
[26]	Bus OK	Active communication (no timenout) via the serial communication port.
[27]	Torque limit & stop	Used for coast stop and in torque limit conditions. If the drive has received a stop signal and is at the 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 modules. To cut out the main voltage from the drive, use the output/ relay.
[31]	Relay 123	Relay is activated when *[0] Control Word* is selected in *parameter group 8-** Communications and Options*.
[32]	Mech brake ctrl	Enables control of an external mechanical brake. For more information on mechanical brake control, refer to the drive-specific design guide.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 is activated.
[35]	External interlock	
[38]	Motor feedback error	
[40]	Out of ref range	Active when the actual speed is outside settings in *parameter 4-52 Warning Speed Low* in *parameter 4-55 Warning Reference High*.
[41]	Below reference, low	Active when the actual speed is below speed reference setting.
[42]	Above ref, high	Active when the actual speed is above speed reference setting.
[43]	Extended PID limit	
[45]	Bus ctrl.	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 retained.
[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).

Option		Function
[54]	24V encoder sim	Digital outputs 27 and 29 simulate a single-signal HTL encoder. Select source for the signal generation in *parameter 5-78 Term 27/29 Encoder Sim*.
[55]	Pulse output	
[58]	Actual position	
[59]	Actual position 4–20 mA	
[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.
[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.
[80]	SL digital output A	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[38] Set dig. out. A high* is executed. The output goes low whenever the smart logic action *[32] Set dig. out. A low* is executed.
[81]	SL digital output B	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[39] Set dig. out. B high* is executed. The output goes low whenever the smart logic action *[33] Set dig. out. B low* is executed.
[82]	SL digital output C	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[40] Set dig. out. C high* is executed. The output goes low whenever the smart logic action *[34] Set dig. out. C low* is executed.
[83]	SL digital output D	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[41] Set dig. out. D high* is executed. The output goes low whenever the smart logic action *[35] Set dig. out. D low* is executed.

Option		Function
[84]	SL digital output E	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[42] Set dig. out. E high* is executed. The output goes low whenever the smart logic action *[36] Set dig. out. E low* is executed.
[85]	SL digital output F	See *parameter 13-52 SL Controller Action*. The output goes high whenever the smart logic action *[43] Set dig. out. F high* is executed. The output goes low whenever the smart logic action *[37] Set dig. out. F low* is executed.
[90]	kWh counter pulse	Sends a pulse (200 ms pulse width) to output terminal whenever kWh counter changes (*parameter 15-02 kWh Counter*).
[120]	Local ref active	Output is high when *parameter 313 Reference Site = [2] Local*.

Table 309: Local Reference Active

Reference site set in *parameter 3-13 Reference Site*	Local reference active [120]	Remote reference active [121]
Reference site: Local *parameter 3-13 Reference Site [2] Local*	1	0
Reference site: Remote *parameter 3-13 Reference Site [1] Remote*	0	1
Reference site: Linked to Hand/ Auto	–	–
Hand	1	0
Hand⇒off	1	0
Auto⇒off	0	0
Auto	0	1

Table 310: 5-30 Digital Outputs - 2

Option		Function
[121]	Remote ref active	Output is high when *parameter 3-13 Reference Site = [1] Remote* or *[0] Linked to hand/auto* while the LCP is in auto-on mode. See Table 309.
[122]	No alarm	Output is high when no alarm is present.
[123]	Start command active	Output is high when there is an active start command (that is via digital input bus connection, hand-on, or auto-on), and no stop or start command is active.
[124]	Running reverse	Output is high when the drive runs counterclockwise (the logical product of the status bits running AND reverse).
[125]	Drive in hand mode	Output is high when the drive is in hand-on mode (as indicated by the LED light above [Hand On]).
[126]	Drive in auto mode	Output is high when the drive is in auto-on mode (as indicated by the LED light above [Auto On]).
[180]	Clock fault	
[181]	Prev. maintenance	
[188]	AHF capacitor connect	The capacitors are turned on at 20% (hysteresis of 50% gives an interval of 10– 30%). The capacitors are disconnected below 10%. The off delay is 10 s and restarts if the nominal power goes above 10% during the delay. *Parameter 5-80 AHF Cap Reconnect Delay* is used to guarantee a minimum off time for the capacitors.

Option		Function
[189]	External fan control	The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	Safe function active	
[191]	Safe opt. reset req.	
[192]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[193]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[194]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[195]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[196]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[197]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[198]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[199]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[221]	IGBT cooling	Use this option for handling the overcurrent trips. When the drive detects an overcurrent condition, it shows *alarm 13, Overcurrent* and triggers a reset. If the overcurrent condition occurs for the 3rd time in a row, the drive shows *alarm 13, Overcurrent* and initiates a 3-minute delay before the next reset.
[231]	In power lim. mot.	
[232]	In power lim. gen.	
[233]	In power limit	

Parameter 5-30 Terminal 27 Digital Output

Table 311: Parameter 5-30 Terminal 27 Digital Output

5-30 Terminal 27 Digital Output		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the function from the available digital input range and the additional options *[60] Counter A (up)*, *[61] Counter A (down)*, *[63] Counter B (up)*, and *[64] Counter B (down)*. Counters are used in smart logic control functions. All functions are described in Table 308 and Table 310.

Option	Name	Description
[0]	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Coast and reset inv	
[4]	Enable/no warning	
[5]	Running	
[6]	Running/no warning	

Option	Name	Description
[7]	Run in range/no warn	
[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	
[22]	Ready,no thermal W	
[23]	Remote,ready, no TW	
[24]	Ready, Voltage OK	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[31]	Relay 123	
[32]	Mech brake ctrl	
[33]	Safe stop active	
[35]	External interlock	
[38]	Motor feedback error	
[39]	Tracking error	
[40]	Out of ref range	
[41]	Below reference, low	

Option	Name	Description
[42]	Above ref, high	
[43]	Extended PID Limit	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[50]	On reference	
[54]	24V Encoder Sim	
[55]	Pulse output	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[79]	PE power off	
[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	
[121]	Remote ref active	
[122]	No alarm	
[123]	Start command activ	

Option	Name	Description
[124]	Running reverse	
[125]	Drive in hand mode	
[126]	Drive in auto mode	
[180]	Clock fault	
[181]	Prev. Maintenance	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	Safe Function active	
[191]	Safe Opt. Reset req.	
[192]	RS Flipflop 0	
[193]	RS Flipflop 1	
[194]	RS Flipflop 2	
[195]	RS Flipflop 3	
[196]	RS Flipflop 4	
[197]	RS Flipflop 5	
[198]	RS Flipflop 6	
[199]	RS Flipflop 7	
[221]	IGBT-cooling	
[231]	In Power Lim. Mot.	
[232]	In Power Lim. Gen.	
[233]	In Power Limit	

Parameter 5-31 Terminal 29 Digital Output

Table 312: Parameter 5-31 Terminal 29 Digital Output

5-31 Terminal 29 Digital Output		
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 5-30 Terminal 27 Digital Output*.

4.6.4 5-4* Relays

Parameters for configuring the timing and the output functions for the relays.

Parameter 5-40 Function Relay

Table 313: Parameter 5-40 Function Relay

5-40 Function Relay		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select options to define the function of the relays. Relay 1 [0], relay 2 [1].

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]	Enable/no warning	Ready for operation. No start or stop commands have been applied (start/disable). No warnings are active.
[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.
[7]	Run in range/no warn	The motor runs within the programmed current and the speed ranges set in *parameter 4-50 Warning Current Low* and *parameter 4-53 Warning Speed High*. 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*.
[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.
[22]	Ready,no thermal W	The drive is ready for operation and there is no overtemperature warning.

Option	Name	Description
[23]	Remote,ready, no TW	The drive is ready for operation and is in auto-on mode. There is no overtemperature warning.
[24]	Ready, Voltage OK	The drive is ready for operation and the mains voltage is within the specified voltage range.
[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.
[31]	Relay 123	Digital output/relay is activated when *[0] Control Word* is selected in *parameter group 8-** Comm. and Options*.
[32]	Mech brake ctrl	Selection of mechanical brake control. When selected parameters in *parameter group 2-2* Mechanical Brake* are active. The output must be reinforced to carry the current for the coil in the brake. Usually solved by connecting an external relay to the selected digital output.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	
[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.
[38]	Motor feedback error	Failure in the speed feedback loop from motor running in closed loop. The output can eventually be used to prepare switching the drive in open loop in an emergency case.
[39]	Tracking error	When the difference between calculated speed and actual speed in *parameter 4-35 Tracking Error* is larger than selected, the digital output/relay is active.
[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*.
[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.
[43]	Extended PID Limit	
[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 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).

Option	Name	Description
[50]	On reference	
[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.
[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.
[79]	PE power off	
[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]	Local ref active	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.

Table 314: Local Reference Active

Reference site set in *parameter 3-1 3 Reference Site*	**Local reference active [120]**	**Remote reference active [121]**
Reference site: Local *parameter 3-13 Reference Site [2] Local*	1	0
Reference site: Remote *parameter 3-13 Reference Site [1] Remote*	0	1
Reference site: Linked to Hand/ Auto		
Hand	1	0
Hand⇒off	1	0
Auto⇒off	0	0
Auto	0	1

Option	Name	Description
[121]	Remote ref active	Output is high when *parameter 3-13 Reference Site = [1] Remote* or *[0] Linked to hand/auto while the LCP*.
[122]	No alarm	Output is high when no alarm is present.
[123]	Start command active	Output is high when the start command is high (that is via digital input, bus connection, [Hand On], or [Auto On]), and a stop has been the last command.
[124]	Running reverse	Output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[125]	Drive in hand mode	Output is high when the drive is in hand-on mode (as indicated by the LED light above [Hand On]).
[126]	Drive in auto mode	Output is high when the drive is in auto-on mode (as indicated by LED on above [Auto On]).
[180]	Clock fault	
[181]	Prev. Maintenance	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	Safe Function active	
[191]	Safe Opt. Reset req.	
[192]	RS Flipflop 0	See *parameter group 13-1* Comparators*.
[193]	RS Flipflop 1	See *parameter group 13-1* Comparators*.
[194]	RS Flipflop 2	See *parameter group 13-1* Comparators*.
[195]	RS Flipflop 3	See *parameter group 13-1* Comparators*.
[196]	RS Flipflop 4	See *parameter group 13-1* Comparators*.
[197]	RS Flipflop 5	See *parameter group 13-1* Comparators*.
[198]	RS Flipflop 6	See *parameter group 13-1* Comparators*.
[199]	RS Flipflop 7	See *parameter group 13-1* Comparators*.

Option	Name	Description
[221]	IGBT-cooling	Use this option for handling the overcurrent trips. When the drive detects an overcurrent condition, it shows *alarm 13, Overcurrent* and triggers a reset. If the overcurrent condition occurs the 3rd time in a row, the drive shows *alarm 13, Overcurrent* and initiates a 3 minute delay before the next reset.
[231]	In Power Lim. Mot.	
[232]	In Power Lim. Gen.	
[233]	In Power Limit	

Parameter 5-41 On Delay, Relay

Table 315: Parameter 5-41 On Delay, Relay

5-41 On Delay, Relay		
Default value: 0.01 s	Parameter type: Range, 0.01 – 600 s, Array [9]	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.

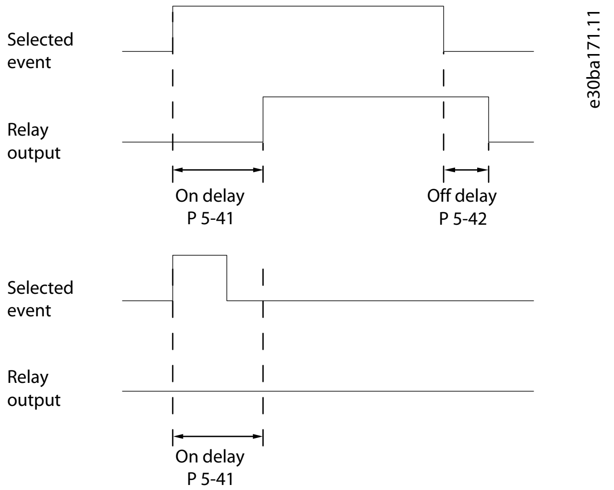


Illustration 55: On Delay, Relay

Parameter 5-42 Off Delay, Relay

Table 316: Parameter 5-42 Off Delay, Relay

5-42 Off Delay, Relay		
Default value: 0.01 s	Parameter type: Range, 0.01 – 600 s, Array [9]	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.

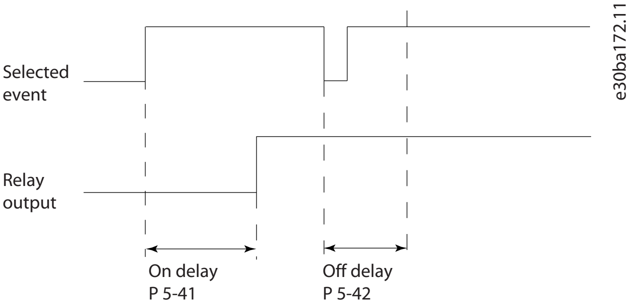


Illustration 56: Off Delay, Relay

If the selected event condition changes before the on delay or off delay timer expires, the relay output is unaffected.

4.6.5 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 terminals 29 or 33 act 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 5-01 Terminal 27 Mode* to *[0] Input*.

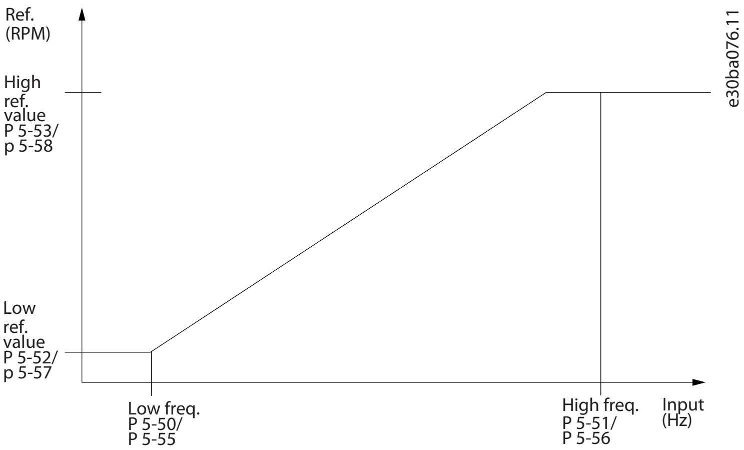


Illustration 57: Pulse Input

Parameter 5-50 Term. 29 Low Frequency

Table 317: Parameter 5-50 Term. 29 Low Frequency

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 Illustration 57.

Parameter 5-51 Term. 29 High Frequency

Table 318: Parameter 5-51 Term. 29 High Frequency

5-51 Term. 29 High Frequency		
Default value: Size related	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*.

Parameter 5-52 Term. 29 Low Ref./Feedb. Value

Table 319: Parameter 5-52 Term. 29 Low Ref./Feedb. Value

5-52 Term. 29 Low Ref./Feedb. Value		
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 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).

Parameter 5-53 Term. 29 High Ref./Feedb. Value

Table 320: Parameter 5-53 Term. 29 High Ref./Feedb. Value

5-53 Term. 29 High Ref./Feedb. Value		
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 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).

Parameter 5-54 Pulse Filter Time Constant #29

Table 321: Parameter 5-54 Pulse Filter Time Constant #29

5-54 Pulse Filter Time Constant #29		
Default value: 100 ms	Parameter type: Range, 1 - 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.

Parameter 5-55 Term. 33 Low Frequency

Table 322: Parameter 5-55 Term. 33 Low Frequency

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*.

Parameter 5-56 Term. 33 High Frequency

Table 323: Parameter 5-56 Term. 33 High Frequency

5-56 Term. 33 High Frequency		
Default value: Size related	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*.

Parameter 5-57 Term. 33 Low Ref./Feedb. Value

Table 324: Parameter 5-57 Term. 33 Low Ref./Feedb. Value

5-57 Term. 33 Low Ref./Feedb. Value		
Default value: Size related	Parameter type: Range, -999999.999 - 999999.999 ReferenceFeed-backUnit	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*.
Parameter 5-58 Term. 33 High Ref./Feedb. Value

Table 325: Parameter 5-58 Term. 33 High Ref./Feedb. Value

5-58 Term. 33 High Ref./Feedb. Value		
Default value: Size related	Parameter type: Range, -999999.999 - 999999.999 ReferenceFeed-backUnit	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*.
Parameter 5-59 Pulse Filter Time Constant #33

Table 326: Parameter 5-59 Pulse Filter Time Constant #33

5-59 Pulse Filter Time Constant #33		
Default value: 100 ms	Parameter type: Range, 1 - 1000 ms	Setup: All setups
Conversion index: -3	Data type: Uint16	Change during operation: False

N O T I C E

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.

4.6.6 5-6* Pulse Outputs

N O T I C E

These parameters cannot be adjusted while the motor is running.

These parameters configure pulse outputs with their functions and scaling. Terminals 27 and 29 are allocated to pulse output via *parameter 5-01 Terminal 27 Mode* and *parameter 5-02 Terminal 29 Mode*, respectively.

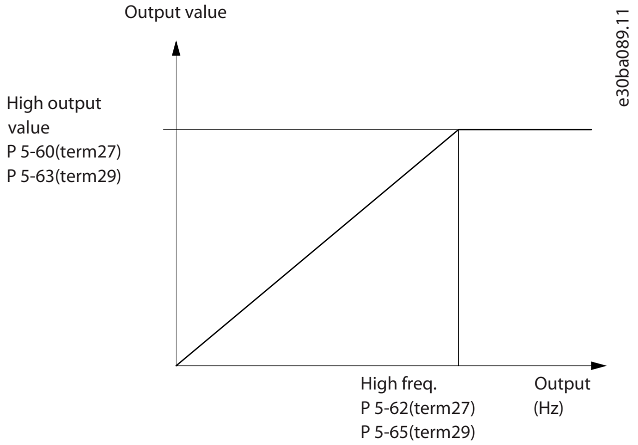


Illustration 58: Configuration of Pulse Outputs

Table 327: Options for Readout Output Variables

Option	Name	Description
		Parameters for configuring the scaling and output functions of pulse outputs. The pulse outputs are designated to terminals 27 or 29. Select terminal 27 output in *parameter 5-01 Terminal 27 Mode* and terminal 29 output in *parameter 5-02 Terminal 29 Mode*.
[0]	No operation	
[45]	Bus control	
[48]	Bus control timeout	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor current	
[104]	Torque relative to limit	
[105]	Torque relative to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max. out freq	

Parameter 5-60 Terminal 27 Pulse Output Variable

Table 328: Parameter 5-60 Terminal 27 Pulse Output Variable

5-60 Terminal 27 Pulse Output Variable		
Default value: Size related	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	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor current	
[104]	Torque rel to limit	
[105]	Torque related to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max out freq	
[119]	Torque % lim	

Parameter 5-62 Pulse Output Max Freq #27

Table 329: Parameter 5-62 Pulse Output Max Freq #27

5-62 Pulse Output Max Freq #27		
Default value: Size related	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*.

Parameter 5-63 Terminal 29 Pulse Output Variable

Table 330: Parameter 5-63 Terminal 29 Pulse Output Variable

5-63 Terminal 29 Pulse Output Variable		
Default value: Size related	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 29.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	

Option	Name	Description
[103]	Motor current	
[104]	Torque rel to limit	
[105]	Torque related to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max out freq	
[119]	Torque % lim	

Parameter 5-65 Pulse Output Max Freq #29

Table 331: Parameter 5-65 Pulse Output Max Freq #29

5-65 Pulse Output Max Freq #29		
Default value: Size related	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 29 corresponding to the output variable selected in *parameter 5-63 Terminal 29 Pulse Output Variable*.

4.6.7 5-7* 24 V Encoder Input

Connect the 24 V encoder to terminal 12 (24 V DC supply), terminal 32 (channel A), terminal 33 (channel B), and terminal 20 (GND). The digital inputs 32/33 are active for encoder inputs when *[1] 24 V encoder* is selected in *parameter 1-02 Flux Motor Feedback Source* and *parameter 7-00 Speed PID Feedback Source*. The encoder used is a dual-channel (A and B) 24 V type. Maximum input frequency: 110 kHz.

Encoder connection to the drive

24 V incremental encoder. Maximum cable length is 5 m (16.4 ft).

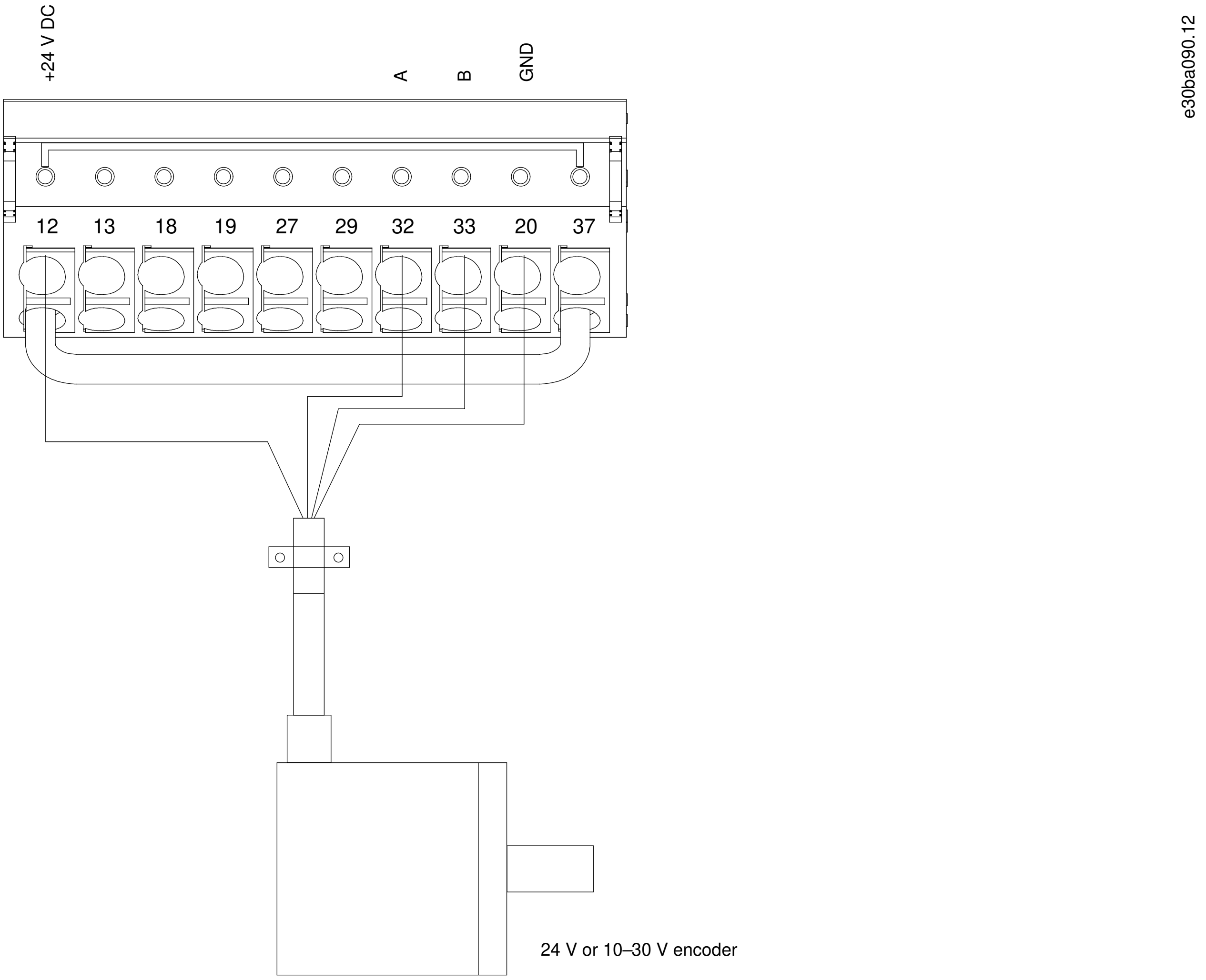


Illustration 59: Encoder Connection

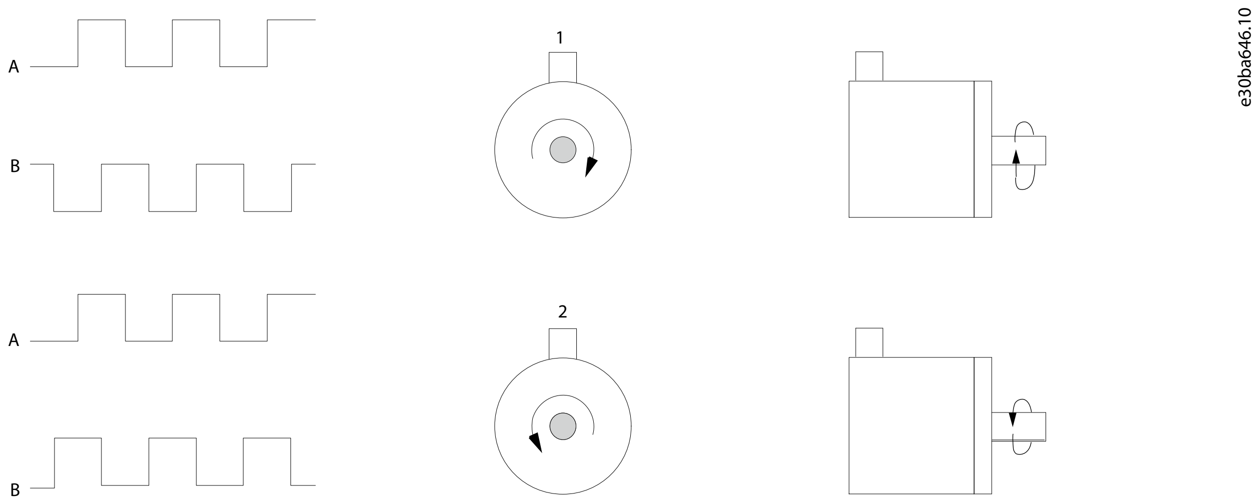


Illustration 60: Encoder Rotation Direction

Parameter 5-70 Term 32/33 Pulses Per Revolution

Table 332: Parameter 5-70 Term 32/33 Pulses Per Revolution

5-70 Term 32/33 Pulses Per Revolution		
Default value: 1024	Parameter type: Range, 1 - 4096	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: False

Set the resolution of the encoder connected to terminal 32/33 in pulses per revolution.
Parameter 5-71 Term 32/33 Encoder Direction

Table 333: 5-71 Term 32/33 Encoder Direction

5-71 Term 32/33 Encoder Direction		
Default value: [0] Clockwise	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

N O T I C E

This parameter cannot be adjusted while the motor is running.

Change the detected encoder rotation direction without changing the wiring to the encoder.

Option	Name	Description
[0]*	Clockwise	Sets channel A 90° (electrical degrees) behind channel B upon clockwise rotation of the encoder shaft.
[1]	Counter clock-wise	Sets channel A 90° (electrical degrees) ahead of channel B upon clockwise rotation of the encoder shaft.

4.6.8 5-8* I/O Options

Parameter 5-80 AHF Cap Reconnect Delay

Table 334: Parameter 5-80 AHF Cap Reconnect Delay

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%.

4.6.9 5-9* Bus-controlled

This parameter group selects digital and relay outputs via a fieldbus setting.
Parameter 5-90 Digital & Relay Bus Control

Table 335: Parameter 5-90 Digital & Relay Bus Control

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.

Table 336: Bus-controlled Digital Outputs and Relays

Bit	Output/Relay
0	Digital output terminal 27
1	Digital output terminal 29
2	Digital output terminal X30/6
3	Digital output terminal X30/7
4	Relay 1 output terminal
5	Relay 2 output terminal
6	Option B relay 1 output terminal
7	Option B relay 2 output terminal
8	Option B relay 3 output terminal
9-15	Reserved for future terminals
16	Option C relay 1 output terminal
17	Option C relay 2 output terminal
18	Option C relay 3 output terminal
19	Option C relay 4 output terminal
20	Option C realy 5 output terminal
21	Option C relay 6 output terminal
22	Option C relay 7 output terminal
23	Option C relay 8 output terminal
21–31	Reserved for future terminals

Parameter 5-93 Pulse Out #27 Bus Control

Table 337: Parameter 5-93 Pulse Out #27 Bus Control

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*.

Parameter 5-94 Pulse Out #27 Timeout Preset

Table 338: Parameter 5-94 Pulse Out #27 Timeout Preset

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.

Parameter 5-95 Pulse Out #29 Bus Control

Table 339: Parameter 5-95 Pulse Out #29 Bus Control

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*.
Parameter 5-96 Pulse Out #29 Timeout Preset

Table 340: Parameter 5-96 Pulse Out #29 Timeout Preset

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.
Parameter 5-97 Pulse Out #X30/6 Bus Control

Table 341: Parameter 5-97 Pulse Out #30/6 Bus Control

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*.
Parameter 5-98 Pulse Out #X30/6 Timeout Preset

Table 342: Parameter 5-98 Pulse Out #30/6 Timeout Preset

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	Change 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.

4.7 Parameter Group 6-** Analog In/Out

4.7.1 6-0* Analog I/O Mode

The analog inputs can be allocated to be either voltage (0 to ±10 V) or current input (0/4–20 mA).

NOTICE
Thermistors may be connected to either an analog or a digital input.

Parameter 6-00 Live Zero Timeout Time

Table 343: Parameter 6-00 Live Zero Timeout Time

6-00 Live Zero Timeout Time		
Default value: 10 s	Parameter type: Range, 0 - 99 s	Setup: All setup
Conversion index: 0	Data type: Int16	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.

Parameter 6-01 Live Zero Timeout Function

Table 344: Parameter 6-01 Live Zero Timeout Function

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.
[20]	Coast	
[21]	Coast and trip	

4.7.2 6-1* Analog Input 1

Parameters for configuring the scaling and limits for analog input 1 (terminal 53).

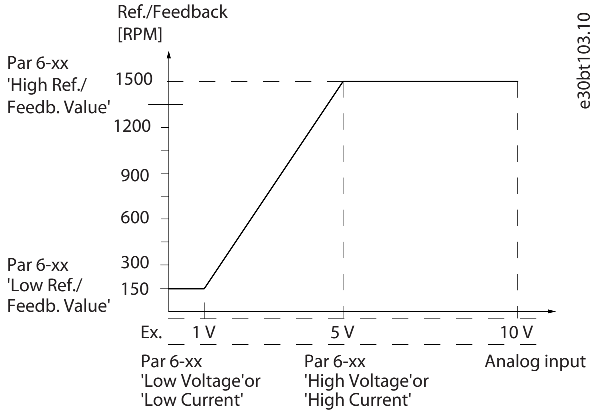


Illustration 61: Analog Input 1

Parameter 6-10 Terminal 53 Low Voltage

Table 345: Parameter 6-10 Terminal 53 Low Voltage

6-10 Terminal 53 Low Voltage		
Default value: Size related	Parameter type: Range, -10.00 - 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*.

Parameter 6-11 Terminl 53 High Voltage

Table 346: Parameter 6-11 Terminal 53 High Voltage

6-11 Terminal 53 High Voltage		
Default value: 10 V	Parameter type: Range, par. 6-11 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*.

