Programming Guide

VLT® AutomationDrive FC 360

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1 Introduction

1.1 Purpose of this Programming Guide

This programming guide provides information on working with parameters on the VLT® AutomationDrive FC 360.

It provides information on how to program the drive, and a list and descriptions of all parameters.

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1.2 Additional Resources

Other resources are available to understand advanced drive functions and programming.

- The operating guide provides basic information on mechanical dimensions, installation, and programming.
- The design guide provides information on how to design motor control systems.

Supplementary publications and manuals are available from the Danfoss website.

1.3 Document and Software Version

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is English.

Table 1: Document and Software Version

Edition	Remarks	Software version
AU275649936274, version 1501	Update for software 4.40 release.	4.40

1.4 Approvals and Certifications

1.5 Electrical Wiring - Control Cables

1.5.1 Overview

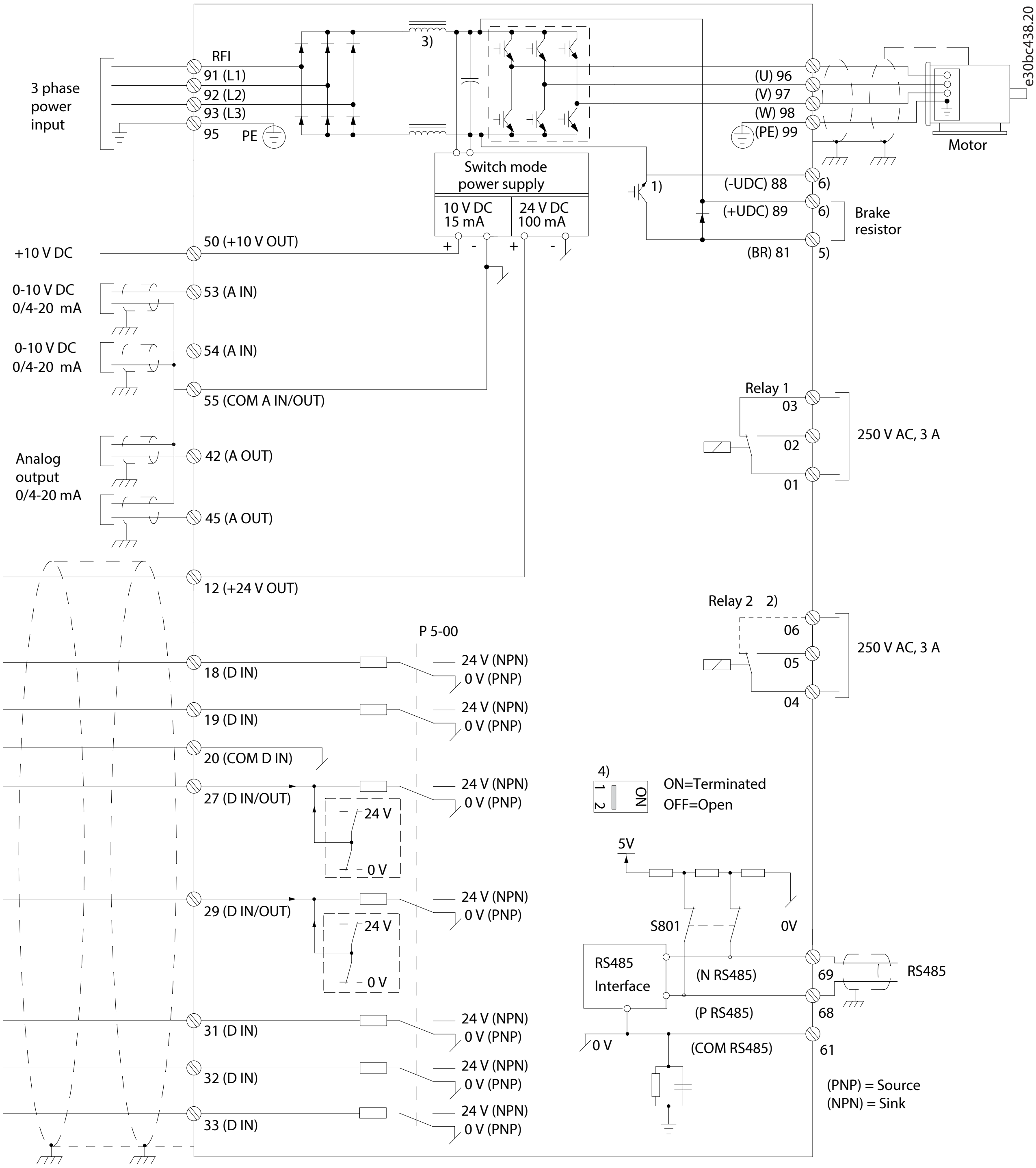

Figure 1: Wiring Diagram

A = Analog, D = Digital

1)	Built-in brake chopper available for J1–J5.
2)	Relay 2 is 2-pole for J1–J3 and 3-pole for J4–J9. Relay 2 of J4–J9 with terminals 4, 5, and 6 has the same NO/NC logic as relay 1. Relays are pluggable in J1–J5 and fixed in J6–J7.

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3)	Single DC choke in J1–J5; Dual DC choke in J6–J9.
4)	Switch S800 (bus terminal) can be used to enable termination on the RS485 port (terminals 68 and 69).
5)	No BR for J6–J9.
6)	No terminal 81, 88 and 89 for J8 and J9.

In rare cases, long control cables and analog signals could result in 50/60 Hz ground loops due to noise from mains supply cables. If this occurs, break the shield or insert a 100 nF capacitor between shield and chassis.

The digital and analog inputs and outputs must be connected separately to the common inputs (terminal 20 and 55) of the drive to avoid ground currents from both groups to affect other groups. For example, switching on the digital input could disturb the analog input signal.

Input polarity of control terminals

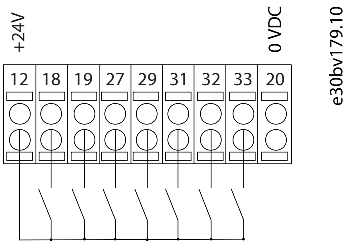

Figure 2: PNP (Source) Digital Input Wiring

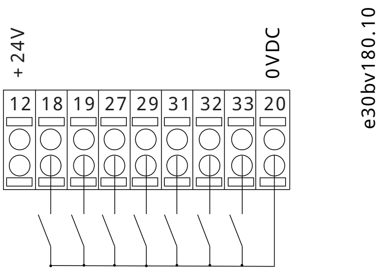

Figure 3: NPN (Sink) Digital Input Wiring

NOTICE
Control cables must be shielded/armored.

See the section *Using Shielded Control Cables* in the design guide for the correct termination of control cables.

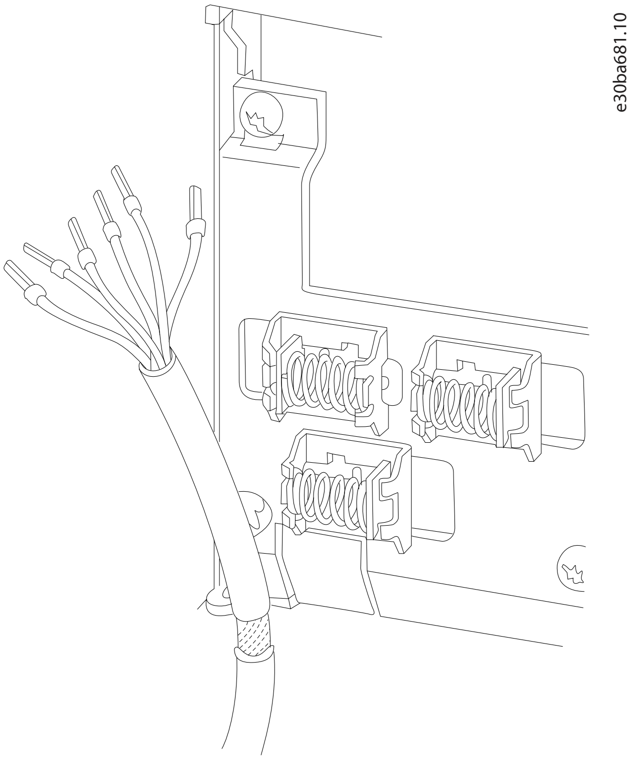

Figure 4: Grounding of Shielded/Armored Control Cables

1.5.2 Start/Stop

NOTICE

Make sure that the drive is under the factory setting before doing the following operation.

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

Terminal 27 = Parameter ***5-12 Terminal 27 Digital Input[0] No operation*** (default coast inverse).

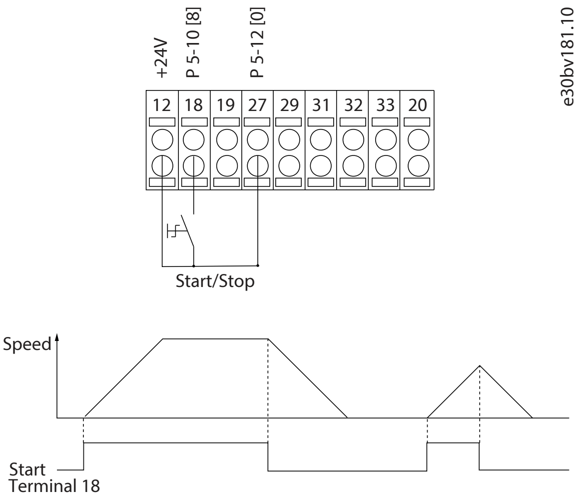

Figure 5: Start/Stop

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1.5.3 Latched Start/Stop Inverse

NOTICE

Make sure that the drive is under the factory setting before doing the following operation.

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

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

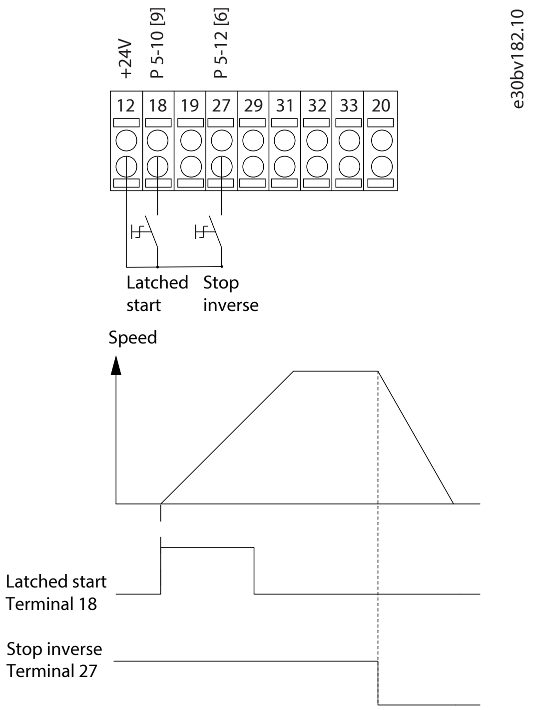

Figure 6: Latched Start/Stop Inverse

1.5.4 Speed Up/Down

NOTICE

Make sure that the drive is under the factory setting before doing the following operation.

Terminals 29/32 = Speed up/down

- Terminal 18 = Parameter ***5-10 Terminal 18 Digital Input[8] Start*** (default).
- Terminal 27 = Parameter ***5-12 Terminal 27 Digital Input[19] Freeze reference***.
- Terminal 29 = Parameter ***5-13 Terminal 29 Digital Input[21] Speed up***.
- Terminal 32 = Parameter ***5-14 Terminal 32 Digital Input[22] Speed down***.

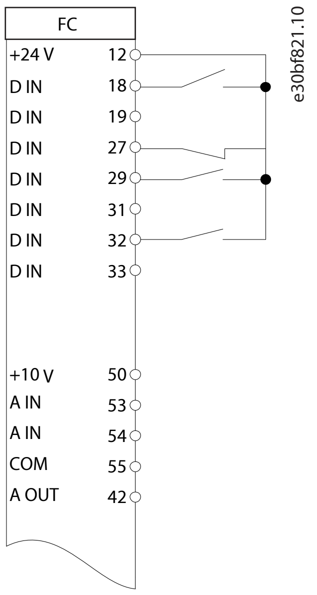

Figure 7: Speed Up/Down

1.5.5 Potentiometer Reference

NOTICE

Make sure that the drive is under the factory setting before doing the following operation.

Voltage reference via a potentiometer

- Reference source 1 = ***[1] Analog input 53*** (default).
- Terminal 53, low voltage = 0 V.
- Terminal 53, high voltage = 10 V.
- Terminal 53, low ref./feedback = 0.
- Terminal 53, high ref./feedback = 50.
- Parameter ***6-19 Terminal 53 mode*** = ***[1] Voltage***.

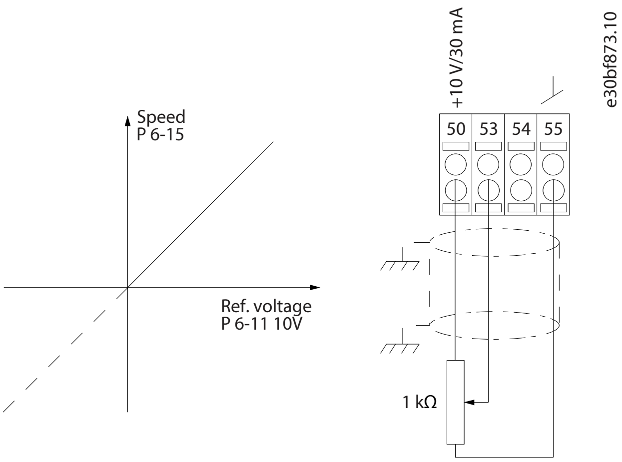

Figure 8: Potentiometer Reference

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

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

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

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

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

	ISO warning symbol for general warnings
	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electric shock
	Symbol for indicating the required discharge time of the capacitors in the product.
	ISO action symbol for referring to the instructions

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the product. Only qualified personnel are allowed to install and operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualified personnel must be familiar with the instructions and safety measures described in this guide.

2.3 Safety Precautions

⚠ WARNING

HIGH VOLTAGE

Drives contain high voltage when connected to AC mains input, DC supply, load sharing, or permanent motors. Failure to use qualified personnel to install, start up, and maintain the drive can result in death or serious injury.

- Only qualified personnel must install, start up, and maintain the drive.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that there is no remaining voltage on the drive.

⚠ WARNING

UNINTENDED START

When the drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage.

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

⚠ WARNING

DISCHARGE TIME

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

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

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully. The minimum waiting time is specified in the table *Discharge time* and is also visible on the product label on the top of the drive.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

Table 2: Discharge Time

Voltage [V]	Power range [kW (hp)]	Minimum waiting time (minutes)
380–480	0.37–7.5 kW (0.5–10 hp)	4
380–480	11–90 kW (15–125 hp)	15
380–480	110–315 kW (150–450 hp)	20

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WARNING

ELECTRICAL SHOCK HAZARD - LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to connect the drive properly to protective earth (PE) can result in death or serious injury.

- Ensure reinforced protective earthing conductor according to IEC 60364-5-54 cl. 543.7 or according to local safety regulations for high touch current equipment. The reinforced protective earthing of the drive can be done with:
- a PE conductor with a cross-section of at least 10 mm^2 (8 AWG) Cu or 16 mm^2 (6 AWG) Al.
- an extra PE conductor of the same cross-sectional area as the original PE conductor as specified by IEC 60364-5-54 with a minimum cross-sectional area of 2.5 mm^2 (14 AWG) (mechanically protected) or 4 mm^2 (12 AWG) (not mechanically protected).
- a PE conductor completely enclosed with an enclosure or otherwise protected throughout its length against mechanical damage.
- a PE conductor part of a multi-conductor power cable with a minimum PE conductor cross-section of 2.5 mm^2 (14 AWG) (permanently connected or pluggable by an industrial connector. The multi-conductor power cable shall be installed with an appropriate strain relief).
- NOTE: In IEC/EN 60364-5-54 cl. 543.7 and some application standards (for example IEC/EN 60204-1), the limit for requiring reinforced protective earthing conductor is 10 mA leakage current.

WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.
- Ensure that electrical work conforms to national and local electrical regulations.
- Follow the procedures in this guide.

CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the drive can result in serious injury when the drive is not properly closed.

- Ensure that all safety covers are in place and securely fastened before applying power.

NOTICE

HIGH ALTITUDES

- For installation at altitudes above 2000 m (6562 ft), contact Danfoss regarding PELV.

NOTICE

USE ON ISOLATED MAINS

- For details about the use of the drive on isolated mains, refer to the section *RFI Switch* in the design guide. Follow the recommendations regarding the installation on IT mains. Use relevant monitoring devices for IT mains to avoid damage.

3 Programming

3.1 Local Control Panel Operations

3.1.1 Local Control Panel (LCP)

The drive supports numerical local control panel (NLCP) LCP 21, graphic local control panel (GLCP) LCP 23. This chapter describes the operations with LCP 21 and LCP 23.

The drive can also be programmed from the VLT® Motion Control Tool MCT 10 on PC via RS-485 com-port. This software can be ordered using code number 130B1000 or downloaded from the Danfoss website: https://www.danfoss.com/en/service-and-support/downloads/dds/vlt-motion-control-tool-mct-10/#tab-overview.

The local control panel is divided into 4 functional sections.

- A. Display.
- B. Menu key.
- C. Navigation keys.
- D. Operation keys and indicator lights (LEDs).

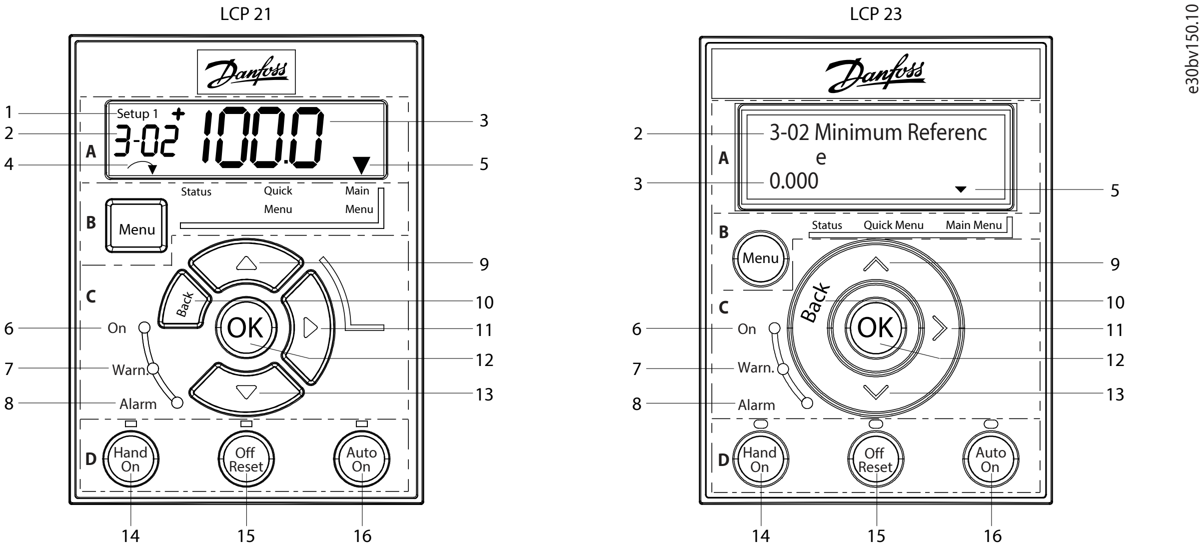

Figure 9: Local Control Panel (LCP 21 and LCP 23)

Functional Section A: Display

Table 3: Display Function

Number	Function
1	The setup number shows the active setup and the edit setup. • For LCP 21: The setup number shows the active setup and the edit setup. If the same setup acts as both active and edit setup, only that setup number is shown (factory setting). • For LCP 23, the setup number is shows in the upper right corner in the status mode. For example, “1(2)” means the active setup is "1" and the editing setup is "2".
2	• LCP 21 shows only parameter number. • LCP 23 shows both parameter number and name.
3	Parameter value.

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Table 3: Display Function - (continued)

Number	Function
4	Motor direction indicated by a small arrow pointing either clockwise or counterclockwise. For LCP 23, it is only shown in the status menu in the upper right corner of the screen.
5	The triangle indicates if the LCP is in Status, Quick Menu, or Main Menu.

Functional Section B: Menu Key

Press [*Menu*] to select among Status, Quick Menu, or Main Menu.

Functional Section C: Indicator Lights (LEDs) and Navigation Keys

Table 4: Indicator Lights (LEDs)

Number	Indicator	Light	Function
6	On	Green	Turns on when the drive receives power from the mains voltage, a DC bus terminal, or a 24 V external supply.
7	Warn.	Yellow	Turns on when warning conditions are met. Text is shown in the display area identifying the warning.
8	Alarm	Red	Flashes when a fault condition occurs. Text is shown in the display area identifying the alarm.

Table 5: Navigation Keys

Number	Key	Function
9/13	Up/Down	• Switches among parameter groups, parameters, and within parameters. • Increase or decrease parameter values. • Set local reference.
10	[*Back*]	Moves to the previous step or layer in the navigation structure.
11	Right	Moves from left to right within the parameter value to change each digit individually.
12	[*OK*]	Selects a parameter and accepts changes to parameter settings.

Functional Section D: Operation Keys and Indicator Lights (LEDs)

Table 6: Operation Keys and Indicator Lights (LEDs)

Number	Key	Function
14	[*Hand On*]	• Starts the drive in local control. • An external stop signal via control input or serial communication overrides the local hand on command.
15	[*Off/Reset*]	• Stops the motor but does not remove power to the drive. • Resets the drive manually after a fault has been cleared. • In alarm mode, the alarm is reset when the alarm condition is removed.
16	[*Auto On*]	Puts the system in remote operational mode, in which the drive only responds to an external start command via control terminals or bus communication.

NOTICE

[2] Coast inverse is the default option for parameter ***5-12 Terminal 27 Digital Input***. If there is no 24 V supply to terminal 27, [*Hand On*] does not start the motor. Connect terminal 12 to terminal 27.

WARNING

HIGH VOLTAGE

Touching the drive after pressing the [*Off/Reset*] key is still dangerous, because the key does not disconnect the drive from the mains.

- Disconnect the drive from the mains and wait for the drive to fully discharge. See the discharge time in the *chapter Safety*.

3.1.2 Quick Menu

The Quick Menu gives easy access to the most frequently used parameters.

1. To enter Quick Menu, press [*Menu*] until the indicator in the display is placed above Quick Menu.
2. Press the *Up/Down* key to select either QM1 or QM2, then press [*OK*].
3. Press the *Up/Down* key to browse through the parameters in Quick Menu.
4. Press [*OK*] to select a parameter.
5. Press the *Up/Down* key to change the value of a parameter setting.
6. Press [*OK*] to accept the change.
7. To exit, press either [*Back*] twice (or 3 times if in QM2 and QM3) to enter Status, or press [*Menu*] once to enter Main Menu.