Parameter 6-12 Terminal 53 Low Current

Table 347: Parameter 6-12 Terminal 53 Low Current

6-12 Terminal 53 Low Current		
Default value: 0.14 mA	Parameter type: Range, par. 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*.

Parameter 6-13 Terminal 53 High Current

Table 348: Parameter 6-13 Terminal 53 High Current

6-13 Terminal 53 High Current		
Default value: 20 mA	Parameter type: Range, par. 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*.

Parameter 6-14 Terminal 53 Low Ref./Feedb. Value

Table 349: Parameter 6-14 Terminal 53 Low 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*.

Parameter 6-15 Terminal 53 High Ref./Feedb. Value

Table 350: Parameter 6-15 Terminal 53 High Ref./Feedb. Value

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*.

Parameter 6-16 Terminal 53 Filter Time Constant

Table 351: Parameter 6-16 Terminal 53 Filter Time Constant

6-16 Terminal 53 Filter Time Constant		
Default value: 0.001 s	Parameter type: Range, 0.001 - 10 s	Setup: All setups
Conversion index: -3	Data type: Uint16	Change during operation: True

N O T I C E

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.

4.7.3 6-2* Analog Input 2

Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

Parameter 6-20 Terminal 54 Low Voltage

Table 352: Parameter 6-20 Terminal 54 Low Voltage

6-20 Terminal 54 Low Voltage		
Default value: Size related	Parameter type: Range, -10.00 - 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*.

Parameter 6-21 Terminal 54 High Voltage

Table 353: Parameter 6-21 Terminal 54 High Voltage

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*.

Parameter 6-22 Terminal 54 Low Current

Table 354: Parameter 6-22 Terminal 54 Low Current

6-22 Terminal 54 Low Current		
Default value: Size related	Parameter type: Range, par. 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*.

Parameter 6-23 Terminal 54 High Current

Table 355: Parameter 6-23 Terminal 54 High Current

6-23 Terminal 54 High Current		
Default value: 20 mA	Parameter type: Range, par. 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*.

Parameter 6-24 Terminal 54 Low Ref./Feedb. Value

Table 356: Parameter 6-24 Terminal 54 Low Ref./Feedb. Value

6-24 Terminal 54 Low Ref./Feedb. Value		
Default value: Size related	Parameter type: Range, -999999.999 - 999999.999 ReferenceFeedbackUnit	Setup: All setup
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*.

Parameter 6-25 Terminal 54 High Ref./Feedb. Value

Table 357: Parameter 6-25 Terminal 54 High Ref./Feedb. Value

6-25 Terminal 54 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 3-03 Maximum Reference*.

Parameter 6-26 Terminal 54 Filter Time Constant

Table 358: Parameter 6-26 Terminal 54 Filter Time Constant

6-26 Terminal 54 Filter Time Constant		
Default value: 0.001 s	Parameter type: Range, 0.001 - 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.

4.7.4 6-5* Analog Output 1

Parameters for configuring the scaling and limits for analog output 1, that is terminal 42. Analog outputs are current outputs of 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. The resolution on analog output is 12 bit.

Parameter 6-50 Terminal 42 Output

Table 359: Parameter 6-50 Terminal 42 Output

6-50 Terminal 42 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 42 as an analog current output. Depending on the selection, the output is either a 0–20 mA or 4–20 mA output. The current value can be read out in the LCP in *parameter 16-65 Analog Output 42 [mA]*.

Option	Name	Description
[0]*	No operation	Indicates no signal on the analog output.
[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	
[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. $\frac{20\text{ mA} \times 22\,A}{38.4\,A} = 11.46\text{ mA}$ When the normal motor current is equal to 20 mA, the output setting of *parameter 6-52 Terminal 42 Output Max Scale* is: $\frac{I_{VLT,MAX} \times 100}{I_{Motor,Nom}} = \frac{38.4 \times 100}{22} = 175\,\%$
[104]	Torque rel to limit	The torque setting is related to the setting in *parameter 4-16 Torque Limit Motor Mode*.

Option	Name	Description
[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	
[119]	Torque % lim	
[130]	Output freq. 4–20mA	0 Hz = 4 mA, 100 Hz = 20 mA.
[131]	Reference 4–20mA	*Parameter 3-00 Reference Range [Min-Max]* 0% = 4 mA; 100% = 20 mA *Parameter 3-00 Reference Range [-Max-Max]* -100% = 4 mA; 0% = 12 mA; +100% = 20 mA.
[132]	Feedback 4–20mA	
[133]	Motor cur. 4–20mA	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. $\frac{16\text{ mA} \times 22\,A}{38.4\,A} = 13.17\text{ mA}$ If the normal motor current is equal to 20 mA, the output setting of *parameter 6-52 Terminal 42 Output Max Scale* is: $\frac{I_{\text{VLT, MAX}} \times 100}{I_{\text{Motor, Nom}}} = \frac{38.4 \times 100}{22} = 175\,\%$
[134]	Torq.% lim 4–20 mA	The torque setting is related to the setting in *parameter 4-16 Torque Limit Motor Mode*.
[135]	Torq.% nom 4–20mA	The torque setting is related to the motor torque setting.
[136]	Power 4–20mA	Taken from *parameter 1-20 Motor Power [kW]*.
[137]	Speed 4–20mA	Taken from *parameter 3-03 Maximum Reference*. 20 mA = value in *parameter 3-03 Maximum Reference*.
[138]	Torque 4–20mA	Torque reference related to 160% torque.
[139]	Bus ctrl. 0-20mA	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[140]	Bus ctrl. 4-20mA	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl 0-20mA t.o.	*Parameter 4-54 Warning Reference Low* defines the behavior of the analog output in case of fieldbus timeout.

Option	Name	Description
[142]	Bus ctrl 4-20mA t.o.	*Parameter 4-54 Warning Reference Low* defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val 0-20mA	
[148]	Main act val 4-20mA	
[149]	Torque % lim 4-20mA	Analog output at 0 torque is 12 mA. Motoring torque increases the output current to maximum torque limit 20 mA (set in *parameter 4-16 Torque Limit Motor Mode*). Generating torque decreases the output to torque limit in generator mode (set in *parameter 4-17 Torque Limit Generator Mode*) Example: *Parameter 4-16 Torque Limit Motor Mode* = 200% and *parameter 4-17 Torque Limit Generator Mode* = 200%. 20 mA = 200% motoring and 4 mA = 200% generating.
[150]	Max Out Fr 4-20mA	0 Hz = 0 mA, *parameter 4-19 Max Output Frequency* = 20 mA.
[158]	Motor Volt. 0-20mA	
[159]	Motor Volt. 4-20mA	

Parameter 6-51 Terminal 42 Output Min Scale

Table 360: Parameter 6-51 Terminal 42 Output Min Scale

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*.

Parameter 6-52 Terminal 42 Output Max Scale

Table 361: Parameter 6-52 Terminal 42 Output Max Scale

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:

$$20\ \text{mA}/\text{desired maximum current} \times 100\,\% \ = 10\ \text{mA}: \frac{20}{10} \times 100 \ = \ 200\,\%$$

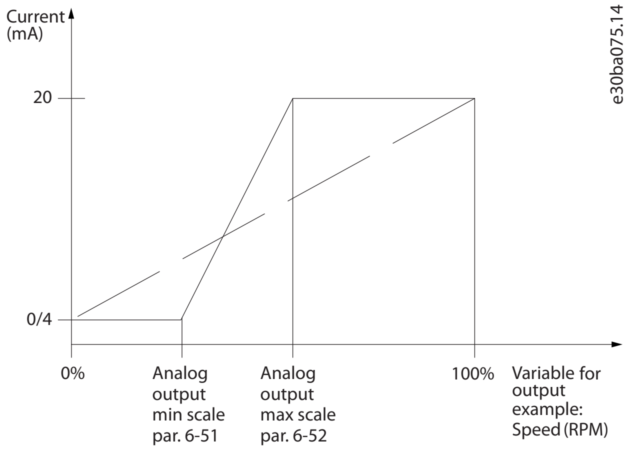


Illustration 62: Output Maximum Scale

Parameter 6-53 Term 42 Output Bus Ctrl

Table 362: Parameter 6-53 Term 42 Output Bus Ctrl

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.

Parameter 6-54 Term 42 Output Timeout Preset

Table 363: Parameter 6-54 Term 42 Output Timeout Preset

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.

Parameter 6-55 Analog Output Filter

Table 364: Parameter 6-55 Analog Output Filter

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 365: Readout Parameters

Selection	0–20 mA	4–20 mA
Motor current (I_{max})	[103]	[133]
Torque limit ($0–T_{lim}$)	[104]	[134]

Selection	0–20 mA	4–20 mA
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.

4.8 Parameter Group 7-** Controllers

4.8.1 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.

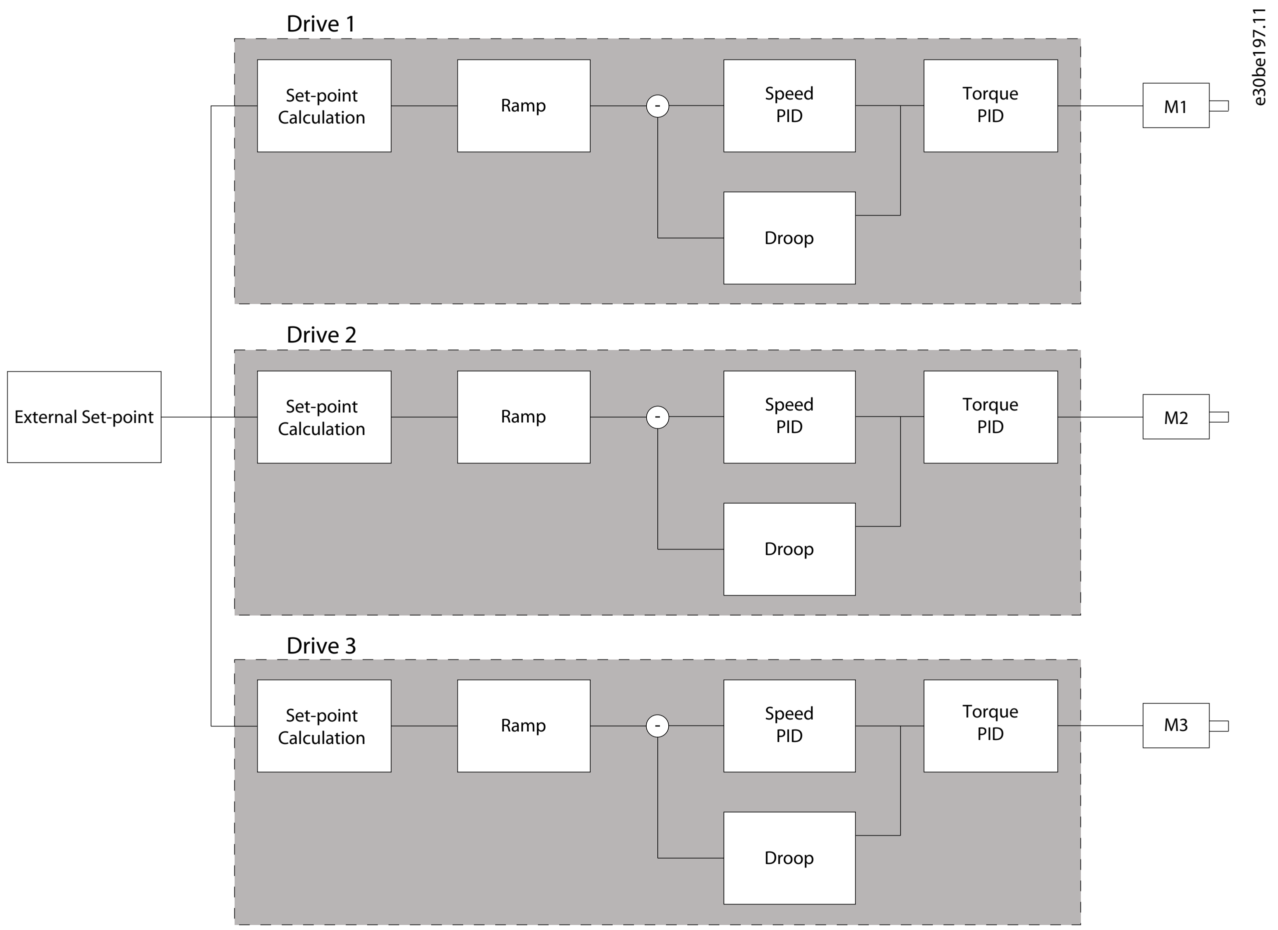


Illustration 63: Concept of Speed PID Droop

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*.

N O T I C E

Do not use overvoltage control when using the PID droop function (select *[0] Disabled* in *parameter 2-17 Over-voltage Control*).

N O T I C E

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.

4.8.2 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.

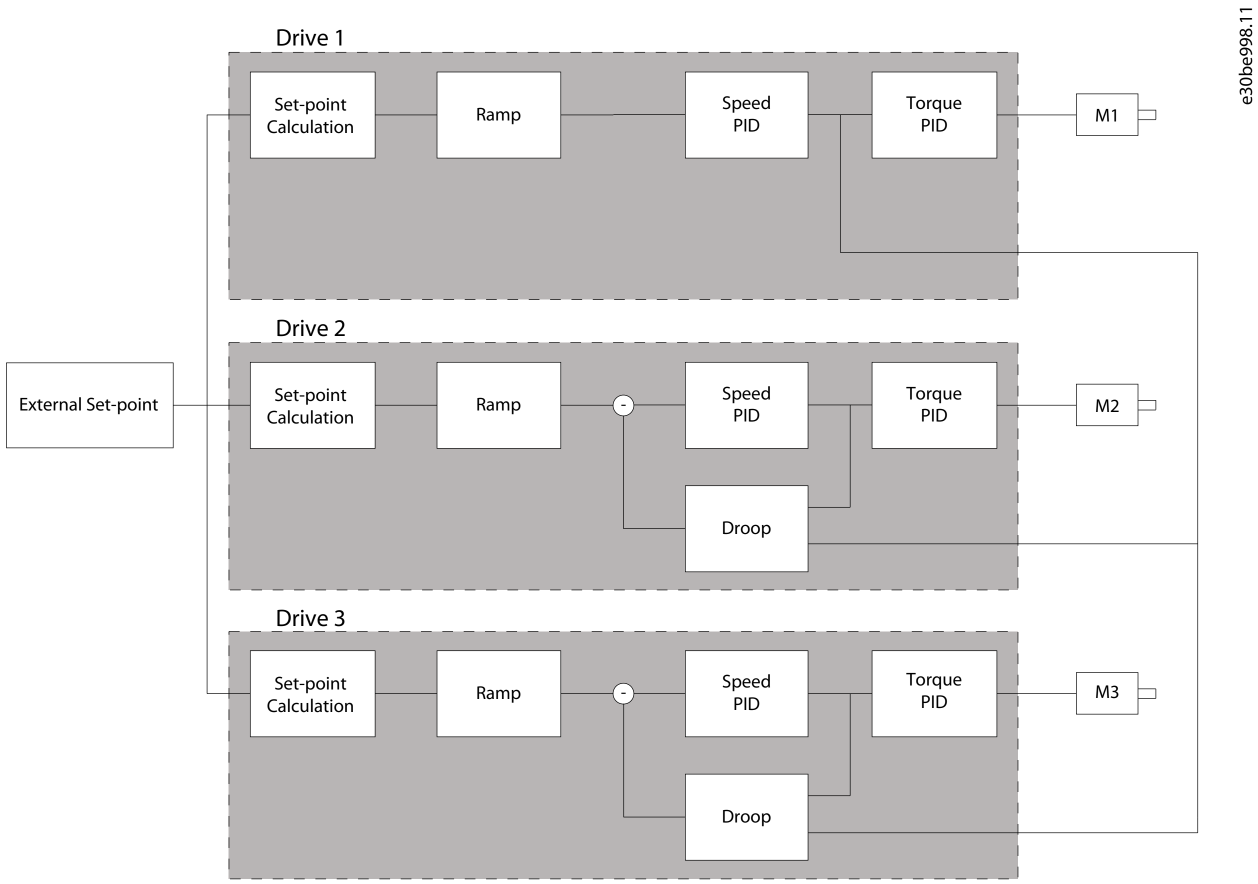


Illustration 64: Speed Trim

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.

4.8.3 7-0* Speed PID Ctrl.

N O T I C E

If separate encoders are used, adjust the ramp-related parameters according to the gear ratio between the 2 encoders.

Parameter 7-00 Speed PID Feedback Source

Table 366: Parameter 7-00 Speed PID Feedback Source

7-00 Speed PID Feedback Source		
Default value: Size related	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

Option	Name	Description
[0]	Motor feedb. P1-02	Use the feedback source selected as motor feedback in *parameter 1-02 Flux Motor Feedback Source*.
[1]	24V encoder 32/33	Single signal generated from 24 V High Threshold Logic (HTL) encoder connected to terminals 32 and 33. Configure the 24 V encoder interface in *parameter group 5-7* 24V Encoder Input*. Program terminals 32/33 to *[0] No operation*.
[6]	Analog input 53	

Option	Name	Description
[7]	Analog input 54	
[8]	Frequency input 29	
[9]	Frequency input 33	
[13]	24V encoder 27/29	Single signal generated from 24 V High Threshold Logic (HTL) encoder connected to terminals 27 and 29. Configure the 24 V encoder interface in *parameter group 5-7* 24V Encoder Input*. Program terminals 27/29 to *[0] No operation*.

Parameter 7-01 Speed PID Droop

Table 367: Parameter 7-01 Speed PID Droop

7-01 Speed PID Droop		
Default value: 0 RPM	Parameter type: Range, 0 - 200 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

The droop function allows the drive to decrease the motor speed proportional to the load. The droop value is directly proportional to the load value. Use the droop function when several motors are mechanically connected and the load on motors can differ. Ensure that *parameter 1-62 Slip Compensation* has a default setting. Enter the droop value at 100% load.

Parameter 7-02 Speed PID Proportional Gain

Table 368: Parameter 7-02 Speed PID Proportional Gain

7-02 Speed PID Proportional Gain		
Default value: 0.015	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*.

Parameter 7-03 Speed PID Integral Time

Table 369: Parameter 7-03 Speed PID Integral Time

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*.

Parameter 7-04 Speed PID Differentiation Time

Table 370: Parameter 7-04 Speed PID Differentiation Time

7-04 Speed PID Differentiation Time		
Default value: Size related	Parameter type: Range, 0 - 200 ms	Setup: All 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*.

Parameter 7-05 Speed PID Diff. Gain Limit

Table 371: Parameter 7-05 Speed PID Diff. Gain Limit

7-05 Speed PID Diff. Gain Limit		
Default value: 5	Parameter type: Range, 1 - 20	Setup: All setups
Conversion index: -1	Data type: Uint16	Change during operation: True

Set a limit for the gain provided by the differentiator. Consider limiting the gain at higher frequencies. For example, set up a pure D-link at low frequencies and a constant D-link at higher frequencies. This parameter is used with *parameter 1-00 Configuration Mode*, *[1] Speed closed loop control*.

Parameter 7-06 Speed PID Lowpass Filter Time

Table 372: Parameter 7-06 Speed PID Lowpass Filter Time

7-06 Speed PID Lowpass Filter Time		
Default value: Size related	Parameter type: Range, 0.1 - 100 ms	Setup: All setups
Conversion index: -4	Data type: Uint16	Change during operation: True

N O T I C E

Severe filtering can be detrimental to dynamic performance. This parameter is used with *parameter 1-00 Configuration Mode*, *[1] Speed closed loop* and *[2] Torque control*. Adjust the filter time in flux sensorless to 3–5 ms.

Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. This is an advantage if there is a great amount of noise in the system. For example, if a time constant (τ) of 100 ms is programmed, the cut-off frequency for the low-pass filter is 1/0.1 = 10 RAD/s, corresponding to (10/2 x π) = 1.6 Hz. The PID regulator only regulates a feedback signal that varies by a frequency of less than 1.6 Hz. If the feedback signal varies by a higher frequency than 1.6 Hz, the PID regulator does not react. Practical settings of *parameter 7-06 Speed PID Lowpass Filter Time* taken from the number of pulses per revolutions from encoder:

Table 373: Speed PID Low-pass Filter Time

Encoder PPR	*Parameter 7-06 Speed PID Lowpass Filter Time* **[ms]**
512	10
1024	5
2048	2
4096	1

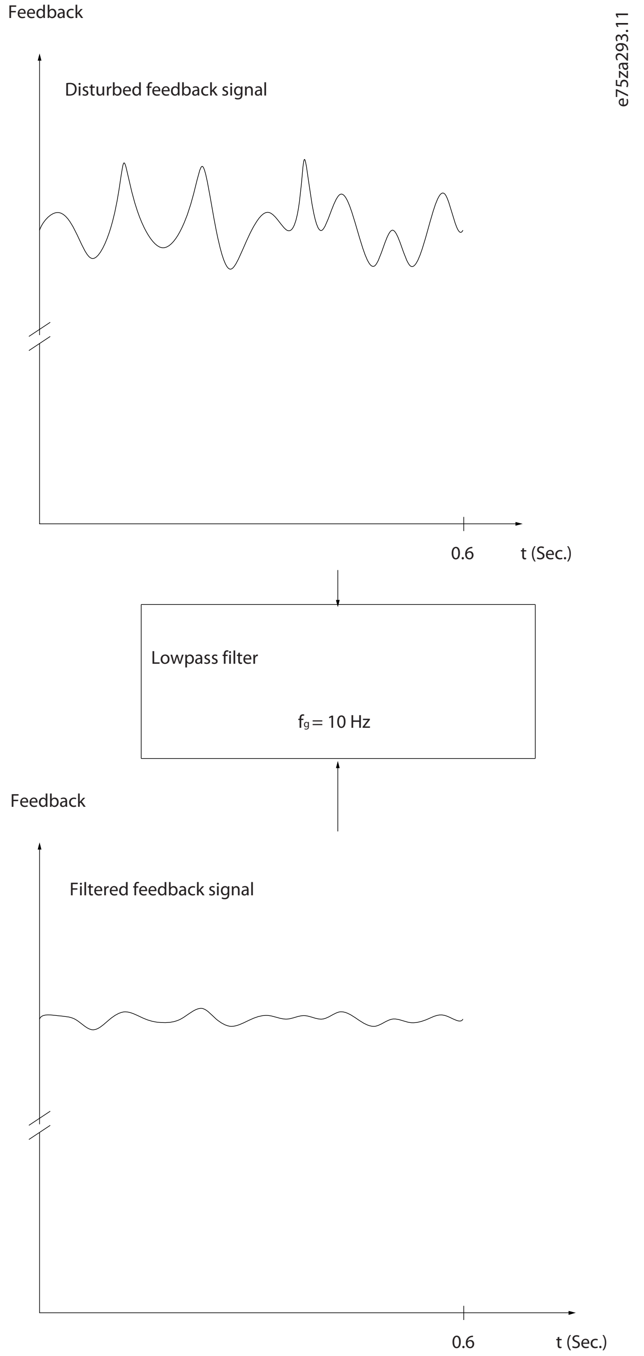


Illustration 65: Feedback Signal

Parameter 7-07 Speed PID Feedback Gear Ratio

Table 374: Parameter 7-07 Speed PID Feedback Gear Ratio

7-07 Speed PID Feedback Gear Ratio		
Default value: 1	Parameter type: Range, 0.0001 - 32.0000	Setup: All setups
Conversion index: -4	Data type: Uint32	Change during operation: False

The drive multiplies the speed feedback by this ratio.

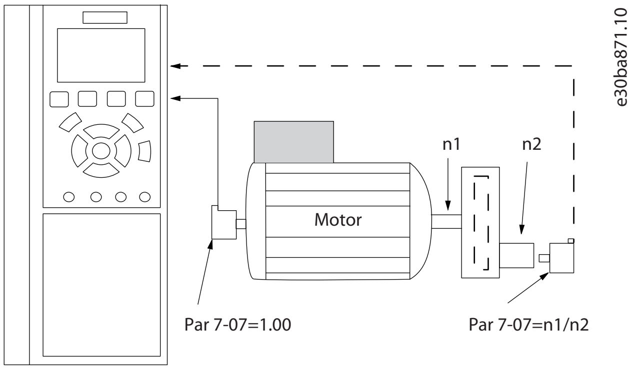


Illustration 66: Speed PID Feedback Gear Ratio

Parameter 7-08 Speed PID Feed Forward Factor

Table 375: Parameter 7-08 Speed PID Feed Forward Factor

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.
Parameter 7-09 Speed PID Error Correction w/Ramp

Table 376: Parameter 7-09 Speed PID Error Correction w/Ramp

7-09 Speed PID Error Correction w/Ramp		
Default value: Size related	Parameter type: Range, 10 - 100000 RPM	Setup: All setups
Conversion index: 67	Data type: Uint32	Change during operation: True

The speed error between ramp and actual speed is held up against the setting in this parameter. If the speed error exceeds this parameter entry, the speed error is corrected via ramping in a controlled way.

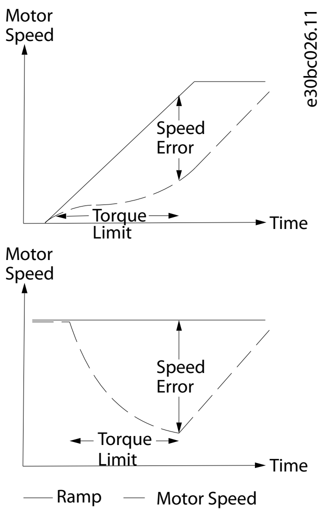


Illustration 67: Speed Error Between Ramp and Actual Speed

4.8.4 7-1* Torque PI Control

Parameters for configuring the torque PI control.

Parameter 7-10 Torque PI Feedback Source

Table 377: Parameter 7-10 Torque PID Feedback Source

7-10 Torque PID Feedback Source		
Default value: [0] Controller off	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the feedback source for the torque controller.

Option	Name	Description
[0]*	Controller off	Select to operate in open loop.
[1]	Analog input 53	Select to use torque feedback from the analog input.
[2]	Analog input 54	Select to use torque feedback from the analog input.
[3]	Estimated torque	Select to use the torque feedback estimated by the drive.

Parameter 7-12 Torque PI Proportional Gain

Table 378: Parameter 7-12 Torque PI Proportional Gain

7-12 Torque PI Proportional Gain		
Default value: 100%	Parameter type: Range, 0 - 500%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

Enter the proportional gain value for the torque controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability.

Parameter 7-13 Torque PI Integration Time

Table 379: Parameter 7-13 Torque PI Integration Time

7-13 Torque PI Integration Time		
Default value: 0.020 s	Parameter type: Range, 0.002 - 2 s	Setup: All setups
Conversion index: -3	Data type: Uint16	Change during operation: True

Enter the integration time for the torque controller. Selection of a low value makes the controller react faster. Too low a setting leads to controller instability.

Parameter 7-16 Torque PI Lowpass Filter Time

Table 380: Parameter 7-16 Torque PI Lowpass Filter Time

7-16 Torque PI Lowpass Filter Time		
Default value: 5 ms	Parameter type: Range, 0.1 - 100 s	Setup: All setups
Conversion index: -4	Data type: Uint16	Change during operation: True

Enter the time constant for the torque control low-pass filter.

Parameter 7-18 Torque PI Feed Forward Factor

Table 381: Parameter 7-18 Torque PI Feed Forward Factor

7-18 Torque PI Feed Forward Factor		
Default value: 0%	Parameter type: Range, 0 - 100%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

Enter the torque feed-forward factor value. The reference signal bypasses the torque controller by this value.
Parameter 7-19 Current Controller Rise Time

Table 382: Parameter 7-19 Current Controller Rise Time

7-19 Current Controller Rise Time		
Default value: Size related	Parameter type: Range, 15 - 100%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

Enter the value for the rise time of the current controller as a percentage of the control period.

4.8.5 7-2* Process Ctrl. Feedb.

Select the feedback sources for the process PID control,and how this feedback should be handled.
Parameter 7-20 Process CL Feedback 1 Resource

Table 383: Parameter 7-20 Process CL Feedback 1 Resource

7-20 Process CL Feedback 1 Resource		
Default value: [0] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

The effective feedback signal is made up of the sum of up to 2 different input signals. Select which drive input should be treated as the source of the 1st of these signals. The 2nd input signal is defined in *parameter 7-22 Process CL Feedback 2 Resource*.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Frerquency input 29	
[4]	Frequency input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	

Parameter 7-22 Process CL Feedback 2 Resource

Table 384: Parameter 7-22 Process CL Feedback 2 Resource

7-22 Process CL Feedback 2 Resource		
Default value: [0] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

The effective feedback signal is made up of the sum of up to 2 different input signals. Select which drive input should be treated as the source of the 2nd of these signals. The 1st input signal is defined in *parameter 7-20 Process CL Feedback 1 Resource*.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Frerquency input 29	
[4]	Frequency input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	

4.8.6 7-3* Process PID Ctrl.

Parameter 7-30 Process PID Normal/ Inverse Control

Table 385: Parameter 7-30 Process PID Normal/ Inverse Control

7-30 Process PID Normal/ Inverse Control		
Default value: [0] Normal	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Normal and inverse controls are implemented by introducing a difference between the reference signal and the feedback signal.

Option	Name	Description
[0]*	Normal	Set the process to increase the output frequency.
[1]	Inverse	Set the process to decrease the output frequency.

Parameter 7-31 Process PID Anti Windup

Table 386: Parameter 7-31 Process PID Anti Windup

7-31 Process PID Anti Windup		
Default value: [1] On	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Normal and inverse controls are implemented by introducing a difference between the reference signal and the feedback signal.

Option	Name	Description
[0]	Off	Continue regulation of an error even when the output frequency cannot be increased or decreased.
[1]*	On	Cease regulation of an error when the output frequency can no longer be adjusted.

Parameter 7-32 Process PID Start Speed

Table 387: Parameter 7-32 Process PID Start Speed

7-32 Process PID Start Speed		
Default value: 0 RPM	Parameter type: Range, 0 - 6000 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the motor speed to be attained as a start signal for commencement of PID control. When the power is switched on, the drive starts to ramp and then operates under speed open-loop control. When the process PID start speed is reached, the drive changes to process PID control.

Parameter 7-33 Process PID Proportional Gain

Table 388: Parameter 7-33 Process PID Proportional Gain

7-33 Process PID Proportional Gain		
Default value: 0.10	Parameter type: Range, 0 - 10	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Enter the PID proportional gain. The proportional gain multiplies the error between the setpoint and the feedback signal.

Parameter 7-34 Process PID Integral Time

Table 389: Parameter 7-34 Process PID Integral Time

7-34 Process PID Integral Time		
Default value: 10000 s	Parameter type: Range, 0.01 - 10000 s	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Enter the PID integral time. The integrator provides an increasing gain at a constant error between the setpoint and the feedback signal. The integral time is the time needed by the integrator to reach the same gain as the proportional gain.

Parameter 7-35 Process PID Differentiation Time

Table 390: Parameter 7-35 Process PID Differentiation Time

7-35 Process PID Differentiation Time		
Default value: 0 s	Parameter type: Range, 0 - 10 s	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

Enter the PID differentiation time. The differentiator does not react to a constant error, but provides a gain only when the error changes. The shorter the PID differentiation time, the stronger the gain from the differentiator.

Parameter 7-36 Process PID Diff. Gain Limit

Table 391: Parameter 7-36 Process PID Diff. Gain Limit

7-36 Process 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

Enter a limit for the differentiator gain. If there is no limit, the differentiator gain increases when there are fast changes. To obtain a pure differentiator gain at slow changes and a constant differentiator gain where fast changes occur, limit the differentiator gain.

Parameter 7-38 Process PID Feed Forward Factor

Table 392: Parameter 7-38 Process PID Feed Forward Factor

7-38 Process PID Feed Forward Factor		
Default value: 0%	Parameter type: Range, 0 - 20%	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

Enter the PID feed-forward factor. The factor sends a constant fraction of the reference signal to bypass the PID control, so the PID control only affects the remaining fraction of the control signal. Any change to this parameter affects the motor speed. When the feed-forward factor is activated, it provides less overshoot and high dynamics when changing the setpoint. *Parameter 7-38 Process PID Feed Forward Factor* is active when *parameter 1-00 Configuration Mode* is set to *[3] Process*.

Parameter 7-39 On Reference Bandwidth

Table 393: Parameter 7-39 On Reference Bandwidth

7-39 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 1.

4.8.7 7-4* Advanced Process PID Ctrl.

This parameter group is only used if *parameter 1-00 Configuration Mode* is set to *[7] Extended PID speed CL* or *[8] Extended PID Speed OL*.

Parameter 7-40 Process PID I-part Reset

Table 394: Parameter 7-40 Process PID I-part Reset

7-40 Process PID I-part Reset		
Default value: [0] No	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select the feedback source for the torque controller.

Option	Name	Description
[0]*	No	
[1]	Yes	Select *[1] Yes* to reset the I-part of the process PID controller. The selection automatically returns to *[0] No. Resetting* the I-part makes it possible to start from a well-defined point after changing something in the process, for example changing a textile roll.

Parameter 7-41 Process PID Output Neg. Clamp

Table 395: Parameter 7-41 Process PID Output Neg. Clamp

7-41 Process PID Output Neg. Clamp		
Default value: -100%	Parameter type: Range, -100 - par. 7-42 %	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

Enter a negative limit for the process PID controller output.

Parameter 7-42 Process PID Output Pos. Clamp

Table 396: Parameter 7-42 Process PID Output Pos. Clamp

7-42 Process PID Output Pos. Clamp		
Default value: 100%	Parameter type: Range, par. 7-41 % - 100%	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

Enter a positive limit for the process PID controller output.

Parameter 7-43 Process PID Gain Scale at Min. Ref.

Table 397: Parameter 7-43 Process PID Gain Scale at Min. Ref.

7-43 Process PID Gain Scale at Min. Ref.		
Default value: -100%	Parameter type: Range, 0 - 100%	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

Enter a scaling percentage to apply to the process PID output when operating at the minimum reference. The scaling percentage is adjusted linearly between the scale at minimum reference (*parameter 7-43 Process PID Gain Scale at Min. Ref.*) and the scale at maximum reference (*parameter 7-44 Process PID Gain Scale at Max. Ref.*).

Parameter 7-44 Process PID Gain Scale at Max. Ref.

Table 398: Parameter 7-44 Process PID Gain Scale at Max. Ref.

7-44 Process PID Gain Scale at Max. Ref.		
Default value: -100%	Parameter type: Range, 0 - 100%	Setup: All setups
Conversion index: 0	Data type: Int16	Change during operation: True

Enter a scaling percentage to apply to the process PID output when operating at the maximum reference. The scaling percentage is adjusted linearly between the scale at minimum reference (*parameter 7-43 Process PID Gain Scale at Min. Ref.*) and the scale at maximum reference (*parameter 7-44 Process PID Gain Scale at Max. Ref.*).

Parameter 7-45 Process PID Feed Fwd Resource

Table 399: Parameter 7-45 Process PID Feed Fwd Resource

7-45 Process PID Feed Fwd Resource		
Default value: [0] No function	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]*	No function	Select which drive input should be used as the feed-forward factor. The factor is added to the output of the PID controller. This increases dynamic performance.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Frerquency input 29	
[8]	Frequency input 33	
[11]	Local bus reference	
[20]	Digital pot.meter	
[21]	Analog input X30/11	

Option	Name	Description
[22]	Analog input X30/12	
[29]	Analog input X48/2	
[32]	Bus PCD	Selects a fieldbus reference configured by *parameter 8-02 Control Word Source*. Change *parameter 8-42 PCD Write Configuration* for the bus used to make the feed forward available in *parameter 7-48 PCD Feed Forward*. Use index 1 for feed forward [748] (and index 2 for reference [1682]).

Parameter 7-46 Process PID Feed Fwd Normal/Inv. Ctrl.

Table 400: Parameter 7-46 Process PID Feed Fwd Normal/Inv. Ctrl.

7-46 Process PID Feed Fwd Normal/Inv. Ctrl.		
Default value: [0] Normal	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Normal	Select *[0] Normal* to set the feed-forward factor to treat the FF resource as a positive value.
[1]	Inverse	Select *[1] Inverse* to treat the feed-forward resource as a negative value.

Parameter 7-48 PCD Feed Forward

Table 401: Parameter 7-48 PCD Feed Forward

7-48 PCD Feed Forward		
Default value: 0	Parameter type: Range, 0 - 65535	Setup: All setups
Conversion index: 0	Data type: Uint16	Change during operation: True

This parameter contains the value of *parameter 7-45 Process PID Feed Fwd Resource*, *[32] Bus PCD*.

Parameter 7-49 Process PID Output Normal/Inv. Ctrl.

Table 402: Parameter 7-49 Process PID Output Normal/Inv. Ctrl.

7-49 Process PID Output Normal/Inv. Ctrl.		
Default value: [0] Normal	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Normal	Select *[0] Normal* to use the resulting output from the process PID controller as is.
[1]	Inverse	Select *[1] Inverse* to invert the resulting output from the process PID controller. This operation is performed after the feed-forward factor is applied.

4.8.8 7-5* Ext. Process PID Ctrl.

This parameter group is only used if *parameter 1-00 Configuration Mode* is set to *[7] Extended PID speed CL* or *[8] Extended PID Speed OL*.

Parameter 7-50 Process PID Extended PID

Table 403: Parameter 7-50 Process PID Extended PID

7-50 Process PID Extended PID		
Default value: [1] Enabled	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Option	Name	Description
[0]	Disabled	Disable the extended parts of the process PID controller.
[1]*	Enabled	Enable the extended parts of the PID controller.

Parameter 7-51 Process PID Feed Fwd Gain

Table 404: Parameter 7-51 Process PID Feed Fwd Gain

7-51 Process PID Feed Fwd Gain		
Default value: 1	Parameter type: Range, 0 - 100	Setup: All setups
Conversion index: -2	Data type: Uint16	Change during operation: True

The feed forward is used to obtain the required level based on a well-known signal available. The PID controller then only takes care of the smaller part of the control, necessary because of unknown characters. The standard feed-forward factor in *parameter 7-38 Process PID Feed Forward Factor* is always related to the reference, whereas *parameter 7-51 Process PID Feed Fwd Gain* has more options. In winder applications, the feed-forward factor is typically the line speed of the system.

Parameter 7-52 Process PID Feed Fwd Ramp Up

Table 405: Parameter 7-52 Process PID Feed Fwd Ramp Up

7-52 Process PID Feed Fwd Ramp Up		
Default value: 0.01 s	Parameter type: Range, 0.01 - 10 s	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Controls the dynamics of the feed-forward signal when ramping up.

Parameter 7-53 Process PID Feed Fwd Ramp Down

Table 406: Parameter 7-53 Process PID Feed Fwd Ramp Down

7-53 Process PID Feed Fwd Ramp Down		
Default value: 0.01 s	Parameter type: Range, 0.01 - 10 s	Setup: All setups
Conversion index: -2	Data type: Uint32	Change during operation: True

Controls the dynamics of the feed-forward signal when ramping down.

Parameter 7-56 Process PID Ref. Filter Time

Table 407: Parameter 7-56 Process PID Ref. Filter Time

7-56 Process PID Ref. Filter Time		
Default value: 0.001 s	Parameter type: Range, 0.001 - 1 s	Setup: All setups
Conversion index: -3	Data type: Uint16	Change during operation: True

Set a time constant for the reference first-order low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the reference/feedback signals. However, severe filtering can be detrimental to dynamic performance.

Parameter 7-57 Process PID Fb. Filter Time

Table 408: Parameter 7-57 Process PID Fb. Filter Time

7-57 Process PID Fb. Filter Time		
Default value: 0.001 s	Parameter type: Range, 0.001 - 1 s	Setup: All setups
Conversion index: -3	Data type: Uint16	Change during operation: True

Set a time constant for the feedback first-order low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the reference/ feedback signals. However, severe filtering can be detrimental to dynamic performance.

4.9 Parameter Group 8-** Communications and Options

4.9.1 8-0* General Settings

Parameter 8-01 Control Site

Table 409: Parameter 8-01 Control Site

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.

Parameter 8-02 Control Word Source

Table 410: Parameter 8-02 Control Word Source

8-02 Control Word Source		
Default value: Size related	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 RS485*, 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 RS485	
[2]	FC USB	

Option	Name	Description
[3]	Option A	
[30]	External can	
[35]	Option A fast	Not applicable for current release.
[37]	Option C0 fast	The reference is transferred faster and without jitter, which ensures more stability and dynamic control. Furthermore, all other references are ignored, which means that the drive is controlled by the C-option reference only.

Parameter 8-03 Control Word Timeout Time

Table 411: 8-03 Control Word Timeout Time

8-03 Control Word Timeout Time		
Default value: 1 s	Parameter type: Range, 0.1 - 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.

Parameter 8-04 Control Word Timeout Function

Table 412: Parameter 8-04 Control Word Timeout Function

8-04 Control Word Timeout Function		
Default value: Size related	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 fails to be updated within the time period specified in *parameter 8-03 Control Word Timeout Time*.

N O T I C E

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.

Option	Name	Description
[7]	Select setup 1	Changes the set-up 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*.
[26]	Trip	

Parameter 8-05 End-of-Timeout Function

Table 413: Parameter 8-05 End-of-Timeout Function

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 set-up 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 set-up.
[1]*	Resume setup	Resumes the setup that was active before the timeout.

Parameter 8-06 Reset Control Word Timeout

Table 414: Parameter 8-06 Reset Control Word 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 im-mediately reverts to the *[0] Do not reset* setting.

Parameter 8-07 Diagnosis Trigger

Table 415: Parameter 8-07 Diagnosis Trigger

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.	

Parameter 8-08 Readout Filtering

Table 416: Parameter 8-08 Readout Filtering

8-08 Readout Filtering		
Default value: Size related	Parameter type: Option	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*

4.9.2 8-1* Ctrl. Word Settings

Parameter 8-10 Control Word Profile

Table 417: Parameter 8-10 Control Word Profile

8-10 Control Word Profile		
Default value: Size related	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]	FC profile	
[1]	PROFIdrive profile	
[5]	ODVA	
[7]	CANopen DSP 402	

Parameter 8-13 Configurable Status Word STW

Table 418: Parameter 8-13 Configurable Status Word STW

8-13 Configurable Status Word STW		
Default value: Size related	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	
[10]	T18DI status	
[11]	T19DI status	
[12]	T27DI status	
[13]	T29DI status	
[14]	T32DI status	
[15]	T33DI status	
[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	
[30]	Brake fault (IGBT)	
[40]	Out of ref range	
[49]	Derate active	
[54]	Running	

Option	Name	Description
[59]	On reference	
[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 out A	
[81]	SL digital out B	
[82]	SL digital out C	
[83]	SL digital out D	
[84]	SL digital out E	
[85]	SL digital out F	
[92]	IGBT-cooling	
[181]	Prev. maintenance	
[200]	User defined alerts	

Option	Name	Description
[231]	In power lim. mot.	
[232]	In power lim. gen.	
[233]	In power limit	

Parameter 8-14 Configurable Control Word CTW

Table 419: Parameter 8-14 Configurable Control Word CTW

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*.
[2]	CTW valid, active low	If set to 1, the drive ignores the remaining bits of the control word.
[4]	PID error inverse	Inverts the resulting error from the process PID controller. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL*, or *[8] Extended PID Speed CL*.
[5]	PID reset I part	Resets the I-part of the process PID controller. Equivalent to *parameter 7-40 Process PID I-part Reset*. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL*, or *[8] Extended PID Speed CL*.
[6]	PID enable	Enables the extended process PID controller. Equivalent to *parameter 7-50 Process PID Extended PID*. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL*, or *[8] Extended PID Speed CL*.
[7]	External interlock	
[10]	Bit 10 = 0>CTW timeout	
[15]	Relay 1	Control relay 1.
[16]	Relay 2	Control relay 1.
[20]	Control word toggle command	Changes the sign of the set target position. For example, if the set target is 1000, the activation of this option changes the value to -1000.
[22]	Digital out 27	
[23]	Digital out 29	
[24]	Digital out X30/6	
[25]	Digital out X30/7	
[54]	Auto start	Not in use currently.
[78]	Reset preventive maintenance word	

Option	Name	Description
[94]	Light load detection	Use this option to ensure drive runs in the direction which requires least energy (UPS capacity), during an emergency.
[95]	Evacuation mode	Use this function to operate the drive at reduced DC voltage for evacuating people in case of power failure.
[231]	Power limit mot.	See *parameter group 4-8* Power Limit*. Use this option in the motor mode only.
[232]	Power limit gen.	See *parameter group 4-8* Power Limit*. Use this option in the generating mode only.
[233]	Power limit both	See *parameter group 4-8* Power Limit*. Use this option in both the motor and the generating modes.
[234]	Light load+evacuation	Use this option to ensure that the drive runs in the direction which requires least energy (UPS capacity), during an emergency and to operate the drive at reduced DC-voltage for evacuating people in case of power failure.

Parameter 8-17 Configurable Alarm and Warning Word

Table 420: Parameter 8-17 Configurable Alarm and Warningword

8-17 Configurable Alarm and Warningword		
Default value: [0] Off	Parameter type: Option, Array [16]	Setup: All setups
Conversion index: –	Data type: Uint16	Change during operation: True

The configurable alarm and warning word has 16 bits (0–15). Each of those 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	

Option	Name	Description
[22]	Hoist mech brake 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	
[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	
[78]	Tracking error warning	
[89]	Mech brake sliding warning	
[10002]	Live zero error alarm	

Option	Name	Description
[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	
[10022]	Hoist brake 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	
[10032]	Phase W missing alarm	
[10033]	Inrush fault alarm	
[10034]	Fieldbus com fault 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 alarm	
[10048]	1.8V supply low alarm	
[10049]	Speed limit alarm	
[10060]	Ext interlock alarm	
[10061]	Feedback error alarm	

Option	Name	Description
[10063]	Mech brake low alarm	
[10065]	Controlboard overtemp alarm	
[10067]	Option config changed alarm	
[10068]	Safe stop alarm	
[10069]	Powercard temp alarm	
[10073]	Safestop auto restart alarm	
[10074]	PTC thermistor alarm	
[10075]	Illegal profile alarm	
[10078]	Tracking error alarm	
[10079]	Illegal PS config alarm	
[10081]	CSIV corrupt alarm	
[10082]	CSIV param error alarm	
[10090]	Feedback monitor alarm	
[10091]	AI54 settings alarm	

Parameter 8-19 Product Code

Table 421: Parameter 8-19 Product Code

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.

4.9.3 8-3* FC Port Settings

Parameter 8-30 Protocol

Table 422: Parameter 8-30 Protocol

8-30 Protocol		
Default value: [0] FC	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	
[1]	FC MC	
[2]	Modbus RTU	

Parameter 8-31 Address

Table 423: Parameter 8-31 Address

8-31 Address		
Default value: 1	Parameter type: Range, 1 - 247	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.

Parameter 8-32 FC Port Baud Rate

Table 424: Parameter 8-32 FC Port Baud Rate

8-32 FC Port Baud Rate		
Default value: Size related	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	

Parameter 8-33 Parity/Stop Bits

Table 425: Parameter 8-33 Parity/Stop Bits

8-33 Parity/Stop Bits		
Default value: [0] Even parity, 1 stop bit	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	

Parameter 8-34 Estimated Cycle Time

Table 426: Parameter 8-34 Estimated Cycle Time

8-34 Estimated Cycle Time		
Default value: 0 ms	Parameter type: Range, 0 - 1000000 ms	Setup: 2 setups
Conversion index: -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.

Parameter 8-35 Minimum Response Delay

Table 427: Parameter 8-35 Minimum Response Delay

8-35 Minimum Response Delay		
Default value: 10 ms	Parameter type: Range, 1 - 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.

Parameter 8-36 Max Response Delay

Table 428: Parameter 8-36 Max Response Delay

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.

Parameter 8-37 Max Inter-Char Delay

Table 429: Parameter 8-37 Max Inter-Char Delay

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*.

4.9.4 8-4* FC MC Protocol Set

Parameter 8-40 Telegram Selection

Table 430: Parameter 8-40 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	

Option	Name	Description
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	
[200]	Custom telegram 1	Enables use of freely configurable telegrams or standard telegrams for the FC port.
[202]	Custom telegram 3	

Parameter 8-41 Parameters for Signals

Table 431: Parameter 8-41 Parameters for Signals

8-41 Parameters for Signals		
Default value: [0] None	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint16	Change during operation: False

Option	Name	Description
[1]*	None	
[15]	Readout: actual setup	
[302]	Minimum reference	
[303]	Maximum reference	
[312]	Catch up/slow down value	
[321]	Touch target	
[322]	Master scale numerator	
[323]	Master scale denominator	
[326]	Master offset	
[328]	Master offset speed ref	
[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	
[381]	Quick stop ramp time	

Option	Name	Description
[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	
[482]	Power limit motor mode	
[483]	Power limit generator mode	
[491]	Positive speed limit [RPM]	
[492]	Positive speed limit [Hz]	
[493]	Negative speed limit [RPM]	
[494]	Negative speed limit [Hz]	
[495]	Positive torque limit	
[496]	Negative torque limit	
[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 #X30/6 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 X54/1 bus control	
[683]	Terminal X54/3 bus control	
[748]	PCD feed forward	
[890]	Bus jog 1 speed	
[891]	Bus jog 2 speed	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	

Option	Name	Description
[1472]	Legacy alarm word	
[1473]	Legacy warning word	
[1474]	Leg. ext. 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 [%]	
[1606]	Actual position	
[1607]	Target position	
[1608]	Position error	
[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	
[1621]	Torque [%] high res.	
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated	
[1625]	Torque [Nm] high	
[1628]	Angle error	

Option	Name	Description
[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	
[1651]	Pulse reference	
[1652]	Feedback [Unit]	
[1653]	Digi pot reference	
[1657]	Feedback [RPM]	
[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	

Option	Name	Description
[1674]	Prec. stop counter	
[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	
[1681]	Fieldbus sync. REF	
[1682]	Fieldbus REF 1	
[1683]	Fieldbus pos. REF	
[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]	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	
[1782]	Home position	
[1783]	Homing speed	
[1788]	Master home position	
[1804]	Mech brake count	
[1820]	Commanded position	
[1821]	Master position	
[1823]	Virtual master pos.	
[1827]	Safe opt. est. speed	

Option	Name	Description
[1828]	Safe opt. meas. speed	
[1829]	Safe opt. speed error	
[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]	
[1860]	Digital input 2	
[3310]	Sync factor master	
[3311]	Sync factor slave	
[3440]	Digital inputs	
[3441]	Digital outputs	
[3450]	Actual position	
[3451]	Commanded position	
[3452]	Actual master position	
[3453]	Slave index position	
[3454]	Master index position	
[3455]	Curve position	
[3456]	Track error	
[3457]	Synchronizing error	
[3458]	Actual velocity	
[3459]	Actual master velocity	
[3460]	Synchronizing status	
[3461]	Axis status	
[3462]	Program status	
[3644]	Terminal X49/7 bus control	

Option	Name	Description
[3654]	Terminal X49/9 bus control	
[3664]	Terminal X49/11 bus control	
[4029]	B-EMF protection log readout	
[4280]	Safe option status	
[4282]	Safe control word	
[4283]	Safe status word	
[4285]	Active safe func.	
[4287]	Time until manual test	

Parameter 8-42 PCD Write Configuration

Table 432: Parameter 8-42 PCD Write Configuration

8-42 PCD Write Configuration		
Default value: Size related	Parameter type: Range, 0 - 9999	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.

Parameter 8-43 PCD Read Configuration

Table 433: Parameter 8-43 PCD Read Configuration

8-43 PCD Read Configuration		
Default value: Size related	Parameter type: Range, 0 - 9999	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.

Block Transfer Mode (BTM)

When Block Transfer Mode (BTM) is enabled, the parameters are written into a temporary buffer in the drive via the fieldbus. After wiring all the required parameters to the drive in BTM mode, a Commit command is sent to the drive. The drive ensures correct adaptation of the parameters.

Parameter 8-45 BTM Transaction Command

Table 434: Parameter 8-45 BTM Transaction Command

8-45 BTM Transaction Command		
Default value: [0] Off	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: False

Option	Name	Description
[0]*	Off	
[1]	Write to active setup	
[2]	Commit transaction	
[3]	Clear error	

Option	Name	Description
[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.

Parameter 8-46 BTM Transaction Status

Table 435: Parameter 8-46 BTM Transaction Status

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]	Commit transaction	
[3]	Transaction timeout	
[4]	Err. non-existing par.	
[5]	Err. par. out of range	
[6]	Transaction failed	
[7]	SO configu check	
[8]	SO config check done	

Parameter 8-47 BTM Timeout

Table 436: Parameter 8-47 BTM Timeout

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.

Parameter 8-49 BTM Error Log

Table 437: Parameter 8-49 BTM Error Log

8-49 BTM Error Log		
Default value: Size related	Parameter type: Range, 0.000 - 9999.255	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).

4.9.5 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*.

Parameter 8-50 Coasting Select

Table 438: Parameter 8-50 Coasting Select

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.

Parameter 8-51 Quick Stop Select

Table 439: Parameter 8-51 Quick Stop Select

8-51 Quick Stop 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 quick stop function.

Option	Name	Description
[0]	Digital input	A digital input triggers the quick stop function.
[1]	Bus	A serial communication port or the fieldbus triggers the quick stop function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the quick stop function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the quick stop function.

Parameter 8-52 DC Brake Select

Table 440: Parameter 8-52 DC Brake Select

8-52 DC Brake Select		
Default value: Size related	Parameter type: Option	Setup: All setups
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.

Parameter 8-53 Start Select

Table 441: Parameter 8-53 Start Select

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.
[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.

Parameter 8-54 Reversing Select

Table 442: Parameter 8-54 Reversing Select

8-54 Reversing Select		
Default value: Size related	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.

Parameter 8-55 Set-up Select

Table 443: Parameter 8-55 Set-up Select

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 set-up selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the set-up selection.
[1]	Bus	A serial communication port or the fieldbus triggers the set-up selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the set-up selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the set-up selection.

Parameter 8-56 Preset Reference Select

Table 444: Parameter 8-56 Preset Reference Select

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.

Parameter 8-57 PROFIdrive OFF2 Select

Table 445: Parameter 8-57 PROFIdrive OFF2 Select

8-57 PROFIdrive OFF2 Select		
Default value: [3] Logic OR	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select control of the drive OFF2 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and ctrl. word* and *parameter 8-10 Control Word Profile* is set to *[1] PROFIdrive profile*.

Option	Name	Description
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3]*	Logic OR	

Parameter 8-58 PROFIdrive OFF3 Select

Table 446: Parameter 8-58 PROFIdrive OFF3 Select

8-58 PROFIdrive OFF3 Select		
Default value: [3] Logic OR	Parameter type: Option	Setup: All setups
Conversion index: –	Data type: Uint8	Change during operation: True

Select control of the drive OFF3 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and ctrl. word* and *parameter 8-10 Control Word Profile* is set to *[1] PROFIdrive profile*.

Option	Name	Description
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3]*	Logic OR	

4.9.6 8-8* FC Port Diagnostics

These parameters are used for monitoring the bus communication via the drive RS485 port terminals 68–69.

Parameter 8-80 Bus Message Count

Table 447: Parameter 8-80 Bus Message Count

8-80 Bus Message Count		
Default value: 0	Parameter type: Range, 0 - 0	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.

Parameter 8-81 Bus Error Count

Table 448: Parameter 8-81 Bus Error Count

8-81 Bus Error Count		
Default value: 0	Parameter type: Range, 0 - 0	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

Table 449: Parameter 8-82 Slave Messages Rcvd

8-82 Slave Messages Rcvd		
Default value: 0	Parameter type: Range, 0 - 0	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.

Parameter 8-83 Slave Error Count

Table 450: Parameter 8-83 Slave Error Count

8-83 Slave Error Count		
Default value: 0	Parameter type: Range, 0 - 0	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.

4.10 Parameter Group 9-** PROFIBUS

For PROFIBUS parameter descriptions, see the VLT® PROFIBUS DP MCA 101 Programming Guide.

4.11 Parameter Group 10-** CAN Fieldbus

For DeviceNet parameter descriptions, see the VLT® DeviceNet MCA 104 Programming Guide.

4.12 Parameter Group 12-** Ethernet

For Ethernet parameter descriptions, see the VLT® EtherNet/IP MCA 121 Programming Guide.

4.13 Parameter Group 13-** Smart Logic Control

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:

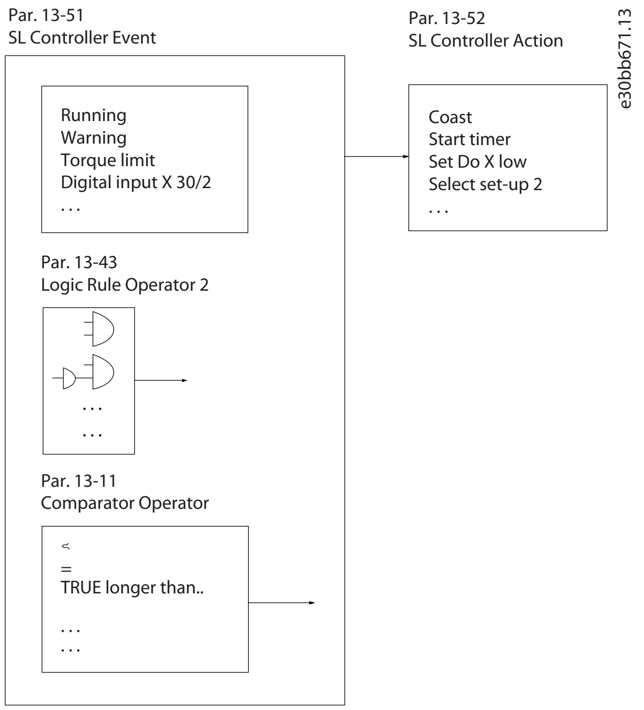


Illustration 68: Smart Logic Control (SLC)

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.

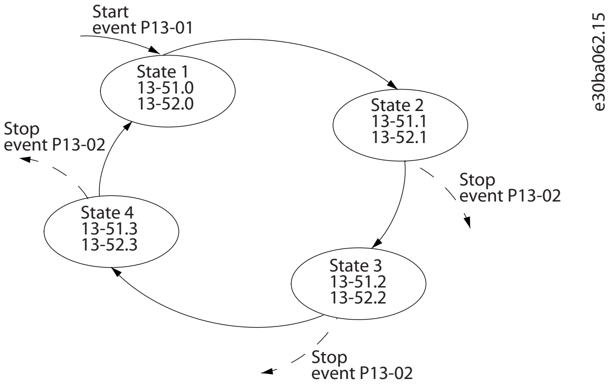


Illustration 69: Example of Events and Actions

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.

4.13.1 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.

Parameter 13-00 SL Controller Mode

Table 451: Parameter 13-00 SL Controller Mode

13-00 SL Controller Mode		
Default Value: Size related	Parameter Type: Option, Array [4]	Setup: 2 set-ups
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	
[1]	On	

Parameter 13-01 Start Event

Table 452: Parameter 13-01 Start Event

13-01 Start Event		
Default Value: Size related	Parameter Type: Option, Array [4]	Setup: 2 set-ups
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.
[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.

Option	Name	Description
[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.
[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*.
[222]	Homing OK	
[223]	On target	

Option	Name	Description
[224]	Position error	
[225]	Position limit	
[226]	Touch on target	
[227]	Touch activated.	

Parameter 13-02 Stop Event

Table 453: Parameter 13-02 Stop Event

13-02 Stop Event		
Default Value:Size related	Parameter Type: Option, Array [4]	Setup: 2 set-ups
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	For descriptions of options *[0] False–[61] Logic rule 5*, see *parameter 13-01 Start Event*.
[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	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[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.

Option	Name	Description
[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	
[79]	Digital input X46/1	
[80]	Digital input X46/3	
[81]	Digital input X46/5	
[82]	Digital input X46/7	
[83]	Digital input X46/9	
[84]	Digital input X46/11	
[85]	Digital input X46/13	
[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]	Relay 1	
[103]	Relay 2	

Parameter 13-03 Reset SLC

Table 454: Parameter 13-03 Reset SLC

13-03 Reset SLC		
Default Value: [0] D not reset SLC	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Do not reset SLC	Retain programmed settings in *parameter group 13-** Smar Logic*
[1]	Reset SLC	Reset all parameters in *parameter group 13-** Smar Logic*

4.13.2 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.

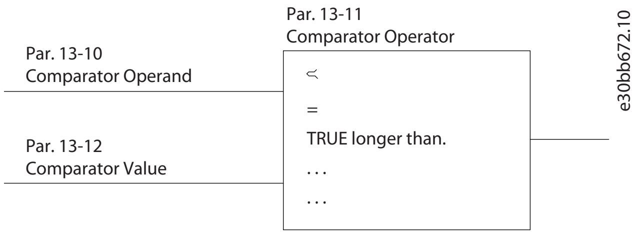


Illustration 70: Comparators

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.

Parameter 13-10 Comparator Operand

Table 455: Parameter 13-10 Comparator Operand

13-10 Comparator Operand		
Default Value:Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	
[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.

Option	Name	Description
[17]	Analog input AICCT	Value is in [°]. AICCT us control card temperature.
[18]	Pulse input FI29	The value is in %.
[19]	Pulse input FI33	The value is in %.
[20]	Alarm number	The number or registered alarms
[21]	Warning number	
[22]	Analog input X30/11	
[23]	Analog input X30/12	
[30]	Counter A	
[31]	Counter B	
[32]	Process PID error	Value of the PID error (*parameter 18-90 Process PID Error*).
[33]	Process PID Output	Value of the PID output (*parameter 18-91 Process PID Output*).
[34]	Analog input X48/2	
[35]	Temp input X48/4	
[36]	Temp input X48/7	
[37]	Temp input X48/10	
[39]	Safe opt. speed error	
[43]	Analog input X49/3	
[45]	Analog input X49/5	
[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.
[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*.