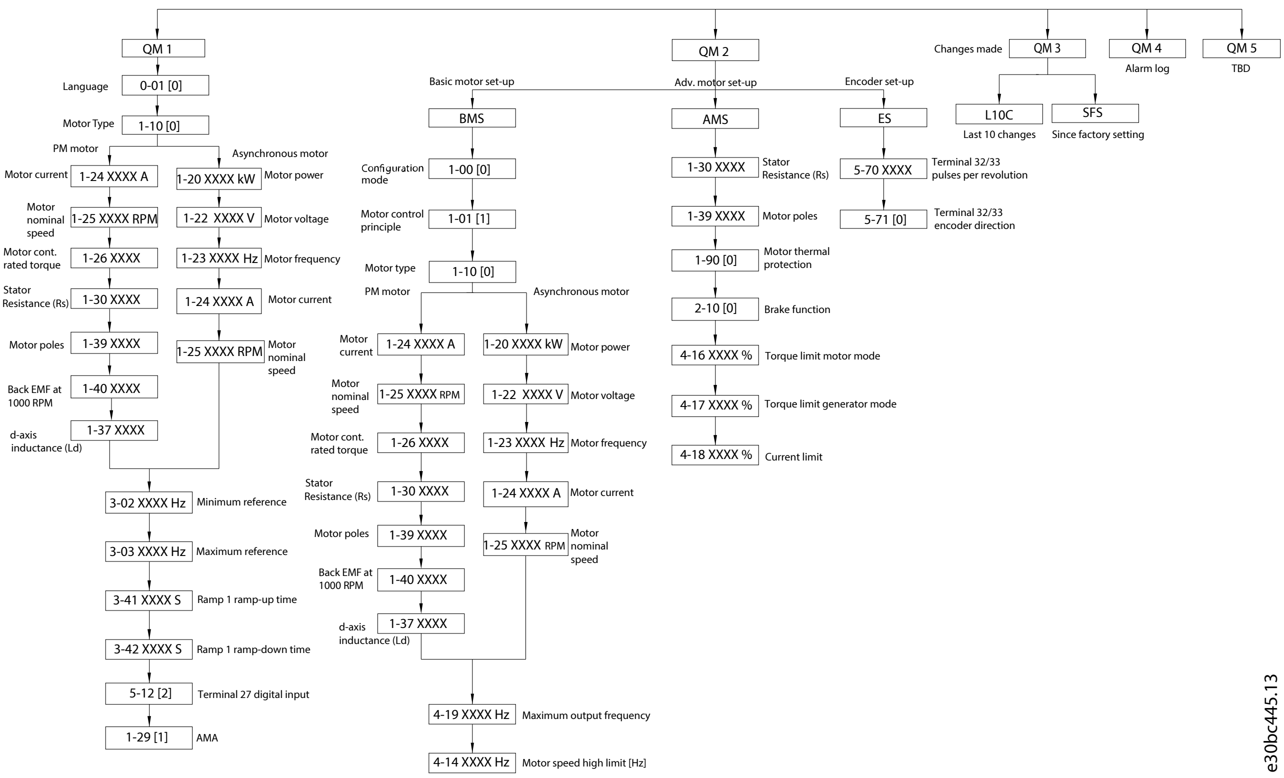

Figure 10: Quick Menu Structure

3.1.3 Status Menu

After power-up, Status Menu is active. Press [*Menu*] to toggle between Status, Quick Menu, and Main Menu.

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To toggle between the options in each menu, press the *Up/Down* key.

The display indicates the status mode with a small arrow above *Status*.

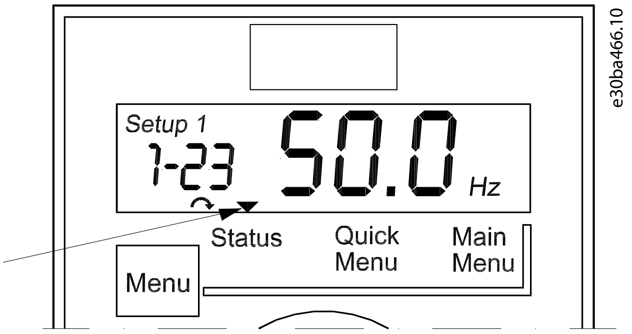

Figure 11: Indicating Status Mode

The following 8 parameters can be accessed from the LCP status menu in auto-on mode:

- Parameter ***16-02 Reference [%].***
- Parameter ***16-09 Custom Readout.***
- Parameter ***16-10 Power [kW].***
- Parameter ***16-13 Frequency.***
- Parameter ***16-14 Motor current.***
- Parameter ***16-16 Torque [Nm].***
- Parameter ***16-30 DC Link Voltage.***
- Parameter ***16-52 Feedback[Unit].***

The following 6 parameters can be accessed from the LCP status menu in hand-on mode:

- Parameter ***16-09 Custom Readout.***
- Parameter ***16-10 Power [kW].***
- Parameter ***16-13 Frequency.***
- Parameter ***16-14 Motor current.***
- Parameter ***16-16 Torque [Nm].***
- Parameter ***16-30 DC Link Voltage.***

3.1.4 Main Menu

The Main Menu gives access to all parameters.

1. To enter Main Menu, press [*Menu*] until the indicator in the display is placed above Main Menu.
2. Use the *Up/Down* key to browse through the parameter groups.
3. Press [*OK*] to select a parameter group.
4. Use the *Up/Down* key to browse through the parameters in the specific group.
5. Press [*OK*] to select the parameter.
6. Use the *Right/Up/Down* key to set/change the parameter value.
7. Press [*OK*] to accept the value.
8. To exit, press either [*Back*] twice (or 3 times for array parameters) to enter Main Menu, or press [*Menu*] once to enter *Status*.

Principles and actions of changing the value of continuous parameters

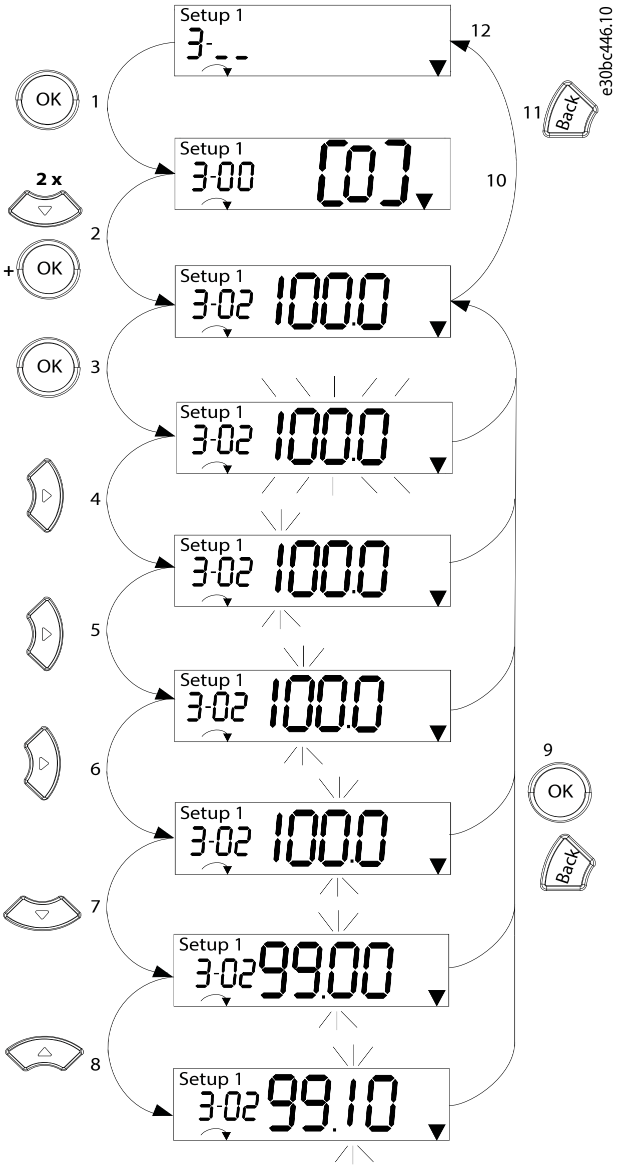

Figure 12: Main Menu Interactions - Continuous Parameters

Table 7: Changing Values in Continuous Parameters

1	[*OK*]: The 1st parameter in the group is shown.
2	Press the *Down* key repeatedly to move down to the parameter.
3	Press [*OK*] to start editing.
4	The *Right* key: First digit flashing (can be edited).
5	The *Right* key: Second digit flashing (can be edited).
6	The *Right* key: Third digit flashing (can be edited).
7	Decreases the parameter value, the decimal point changes automatically.
8	The *Up* key: Increases the parameter value.
9	[*Back*]: Cancel changes, return to 2. [*OK*]: Accept changes, return to 2.

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Table 7: Changing Values in Continuous Parameters - (continued)

10	The *Up/Down* key: Select parameter within the group.
11	[*Back*]: Removes the value and shows the parameter group.
12	The *Up/Down* key: Select group.

Principles and actions of changing the value of enumerated parameters

For enumerated parameters, the interaction is similar, but the parameter value is shown in brackets because of the LCP 21 digits limitation (4 large digits), and the enum can be greater than 99. When the enum value is greater than 99, the LCP 21 can only show the 1st part of the bracket.

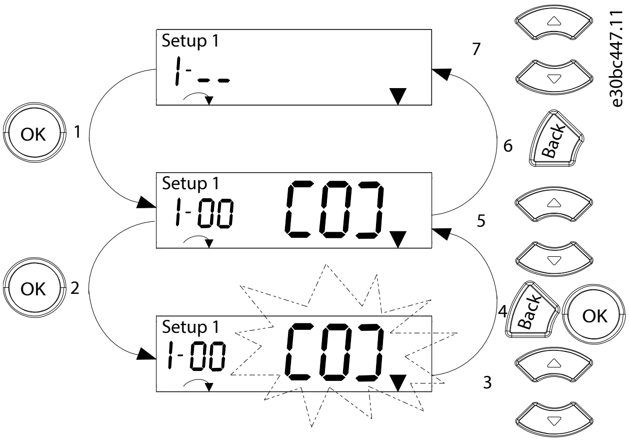

Figure 13: Main Menu Interactions - Enumerated Parameters

Table 8: Changing Values in Enumerated Parameters

1	[*OK*]: The 1st parameter in the group is shown.
2	Press [*OK*] to start editing.
3	The *Up/Down* key: Change parameter value (flashing).
4	Press [*Back*] to cancel changes or [*OK*] to accept changes (return to screen 2).
5	The *Up/Down* key: Select a parameter within the group.
6	[*Back*]: Removes the value and shows the parameter group.
7	The *Up/Down* key: Select a group.

Principles and actions of changing the value of array parameters

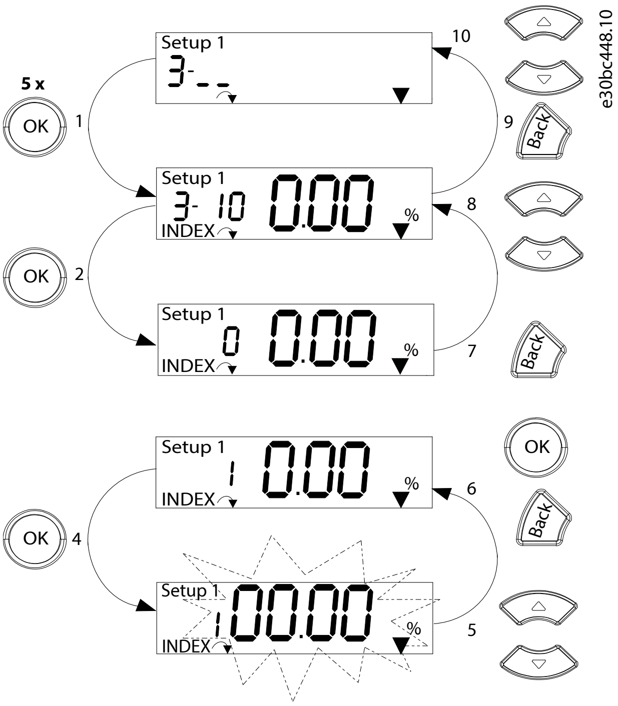

Figure 14: Main Menu Interactions - Array Parameters

Table 9: Changing Values in Array Parameters

1	[*OK*]: Shows parameter numbers and the value in the 1st index.
2	[*OK*]: Index can be selected.
3	The *Up/Down* key: Select index.
4	[*OK*]: Value can be edited.
5	The *Up/Down* key: Change parameter value (flashing).
6	[*Back*]: Cancels changes. [*OK*]: Accepts changes.
7	[*Back*]: Cancels editing index, a new parameter can be selected.
8	The *Up/Down* key: Select parameter within the group.
9	[*Back*]: Removes parameter index value and shows the parameter group.
10	The *Up/Down* key: Select group.

3.1.5 Backing Up/Downloading Parameters with LCP

Establishing the correct programming for applications often requires setting functions in several related parameters. Parameter details are provided in the *chapter Parameter Descriptions*.

Programming data is stored internally in the drive.

- For backup, upload data into the LCP memory.
- To download data to another drive, connect the LCP to that unit and download the stored settings.
- Restoring factory default settings does not change data stored in the LCP memory.
  1. Press [*Off/Reset*] on the LCP to stop the motor before uploading or downloading data.
  2. Press [*Main Menu*] parameter ***0-50 LCP Copy***and press [*OK*].

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3. Select ***[1] All to LCP*** to upload data to the LCP, or select ***[2] All from LCP*** to download data from the LCP, or select ***[3] Size indep. from LCP*** to download motor size independent parameters from LCP.
4. Press [*OK*]. A progress bar shows the uploading or downloading progress.
5. Press [*Hand On*] or [*Auto On*] to return to normal operation.

3.1.6 Restoring Default Settings with LCP

3.1.6.1 Overview

NOTICE

Risk of losing programming, motor data, localization, and monitoring records by restoration of default settings. To provide a backup, upload data to the LCP before initialization.

Restoring the default parameter settings is done by initialization of the drive. There are 2 ways to initialize the drive to the default settings.

- Initialization using parameter ***14-22 Operation Mode*** (recommended).
  - Do not reset drive settings, such as operating hours, serial communication settings, fault log, alarm log, and other monitoring functions.
  - Do not reset the settings for parameter ***1-06 Clockwise Direction*** and parameter ***0-03 Regional Settings***.
- Manual initialization.
  - Erases all motor, programming, localization, and monitoring data and restores factory default settings.
  - Do not reset the following drive information:
    - Parameter ***0-03 Regional Settings***
    - Parameter ***1-06 Clockwise Direction***
    - Parameter ***15-00 Operating hours***
    - Parameter ***15-03 Power Up's***
    - Parameter ***15-04 Over Temp's***
    - Parameter ***15-05 Over Volt's***
    - Parameter ***15-30 Alarm Log: Error Code***

3.1.6.2 Recommended Initialization

1. Select parameter ***14-22 Operation Mode*** and press [*OK*].
2. Select ***[2] Initialization*** and press [*OK*].
3. Remove power to the unit and wait until the display turns off.
4. Apply power to the unit.

   Default parameter settings are restored during start-up. This may take slightly longer than normal.
5. ***Alarm 80, Drive initialized to default value*** is shown.
6. Press [*Reset*] to return to operating mode.

3.1.6.3 Manual Initialization

1. Remove power to the unit and wait until the display turns off.
2. Press and hold [*Status*], [*Main Menu*], and [*OK*] at the same time on the GLCP, or press [*Menu*] and [*OK*] at the same time on the NLCP while applying power to the unit (approximately 5 s or until a click is heard and the fan starts).

Factory default parameter settings are restored during start-up. This may take slightly longer than normal.

3.2 Basic Programming

3.2.1 Asynchronous Motor Setup

Enter the following motor data in the listed order. Find the information on the motor nameplate.

1. Parameter ***1-20 Motor Power.***
2. Parameter ***1-22 Motor Voltage.***
3. Parameter ***1-23 Motor Frequency.***
4. Parameter ***1-24 Motor Current.***
5. Parameter ***1-25 Motor Nominal Speed.***

For optimum performance in VVC+ mode, extra motor data is required to set up the following parameters.

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

The data is found in the motor datasheet (this data is typically not available on the motor nameplate). Run a complete AMA using parameter ***1-29 Automatic Motor Adaption (AMA) [1] Enable Complete AMA*** or enter the parameters manually.

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.

3.2.2 PM Motor Set-up in VVC+

3.2.2.1 Initial Programming Steps

1. Set parameter ***1-10 Motor Construction*** to the following options to activate PM motor operation:
   - ***[1] PM, non salient SPM***
   - ***[3] PM, salient IPM***
2. Select ***[0] Open Loop*** in parameter ***1-00 Configuration Mode***.

NOTICE

If PM speed closed loop is needed, choose flux control mode.

3.2.2.2 Programming Motor Data

When the initial programming steps are completed, the PM motor-related parameters in parameter groups ***1-2* Motor Data***, ***1-3* Adv. Motor Data I***, and ***1-4* Adv. Motor Data II*** are active.

The information is on the motor nameplate and in the motor datasheet.

1. Program the following parameters in the listed order:
   - Parameter ***1-24 Motor Current.***
   - Parameter ***1-26 Motor Cont. Rated Torque.***

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- Parameter ***1-25 Motor Nominal Speed.***
- Parameter ***1-39 Motor Poles.***
- Parameter ***1-40 Back EMF at 1000 RPM.***
- Parameter ***1-42 Motor Cable Length.***

2. Run a complete AMA using parameter ***1-29 Automatic Motor Adaption (AMA)*** and select ***[1] Enable Complete AMA***.
3. If a complete AMA is not performed successfully, configure the following parameters manually.
   a. Parameter ***1-30 Stator Resistance (Rs)***. Enter phase common stator winding resistance (Rs). If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value. It is also possible to measure the value with an ohmmeter, which also takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.
   b. Parameter ***1-37 d-axis Inductance (Ld)***. Enter direct axis inductance of the PM motor. If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value. It is also possible to measure the value with an inductance meter, which also takes the inductance of the cable into account. Divide the measured value by 2 and enter the result.
   c. Parameter ***1-38 q-axis Inductance (Lq)***. This parameter is active only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. Enter the quadrature axis inductance of the PM motor. If only phase-to-phase data is available, divide the phase-to-phase value by 2 to achieve the phase value. It is also possible to measure the value with an inductance meter, which also takes the inductance of the cable into account. Make 1 rotation of the motor's rotor and find the maximum phase-to-phase inductance value. Divide the value by 2 and enter the result.
   d. Parameter ***1-44 d-axis Inductance Sat. (LdSat)***. This parameter is active only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. This parameter corresponds to the saturation inductance of d-axis. The default value is the value set in parameter ***1-37 d-axis Inductance (Ld)***. Do not change the default value in most cases. If the motor supplier provides the saturation curve, enter the d-axis inductance value, which is 100% of the nominal current.
   e. Parameter ***1-45 q-axis Inductance Sat. (LqSat)***. This parameter is active only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. This parameter corresponds to the saturation inductance of q-axis. The default value is the value set in parameter ***1-38 q-axis Inductance (Lq)***. In most cases, do not change the default. If the motor supplier provides the saturation curve, enter the q-axis inductance value, which is 100% of the nominal current.

3.2.2.3 Testing Motor Operation

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

3.2.2.3.1 Rotor Detection

This function is the recommended selection for applications where the motor starts from standstill, for example pumps or conveyors. For some motors, a sound is heard when the drive performs the rotor detection. This sound does not harm the motor. Adjust the value in parameter ***1-46 Position Detection Gain*** for different motors. If the drive fails to start, or an overcurrent alarm occurs when the drive starts, check if the rotor is blocked or not. If the rotor is not blocked, set parameter ***1-70 Start Mode*** to ***[1] Parking*** and try again.

3.2.2.3.2 Parking

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

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. The table below shows recommendations in different applications.

Table 10: Recommendations in Different Applications

Application	Settings
Low inertia applications $I_{Load}/I_{Motor}<5^{(1)}$	• Increase the value of parameter ***1-17 Voltage filter time const.*** by factor 5 to 10. • Reduce the value of parameter ***1-14 Damping Gain***. • Reduce the value (<100%) of parameter ***1-66 Min. Current at Low Speed***.
Medium inertia applications $50>I_{Load}/I_{Motor}>5$	Keep calculated values.
High inertia applications $I_{Load}/I_{Motor}>50$	Increase the values of 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)	Decrease parameter ***1-17 Voltage filter time const***. Decrease parameter ***1-66 Min. Current at Low Speed*** (>100% for longer time can overheat the motor).

1) I_{Load}=The inertia of load. I_{Motor}=The inertia of motor.

If the motor starts oscillating at a certain speed, increase parameter ***1-14 Damping Gain***. Increase the value in small steps.

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

3.2.3 Automatic Motor Adaptation (AMA)

3.2.3.1 Overview

It is highly recommended to run AMA because it measures the electrical characteristics of the motor to optimize compatibility between the drive and the motor under VVC+ mode.

- The drive builds a mathematical model of the motor for regulating output motor current, thus enhancing motor performance.
- Some motors are unable to run the complete version of the test. In that case, select ***[2] Enable reduced AMA*** (not for PM).
- If warnings or alarms occur, see the *chapter Warning/Alarm Messages*.
- Run this procedure on a cold motor for best results.

⚠ WARNING

MOTOR MAY RUN AT HIGH SPEED

The AMA function can be done without the motor running. If ***[7] Enable Inertia Run*** in parameter ***1-29 Automatic Motor Adaption (AMA)*** is selected, the motor may run at high speed.

- Only qualified personnel must perform AMA.

3.2.3.2 Running AMA Using the Numeric LCP

1. By default parameter setting, connect terminals 12 and 27 before running AMA.
2. Enter the Main Menu.
3. Go to parameter group ***1-** Load and Motor***.
4. Press [*OK*].
5. Set motor parameters using nameplate data for parameter group ***1-2* Motor Data***.
6. Set parameter ***1-39 Motor Poles*** for IM and PM.
7. Set parameter ***1-40 Back EMF*** at 1000 RPM for PM.
8. Set motor cable length in parameter ***1-42 Motor Cable Length***.

9. Go to parameter ***1-29 Automatic Motor Adaptation (AMA)***.
10. Press [*OK*].
11. Select *[1] Enable complete AMA*.
12. Press [*OK*].
13. Press [*Hand On*] to activate AMA.
14. The test runs automatically and indicates when it is complete.

    Depending on the power size, the AMA takes 3–10 minutes to complete.

4 Parameter Descriptions

4.1 Parameter Group 0-** Operation/Display

4.1.1 Introduction

This chapter introduces parameters related to the basic functions of the drive, function of the LCP buttons, and configuration of the LCP display.

4.1.2 0-0* Basic Settings

0-01 Language

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

Select the language to be used in the display.

Option	Name
[0]	English
[10]	Chinese
[28]	Portuguese

0-02 Motor Speed Unit

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

Select the display of motor speed (for example, limits) as shaft speed (RPM) or output frequency to motor (Hz).

Option	Name
[0]	RPM
[1]	Hz

0-03 Regional Settings

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

To meet the needs for different default settings in different parts of the world, parameter ***0-03 Regional Settings*** is implemented in the drive. The selected setting influences the default setting of the motor nominal frequency.

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

0-04 Operating State at Power-up

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 after 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 Reset*]) selected before 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 after restarting the drive.

0-06 GridType

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

Select the grid type of the supply voltage/frequency.

- IT Grid is a supply mains where there are no connections to the ground.
- Delta is a supply mains where the secondary part of the transformer is delta connected and 1 phase is connected to the ground.

NOTICE

Not all options are supported in all power sizes.

Option	Name
[10]	380-440V/50Hz/IT-grid
[11]	380-440V/50Hz/Delta
[12]	380-440V/50Hz
[20]	440-480V/50Hz/IT-grid
[21]	440-480V/50Hz/Delta
[22]	440-480V/50Hz
[110]	380-440V/60Hz/IT-grid

Option	Name
[111]	380-440V/60Hz/Delta
[112]	380-440V/60Hz
[120]	440-480V/60Hz/IT-grid
[121]	440-480V/60Hz/Delta
[122]	440-480V/60Hz

0-07 Auto DC Braking

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

Protective function against overvoltage at coast in an IT grid environment. This parameter is active only when ***[1] On*** is selected in this parameter, and IT-grid options are selected in parameter ***0-06 GridType***.

Option	Name	Description
[0]	Off	This function is not active.
[1]	On	This function is active.

4.1.3 0-1* Set-up Operations

Define and control the individual parameter setups. The drive has 2 parameter setups that can be programmed independently of each other. This makes the drive flexible and able to solve advanced control functionality problems, often saving the cost of external control equipment. For example, the 2 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, they can be used by an OEM machine builder to program all their factory-fitted drives for different machine types within a range to have the same parameters and then 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 operating) can be selected in parameter ***0-10 Active Set-up*** and is shown in the LCP. By selecting ***[9] Multi Set-up***, it is possible to switch between setups with the drive running or stopped, via digital input or serial communication commands. If it is necessary to change setups while running, ensure that parameter ***0-12 Link Setups*** is set as required. Use parameter ***0-11 Programming Set-up*** 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 that being edited. Use parameter ***0-51 Set-up Copy*** to copy parameter settings between the setups to enable quicker commissioning if similar parameter settings are required in different setups.

0-10 Active Set-up

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

Select the setup in which the drive is to operate. Select parameter ***0-51 Set-up Copy*** to copy a setup to 1 or all setups. To avoid conflicting settings of the same parameter within 2 different setups, link the setups together in parameter ***0-12 Link Setups***. Stop the drive before switching between setups where the parameters are marked *Change during operation = False*.