Option	Name	Description
[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 & 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.
[93]	Mech. brake control	The mechanical brake is active.
[94]	Safe stop active	
[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.
[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.

Option	Name	Description
[115]	Logic rule 5	The result of logic rule 5.
[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.
[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).
[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).
[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.

Option	Name	Description
[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.
[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 giv-en	
[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	
[249]	Therm. sensor temp.	

Parameter 13-11 Comparator Operator

Table 456: Parameter 13-11 Comparator Operator

13-11 Comparator Operator		
Default Value: Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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]	<	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]	>	Inverse logic of option *[0]* <.
[5]	TRUE longer than..	

Option	Name	Description
[6]	FALSE longerthan..	
[7]	TRUE shorter than..	
[8]	FALSE shorter than..	

Parameter 13-12 Comparator Value

Table 457: Parameter 13-12 Comparator Value

13-12 Comparator Value		
Default value: Size related	Parameter type: Range, -100000.000 - 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.

4.13.2.1 RS FlipFlops

The reset/set flipflops hold the signal until set/reset.

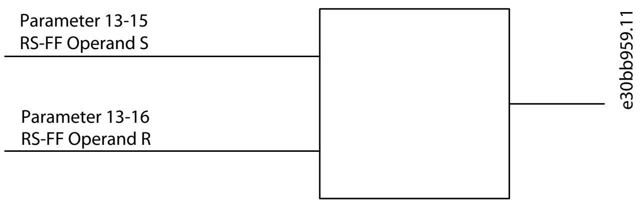


Illustration 71: Reset/Set Flipflops

Two parameters are used and the output can be used in the logic rules and as events.

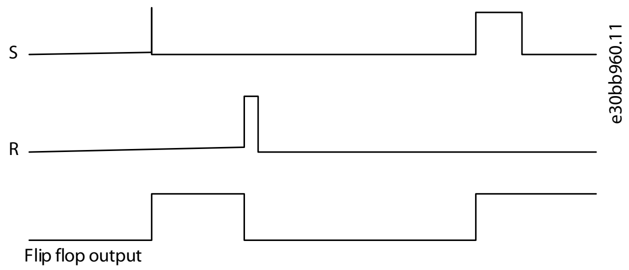


Illustration 72: Flipflop Outputs

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 458: 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	Setting	Notes
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*	–
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 Log ic Rule Operator 1* [0].
Parameter 13-16 RS-FF Operand R [0]	*[27] Logic rule 1*	Output from *parameter 13-41 Log ic 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*	–

Parameter 13-15 RS-FF Operand S

Table 459: Parameter 13-15 RS-FF Operand S

13-15 RS-FF Operand S		
Default Value: Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

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	

Option	Name	Description
[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	
[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.

Option	Name	Description
[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	
[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	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[79]	Digital input 46/1	
[80]	Digital input 46/3	
[81]	Digital input 46/5	
[82]	Digital input 46/7	
[83]	Digital input 46/9	
[84]	Digital input 46/11	
[85]	Digital input X46/13	
[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	

Parameter 13-16 RS-FF Operand R

Table 460: Parameter 13-16 RS-FF Operand R

13-16 RS-FF Operand R		
Default Value: Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

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)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	

Option	Name	Description
[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	
[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	
[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	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[79]	Digital input 46/1	

Option	Name	Description
[80]	Digital input 46/3	
[81]	Digital input 46/5	
[82]	Digital input 46/7	
[83]	Digital input 46/9	
[84]	Digital input 46/11	
[85]	Digital input X46/13	
[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	
[102]	Relay 1	
[103]	Relay 2	

4.13.3 13-2* Timers

Use the result (true or false) from 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 13-44 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 it becomes true again. All parameters in this parameter group are array parameters with index 0–9. Select index 0 to program timer 0, select index 1 to program timer 1, and so on.

Parameter 13-20 SL Controller Time

Table 461: Parameter 13-20 SL Controller Timer

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.

4.13.4 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*.

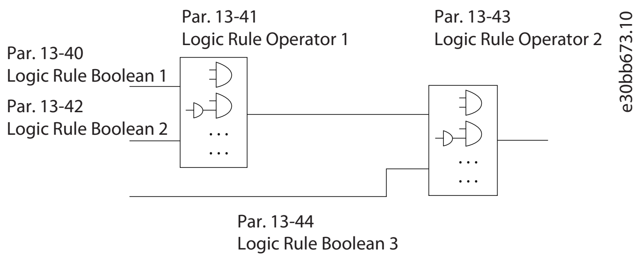


Illustration 73: Logic Rules

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.

Parameter 13-40 Logic Rule Boolean 1

Table 462: Parameter 13-40 Logic Rule Boolean 1

13-40 Logic Rule Boolean 1		
Default Value: Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	
[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	

Option	Name	Description
[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	
[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	

Option	Name	Description
[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	
[79]	Digital input X46/1	
[80]	Digital input X46/3	
[81]	Digital input X46/5	
[82]	Digital input X46/7	
[83]	Digital input X46/9	
[84]	Digital input X46/11	
[85]	Digital input X46/13	
[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]	Relay 1	
[103]	Relay 2	

Parameter 13-41 Logic Rule Operator 1

Table 463: Parameter 13-41 Logic Rule Operator 1

13-41 Logic Rule Operator 1		
Default Value:Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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].
[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].

Parameter 13-42: Logic Rule Boolean 2

Table 464: Parameter 13-42 Logic Rule Boolean 2

13-42 Logic Rule Boolean 2		
Default Value: Size related	Parameter Type: Option, Array [4]	Setup: 2 set-ups
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	

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	
[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.

Option	Name	Description
[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	
[79]	Digital input X46/1	
[80]	Digital input X46/3	
[81]	Digital input X46/5	
[82]	Digital input X46/7	
[83]	Digital input X46/9	
[84]	Digital input X46/11	
[85]	Digital input X46/13	
[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]	Relay 1	
[103]	Relay 2	

Parameter 13-43 Logic Rule Operator 2

Table 465: Parameter 13-43 Logic Rule Operator 2

13-43 Logic Rule Operator 2		
Default Value:Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	

Parameter 13-44 Logic Rule Boolean 3

Table 466: Parameter 13-44 Logic Rule Boolean 3

13-44 Logic Rule Boolean 3		
Default Value: Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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* (options *[0] False–[61] Logic rule 5*) and *parameter 13-02 Stop Event* (options *[70] SL Time-out 3–[75] Start command given*) for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	

Option	Name	Description
[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	
[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	

Option	Name	Description
[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	
[79]	Digital input X46/1	
[80]	Digital input X46/3	
[81]	Digital input X46/5	
[82]	Digital input X46/7	
[83]	Digital input X46/9	
[84]	Digital input X46/11	
[85]	Digital input X46/13	
[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*.

Option	Name	Description
[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]	Relay 1	
[103]	Relay 2	

4.13.5 13-5* States

Parameter 13-51 SL Controller Event

Table 467: Parameter 13-51 SL Controller Event

13-51 SL Controller Event		
Default Value:Size related	Parameter Type: Option, Array [20]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select the boolean input (true or false) to define the smart logic controller event. See *parameter 13-01 Start Event* (options *[0] False–[61] Logic rule 5*) and *parameter 13-02 Stop Event* (options *[70] SL Time-out 3–[74] SL Time-out 7*) for more information.

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	

Option	Name	Description
[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	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	

Option	Name	Description
[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	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[79]	Digital input X46/1	
[80]	Digital input X46/3	
[81]	Digital input X46/5	
[82]	Digital input X46/7	
[83]	Digital input X46/9	
[84]	Digital input X46/11	
[85]	Digital input X46/13	
[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*.

Option	Name	Description
[101]	RS Flipflop 7	See *parameter group 13-1* Comparators*.
[102]	Relay 1	
[103]	Relay 2	

Parameter 13-52 SL Controller Action

Table 468: Parameter 13-52 SL Controller Action

13-52 SL Controller Action		
Default Value:Size related	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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.

Option	Name	Description
[0]	DISABLED	
[1]	No action	
[2]	Select set-up 1	Changes the active setup (*parameter 0-10 Active Set-up*) to 1. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via a fieldbus.
[3]	Select set-up 2	Changes the active setup (*parameter 0-10 Active Set-up*) to 2. If the setup is changed, it merges with other set-up commands coming from either the digital inputs or via a fieldbus.
[4]	Select set-up 3	Changes the active setup (*parameter 0-10 Active Set-up*) to 3. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via a fieldbus.
[5]	Select set-up 4	Changes the active setup (*parameter 0-10 Active Set-up*) to 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via a fieldbus.
[10]	Select preset ref 0	Selects preset reference 0. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[11]	Select preset ref 1	Selects preset reference 1. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[12]	Select preset ref 2	Selects preset reference 2. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[13]	Select preset ref 3	Selects preset reference 3. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[14]	Select preset ref 4	Selects preset reference 4. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[15]	Select preset ref 5	Selects preset reference 5. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[16]	Select preset ref 6	Selects preset reference 6. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[17]	Select preset ref 7	Selects preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[18]	Select ramp 1	Selects ramp 1.

Option	Name	Description
[19]	Select ramp 2	Selects ramp 2.
[20]	Select ramp 3	Selects ramp 3.
[21]	Select ramp 4	Selects ramp 4.
[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.
[25]	Qstop	Issues a quick stop command to the drive.
[26]	Dcstop	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	Starts timer 0, see *parameter 13-20 SL Controller Timer* for further description.
[30]	Start timer 1	Starts timer 1, see *parameter 13-20 SL Controller Timer* for further description.
[31]	Start timer 2	Starts timer 2, see *parameter 13-20 SL Controller Timer* for further description.
[32]	Set digital out A low	Any output with smart logic output A is low.
[33]	Set digital out B low	Any output with smart logic output B is low.
[34]	Set digital out C low	Any output with smart logic output C is low.
[35]	Set digital out D low	Any output with smart logic output D is low.
[36]	Set digital out E low	Any output with smart logic output E is low.
[37]	Set digital out F low	Any output with smart logic output F is low.
[38]	Set digital out A high	Any output with smart logic output A is high.
[39]	Set digital out B high	Any output with smart logic output B is high.
[40]	Set digital out C high	Any output with smart logic output C is high.
[41]	Set digital out D high	Any output with smart logic output D is high.
[42]	Set digital out E high	Any output with smart logic output E is high.
[43]	Set digital out F high	Any output with smart logic output F is high.
[60]	Reset Counter A	Resets counter A to 0.
[61]	Reset Counter B	Resets counter B to 0.
[62]	Counter A (up)	
[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.

Option	Name	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.

4.13.6 13-9* User-defined Alerts and Readouts

Parameters in this group allow the configuration of application-specific messages, warnings, and alarms. 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*.

Parameter 13-90 Alert Trigger

Table 469: Parameter 13-90 Alert Trigger

13-90 Alert Trigger		
Default Value: [0] False	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	

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	
[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	

Parameter 13-91 Alert Action

Table 470: Parameter 13-91 Alert Action

13-91 Alert Action		
Default Value: [0] Info	Parameter Type: Option, Array [10]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

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	
[5]	Stop & warning	
[6]	Jogging	
[7]	Jogging & warning	
[8]	Max speed	

Option	Name	Description
[9]	Max speed & warn	
[10]	Stop and trip	
[11]	Stop and w manual reset	
[12]	Trip	
[13]	Trip w manual reset	
[14]	Trip lock	

Parameter 13-92 Alert Text

Table 471: Parameter 13-92 Alert Text

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 is defined in *parameter 13-90 Alert Trigger* occurs.

Parameter 13-97 Alert Alarm Word

Table 472: Parameter 13-97 Alert Alarm Word

13-97 Alert Alarm Word		
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 of a user-defined alarm in hex code.

Parameter 13-98 Alert Warning Word

Table 473: Parameter 13-98 Alert Warning Word

13-98 Alert 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 of a user-defined alarm in hex code.

Parameter 13-99 Alert Status Word

Table 474: Parameter 13-99 Alert Status Word

13-99 Alert Status Word		
Default value: 0	Parameter type: Range, 0 - 4294967295	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.

4.14 Parameter Group 14-** Special Functions

4.14.1 14-0* Inverter Switching

Parameter 14-00 Switching Pattern

Table 475: Parameter 14-00 Switching Pattern

14-00 Switching Pattern		
Default Value: [1] SFAVM	Parameter Type: Option	Setup: All set-ups
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	

Parameter 14-01 Switching Frequency

Table 476: Parameter 14-01 Switching Frequency

14-01 Switching Frequency		
Default Value: Size related	Parameter Type: Option	Setup: All set-ups
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	Default switching frequency for 355–1200 kW [500–1600 hp], 690 V.
[2]	2.0 kHz	Default switching frequency for 250–800 kW [350–1075 hp], 400 V, and 37–315 kW [50–450 hp], 690 V.
[3]	2.5 kHz	
[4]	3.0 kHz	Default switching frequency for 18.5–37 kW [25–50 hp], 200 V, and 37–200 kW [50–300 hp], 400 V.
[5]	3.5 kHz	
[6]	4.0 kHz	Default switching frequency for 5.5–15 kW [7.5–20 hp], 200 V, and 11–30 kW [15-40], 400 V.

Option	Name	Description
[7]	5.0 kHz	Default switching frequency for 0.25–3.7 kW [0.34–5 hp], 200 V, and 0.37–7.5 kW [0.5–10 hp], 400 V.
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	
[12]	12.0 kHz	
[13]	14.0 kHz	
[14]	16.0 kHz	

Parameter 14-03 Overmodulation

Table 477: Parameter 14-03 Overmodulation

14-03 Overmodulation		
Default Value: Size related	Parameter Type: Option	Setup: All set-ups
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*.

Parameter 14-04 Acoustic Noise Reduction

Table 478: Parameter 14-04 Acoustic Noise Reduction

14-04 Acoustic Noise Reduction		
Default Value: [0] Off	Parameter Type: Option	Setup: All set-ups
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.

Parameter 14-06 Dead Time Compensation

Table 479: Parameter 14-06 Dead Time Compensation

14-06 Dead Time Compensation		
Default Value: [1] On	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]	Off	No compensation.
[1]*	On	Activates dead-time compensation.

4.14.2 14-1* Mains On/Off

Parameters for configuring mains failure monitoring and handling. If a mains failure appears, the drive tries to continue in a controlled way until the power in the DC link is exhausted.

Parameter 14-10 Mains Failure

Table 480: Parameter 14-10 Mains Failure

14-10 Mains Failure		
Default Value: [0] No function	Parameter Type: Option	Setup: All set-ups
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*
- *[2] Ctrl. ramp-down, trip*
- *[5] Kinetic back-up, trip*
- *[7] Kin. back-up, trip w recovery*

N O T I C E
This parameter cannot be changed while the motor is running.

Parameter 14-10 Mains Failure is typically used where very 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

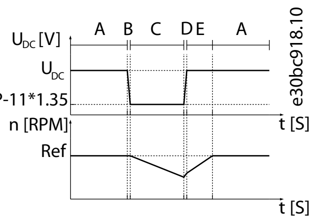
<table>
<tr><th>Op-tion</th><th>Name</th><th>Description</th></tr>
<tr><td></td><td></td><td>speed via the normal ramp-up. If the energy in the DC link disappears before the motor is ramped to 0, the motor is coasted. Limitation: See the introduction text in this parameter.</td></tr>
<tr><td>[2]</td><td>Ctrl. ramp-down, trip</td><td>The funcitonality is the same as in [1] Ctrl. ramp-down, except in this option a reset is necessary for starting up after power-up.</td></tr>
<tr><td>[3]</td><td>Coast-ing</td><td>Centrifuges can run for 1 hour without supply. In those situations, it is possible to select a coast function at mains interruption, together with a flying start, which occurs when the mains is restored.</td></tr>
<tr><td>[4]</td><td>Kinetic back-up</td><td>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.


Illustration 74: Kinetic Back-up
<table>
<tr><td>A</td><td>Normal operation</td><td>D</td><td>Mains return</td></tr>
<tr><td>B</td><td>Mains failure</td><td>E</td><td>Normal operation: Ramping</td></tr>
<tr><td>C</td><td>Kinetic back-up</td><td></td><td></td></tr>
</table>
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 fulfil 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.</td></tr>
<tr><td>[5]</td><td>Kinetic bac-up, trip</td><td>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.</td></tr>
</table>

<table>
<tr><th>Op-tion</th><th>Name</th><th>Description</th></tr>
<tr><td></td><td></td><td>

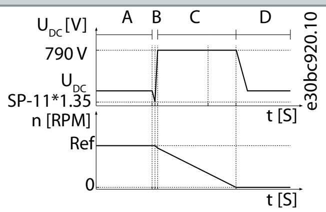


Illustration 75: Kinetic Back-up Trip

<table>
<tr><td>A</td><td>Normal operation</td><td>C</td><td>Kinetic back-up</td></tr>
<tr><td>B</td><td>Mains failure</td><td>D</td><td>Trip</td></tr>
</table>

</td></tr>
<tr><td>[6]</td><td>Alarm</td><td></td></tr>
<tr><td>[7]</td><td>Kin. back-up, trip w re-covery</td><td>

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.

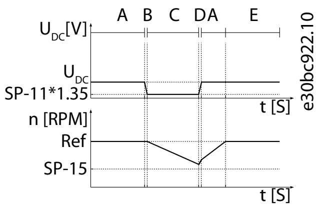


Illustration 76: Kinetic Back-up Trip w/Recovery, Mains Returns Above Parameter 14-15 Kin. Back-up Trip Recovery Level

<table>
<tr><td>A</td><td>Normal operation</td><td>D</td><td>Mains return</td></tr>
<tr><td>B</td><td>Mains Failure</td><td>E</td><td>Normal operation: Ramping</td></tr>
<tr><td>C</td><td>Kinetic back-up</td><td></td><td></td></tr>
</table>

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).

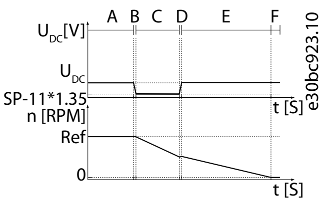


Illustration 77: Kinetic Back-up Trip w/Recovery, Slow Ramp, Mains Returns Below Parameter 14-15 Kin. Back-up Trip Recovery Level

<table>
<tr><td>A</td><td>Normal operation</td><td>D</td><td>Mains return</td></tr>
<tr><td>B</td><td>Mains failure</td><td>E</td><td>Kinetic back-up, ramping to trip</td></tr>
<tr><td>C</td><td>Kinetic back-up</td><td>F</td><td>Trip</td></tr>
</table>

</td></tr>
</table>

Op-tion	Name	Description
		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.

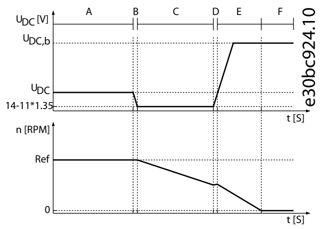


Illustration 78: Kinetic Back-up Trip w/Recovery, Quick Ramp, Mains Returns Below Parameter 14-15 Kin. Back-up Trip Recovery Level

A	Normal operation	D	Mains return
B	Mains failure	E	Kinetic back-up ramping to trip
C	Kinetic back-up	F	Trip

Parameter 14-11 Mains Fault Voltage Level

Table 481: Parameter 14-11 Mains Fault Voltage Level

14-11 Mains Fault Voltage Level		
Default value: Size related	Parameter type: Range, 100 - 800 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).

Parameter 14-12 Response to Mains Imbalance

Table 482: Parameter 14-12 Response to Mains Imbalance

14-12 Response to Mains Imbalance		
Default Value: [0] Trip	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Operation under severe main 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).

Option	Name	Description
[0]*	Trip	Trips the drive.
[1]	Warning	Issues a warning.
[2]	Disabled	No action.
[3]	Derate	

Parameter 14-14 Kin. Back-up Time-up

Table 483: Parameter 14-14 Kin. Back-up Time-up

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.

Parameter 14-15 Kin. Back-up Trip Recovery Level

Table 484: Parameter 14-15 Kin. Back-up Trip Recovery Level

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*.

Parameter 14-16 Kin. Back-up Gain

Table 485: Parameter 14-16 Kin. Back-up Gain

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.

4.14.3 14-2* Trip Reset

Parameters for configuring auto reset handling, special trip handling, and control card self-test or initialization.

Parameter 14-20 Reset Mode

Table 486: Parameter 14-20 Reset Mode

14-20 Reset Mode		
Default Value: [0] Manual reset	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select the reset function after tripping. Once reset, the drive can be restarted.

N O T I C E

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]	Reset at power-up	

Parameter 14-21 Automatic Restart Time

Table 487: Parameter 14-21 Automatic Restart Time

14-21 Automatic Restart Time		
Default value: Size related	Parameter type: Range, 0 - 3600 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*.

Parameter 14-22 Operation Mode

Table 488: Parameter 14-22 Operation Mode

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.

<table>
<tr><td>If the test is OK</td><td>LCP readout: Control card OK.
Disconnect the mains supply and remove the test plug. The green indicator light on the control card lights up.</td></tr>
<tr><td>If the test fails</td><td>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.

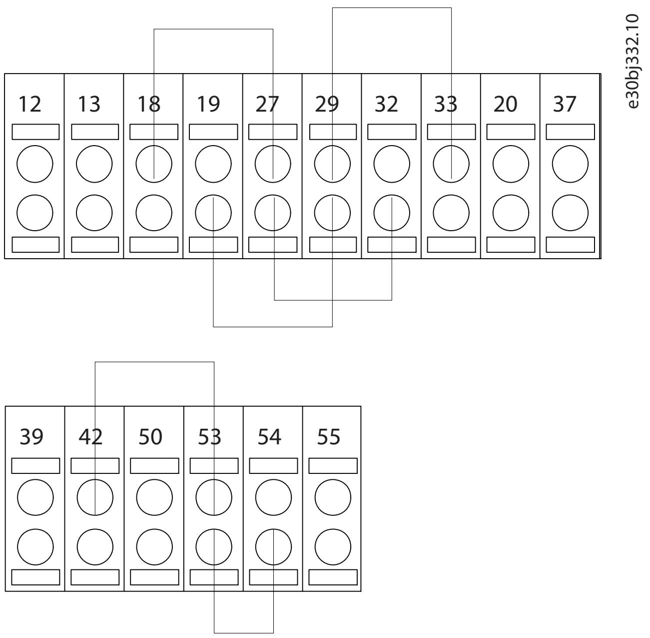


Illustration 79: Test Plugs</td></tr>
</table>

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	
[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. This option does not clear the service logs.
[3]	Boot mode	
[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.

Parameter 14-24 Trip Delay at Current Limit

Table 489: Parameter 14-24 Trip Delay at Current Limit

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.
Parameter 14-26 Trip Delay at Inverter Fault

Table 490: Parameter 14-26 Trip Delay at Inverter Fault

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.

NOTICE
Disable protection mode in hoisting applications.

4.14.4 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 18–33 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.
Parameter 14-30 Current Lim Ctrl, Proportional Gain

Table 491: Parameter 14-30 Current Lim Ctrl, Proportional Gain

14-30 Current Lim Ctrl, Proportional Gain		
Default value: 100%	Parameter type: Range, 0 - 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.
Parameter 14-31 Current Lim Ctrl, Integration Time

Table 492: Parameter 14-31 Current Lim Ctrl, Integration Time

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.

Parameter 14-32 Current Lim Ctrl, Filter Time

Table 493: Parameter 14-32 Current Lim Ctrl, Filter Time

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: True

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.

Parameter 14-35 Stall Protection

Table 494: Parameter 14-35 Stall Protection

14-35 Stall Protection		
Default Value: [1] Enabled	Parameter Type: Option	Setup: All set-ups
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.

Parameter 14-36 Field-weakening Function

Table 495: Parameter 14-36 Field-weakening Function

14-36 Field-weakening Function		
Default Value: [0] Auto	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select the field-weakening function mode in flux mode.

Option Number	Option Name	Description
[0]*	Auto	In this mode, the drive calculates the optimal torque output. Measured DC-link voltage determines the phase-to-phase motor voltage. Magnetizing reference is based on the actual voltage and utilizes the information about the model of the motor.
[1]	1/x	The drive reduces torque output. The drive sets the magnetizing reference inversely proportional to the speed using a static curve that shows the relationship between DC-link voltage and the speed.

Parameter 14-37 Fieldweakening Speed

Table 496: Parameter 14-37 Fieldweakening Speed

14-37 Fieldweakening Speed		
Default value: Size related	Parameter type: Range, 10 - 60000 RPM	Setup: All setups
Conversion index: 67	Data type: Uint16	Change during operation: True

Enter the start speed for option *[1] [1/x]* in *parameter 14-36 Fieldweakening Function*.

4.14.5 14-4* Energy Optimizing

Parameters for adjusting the energy optimization level in both variable torque (VT) and automatic energy optimization (AEO) mode in *parameter 1-03 Torque Characteristics*.

Parameter 14-40 VT Level

Table 497: Parameter 14-40 VT Level

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.

Parameter 14-41 AEO Minimum Magnetisation

Table 498: Parameter 14-41 AEO Minimum Magnetisation

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.

Parameter 14-42 Minimum AEO Frequency

Table 499: Parameter 14-42 Minimum AEO Frequency

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 frequencyat which the automatic energy optimization (AEO)is to be active.

Parameter 14-43 Motor Cosphi

Table 500: Parameter 14-43 Motor Cosphi

14-43 Motor Cosphi		
Default value: Size related	Parameter type: Range, 0 - 255 Hz	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.

Parameter 14-44 d-axis Reference Gain

Table 501: Parameter 14-44 d-axis Reference Gain

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.

Parameter 14-46 PROFIEnergy Times

Table 502: Parameter 14-46 PROFIEnergy Times

14-46 PROFIEnergy Times		
Default value: Size related	Parameter type: Range, 0 - 0x7ffffff, Array [3]	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Parameter with an array of 3. *[0] Time to pause*, *[1] Time min stay*, *[2] Time regular operate*.

Parameter 14-47 PROFIEnergy State

Table 503: Parameter 14-47 PROFIEnergy State

14-47 PROFIEnergy State		
Default Value: [255] Ready to operate	Parameter Type: Option	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

Option	Name	Description
[1]	LCP off	
[1]	Internal fan off	
[7]	Gatedrive off	
[10]	Mains off	
[13]	External fan off	
[255]*	Ready to operate	

Parameter 14-48 PROFIEnergy Desired State

Table 504: Parameter 14-48 PROFIEnergy Desired State

14-48 PROFIEnergy Desired State		
Default Value: [255] Ready to operate	Parameter Type: Option	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

Option	Name	Description
[1]	LCP off	
[1]	Internal fan off	
[7]	Gatedrive off	
[10]	Mains off	
[13]	External fan off	
[255]*	Ready to operate	

Parameter 14-49 PROFIEnergy Info

Table 505: Parameter 14-49 PROFIEnergy Info

14-49 PROFIEnergy Info		
Default value: 0	Parameter type: Range, 0 - 0x7ffffff, Array [115]	Setup: All setups
Conversion index: 0	Data type: Uint32	Change during operation: True

Read-out information about PROFIEnergy.

4.14.6 14-5* Environment

N O T I C E

Perform a power cycle after changing any of the parameters in this parameter group.

Use these parameters when operating the drive under special environmental conditions.

Parameter 14-50 RFI Filter

Table 506: Parameter 14-50 RFI Filter

14-50 RFI Filter		
Default Value: [1] On	Parameter Type: Option	Setup: 1 set-up
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	

Parameter 14-51 DC-link Compensation

Table 507: Parameter 14-51 DC-link Compensation

14-51 DC-link Compensation		
Default Value: [1] On	Parameter Type: Option	Setup: All set-ups
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.

Parameter 14-52 Fan Control

Table 508: Parameter 14-52 Fan Control

14-52 Fan Control		
Default Value: [0] Auto	Parameter Type: Option	Setup: All set-ups
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*.

Parameter 14-53 Fan Monitor

Table 509: Parameter 14-53 Fan Monitor

14-53 Fan Monitor		
Default Value: [1] Warning	Parameter Type: Option	Setup: All set-ups
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	

Parameter 14-55 Output Filter

Table 510: Parameter 14-55 Output Filter

14-55 Output Filter		
Default Value: [0] No filter	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

NOTICE

This parameter cannot be adjusted while the motor is running.

NOTICE

Reset the drive after selecting *[2] Sine-wave filter fixed*.

CAUTION

OVERHEATING OF DRIVE

When using sine-wave filters, there is a risk of overheating of the drive, which can result in personal injury and equipment damage. Always set *parameter 14-55 Output Filter* to *[2] Sine-wave fixed* when using a sine-wave filter.

Select the type of output filter connected.

Option	Name	Description
[0]*	No filter	This is the default setting and should be used with dU/dt filters or high frequency common mode (HFCM) filters.
[1]	Sine-wave filter	This setting is only for backwards compatibility. It enables operation with flux control principle when *parameter 14-56 Capacitance Output Filter* and *parameter 14-57 Inductance Output Filter* are programmed with the output filter capacitance and inductance. It does not limit the range of the switching frequency.
[2]	Sine-Wave Filter Fixed	This parameter sets a minimum allowed limit to the switching frequency and ensures that the filter is operated within the safe range of switching frequencies. Operation is possible with all control principles. For flux control principle, program *parameter 14-56 Capacitance Output Filter* and *parameter 14-57 Inductance Output Filter* (these parameters have no effect in VVC$^+$ and U/f). The modulation pattern is set to SFAVM, which gives the lowest acoustic noise in the filter.

Parameter 14-56 Capacitance Output Filter

Table 511: Parameter 14-56 Capacitance Output Filter

14-56 Capacitance Output Filter		
Default value: Size related	Parameter type: Range, 0.1 - 6500 uF	Setup: All setups
Conversion index: -7	Data type: Uint16	Change during operation: False

Compensation function of the LC filter requires the per-phase equivalent star-connected capacitance of the filter (3 times the capacity between 2 phases when capacitance is delta connection). Set the capacitance of the output filter. The value can be found on the filter label.

NOTICE

This is required for correct compensation in flux mode (*parameter 1-01 Motor Control Principle*).

Parameter 14-57 Inductance Output Filter

Table 512: Parameter 14-57 Inductance Output 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. The value can be found on the filter label.

NOTICE
This is required for correct compensation in flux mode (*parameter 1-01 Motor Control Principle*).

Parameter 14-59 Actual Number of Inverter Units

Table 513: Parameter 14-59 Actual Number of Inverter Units

14-59 Actual Number of Inverter Units		
Default value: Size related	Parameter type: Range, 1 - 1	Setup: All setups
Conversion index: 0	Data type: Uint8	Change during operation: False

Set the actual number of power units.

4.14.7 14-6* Auto Derate

This parameter group contains parameters for derating the drive if there is high temperature.

Parameter 14-60 Function at Over Temperature

Table 514: Parameter 14-60 Function at Over Temperature

14-60 Function at Over Temperature		
Default Value: [0] Trip	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

If either heat sink or control card temperature exceeds a factory-programmed temperature limit, a warning is activated. If the temperature increases further, select whether the drive should trip (trip lock) or derate the output current.

Option	Name	Description
[0]*	Trip	The drive trips (trip lock) and generates an alarm. Cycle power to reset the alarm. The motor restarts when the heat sink temperature has dropped below the alarm limit.
[1]	Derate	If the critical temperature is exceeded, the output current is reduced until the allowable temperature has been reached.

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.

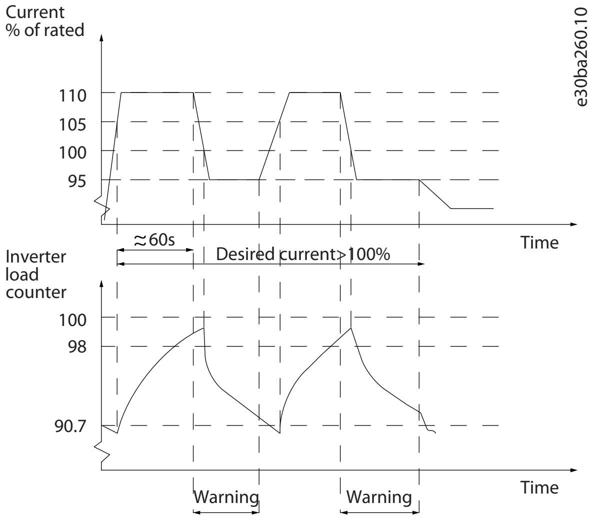


Illustration 80: Output Current in Overload Condition

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.

Parameter 14-61 Function at Inverter Overload

Table 515: Parameter 14-61 Function at Inverter Overload

14-61 Function at Inverter Overload		
Default Value: [0] Trip	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Use 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.

Parameter 14-62 Inv. Overload Derate Current

Table 516: Parameter 14-62 Inv. Overload Derate Current

14-62 Inv. Overload Derate Current		
Default Value: 95%	Parameter Type: Range, 50 - 100%	Setup: All set-ups
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).

4.14.8 14-8* Options

Parameter 14-88 Option Data Storage

Table 517: Parameter 14-88 Option Data Storage

14-88 Option Data Storage		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [24]	Setup: 2 set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

This parameter stores information about options over a power cycle.

Parameter 14-89 Option Detection

Table 518: Parameter 14-89 Option Detection

14-89 Option Detection		
Default Value: [0] Protect option config.	Parameter Type: Option	Setup: 1 set-up
Conversion Index: -	Data Type: Uint8	Change during operation: True

Selects the behavior of the drive when a change in the option configuration is detected.

Option	Name	Description
[0]*	Protect option config.	Freezes the current settings and prevents unwanted changes when missing or defective options are detected.
[1]	Enable option change	Changes drive settings and is used when modifying the system configuration. This parameter setting returns to *[0] Protect option config.* after an option change.

4.14.9 14-9* Fault Settings

Parameter 14-90 Fault Level

Table 519: Parameter 14-90 Fault Level

14-90 Fault Level		
Default Value: Size related	Parameter Type: Option, Array [26]	Setup: 1 set-up
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 520: Selection of Action when Selected Alarm Appears

Failure	Alarm	Element in parameter 14-90 F ault Level	Off	Warning	Trip	Trip lock	Trip with delayed reset
10 V low	1	1490.0	X	D	–	–	–
24 V supply low	47	1490.1	X	–	–	D	–
1.8 V supply low	48	1490.2	X	–	–	D	–
Voltage level	64	1490.3	X	D	–	–	–
Ground fault during ramping	14	1490.4	–	–	D	X	–
Ground fault 2 during continuous operation	45	1490.5	–	–	D	X	–
Torque limit	12	1490.6	X	D	–	–	–
Overcurrent	13	1490.7	–	–	X	D	–
Short circuit	16	1490.8	–	–	X	D	–
Heat sinke temperature	29	1490.9	–	–	X	D	–
Heat sink sensor	39	1490.10	–	–	X	D	–
Control card temperature	65	1490.11	–	–	X	D	–
Power card temperature	69	1490.12	–	(1)	X	D	–
Heat sink temperature(2)	244	1490.13	–	–	X	D	–
Heat sink sensor(2)	245	1490.14	–	–	X	D	–
Power card temperature(2)	247	1490.15	–	–	X	D	–
Motor phase U missing	30	1490.16	–	–	X	D	–
Motor phase V missing	31	1490.16	–	–	X	D	–
Motor phase W missing	32	1490.16	–	–	X	D	–
Current limit(3)	59	1490.19	X	D	–	–	–
Locked rotor	99	1490.20	–	–	D	X	–

[1] In small and medium power drives, alarm 69, Power card temperature is only a warning.

[2] Only high-power drives.

[3] Warning 59 is configured in 1490.19. The current limit warning can be disabled by choice. The alarm cannot be configured.

VLT® Motion Control Tool MCT 10 has the element numbers listed in the column ID. Use this table with MCT 10 to get information about specific fault levels.

4.15 Parameter Group 15-** Drive Information

4.15.1 15-0* Operating Data

Parameter 15-00 Operating Hours

Table 521: Parameter 15-00 Operating Hours

15-00 Operating Hours		
Default Value: 0 h	Parameter Type: Range, 0 - 2147483647 h	Setup: All set-ups
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.

Parameter 15-01 Running Hours

Table 522: Parameter 15-01 Running Hours

15-01 Running Hours		
Default Value: 0 h	Parameter Type: Range, 0 - 2147483647 h	Setup: All set-ups
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.

Parameter 15-02 kWh Counter

Table 523: Parameter 15-02 kWh Counter

15-02 kWh Counter		
Default Value: 0 kWh	Parameter Type: Range, 0 - 2147483647 kWh	Setup: All set-ups
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*.

Parameter 15-03 Power Up's

Table 524: Parameter 15-03 Power Up's

15-03 Power Up's		
Default Value: 0	Parameter Type: Range, 0 - 2147483647	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

View the number of times the drive has been powered up.

Parameter 15-04 Over Temp's

Table 525: Parameter 15-04 Over Temp's

15-04 Over Temp's		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View the number of drive temperature faults.

Parameter 15-05 Over Volt's

Table 526: Parameter 15-05 Over Volt's

15-05 Over Volt's		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View the number of drive overvoltages.

Parameter 15-06 Reset kWh Counter

Table 527: Parameter 15-06 Reset kWh Counter

15-06 Reset kWh Counter		
Default Value: [0] Do not reset	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	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*).

Parameter 15-07 Reset Running Hours Counter

Table 528: Parameter 15-07 Reset Running Hours Counter

15-07 Reset Running Hours Counter		
Default Value: [0] Do not reset	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Do not reset	
[1]	Reset counter	To reset the running hours counter to 0, select *[1] Reset* and press [OK] (see *parameter 15-01 Running Hours*). This parameter cannot be selected via the serial port, RS485. Select *[0] Do not reset* if no reset of the running-hours counter is required.

4.15.2 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.

Parameter 15-10 Logging Source

Table 529: Parameter 15-10 Logging Source

15-10 Logging Source		
Default Value: [0] None	Parameter Type: Option, Array [4]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint16	Change during operation: True

Select the variables to be logged.

Option	Name	Description
[0]*	None	
[15]	Readout: Actual setup	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1472]	Legacy alarm word	
[1473]	Legacy warning word	
[1474]	Leg. ext. status word	
[1600]	Control word	
[1601]	Reference [Unit]	
[1602]	Reference %	
[1603]	Status word	
[1606]	Actual position	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1620]	Motor angle	
[1621]	Torque [%] high res.	
[1622]	Torque [%]	
[1624]	Calibrated stator resistance	
[1625]	Torque [Nm] high	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1645]	Motor phase U current	

Option	Name	Description
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1651]	Pulse reference	
[1652]	Feedback[Unit]	
[1657]	Feedback [RPM]	
[1660]	Digital input	
[1662]	Analog input 53	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[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	
[1692]	Warning word	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1820]	Commanded position	
[1821]	Master position	
[1823]	Virtual master pos.	
[1827]	Safe opt. est. speed	
[1828]	Safe opt. meas. speed	
[1829]	Safe opt. speed error	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	

Option	Name	Description
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 digital output [bin]	
[1860]	Digital input 2	
[3110]	Bypass status word	
[3466]	SPI error counter	

Parameter 15-11 Logging Interval

Table 530: Parameter 15-11 Logging Interval

15-11 Logging Interval		
Default Value: Size related	Parameter Type: Range, 0.000 - 0.000	Setup: 2 set-ups
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.

Parameter 15-12 Trigger Event

Table 531: Parameter 15-12 Trigger Event

15-12 Trigger Event		
Default Value: [0] False	Parameter Type: Option	Setup: 1 set-up
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	

Option	Name	Description
[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	
[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	

Parameter 15-13 Logging Mode

Table 532: Parameter 15-13 Logging Mode

15-13 Logging Mode		
Default Value: [0] Log always	Parameter Type: Option	Setup: 2 set-ups
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*.

Parameter 15-14 Samples Before Trigger

Table 533: Parameter 15-14 Samples Before Trigger

15-14 Samples Before Trigger		
Default Value: 50	Parameter Type: Range, 0 - 100	Setup: 2 set-ups
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*.

Parameter 15-15 Info Message: "Service Log Full"

Table 534: Parameter 15-15 Info Message: "Service Log Full"

15-15 Info Message: "Service Log Full"		
Default Value: [0] Disabled	Parameter Type: Option	Setup: 1 set-up
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,

4.15.3 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.

Find the list of alarms that trigger a service log record in 4.15.7 Alarms that Trigger a Service Log Record. Application-dependent trips/alarms, for example, Safe Torque Off, do not trigger a service log record.

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 535: Service Log Data

#	Alarm log data	Parameter
1	Time of trip (1 of the values):	*Parameter 0-89 Date and Time Readout* or *parameter 15-32 Fault Log: Time*

#	Alarm log data	Parameter
	• Priority real-time clock (if available). • Priority operating time (if RTC is not available).	
2	Alarm code	*Parameter 15-30 Fault Log: Error Code*
3	Frequency	*Parameter 16-13 Frequency*
4	Speed (RPM)	*Parameter 16-17 Speed [RPM]*
5	Reference (%)	*Parameter 16-02 Reference %*
7	DC-link voltage	*Parameter 16-30 DC Link Voltage*
9	Motor phase U current	*Parameter 16-45 Motor Phase U Current*
10	Motor phase V current	*Parameter 16-46 Motor Phase V Current*
11	Motor phase W current	*Parameter 16-47 Motor Phase W Current*
12	Motor phase voltage	*Parameter 16-12 Motor Voltage*
15	Control word	*Parameter 16-00 Control Word*
16	Status word	*Parameter 16-03 Status Word*

4.15.4 Clearing the Service Log

The flash memory stores up to 24 records. To save more logs, clear the service log memory.
Save the service log records using the VLT® Motion Control Tool MCT 10 before clearing the service log.
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.

4.15.5 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.

4.15.6 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*.

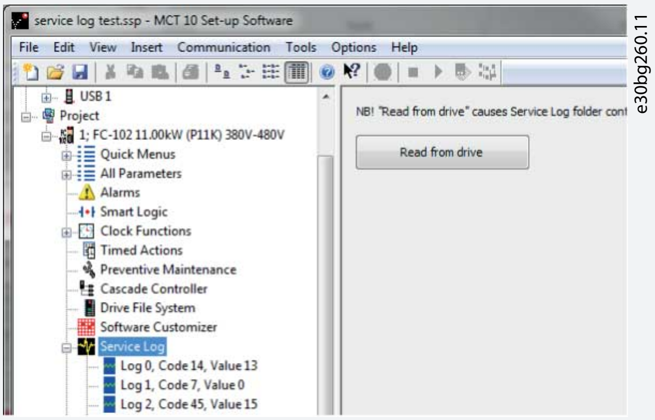


Illustration 81: MCT 10, Read From Drive

The service log view in MCT 10 looks as shown in Illustration 82. Use the cursor to view the detailed readings at a specific time.

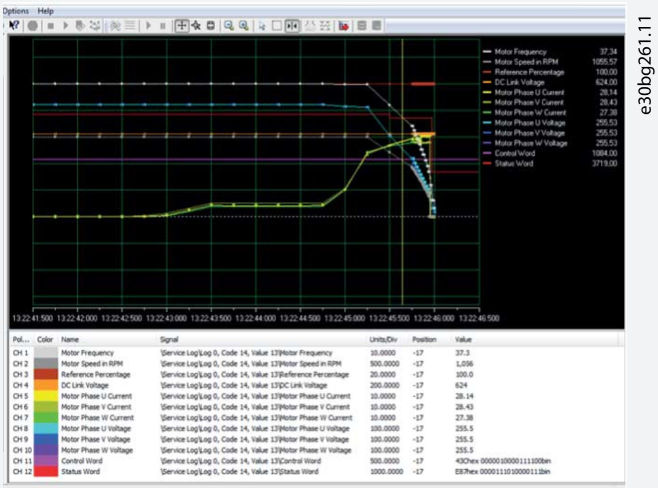


Illustration 82: Service Log View, 5 s

Use the zoom function to focus on the last 250 ms before the fault. See Illustration 83.

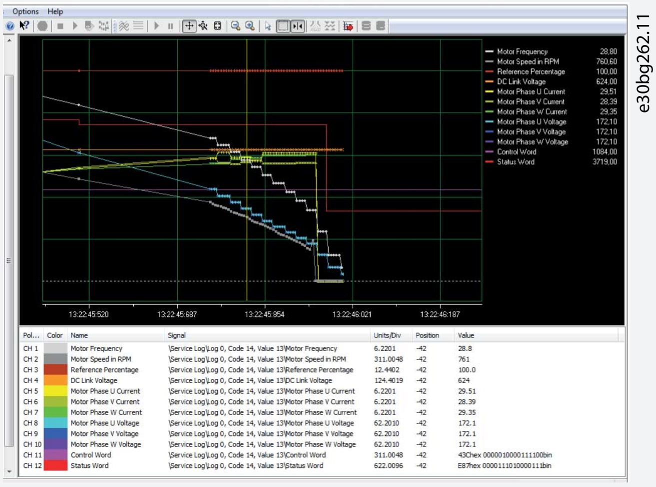


Illustration 83: Service Log Detailed View, 250 ms

4.15.7 Alarms that Trigger a Service Log Record

Table 536: 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

N O T I C E

If an alarm has 2 states (warning/alarm), it only triggers a service log record when going into the alarm state.

4.15.8 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.

Parameter 15-20 Historic Log: Event

Table 537: Parameter 15-20 Historic Log: Event

15-20 Historic Log: Event		
Default Value: 0	Parameter Type: Range, 0 - 255, Array [50]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint8	Change during operation: False

View the event type of the logged events.

Parameter 15-21 Historic Log: Value

Table 538: Parameter 15-21 Historic Log: Value

15-21 Historic Log: Value		
Default Value: 0	Parameter Type: Range, 0 - 2147483647, Array [50]	Setup: All set-ups
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.

Parameter 15-22 Historic Log: Time

Table 539: Parameter 15-22 Historic log: Time

15-22 Historic log: Time		
Default Value: 0 ms	Parameter Type: Range, 0 - 2147483647 ms, Array [50]	Setup: All set-ups
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 the drive was started. The maximum value corresponds to approximately 24 days, which means that the count restarts at 0 after this period.

4.15.9 15-3* Alarm Log

Parameters in this group are array parameters where up to 10 fault logs can be viewed. 0 is the most recent logged data and 9 is the oldest. Fault codes, values, and time stamp can be viewed for all logged data.

Parameter 15-30 Fault Log: Error Code

Table 540: Parameter 15-30 Fault Log: Error Code

15-30 Fault Log: Error Code		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View the fault code and look up its meaning in 5 Troubleshooting.

Parameter 15-31 Fault Log: Value

Table 541: Parameter 15-31 Fault Log: Value

15-31 Fault Log: Value		
Default Value: 0	Parameter Type: Range, -32767 - 32767, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View an extra description of the error. This parameter is mostly used with *alarm 38, internal fault*.

Parameter 15-32 Fault Log: Time

Table 542: Parameter 15-32 Fault Log: Time

15-32 Fault Log: Time		
Default Value: 0 s	Parameter Type: Range, 0 - 2147483647, Array [10]	Setup: All set-ups
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.

Parameter 15-33 Fault Log: Date and Time

Table 543: Parameter 15-33 Fault Log: Date and Time

15-33 Fault Log: Date and Time		
Default Value: Size related	Parameter Type: Range, 0 - 2147483647, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: TimeOfDay	Change during operation: False

Array parameter; Date & Time 0–9: This parameter shows when the logged event occurred.

4.15.10 15-4* Drive Identification

Parameters containing read-only information about the hardware and software configuration of the drive.

Parameter 15-40 FC Type

Table 544: Parameter 15-40 FC Type

15-40 FC Type		
Default Value: 0	Parameter Type: Range, 0 - 6	Setup: All set-ups
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.

Parameter 15-41 Power Section

Table 545: Parameter 15-41 Power Section

15-41 Power Section		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the drive type. The readout is identical to the drive power field of the type code definition, characters 7–10.

Parameter 15-42 Voltage

Table 546: Parameter 15-42 Voltage

15-42 Voltage		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the drive type. The readout is identical to the drive power field of the type code definition, characters 11-12.

Parameter 15-43 Software Version

Table 547: Parameter 15-43 Software Version

15-43 Software Version		
Default Value: 0	Parameter Type: Range, 0 - 5	Setup: All set-ups
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.

Parameter 15-44 Ordered Typecode String

Table 548: Parameter 15-44 Ordered Typecode String

15-44 Ordered Typecode String		
Default Value: 0	Parameter Type: Range, 0 - 40	Setup: All set-ups
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.

Parameter 15-45 Actual Typecode String

Table 549: Parameter 15-45 Actual Typecode String

15-45 Actual Typecode String		
Default Value: 0	Parameter Type: Range, 0 - 40	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[40]	Change during operation: False

View the actual type code string.

Parameter 15-46 Frequency Converter Ordering No

Table 550: Parameter 15-46 Frequency Converter Ordering No

15-46 Frequency Converter Ordering No		
Default Value: 0	Parameter Type: Range, 0 - 8	Setup: All set-ups
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*.

Parameter 15-47 Power Card Ordering No

Table 551: Parameter 15-47 Power Card Ordering No

15-47 Power Card Ordering No		
Default Value: 0	Parameter Type: Range, 0 - 8	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[8]	Change during operation: False

View the power card code number.

Parameter 15-48 LCP ID No

Table 552: Parameter 15-48 LCP ID No

15-48 LCP ID No		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the LCP ID number.

Parameter 15-49 SW ID Control Card

Table 553: Parameter 15-49 SW ID Control Card

15-49 SW ID Control Card		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the control card software version number.

Parameter 15-50 SW ID Power Card

Table 554: Parameter 15-50 SW ID Power Card

15-50 SW ID Power Card		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the power card software version number.

Parameter 15-51 Frequency Converter Serial Number

Table 555: Parameter 15-51 Frequency Converter Serial Number

15-51 Frequency Converter Serial Number		
Default Value: 0	Parameter Type: Range, 0 - 10	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[10]	Change during operation: False

View the drive serial number.

Parameter 15-53 Power Card Serial Number

Table 556: Parameter 15-53 Power Card Serial Number

15-53 Power Card Serial Number		
Default Value: 0	Parameter Type: Range, 0 - 19	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[19]	Change during operation: False

View the power card serial number.

Parameter 15-58 Smart Setup Filename

Table 557: Parameter 15-58 Smart Setup Filename

15-58 Smart Setup Filename		
Default Value: Size related	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[16]	Change during operation: True

Shows the SmartStart file name.
Parameter 15-59 Filename

Table 558: Parameter 15-59 Filename

15-59 Filename		
Default Value: Size related	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[16]	Change during operation: False

Shows the currently used customer-specific initial values (CSIV) file name.

4.15.11 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.
Parameter 15-60 Option Mounted

Table 559: Parameter 15-60 Option Mounted

15-60 Option Mounted		
Default Value: 0	Parameter Type: Range, 0 - 30, Array [8]	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[30]	Change during operation: False

Shows the type of installed option.
Parameter 15-61 Option SW Version

Table 560: Parameter 15-61 Option SW Version

15-61 Option SW Version		
Default Value: 0	Parameter Type: Range, 0 - 20, Array [8]	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the installed option software version.
Parameter 15-62 Option Ordering No

Table 561: Parameter 15-62 Option Ordering No

15-62 Option Ordering No		
Default Value: 0	Parameter Type: Range, 0 - 8, Array [8]	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[8]	Change during operation: False

Shows the code number for the installed options.

Parameter 15-63 Option Serial No

Table 562: Parameter 15-63 Option Serial No

15-63 Option Serial No		
Default Value: 0	Parameter Type: Range, 0 - 18, Array [8]	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[18]	Change during operation: False

View the installed option serial number.

Parameter 15-70 Option in Slot A

Table 563: Parameter 15-70 Option in Slot A

15-70 Option in Slot A		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

Parameter 15-71 Slot A Option SW Version

Table 564: Parameter 15-71 Slot A Option SW Version

15-71 Slot A Option SW Version		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the software version for the option installed in slot A.

Parameter 15-72 Option in Slot B

Table 565: Parameter 15-72 Option in Slot B

15-72 Option in Slot B		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

Parameter 15-73 Slot B SW Version

Table 566: Parameter 15-73 Slot B SW Version

15-73 Slot B SW Version		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the software version for the option installed in slot B.

Parameter 15-74 Option in Slot C0/E0

Table 567: Parameter 15-74 Option in Slot C0/E0

15-74 Option in Slot C0/E0		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

Parameter 15-75 Slot C0/E0 Option SW Version

Table 568: Parameter 15-75 Slot C0/E0 Option SW Version

15-75 Slot C0/E0 Option SW Version		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

View the software version for the option installed in slot C.

Parameter 15-76 Option in Slot C1/E1

Table 569: Parameter 15-76 Option in Slot C1/E1

15-76 Option in Slot C1/E1		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[30]	Change during operation: False

Shows the type code string for the option in slot C1 (*CXXXX* if no option) and the translation, that is *No option*.

Parameter 15-77 Slot C1/E1 Option SW Version

Table 570: Parameter 15-77 Slot C1/E1 Option SW Version

15-77 Slot C1/E1 Option SW Version		
Default Value: 0	Parameter Type: Range, 0 - 20	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[20]	Change during operation: False

Shows the software version for the installed option in option slot C.

4.15.12 15-8* Operating Data II

Parameter 15-80 Fan Running Hours

Table 571: Parameter 15-80 Fan Running Hours

15-80 Fan Running Hours		
Default Value: 0 h	Parameter Type: Range, 0 - 2147483647 h	Setup: All set-ups
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.

Parameter 15-81 Preset Fan Running Hours

Table 572: Parameter 15-81 Preset Fan Running Hours

15-81 Preset Fan Running Hours		
Default Value: 0 h	Parameter Type: Range, 0 - 99999 h	Setup: All set-ups
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.

Parameter 15-89 Configuration Change Counter

Table 573: Parameter 15-89 Configuration Change Counter

15-89 Configuration Change Counter		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

NOTICE

This parameter cannot be adjusted while the motor is running.

4.15.13 15-9* Parameter Info

Parameter 15-92 Defined Parameters

Table 574: Parameter 15-92 Defined Parameters

15-92 Defined Parameters		
Default Value: 0	Parameter Type: Range, 0 - 9999, Array [1000]	Setup: All set-ups
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.

Parameter 15-98 Drive Identification

Table 575: Parameter 15-98 Drive Identification

15-98 Drive Identification		
Default Value: 0	Parameter Type: Range, 0 - 40	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[40]	Change during operation: False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

Parameter 15-99 Parameter Metadata

Table 576: Parameter 15-99 Parameter Metadata

15-99 Parameter Metadata		
Default Value: 0	Parameter Type: Range, 0 - 9999, Array [35]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

4.16 Parameter Group 16-** Data Readouts

4.16.1 16-0* General Status

Parameter 16-00 Control Word

Table 577: Parameter 16-00 Control Word

16-00 Control Word		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: V2	Change during operation: False

View the control word sent from the drive via the serial communication port in hex code.

Parameter 16-01 Reference [Unit]

Table 578: Parameter 16-01 Reference [Unit]

16-01 Reference [Unit]		
Default Value: 0 ReferenceFeedbackUnit	Parameter Type: Range, -999999 ReferenceFeedbackUnit - 999999 ReferenceFeedbackUnit	Setup: All set-ups
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).

Parameter 16-02 Reference %

Table 579: Parameter 16-02 Reference %

16-02 Reference %		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
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.

Parameter 16-03 Status Word

Table 580: Parameter 16-03 Status Word

16-03 Status Word		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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.

Parameter 16-05 Main Actual Value [%]

Table 581: Parameter 16-05 Main Actual Value [%]

16-05 Main Actual Value [%]		
Default Value: 0%	Parameter Type: Range, -100 - 100%	Setup: All set-ups
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.

Parameter 16-09 Customer Readout

Table 582: Parameter 16-09 Customer Readout

16-09 Customer Readout		
Default Value: 0 CustomReadoutUnit	Parameter Type: Range, 0 CustomReadoutUnit - 999999.99 CustomReadoutUnit	Setup: All set-ups
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*.

4.16.2 16-1* Motor Status

Parameter 16-10 Power [kW]

Table 583: Parameter 16-10 Power [kW]

16-10 Power [kW]		
Default Value: 0 kW	Parameter Type: Range, 0 - 10000 kW	Setup: All set-ups
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.

Parameter 16-11 Power [hp]

Table 584: Parameter 16-11 Power [hp]

16-11 Power [hp]		
Default Value: 0 hp	Parameter Type: Range, 0 - 10000 hp	Setup: All set-ups
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.

Parameter 16-12 Motor Voltage

Table 585: Parameter 16-12 Motor Voltage

16-12 Motor Voltage		
Default Value: 0 V	Parameter Type: Range, 0 - 6000 V	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: False

View the motor voltage, a calculated value used for controlling the motor.

Parameter 16-13 Frequency

Table 586: Parameter 16-13 Frequency

16-13 Frequency		
Default Value: 0 Hz	Parameter Type: Range, 0 - 6500 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: False

View the motor frequency without resonance damping.

Parameter 16-14 Motor Current

Table 587: Parameter 16-14 Motor Current

16-14 Motor Current		
Default Value: 0 A	Parameter Type: Range, 0 - 10000 A	Setup: All set-ups
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.

Parameter 16-15 Frequency [%]

Table 588: Parameter 16-15 Frequency [%]

16-15 Frequency [%]		
Default Value: 0%	Parameter Type: Range, -100 - 100%	Setup: All set-ups
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.

Parameter 16-16 Torque [Nm]

Table 589: Parameter 16-16 Torque [Nm]

16-16 Torque [Nm]		
Default Value: 0 Nm	Parameter Type: Range, -3000 - 3000 Nm	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	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.

Parameter 16-17 Speed [RPM]

Table 590: Parameter 16-17 Speed [RPM]

16-17 Speed [RPM]		
Default Value: 0 RPM	Parameter Type: Range, -30000 - 30000 Nm	Setup: All set-ups
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.

Parameter 16-18 Motor Thermal

Table 591: Parameter 16-18 Motor Thermal

16-18 Motor Thermal		
Default Value: 0%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
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*.

Parameter 16-19 Thermistor Sensor Temperature

Table 592: Parameter 16-19 Thermistor Sensor Temperature

16-19 Thermistor Sensor Temperature		
Default Value: 0 °C	Parameter Type: Range, 0 - 0 °C	Setup: All set-ups
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*.

Parameter 16-20 Motor Angle

Table 593: Parameter 16-20 Motor Angle

16-20 Motor Angle		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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).

Parameter 16-21 Torque [%] High Res.

Table 594: Parameter 16-21 Torque [%] High Res.

16-21 Torque [%] High Res.		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

The value shown is the torque in percent of nominal torque, with sign and 0.1% resolution, applied to the motor shaft.

Parameter 16-22 Torque [%]

Table 595: Parameter 16-22 Torque [%]

16-22 Torque [%]		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: 1	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.

Parameter 16-23 Motor Shaft Power [kW]

Table 596: Parameter 16-23 Motor Shaft Power [kW]

16-23 Motor Shaft Power [kW]		
Default Value: 0 kW	Parameter Type: Range, 0 - 10000 kW	Setup: All set-ups
Conversion Index: -1	Data Type: Int32	Change during operation: True

Readout of the mechanical power applied to the motor shaft.

Parameter 16-24 Calibrated Stator Resistance

Table 597: Parameter 16-24 Calibrated Stator Resistance

16-24 Calibrated Stator Resistance		
Default Value: 0.0000 Ohm	Parameter Type: Range, 0.0000 - 100.0000 Ohm	Setup: All set-ups
Conversion Index: -4	Data Type: Uint32	Change during operation: True

Shows the calibrated stator resistance.

Parameter 16-25 Torque [Nm] High

Table 598: Parameter 16-25 Torque [Nm] High

16-25 Torque [Nm] High		
Default Value: 0 Nm	Parameter Type: Range, -200000000 - 200000000 Nm	Setup: All set-ups
Conversion Index: -1	Data Type: Int32	Change during operation: False

View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. Therefore, the minimum value and the maximum value depend on the maximum motor current as well as the motor used. This specific readout has been adapted to be able to show higher values than the standard readout in *parameter 16-16 Torque [Nm]*.

4.16.3 16-3* Drive Status

Parameter 16-30 DC Link Voltage

Table 599: Parameter 16-30 DC Link Voltage

16-30 DC Link Voltage		
Default Value: 0 V	Parameter Type: Range, 0 - 10000 V	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View a measured value. The value is filtered with a 30 ms time constant.

Parameter 16-31 System Temp.

Table 600: Parameter 16-31 System Temp.

16-31 System Temp.		
Default Value: 0 °C	Parameter Type: Range, -128 - 127 °C	Setup: All set-ups
Conversion Index: 100	Data Type: Int8	Change during operation: True

Shows the highest internal system temperature. In the smaller enclosure sizes (A–C), the system temperature matches the control card temperature measurement in *parameter 16-39 Control Card Temp*. In the larger enclosure sizes (D–F), the system temperature is the highest temperature measured on hardware components with temperature sensors, for example, the power card(s).

Parameter 16-32 Brake Energy /s

Table 601: Parameter 16-32 Brake Energy /s

16-32 Brake Energy /s		
Default Value: 0 kW	Parameter Type: Range, 0 - 10000 kW	Setup: All set-ups
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.

Parameter 16-33 Brake Energy Average

Table 602: Parameter 16-33 Brake Energy Average

16-33 Brake Energy Average		
Default Value: 0 kW	Parameter Type: Range, 0 - 10000 kW	Setup: All set-ups
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*.

Parameter 16-34 Heatsink Temp.

Table 603: Parameter 16-34 Heatsink Temp.

16-34 Heatsink Temp.		
Default Value: 0 °C	Parameter Type: Range, 0 - 255 °C	Setup: All set-ups
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).

Parameter 16-35 Inverter Thermal

Table 604: Parameter 16-35 Inverter Thermal

16-35 Inverter Thermal		
Default Value: 0%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: 0	Data Type: Uint8	Change during operation: False

View the percentage load on the inverter.

Parameter 16-36 Inv. Nom. Current

Table 605: Parameter 16-36 Inv. Nom. Current

16-36 Inv. Nom. Current		
Default Value: Size related	Parameter Type: Range, 0.01 - 10000 A	Setup: All set-ups
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.