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Option	Name	Description
[1]	Set-up 1	Setup 1 is active.
[2]	Set-up 2	Setup 2 is active.
[9]	Multi Set-up	This option is used for remote setup selections via digital inputs and the serial communication port. This setup uses the settings from parameter ***0-12 Link Setups***.

0-11 Programming Set-up

Default value:	[9] Active Set-up	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the setup to be programmed during operation, either the active setup or the inactive setup. The setup number being edited flashes in the LCP.

Option	Name	Description
[1]	Set-up 1	Setup 1 can be edited freely during operation, independently of the active setup.
[2]	Set-up 2	Setup 2 can be edited freely during operation, independently of the active setup.
[9]	Active Set-up	The setup in which the drive is operating can also be edited during operation.

0-12 Link Setups

Default value:	[20] Linked	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

The link ensures synchronizing of the *Not changeable during operation* parameter values enabling shift from 1 setup to another during operation. If the setups are not linked, a change between them is not possible while the motor is running. Thus the setup change does not occur until the motor is coasted.

Option	Name	Description
[0]	Not linked	Leave parameters unchanged in both setups. These parameters cannot be changed while the motor is running.
[20]	Linked	Copy *Not changeable during operation* parameters from 1 setup to the other, so they are identical in both setups.

0-14 Readout: Edit Set-ups/Channel

Default value:	0	**Parameter type:**	Range (-2147483647–2147483647)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

View the setting of parameter ***0-11 Programming Set-up***. Edit setup for each communication channel. A means active setup; F means factory; numbers indicate setup code. Communication channels from right to left are LCP and FC-bus.

0-16 Application Selection

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

Select integrated application functions. When an application is selected, a set of related parameters are set automatically.

Option	Name
[0]	None
[1]	Simple Process Close Loop
[2]	Local/Remote
[3]	Speed Open Loop
[4]	Simple Speed Close Loop
[5]	Multi Speed
[6]	OGD LA10
[7]	OGD V210
[8]	Hoist
[9]	Hoist Speed Close Loop
[10]	Horizontal Position Control
[11]	Vertical Position Control
[25]	Flux Basic Hoist
[26]	Flux Basic Hoist Speed Close Loop
[27]	Stacker Crane Horizontal
[28]	Stacker Crane Vertical

NOTICE

The option ***[25] Flux Basic Hoist*** and ***[26] Flux Basic Hoist Speed Close Loop*** are hidden without flux license activation.

4.1.4 0-2* LCP Display

Use parameters in this group to define the variables that are shown in the GLCP.

0-20 Display Line 1.1 Small

Default value:	[1602] Reference [%]	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable to be shown in line 1, left position.

Option	Name
[0]	None
[37]	Display Text 1
[38]	Display Text 2
[39]	Display Text 3
[748]	PCD Feed Forward
[953]	Profibus Warning Word
[1230]	Warning Parameter
[1501]	Running Hours
[1502]	kWh Counter
[1600]	Control Word
[1601]	Reference [Unit]
[1602]	Reference [%]
[1603]	Status Word
[1605]	Main Actual Value [%]
[1609]	Custom Readout
[1610]	Power [kW]
[1611]	Power [hp]
[1612]	Motor Voltage
[1613]	Frequency
[1614]	Motor current
[1615]	Frequency [%]
[1616]	Torque [Nm]
[1617]	Speed [RPM]
[1618]	Motor Thermal
[1620]	Motor Angle
[1622]	Torque [%]
[1624]	Calibrated Stator Resistance
[1630]	DC Link Voltage
[1633]	Brake Energy /2 min
[1634]	Heat sink Temp.
[1635]	Inverter Thermal
[1636]	Inv. Nom. Current
[1637]	Inv. Max. Current
[1638]	SL Controller State
[1639]	Control Card Temp.
[1642]	Service Log Counter
[1644]	Speed Error [RPM]

Option	Name
[1648]	Speed Ref. After Ramp [RPM]
[1650]	External Reference
[1652]	Feedback[Unit]
[1653]	Digi Pot Reference
[1657]	Feedback [RPM]
[1660]	Digital Input
[1661]	Terminal 53 Setting
[1662]	Analog input 53
[1663]	Terminal 54 Setting
[1664]	Analog input 54
[1665]	Analog output 42 [mA]
[1666]	Digital Output
[1667]	Pulse input 29 [Hz]
[1668]	Pulse input 33 [Hz]
[1669]	Pulse output 27 [Hz]
[1670]	Pulse output 29 [Hz]
[1671]	Relay output
[1672]	Counter A
[1673]	Counter B
[1679]	Analog output 45 [mA]
[1680]	Fieldbus CTW 1
[1682]	Fieldbus REF 1
[1684]	Comm. Option STW
[1685]	FC Port CTW 1
[1686]	FC Port REF 1
[1688]	Fieldbus Torque FF.
[1690]	Alarm Word
[1691]	Alarm Word 2
[1692]	Warning Word
[1693]	Warning Word 2
[1694]	Ext. Status Word
[1695]	Ext. Status Word 2
[1697]	Alarm Word 3
[1698]	Warning Word 3
[1837]	Temp. Input X48/4
[1838]	Temp. Input X48/7
[1839]	Temp. Input X48/10

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Option	Name
[1866]	Switching Frequency
[1887]	Inv. Max. Current
[1888]	Motor current
[1890]	Process PID Error
[1891]	Process PID Output
[1892]	Process PID Clamped Output
[1893]	Process PID Gain Scaled Output
[2117]	Ext. 1 Reference [Unit]
[2118]	Ext. 1 Feedback [Unit]
[2119]	Ext. 1 Output [%]
[3401]	PCD 1 Write For Application
[3402]	PCD 2 Write For Application
[3403]	PCD 3 Write For Application
[3404]	PCD 4 Write For Application
[3405]	PCD 5 Write For Application
[3406]	PCD 6 Write For Application
[3407]	PCD 7 Write For Application
[3408]	PCD 8 Write For Application
[3409]	PCD 9 Write For Application
[3410]	PCD 10 Write For Application
[3421]	PCD 1 Read For Application
[3422]	PCD 2 Read For Application
[3423]	PCD 3 Read For Application
[3424]	PCD 4 Read For Application
[3425]	PCD 5 Read For Application
[3426]	PCD 6 Read For Application
[3427]	PCD 7 Read For Application
[3428]	PCD 8 Read For Application
[3429]	PCD 9 Read For Application
[3430]	PCD 10 Read For Application
[3450]	Actual Position
[3456]	Track Error
[3910]	Plc Function
[3920]	Plc Application continuous 1st
[3921]	Plc Application continuous 2nd
[3922]	Plc Application continuous 3rd
[3923]	Plc Application continuous 4th

Option	Name
[3924]	Plc Application continuous 5th
[3925]	Plc Application continuous 6th
[3926]	Plc Application continuous 7th
[3927]	Plc Application continuous 8th
[3928]	Plc Application continuous 9th
[3929]	Plc Application continuous 10th
[3930]	Plc Application enum 1st
[3931]	Plc Application enum 2nd
[3932]	Plc Application enum 3rd
[3933]	Plc Application enum 4th
[3934]	Plc Application enum 5th
[3935]	Plc Application enum 6th
[3936]	Plc Application enum 7th
[3937]	Plc Application enum 8th
[3938]	Plc Application enum 9th
[3939]	Plc Application enum 10th

0-21 Display Line 1.2 Small

Default value:	[1614] Motor current	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable to be shown in line 1, center position.

For the options of parameter ***0-21 Display Line 1.2 Small***, refer to parameter ***0-20 Display Line 1.1 Small***.

0-22 Display Line 1.3 Small

Default value:	[1610] Power [kW]	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable to be shown in line 1, right position.

For the options of parameter ***0-22 Display Line 1.3 Small***, refer to parameter ***0-20 Display Line 1.1 Small***.

0-23 Display Line 2 Large

Default value:	[1613] Frequency	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable to be shown in line 2.

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For the options of parameter ***0-23 Display Line 2 Large***, refer to parameter ***0-20 Display Line 1.1 Small***.

0-24 Display Line 3 Large

Default value:	[1502] kWh Counter	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select a variable to be shown in line 3.

For the options of parameter ***0-24 Display Line 3 Large***, refer to parameter ***0-20 Display Line 1.1 Small***.

4.1.5 0-3* LCP Custom Readout

Parameters for configuring the custom readout value and defining custom display texts. It is possible to customize the display elements for various purposes.

Custom readout

The calculated value to be shown is based on 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 ***4-14 Motor Speed High Limit [Hz]***, and actual speed.

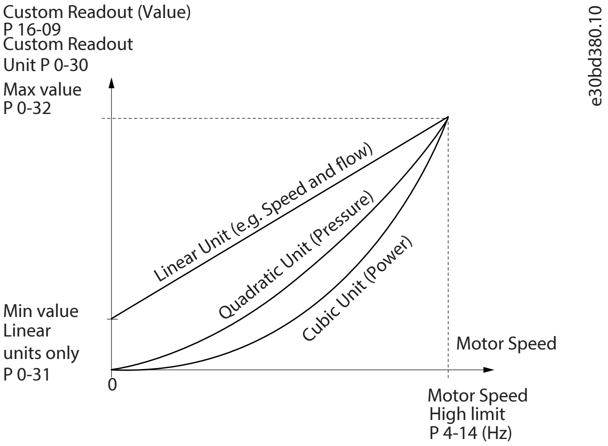

Figure 15: Custom Readout

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

Table 11: Relation between Unit Type and Speed

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

0-30 Custom Readout Unit

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

Set a value to be shown in the LCP. The value has a linear, squared, or cubed relation to speed. This relation depends on the unit selected. See the above table. The actual calculated value can be read in parameter ***16-09 Custom Readout***.

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

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Option	Name
[123]	gal/h
[124]	CFM
[127]	ft^3/h
[140]	ft/s
[141]	ft/min
[160]	°F
[170]	psi
[171]	lb/in^2
[172]	in WG
[173]	ft WG
[180]	HP

0-31 Custom Readout Min Value

Default value:	0.00 CustomReadoutUnit	**Parameter type:**	Range (0.00–999999.99 CustomReadoutUnit)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

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

0-32 Custom Readout Max Value

Default value:	100.00 CustomReadoutUnit	**Parameter type:**	Range (0.00–999999.99 CustomReadoutUnit)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

This parameter sets the maximum value to be shown when the motor speed has reached the value set in parameter ***4-14 Motor Speed High Limit [Hz]***.

0-37 Display Text 1

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

Free text, for example, used for the device tag of fieldbus application.

0-38 Display Text 2

Default value:	–	**Parameter type:**	Range
Setup:	1 setup	**Conversion index:**	0

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

Free text, for example, used for the location tag of fieldbus application.

0-39 Display Text 3

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

Free text, for example, used for the help tag of fieldbus application.

4.1.6 0-4* LCP Keypad

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

0-40 [Hand on] Key on LCP

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

Select ***[0] Disabled*** to avoid accidental start of the drive in hand-on mode. Setting can be locked by parameter ***0-60 Main Menu Password***.

Option	Name	Description
[0]	Disabled	Avoid accidental start of the drive in hand-on mode.
[1]	Enabled	Hand-on mode is enabled.

0-42 [Auto on] Key on LCP

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

Select ***[0] Disabled*** to avoid accidental start of the drive in auto-on mode. Setting can be locked by parameter ***0-60 Main Menu Password***.

Option	Name	Description
[0]	Disabled	Avoid accidental start of the drive in auto-on mode.
[1]	Enabled	Auto-on mode is enabled.

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

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Select ***[0] Disabled*** to avoid accidental stop or reset of the drive from LCP. Setting can be locked by parameter ***0-60 Main Menu Password***.

Option	Name	Description
[0]	Disabled	Avoid accidental stop or reset of the drive from LCP.
[1]	Enabled	Off/reset mode is enabled.
[7]	Enable Reset Only	Only reset mode is enabled.

4.1.7 0-5* Copy/Save

0-50 LCP Copy

Default value:	[0] No copy	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Copy parameters from and to the LCP.

Option	Name	Description
[0]	No copy	No function.
[1]	All to LCP	Copy all parameters in all setups from the drive memory to the LCP. For service purposes, copy all parameters to the LCP after commissioning.
[2]	All from LCP	Copy all parameters in all setups from the LCP memory to the drive memory.
[3]	Size indep. from LCP	Copy only the parameters that are independent of the motor size. This selection can be used to program several drives with the same function without disturbing motor data that is already set.

0-51 Set-up Copy

Default value:	[0] No copy	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Copy parameters between factory settings and the parameter setups.

Option	Name	Description
[0]	No copy	No function.
[1]	Copy from setup 1	Copy from setup 1 to setup 2.
[2]	Copy from setup 2	Copy from setup 2 to setup 1.
[9]	Copy from factory setup	Copy factory setting to programming setup (selected in parameter ***0-11 Programming Set-up***).

4.1.8 0-6* Password

0-60 Main Menu Password

Default value:	0	**Parameter type:**	Range (0–999)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Define the password for access to the Main Menu via the *[Main Menu]* key. Setting values to 0 disables the password function.

4.2 Parameter Group 1-** Load and Motor

4.2.1 1-0* General Settings

1-00 Configuration Mode

Default value:	[0] Open Loop	**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.

Option	Name	Description
[0]	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***.
[1]	Speed Closed Loop	Enables speed closed loop control with feedback. For increased speed accuracy, provide a feedback signal and set the Speed PID control. The speed control parameters are set in parameter group ***7-0* Speed PID Control***.
[2]	Torque Closed Loop	Enables torque closed loop control with speed feedback. Only possible when option ***[1] VVC+*** is selected in parameter ***1-01 Motor Control Principle***.
[3]	Process Closed Loop	Enables the use of process control in the drive. The process control parameters are set in parameter group ***7-2* Process Ctrl. Feedback*** and parameter group ***7-3* Process PID Ctrl***.
[4]	Torque Open Loop	Enables the use of torque open loop in VVC+ mode (parameter ***1-01 Motor Control Principle***). The torque PID parameters are set in parameter group ***7-1* Torque PI Control***.
[6]	Surface Winder	Enables the use of surface winder control. Specific parameters in parameter group ***7-2* Process Ctrl. Feedb.*** and parameter group ***7-3* Process PID Ctrl***.
[7]	Extended PID Speed OL	Enables the use of extended PID speed OL. Specific parameters in parameter group ***7-2* Process Ctrl. Feedb.*** to parameter group ***7-5* Ext. Process PID Ctrl***.

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1-01 Motor Control Principle

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

Select U/f mode, VVC+ mode, or flux basic mode as motor control principle.

NOTICE

When parameter ***1-10 Motor Construction*** is set to PM enabled options, only option ***[0] U/f*** is not available.

Option	Name	Description
[0]	U/f	Used for parallel-connected motors and/or special motor applications. Set the U/f settings in parameter ***1-55 U/f Characteristic - U*** and parameter ***1-56 U/f Characteristic - F***.
[1]	VVC+	Normal running mode, including slip and load compensations.
[2]	Flux basic sensorless	
[3]	Flux basic w/motor feedb	

NOTICE

The option ***[2] Flux basic sensorless*** and ***[3] Flux basic w/motor feedb*** are hidden without flux license activation.

1-03 Torque Characteristics

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

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

Option	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. CT	Automatically optimizes energy consumption by minimizing magnetization and frequency via parameter ***14-41 AEO Minimum Magnetization***.
[5]	Constant Power	

1-06 Clockwise Direction

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

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 drive is connected to motor (U to U; V to V; and W to W).
[1]	Inverse	The motor shaft turns in counterclockwise direction when drive is connected to motor (U to U; V to V; and W to W).

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

Select motor angle offset adjustment type.

Option	Name	Description
[0]	Manual	Adjustment of parameter ***1-41 Motor Angle Offset*** is required. Only for absolute feedback devices.
[1]	Auto	Adjustment of parameter ***1-41 Motor Angle Offset***. For all types of feedback devices during first start after power-up.
[2]	Auto Every Start	Same as ***[1] Auto*** for every start.
[3]	Off	Same as ***[0] Manual*** for all feedback devices.
[4]	Once with Store	Same as ***[0] Manual*** for all feedback devices, but the value in parameter ***1-41 Motor Angle Offset*** will be automatically updated.
[5]	Auto Every Start & Run	Same as ***[2] Auto Every Start*** but when output frequency is above parameter ***1-53 Model Shift Frequency***, the control switches to open loop angle estimation.

1-08 Motor Control Bandwidth

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

Select motor control bandwidth type.

Option	Name	Description
[0]	High	Suitable for high dynamic response.
[1]	Medium	Suitable for smooth steady state operation.
[2]	Low	Suitable for smooth steady state operation with lowest dynamic response.
[3]	Adaptive 1	Optimized for smooth steady state operation, with extra active damping.
[4]	Adaptive 2	Focus on low-inductance PM motors. This option is an alternative to ***[3] Adaptive 1***.

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4.2.2 1-1* Motor Selection

Parameter group for setting general motor data. This parameter group cannot be adjusted while the motor is running.

The active parameters are shown in the following table. x indicates that a particular parameter is active when the option is selected.

Table 12: Active Parameters

Parameter *1-10 Motor Construction*	*[0] Asynchron*	*[1] PM, non salient SPM*	*[3] PM, salient IPM*
Parameter *1-00 Configuration Mode*	x	x	x
Parameter *1-03 Torque Characteristics*	x		
Parameter *1-06 Clockwise Direction*	x	x	x
Parameter *1-07 Motor Angle Offset Adjust*		x	x
Parameter *1-08 Motor Control Bandwidth*	x	x	x
Parameter *1-14 Damping Gain*		x	x
Parameter *1-15 Low Speed Filter Time Const.*		x	x
Parameter *1-16 High Speed Filter Time Const.*		x	x
Parameter *1-17 Voltage Filter Time const.*		x	x
Parameter *1-18 Min. Current at No Load*		x	x
Parameter *1-20 Motor Power [kW]*	x		
Parameter *1-22 Motor Voltage*	x		
Parameter *1-23 Motor Frequency*	x		
Parameter *1-24 Motor Current*	x	x	x
Parameter *1-25 Motor Nominal Speed*	x	x	x
Parameter *1-26 Motor Cont. Rated Torque*		x	x
Parameter *1-29 Automatic Motor Adaption (AMA)*	x	x	x
Parameter *1-30 Stator Resistance (Rs)*	x	x	x
Parameter *1-31 Rotor Resistance (Rr)*	x		
Parameter *1-33 Stator Leakage Reactance (X1)*	x		
Parameter *1-35 Main Reactance (Xh)*	x		
Parameter *1-37 d-axis Inductance (Ld)*		x	x
Parameter *1-38 q-axis Inductance (Lq)*			x
Parameter *1-39 Motor Poles*	x	x	x
Parameter *1-40 Back EMF at 1000 RPM*		x	x
Parameter *1-41 Motor Angle Offset*		x	x
Parameter *1-42 Motor Cable Length*	x	x	x
Parameter *1-43 Motor Cable Length Feet*	x	x	x
Parameter *1-44 d-axis Inductance Sat. (LdSat)*			x
Parameter *1-45 q-axis Inductance Sat. (LqSat)*			x
Parameter *1-46 Position Detection Gain*		x	x
Parameter *1-48 Current at Min Inductance for d-axis*			x
Parameter *1-49 Current at Min Inductance for q-axis*			x

Table 12: Active Parameters - (continued)

Parameter *1-10 Motor Construction*	*[0] Asynchron*	*[1] PM, non salient SPM*	*[3] PM, salient IPM*
Parameter *1-50 Motor Magnetisation at Zero Speed*	x		
Parameter *1-52 Min Speed Normal Magnetising [Hz]*	x		
Parameter *1-53 Model Shift Frequency*	x	x	x
Parameter *1-54 Voltage reduction in fieldweakening*	x	x	x
Parameter *1-55 U/f Characteristic - U*	x		
Parameter *1-56 U/f Characteristic - F*	x		
Parameter *1-57 Torque Estimation Time Constant*	x	x	x
Parameter *1-60 Low Speed Load Compensation*	x		
Parameter *1-61 High Speed Load Compensation*	x		
Parameter *1-62 Slip Compensation*	x		
Parameter *1-63 Slip Compensation Time Constant*	x		
Parameter *1-64 Resonance Dampening*	x		
Parameter *1-65 Resonance Dampening Time Constant*	x		
Parameter *1-66 Min. Current at Low Speed*		x	x
Parameter *1-67 Load Type*	x		
Parameter *1-68 Motor Inertia*	x	x	x
Parameter *1-69 System Inertia*	x	x	x
Parameter *1-70 Start Mode*		x	x
Parameter *1-71 Start Delay*	x	x	x
Parameter *1-72 Start Function*	x	x	x
Parameter *1-73 Flying Start*	x	x	x
Parameter *1-80 Function at Stop*	x	x	x
Parameter *1-88 AC Brake Gain*	x		
Parameter *1-90 Motor Thermal Protection*	x	x	x
Parameter *2-00 DC Hold Current*	x	x	x
Parameter *2-01 DC Brake Current*	x	x	x
Parameter *2-02 DC Braking Time*	x	x	x
Parameter *2-04 DC Brake Cut In Speed [Hz]*	x	x	x
Parameter *2-06 Parking Current*		x	x
Parameter *2-07 Parking Time*		x	x
Parameter *2-10 Brake Function*	x	x	x
Parameter *2-16 AC brake Max. Current*	x		
Parameter *2-17 Over-voltage Control*	x	x	x
Parameter *4-10 Motor Speed Direction*	x	x	x
Parameter *4-14 Motor Speed High Limit [Hz]*	x	x	x
Parameter *4-16 Torque Limit Motor Mode*	x		

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Table 12: Active Parameters - (continued)

Parameter *1-10 Motor Construction*	*[0] Asynchron*	*[1] PM, non salient SPM*	*[3] PM, salient IPM*
Parameter *4-17 Torque Limit Generator Mode*	x		
Parameter *4-18 Current Limit*	x	x	x
Parameter *4-19 Max Output Frequency*	x	x	x
Parameter *4-43 Motor Speed Monitor Function*	x	x	x
Parameter *4-44 Motor Speed Monitor Max*	x	x	x
Parameter *4-45 Motor Speed Monitor Timeout*	x	x	x
Parameter *4-58 Missing Motor Phase Function*	x	x	x
Parameter *4-59 Motor Check At Start*	x	x	x
Parameter *7-01 Speed PID Droop*	x	x	x
Parameter *7-02 Speed PID Proportional Gain*	x	x	x
Parameter *7-03 Speed PID Integral Time*	x	x	x
Parameter *7-04 Speed PID Differentiation Time*	x	x	x
Parameter *7-05 Speed PID Diff. Gain Limit*	x	x	x
Parameter *7-06 Speed PID Lowpass Filter Time*	x	x	x
Parameter *7-07 Speed PID Feedback Gear Ratio*	x	x	x
Parameter *7-08 Speed PID Feed Forward Factor*	x		x
Parameter *7-09 Speed PID Error Correction w/ Ramp*	x	x	x
Parameter *7-10 Torque PI Feedback Source*	x	x	x
Parameter *7-12 Torque PID Proportional Gain*	x	x	x
Parameter *7-13 Torque PID Integration Time*	x	x	x
Parameter *7-16 Torque PI Lowpass Filter Time*	x	x	x
Parameter *7-19 Current Controller Rise Time*	x	x	x
Parameter *7-28 Low Speed PID Proportional Gain*	x	x	x
Parameter *7-29 Low Speed PID Integral Time*	x	x	x
Parameter *14-01 Switching Frequency*	x	x	x
Parameter *14-03 Overmodulation*	x	x	x
Parameter *14-07 Dead Time Compensation Level*	x	x	x
Parameter *14-08 Damping Gain Factor*	x	x	x
Parameter *14-09 Dead Time Bias Current Level*	x	x	x
Parameter *14-10 Mains Failure*	x		
Parameter *14-11 Mains Fault Voltage Level*	x		
Parameter *14-12 Function at Mains Imbalance*	x	x	x
Parameter *14-27 Action At Inverter Fault*	x	x	x
Parameter *14-37 Fieldweakening Speed*	x	x	x
Parameter *14-38 Field Weakening Controller Gain*	x	x	x
Parameter *14-40 VT Level*	x		

Table 12: Active Parameters - (continued)

Parameter *1-10 Motor Construction*	*[0] Asynchron*	*[1] PM, non salient SPM*	*[3] PM, salient IPM*
Parameter *14-41 AEO Minimum Magnetisation*	x		
Parameter *14-42 Minimum AEO Frequency*		x	x
Parameter *14-44 d-axis current optimization for IPM*		x	x
Parameter *14-50 RFI Filter*	x	x	x
Parameter *14-51 DC-Link Voltage Compensation*	x	x	x
Parameter *14-55 Output Filter*	x	x	x
Parameter *14-64 Dead Time Compensation Zero Current Level*	x	x	x
Parameter *14-65 Speed Derate Dead Time Compensation*	x	x	x
Parameter *30-22 Locked Rotor Protection*		x	x
Parameter *30-23 Locked Rotor Detection Time [s]*		x	x
Parameter *40-50 Flux Sensorless Model Shift*	x	x	x
Parameter *40-51 Flux Sensorless Corr. Gain*	x	x	x
Parameter *40-52 Speed PID Anti Windup Gain*	x	x	x
Parameter *40-53 Current PID Anti Windup Gain*	x	x	x
Parameter *40-54 Flux /w Feedback Dynamic Mode*	x	x	x
Parameter *40-56 Rotor Position Estimation Gain*		x	x
Parameter *40-57 Low Speed Flux Compensation Gain*	x	x	x

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	For asynchronous motors.
[1]	PM, non salient SPM	For permanent magnet (PM) motors with surface-mounted (non-salient) magnets. Refer to parameter ***1-14 Damping Gain*** to parameter ***1-17 Voltage Filter Time Const.*** for details about optimizing the motor operation.
[3]	PM, salient IPM	For permanent magnet (PM) motors with interior (salient) magnets.

1-14 Damping Gain

Default value:	120%	**Parameter type:**	Range (0–500%)
Setup:	All setups	**Conversion index:**	0

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

The parameter stabilizes the PM motor to ensure smooth and stable operation. The value of damping gain controls the dynamic performance of the PM motor. Low damping gain results in high dynamic performance and a high value results in a low dynamic performance. The dynamic performance is related to the motor data and load type. If the damping gain is too high or too low, the control becomes unstable.

1-15 Low Speed Filter Time Const.

Default value:	Size related	**Parameter type:**	Range (0.01–20.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

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

1-16 High Speed Filter Time Const.

Default value:	Size related	**Parameter type:**	Range (0.01–20.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

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

1-17 Voltage Filter Time Const.

Default value:	Size related	**Parameter type:**	Range (0.001–1.000 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.

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 the "Isd" current in no load situations to achieve a smoother motor operation.

4.2.3 1-2* Motor Data

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

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

1-20 Motor Power

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

Select the nominal motor power from the motor nameplate data.

Option	Name
[2]	0.12 kW - 0.16 hp
[3]	0.18 kW - 0.25 hp
[4]	0.25 kW - 0.33 hp
[5]	0.37 kW - 0.5 hp
[6]	0.55 kW - 0.75 hp
[7]	0.75 kW - 1 hp
[8]	1.1 kW - 1.5 hp
[9]	1.5 kW - 2 hp
[10]	2.2 kW - 3 hp
[11]	3 kW - 4 hp
[12]	3.7 kW - 5 hp
[13]	4 kW - 5.4 hp
[14]	5.5 kW - 7.5 hp
[15]	7.5 kW - 10 hp
[16]	11 kW - 15 hp
[17]	15 kW - 20 hp
[18]	18.5 kW - 25 hp
[19]	22 kW - 30 hp
[20]	30 kW - 40 hp
[21]	37 kW - 50 hp
[22]	45 kW - 60 hp
[23]	55 kW - 75 hp
[24]	75 kW - 100 hp
[25]	90 kW - 120 hp
[26]	110 kW - 150 hp
[27]	132 kW - 180 hp
[28]	160 kW - 215 hp
[29]	200 kW - 270 hp
[30]	250 kW - 340 hp
[31]	315 kW - 425 hp
[32]	355 kW - 480hp

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1-22 Motor Voltage

Default value:	Size related	**Parameter type:**	Range (50–1000 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.

1-23 Motor Frequency

Default value:	Size related	**Parameter type:**	Range (5–500 Hz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Select the motor frequency value from the motor nameplate. For 87 Hz operation with 230/440 V motors, set the value according to the nameplate data for 230 V/50 Hz. Adapt parameter ***4-14 Motor Speed High Limit [Hz]*** and parameter ***3-03 Maximum Reference*** to the 87 Hz application.

1-24 Motor Current

Default value:	Size related	**Parameter type:**	Range (0.01–1000.00 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. This data is used for calculating motor torque, motor thermal protection, and so on.

1-25 Motor Nominal Speed

Default value:	Size related	**Parameter type:**	Range (50–60000 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

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

1-26 Motor Cont. Rated Torque

Default value:	Size related	**Parameter type:**	Range (0.1–30000.0 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*** or ***[3] PM, salient IPM***, that is, the parameter is valid for PM, non-salient SPM and PM, salient IPM motors only.

1-29 Automatic Motor Adaption (AMA)

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

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

The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters.

NOTICE

Terminal 27 digital input (parameter ***5-12 Terminal 27 Digital Input***) has coast inverse as the default setting. This setting means that AMA cannot be performed if terminal 27 is switched off.

Option	Name	Description
[0]	Off	No function.
[1]	Enable Complete AMA	Depending on the option selected in parameter ***1-10 Motor Construction***, the AMA is performed on different parameters. • If ***[0] Asynchron***is selected, the AMA is performed on: ◆ Parameter ***1-30 Stator Resistance (Rs)*** ◆ Parameter ***1-31 Rotor Resistance (Rr)*** ◆ Parameter ***1-33 Stator Leakage Reactance (X1)*** ◆ Parameter ***1-35 Main Reactance (Xh)*** • If ***[1] PM, non-salient SPM*** is selected, the AMA is performed on: ◆ Parameter ***1-30 Stator Resistance (Rs)*** ◆ Parameter ***1-37 d-axis Inductance (Ld)*** • If ***[3] PM, salient IPM*** is selected, the AMA is performed on: ◆ Parameter ***1-30 Stator Resistance (Rs)*** ◆ Parameter ***1-37 d-axis Inductance (Ld)*** ◆ Parameter ***1-38 q-axis Inductance (Lq)*** ◆ Parameter ***1-44 d-axis Inductance Sat. (LdSat)*** ◆ Parameter ***1-45 q-axis Inductance Sat. (LqSat)***
[2]	Enable Reduced AMA	Perform a reduced AMA of the stator resistance Rs (Parameter ***1-30 Stator Resistance (Rs)***) in the system only. If an LC filter is used between the drive and the motor, select this option. (This option is only for asynchronous motors.)
[7]	Enable Inertia Run	

4.2.4 1-3* Adv. Motor Data I

Set parameters for advanced motor data. The motor data from parameter ***1-30 Stator Resistance (Rs)*** to parameter ***1-39 Motor Poles*** must match the motor for optimal performance. If the motor data is not known, running an AMA is recommended.

1-30 Stator Resistance (Rs)

Default value:	Size related	**Parameter type:**	Range (0.000–9999.000 Ohm)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

Set the stator resistance value. Enter the value from a motor data sheet or perform an AMA on a cold motor.

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1-31 Rotor Resistance (Rr)

Default value:	Size related	**Parameter type:**	Range (1.000–9999.000 Ohm)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

Enter the rotor resistance value. Obtain the value from a motor data sheet or by performing an AMA on a cold motor. The default setting is calculated by the drive from the motor nameplate data.

1-33 Stator Leakage Reactance (X1)

Default value:	Size related	**Parameter type:**	Range (0.000–9999.000 Ohm)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

Set the stator leakage reactance value. Obtain the value from a motor data sheet or perform an AMA on a cold motor. The default setting is calculated by the drive from the motor nameplate data.

1-35 Main Reactance (Xh)

Default value:	Size related	**Parameter type:**	Range (0.00–9999.00 Ohm)
Setup:	All setups	**Conversion index:**	-2
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.

1-36 Iron Loss Resistance (Rfe)

Default value:	Size related	**Parameter type:**	Range (0.000–2147483.647 Ohm)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

Enter the equivalent iron loss resistance value, Rfe. The iron loss resistance value cannot be found by performing an AMA. If Rfe is unknown, use the default setting for this parameter.

1-37 d-axis Inductance (Ld)

Default value:	Size related	**Parameter type:**	Range (0.001–65535.000 mH)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor data sheet or perform an AMA on a cold motor.

1-38 q-axis Inductance (Lq)

Default value:	Size related	**Parameter type:**	Range (0.001–65535.000 mH)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

Set the value of the q-axis inductance. Find the value in the motor data sheet or perform an AMA on a cold motor.

1-39 Motor Poles

Default value:	Size related	**Parameter type:**	Range (2–100)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Enter the number of motor poles. The motor pole value is always an even number, because it refers to the total pole numbers, not pairs of poles.

4.2.5 1-4* Adv. Motor Data II

Set parameters for advanced motor data.

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

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: If back EMF is, for example, 320 V at 1800 RPM, it can be calculated at 1000 RPM:

Example:

Back EMF 320 V at 1800 RPM. Back EMF = (Voltage/RPM)*1000 = (320/1800)*1000 = 178.

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

NOTICE

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

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

Enter the offset angle between PM motor and index position of the attached encoder.

When to find the offset angle: after the drive start-up, applying DC hold, and entering the value of parameter ***16-20 Motor Angle***.

This parameter is only active when parameter ***1-10 Motor Construction*** is set to ***[1] PM motor***.

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1-42 Motor Cable Length

Default value:	Size related	**Parameter type:**	Range (0–100 m)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set the motor cable length in meters.

1-43 Motor Cable Length Feet

Default value:	Size related	**Parameter type:**	Range (0–328 ft)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Set the motor cable length. The length unit is foot.

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

Default value:	Size related	**Parameter type:**	Range (0.001–65535.000 mH)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

This parameter is active only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. This parameter corresponds to the saturation inductance of d-axis. The default value is the value set in parameter ***1-37 d-axis Inductance (Ld)***. In most cases, do not change the default value. If the motor supplier provides the saturation curve, enter the d-axis inductance value, which is under 100% of the nominal current or perform an AMA on a cold motor.

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

Default value:	Size related	**Parameter type:**	Range (0.001–65535.000 mH)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	False

This parameter is active only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. This parameter corresponds to the q-axis saturation inductance. The default value is the value set in parameter ***1-38 q-axis Inductance (Lq)***. In most cases, do not change the default value. If the motor supplier provides the saturation curve, enter the q-axis inductance value, which is under 100% of the nominal current or perform an AMA on a cold motor.

1-46 Position Detection Gain

Default value:	100%	**Parameter type:**	Range (20–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

1-47 Low Speed Torque Calibration

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

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

Measure the actual losses during start to optimize the torque estimate at low speed.

Option	Name
[0]	Off
[1]	1st start after pwr-up
[2]	Every start
[3]	1st start with store
[4]	Every start with store

1-48 Current at Min Inductance for d-axis

Default value:	100%	**Parameter type:**	Range (20–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

Use this parameter to set the inductance saturation point.

1-49 Current at Min Inductance for q-axis

Default value:	100%	**Parameter type:**	Range (20–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter specifies the saturation curve of the q-inductance values. From 20–100% of this parameter, the inductance is linearly approximated due to parameter ***1-38 q-axis Inductance (Lq)*** and parameter ***1-45 q-axis Inductance Sat. (LqSat)***. These parameters are related to the motor nameplate load compensations, the application load type, and the electronic brake function for quick stop/hold of the motor.

4.2.6 1-5* Load Indep. Setting

Parameters for load-independent motor settings.

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

Use this parameter along with parameter ***1-52 Min Speed Normal Magnetising [Hz]*** to obtain a different thermal load on the motor when running at low speed. Enter a value that is a percentage of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

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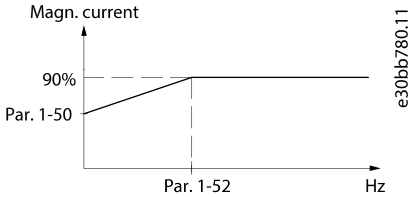

Figure 16: Motor Magnetization

1-52 Min Speed Normal Magnetizing [Hz]

Default value:	1.0 Hz	**Parameter type:**	Range (0.1–10.0 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set the required frequency for normal magnetizing current. Use this parameter along with parameter ***1-50 Motor Magnetisation at Zero Speed***.

1-53 Model Shift Frequency

Default value:	Size related	**Parameter type:**	Range (4.0–65535.0 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

Enter the frequency value for shift between 2 models for determining motor speed. This parameter is used in some sensitive speed and torque control applications.

1-54 Voltage Reduction in Field Weakening

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

The value of this parameter reduces/increases the maximal voltage available for the flux of the motor in field weakening, giving more voltage available for torque. Too high value may give stall problems at high speed. When reducing the voltage below 0, the output voltage is increased and at some point the current controller is forced into "Voltage Limit".

1-55 U/f Characteristic - U

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

Enter voltage at each frequency point to manually form a U/f characteristic which matches the motor. Frequency points are defined in parameter ***1-56 U/f Characteristic - F***.

1-56 U/f Characteristic - F

Default value:	Size related	**Parameter type:**	Range (0–500 Hz), Array [6]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter frequency points to form a U/f characteristic which matches the motor. Voltage at each point is defined in parameter ***1-55 U/f Characteristic - U***. Make a U/f characteristic based on 6 definable voltages and frequencies.

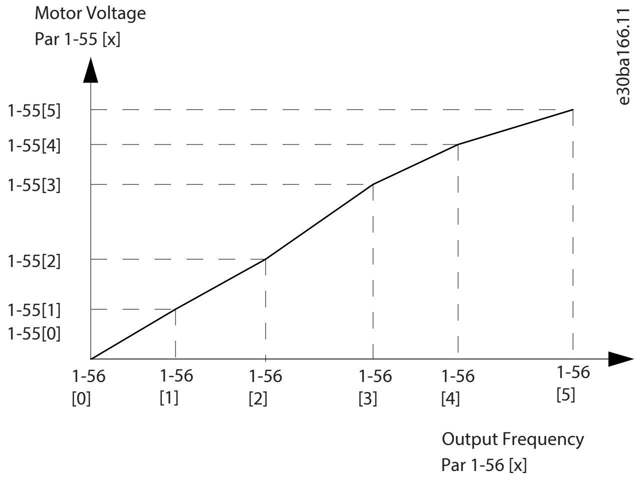

Figure 17: Example of U/f Characteristic

1-57 Torque Estimation Time Constant

Default value:	150 ms	**Parameter type:**	Range (50–1000 ms)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the time constant for the torque estimation below model change point in Flux Sensorless.

4.2.7 1-6* Load Depen. Setting

Parameters for adjusting the load-dependent motor settings.

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 low-speed voltage compensation value in percent. This parameter is used for optimizing the low-speed load performance. This parameter is only active if parameter ***1-10 Motor Construction*** = ***[0] Asynchron***.

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 high-speed voltage compensation value in percent. This parameter is used for optimizing the high-speed load performance. This parameter is only active if parameter ***1-10 Motor Construction*** = ***[0] Asynchron***.

1-62 Slip Compensation

Default value:	Size related	**Parameter type:**	Range (-400–400%)

Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

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

1-63 Slip Compensation Time Constant

Default value:	0.10 s	**Parameter type:**	Range (0.05–5.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

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 occur, use a longer time setting.

1-64 Resonance Dampening

Default value:	Size related	**Parameter type:**	Range (0–500%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

1-65 Resonance Dampening Time Constant

Default value:	0.005 s	**Parameter type:**	Range (0.001–0.050 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

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

1-66 Min. Current at Low Speed

Default value:	Size related	**Parameter type:**	Range (0–120%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the minimum motor current at low speed. Increasing this current improves motor torque at low speed. Parameter ***1-66 Min. Current at Low Speed*** is enabled only for PM motor.

1-67 Load Type

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

Select the load type.

Option	Name
[0]	Passive load
[1]	Active load

1-68 Motor Inertia

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

Enter the minimum inertia moment of the mechanical system.

1-69 System Inertia

Default value:	Size related	**Parameter type:**	Range (0.0000–10000.0000 kgm^2)
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

The system inertia is used to calculate feed forward on the speed controller.

4.2.8 1-7* Start Adjustments

Parameters for adjusting the motor start settings.

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 PM motor startup mode. To initialize the VVC+ control core for previously free-running PM motor. Active for PM motors in VVC + only if the motor is stopped (or running at low speed).

Option	Name	Description
[0]	Rotor Detection	Estimates the electrical angle of the rotor and uses this angle as a starting point. This option is the standard selection for industrial applications. If fly start detects that the motor runs at low speed or has stopped, the drive detects the rotor position (the angle) and starts the motor from that position.
[1]	Parking	The parking function applies DC current across the stator winding and rotates the rotor to electrical 0 position. This option is typically for pump and fan applications. If fly start detects that the motor runs at low speed or has stopped, the drive sends out a DC current to make the motor park at an angle and then starts the motor from that position.

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Option	Name	Description
[2]	Rotor Det. w/Parking	This option adjusts the motor angle offset to avoid the significant rotor shift by ***[1] Parking***, and get a more precise rotor position than by ***[0] Rotor Detection***.
[3]	Rotor Last Position	This option takes the advantage of the last position of rotor at stop and gives a quick start. It is only used in the situation of controlled stop. The drive records the last position of rotor at stop and starts the motor directly without rotor detection and angle calculation. In a non-controlled stop and power cycle, the drive must detect the rotor position. This option can be used for fast restart application. Start may fail if the rotor position has been changed.

1-71 Start Delay

Default value:	0.0 s	**Parameter type:**	Range (0.0–25.5 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

This parameter enables a delay of the starting time. The drive begins with the start function selected in parameter ***1-72 Start Function***. Set the start delay time until acceleration is to begin.

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	Energizes motor with a DC hold current (parameter ***2-00 DC Hold/ Motor Preheat 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+. Regardless of the value applied by the reference signal, the output speed applies the setting of the start speed in parameter ***1-75 Start Speed [Hz]***, and the output current corresponds to the setting of the start current in parameter ***1-76 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 ***1-75 Start Speed [Hz]*** and parameter ***1-76 Start Current*** during the start delay time. The motor rotates in the reference direction. If the reference signal equals zero (0), parameter ***1-75 Start Speed [Hz]*** is ignored, and the output speed equals zero (0). The output current corresponds to the setting of the start current in parameter ***1-76 Start Current***.

Option	Name	Description
[5]	VVC+ clockwise	The start speed is calculated automatically. This function uses the start speed in the start delay time only.
[6]	Hoist Mech. Brake Rel	For hoist function, select this option during start delay.

1-73 Flying Start

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

Catch a motor which is spinning freely due to a mains dropout.

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.

Option	Name	Description
[0]	Disabled	No function.
[1]	Enabled	Enable the drive to catch and control a spinning motor. When parameter ***1-73 Flying Start*** is enabled, parameter ***1-71 Start Delay*** and parameter ***1-72 Start Function*** have no function.
[2]	Enabled Always	Enable flying start at every start command.
[3]	Enabled Ref. Dir.	Enable the drive to catch and control a spinning motor. The search is performed only in the reference direction.
[4]	Enab. Always Ref. Dir.	Enable flying start at every start command. The search is performed only in the reference direction.
[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.

1-75 Start Speed [Hz]

Default value:	Size related	**Parameter type:**	Range (0.0–500.0 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+ clockwise***, and set a start delay time in parameter ***1-71 Start Delay***.

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1-76 Start Current

Default value:	Size related	**Parameter type:**	Range (0.00–1000.00 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 this parameter. 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***.

1-78 Compressor Start Max Speed [Hz]

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–500.0 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This parameter enables high starting torque. This function ignores current limit and torque limit during start of the motor. The time from the start signal is given until the speed exceeds the speed set in this parameter becomes a start zone. In the start zone, the current limit and motoric torque limit are set to the maximum possible value for the drive/motor combination. The time without protection from the current limit and torque limit must not exceed the value set in parameter ***1-79 Compressor Start Max Time to Trip***. Otherwise, the drive trips with ***alarm 18, Start Failed***.

1-79 Compressor Start Max Time to Trip

Default value:	5.0 s	**Parameter type:**	Range (0.0–10.0 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

The time from the start signal is given until the speed exceeds the speed set in parameter ***1-78 Compressor Start Max Speed [Hz]*** must not exceed the time set in this parameter. Otherwise, the drive trips with ***alarm 18, Start Failed***. Any time set in parameter ***1-71 Start Delay*** for use of a start function must be executed within the time limit.

4.2.9 1-8* Stop Adjustments

Parameters for adjusting motor stop settings.

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 ***1-82 Min Speed for Function at Stop [Hz]***. Available selections depend on the setting in parameter ***1-10 Motor Construction***.

- ***[0] Asynchron***
  - ***[0] Coast***
  - ***[1] DC hold/Motor Preheat***
  - ***[3] Pre-magnetizing***
- ***[1] PM, non salient SPM***

- *[3] PM, salient IPM*
  - *[0] Coast*
  - *[1] DC hold/Motor Preheat*

Option	Name	Description
[0]	Coast	Leaves the motor in free mode.
[1]	DC hold/Motor Preheat	Energizes the motor with a DC hold current (see parameter ***2-00 DC Hold/Motor Preheat Current***).
[3]	Pre-magnetizing	Builds up a magnetic field while the motor is stopped. This allows the motor to produce torque quickly at commands (induction 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: Solution 1: 1. Start the drive with a 0 RPM reference. 2. Wait 2 to 4 rotor time constants (see the following formula) before increasing the speed reference. Solution 2: 1. Set parameter ***1-71 Start Delay*** to the premagnetize time (2–4 rotor time constants). 2. Set parameter ***1-72 Start Function*** to ***[0] DC hold***. 3. Set the DC hold current magnitude (parameter ***2-00 DC Hold/ Motor Preheat Current*** to be equal to $I_{pre\text{-}mag}=U_{nom}/(1.73 \times Xh)$). 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

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

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–500.0 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***.

1-88 AC Brake Gain

Default value:	1.4	**Parameter type:**	Range (1.0–2.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This parameter is used to set AC brake power capability (set ramp-down time when inertia is constant). In cases where the DC-link voltage is not higher than the DC-link voltage trip value, the generator torque can be adjusted with this parameter. The higher the AC brake gain is, the stronger the brake capability is. Selecting 1.0 means that there is no AC brake capability.

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NOTICE

If there is continuous generator torque, higher generator torque causes higher motor current, and the motor becomes hot. In this condition, parameter ***2-16 AC Brake, Max current*** can be used to protect the motor from overheating.

4.2.10 1-9* Motor Temperature

Parameters for adjusting temperature protection settings for the motor.

1-90 Motor Thermal Protection

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

Motor thermal protection can be implemented via a PTC sensor in the motor windings connected to 1 of the analog or digital inputs (parameter ***1-93 Thermistor Source***), or 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 $f_{M,N}$. It is possible to activate an overheat warning or alarm.

Option	Name	Description
[0]	No protection	Continuously overloaded motor, when no warning or trip of the drive is required.
[1]	Thermistor warning	Activate a warning when the connected thermistor in the motor reacts to a motor overtemperature.
[2]	Thermistor trip	Stop (trip) the drive when the connected thermistor in the motor reacts to a motor overtemperature. The thermistor cut out value must be > 3 kΩ. Integrate a thermistor (PTC sensor) in the motor for winding protection.
[3]	ETR warning 1	Calculates the load and activates a warning in the display when the motor is overloaded. Program a warning signal via 1 of the digital outputs.
[4]	ETR trip 1	Calculates the load 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). Once the ***MOTOR ETR OVER*** alarm is reported, it can reset immediately.
[22]	ETR Trip – Extended Detection	Calculates the load 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). Once the ***MOTOR ETR OVER*** alarm is reported, it can only reset after parameter ***16-18 Motor Thermal*** decreases to 0.