Parameter 16-37 Inv. Max. Current

Table 606: Parameter 16-37 Inv. Max. Current

16-37 Inv. Max. Current		
Default Value: Size related	Parameter Type: Range, 0.01 - 10000 A	Setup: All set-ups
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.

Parameter 16-38 SL Controller State

Table 607: Parameter 16-38 SL Controller State

16-38 SL Controller State		
Default Value: 0	Parameter Type: Range, 0 - 100, Array [4]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint8	Change during operation: False

View the state of the event under execution by the SL controller.

Parameter 16-39 Control Card Temp.

Table 608: Parameter 16-39 Control Card Temp.

16-39 Control Card Temp.		
Default Value: 0 °C	Parameter Type: Range, 0 - 100 °C	Setup: All set-ups
Conversion Index: 100	Data Type: Uint8	Change during operation: False

View the temperature on the control card, stated in °C.

Parameter 16-40 Logging Buffer Full

Table 609: Parameter 16-40 Logging Buffer Full

16-40 Logging Buffer Full		
Default Value: [0] No	Parameter Type: Option	Setup: All set-ups
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	

Parameter 16-41 Performance Maintenance

Table 610: Parameter 16-41 Performance Maintenance

16-41 Performance Maintenance		
Default Value: 0	Parameter Type: Range, 0 - 2147483647	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[50]	Change during operation: True

Parameter 16-42 Service Log Counter

Table 611: Parameter 16-42 Service Log Counter

16-42 Service Log Counter		
Default Value: 0	Parameter Type: Range, 0 - 2147483647	Setup: All set-ups
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.

Parameter 16-43 Timed Actions Status

Table 612: Parameter 16-43 Timed Actions Status

16-43 Timed Actions Status		
Default Value: [0] Timed actions auto	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select the times actions view.

Option	Name	Description
[0]*	Timed actions auto	
[1]	Timed actions disabled	
[2]	Constant on action	
[3]	Constant off actions	

Parameter 16-45 Motor Phase U Current

Table 613: Parameter 16-45 Motor Phase U Current

16-45 Motor Phase U Current		
Default Value: 0 A	Parameter Type: Range, 0 - 10000 A	Setup: All set-ups
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.

Parameter 16-46 Motor Phase V Current

Table 614: Parameter 16-46 Motor Phase V Current

16-46 Motor Phase V Current		
Default Value: 0 A	Parameter Type: Range, 0 - 10000 A	Setup: All set-ups
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.

Parameter 16-47 Motor Phase W Current

Table 615: Parameter 16-47 Motor Phase W Current

16-47 Motor Phase W Current		
Default Value: 0 A	Parameter Type: Range, 0 - 10000 A	Setup: All set-ups
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.

Parameter 16-48 Speed Ref. After Ramp [RPM]

Table 616: Parameter 16-48 Speed Ref. After Ramp [RPM]

16-48 Speed Ref. After Ramp [RPM]		
Default Value: 0 RPM	Parameter Type: Range, -30000 - 30000 RPM	Setup: All set-ups
Conversion Index: 67	Data Type: Int32	Change during operation: False

This parameter specifies the reference given to the drive after the speed ramp.

Parameter 16-49 Current Fault Source

Table 617: Parameter 16-49 Current Fault Source

16-49 Current Fault Source		
Default Value: 0	Parameter Type: Range, 0 - 8	Setup: All set-ups
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

4.16.4 16-5* Ref. & Feedb.

Parameter 16-50 External Reference

Table 618: Parameter 16-50 External Reference

16-50 External Reference		
Default Value: 0	Parameter Type: Range, -200 - 200	Setup: All set-ups
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.
Parameter 16-51 Pulse Reference

Table 619: Parameter 16-51 Pulse Reference

16-51 Pulse Reference		
Default Value: 0	Parameter Type: Range, -200 - 200	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

View the reference value from programmed digital inputs. The readout can also reflect the impulses from an incremental encoder.
Parameter 16-52 Feedback[Unit]

Table 620: Parameter 16-52 Feedback[Unit]

16-52 Feedback[Unit]		
Default Value: 0 ReferenceFeedback-Unit	Parameter Type: Range, -999999.999 ReferenceFeed-backUnit - 999999.999 ReferenceFeedbackUnit	Setup: All set-ups
Conversion Index: -3	Data Type: Int32	Change during operation: False

View the feedback unit resulting from the selection of unit and scaling in *parameter 3-00 Reference Range*, *parameter 3-01 Reference/Feedback Unit*, *parameter 3-02 Minimum Reference*, and *parameter 3-03 Maximum Reference*.
Parameter 16-53 Digi Pot Reference

Table 621: Parameter 16-53 Digi Pot Reference

16-53 Digi Pot Reference		
Default Value: 0	Parameter Type: Range, -200 - 200	Setup: All set-ups
Conversion Index: -2	Data Type: Int16	Change during operation: False

View the contribution of the digital potentiometer to the actual reference.
Parameter 16-57 Feedback [RPM]

Table 622: Parameter 16-57 Feedback [RPM]

16-57 Feedback [RPM]		
Default Value: 0 RPM	Parameter Type: Range, -30000 - 30000 RPM	Setup: All set-ups
Conversion Index: 67	Data Type: Int32	Change during operation: False

Readout parameter where the actual motor RPM from the feedback source can be read in both closed loop and open loop. The feedback source is selected in *parameter 7-00 Speed PID Feedback Source*.

4.16.5 16-6* Inputs and Outputs

Parameter 16-61 Terminal 53 Switch Setting

Table 623: Parameter 16-61 Terminal 53 Switch Setting

16-61 Terminal 53 Switch Setting		
Default Value: [0] Current	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

View the setting of input terminal 53.

Option	Name	Description
[0]*	Current	
[1]	Voltage	

Parameter 16-62 Analog Input 53

Table 624: Parameter 16-62 Analog Input 53

16-62 Analog Input 53		
Default Value: 0	Parameter Type: Range, -20 - 20	Setup: All set-ups
Conversion Index: -3	Data Type: Int32	Change during operation: False

View the actual value at input 53.

Parameter 16-63 Terminal 54 Switch Setting

Table 625: Parameter 16-63 Terminal 54 Switch Setting

16-63 Terminal 54 Switch Setting		
Default Value: [0] Current	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

View the setting of terminal 54.

Option	Name	Description
[0]*	Current	
[1]	Voltage	

Parameter 16-64 Analog Input 54

Table 626: Parameter 16-64 Analog Input 54

16-64 Analog Input 54		
Default Value: 0	Parameter Type: Range, -20 - 20	Setup: All set-ups
Conversion Index: -3	Data Type: Int32	Change during operation: False

View the actual value at input 54.

Parameter 16-65 Analog Output 42 [mA]

Table 627: Parameter 16-65 Analog Output 42 [mA]

16-65 Analog Output 42 [mA]		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

Parameter 16-66 Digital Output [bin]

Table 628: Parameter 16-66 Digital Output [bin]

16-66 Digital Output [bin]		
Default Value: 0	Parameter Type: Range, 0 - 15	Setup: All set-ups
Conversion Index: 0	Data Type: Int16	Change during operation: False

View the binary value of all digital outputs.
Parameter 16-67 Freq. Input #29 [Hz]

Table 629: Parameter 16-67 Freq. Input #29 [Hz]

16-67 Freq. Input #29 [Hz]		
Default Value: 0	Parameter Type: Range, 0 - 130000	Setup: All set-ups
Conversion Index: 0	Data Type: Int32	Change during operation: False

View the actual frequency rate on terminal 29.
Parameter 16-68 Freq. Input #33 [Hz]

Table 630: Parameter 16-68 Freq. Input #33 [Hz]

16-68 Freq. Input #33 [Hz]		
Default Value: 0	Parameter Type: Range, 0 - 130000	Setup: All set-ups
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.
Parameter 16-69 Pulse Output #27 [Hz]

Table 631: Parameter 16-69 Pulse Output #27 [Hz]

16-69 Pulse Output #27 [Hz]		
Default Value: 0	Parameter Type: Range, 0 - 40000	Setup: All set-ups
Conversion Index: 0	Data Type: Int32	Change during operation: False

View the actual value of pulses applied to terminal 27 in digital output mode.
Parameter 16-70 Pulse Output #29 [Hz]

Table 632: Parameter 16-70 Pulse Output #29 [Hz]

16-70 Pulse Output #29 [Hz]		
Default Value: 0	Parameter Type: Range, 0 - 40000	Setup: All set-ups
Conversion Index: 0	Data Type: Int32	Change during operation: False

View the actual value of pulses at terminal 29 in digital output mode.
Parameter 16-71 Relay Output [bin]

Table 633: Parameter 16-71 Relay Output [bin]

16-71 Relay Output [bin]		
Default Value: 0	Parameter Type: Range, 0 - 511	Setup: All set-ups
Conversion Index: 0	Data Type: Int16	Change during operation: False

View the settings of all relays.

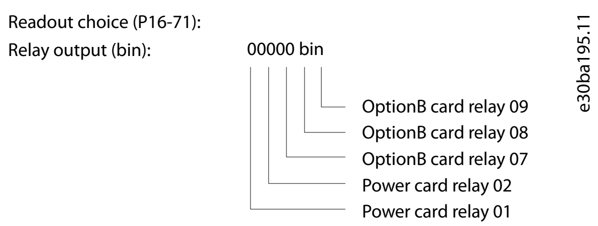


Illustration 84: Relay Settings

Parameter 16-72 Counter A

Table 634: Parameter 16-72 Counter A

16-72 Counter A		
Default Value: 0	Parameter Type: Range, -2147483648 - 2147483647	Setup: All set-ups
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*).

Parameter 16-73 Counter B

Table 635: Parameter 16-73 Counter B

16-73 Counter B		
Default Value: 0	Parameter Type: Range, -2147483648 - 2147483647	Setup: All set-ups
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*).

Parameter 16-74 Prec. Stop Counter

Table 636: Parameter 16-74 Prec. Stop Counter

16-74 Prec. Stop Counter		
Default Value: 0	Parameter Type: Range, 0 - 2147483647	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: True

Returns the actual counter value of precise counter (*parameter 1-84 Precise Stop Counter Value*).

Parameter 16-77 Analog Out X30/8 [mA]

Table 637: Parameter 16-77 Analog Out X30/8 [mA]

16-77 Analog Out X30/8 [mA]		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
Conversion Index: -3	Data Type: Int16	Change during operation: False

View the actual value at input X30/8 in mA.

Parameter 16-78 Analog Out X45/1 [mA]

Table 638: Parameter 16-78 Analog Out X45/1 [mA]

16-78 Analog Out X45/1 [mA]		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

Parameter 16-79 Analog Out X45/3 [mA]

Table 639: Parameter 16-79 Analog Out X45/3 [mA]

16-79 Analog Out X45/3 [mA]		
Default Value: 0	Parameter Type: Range, 0 - 30	Setup: All set-ups
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*.

4.16.6 16-8* Fieldbus & FC Port

Parameter 16-80 Fieldbus CTW 1

Table 640: Parameter 16-80 Fieldbus CTW 1

16-80 Fieldbus CTW 1		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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.

Parameter 16-82 Fieldbus REF 1

Table 641: Parameter 16-82 Fieldbus REF 1

16-82 Fieldbus REF 1		
Default Value: 0	Parameter Type: Range, -200 - 200	Setup: All set-ups
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.

Parameter 16-84 Comm. Option STW

Table 642: Parameter 16-84 Comm. Option STW

16-84 Comm. Option STW		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: V2	Change during operation: False

Show the status word of the extended fieldbus communication option. For more information, refer to the relevant fieldbus manual.

Parameter 16-85 FC Port CTW 1

Table 643: Parameter 16-85 FC Port CTW 1

16-85 FC Port CTW 1		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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*.

Parameter 16-86 FC Port REF 1

Table 644: Parameter 16-86 FC Port REF 1

16-86 FC Port REF 1		
Default Value: 0	Parameter Type: Range, -200 - 200	Setup: All set-ups
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*.

Parameter 16-87 Bus Readout Alarm/Warning

Table 645: Parameter 16-87 Bus Readout Alarm/Warning

16-87 Bus Readout Alarm/Warning		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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 1^{st} that occurred after the last reset.

Parameter 16-89 Configurable Alarm/Warning Word

Table 646: Parameter 16-89 Configurable Alarm/Warning Word

16-89 Configurable Alarm/Warning Word		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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.

4.16.7 16-9* Diagnosis Readouts

Parameter 16-90 Alarm Word

Table 647: Parameter 16-90 Alarm Word

16-90 Alarm Word		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Show the alarm word sent via the serial communication port in hex code.

Parameter 16-91 Alarm Word 2

Table 648: Parameter 16-91 Alarm Word 2

16-91 Alarm Word 2		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Show the alarm word sent via the serial communication port in hex code.

Parameter 16-92 Warning Word

Table 649: Parameter 16-92 Warning Word

16-92 Warning Word		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Show the warning word sent via the serial communication port in hex code.

Parameter 16-93 Warning Word 2

Table 650: Parameter 16-93 Warning Word 2

16-93 Warning Word 2		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Show the warning word sent via the serial communication port in hex code.

Parameter 16-94 Ext. Status Word

Table 651: Parameter 16-94 Ext. Status Word

16-94 Ext. Status Word		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Returns the extended status word sent via the serial communication port in hex code.

Parameter 16-95 Ext. Status Word 2

Table 652: Parameter 16-95 Ext. Status Word 2

16-95 Ext. Status Word 2		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Returns the extended warning word sent via the serial communication port in hex code.

Parameter 16-96 Maintenance Word

Table 653: Parameter 16-96 Maintenane Word

16-96 Maintenane Word		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
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
- Bit 15: Service log full

The following table details the display of the maintenance word.

Table 654: 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.

Parameter 16-97 Alarm Word 3

Table 655: Parameter 16-97 Alarm Word 3

16-97 Alarm Word 3		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Shows the alarm word sent via the serial communication port in hex code.

Parameter 16-98 Warning Word 3

Table 656: Parameter 16-98 Warning Word 3

16-98 Warning Word 3		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Shows the warning word sent via the serial communication port in hex code.

4.17 Parameter Group 18-** Data Readouts 2

4.17.1 18-0* Maintenance Log

This group contains the last 10 preventive maintenance events. Maintenance log 0 is the latest and maintenance log 9 the oldest. By selecting 1 of the logs and pressing [OK], the maintenance item, action, and time of the occurrence are shown in *parameter 18-00 Maintenance Log: Item – parameter 18-03 Maintenance Log: Date and Time*.

The alarm log key allows access to both alarm log and maintenance log.

Parameter 18-00 Maintenance Log: Item

Table 657: Parameter 18-00 Maintenance Log: Item

18-00 Maintenance Log: Item		
Default Value: 0	Parameter Type: Range, 0 - 255, Array [10]	Setup: All set-ups
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*.

Parameter 18-01 Maintenance Log: Action

Table 658: Parameter 18-01 Maintenance Log: Action

18-01 Maintenance Log: Action		
Default Value: 0	Parameter Type: Range, 0 - 255, Array [10]	Setup: All set-ups
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*.

Parameter 18-02 Maintenance Log: Time

Table 659: Parameter 18-02 Maintenance Log: Time

18-02 Maintenance Log: Time		
Default Value: 0 s	Parameter Type: Range, 0 - 2147483647 s, Array [10]	Setup: All set-ups
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.

Parameter 18-03 Maintenance Log: Date and Time

Table 660: Parameter 18-03 Maintenance Log: Date and Time

18-03 Maintenance Log: Date and Time		
Default Value: Size related	Parameter Type: Range, 0 - 0, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: TimeOfDay	Change during operation: False

Shows when the logged event occurred.

N O T I C E

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*.

N O T I C E

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.

Parameter 18-04 Mech Brake Count

Table 661: Parameter 18-04 Mech Brake Count

18-04 Mech Brake Count		
Default Value: 0	Parameter Type: Range, 0 - 4294967295	Setup: All set-ups
Conversion Index: 0	Data Type: Uint32	Change during operation: False

Number of occurrences the mechanical brake is engaged.

4.17.2 18-3* Analog Readouts

Parameter 18-36 Analog Input X48/2 [mA]

Table 662: Parameter 18-36 Analog Input X48/2 [mA]

18-36 Analog Input X48/2 [mA]		
Default Value: 0	Parameter Type: Range, -20 - 20	Setup: All set-ups
Conversion Index: -3	Data Type: Int32	Change during operation: True

View the actual current measured at input X48/2.

Parameter 18-37 Temp. Input X48/4

Table 663: Parameter 18-37 Temp. Input X48/4

18-37 Temp. Input X48/4		
Default Value: 0	Parameter Type: Range, -500 - 500	Setup: All set-ups
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*.

Parameter 18-38 Temp. Input X48/7

Table 664: Parameter 18-38 Temp. Input X48/7

18-38 Temp. Input X48/7		
Default Value: 0	Parameter Type: Range, -500 - 500	Setup: All set-ups
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*.

Parameter 18-39 Temp. Input X48/10

Table 665: Parameter 18-39 Temp. Input X48/10

18-39 Temp. Input X48/10		
Default Value: 0	Parameter Type: Range, -500 - 500	Setup: All set-ups
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*.

4.17.3 18-5* Active Alarms/Warnings

The parameters in this group show the numbers of currently active alarms or warnings.

Parameter 18-55 Active Alarm Numbers

Table 666: Parameter 18-55 Active Alarm Numbers

18-55 Active Alarm Numbers		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [20]	Setup: All set-ups
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.

Parameter 18-56 Active Warning Numbers

Table 667: Parameter 18-56 Active Warning Numbers

18-56 Active Warning Numbers		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [20]	Setup: All set-ups
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.

4.17.4 18-6* Inputs & Outputs 2

Parameter 18-60 Digital Input 2

Table 668: Parameter 18-60 Digital Input 2

18-60 Digital Input 2		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
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

4.17.5 18-7* Rectifier Status

Parameter 18-70 Mains Voltage

Table 669: Parameter 18-70 Mains Voltage

18-70 Mains Voltage		
Default Value: 0 V	Parameter Type: Range, 0 - 1000 V, Array [4]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Shows the mains line-to-line voltage.

Parameter 18-71 Mains Frequency

Table 670: Parameter 18-71 Mains Frequency

18-71 Mains Frequency		
Default Value: 0 Hz	Parameter Type: Range, -100 - 100 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: True

Shows the mains frequency.

Parameter 18-72 Mains Imbalance

Table 671: Parameter 18-72 Mains Imbalance

18-72 Mains Imbalance		
Default Value: 0%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: True

Shows the maximum imbalance for the 3 mains line-to-line measurements.

Parameter 18-75 Rectifier DC Volt

Table 672: Parameter 18-75 Rectifier DC Volt

18-75 Rectifier DC Volt		
Default Value: 0 V	Parameter Type: Range, 0 - 10000 V	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Shows the DC voltage measured on the rectifier module.

4.17.6 18-9* PID Readouts

Parameter 18-90 Process PID Error

Table 673: Parameter 18-90 Process PID Error

18-90 Process PID Error		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

Gives the present error value used by the process PID controller.

Parameter 18-91 Process PID Output

Table 674: Parameter 18-91 Process PID Output

18-91 Process PID Output		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

Gives the present raw output value from the process PID controller.

Parameter 18-92 Process PID Clamped Output

Table 675: Parameter 18-92 Process PID Clamped Output

18-92 Process PID Clamped Output		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

Gives the present output value from the process PID controller after the clamp limits have been observed.

Parameter 18-93 Process PID Gain Scaled Output

Table 676: Parameter 18-93 Process PID Gain Scaled Output

18-93 Process PID Gain Scaled Output		
Default Value: 0%	Parameter Type: Range, -200 - 200%	Setup: All set-ups
Conversion Index: -1	Data Type: Int16	Change during operation: False

Gives the present output value from the process PID controller after the clamp limits have been observed, and the resulting value has been gain scaled.

4.18 Parameter Group 22-** Appl. Functions

Parameter group for application monitoring functions.

4.18.1 22-0* Miscellaneous

Parameter 22-00 External Interlock Delay

Table 677: Parameter 22-00 External Interlock Delay

22-00 External Interlock Delay		
Default Value: 0 s	Parameter Type: Range, 0 - 600 s	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Set the delay time for the external interlock command.

4.19 Parameter Group 23-** Time-based Functions

4.19.1 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*).

N O T I C E

A change in mode via the digital inputs can only take place if *parameter 23-08 Timed Actions Mode* is set for *[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*.

N O T I C E

Program the clock (*parameter group 0-7* Clock Settings*) correctly for timed actions to function.

N O T I C E

The PC-based configuration tool VLT® Motion Control Tool MCT 10 comprises a special guide for easy programming of timed actions.

Parameter 23-00 ON Time

Table 678: Parameter 23-00 ON Time

23-00 ON Time		
Default Value: Size related	Parameter Type: Range, 0 - 0	Setup: 2 set-ups
Conversion Index: 0	Data Type: TimeOfDayWoDate	Change during operation: True

Sets the ON time for the desired action.

N O T I C E

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.

Parameter 23-01 ON Action

Table 679: Parameter 23-01 ON Action

23-01 ON Action		
Default Value: [0] Disabled	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[20]	Select ramp 3	
[21]	Select ramp 4	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[25]	Qstop	
[26]	Dcstop	
[27]	Coast	
[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	

Option	Name	Description
[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)	

Parameter 23-02 OFF Time

Table 680: Parameter 23-02 OFF Time

23-02 OFF Time		
Default Value: Size related	Parameter Type: Range, 0 - 0	Setup: 2 set-ups
Conversion Index: 0	Data Type: TimeOfDayWoDate	Change during operation: True

Sets the OFF time for the desired action.

N O T I C E

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.

Parameter 23-03 OFF Action

Table 681: Parameter 23-03 OFF Action

23-03 OFF Action		
Default Value: [1] No action	Parameter Type: Option, Array [10]	Setup: 2 set-ups
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	
[3]	Select set-up 2	

Option	Name	Description
[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	
[20]	Select ramp 3	
[21]	Select ramp 4	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[25]	Qstop	
[26]	Dcstop	
[27]	Coast	
[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	

Option	Name	Description
[60]	Reset counter A	
[61]	Reset counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	

Parameter 23-04 Occurrence

Table 682: Parameter 23-04 Occurrence

23-04 Occurrence		
Default Value: [0] All days	Parameter Type: Option, Array [10]	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select which days the timed action applies to. Specify working/nonworking 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]	Thurday	
[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	

Option	Name	Description
[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	
[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	

Parameter 23-08 Timed Actions Mode

Table 683: Parameter 23-08 Timed Actions Mode

23-08 Timed Actions Mode		
Default Value: [0] Timed actions auto	Parameter Type: Option	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Enable and disable automatic timed actions.

Option	Name	Description
[0]*	Timed actions auto	Enable timed actions.
[1]	Timed actions disabled	Disable timed actions, normal operation according to control commands.
[2]	Constant on actions	Disable timed actions. Constant on actions are activated.
[3]	Constant off actions	Disable timed actions. Constant off actions are activated.

Parameter 23-09 Timed Actions Reactivation

Table 684: Parameter 23-09 Timed Actions Reactivation

23-09 Timed Actions Reactivation		
Default Value: [1] Enabled	Parameter Type: Option	Setup: 2 setups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]	Disabled	After an update of: • power cycling • setting date • time • change of summertime • change of Hand Auto mode • change of Constant On and Off • set-up change where all activated ON actions are overridden to OFF actions until passing the next time for an ON action. Any OFF actions remain unchanged.
[1]*	Enabled	After an update of time/condition On and OFF actions are immediately set to the actual time programming of ON and OFF actions.

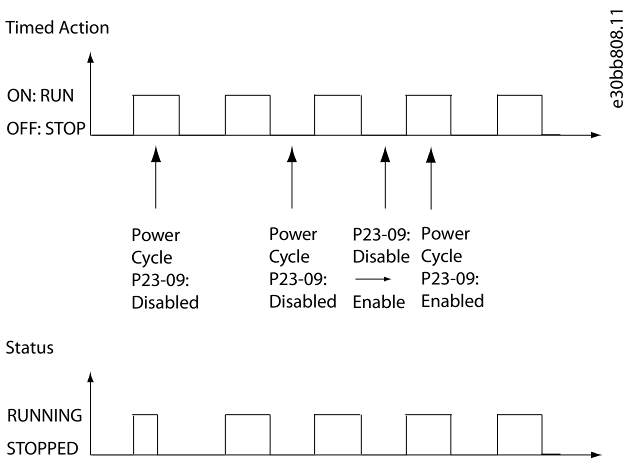


Illustration 85: Example of Reactivation Test

4.19.2 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.

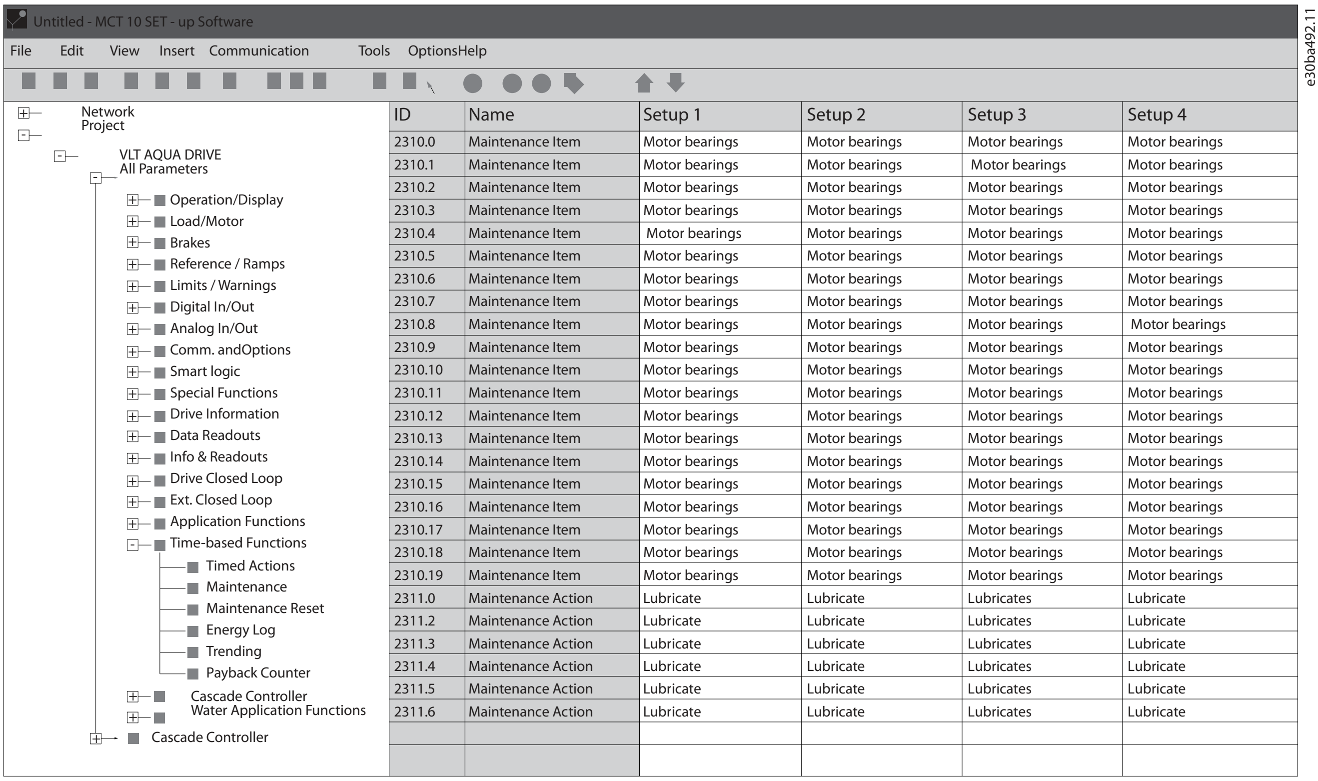
Specify the following for each event:

- 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.

N O T I C E

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.



ID	Name	Setup 1	Setup 2	Setup 3	Setup 4
2310.0	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.1	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.2	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.3	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.4	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.5	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.6	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.7	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.8	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.9	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.10	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.11	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.12	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.13	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.14	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.15	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.16	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.17	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.18	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2310.19	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings
2311.0	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate
2311.2	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate
2311.3	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate
2311.4	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate
2311.5	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate
2311.6	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate

Illustration 86: 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*.

N O T I C E

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*.

Parameter 23-10 Maintenance Item

Table 685: Parameter 23-10 Maintenance Item

23-10 Maintenance Item		
Default Value: [1] Motor Bearings	Parameter Type: Option, Array [6]	Setup: 1 set-up
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	
[11]	Drive cooling fan	
[12]	System health check	
[13]	Warranty	
[14]	Mech brake	
[20]	Maintenance text 0	
[21]	Maintenance text 1	
[22]	Maintenance text 2	
[23]	Maintenance text 3	
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[26]	Service log full	

Parameter 23-11 Maintenance Action

Table 686: Parameter 23-11 Maintenance Action

23-11 Maintenance Action		
Default Value: [1] Lubricate	Parameter Type: Option, Array [6]	Setup: 1 set-up
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	
[21]	Maintenance text 1	
[22]	Maintenance text 2	
[23]	Maintenance text 3	

Option	Name	Description
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[28]	Clear logs	

Parameter 23-12 Maintenance Base

Table 687: Parameter 23-12 Maintenance Base

23-12 Maintenance Base		
Default Value: Size related	Parameter Type: Option, Array [6]	Setup: 1 set-up
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*.
[4]	No of counts	

Parameter 23-13 Maintenance Interval

Table 688: Parameter 23-13 Maintenance Interval

23-13 Maintenance Interval		
Default Value: 1	Parameter Type: Range, 1 - 2147483647, Array [6]	Setup: 1 set-up
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*.

Example

A preventive maintenance event is set up Monday at 8:00. *Parameter 23-12 Maintenance Base* is *[2] Operating hours* and *parameter 23-13 Maintenance Interval* is 7 x 24 hours=168 hours. Next maintenance event is indicated the following Monday at 8:00. If this maintenance event is not reset until Tuesday at 9:00, the next occurrence is the following Tuesday at 9:00.

Parameter 23-14 Maintenance Data and Time

Table 689: Parameter 23-14 Maintenance Data and Time

23-14 Maintenance Data and Time		
Default Value: Size related	Parameter Type: Range, 0 - 0, Array [6]	Setup: 1 set-up
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.

Parameter 23-15 Reset Maintenance Word

Table 690: Parameter 23-15 Reset Maintenance Word

23-15 Reset Maintenance Word		
Default Value: [0] Do not reset	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	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	

Parameter 23-16 Maintenance Text

Table 691: Parameter 23-16 Maintenance Text

23-16 Maintenance Text		
Default Value: 0	Parameter Type: Range, 0 - 20, Array [6]	Setup: 1 set-up
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*.

Parameter 23-18 Reset Mechanical Brake Counter

Table 692: Parameter 23-18 Reset Mechanical Brake Counter

23-18 Reset Mechanical Brake Counter		
Default Value: [0] Do not reset	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Do not reset	Select this option to disable the reset of the mechanical brake counter.
[1]	Do reset	Select this option to enable the reset of the mechanical brake counter. After resetting the mechanical brake counter, the parameter is set to *[0] Do not reset*, which is the default option.

4.20 Parameter Group 30-** Special Features

4.20.1 30-0* Wobble Function

The wobble function is primarily used for synthetic yarn winding applications. The wobble option is installed in the drive controlling the traverse drive. The yarn moves back and forth in a diamond pattern across the surface of the yarn package. To prevent a build-up of yarn at the same points at the surface, this pattern must be altered. The wobble option can accomplish this by continuously varying the traverse velocity in a programmable cycle. The wobble function is created by superimposing a delta frequency around a center frequency. To compensate for the inertia in the system, a quick frequency jump can be included. Suitable for elastic yarn applications, the option features a randomized wobble ratio.

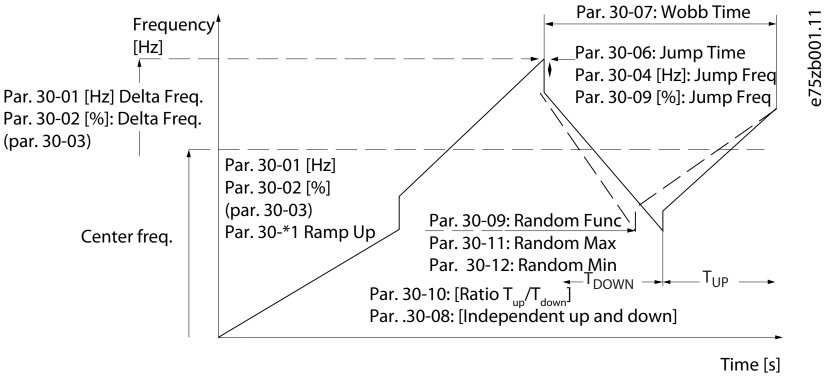


Illustration 87: Wobble Function

Parameter 30-00 Wobble Mode

Table 693: Parameter 30-00 Wobble Mode

30-00 Wobble Mode		
Default Value: [0] Abs. freq., abs. time	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

N O T I C E

This parameter cannot be changed while the motor is running.

The standard speed open-loop mode in *parameter 1-00 Configuration Mode* is extended with a wobble function. In this parameter, it is possible to select which method to be used for the wobbler. Set the parameters as absolute values (direct frequencies) or as relative values (percentage of other parameter). Set the wobble cycle time as an absolute value or as independent up and down times. When using an absolute cycle time, the up and down times are configured through the wobble ratio.

Option	Name	Description
[0]*	Abs. freq., abs. time	
[1]	Abs. freq., up/down time	
[2]	Rel. freq., abs. time	
[3]	Rel. freq., up/down time	

Parameter 30-01 Wobble Delta Frequency [Hz]

Table 694: Parameter 30-01 Wobble Delta Frequency [Hz]

30-01 Wobble Delta Frequency [Hz]		
Default Value: 5 Hz	Parameter Type: Range, 0 - 25 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Uint8	Change during operation: True

The delta frequency determines the magnitude of the wobble frequency. The delta frequency is superimposed on the center frequency. *Parameter 30-01 Wobble Delta Frequency [Hz]* contains both the positive and negative delta frequency. The setting of *parameter 30-01 Wobble Delta Frequency [Hz]* must thus not exceed the setting of the center frequency. The initial ramp-up time from standstill until the wobble sequence runs is determined in *parameter group 3-1* References*.

Parameter 30-02 Wobble Delta Freqeuncy [%]

Table 695: Parameter 30-02 Wobble Delta Freqeuncy [%]

30-02 Wobble Delta Freqeuncy [%]		
Default Value: 25%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: 0	Data Type: Uint8	Change during operation: True

The delta frequency can also be expressed as a percentage of the center frequency and can thus be maximum 100%. The function is the same as for *parameter 30-01 Wobble Delta Frequency [Hz]*.

Parameter 30-03 Wobble Delta Freq. Scaling Resource

Table 696: Parameter 30-03 Wobble Delta Freq. Scaling Resource

30-03 Wobble Delta Freq. Scaling Resource		
Default Value: [0] No function	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Select the drive input to be used for scaling the delta frequency setting.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Frequency input 29	
[4]	Frequency input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	

Parameter 30-04 Wobble Jump Frequency [Hz]

Table 697: Parameter 30-04 Wobble Jump Frequency [Hz]

30-04 Wobble Jump Frequency [Hz]		
Default Value: 0 Hz	Parameter Type: Range, 0 - 20.0 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Uint8	Change during operation: True

The jump frequency is used to compensate for the inertia in the traverse system. If a jump in the output frequency is required at the boundaries of the wobble sequence, the frequency jump is set in this parameter. If the traverse system has a very high inertia, a high jump frequency may create a torque limit warning or trip or an overvoltage warning or trip. This parameter can only be changed in stop mode.

Parameter 30-05 Wobble Jump Frequency [%]

Table 698: Parameter 30-05 Wobble Jump Frequency [%]

30-05 Wobble Jump Frequency [%]		
Default Value: 0%	Parameter Type: Range, 0 - 100 %	Setup: All set-ups
Conversion Index: 0	Data Type: Uint8	Change during operation: True

The jump frequency can also be expressed as a percentage of the center frequency. The function is the same as for *parameter 30-04 Wobble Jump Frequency [Hz]*.

Parameter 30-06 Wobble Jump Time

Table 699: Parameter 30-06 Wobble Jump Time

30-06 Wobble Jump Time		
Default Value: Size related	Parameter Type: Range, 0.005 - 5.000 s	Setup: All set-ups
Conversion Index: -3	Data Type: Uint16	Change during operation: True

This parameter determines the slope of the jump ramp at the maximum and minimum wobble frequency.

Parameter 30-07 Wobble Sequence Time

Table 700: Parameter 30-07 Wobble Sequence Time

30-07 Wobble Sequence Time		
Default Value: 10 s	Parameter Type: Range, 1 - 1000 s	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: True

This parameter determines the wobble sequence period. This parameter can only be changed in stop mode.

$$\text{Wobble time} = t\text{up} + t\text{down}$$

Parameter 30-09 Wobble Random Function

Table 701: Parameter 30-09 Wobble Random Function

30-09 Wobble Random Function		
Default Value: [0] Off	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Off	
[1]	On	

Parameter 30-10 Wobble Ratio

Table 702: Parameter 30-10 Wobble Ratio

30-10 Wobble Ratio		
Default Value: 1	Parameter Type: Range, 0.1 - 10	Setup: All set-ups
Conversion Index: -1	Data Type: Uint8	Change during operation: True

If the ratio 0.1 is selected: t_{down} is 10 times greater than t_{up}. If the ratio 10 is selected: t_{up} is 10 times greater than t_{down}.

Center frequency

Use *parameter group 3-1* References* to set the center frequency.

Parameter 30-11 Wobble Random Ratio Max.

Table 703: Parameter 30-11 Wobble Random Ratio Max.

30-11 Wobble Random Ratio Max.		
Default Value: 10	Parameter Type: Range, par. 17-53 - 10	Setup: All set-ups
Conversion Index: -1	Data Type: Uint8	Change during operation: True

Enter the maximum allowed wobble ratio.
Parameter 30-12 Wobble Random Ratio Min.

Table 704: Parameter 30-12 Wobble Random Ratio Min.

30-12 Wobble Random Ratio Min.		
Default Value: 0.1	Parameter Type: Range, 0.1 - par. 30-11	Setup: All set-ups
Conversion Index: -1	Data Type: Uint8	Change during operation: True

Enter the minimum allowed wobble ratio.
Parameter 30-19 Wobble Delta Freq. Scaled

Table 705: Parameter 30-19 Wobble Delta Freq. Scaled

30-19 Wobble Delta Freq. Scaled		
Default Value: 0 Hz	Parameter Type: Range, 0 - 1000 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: False

Readout parameter. View the actual wobble delta frequency after scaling has been applied.

4.20.2 30-2* Adv. Start Adjust

Parameter 30-20 High Starting Torque Time [s]

Table 706: Parameter 30-20 High Starting Torque Time [s]

30-20 High Starting Torque Time [s]		
Default Value: Size related	Parameter Type: Range, 0 - 60 s	Setup: All set-ups
Conversion Index: -2	Data Type: Uint16	Change during operation: True

High starting torque time for PM motor in flux control principle without feedback.
Parameter 30-21 High Starting Torque Current [%]

Table 707: Parameter 30-21 High Starting Torque Current [%]

30-21 High Starting Torque Current [%]		
Default Value: Size related	Parameter Type: Range, 0 - 200.0%	Setup: All set-ups
Conversion Index: -1	Data Type: Uint32	Change during operation: True

High starting torque current for PM motor in VVC^{+} and flux mode without feedback.
Parameter 30-22 Locked Rotor Protection

Table 708: Parameter 30-22 Locked Rotor Protection

30-22 Locked Rotor Protection		
Default Value: Size related	Parameter Type: Option	Setup: All set-ups
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.

Parameter 30-23 Locked Rotor Detection Time [s]

Table 709: Parameter 30-23 Locked Rotor Detection Time [s]

30-23 Locked Rotor Detection Time [s]		
Default Value: Size related	Parameter Type: Range, 0.05 - 1 s	Setup: All set-ups
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.
Parameter 30-24 Locked Rotor Detection Speed Error [%]

Table 710: Parameter 30-24 Locked Rotor Detection Speed Error [%]

30-24 Locked Rotor Detection Speed Error [%]		
Default Value: 25%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: -1	Data Type: Uint32	Change during operation: True

Detects locked rotor condition for SPMSM at high speed.
Light-load detection
Light-load detection is a feature for lift application to ensure lift evacuation in a direction, which requires the least energy (UPS capacity) during an emergency. When a light-load detection and start signal is received, the drive starts in the selected direction. After the delay in seconds specified in *parameter 30-26 Delay Before Measurements*, the drive integrates the current consumption within the time defined in *parameter 30-25 Measurement Duration*. After completing current integration for 1 direction, the drive starts in the other direction and repeats the current integration. On comparing the 2 integrated currents, the lift evacuates in the direction which requires the least current.
Parameter 30-25 Measurement Duration

Table 711: Parameter 30-25 Measurement Duration

30-25 Measurement Duration		
Default Value: 0.000 s	Parameter Type: Range, 0.000 - 10.000 s	Setup: All set-ups
Conversion Index: -3	Data Type: Uint32	Change during operation: True

Duration of current integration measurement. The measurement is done in both directions. The direction with the lowest measurement value is selected by the drive.
Parameter 30-26 Delay Before Measurements

Table 712: Parameter 30-26 Delay Before Measurements

30-26 Delay Before Measurements		
Default Value: 0.000 s	Parameter Type: Range, 0.000 - 10.000 s	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Delay before current measurement. Allows to avoid mismatch in measurements caused by mechanical friction during opening of mechanical brakes.

Parameter 30-27 Light Load Speed [%]

Table 713: Parameter 30-27 Light Load Speed [%]

30-27 Light Load Speed [%]		
Default Value: 0%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Use this parameter when the light-load detection is active to define the speed during current measurement. Enter the reference speed during the light-load detection. The value is a percentage of nominal motor speed in *parameter 1-25 Motor Nominal Speed*. For standard asynchronous motors, the synchronous speed is used instead of *parameter 1-25 Motor Nominal Speed* due to slip.

Parameter 30-28 Evacuation Speed [%]

Table 714: Parameter 30-28 Evacuation Speed [%]

30-28 Evacuation Speed [%]		
Default Value: 0%	Parameter Type: Range, 0 - 100%	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Speed for evacuation after detection of light-load direction.

Parameter 30-29 Ramp Time

Table 715: Parameter 30-29 Ramp Time

30-29 Ramp Time		
Default Value: Size related	Parameter Type: Range, 0.01 - 3600 s	Setup: All set-ups
Conversion Index: -2	Data Type: Uint32	Change during operation: True

Ramp times during evacuation and measurement sequences.

4.20.3 30-5* Unit Configuration

Parameters in this group allow to configure the operation of internal units that communicate with the drive. The settings affect the behavior of hardware components inside the drive.

Parameter 30-50 Heat Sink Fan Mode

Table 716: Parameter 30-50 Heat Sink Fan Mode

30-50 Heat Sink Fan Mode		
Default Value: Size related	Parameter Type: Option	Setup: 2 set-ups
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	

4.20.4 30-8* Compatibility (I)

Parameter 30-80 d-axis Inductance (Ld)

Table 717: Parameter 30-80 d-axis Inductance (Ld)

30-80 d-axis Inductance (Ld)		
Default Value: Size related	Parameter Type: Range, 0.000 - 1000.000 mH	Setup: All set-ups
Conversion Index: -6	Data Type: Int32	Change during operation: False

Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor datasheet. The d-axis inductance cannot be found by performing an AMA.

Parameter 30-81 Brake Resistor (ohm)

Table 718: Parameter 30-81 Brake Resistor (ohm)

30-81 Brake Resistor (ohm)		
Default Value: Size related	Parameter Type: Range, 0.01 - 65535.00 ohm	Setup: 1 set-up
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.

Parameter 30-83 Speed PID Proportional Gain

Table 719: Parameter 30-83 Speed PID Proportional Gain

30-83 Speed PID Proportional Gain		
Default Value: Size related	Parameter Type: Range, 0 - 1	Setup: All set-ups
Conversion Index: -4	Data Type: Uint32	Change during operation: True

Enter the speed controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable.

Parameter 30-84 Process PID Proportional Gain

Table 720: Parameter 30-84 Process PID Proportional Gain

30-84 Process PID Proportional Gain		
Default Value: Size related	Parameter Type: Range, 0 - 10	Setup: All set-ups
Conversion Index: -3	Data Type: Uint16	Change during operation: True

Enter the process controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable.

Parameter 30-85 Motor Frequency

Table 721: Parameter 30-85 Motor Frequency

30-85 Motor Frequency		
Default Value: Size related	Parameter Type: Range, 20.0 - 1000.0 Hz	Setup: All set-ups
Conversion Index: -1	Data Type: Uint32	Change during operation: False

N O T I C E

Changing this parameter affects the settings of other parameters.

Select the motor frequency from the motor nameplate data.

4.21 Parameter Group 31-** Bypass Option

Parameter 31-00 Bypass Mode

Table 722: Parameter 31-00 Bypass Mode

31-00 Bypass Mode		
Default Value: [0] Drive	Parameter Type: Option	Setup: All set-ups
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.

Parameter 31-01 Bypass Start Time Delay

Table 723: Parameter 31-01 Bypass Start Time Delay

31-01 Bypass Start Time Delay		
Default Value: 30 s	Parameter Type: Range, 0 - 60 s	Setup: All set-ups
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.

Parameter 31-02 Bypass Trip Time Delay

Table 724: Parameter 31-02 Bypass Trip Time Delay

31-02 Bypass Trip Time Delay		
Default Value: 0 s	Parameter Type: Range, 0 - 300 s	Setup: All set-ups
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.

Parameter 31-03 Test Mode Activation

Table 725: Parameter 31-03 Test Mode Activation

31-03 Test Mode Activation		
Default Value: [0] Disabled	Parameter Type: Option	Setup: All set-ups
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.

Parameter 31-10 Bypass Status Word

Table 726: Parameter 31-10 Bypass Status Word

31-10 Bypass Status Word		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 74	Data Type: V2	Change during operation: False

View the status of the bypass as a hexadecimal value.

Parameter 31-11 Bypass Running Hours

Table 727: Parameter 31-11 Bypass Running Hours

31-11 Bypass Running Hours		
Default Value: 0 h	Parameter Type: Range, 0 - 2147483647 h	Setup: All set-ups
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.

Parameter 31-19 Remote Bypass Activation

Table 728: Parameter 31-19 Remote Bypass Activation

31-19 Remote Bypass Activation		
Default Value: [0] Disabled	Parameter Type: Option	Setup: 2 set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: True

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

4.22 Parameter Group 40-** Special Settings

4.22.1 40-2* PM Motor Specific

Parameter 40-28 Back EMF Protection

Table 729: Parameter 40-28 Back EMF Protection

40-28 Back EMF Protection		
Default Value: [1] Enabled	Parameter Type: Option	Setup: All set-ups
Conversion Index: -	Data Type: Uint8	Change during operation: False

The drive is protected by default from Back EMF, which can be generated by IPM or SPM motor types due to calculated speed limitation. The actual limitation is based on *parameter 1-40 Back EMF at 1000 RPM* and protects the drive from motor-generated overvoltage.

CAUTION

By disabling the speed limitation, a risk of destructive effect on the IGBTs can be encountered when the drive loses the motor. If the function is disabled, ensure to protect the drive by other means to prevent motor-generated overvoltage.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

Parameter 40-29 B-EMF Protection Log Readout

Table 730: Parameter 40-29 B-EMF Protection Log Readout

40-29 B-EMF Protection Log Readout		
Default Value: 0	Parameter Type: Range, 0 - 65535	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: True

Readout parameter to log events if the Back EMF has been enabled or disabled. The range of the readout parameter is between [0x0 -0xFFFF] hex. The value indicates the bit pattern to identify the current state of Back EMF in the drive. Bit 1 is set: When Back EMF is enabled, the bit is set to 1. Once enabled the Back EMF cannot be reversed. Bit 1 and bit 2: Motor frequency exceeded Back EMF limitation. Bit 2 can be reversed. Bit 1, bit 2, and bit 3: The drive has been coasted as motor frequency exceeded the Back EMF limitation. Bit 1, bit 2, bit 3, bit 4: The drive has generated an overvoltage alarm because the drive has coasted as the motor frequency exceeded Back EMF limitation.

4.22.2 40-4* Extend. Fault Log

Parameter 40-40 Fault Log: Ext. Reference

Table 731: Parameter 40-40 Fault Log: Ext. Reference

40-40 Fault Log: Ext. Reference		
Default Value: 0%	Parameter Type: Range, -200 - 200%, Array [10]	Setup: All set-ups
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.

Parameter 40-41 Fault Log: Frequency

Table 732: Parameter 40-41 Fault Log: Frequency

40-41 Fault Log: Frequency		
Default Value: 0 Hz	Parameter Type: Range, 0 - 6500 Hz, Array [10]	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: False

View the actual motor frequency value when the logged event occurred.

Parameter 40-42 Fault Log: Current

Table 733: Parameter 40-42 Fault Log: Current

40-42 Fault Log: Current		
Default Value: 0 A	Parameter Type: Range, 0 - 10000 A, Array [10]	Setup: All set-ups
Conversion Index: -2	Data Type: Int32	Change during operation: False

View the motor current measured when the logged event occurred.

Parameter 40-43 Fault Log: Voltage

Table 734: Parameter 40-43 Fault Log: Voltage

40-43 Fault Log: Voltage		
Default Value: 0 V	Parameter Type: Range, 0 - 6000 V, Array [10]	Setup: All set-ups
Conversion Index: -1	Data Type: Uint16	Change during operation: False

View the motor voltage when the logged event occurred.

Parameter 40-44 Fault Log: DC Link Voltage

Table 735: Parameter 40-44 Fault Log: DC Link Voltage

40-44 Fault Log: DC Link Voltage		
Default Value: 0 V	Parameter Type: Range, 0 - 10000 V, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: Uint16	Change during operation: False

View the DC-link voltage when the logged event occurred.

Parameter 40-45 Fault Log: Control Word

Table 736: Parameter 40-45 Fault Log: Control Word

40-45 Fault Log: Control Word		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: V2	Change during operation: False

View the control word sent from the drive when the logged event occurred.

Parameter 40-46 Fault Log: Status Word

Table 737: Parameter 40-46 Fault Log: Status Word

40-46 Fault Log: Status Word		
Default Value: 0	Parameter Type: Range, 0 - 65535, Array [10]	Setup: All set-ups
Conversion Index: 0	Data Type: V2	Change during operation: False

View the status word sent from the drive, when the logged event occurred.

4.22.3 40-5* Advanced Control Settings

Parameters for configuring the advanced motor control settings.

Parameter 40-50 Flux Sensorless Model Shift

Table 738: Parameter 40-50 Flux Sensorless Model Shift

40-50 Flux Sensorless Model Shift		
Default Value: Size related	Parameter Type: Option	Setup: All set-ups
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	

Parameter 40-51 Flux Sensorless Corr. Gain

Table 739: Parameter 40-51 Flux Sensorless Corr. Gain

40-51 Flux Sensorless Corr. Gain		
Default Value: Size related	Parameter Type: Range, 0.1 - 200.0	Setup: All set-ups
Conversion Index: -1	Data Type: Uint32	Change during operation: True

Adjust the flux correction gain used at low speed.

4.23 Parameter Group 43-** Unit Readouts

The parameters in this group provide readouts for monitoring the operation of drives in enclosure sizes D–F.

4.23.1 43-0* Component Status

This parameter group contains read-only information on hardware components in the power section. All parameters in this group are arrays:

- [0]: Power card 1 (the master power card in a parallel drive, or the only power card in a drive with a single inverter section).
- [1]: Power card 2 (inverter connection in a parallel drive).
- [2]: Power card 3 (inverter connection in a parallel drive).
- [3]: Power card 4 (inverter connection in a parallel drive).
- [4]: Power card 5 (rectifier connection in a parallel drive).
- [5]: Power card 6 (rectifier connection in a parallel drive).
- [6]: Power card 7 (rectifier connection in a parallel drive).
- [7]: Power card 8 (rectifier connection in a parallel drive).
- [8]: Inrush card (optional).
- [9]: Fan power card 1 (optional).
- [10]: Fan power card 2 (optional).

Parameter 43-00 Component Temp.

Table 740: Parameter 43-00 Component Temp.

43-00 Component Temp.		
Default Value: 0 °C	Parameter Type: Range, -128 - 127 °C, Array [18]	Setup: All set-ups
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.

Parameter 43-01 Auxiliary Temp.

Table 741: Parameter 43-01 Auxiliary Temp.

43-01 Auxiliary Temp.		
Default Value: 0 °C	Parameter Type: Range, -128 - 127 °C, Array [18]	Setup: All set-ups
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.

Parameter 43-02 Component SW ID

Table 742: Parameter 43-02 Component SW ID

43-02 Component SW ID		
Default Value: 0	Parameter Type: Range, 0 - 20, Array [18]	Setup: All set-ups
Conversion Index: 0	Data Type: VisStr[18]	Change during operation: True

Shows the software version of the installed option.

4.23.2 43-1* Power Card Status

This parameter group contains read-only information on the power card status. All parameters in this group are arrays:

- [0]: Power card 1 (the master power card in a parallel drive, or the only power card in a drive with a single inverter section).
- [1]: Power card 2 (inverter connection in a parallel drive).
- [2]: Power card 3 (inverter connection in a parallel drive).
- [3]: Power card 4 (inverter connection in a parallel drive).
- [4]: Power card 5 (rectifier connection in a parallel drive).
- [5]: Power card 6 (rectifier connection in a parallel drive).
- [6]: Power card 7 (rectifier connection in a parallel drive).
- [7]: Power card 8 (rectifier connection in a parallel drive).

Parameter 43-10 HS Temp. ph.U

Table 743: Parameter 43-10 HS Temp. ph.U

43-10 HS Temp. ph.U		
Default Value: 0 °C	Parameter Type: Range, -128 - 127, Array [8]	Setup: All set-ups
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.

Parameter 43-11 HS Temp. ph.V

Table 744: Parameter 43-11 HS Temp. ph.V

43-11 HS Temp. ph.V		
Default Value: 0 °C	Parameter Type: Range, -128 - 127, Array [8]	Setup: All set-ups
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.

Parameter 43-12 HS Temp. ph.W

Table 745: Parameter 43-12 HS Temp. ph.W

43-12 HS Temp. ph.W		
Default Value: 0 °C	Parameter Type: Range, -128 - 127, Array [8]	Setup: All set-ups
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.

Parameter 43-13 PC Fan A Speed

Table 746: Parameter 43-13 PC Fan A Speed

43-13 PC Fan A Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [8]	Setup: All set-ups
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.

Parameter 43-14 PC Fan B Speed

Table 747: Parameter 43-14 PC Fan B Speed

43-14 PC Fan B Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [8]	Setup: All set-ups
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.

Parameter 43-15 PC Fan C Speed

Table 748: Parameter 43-15 PC Fan C Speed

43-15 PC Fan C Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [8]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change 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.

4.23.3 43-2* Fan Pow.Card Status

Parameter 43-20 FPC Fan A Speed

Table 749: Parameter 43-20 FPC Fan A Speed

43-20 FPC Fan A Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [2]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change during operation: True

Shows the speed of the power card fan A.

Parameter 43-21 FPC Fan B Speed

Table 750: Parameter 43-21 FPC Fan B Speed

43-21 FPC Fan B Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [2]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change during operation: True

Shows the speed of the power card fan B.

Parameter 43-23 FPC Fan D Speed

Table 751: Parameter 43-23 FPC Fan D Speed

43-23 FPC Fan D Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [2]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change during operation: True

Shows the speed of the power card fan D.

Parameter 43-24 FPC Fan E Speed

Table 752: Parameter 43-24 FPC Fan E Speed

43-24 FPC Fan E Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [2]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change during operation: True

Shows the speed of the power card fan E.

Parameter 43-25 FPC Fan F Speed

Table 753: Parameter 43-25 FPC Fan F Speed

43-25 FPC Fan F Speed		
Default Value: 0 RPM	Parameter Type: Range, 0 - 65535, Array [2]	Setup: All set-ups
Conversion Index: 67	Data Type: Uint16	Change during operation: True

Shows the speed of the power card fan F.

5 Troubleshooting

5.1 Status Messages

5.1.1 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.

N O T I C E

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.

N O T I C E

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*.

5.1.2 Alarm/Warning Code List

Table 754: Alarm/Warning Code List

Number	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
1	10 volts low	X	–	–	–
2	Live zero error	(X)	(X)	–	*Parameter 6-01 Live Zero Timeout Function*
3	No motor	(X)	–	–	*Parameter 1-80 Function at Stop*
4	Mains phase loss	(X)	(X)	(X)	*Parameter 14-12 Response to Mains Imbalance*
5	DC-link voltage high	X	–	–	–
6	DC-link voltage low	X	–	–	–
7	DC overvoltage	X	X	–	–
8	DC undervoltage	X	X	–	–
9	Inverter overloaded	X	X	–	–

Number	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
10	Motor ETR overtemperature	(X)	(X)	–	*Parameter 1-90 Motor Thermal Protection*
11	Motor thermistor overtemperature	(X)	(X)	–	*Parameter 1-90 Motor Thermal Protection*
12	Torque limit	X	X	–	–
13	Over current	X	X	X	–
14	Ground fault	X	X	–	–
15	Hardware mismatch	–	X	X	–
16	Short circuit	–	X	X	–
17	Control word timeout	(X)	(X)	–	*Parameter 8-04 Control Word Timeout Function*
20	Temp. input error	–	X	–	–
21	Param error	–	–	X	–
22	Hoist mech. brake	(X)	(X)	–	*Parameter group 2-2* Mechanical Brake*
23	Internal fans	X	–	–	–
24	External fans	X	–	–	–
25	Brake resistor short-circuited	X	–	–	–
26	Brake resistor power limit	(X)	(X)	–	*Parameter 2-13 Brake Power Monitoring*
27	Brake chopper short-circuited	X	X	–	–
28	Brake check	(x)	(X)	–	*Parameter 2-15 Brake Check*
29	Heat sink temp	X	X	X	–
30	Motor phase U missing	(X)	(X)	(X)	*Parameter 4-58 Missing Motor Phase Function*
31	Motor phase V missing	(X)	(X)	(X)	*Parameter 4-58 Missing Motor Phase Function*
32	Motor phase W missing	(X)	(X)	(X)	*Parameter 4-58 Missing Motor Phase Function*
33	Inrush fault	–	X	X	–
34	Fieldbus communication fault	X	X	–	–
35	Option fault	–	–	X	–
36	Mains failure	X	X	–	–
37	Imbalance of supply voltage	–	X	–	–
38	Internal fault	–	X	X	–
39	Heat sink sensor	–	X	X	–

Number	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
40	Overload of digital output terminal 27	(X)	–	–	*Parameter 5-00 Digital I/O Mode, parameter 5-01 Terminal 27 Mode*
41	Overload of digital output terminal 29	(X)	–	–	*Parameter 5-00 Digital I/O Mode, parameter 5-02 Terminal 29 Mode*
42	Ovrld X30/6-7	(X)	–	–	–
43	Ext. supply (option)	X	–	–	–
45	Ground fault 2	X	X	–	–
46	Pwr. card supply	–	X	X	–
47	24 V supply low	X	X	X	–
48	1.8 V supply low	–	X	X	–
50	AMA calibration failed	–	X	–	–
51	AMA check U_{nom} and I_{nom}	–	X	–	–
52	AMA low I_{nom}	–	X	–	–
53	AMA motor too big	–	X	–	–
54	AMA motor too small	–	X	–	–
55	AMA parameter out of range	–	X	–	–
56	AMA interrupted by user	–	X	–	–
57	AMA time-out	–	X	–	–
58	AMA internal fault	X	X	–	–
59	Current limit	X	–	–	–
60	External interlock	X	X	–	–
61	Feedback error	(X)	(X)	–	*Parameter 4-30 Motor Feedback Loss Function*
62	Output frequency at maximum limit	X	X	–	–
63	Mechanical brake low	–	(X)	–	*Parameter 4-30 Motor Feedback Loss Function*
64	Voltage limit	X	–	–	–
65	Control board overtemperature	X	X	X	–
66	Heat sink temperature low	X	–	–	–
67	Option configuration has changed	–	X	–	–
68	Safe stop	(X)	(X)[1]	–	*Parameter 5-19 Terminal 37 Safe Stop*
69	Pwr. card temp	–	X	X	–
70	Illegal FC configuration	–	–	X	–
73	Safe stop auto restart	(X)	(X)	–	*Parameter 5-19 Terminal 37 Safe Stop*

Number	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
76	Power unit setup	X	–	–	–
77	Reduced power mode	X	–	–	*Parameter 14-59 Actual Number of Inverter Units*
78	Tracking error	(X)	(X)	–	*Parameter 4-34 Tracking Error Function*
79	Illegal PS config	–	X	X	–
80	Drive Initialized to default value	–	X	–	–
81	CSIV corrupt	–	X	–	–
82	CSIV parameter error	–	X	–	–
83	Illegal option combination	–	–	X	–
88	Option detection	–	–	X	–
89	Mechanical brake sliding	X	–	–	–
90	Feedback monitor	(X)	(X)	–	*Parameter 17-61 Feedback Signal Monitoring*
91	Analog input 54 wrong settings	–	–	X	S202
99	Locked rotor	–	X	X	–
101	Speed monitor	X	X	–	–
104	Mixing fans	X	X	–	–
122	Mot. rotat. unexp.	–	X	–	–
123	Motor mod. changed	–	X	–	–
157	Power limit mot.	–	X	–	*Parameter 4-80 Power Limit Func. Motor Mode, parameter 4-82 Power Limit Motor Mode*
158	Power limit gen.	–	X	–	*Parameter 4-81 Power Limit Func. Generator Mode, parameter 4-83 Power Limit Generator Mode*
210	Position tracking	X	X	–	*Parameter 4-70 Position Error Function, parameter 4-71 Maximum Position Error, parameter 4-72 Position Error Timeout*
211	Position limit	X	X	–	*Parameter 3-06 Minimum Position, parameter 3-07 Maximum Position, parameter 4-73 Position Limit Function*
212	Homing not done	–	X	–	*Parameter 17-80 Homing Function*
213	Homing timeout	–	X	–	*Parameter 17-85 Homing Timout*
214	No sensor input	–	X	–	–

Number	Description	Warning	Alarm/trip	Alarm/trip lock	Parameter reference
215	Start fwd/rev	X	X	–	*Parameter 4-74 Start Fwd/Rev Function*
216	Touch timeout	–	X	–	*Parameter 4-75 Touch Timout*
220	Configuration File Version not supported	X	–	–	–
246	Power card supply	–	–	X	–
250	New spare part	–	–	X	–
251	New type code	–	X	X	–
430	PWM disabled	–	X	–	–

[1] Cannot be auto reset via *parameter 14-20 Reset Mode*.