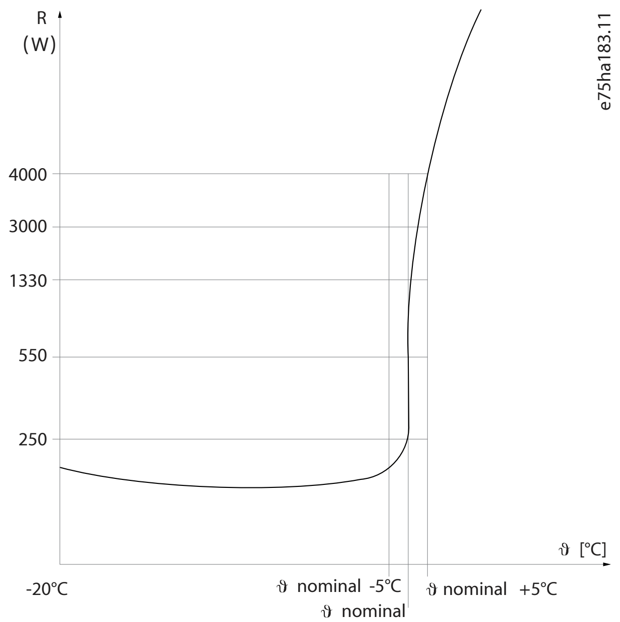

Figure 18: PTC Profile

Using a digital input and 10 V as supply:

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

Parameter setup:

- Set parameter ***1-90 Motor Thermal Protection*** to ***[2] Thermistor Trip***.
- Set parameter ***1-93 Thermistor Source*** to ***[6] Digital Input 33***.

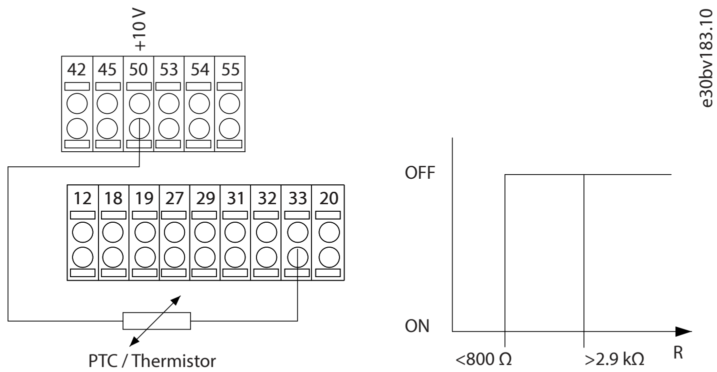

Figure 19: PTC Thermistor Connection - Digital Input

Using an analog input and 10 V as supply:

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

Parameter setup:

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

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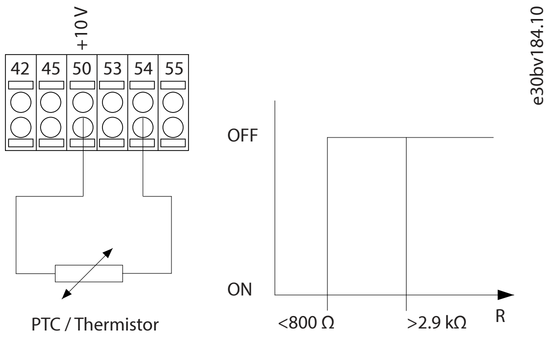

Figure 20: PTC Thermistor Connection - Analog Input

Table 13: Threshold Cut Out Values

Input digital/analog	Supply voltage	Threshold cut out values
Digital	10 V	<800 Ω - 2.9 kΩ
Analog	10 V	<800 Ω - 2.9 kΩ

NOTICE

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

1-93 Thermistor Source

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

Select the input to which the thermistor (PTC sensor) should be connected. If an analog input in this parameter is set as a source, it cannot be used for another purpose, for example, reference or feedback.

NOTICE

Digital input should be set to ***[0] PNP*** - Active at 24 V in parameter ***5-00 Digital Input Mode***.

Option	Name
[0]	None
[1]	Analog Input 53
[2]	Analog Input 54
[3]	Digital input 18
[4]	Digital input 19
[5]	Digital input 32
[6]	Digital input 33
[7]	Digital input 31

4.3 Parameter Group 2-** Brakes

4.3.1 2-0* DC-Brake

Use this parameter group to configure DC brake and DC hold functions.

2-00 DC Hold/Motor Preheat Current

Default value:	50%	**Parameter type:**	Range (0–160%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the holding current as a percentage of the rated motor current $I_{M,N}$ parameter ***1-24 Motor Current***. This parameter holds the motor function (holding torque) or pre-heats the motor. This parameter is active if ***[0] DC hold*** is selected in parameter ***1-72 Start Function***, or if ***[1] DC hold/preheat*** is selected in parameter ***1-80 Function at Stop***.

NOTICE

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

2-01 DC Brake Current

Default value:	50%	**Parameter type:**	Range (0–150%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set current as % of rated motor current, parameter ***1-24 Motor Current***. When the speed is below the limit set in parameter ***2-04 DC Brake Cut In Speed***, or when the DC brake inverse function is active (in parameter group ***5-1* Digital Inputs*** set to ***[5] DC-brake inverse***; or via the serial port), a DC brake current is applied on a stop command. See parameter ***2-02 DC Braking Time*** for duration.

NOTICE

MOTOR OVERHEATING

The maximum value depends on the rated motor current.

- To avoid motor damage caused by overheating, do not run at 100% for too long.

2-02 DC Braking Time

Default value:	10.0 s	**Parameter type:**	Range (0.0–60.0 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

2-04 DC Brake Cut In Speed

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–par. 4-14 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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This parameter is for setting the DC brake cut-in speed at which the DC brake current parameter ***2-01 DC Brake Current*** is to be active, with a stop command.

2-06 Parking Current

Default value:	100%	**Parameter type:**	Range (0–150%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set current as percentage of rated motor current, parameter ***1-24 Motor Current***.

Before setting this parameter, select ***[1] Parking*** in parameter ***1-70 Start Mode***.

2-07 Parking Time

Default value:	3.0 s	**Parameter type:**	Range (0.1–60.0 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 braking parameters. Only valid for drives with brake chopper.

2-10 Brake Function

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

Select method for dissipation of excess brake energy.

Option	Name	Description
[0]	Off	No brake resistor is installed.
[1]	Resistor brake	A brake resistor is incorporated in the system for dissipating surplus brake energy as heat. Connecting a brake resistor allows a higher DC-link voltage during braking (generating operation). The brake resistor function is only active in drives with an integral dynamic brake.
[2]	AC brake	**NOTICE** The AC brake is not as efficient as dynamic braking with resistor. AC brake is for VVC+ and flux mode in both open and closed loop. Improve 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 braking torque without exceeding the voltage limit.

2-11 Brake Resistor (ohm)

Default value:	Size related	**Parameter type:**	Range (0.0–6200.0 Ohm)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor. Parameter ***2-11 Brake Resistor (ohm)*** is only active in drives with an integral dynamic brake. Use this parameter for values without decimals.

2-12 Brake Power Limit (kW)

Default value:	Size related	**Parameter type:**	Range (0.001–2000.000 kW)
Setup:	All setups	**Conversion index:**	-3
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 specifies when a warning/alarm is given. To calculate parameter ***2-12 Brake Power Limit (kW)***, the following formula can be used.

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

$P_{br,avg}$ is the average power dissipated in the brake resistor. R_{br} is the resistance of the brake resistor. t_{br} is the active breaking time within the 120 s period T_{br}. U_{br} is the DC voltage where the brake resistor is active. For T4 units, the DC voltage is 770 V, which can be reduced by parameter ***2-14 Brake voltage reduce***.

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 out parameter ***16-33 Brake Energy Average***, and then enter this value + 20% in parameter ***2-12 Brake Power Limit (kW)***.

2-14 Brake Voltage Reduce

Default value:	0 V	**Parameter type:**	Range (0–500 V)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Setting this parameter may change the brake resistor (parameter ***2-11 Brake Resistor (ohm)***).

This parameter can reduce the DC voltage where the brake resistor is active.

2-16 AC Brake, Max Current

Default value:	100%	**Parameter type:**	Range (0–160%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

NOTICE

Parameter ***2-16 AC Brake, Max Current*** is only available for asynchronous motors.

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2-17 Overvoltage 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.

Option	Name	Description
[0]	Disabled	No OVC required.
[1]	Enabled (not at stop)	Activate OVC except when using a stop signal to stop the drive.
[2]	Enabled	Activate OVC.

CAUTION

PERSONAL INJURY AND EQUIPMENT DAMAGE

Enabling OVC in hoisting applications may lead to personal injuries and equipment damage.

- DO NOT enable OVC in hoisting applications.

2-19 Overvoltage Gain

Default value:	100%	**Parameter type:**	Range (0–2500%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter enables the user to fine-tune the overvoltage gain for parameter ***2-17 Overvoltage Control***. It is not necessary to change this parameter for normal applications.

4.3.3 2-2* Mechanical Brake

2-20 Release Brake Current

Default value:	0.00 A	**Parameter type:**	Range (0.00–100.00 A)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Set the motor current for release of the mechanical brake when a start condition is present.

NOTICE

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

2-22 Activate Brake Speed [Hz]

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–400.0 Hz)
Setup:	All setups	**Conversion index:**	-1

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

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

2-23 Activate Brake Delay

Default value:	0.0 s	**Parameter type:**	Range (0.0–5.0 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 brake has locked the load before the motor enters coast mode.

2-24 Stop Delay

Default value:	0.0 s	**Parameter type:**	Range (0.0–5.0 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

It is used to define a time, during which the speed closed loop controls the motor to run at 0 RPM. After that the brake is activated.

2-25 Brake Release Time

Default value:	0.00 s	**Parameter type:**	Range (0.00–5.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

It reserves a time before ramping up after opening the brake, and the speed closed loop control controls the speed at 0 RPM.

2-26 Torque Ref

Default value:	0.00%	**Parameter type:**	Range (-300.00–300.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Set the torque reference.

2-27 Torque Ramp Time

Default value:	0.2 s	**Parameter type:**	Range (0.0–5.0 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

Set the torque ramp time.

2-28 Gain Boost Factor

Default value:	1.00	**Parameter type:**	Range (0.00–4.00)
Setup:	All setups	**Conversion index:**	-2

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

Set the Gain Boost Factor.

2-29 Torque Ramp Down Time

Default value:	0.0 s	**Parameter type:**	Range (0.0–5.0 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

Set the torque ramp-down time.

4.3.4 2-3* Adv. Mech Brake

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 large, the process may become unstable.

2-31 Speed PID Start Proportional Gain

Default value:	0.015	**Parameter type:**	Range (0.000 = Off–1.000)
Setup:	All setups	**Conversion index:**	-3
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 large, the process may become unstable.

2-32 Speed PID Start Integral Time

Default value:	200.0 ms	**Parameter type:**	Range (1.0 ms–20000.0 = Off ms)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Enter the speed controller integral time. Obtain quick control through a short integral time, if the integral time is short, the process becomes unstable. An excessively long integral time disables the integral action.

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:**	-1
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.

2-39 Mech. Brake w/ dir. Change

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

Enable or disable the mechanical brake function when the shaft changes direction.

Option	Name	Description
[0]	OFF	Disable the mechanical brake function when the shaft changes direction.
[1]	ON	Enable the mechanical brake function when the shaft changes direction.
[2]	ON with start delay	The start delay time is set in parameter ***1-71 Start Delay***.

4.4 Parameter Group 3-** Reference/Ramps

4.4.1 3-0* Reference Limits

Parameters for setting the reference unit, limits, and ranges.

3-00 Reference Range

Default value:	[0] Min - Max	**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.

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.
[1]	-Max - +Max	For both positive and negative values (both directions), relative to parameter ***4-10 Motor Speed Direction***.

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 feedback.

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Option	Name
[0]	None
[1]	%
[2]	RPM
[3]	Hz
[4]	Nm
[5]	PPM
[10]	1/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
[123]	gal/h
[124]	CFM
[125]	ft^3/s
[126]	ft^3/min

Option	Name
[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^2
[172]	in WG
[173]	ft WG
[180]	HP

3-02 Minimum Reference

Default value:	0.000 ReferenceFeedbackUnit	**Parameter type:**	Range (-4999.000–4999.000 ReferenceFeedbackUnit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

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

- The option in parameter ***1-00 Configuration Mode***.
- The unit selected in parameter ***3-01 Reference/Feedback Unit***.

3-03 Maximum Reference

Default value:	Size related	**Parameter type:**	Range (-4999.000–4999.000 ReferenceFeedbackUnit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

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

- The option selected in parameter ***1-00 Configuration Mode***.
- The unit selected in parameter ***3-00 Reference Range***.

3-04 Reference Function

Default value:	[0] Sum	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

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

Select the reference function.

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

3-05 On Reference Window

Default value:	Size related	**Parameter type:**	Range (0.000–999999.999 ReferenceFeedbackUnit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Use this parameter to define the maximum deviation before on-reference is accepted.

4.4.2 3-1* References

Parameters for setting up the reference sources.

3-10 Preset Reference

Default value:	0.00%	**Parameter type:**	Range (-100.00–100.00%), 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. For selecting dedicated references, select preset reference bit 0/1/2 [16], [17], or [18] for the corresponding digital inputs in parameter group ***5-1* Digital Inputs***.

Table 14: 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

3-11 Jog Speed [Hz]

Default value:	5.0 Hz	**Parameter type:**	Range (0.0–500.0 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 runs when the jog function is activated. See also parameter ***3-80 Jog Ramp Time***. The jog speed must not exceed the setting in parameter ***4-14 Motor Speed High Limit [Hz]***.

3-12 Catch Up/Slow Down Value

Default value:	0.00%	**Parameter type:**	Range (0.00–100.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

Enter a percentage value to be either added to or deducted from the actual reference for catching up or slowing down respectively. If ***[28] 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 value is added to the total reference. If ***[29] 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 value is deducted from the total reference.

3-13 Reference Site

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

Select which reference site to activate.

Option	Name	Description
[0]	Linked to Hand/Auto	Use the local reference in hand-on mode or the remote reference in auto-on mode.
[1]	Remote	Use the reference in hand-on mode.
[2]	Local	Use the reference in auto-on mode.

3-14 Preset Relative Reference

Default value:	0.00%	**Parameter type:**	Range (-100.00–100.00%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

The actual reference (X) is increased or decreased with the percentage Y, set in parameter ***3-14 Preset Relative Reference***. This results in the actual reference Z. Actual reference (X) is the sum of the inputs selected in parameter ***3-15 Reference 1 Source***, parameter ***3-16 Reference 2 Source***, parameter ***3-17 Reference 3 Source***, and parameter ***8-02 Control Source***.

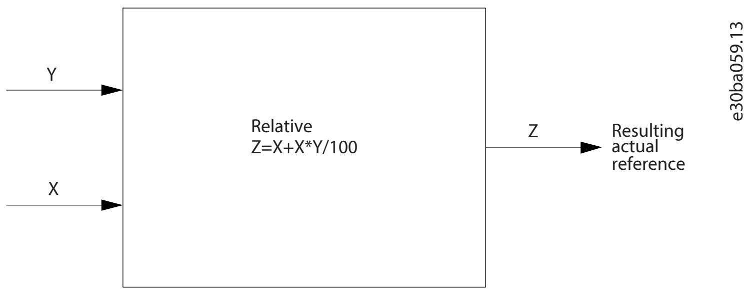

Figure 21: Preset Relative Reference

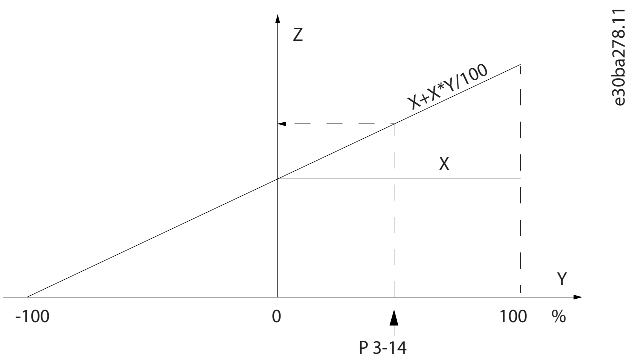

Figure 22: Actual Reference

3-15 Reference 1 Source

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

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

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33
[11]	Local bus reference
[20]	Digital pot. meter
[32]	Bus PCD

3-16 Reference 2 Source

Default value:	[2] Analog Input 54	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

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

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54

Option	Name
[7]	Frequency input 29
[8]	Frequency input 33
[11]	Local bus reference
[20]	Digital pot. meter
[32]	Bus PCD

3-17 Reference 3 Source

Default value:	[11] Local bus reference	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

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

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33
[11]	Local bus reference
[20]	Digital pot. meter
[32]	Bus PCD

3-18 Relative Scaling Reference Resource

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

Select a variable value to be added to the fixed value (defined in parameter ***3-14 Preset Relative Reference***). The sum of the fixed and variable values (labeled Y in Figure 23) is multiplied by the actual reference (labeled X in the following illustration). This product is then added to the actual reference (X+X*Y/100) to give the resulting actual reference.

NOTICE

This parameter cannot be adjusted while the motor is running.

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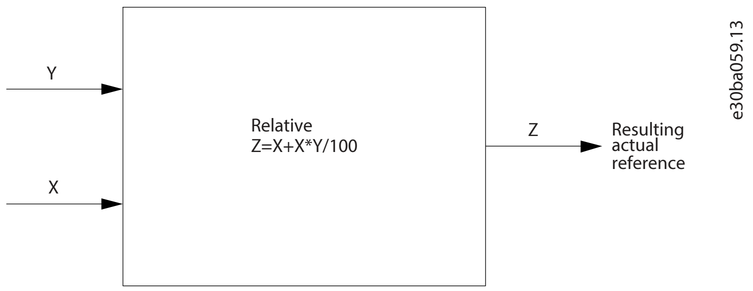

Figure 23: Resulting Actual Reference

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33
[11]	Local bus reference

4.4.3 3-4* Ramp 1

Configure the ramp parameter, ramping times, for each of the 4 ramps (parameter group ***3-4* Ramp 1***, parameter group ***3-5* Ramp 2***, parameter group ***3-6* Ramp 3***, and parameter group ***3-7* Ramp 4***).

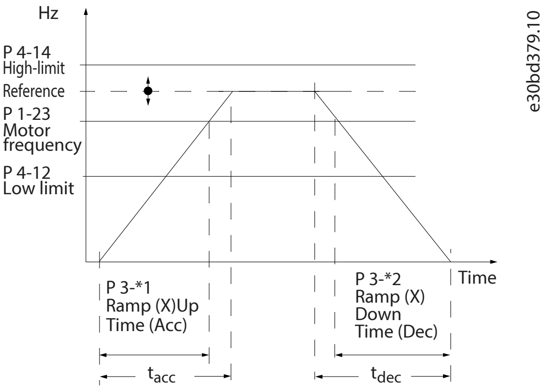

Figure 24: Example of Ramp 1

3-40 Ramp 1 Type

Default value:	[0] 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. A sine 2 ramp gives non-linear acceleration.

Option	Name	Description
[0]	Linear	Linear ramp.
[2]	Sine 2 Ramp	(Only to be used with speed control mode.) Sine 2 ramp based on the values set in parameter ***3-41 Ramp 1 Ramp Up Time*** and parameter ***3-42 Ramp 1 Ramp Down Time***.

3-41 Ramp 1 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, which is the acceleration time from 0 Hz to the synchronous motor speed n_S or from 0 Nm to the nominal torque if torque configuration modes are selected. It is applicable for ramp 1 to ramp 4. Select a ramp-up time such that the output current does not exceed the current limit in parameter ***4-18 Current Limit*** during ramping. See ramp-down time in parameter ***3-42 Ramp 1 Ramp Down Time***.

$$\text{Par.}3-41 = \frac{t_{acc}[s] \times n_S[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

3-42 Ramp 1 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, which is the deceleration time from the synchronous motor speed n_s to 0 Hz or from the nominal torque to 0 Nm if the torque configuration modes are selected. Select a ramp-down time such that no overvoltage arises 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***. See ramp-up time in parameter ***3-41 Ramp 1 Ramp Up Time***.

$$\text{Par.}3-42 = \frac{t_{dec}[s] \times n_S[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

4.4.4 3-5* Ramp 2

This parameter group configures ramp 2 parameters.

3-50 Ramp 2 Type

Default value:	[0] 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. A sine 2 ramp gives non-linear acceleration.

Option	Name	Description
[0]	Linear	Linear ramp.
[2]	Sine 2 Ramp	Sine 2 ramp based on the values set in parameter ***3-51 Ramp 2 Ramp Up Time*** and parameter ***3-52 Ramp 2 Ramp Down Time***.

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3-51 Ramp 2 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, which is the acceleration time from 0 Hz to the rated motor speed n_S. Select a ramp-up time such that the output current does not exceed the current limit in parameter ***4-18 Current Limit*** during ramping. See ramp-down time in parameter ***3-52 Ramp 2 Ramp Down Time***.

$$\text{Par.}3-51=\frac{t_{acc}[s]\times n_s[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

3-52 Ramp 2 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, which is the deceleration time from the rated motor speed n_s to 0 Hz or from the nominal torque to 0 Nm if the torque configuration modes are selected. Select a ramp-down time such that no overvoltage arises 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***. See ramp-up time in parameter ***3-51 Ramp 2 Ramp Up Time***.

$$\text{Par.}3-52=\frac{t_{dec}[s]\times n_s[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

4.4.5 3-6* Ramp 3

This parameter group configures ramp 3 parameters.

3-60 Ramp 3 Type

Default value:	[0] 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. A sine 2 ramp gives non-linear acceleration.

Option	Name	Description
[0]	Linear	Linear ramp.
[2]	Sine 2 Ramp	Sine 2 ramp based on the values set in parameter ***3-61 Ramp 3 Ramp Up Time*** and parameter ***3-62 Ramp 3 Ramp Down Time***.

3-61 Ramp 3 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, which is the acceleration time from 0 Hz to the rated motor speed n_S. Select a ramp-up time such that the output current does not exceed the current limit in parameter ***4-18 Current Limit*** during ramping. See ramp-down time in parameter ***3-62 Ramp 3 Ramp Down Time***.

$$\text{Par.}3-61 = \frac{t_{acc}[s] \times n_S[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

3-62 Ramp 3 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, which is the deceleration time from the rated motor speed n_s to 0 Hz. Select a ramp-down time such that no overvoltage arises 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***. See ramp-up time in parameter ***3-61 Ramp 3 Ramp Up Time***.

$$\text{Par.}3-62 = \frac{t_{dec}[s] \times n_S[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

4.4.6 3-7* Ramp 4

This parameter group configures ramp 4 parameters.

3-70 Ramp 4 Type

Default value:	[0] 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. A sine 2 ramp gives non-linear acceleration.

Option	Name	Description
[0]	Linear	Linear ramp.
[2]	Sine 2 Ramp	Sine 2 ramp based on the values set in parameter ***3-71 Ramp 4 Ramp Up Time*** and parameter ***3-72 Ramp 4 Ramp Down Time***.

3-71 Ramp 4 Ramp Up Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-up time, which is the acceleration time from 0 Hz to the rated motor speed n_S. Select a ramp-up time such that the output current does not exceed the current limit in parameter ***4-18 Current Limit*** during ramping. See ramp-down time in parameter ***3-72 Ramp 4 Ramp Down Time***.

$$\text{Par.}3-71 = \frac{t_{acc}[s] \times n_S[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

3-72 Ramp 4 Ramp Down Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)

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Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the ramp-down time, which is the deceleration time from the rated motor speed n_s to 0 Hz. Select a ramp-down time such that no overvoltage arises 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***. See ramp-up time in parameter ***3-71 Ramp 4 Ramp Up Time***.

$$\text{Par.}3-72=\frac{t_{dec}[s]\times n_s[\text{Hz}]}{\text{ref}[\text{Hz}]}$$

4.4.7 3-8* Other Ramps

3-80 Jog Ramp Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the jog ramp time, which is the acceleration/deceleration time between 0 Hz 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 when activating a jog signal via the LCP, a selected digital output, or the serial communication port. When jog state is disabled, the normal ramping times are valid.

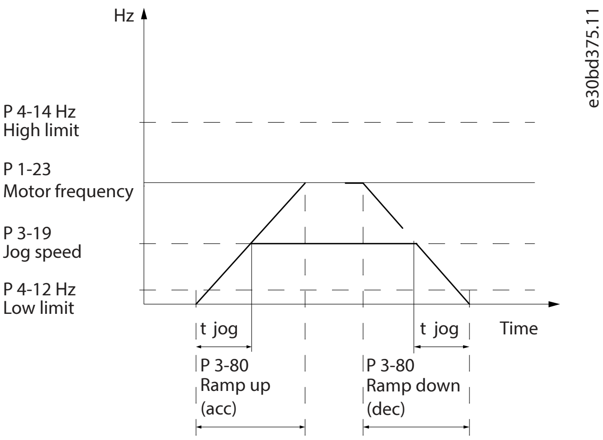

Figure 25: Jog Ramp Time

$$\text{Par.}3-80=\frac{t_{jog}[s]\times n_s[\text{Hz}]}{\Delta\text{jogspeed}(\text{par.}3-19)[\text{Hz}]}$$

3-81 Quick Stop Ramp Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Enter the quick-stop ramp-down time, which is the deceleration time from the synchronous motor speed to 0 Hz. 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***). Activate quick stop with a signal on a selected digital input, or via the serial communication port.

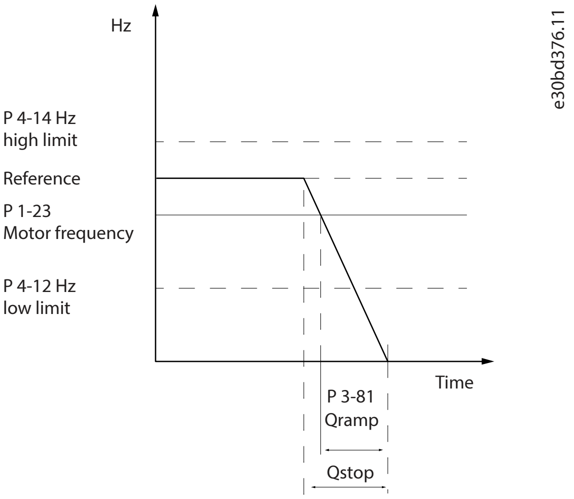

Figure 26: Quick Stop Ramp Time

3-82 Starting Ramp Up Time

Default value:	Size related	**Parameter type:**	Range (0.01–3600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

The starting ramp-up time is the acceleration time from 0 RPM to the nominal motor speed set in parameter ***1-25 Motor Nominal Speed*** when the high starting torque is active.

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, at least 1 digital input must be set to Increase or Decrease.

3-90 Step Size

Default value:	0.10%	**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/decreased by the amount set in this parameter.

3-92 Power Restore

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

Reset or restore the digital potentiometer reference.

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Option	Name	Description
[0]	Off	Reset the digital potentiometer reference to 0% after power-up.
[1]	On	Restore the most recent digital potentiometer power-up.

3-93 Maximum Limit

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

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

3-94 Minimum Limit

Default value:	-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.

3-95 Ramp Delay

Default value:	1000 ms	**Parameter type:**	Range (0–3600000 ms)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**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.

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.

4-10 Motor Speed Direction

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

Select the motor speed direction(s) required. Use this parameter to avoid unwanted reversing.

Option	Name	Description
[0]	Clockwise	Only operation in clockwise direction is allowed. **NOTICE** The setting in parameter ***4-10 Motor Speed Direction*** has impact on parameter ***1-73 Flying Start***.
[2]	Both directions	Operation in both clockwise and counterclockwise directions is allowed.

4-11 Motor Speed Low Limit [RPM]

Default value:	Size related	**Parameter type:**	Range (0–1500 RPM)
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

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

4-12 Motor Speed Low Limit [Hz]

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–400.0 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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

4-13 Motor Speed High Limit [RPM]

Default value:	Size related	**Parameter type:**	Range (0–60000 RPM)
Setup:	All setups	**Conversion index:**	–
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]***.

NOTICE

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

4-14 Motor Speed High Limit [Hz]

Default value:	65.0 Hz	**Parameter type:**	Range (0.1–500 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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Enter the maximum limit for motor speed. The motor speed high limit can be set to correspond to the manufacturer's recommended maximum of the motor shaft. The motor speed high limit must exceed the value in parameter ***4-12 Motor Speed Low Limit [Hz]*** and must not exceed the value in parameter ***4-19 Max Output Frequency***.

NOTICE

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

4-16 Torque Limit Motor Mode

Default value:	Size related	**Parameter type:**	Range (0–1000%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

4-17 Torque Limit Generator Mode

Default value:	100%	**Parameter type:**	Range (0–1000%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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

4-18 Current Limit

Default value:	Size related	**Parameter type:**	Range (0–1000%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the current limit for motor and generator operation. Parameter ***4-18 Current Limit*** changes automatically once the nominal motor current (set in parameter ***1-24 Motor Current***) is updated.

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

4-19 Max Output Frequency

Default value:	Size related	**Parameter type:**	Range (0.0–500.0 Hz)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	False

Provide a final limit on the output frequency for improved safety in applications at risk of overspeeding. This limit is final in all configurations (independent of the setting in parameter ***1-00 Configuration Mode***).

NOTICE

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

4.5.2 4-2* Limit Factors

4-20 Torque Limit Factor Source

Default value:	[0] 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 set to ***[0] Open Loop*** or ***[1] Speed Closed Loop***.

Option	Name
[0]	No function
[2]	Analog in 53
[4]	Analog in 53 inv
[6]	Analog in 54
[8]	Analog in 54 inv
[18]	Bus Control

4-21 Speed Limit Factor Source

Default value:	[0] 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 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 torque mode.

Option	Name
[0]	No function
[2]	Analog in 53
[4]	Analog in 53 inv
[6]	Analog in 54
[8]	Analog in 54 inv
[18]	Bus Control

4-22 Break Away Boost

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

The drive provides higher current than normal current levels to enhance breakaway-torque capacity.

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Option	Name
[0]	Off
[1]	On

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

Set an analog input to scale the motoric power limit set in parameter ***4-82 Power Limit Motor Mode*** from 0% to 100%.

Option	Name
[0]	No function
[2]	Analog in 53
[4]	Analog in 53 inv
[6]	Analog in 54
[8]	Analog in 54 inv

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

Set an analog input to scale the generatoric power limit set in parameter ***4-83 Power Limit Generator Mode*** from 0% to 100%.

Option	Name
[0]	No function
[2]	Analog in 53
[4]	Analog in 53 inv
[6]	Analog in 54
[8]	Analog in 54 inv

4-27 Torque Limit Bus Control

Default value:	0	**Parameter type:**	Range (0–16384)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is used to specify the bus factor to control the torque limit. It only works when parameter ***4-20 Torque Limit Factor Source*** is set to ***[18] Bus Control***.

4-28 Speed Limit Bus Control

Default value:	0	**Parameter type:**	Range (0–16384)

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

This parameter is used to specify the bus factor to control the speed limit. It only works when parameter ***4-21 Speed Limit Factor Source*** is set to ***[18] Bus Control***.

4.5.3 4-3* Motor Fb Monitor

4-30 Motor Feedback Loss Function

Default value:	[2] Trip	**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 if the feedback signal is available. Select the action of the drive if a feedback fault is detected. The selected action takes 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
[0]	Disabled
[1]	Warning
[2]	Trip
[3]	Jog
[4]	Freeze Output
[5]	Max Speed
[6]	Switch to Open Loop

4-31 Motor Feedback Speed Error

Default value:	20 Hz	**Parameter type:**	Range (0–50 Hz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Select the maximum allowed error in speed (output speed versus feedback).

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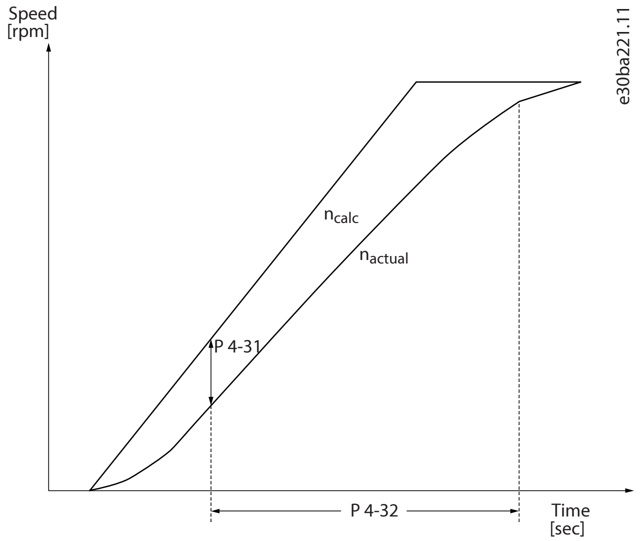

Figure 27: Motor Feedback Speed Error

4-32 Motor Feedback Loss Timeout

Default value:	0.05 s	**Parameter type:**	Range (0.00 s–60.00 s)
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***.

4.5.4 4-4* Adj. Warnings 2

4-40 Warning Freq. Low

Default value:	Size related	**Parameter type:**	Range (0.0–500.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Use this parameter for setting a lower limit for the frequency range. When the motor speed drops below this limit, the display reads Speed low. Warning bit 10 is set in parameter ***16-94 Ext. Status Word***. Output relay can be configured to indicate this warning. LCP warning indicator light is not lit when the limit set is reached. The value must not exceed the setting in parameter ***4-41 Warning Freq. High***.

4-41 Warning Freq. High

Default value:	Size related	**Parameter type:**	Range (0.0–500.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Use this parameter for setting a higher limit for the frequency range. When the motor speed exceeds this limit, the display reads Speed high. Warning bit 9 is set in parameter ***16-94 Ext. Status Word***. Output relay can be configured to indicate this warning. LCP warning indicator light is not lit when the limit set is reached. The value must exceed the value in parameter ***4-40 Warning Freq. Low*** and must not exceed the value in parameter ***4-14 Motor Speed High Limit [Hz]***.

4-42 Adjustable Temperature Warning

Default value:	0	**Parameter type:**	Range (0–200)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Use this parameter to set the motor temperature limit.

4-43 Motor Speed Monitor Function

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

Select how the drive should react when too high speed is detected, that is, when the motor speed signal is higher that the reference after the speed ramp with more than specified in parameter ***4-44 Motor Speed Monitor Max*** during the time set in parameter ***4-45 Motor Speed Monitor Timeout***.

Option	Name
[0]	Disabled
[1]	Warning
[2]	Trip
[12]	Trip/Warning
[13]	Trip/Catch

4-44 Motor Speed Monitor Max

Default value:	300 RPM	**Parameter type:**	Range (10–500 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the maximum allowed speed between the reference after the ramp and the actual mechanical shaft speed.

4-45 Motor Speed Monitor Timeout

Default value:	0.10 s	**Parameter type:**	Range (0.00 s–60.00 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 ***4-44 Motor Speed Monitor Max*** is allowed. If the error goes inside the limit, the counter is reset.

4.5.5 4-5* Adj. Warnings

Use these parameters to adjust warning limits for current, speed, reference, and feedback.

4-50 Warning Current Low

Default value:	0.00 A	**Parameter type:**	Range (0.00–500.00 A)

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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, a bit in the status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

4-51 Warning Current High

Default value:	Size related	**Parameter type:**	Range (0.00–500.00 A)
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, a bit in the status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

4-54 Warning Reference Low

Default value:	-4999.000	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the low reference limit. When the actual reference drops below this limit, the display shows Ref_{LOW}. Bit 20 is set in parameter ***16-94 Ext. Status Word***. The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached.

4-55 Warning Reference High

Default value:	4999.000	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Use this parameter to set a high limit for the reference range. When the actual reference exceeds this limit, the display shows Ref_{HIGH}. Bit 19 is set in parameter ***16-94 Ext. Status Word***. The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached.

4-56 Warning Feedback Low

Default value:	-4999.000 ProcessCtrlUnit	**Parameter type:**	Range (-4999.000–4999.000 ProcessCtrlUnit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Use this parameter to set a low limit for the feedback range. When the feedback drops below this limit, the display shows *Feedb Low*. Bit 6 is set in parameter ***16-94 Ext. Status Word***. The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached.

4-57 Warning Feedback High

Default value:	4999.000 ProcessCtrlUnit	**Parameter type:**	Range (-4999.000–4999.000 ProcessCtrlUnit)

Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Use this parameter to set a high limit for the feedback range. When the feedback exceeds this limit, the display reads *Feedb High*. Bit 5 is set in parameter ***16-94 Ext. Status Word***. The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached.

4-58 Missing Motor Phase Function

Default value:	[1] Trip 10s	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Turn on the missing motor phase function or trip.

Option	Name
[0]	Off
[1]	Trip 10s
[6]	Trip 1s 3ph detec.

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

3-phase motor check at start.

Option	Name
[0]	Off
[1]	On

4.5.6 4-6* Speed Bypass

4-61 Bypass Speed From [Hz]

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–500.0 Hz), Array [4]
Setup:	All setups	**Conversion index:**	-1
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. The bypass speed from must not exceed the setting in parameter ***4-14 Motor Speed High Limit [Hz]***.

4-63 Bypass Speed To [Hz]

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–500.0 Hz), Array [4]
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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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. The bypass speed to must not exceed the setting in parameter ***4-14 Motor Speed High Limit [Hz]***.

4.5.7 4-8* Power Limit

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

The power limit motor mode is defined by parameter ***4-82 Power Limit Motor Mode***.

Option	Name	Description
[0]	Disabled	Disable the function.
[1]	Enabled	Enable the function.
[2]	When Activated	This option requires activation by digital input or configurable control word.

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

The power limit generator mode is defined by parameter ***4-82 Power Limit Motor Mode***.

Option	Name	Description
[0]	Disabled	Disable the function.
[1]	Enabled	Enable the function.
[2]	When Activated	This option requires activation by digital input or configurable control word.

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

The power limit motor mode is defined according to the motor power in parameter ***1-20 Motor Power***.

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

The power limit generator mode is defined according to the motor power in parameter ***1-20 Motor Power***.

4.5.8 4-9* Directional Limits

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
[0]	Disabled
[1]	Speed
[2]	Torque
[3]	Speed and Torque

4-92 Positive Speed Limit [Hz]

Default value:	Size related	**Parameter type:**	Range (0.0–500.0 Hz)
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.

4-94 Negative Speed Limit [Hz]

Default value:	Size related	**Parameter type:**	Range (0.0–500.0 Hz)
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.

4-95 Positive Torque limit

Default value:	Size related	**Parameter type:**	Range (0.0–160.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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

4-96 Negative Torque limit

Default value:	Size related	**Parameter type:**	Range (0.0–160.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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

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4.6 Parameter Group 5-** Digital In/Out

4.6.1 5-0* Digital I/O mode

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

5-00 Digital Input Mode

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

Set NPN or PNP mode for digital inputs.

Option	Name	Description
[0]	PNP	Action on positive directional pulses (0). PNP systems are pulled down to ground (GND).
[1]	NPN	Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the drive.

5-01 Terminal 27 Mode

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

Define terminal 27 as a digital input or output.

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

5-02 Terminal 29 Mode

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

Define terminal 29 as a digital input or output.

Option	Name	Description
[0]	Input	Define terminal 29 as a digital input.
[1]	Output	Define terminal 29 as a digital output.

4.6.2 5-1* Digital Inputs

5-10 Terminal 18 Digital Input

Default value:	[8] Start	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range.

Option	Name	Description
[0]	No operation	No reaction to signals sent to the terminal.
[1]	Reset	Reset the drive after a TRIP/ALARM. Not all alarms can be reset.
[2]	Coast inverse	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). Leave motor in free mode and reset the drive. Logic 0=>coast stop. Logic 1 to Logic 0=>reset.
[4]	Quick stop inverse	Inverted input (NC). Generate a stop in accordance with the 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). Stop the motor by energizing it with a DC current for a certain time period. See parameter ***2-01 DC Brake Current*** to parameter ***2-04 DC Brake Cut In Speed [Hz]***. 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. Generate a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (parameter ***3-42 Ramp 1 Ramp Down Time***, parameter ***3-52 Ramp 2 Ramp Down Time***, parameter ***3-62 Ramp 3 Ramp down Time***, 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 & stop*** and connect this digital output to a digital input that is configured as coast.
[8]	Start	Select start for a start/stop command. Logic 1 = start, logic 0 = stop.
[9]	Latched start	The motor starts when a pulse is applied for minimum 4 ms. The motor stops when stop commands are given.

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Option	Name	Description
[10]	Reversing	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	Disengage the counterclockwise movement and allows clockwise direction.
[13]	Enable start reverse	Disengage the clockwise movement and allows counterclockwise direction.
[14]	Jog	Use to activate jog speed. See parameter ***3-11 Jog Speed [Hz]***.
[15]	Preset reference on	Shift 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 ref. bits 0, 1, and 2 enable the selection of 1 of the 8 preset references according to Table 15.
[17]	Preset ref bit 1	Same as ***[16] Preset ref bit 0***.
[18]	Preset ref bit 2	Same as ***[16] Preset ref bit 0***.
[19]	Freeze reference	Freeze the actual reference, which is now the point of enable/condition for ***[21] Speed up*** and ***[22] Speed down*** to be used. If ***[21] Speed up*** or ***[22] 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	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for ***[21] Speed up*** and ***[22] Speed down*** to be used. If ***[21] Speed up*** or ***[22] 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 ***[20] Freeze output*** is active, the drive cannot be stopped by setting the signal on ***[8] Start*** to low. Stop the drive via a terminal programmed for ***[2] Coasting inverse*** or ***[3] Coast and reset inverse***.

Option	Name	Description
[21]	Speed up	Select ***[21] Speed up*** and ***[22] Speed down*** if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either ***[19] Freeze reference*** 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 parameter ***3-51 Ramp 2 Ramp Up Time***/parameter ***3-52 Ramp 2 Ramp Down Time***. See Table 16.
[22]	Speed down	Same as ***[21] Speed up***.
[23]	Set-up select bit 0	Select ***[23] Set-up select bit 0*** to select 1 of the 2 setups. Set parameter ***0-10 Active Set-up*** to ***[9] Multi Set-up***.
[28]	Catch up	Increase reference value by percentage (relative) set in parameter ***3-12 Catch Up/Slow Down Value***.
[29]	Slow down	Reduce reference value by percentage (relative) set in parameter ***3-12 Catch Up/Slow Down Value***.
[34]	Ramp bit 0	Enable a selection from the 4 ramps available, according to Table 17.
[35]	Ramp bit 1	Same as ***[34] Ramp bit 0***.
[45]	Latched start reverse	The motor starts to run reverse when a pulse is applied for minimum 4 ms. The motor stops when stop commands are given.
[51]	External Interlock	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	Clear the digital potentiometer reference described in parameter group ***3-9* Digital Pot. Meter***.
[60]	Counter A (up)	Input for increment counting in the SLC counter.
[61]	Counter A (down)	Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B (up)	Input for increment counting in the SLC counter.
[64]	Counter B (down)	Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[72]	PID error inverse	Invert the calculated error from the Process PID Controller. Available only if parameter ***1-00 Configuration Mode*** is set to ***[6] Surface Winder*** or ***[7] Extended PID Speed OL***.
[73]	PID reset I part	Reset the I-part of the Process PID Controller. Equivalent to parameter ***7-40 Process PID I-part Reset***. Available only when parameter ***1-00 Configuration Mode*** is set to ***[6] Surface Winder*** or ***[7] Extended PID Speed OL***.

Option	Name	Description
[74]	PID enable	This option 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***.
[150]	Homing Start	The drive moves to the home position.
[151]	Home Ref. Switch	Indicate the status of the home referenced switch. *On* means that the home position is reached, *Off* means that the home position is not reached.
[155]	HW Limit Positive Inv	The positive hardware position limit is exceeded. This option is active on the falling edge.
[156]	HW Limit Negative Inv	The negative hardware position limit is exceeded. This option is active on the falling edge.
[157]	Pos. Quick Stop Inv	Stop the drive during positioning with the ramp time that is set in parameter ***32-81 Motion Ctrl Quick Stop Ramp***. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[158]	Pos. Jog Forward	
[159]	Pos. Jog Reverse	
[160]	Positioning Start	The drive moves to the target position. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[162]	Pos. Idx Bit0	Position index bit 0. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[163]	Pos. Idx Bit1	Position index bit 1. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[164]	Pos. Idx Bit2	Position index bit 2. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[231]	Power Limit Mot.	
[232]	Power Limit Gen.	
[233]	Power Limit Both	

Table 15: Preset Ref. 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. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

Table 16: 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 17: Preset Ramp Bits

Preset ramp bit	1	0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Ramp 4	1	1

5-11 Terminal 19 Digital Input

Default value:	[10] Reversing	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range.

For the options of parameter ***5-11 Terminal 19 Digital Input***, see parameter ***5-10 Terminal 18 Digital Input***.

5-12 Terminal 27 Digital Input

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

Select the function from the available digital input range.

For the options of parameter ***5-12 Terminal 27 Digital Input***, see parameter ***5-10 Terminal 18 Digital Input***.

5-13 Terminal 29 Digital Input

Default value:	[14] Jog	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range.

For the options of parameter ***5-13 Terminal 29 Digital Input***, see parameter ***5-10 Terminal 18 Digital Input***.

5-14 Terminal 32 Digital Input

Default value:	[0] No operation	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

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

Select the function from the available digital input range.

For the options of parameter ***5-14 Terminal 32 Digital Input***, see parameter ***5-10 Terminal 18 Digital Input***.

5-15 Terminal 33 Digital Input

Default value:	[16] Preset ref bit 0	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the function from the available digital input range.

For the options of parameter ***5-15 Terminal 33 Digital Input***, see parameter ***5-10 Terminal 18 Digital Input***.

5-16 Terminal 31 Digital Input

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

Select the function from the available digital input range.

For the options of parameter ***5-16 Terminal 31 Digital Input***, see parameter ***5-10 Terminal 18 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***. Terminals 42 and 45 can also be configured as digital outputs.

NOTICE

These parameters cannot be adjusted while the motor is running.

5-30 Terminal 27 Digital Output

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

Select the function to control the digital output.

Option	Name	Description
[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 board.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Stand-by/no warning	Ready for operation. No start or stop command is given (start/disable). No warnings are active.

Option	Name	Description
[5]	Running	The motor is running and shaft torque is present.
[6]	Running/no warning	The motor is running and there are no warnings.
[7]	Run in range/no warn	The motor is running within the programmed current and speed ranges set in parameter ***4-50 Warning Current Low*** to parameter ***4-51 Warning Current High***. There are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output.
[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 frequency range	Output frequency is outside the frequency range.
[16]	Below frequency, low	The output speed is lower than the setting in parameter ***4-40 Warning Freq. Low***.
[17]	Above frequency, high	The output speed is higher than the setting in parameter ***4-41 Warning Freq. High***.
[18]	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***.
[19]	Below feedback, low	The feedback is below the limit set in parameter ***4-56 Warning Feedback Low***.
[20]	Above feedback, high	The 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 warning	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, no over-/undervoltage	The drive is ready for operation and the mains voltage is within the specified voltage range (see the *Specifications* section in the design guide).
[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.

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Option	Name	Description
[27]	Torque limit & stop	Use in performing a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake warning	The brake is active and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[31]	Relay 123	The relay is activated when ***[0] Control Word*** is selected in parameter group ***8-** Communications and Options***.
[32]	Mech brake ctrl	Enable control of an external mechanical brake. See parameter group ***2-2* Mechanical Brake***for more details.
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	This option is active when the actual speed is outside the settings in parameter ***4-54 Warning Reference Low*** to parameter ***4-55 Warning Reference High***.
[41]	Below reference, low	This option is active when the actual speed is below the speed reference setting.
[42]	Above ref, high	This option is active when the actual speed is above the speed reference setting.
[43]	Extended PID Limit	
[45]	Bus ctrl.	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. The output state is retained in the event of fieldbus timeout.
[46]	Bus control, timeout: On	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. When bus timeout occurs, the output state is set high (On).
[47]	Bus control, timeout: Off	
[55]	Pulse output	
[56]	Heat sink cleaning warning, high	
[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.

Option	Name	Description
[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.
[91]	Encoder emulate output A	
[95]	Power Loss Detection	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command active	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[168]	Drive in hand mode	The output is high when the drive is in hand-on mode.
[169]	Drive in auto mode	The output is high when the drive is in auto-on mode.

Option	Name	Description
[170]	Homing Completed	The homing operation is completed. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[171]	Target Position Reached	The target position is reached. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[172]	Position Control Fault	A fault occurred in the positioning process. Refer to parameter ***37-18 Pos. Ctrl Fault Reason***for details about the fault. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[193]	Sleep Mode	The drive/system has entered sleep mode. See parameter group ***22-4* Sleep Mode***.
[194]	Broken Belt Function	A broken belt condition has been detected. See parameter group ***22-4* Sleep Mode***.