(X) Dependent on parameter.

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.

5.1.3 Indicator Light

Table 755: Indicator Light

Warning	Yellow
Alarm	Flashing red
Trip locked	Yellow and red

5.1.4 Alarm Word, Warning Word, and Extended Status Word

Table 756: Description of Alarm Word, Warning Word, and Extended Status Word

Bit	Hex	Dec	Alarm word	Alarm word 2	Warning word	Warning word 2	Extended status word
Alarm Word Extended Status Word							
0	00000001	1	Brake check (A28)	Servicetrip, read/ write	Brake check (W28)	Start delayed	Ramping
1	00000002	2	Pwr.card temp (A69)	Servicetrip, (reserved)	Pwr.card temp (A69)	Stop delayed	AMA running
2	00000004	4	Earth fault (A14)	Servicetrip, typecode/ spare part	Earth fault (W14)	Reserved	Start CW/CCW start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the reference sign
3	00000008	8	Ctrl.card temp (A65)	Servicetrip, (reserved)	Ctrl.card temp (W65)	Reserved	Slow down

Bit	Hex	Dec	Alarm word	Alarm word 2	Warning word	Warning word 2	Extended status word
							slow down command active, for example via CTW bit 11 or DI
4	00000010	16	Ctrl. word TO (A17)	Servicetrip, (reserved)	Ctrl. word TO (W17)		Catch up catch up command active, for example via CTW bit 12 or DI
5	00000020	32	Overcurrent (A13)	Reserved	Overcurrent (W13)	Reserved	Feedback high feedback >*parameter 4-57 Warning Feedback High*
6	00000040	64	Torque limit (A12)	Reserved	Torque limit (W12)	Reserved	Feedback low feedback <*parameter 4-56 Warning Feedback Low*
7	00000080	128	Motor th over (A11)	Reserved	Motor th over (W11)	Reserved	Output current high current >*parameter 4-51 Warning Current High*
8	00000100	256	Motor ETR over (A10)	Reserved	Motor ETR over (W10)	Reserved	Output current low current <*parameter 4-50 Warning Current Low*
9	00000200	512	Inverter overld. (A9)	Discharge high	Inverter Overld (W9)	Discharge high	Output freq high speed >*parameter 4-53 Warning Speed High*
10	00000400	1024	DC under volt (A8)	Start failed	DC under volt (W8)	Multi-motor underload	Output freq low speed <*parameter 4-52 Warning Speed Low*
11	00000800	2048	DC over volt (A7)	Speed limit	DC over volt (W7)	Multi-motor overload	Brake check OK brake test NOT OK
12	00001000	4096	Short circuit (A16)	External interlock	DC voltage low (W6)	Compressor interlock	Braking max. BrakePower > Brakepowerlimit (2-12)
13	00002000	8192	Inrush fault (A33)	Illegal option combi.	DC voltage high (W5)	Mechanical brake sliding	Braking
15	00008000	32768	AMA not OK	Reserved	No motor (W3)	Auto DC braking	OVC active
16	00010000	65536	Live zero error (A2)	Reserved	Live zero error (W2)		AC brake
17	00020000	131072	Internal fault (A38)	KTY error	10 V low (W1)	KTY warn	Password timelock number of allowed password trials exceeded - timelock active

Bit	Hex	Dec	Alarm word	Alarm word 2	Warning word	Warning word 2	Extended status word
18	00040000	262144	Brake overload (A26)	Fans error	Brake overload (W26)	Fans warn	Password protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY
19	00080000	524288	U phase loss (A30)	ECB error	Brake resistor (W25)	ECB warn	Reference high reference >*parameter 4-55 Warning Reference High*
20	00100000	1048576	V phase loss (A31)	Hoist mechanical brake (A22)	Brake IGBT (W27)	Hoist mechanical brake (W22)	Reference low reference <*parameter 4-54 Warning Reference Low*
21	00200000	2097152	W phase loss (A32)	Reserved	Speed limit (W49)	Reserved	Local reference reference site = REMOTE -> auto on pressed & active
22	00400000	4194304	Fieldbus fault (A34)	Reserved	Fieldbus fault (W34)	Reserved	Protection mode notification
23	00800000	8388608	24 V supply low (A47)	Reserved	24 V supply low (W47)	Reserved	Unused
24	01000000	16777216	Mains failure (A36)	Reserved	Mains failure (W36)	Reserved	Unused
25	02000000	33554432	1.8 V supply low (A48)	Current limit (A59)	Current limit (W59)	Power Limit Motor	Unused
26	04000000	67108864	Brake resistor (A25)	Motor rotating unexpectedly (A122)	Low temp (W66)	Power Limit Generator	Unused
27	08000000	134217728	Brake IGBT (A27)	Reserved	Voltage limit (W64)	Reserved	Unused
28	10000000	268435456	Option change (A67)	Reserved	Encoder loss (W90)	Reserved	Unused
29	20000000	536870912	Drive initialized (A80)	Encoder loss (A90)	Output freq. lim. (W62)	BackEMF too high	Unused
30	40000000	1073741824	Safe stop (A68)	PTC thermistor (A74)	Safe stop (W68)	PTC thermistor (W74)	Unused
31	80000000	2147483648	Mech. brake low (A63	Dangerous failure (A72)	Extended status word		Protection mode

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*.

5.2 Descriptions of Warnings and Alarms

Depending on settings, FC 301/302 is able to give warnings or trigger alarms. In the Programming Guide for VLT® AutomationDrive FC 301/302, a full list of all warnings and alarms can be found. Below, an extract of most common alarms and warnings can be found.

The following warning and alarm information defines each warning or alarm condition, provides the probable cause for the condition, and entails a remedy or troubleshooting procedure.

5.2.1 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.

5.2.2 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 a faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all analog mains 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 an input terminal signal test.

5.2.3 WARNING/ALARM 3, No Motor

Cause

No motor is connected to the output of the drive.

5.2.4 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 Function at Mains Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the drive.

5.2.5 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.

5.2.6 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.

5.2.7 WARNING/ALARM 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a certain time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter 2-10 Brake Function*.
- Increase *parameter 14-26 Trip Delay at Inverter Fault*.

- If the alarm/warning occurs during a power sag, use kinetic back-up (*parameter 14-10 Mains Failure*).
- Connect a brake resistor.

5.2.8 WARNING/ALARM 8, DC Undervoltage

Cause

If the DC-link voltage drops below the undervoltage limit, the drive checks for 24 V DC back-up supply. If no 24 V DC back-up supply is connected, 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 an input voltage test.
- Perform a soft-charge circuit test.

5.2.9 WARNING/ALARM 9, Inverter Overload

Cause

The drive has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100% with an alarm. The drive cannot be reset until the counter is below 90%.

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.

5.2.10 WARNING/ALARM 10, Motor Overload Temperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot.

Select 1 of these options:

- The drive issues a warning or an alarm when the counter is >90% if *parameter 1-90 Motor Thermal Protection* is set to warning options.
- The drive trips when the counter reaches 100% if *parameter 1-90 Motor Thermal Protection* is set to trip options.

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 *parameters 1-20* to *1-25* is set correctly.
- If an external fan is in use, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *parameter 1-29 Automatic Motor Adaptation (AMA)* tunes the drive to the motor more accurately and reduces thermal loading.

5.2.11 WARNING/ALARM 11, Motor Thermistor Overtemp

Cause

The motor thermistor indicates that the motor temperature is too high.

Troubleshooting

- Check for motor overheating.
- Check that the thermistor is securely connected.
- 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 and 54 is set for voltage. Check that *parameter 1-93 Thermistor Resource* selects 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*.

5.2.12 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 time, 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.

5.2.13 WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the drive trips and issues an alarm. Shock loading or quick acceleration with high-inertia loads can cause this fault. If the acceleration during ramp-up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, a trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check that the motor data is correct in *parameters 1-20* to *1-25*.

5.2.14 ALARM 14, Earth (Ground) Fault

Cause

There is current from the output phase to ground, either in the cable between the drive and the motor, or in the motor itself. The current transducers detect the ground fault by measuring current going out from the drive and current going into the drive from the motor. Ground fault is issued if the deviation of the 2 currents is too large. The current going out of the drive must be the same as the current going into the drive.

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 megohmmeter.
- Reset any potential individual offset in the 3 current transducers in the drive. Perform a manual initialization or perform a complete AMA. This method is most relevant after changing the power card.

5.2.15 ALARM 15, Hardware Mismatch

Cause

A fitted option is not operational with the present control card hardware or software.

Troubleshooting

Record the value of the following parameters and contact .

- *Parameter 15-40 FC Type*.
- *Parameter 15-41 Power Section*.
- *Parameter 15-42 Voltage*.
- *Parameter 15-43 Software Version*.
- *Parameter 15-45 Actual Typecode String*.
- *Parameter 15-49 SW ID Control Card*.
- *Parameter 15-50 SW ID Power Card*.
- *Parameter 15-60 Option Mounted*.
- *Parameter 15-61 Option SW Version* (for each option slot).

5.2.16 ALARM 16, Short Circuit

Cause

There is short-circuiting in the motor or motor wiring.

Troubleshooting

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 skilled personnel can result in death or serious injury.

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

- Disconnect power before proceeding.
- Remove the power to the drive and repair the short circuit.

5.2.17 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, and the drive ramps down to a stop and shows an alarm.

Troubleshooting

- Check the connections on the serial communication cable.
- Increase *parameter 8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

5.2.18 WARNING/ALARM 20, Temp. Input Error

Cause

The temperature sensor is not connected.

5.2.19 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.

5.2.20 WARNING/ALARM 22, Hoist Mechanical Brake

Cause

The value of this warning/alarm shows the type of warning/alarm.

0 = The torque reference was not reached before timeout (*parameter 2-27 Torque Ramp Up Time*).

1 = Expected brake feedback was not received before timeout (*parameter 2-23 Activate Brake Delay*, *parameter 2-25 Brake Release Time*).

5.2.21 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* (*[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 alarm 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 control card.

5.2.22 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* (*[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.

5.2.23 WARNING 25, Brake Resistor Short Circuit

Cause

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The drive is still operational, but without the brake function.

Troubleshooting

- Remove the power to the drive and replace the brake resistor (refer to *parameter 2-15 Brake Check*).

5.2.24 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 2-16 AC Brake Max. Current*. The warning is active when the dissipated braking power is higher than 90% of the brake resistor power. If option *[2] Trip* is selected in *parameter 2-13 Brake Power Monitoring*, the drive trips when the dissipated braking power reaches 100%.

5.2.25 WARNING/ALARM 27, Brake Chopper Fault

Cause

The brake transistor is monitored during operation, and if a short circuit occurs, the brake function is disabled, and a warning is issued. The drive is still operational, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

5.2.26 WARNING/ALARM 28, Brake Check Failed

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check *parameter 2-15 Brake Check*.

5.2.27 ALARM 29, Heat Sink 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.

5.2.28 ALARM 30, Motor Phase U Missing

Cause

Motor phase U between the drive and the motor is missing.

Troubleshooting

⚠ W A R N I N G ⚠

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 skilled personnel can result in death or serious injury.

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

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase U.

5.2.29 ALARM 31, Motor Phase V Missing

Cause

Motor phase V between the drive and the motor is missing.

Troubleshooting

⚠ W A R N I N G ⚠

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 skilled personnel can result in death or serious injury.

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

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase V.

5.2.30 ALARM 32, Motor Phase W Missing

Cause

Motor phase W between the drive and the motor is missing.

Troubleshooting

⚠ W A R N I N G ⚠

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 skilled personnel can result in death or serious injury.

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

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase W.

5.2.31 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.

5.2.32 WARNING/ALARM 34, Fieldbus Communication Fault

Cause

The fieldbus on the communication option card is not working.

5.2.33 WARNING/ALARM 35, Option Fault

Cause

An option alarm is received. The alarm is option-specific. The most likely cause is a power-up or a communication fault.

5.2.34 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.

5.2.35 ALARM 37, Phase Imbalance

Cause

There is a current imbalance between the power units.

5.2.36 ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number defined in Table 757 is shown.

Troubleshooting

- Cycle power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

It may be necessary to contact the supplier or service department. Note the code number for further troubleshooting directions.

Table 757: Internal Fault Codes

Number	Text
0	The serial port cannot be initialized. Contact the supplier or service department.
256–258	The power EEPROM data is defective or too old. Replace the power card.
512–519	Internal fault. Contact the supplier or service department.
783	Parameter value outside of minimum/maximum limits.
1024–1284	Internal fault. Contact the supplier or service department.
1299	The option software in slot A is too old.
1300	The option software in slot B is too old.
1302	The option software in slot C1 is too old.
1315	The option software in slot A is not supported/allowed.
1316	The option software in slot B is not supported/ allowed.
1318	The option software in slot C1 is not supported/ allowed.
1379–2819	Internal fault. Contact the supplier or service department.
1792	Hardware reset of digital signal processor.
1793	Motor-derived parameters not transferred correctly to the digital signal processor.
1794	Power data not transferred correctly at power-up to the digital signal processor.
1795	The digital signal processor has received too many unknown SPI telegrams. This situation can occur due to poor EMC protection or improper grounding.

Number	Text
1796	RAM copy error.
2561	Replace the control card.
2820	LCP stack overflow.
2821	Serial port overflow.
2822	USB port overflow.
3072–5122	Parameter value is outside its limits.
5123	Option in slot A: Hardware incompatible with the control board hardware.
5124	Option in slot B: Hardware incompatible with the control board hardware.
5125	Option in slot C0: Hardware incompatible with the control board hardware.
5126	Option in slot C1: Hardware incompatible with the control board hardware.
5376– 6231	Internal fault. Contact the supplier or service department.

5.2.37 ALARM 39, Heat Sink Sensor

Cause

No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate-drive card, or on the ribboncable between the power card and the gatedrive card.

5.2.38 WARNING 40, Overload of Digital Output Terminal 27

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*.

5.2.39 WARNING 41, Overload of Digital Output Terminal 29

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*.

5.2.40 WARNING 42, Ovrld X30/6-7

Troubleshooting

For terminal X30/6:

- Check the load connected to the terminal, or remove the short-circuit connection.

For terminal X30/7:

- Check the load connected to the terminal, or remove the short-circuit connection.

5.2.41 ALARM 45, Earth Fault 2

Cause

Ground fault.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

5.2.42 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 a 24 V DC supply is used, verify proper supply power.
- Check for a defective heat sink fan.

5.2.43 WARNING 47, 24 V Supply Low

Cause

The supply on the power card is out of range.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V
- 5 V
- ±18 V

Troubleshooting

- Check for a defective power card.

5.2.44 WARNING 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 card is present, check for overvoltage.

5.2.45 WARNING 49, Speed Limit

Cause

The warning is shown when the speed is outside of the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*. When the speed is below the specified limit in *parameter 1-86 Trip Speed Low [RPM]* (except when starting or stopping), the drive trips.

5.2.46 ALARM 50, AMA Calibration Failed

Cause

A calibration error has occurred.

Troubleshooting

- Contact the supplier or service department.

5.2.47 ALARM 51, AMA Check Unom and Inom

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check settings in *parameters 1-20* to *1-25*.

5.2.48 ALARM 52, AMA Low Inom

Cause

The motor current is too low.

Troubleshooting

- Check the settings in *parameter 1-24 Motor Current*.

5.2.49 ALARM 53, AMA Motor Too Big

Cause

The motor is too big for the AMA to operate.

Troubleshooting

- Check the settings in *parameter group 1-2* Motor Data*.

5.2.50 ALARM 54, AMA Motor Too Small

Cause

The motor is too small for the AMA to operate.

Troubleshooting

- Check the settings in *parameter group 1-2* Motor Data*.

5.2.51 ALARM 55, AMA Parameter Out of Range

Cause

The AMA cannot run because the paramenter values of the motor are out of the acceptable range.

Troubleshooting

- Check the settings in *parameter group 1-2* Motor Data*.

5.2.52 ALARM 56, AMA Interrupted by User

Cause

The AMA is manually interrupted.

Troubleshooting

- Re-run the AMA calibration.

5.2.53 ALARM 57, AMA Internal Fault

Cause

Internal fault.

Troubleshooting

Try to restart the AMA. Repeated restarts can overheat the motor.

5.2.54 ALARM 58, AMA Internal Fault

Cause

Internal fault.

Troubleshooting

Contact the supplier.

5.2.55 WARNING 59, Current Limit

Cause

The current is higher than the value in *parameter 4-18 Current Limit*.

Troubleshooting

- Ensure that the motor data in *parameters 1-20* to *1-25* is set correctly.
- Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

5.2.56 WARNING 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.

5.2.57 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*.

5.2.58 WARNING 62, Output Frequency at Maximum Limit

Cause

The output frequency has reached the value set in *parameter 4-19 Max Output Frequency*.

Troubleshooting

- Check the application for possible causes.
- Increase the output frequency limit. Be sure that the system can operate safely at a higher output frequency.

The warning clears when the output drops below the maximum limit.

5.2.59 ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

5.2.60 WARNING 64, Voltage Limit

Cause

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

5.2.61 WARNING/ALARM 65, Control Card Overtemperature

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 for clogged filters.
- Check fan operation.
- Check the control card.

5.2.62 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*.

5.2.63 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.

5.2.64 ALARM 68, Safe Stop Activated

Cause

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, or by pressing [Reset]).

5.2.65 ALARM 69, Power Card Temperature

Cause

The internal temperature has exceeded the allowed operating limits.

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check for clogged filters.
- Check fan operation.
- Check the power card.

5.2.66 ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the supplier with the type code from the unit nameplate and the part numbers on the cards.

5.2.67 WARNING 73, Safe Stop Auto Restart

Cause

STO activated.

Troubleshooting

- With automatic restart enabled, the motor can start when the fault is cleared.

5.2.68 Warning 76, Power Unit Setup

Cause

The required number of power units do not match the detected number of active power units.

Troubleshooting

- When replacing an F-frame module, this will occur if the power specific data in the module power card does not match the rest of the drive. Confirm the spare part and its power card are the correct part number.

5.2.69 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.

5.2.70 ALARM 78, Tracking Error

Cause

The difference between setpoint value and actual value exceeds the value in *parameter 4-35 Tracking Error*.

Troubleshooting

- Disable the function or select an alarm/warning in *parameter 4-34 Tracking Error Function*.
- Investigate the mechanics around the load and motor. Check feedback connections from motor encoder to drive.
- Select motor feedback function in *parameter 4-30 Motor Feedback Loss Function*.
- Adjust the tracking error band in *parameter 4-35 Tracking Error* and *parameter 4-37 Tracking Error Ramping*.

5.2.71 ALARM 79, Illegal Power Section Configuration

Cause

The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

5.2.72 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.

5.2.73 ALARM 81, CSIV Corrupt

Cause

The CSIV file has syntax errors.

5.2.74 ALARM 82, CSIV Parameter Error

Cause

CSIV failed to initialize a parameter.

5.2.75 ALARM 83, Illegal Option Combination

Cause

The mounted options are incompatible.

5.2.76 ALARM 88, Option Detection

Cause

A change in the option layout is detected. *Parameter 14-89 Option Detection* is set to *[0] Frozen configuration* and the option layout has been changed.

Troubleshooting

- To apply the change, enable option layout changes in *parameter 14-89 Option Detection*.
- Alternatively, restore the correct option configuration.

5.2.77 WARNING 89, Mechanical Brake Sliding

Cause

The hoist brake monitor detects a motor speed exceeding 10 RPM.

5.2.78 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.

5.2.79 ALARM 99, Locked Rotor

Cause

The rotor is blocked.

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]*.

5.2.80 WARNING/ALARM 101, Speed Monitor

Cause

The speed monitor is out of range.

5.2.81 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.

5.2.82 WARNING/ALARM 122, Mot. Rotat. Unexp.

Cause

The drive performs a function that requires the motor to be at standstill, for example DC hold for PM motors.

5.2.83 WARNING 123, Motor Mod. Changed

Cause

The motor selected in *parameter 1-11 Motor Model* is not correct.

Troubleshooting

- Check the motor model.

5.2.84 WARNING/ALARM 157, Power Limit Mot.

Cause

The output power exceeds the value defined in *parameter 4-82 Power Limit Motor Mode*.

5.2.85 WARNING/ALARM 158, Power Limit Gen.

Cause

The generating power exceeds the value defined in *parameter 4-83 Power Limit Generator Mode*.

5.2.86 WARNING/ALARM 210, Position Tracking

Cause

The actual position error exceeds the value in *parameter 4-71 Maximum Position Error*. *Parameter 4-70 Position Error Function* defines whether this is a warning or an alarm.

5.2.87 WARNING/ALARM 211, Position Limit

Cause

The position is outside the limits defined in *parameter 3-06 Minimum Position* and *parameter 3-07 Maximum Position*. *Parameter 4-73 Position Limit Function* defines the function for this warning/alarm.

5.2.88 WARNING/ALARM 212, Homing not Done

Cause

A homing function is selected in *parameter 17-80 Homing Function* and absolute positioning is executed before homing is completed.

5.2.89 ALARM 213, Homing Timeout

Cause

Homing was started but did not finish within the time defined in *parameter 17-85 Homing Timout*.

5.2.90 ALARM 214, No Sensor Input

Cause

A homing process with a homing function that requires a sensor, or touch probe positioning is started with no input defined for the sensor.

5.2.91 WARNING/ALARM 215, Start Fwd/Rev

Cause

One of the hardware end-limit options, *[12] Enable Start Forward* or *[13] Enable Start Reverse* is active.

5.2.92 WARNING/ALARM 216, Touch Timeout

Cause

A touch probe sensor is not found within the time in *parameter 4-75 Touch Timout*. The timeout timer is started as soon as the touch probe positioning is activated even if the application is not moving.

5.2.93 WARNING 220, Configuration File Version not Supported

Cause

The drive does not support the current configuration file version. Customization is aborted.

5.2.94 WARNING 250, New Spare Part

Cause

A component in the drive system has been replaced.

Troubleshooting

- Reset the drive system to restore normal operation.

5.2.95 ALARM 430, PWM Disabled

Cause

The PWM on the power card is disabled.

6 Appendix

6.1 Symbols and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
AC	Alternating current
AEO	Automatic energy optimization
ASM	Asynchronous motor or standard induction motor
AWG	American wire gauge
AMA	Automatic motor adaptation
DC	Direct current
EMC	Electro-magnetic compatibility
ETR	Electronic thermal relay
$f_{M,N}$	Nominal motor frequency
I_{INV}	Rated inverter output current
I_{LIM}	Current limit
$I_{M,N}$	Nominal motor current
$I_{VLT,MAX}$	Maximum output current
$I_{VLT,N}$	Rated output current supplied by the drive
IP	Ingress protection
LCP	Local control panel
MCT	Motion control tool
n_s	Synchronous motor speed
$P_{M,N}$	Nominal motor power
PELV	Protective extra low voltage
PCB	Printed circuit board
PM motor	Permanent magnet motor
PWM	Pulse width motor
RPM	Revolutions per minute
Regen	Regenerative terminals
SPM	PM motor with surface-mounted magnets

SynRM	Synchronous reluctance motor
T_{LIM}	Torque limit
$U_{M,N}$	Nominal motor voltage

6.2 Conventions

Numbered lists indicate procedures. Bullet lists indicate other information.

Italicized text indicates:

- Cross-reference.
- Link.
- Parameter name.
- Parameter group name.
- Parameter option.
- Footnote.

All dimensions in drawings are in [mm] (in).

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VLT FC 321 Glossary

A

Actual position
The actual position from an encoder, or a value that the motor control calculates in open loop. The drive uses the actual position as feedback for position PI.

Analog reference
A signal transmitted to the analog inputs 53 or 54 (voltage or current).

Analog inputs
The analog inputs are used for controlling various functions of the drive.

There are 2 types of analog inputs:

Current input, 0–20 mA, and 4–20 mA

Voltage input, -10 V DC to +10 V DC.

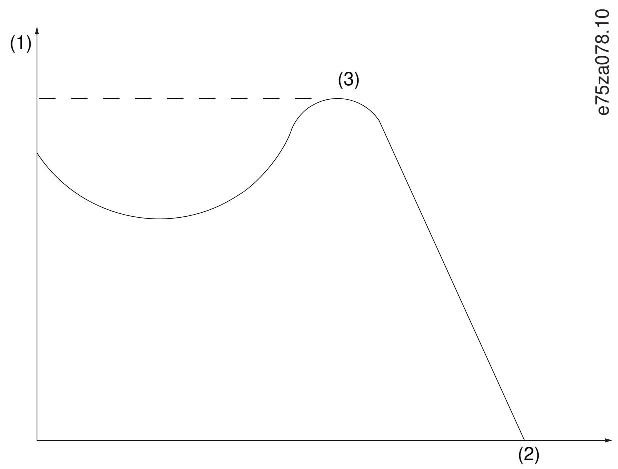
Analog outputs
The analog outputs can supply a signal of 0–20 mA, 4–20 mA.

B

BDM
A BDM is a drive module, which consists of a power converter module and a control and regulating device for speed, torque, current, or voltage.

Binary reference
A signal transmitted to the serial communication port.

Break-away torque



C

CDM
A CDM is a drive system without the motor and without the measuring sensors, which are mechanically connected to the motor shaft. The drive system consists of, but is not restricted to, the BDM and extensions, such as the feed module and auxiliary equipment.

CT characteristics
Constant-torque characteristics used for all applications such as conveyor belts, displacement pumps, and cranes.

Commanded position
The actual position reference calculated by the profile generator. The drive uses the commanded position as setpoint for position PI.

Control command
Functions are divided into 2 groups.

Functions in group 1 have higher priority than functions in group 2.

Table 1: Function Groups

Group 1	Group 2
Reset, coast stop, reset and coast stop, quick stop, DC brake, stop, the LCP [OFF] key.	Start, pulse start, reversing, start reversing, jog, freeze output.

D

DSP Digital signal processor.

Digital inputs The digital inputs can be used for controlling various functions of the drive.

Digital outputs The drive features 2 solid-state outputs that can supply a 24 V DC (maximum 40 mA) signal.

F

f_M Motor frequency.

$f_{M,N}$ Rated motor frequency (nameplate data).

f_{MAX} Maximum motor frequency.

f_{MIN} Minimum motor frequency.

f_{jog} Motor frequency when the jog function is activated (via digital terminals).

I

I_M Motor current (actual).

$I_{M,N}$ Rated motor current (nameplate data).

Intermittent duty cycle An intermittent duty rating refers to a sequence of duty cycles. Each cycle consists of an on-load and an off-load period. The operation can be either periodic duty or non-periodic duty.

L

LCP The local control panel is the keypad for controlling the drive.

lsb Least significant bit.

M

MCM Short for "mille circular mil", an American measuring unit for cable cross-section. 1 MCM=0.5067 mm^2

Motor running Torque generated on output shaft and speed from 0 RPM to maximum speed on motor.

msb Most significant bit.

N

$n_{M,N}$ Nominal motor speed (nameplate data).

n_s Synchronous motor speed.

$$ns = \frac{2 \times \mathrm{par.}\ 1-23 \times 60\ s}{\mathrm{par.}\ 1-39}$$

n_{slip} Motor slip.

O

Online/offline parameters	Changes to online parameters are activated immediately after the data value is changed. Press [OK] to activate changes to off-line parameters.

P

PCD	Process-control data.
PDS	The PDS is a speed control system for an electric motor, including the CDM and motor, but without the equipment which it powers.
$P_{M,N}$	Rated motor power (nameplate data in kW or hp).
Position error	Position error is the difference between the actual position and the commanded position. The position error is the input for the position PI controller.
Position unit	The physical unit for position values.
Power factor	The power factor is the relation between I_1 and I_{RMS}. $\text{Power factor} = \frac{\sqrt{3 \times U \times I_{1\cos\phi}}}{\sqrt{3 \times U \times I_{RMS}}}$ The power factor for 3-phase control: $\text{Power factor} = \frac{I_1 \times \cos\phi 1}{I_{RMS}} = \frac{I_1}{I_{RMS}} \text{ since } \cos\phi 1 = 1$ The power factor indicates to which extent the drive imposes a load on the mains supply. The lower the power factor, the higher the I_{RMS} for the same kW performance. $I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2} + .. + I_n^2$ In addition, a high-power factor indicates that the different harmonic currents are low. The DC coils in the drive produce a high-power factor, which minimizes the imposed load on the mains supply.
Preset reference	A defined preset reference to be set from -100% to +100% of the reference range. Selection of 8 preset references via the digital terminals.
Process PID	The PID control maintains the required speed, pressure, temperature, and so on, by adjusting the output frequency to match the varying load.
Pulse reference	A pulse frequency signal transmitted to the digital inputs (terminal 29 or 33).

R

RCD	Residual-current device.

S

STW	Status word.
Safe Torque Off (STO)	The STO function brings the drive safely to a no-torque state.
Set-up	Save parameter settings in 4 set-ups. Change between the 4 parameter set-ups and edit 1 set-up, while another set-up is active.
Slip compensation	The drive compensates for the motor slip by giving the frequency a supplement that follows the measured motor load keeping the motor speed almost constant.

Start-disable command — A start command belonging to Group 2 control commands, see the *table Function Groups* under *Control Command*.

Stop command — A stop command belonging to Group 1 control commands, see the *table Function Groups* under *Control Command*.

T

$T_{M,N}$ — Rated torque (motor).

Target position — The final target position specified by positioning commands. The profile generator uses this position to calculate the speed profile.

Thermistor — A temperature-dependent resistor placed on the drive or the motor.

Trip — A state entered in fault situations, for example, if the drive is subject to an overtemperature or when the drive is protecting the motor, process, or mechanism. The drive prevents a restart until the cause of the fault has disappeared. To cancel the trip state, restart the drive. Do not use the trip state for personal safety.

Trip lock — The drive enters this state in fault situations to protect itself. The drive requires physical intervention, for example when there is a short circuit on the output. A trip lock can only be canceled by disconnecting mains, removing the cause of the fault, and reconnecting the drive. Restart is prevented until the trip state is canceled by activating reset or, sometimes, by being programmed to reset automatically. Do not use the trip lock state for personal safety.

U

U_M — Motor voltage.

$U_{M,N}$ — Rated motor voltage (nameplate data).

V

VT characteristics — Variable torque characteristics typical for many pumps and fans.

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