5-31 Terminal 29 Digital Output

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

Select the function to control the digital output.

Option	Name	Description
[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 board.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Stand-by/no warning	Ready for operation. No start or stop command is given (start/ disable). No warnings are active.
[5]	Running	The motor is running and shaft torque is present.
[6]	Running/no warning	The motor is running and there are no warnings.
[7]	Run in range/no warn	The motor is running within the programmed current and speed ranges set in parameter ***4-50 Warning Current Low*** to parameter ***4-51 Warning Current High***. There are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in parameter ***4-16 Torque Limit Motor Mode***, or parameter ***4-17 Torque Limit Generator Mode*** has been exceeded.
[12]	Out of current range	The motor current is outside the range set in parameter ***4-18 Current Limit***.

Option	Name	Description
[13]	Below current, low	The motor current is lower than set in parameter ***4-50 Warning Current Low***.
[14]	Above current, high	The motor current is higher than set in parameter ***4-51 Warning Current High***.
[15]	Out of frequency range	Output frequency is outside the frequency range.
[16]	Below frequency, low	The output speed is lower than the setting in parameter ***4-40 Warning Freq. Low***.
[17]	Above frequency, high	The output speed is higher than the setting in parameter ***4-41 Warning Freq. High***.
[18]	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***.
[19]	Below feedback, low	The feedback is below the limit set in parameter ***4-56 Warning Feedback Low***.
[20]	Above feedback, high	The 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 warning	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, no over-/undervoltage	The drive is ready for operation and the mains voltage is within the specified voltage range (see the *Specifications* section in the design guide).
[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 in performing a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake warning	The brake is active and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[31]	Relay 123	The relay is activated when ***[0] Control Word*** is selected in parameter group ***8-** Communications and Options***.
[32]	Mech brake ctrl	Enable control of an external mechanical brake. See parameter group ***2-2* Mechanical Brake*** for more details.
[36]	Control word bit 11	

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Option	Name	Description
[37]	Control word bit 12	
[40]	Out of ref range	This option is active when the actual speed is outside the settings in parameter ***4-54 Warning Reference Low*** to parameter ***4-55 Warning Reference High***.
[41]	Below reference, low	This option is active when the actual speed is below the speed reference setting.
[42]	Above ref, high	This option is active when the actual speed is above the speed reference setting.
[43]	Extended PID Limit	
[45]	Bus ctrl.	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. The output state is retained in the event of fieldbus timeout.
[46]	Bus control, timeout: On	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. When bus timeout occurs, the output state is set high (On).
[47]	Bus control, timeout: Off	
[55]	Pulse output	
[56]	Heat sink cleaning warning, high	
[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.

Option	Name	Description
[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.
[92]	Encoder emulate output B	
[95]	Power Loss Detection	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command active	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[168]	Drive in hand mode	The output is high when the drive is in hand-on mode.
[169]	Drive in auto mode	The output is high when the drive is in auto-on mode.
[170]	Homing Completed	The homing operation is completed. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[171]	Target Position Reached	The target position is reached. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[172]	Position Control Fault	A fault occurred in the positioning process. Refer to parameter ***37-18 Pos. Ctrl Fault Reason***for details about the fault. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[193]	Sleep Mode	The drive/system has entered sleep mode. See parameter group ***22-4* Sleep Mode***.
[194]	Broken Belt Function	A broken belt condition has been detected. See parameter group ***22-4* Sleep Mode***.

5-34 On Delay, Digital Output

Default value:	0.01 s	**Parameter type:**	Range (0.00 s–600.00 s)

Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the digital output on delay time.

5-35 Off Delay, Digital Output

Default value:	0.01 s	**Parameter type:**	Range (0.00 s–600.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the digital output off delay time.

4.6.4 5-4* Relays

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

The parameter is an array parameter showing 2 relays: Array [2] (Relay 1 [0], Relay 2 [1]).

5-40 Function Relay

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

Select the function to control the output relays.

Option	Name	Description
[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 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]	Stand-by/no warning	Ready for operation. No start or stop command is given (start/disable). No warnings are active.
[5]	Running	The motor is running and shaft torque is present.
[6]	Running/no warning	The motor is running and there are no warnings.
[7]	Run in range/no warn	The motor is running within the programmed current and speed ranges set in parameter ***4-50 Warning Current Low*** to parameter ***4-51 Warning Current High***. There are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in parameter ***4-16 Torque Limit Motor Mode*** or parameter ***4-17 Torque Limit Generator Mode***has been exceeded.
[12]	Out of current range	The motor current is outside the range set in parameter ***4-18 Current Limit***.

Option	Name	Description
[13]	Below current, low	The motor current is lower than set in parameter ***4-50 Warning Current Low***.
[14]	Above current, high	The motor current is higher than set in parameter ***4-51 Warning Current High***.
[15]	Out of frequency range	Output frequency is outside the frequency range.
[16]	Below frequency, low	The output speed is lower than the setting in parameter ***4-40 Warning Freq. Low***.
[17]	Above frequency, high	The output speed is higher than the setting in parameter ***4-41 Warning Freq. High***.
[18]	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***.
[19]	Below feedback, low	The feedback is below the limit set in parameter ***4-56 Warning Feedback Low***.
[20]	Above feedback, high	The 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 warning	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, no over-/undervoltage	The drive is ready for operation and the mains voltage is within the specified voltage range (see *Specifications* section in the design guide).
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and counterclockwise when logic = 1. The output changes when the reversing signal is applied.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Use in performing a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake warning	The brake is active and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[31]	Relay 123	The relay is activated when ***[0] Control Word*** is selected in parameter group ***8-** Communications and Options***.

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Option	Name	Description
[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. This issue is solved by connecting an external relay to the selected digital output.
[36]	Control word bit 11	Activate relay 1 by a control word from the fieldbus. No other functional impact on the drive. Typical application: Controlling an auxiliary device from a fieldbus. The function is valid when ***[0] FC Profile*** is selected in parameter ***8-10 Control Word Profile***.
[37]	Control word bit 12	Activate relay 2 by a control word from the fieldbus. No other functional impact on the drive. Typical application: Controlling an auxiliary device from a fieldbus. The function is valid when ***[0] FC Profile*** is selected in parameter ***8-10 Control Word Profile***.
[40]	Out of ref range	This option is active when the actual speed is outside the settings in parameter ***4-54 Warning Reference Low*** to parameter ***4-55 Warning Reference High***.
[41]	Below reference, low	This option is active when the actual speed is below the speed reference setting.
[42]	Above ref, high	This option is active when the actual speed is above the speed reference setting.
[45]	Bus ctrl.	Control the digital output/relay via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. The output state is retained in the event of fieldbus timeout.
[46]	Bus control, timeout: On	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. When bus timeout occurs, the output state is set high (On).
[47]	Bus control, timeout: Off	Control output via bus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. When a bus timeout occurs, the output state is set low (off).
[56]	Heat sink cleaning warning, high	
[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.

Option	Name	Description
[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***. Output A is low on ***[32] Smart Logic Action***. Output A is high on ***[38] Smart Logic Action***.
[81]	SL digital output B	See parameter ***13-52 SL Controller Action***. Output B is low on ***[32] Smart Logic Action***. Output B is high on ***[38] Smart Logic Action***.
[82]	SL digital output C	See parameter ***13-52 SL Controller Action***. Output C is low on ***[32] Smart Logic Action***. Output C is high on ***[38] Smart Logic Action***.
[83]	SL digital output D	See parameter ***13-52 SL Controller Action***. Output D is low on ***[32] Smart Logic Action***. Output D is high on ***[38] Smart Logic Action***.
[95]	Power Loss Detection	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command active	The output is high when there is an active start command, and no stop command is active.
[168]	Drive in hand mode	The output is high when the drive is in hand-on mode.
[169]	Drive in auto mode	The output is high when the drive is in auto-on mode.
[170]	Homing Completed	The homing operation is completed. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[171]	Target Position Reached	The target position is reached. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[172]	Position Control Fault	A fault occurred in the positioning process. Refer to parameter ***37-18 Pos. Ctrl Fault Reason*** for details about the fault. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[193]	Sleep Mode	The drive/system has entered sleep mode. See parameter group ***22-4* Sleep Mode***.
[194]	Broken Belt Function	A broken belt condition has been detected. See parameter group ***22-4* Sleep Mode***.

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5-41 On Delay, Relay

Default value:	0.01 s	**Parameter type:**	Range (0.00–600.00 s), Array [2]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the delay of the relay cut-in time. The relay only cuts in if the condition in parameter ***5-40 Function Relay*** is uninterrupted during the specified time.

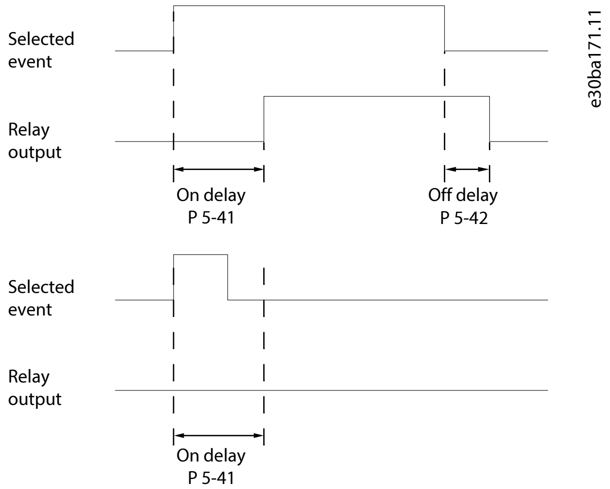

Figure 28: On Delay, Relay

5-42 Off Delay, Relay

Default value:	0.01 s	**Parameter type:**	Range (0.00–600.00 s), Array [2]
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the delay of the relay cutout time.

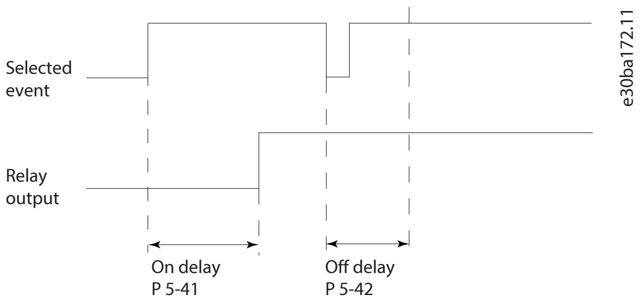

Figure 29: Off Delay, Relay

If the selected event condition changes before the on- 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, then set parameter ***5-02 Terminal 29 Mode*** to ***[0] Input***.

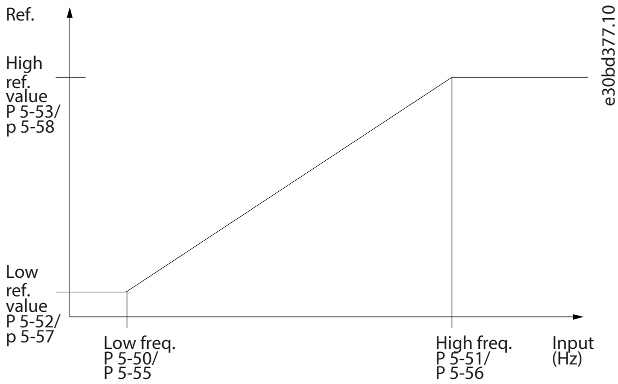

Figure 30: Pulse Input

5-50 Term. 29 Low Frequency

Default value:	4 Hz	**Parameter type:**	Range (4–31999 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 (which is low reference value) in parameter ***5-52 Term. 29 Low Ref./Feedb. Value***.

5-51 Term. 29 High Frequency

Default value:	32000 Hz	**Parameter type:**	Range (5–32000 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 (which is high reference value) in parameter ***5-53 Term. 29 High Ref./Feedb. Value***.

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

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the low reference value limit for the motor shaft speed [Hz]. This value 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*** and parameter ***5-13 Terminal 29 Digital Input***= applicable value).

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

Default value:	Size related	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the high reference value [Hz] 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).

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5-54 Term.29 Pulse Filter Time Constant

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, an advantage when there is a lot of noise. A high value results in better dampening but also increases the time delay through the filter.

5-55 Term. 33 Low Frequency

Default value:	4 Hz	**Parameter type:**	Range (4–31999 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 (which is low reference value) in parameter ***5-57 Term. 33 Low Ref./ Feedb. Value***.

5-56 Term. 33 High Frequency

Default value:	32000 Hz	**Parameter type:**	Range (5–32000 Hz)
Setup:	All setups	**Conversion index:**	–
Data type:	Uint32	**Change during operation:**	True

Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in parameter ***5-58 Term. 33 High Ref./Feedb. Value***.

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

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the low reference value [Hz] for the motor shaft speed. This value is also the low feedback value. See also parameter ***5-52 Term. 29 Low Ref./Feedb. Value***.

5-58 Term. 33 High Ref./Feedb. Value

Default value:	Size related	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the high reference value [Hz] for the motor shaft speed. See also parameter ***5-53 Term. 29 High Ref./ Feedb. Value***.

5-59 Term.33 Pulse Filter Time Constant

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, an advantage when there is a lot of noise. A high value results in better dampening but also increases the time delay through the filter.

4.6.6 5-6* Pulse Output

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

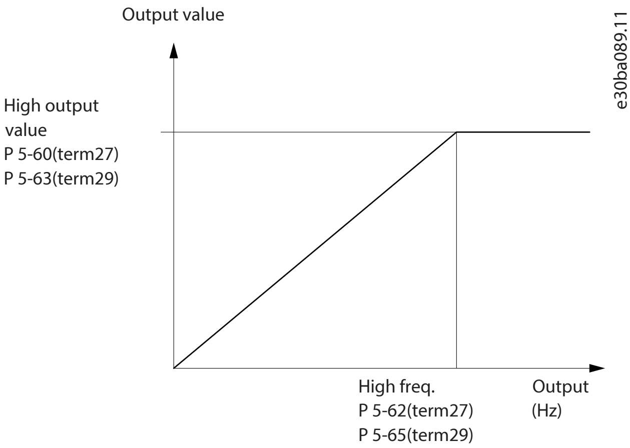

Figure 31: Configuration of Pulse Outputs

NOTICE

These parameters cannot be adjusted while the motor is running.

5-60 Terminal 27 Pulse Output Variable

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

Select the desired output on terminal 27.

Option	Name
[0]	No operation
[45]	Bus ctrl.
[48]	Bus ctrl., timeout
[100]	Output frequency
[101]	Reference
[102]	Process Feedback
[103]	Motor Current
[104]	Torque rel to limit
[105]	Torq relate to rated
[106]	Power
[107]	Speed
[109]	Max Out Freq

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Option	Name
[113]	PID Clamped Output
[143]	Ext. CL 1

5-62 Pulse Output Max Freq 27

Default value:	5000 Hz	**Parameter type:**	Range (4–32000 Hz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set the maximum frequency for terminal 27, corresponding to the output variable selected in parameter ***5-60 Terminal 27 Pulse Output Variable***.

5-63 Terminal 29 Pulse Output Variable

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

Select the variable for viewing on the terminal 29 display.

Option	Name
[0]	No operation
[45]	Bus ctrl.
[48]	Bus ctrl., timeout
[100]	Output frequency
[101]	Reference
[102]	Process Feedback
[103]	Motor Current
[104]	Torque rel to limit
[105]	Torq relate to rated
[106]	Power
[107]	Speed
[109]	Max Out Freq
[113]	PID Clamped Output
[143]	Ext. CL 1

5-65 Pulse Output Max Freq 29

Default value:	5000 Hz	**Parameter type:**	Range (4–32000 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 set in parameter ***5-63 Terminal 29 Pulse Output Variable***.

4.6.7 5-7* 24V 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 ***7-00 Speed PID Feedback Source***. The encoder is a dual channel (A and B) 24 V type. Maximum input frequency: 32 kHz.

Encoder connection to the drive

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

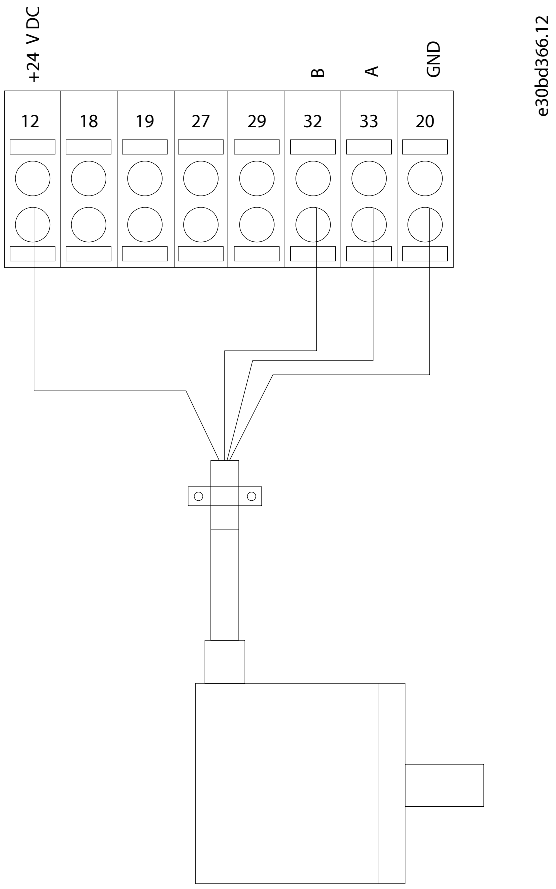

Figure 32: 24 V or 10–30 V Encoder Connection

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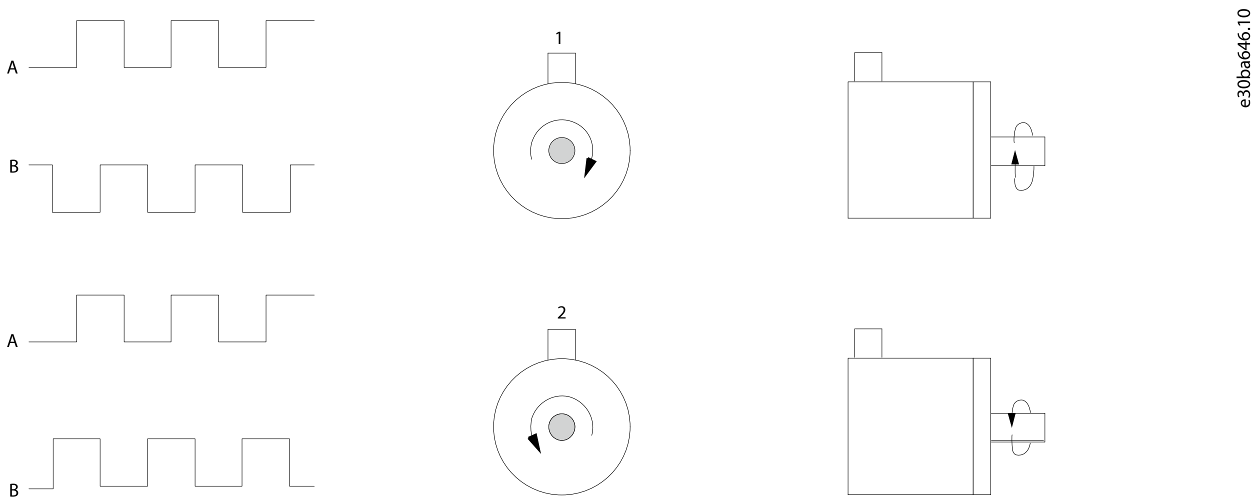

Figure 33: Encoder Rotation Direction

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 encoder pulses per revolution on the motor shaft. Read the correct value from the encoder.

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

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

Option	Name	Description
[0]	Clockwise	Set channel A 90° (electrical degrees) behind channel B after clockwise rotation of the encoder shaft.
[1]	Counterclockwise	Set channel A 90° (electrical degrees) ahead of channel B after clockwise rotation of the encoder shaft.

4.6.8 5-9* Bus Controlled

This parameter group selects digital and relay outputs via a fieldbus setting.

5-90 Digital & Relay Bus Control

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFF)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter holds the state of the bus-controlled digital outputs and relays. A logical 1 indicates that the output is high or active. A logical 0 indicates that the output is low or inactive.

Table 18: Bit Functions

Bit 0	Digital output terminal 27
Bit 1	Digital output terminal 29
Bit 2–3	Reserved
Bit 4	Relay 1 output terminal
Bit 6–23	Reserved
Bit 24	Terminal 42 digital output
Bit 26–31	Reserved

5-93 Pulse Out 27 Bus Control

Default value:	0.00%	**Parameter type:**	Range (0.00–100.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to the output terminal 27 when the terminal is configured as ***[45] Bus Controlled*** in parameter ***5-60 Terminal 27 Pulse Output Variable***.

5-94 Pulse Out 27 Timeout Preset

Default value:	0.00%	**Parameter type:**	Range (0.00–100.00%)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to the output terminal 27 when the terminal is configured as ***[48] Bus Ctrl Timeout*** in parameter ***5-60 Terminal 27 Pulse Output Variable*** and a timeout is detected.

5-95 Pulse Out 29 Bus Control

Default value:	0.00%	**Parameter type:**	Range (0.00–100.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to the output terminal 29 when the terminal is configured as ***[45] Bus Controlled*** in parameter ***5-63 Terminal 29 Pulse Output Variable***.

5-96 Pulse Out 29 Timeout Preset

Default value:	0.00%	**Parameter type:**	Range (0.00–100.00%)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Set the output frequency transferred to the 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.

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4.7 Parameter Group 6-** Analog In/Out

4.7.1 Introduction

Parameter group for setting up the analog I/O configuration and the digital output.

The drive provides 2 analog inputs:

- Terminal 53
- Terminal 54

The analog inputs can be freely allocated to either voltage (0–10 V) or current input (0/4–20 mA).

4.7.2 6-0* Analog I/O Mode

6-00 Live Zero Timeout Time

Default value:	10 s	**Parameter type:**	Range (1–99 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the timeout time.

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. The function set in parameter ***6-01 Live Zero Timeout Function*** is activated 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***, or parameter ***6-22 Terminal 54 Low Current*** for a time period defined in parameter ***6-00 Live Zero Timeout Time***.

Option	Name
[0]	Off
[1]	Freeze output
[2]	Stop
[3]	Jogging
[4]	Max. speed
[5]	Stop and trip

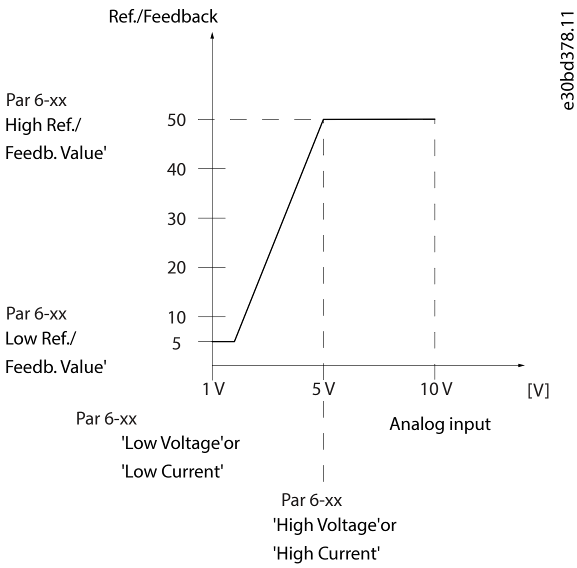

Figure 34: Timeout Function

4.7.3 6-1* Analog Input 53

Parameters for configuring the scaling and limits for analog input 53 (terminal 53).

6-10 Terminal 53 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range (0.00–10.00 V)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the voltage (V) that corresponds to parameter ***6-14 Terminal 53 Low Ref./Feedb. Value***. To activate parameter ***6-01 Live Zero Timeout Function***, set the value to >1 V.

6-11 Terminal 53 High Voltage

Default value:	10.00 V	**Parameter type:**	Range (0.00–10.00 V)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the voltage (V) that corresponds to the high reference value (set in parameter ***6-15 Terminal 53 High Ref./Feedb. Value***).

6-12 Terminal 53 Low Current

Default value:	4.0 mA	**Parameter type:**	Range (0.00–20.00 mA)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the low current value. This reference signal corresponds to the low reference feedback value that is set in parameter ***6-14 Terminal 53 Low Ref./Feedb. Value***. To activate parameter ***6-01 Live Zero Timeout Function***, set the value to >2 mA.

6-13 Terminal 53 High Current

Default value:	20.00 mA	**Parameter type:**	Range (0.00–20.00 mA)

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Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the high current value corresponding to the high reference/feedback set in parameter ***6-15 Terminal 53 High Ref./Feedb. Value***.

6-14 Terminal 53 Low Ref./Feedb. Value

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value that corresponds to the voltage or current set in parameter ***6-10 Terminal 53 Low Voltage*** to parameter ***6-12 Terminal 53 Low Current***.

6-15 Terminal 53 High Ref./Feedb. Value

Default value:	Size related	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value that corresponds to the voltage or current set in parameter ***6-11 Terminal 53 High Voltage*** to parameter ***6-13 Terminal 53 High Current***.

6-16 Terminal 53 Filter Time Constant

Default value:	0.01 s	**Parameter type:**	Range (0.01–10.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the time constant. This constant is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening, but also increases the time delay through the filter.

6-17 Terminal 53 Live Zero

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

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are used to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name
[0]	Disabled
[1]	Enabled

6-19 Terminal 53 mode

Default value:	[1] Voltage mode	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

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

Select whether terminal 53 is used for current or voltage input.

Option	Name
[0]	Current mode
[1]	Voltage mode

4.7.4 6-2* Analog Input 54

Parameters for configuring the scaling and limits for analog input 54 (terminal 54).

6-20 Terminal 54 Low Voltage

Default value:	0.07 V	**Parameter type:**	Range (0.00–10.00 V)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the voltage (V) that corresponds to the low reference value (set in parameter ***6-24 Terminal 54 Low Ref./Feedb. Value***). To activate parameter ***6-01 Live Zero Timeout Function***, set the value to >1 V.

6-21 Terminal 54 High Voltage

Default value:	10.00 V	**Parameter type:**	Range (0.00–10.00 V)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the voltage (V) that corresponds to the high reference value (set in parameter ***6-25 Terminal 54 High Ref./Feedb. Value***).

6-22 Terminal 54 Low Current

Default value:	4.00 mA	**Parameter type:**	Range (0.00–20.00 mA)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the low current value. This reference signal corresponds to the low reference feedback value set in parameter ***6-24 Terminal 54 Low Ref./Feedb. Value***. To activate the Live Zero Timeout function in parameter ***6-01 Live Zero Timeout Function***, set the value to >2 mA.

6-23 Terminal 54 High Current

Default value:	20.00 mA	**Parameter type:**	Range (0.00–20.00 mA)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the high current value corresponding to the high reference feedback value set in parameter ***6-25 Terminal 54 High Ref./Feedb. Value***.

6-24 Terminal 54 Low Ref./Feedb. Value

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)

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Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value that corresponds to the voltage or current set in parameter ***6-21 Terminal 54 High Voltage***/ parameter ***6-22 Terminal 54 Low Current***.

6-25 Terminal 54 High Ref./Feedb. Value

Default value:	Size related	**Parameter type:**	Range (-4999.000–4999.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Enter the reference or feedback value that corresponds to the voltage or current set in parameter ***6-21 Terminal 54 High Voltage***/ parameter ***6-23 Terminal 54 High Current***.

6-26 Terminal 54 Filter Time Constant

Default value:	0.01 s	**Parameter type:**	Range (0.01–10.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Enter the time constant, which is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening, but also increases the time delay through the filter.

6-27 Terminal 54 Live Zero

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

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are used to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name
[0]	Disabled
[1]	Enabled

6-29 Terminal 54 mode

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

Select if terminal 54 is used for current input or voltage input.

Option	Name
[0]	Current mode
[1]	Voltage mode

4.7.5 6-7* Analog/Digital Output 45

Parameters for configuring the scaling and limits for analog/digital output terminal 45. Analog outputs are current outputs: 0/4–20 mA. Resolution on analog output is 12 bit. Analog output terminals can also be set up as digital output.

6-70 Terminal 45 Mode

Default value:	[0] 0-20 mA	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set terminal 45 to act as analog output or as digital output.

Option	Name
[0]	0-20 mA
[1]	4-20 mA
[2]	Digital Output

6-71 Terminal 45 Analog 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 45 as an analog current output.

Option	Name	Range
[0]	No operation	
[100]	Output frequency	0–100 Hz
[101]	Reference	Min_{Ref}–Max_{Ref}
[102]	Process Feedback	Min_{FB}–Max_{FB}
[103]	Motor Current	0–I_{max}
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	0–P_{nom}
[107]	Speed	
[109]	Max Out Freq	
[111]	Speed Feedback	
[113]	PID Clamped Output	
[139]	Bus Control	0–100%
[143]	Ext. CL 1	
[254]	DC Link Voltage	

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6-72 Terminal 45 Digital Output

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

Select the function of terminal 45 as a digital current output. See also parameter ***6-70 Terminal 45 Mode***.

Option	Name	Description
[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 board.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Stand-by/no warning	Ready for operation. No start or stop command is given (start/ disable). No warnings are active.
[5]	Running	The motor is running and shaft torque is present.
[6]	Running/no warning	The motor is running and there are no warnings.
[7]	Run in range/no warn	The motor is running within the programmed current and speed ranges set in parameter ***4-50 Warning Current Low*** to parameter ***4-51 Warning Current High***. There are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output.
[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 frequency range	Output frequency is outside the frequency range.
[16]	Below frequency, low	The output speed is lower than the setting in parameter ***4-40 Warning Freq. Low***.
[17]	Above frequency, high	The output speed is higher than the setting in parameter ***4-41 Warning Freq. High***.
[18]	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***.
[19]	Below feedback, low	The feedback is below the limit set in parameter ***4-56 Warning Feedback Low***.
[20]	Above feedback, high	The feedback is above the limit set in parameter ***4-57 Warning Feedback High***.

Option	Name	Description
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[22]	Ready, no thermal warning	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, no over-/undervoltage	The drive is ready for operation and the mains voltage is within the specified voltage range (see the *Specifications* section in the design guide).
[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 in performing a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake warning	The brake is active and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[31]	Relay 123	The relay is activated when ***[0] Control Word*** is selected in parameter group ***8-** Communications and Options***.
[32]	Mech brake ctrl	Enable control of an external mechanical brake. See parameter group ***2-2* Mechanical Brake*** for more details.
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	This option is active when the actual speed is outside the settings in parameter ***4-54 Warning Reference Low*** to parameter ***4-55 Warning Reference High***.
[41]	Below reference, low	This option is active when the actual speed is below the speed reference setting.
[42]	Above ref, high	This option is active when the actual speed is above the speed reference setting.
[45]	Bus ctrl.	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. The output state is retained in the event of fieldbus timeout.
[46]	Bus control, timeout: On	Control output via fieldbus. The state of the output is set in parameter ***5-90 Digital & Relay Bus Control***. When bus timeout occurs, the output state is set high (On).
[47]	Bus control, timeout: Off	

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Option	Name	Description
[56]	Heat sink cleaning warning, high	
[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.
[95]	Power Loss Detection	
[160]	No alarm	The output is high when no alarm is present.

Option	Name	Description
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command active	The output is high when the drive is running counterclockwise (the logical product of the status bits Running AND Reverse).
[168]	Drive in hand mode	The output is high when the drive is in hand-on mode.
[169]	Drive in auto mode	The output is high when the drive is in auto-on mode.
[170]	Homing Completed	The homing operation is completed. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[171]	Target Position Reached	The target position is reached. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[172]	Position Control Fault	A fault occurred in the positioning process. Refer to parameter ***37-18 Pos. Ctrl Fault Reason***for details about the fault. This option is only effective when parameter ***37-00 Application Mode*** is set to ***[2] Position Control***.
[193]	Sleep Mode	The drive/system has entered sleep mode. See parameter group ***22-4* Sleep Mode***.
[194]	Broken Belt Function	A broken belt condition has been detected. See parameter group ***22-4* Sleep Mode***.
[198]	Drive Bypass	

6-73 Terminal 45 Output Min Scale

Default value:	0.00%	**Parameter type:**	Range (0.00–200.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Scale for the minimum output (0 or 4 mA) of the analog signal at terminal 45. Set the value to be the percentage of the full range of the variable selected in parameter ***6-71 Terminal 45 Analog Output***.

6-74 Terminal 45 Output Max Scale

Default value:	100.00%	**Parameter type:**	Range (0.00–200.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Scale for the maximum output (20 mA) of the analog signal at terminal 45. Set the value to be the percentage of the full range of the variable selected in parameter ***6-71 Terminal 45 Analog Output***.

6-76 Terminal 45 Output Bus Control

Default value:	0	**Parameter type:**	Range (0–16384)
Setup:	All setups	**Conversion index:**	0

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

Hold the level of analog output if controlled by bus.

4.7.6 6-9* Analog/Digital Output 42

Parameters for configuring the limits for analog/digital output terminal 42. Analog outputs are current outputs: 0/4–20 mA. Resolution on analog outputs is 12 bit. Analog output terminals can also be set up as digital output.

6-90 Terminal 42 Mode

Default value:	[0] 0-20 mA	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Set terminal 42 to act as analog output or as digital output.

Option	Name
[0]	0-20 mA
[1]	4-20 mA
[2]	Digital Output

6-91 Terminal 42 Analog 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.

Option	Name	Range
[0]	No operation	
[100]	Output frequency	0–100 Hz
[101]	Reference	Min_{Ref}–Max_{Ref}
[102]	Process Feedback	Min_{FB}–Max_{FB}
[103]	Motor Current	0–I_{max}
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	0–P_{nom}
[107]	Speed	
[109]	Max Out Freq	
[111]	Speed Feedback	
[113]	PID Clamped Output	
[139]	Bus Control	0–100%

Option	Name	Range
[143]	Ext. CL 1	
[254]	DC Link Voltage	

6-92 Terminal 42 Digital Output

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

For the options of parameter ***6-92 Terminal 42 Digital Output***, see parameter ***6-72 Terminal 45 Digital Output***.

6-93 Terminal 42 Output Min Scale

Default value:	0.00%	**Parameter type:**	Range (0.00–200.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**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 ***6-91 Terminal 42 Analog Output***.

6-94 Terminal 42 Output Max Scale

Default value:	100.00%	**Parameter type:**	Range (0.00–200.00%)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

Scale for maximum output (20 mA) of the scaling at terminal 42. Set the value to be the percentage of the full range of the variable selected in parameter ***6-91 Terminal 42 Analog Output***.

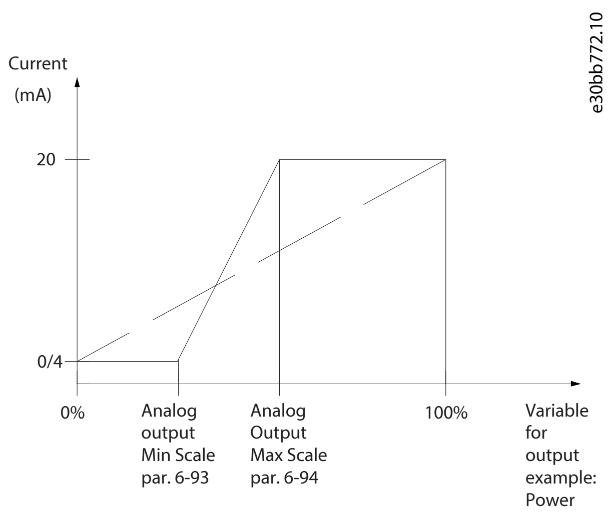

Figure 35: Output Scale versus Current

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6-96 Terminal 42 Output Bus Control

Default value:	0	**Parameter type:**	Range (0–16384)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Hold the analog output at terminal 42 if controlled by bus.

4.8 Parameter Group 7-** Controllers

4.8.1 7-0* Speed PID Ctrl.

7-00 Speed PID Feedback Source

Default value:	[20] None	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select feedback source for speed CL control.

Option	Name
[1]	24 V encoder
[2]	MCB 102
[3]	MCB 103
[6]	Analog Input 53
[7]	Analog Input 54
[8]	Frequency input 29
[9]	Frequency input 33
[12]	MCB 102 Absolute
[20]	None

7-01 Speed PID Droop

Default value:	0 RPM	**Parameter type:**	Range (0–200 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Adjust the speed reduction at 100% load.

7-02 Speed PID Proportional Gain

Default value:	0.015	**Parameter type:**	Range (0.000–1.000)
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 [1] Speed closed loop control***. Quick control is obtained at high amplification. However, if the amplification is too high, the process may become unstable.

7-03 Speed PID Integral Time

Default value:	Size related	**Parameter type:**	Range (2.0–20000.0 ms)
Setup:	All setups	**Conversion index:**	-1
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 ***[1] Speed closed loop control*** set in parameter ***1-00 Configuration Mode***.

7-04 Speed PID Differentiation Time

Default value:	Size related	**Parameter type:**	Range (0.0–200.0 ms)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Enter the speed controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the speed feedback. The quicker the error changes, the stronger the gain from the differentiator. The gain is proportional with the speed at which errors change. Setting this parameter to 0 disables the differentiator. This parameter is used with parameter ***1-00 Configuration Mode [1] Speed closed loop control***.

7-05 Speed PID Diff. Gain Limit

Default value:	5.0	**Parameter type:**	Range (1.0–20.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a limit for the gain provided by the differentiator. Since the differential gain increases at higher frequencies, limiting the gain may be useful. 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***.

7-06 Speed PID Lowpass Filter Time

Default value:	10.0 ms	**Parameter type:**	Range (1.0–6000.0 ms)
Setup:	All setups	**Conversion index:**	-1
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. This parameter is used with parameter ***1-00 Configuration Mode [1] Speed closed loop*** or ***[2] Torque closed loop***. This parameter is useful if there is a great amount of noise in the system, see Figure 36. For example, if a time constant of 100 ms is programmed, the cutoff 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.

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Practical settings of parameter ***7-06 Speed PID Lowpass Filter Time*** taken from the number of pulses per revolutions from encoder:

Encoder PPR	Parameter *7-06 Speed PID Lowpass Filter Time*
512	10 ms
1024	5 ms
2048	2 ms
4096	1 ms

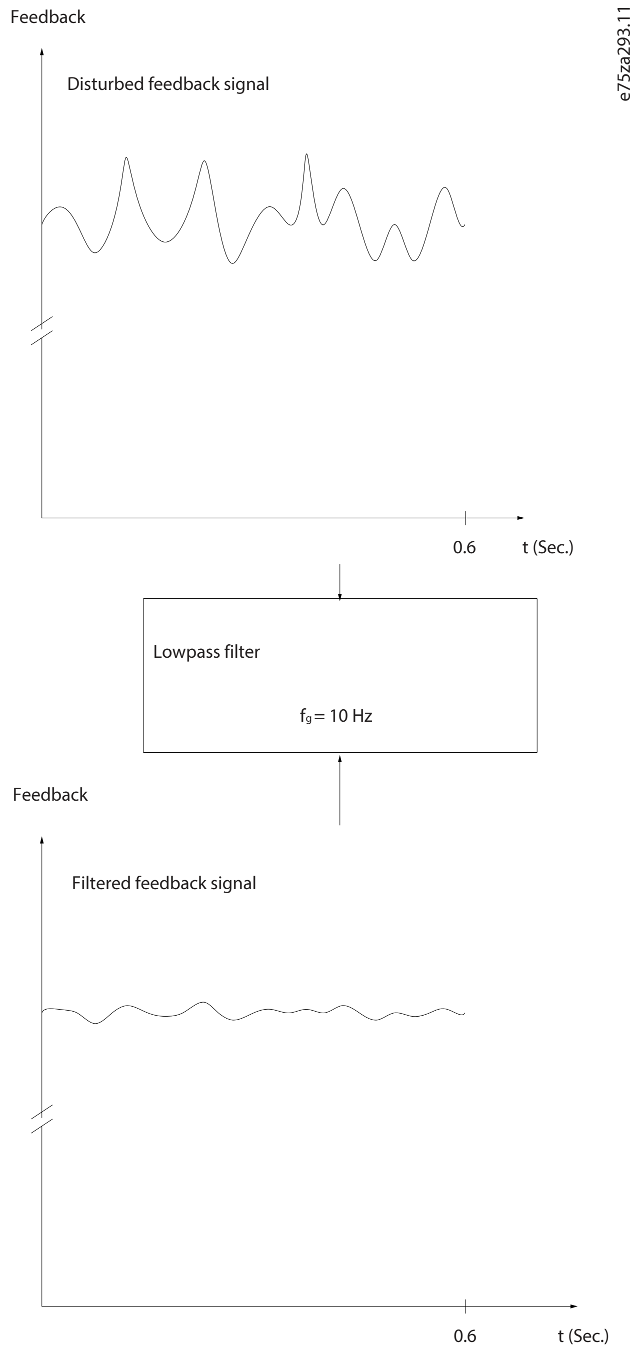

Figure 36: Feedback Signal

NOTICE

Severe filtering can be detrimental to dynamic performance.

7-07 Speed PID Feedback Gear Ratio

Default value:	1.0000	**Parameter type:**	Range (0.0001–32.0000)
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	False

The speed feedback is multiplied by this factor.

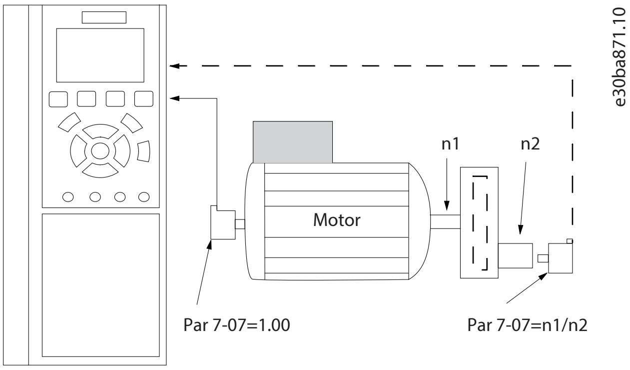

Figure 37: Speed PID Feedback Gear Ratio

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.

7-09 Speed PID Error Correction w/ Ramp

Default value:	300 RPM	**Parameter type:**	Range (10–100000 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Specify the speed error, between ramp and actual speed, which must be corrected by the ramp.

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.

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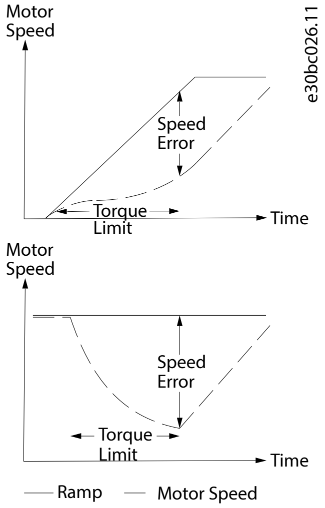

Figure 38: Speed Error Between Ramp and Actual Speed

4.8.2 7-1* Torque PID Ctrl.

Parameters for configuring the Torque PI control.

7-10 Torque PI 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
[0]	Controller Off
[1]	Analog Input 53
[2]	Analog Input 54
[3]	Estimated Torque

7-12 Torque PID 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.

7-13 Torque PID Integration Time

Default value:	0.020 s	**Parameter type:**	Range (0.002–2.000 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 control instability.

7-16 Torque PI Lowpass Filter Time

Default value:	5.0 ms	**Parameter type:**	Range (0.1–100.0 ms)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a time constant for the torque control low-pass filter.

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

The reference signal bypasses the torque controller by an amount as specified.

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

Adjust the response time of the current controller relative to the control period.

4.8.3 7-2* Process and Speed Ctrl.

Select the feedback sources for the process PID control, and how this feedback should be handled.

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 input is 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
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[3]	Frequency input 29
[4]	Frequency input 33

7-22 Process CL Feedback 2 Resource

Default value:	[0] No function	**Parameter type:**	Option

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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 input is treated as the source of the 2nd of these signals. The 1st input signal is defined in parameter ***7-22 Process CL Feedback 2 Resource***.

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[3]	Frequency input 29
[4]	Frequency input 33

7-28 Low Speed PID Proportional Gain

Default value:	0.0500	**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 and validate when the motor speed is less than parameter ***1-53 Model Shift Frequency***. Quick control is obtained at high amplification. However, if the amplification is too great, the process may become unstable.

7-29 Low Speed PID Integral Time

Default value:	100.0 ms	**Parameter type:**	Range (1.0–20000.0 ms)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Enter the speed controller integral time and validate when the motor speed is less than parameter ***1-53 Model Shift Frequency***. 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.

4.8.4 7-3* Process PID Ctrl.

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 process control to increase the output frequency.
[1]	Inverse	Set process control to decrease the output frequency.

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

Select for the Process PID Anti Windup function.

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.

7-32 Process PID Start Speed

Default value:	0 RPM	**Parameter type:**	Range (0–6000 RPM)
Setup:	All setups	**Conversion index:**	0
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.

7-33 Process PID Proportional Gain

Default value:	0.01	**Parameter type:**	Range (0.00–10.00)
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.

7-34 Process PID Integral Time

Default value:	9999.00 s	**Parameter type:**	Range (0.10–9999.00 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.

7-35 Process PID Differentiation Time

Default value:	0.00 s	**Parameter type:**	Range (0.00 s–20.00 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.

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7-36 Process PID Diff. Gain Limit

Default value:	5.0	**Parameter type:**	Range (1.0–50.0)
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.

7-38 Process PID Feed Forward Factor

Default value:	0%	**Parameter type:**	Range (0–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the PID feedforward (FF) factor. The FF 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 FF 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***.

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.

4.8.5 7-4* Adv. Process PID I

This parameter group is only used if parameter ***1-00 Configuration Mode*** is set to ***[7] Extended PID speed CL***.

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 ***[1] Yes*** to reset the I-part of the Process PID Controller. The selection automatically reverts 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.

Option	Name
[0]	No
[1]	Yes

7-41 Process PID Output Neg. Clamp

Default value:	-100%	**Parameter type:**	Range (-100–100%)
Setup:	All setups	**Conversion index:**	0

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

Enter a negative limit for the Process PID Controller output.

7-42 Process PID Output Pos. Clamp

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

Enter a positive limit for the Process PID Controller output.

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.***).

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.***).

7-45 Process PID Feed Fwd Resource

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

Select which drive input is used as the feedforward factor. The FF factor is added directly to the output of the PID controller. This parameter can increase dynamic performance. The feedforward set from bus should be in N2 format.

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33

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Option	Name
[11]	Local bus reference
[32]	Bus PCD

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

Select for the process PID feed forward normal or inverse control.

Option	Name	Description
[0]	Normal	Set the feed forward factor to treat the FF resource as a positive value.
[1]	Inverse	Treat the feed forward resource as a negative value.

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

Readout parameter where the bus parameter ***7-45 Process PID Feed Fwd Resource [32] Bus PCD*** can be read. The feed forward set from bus should be in N2 format.

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

Select for the process PID output normal or inverse control.

Option	Name	Description
[0]	Normal	Use the calculated output from the Process PID Controller.
[1]	Inverse	Invert the calculated output from the Process PID Controller. This operation is performed after the feed forward factor is applied.

4.8.6 7-5* Adv. Process PID II

This parameter group is only used if parameter ***1-00 Configuration Mode*** is set to ***[7] Extended PID speed CL***.

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

Enable or disable the extended parts of the PID controller.

Option	Name
[0]	Disabled
[1]	Enabled

7-51 Process PID Feed Fwd Gain

Default value:	1.00	**Parameter type:**	Range (0.00–100.00)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The feedforward is used to obtain the gain, 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 feedforward 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 feedforward factor is typically the line speed of the system.

7-52 Process PID Feed Fwd Ramp up

Default value:	0.01 s	**Parameter type:**	Range (0.01–100.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Control dynamics of the feedforward signal when ramping up.

7-53 Process PID Feed Fwd Ramp down

Default value:	0.01 s	**Parameter type:**	Range (0.01–100.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

Control the dynamics of the feedforward signal when ramping down.

7-56 Process PID Ref. Filter Time

Default value:	0.001 s	**Parameter type:**	Range (0.001–1.000 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.

7-57 Process PID Fb. Filter Time

Default value:	0.001 s	**Parameter type:**	Range (0.001–1.000 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

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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.

4.8.7 7-6* Feedback Conversion

Use the parameter group to configure conversions for feedback signals.

7-60 Feedback 1 Conversion

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

Select a conversion for the feedback 1 signal. Select ***[0] Linear*** to leave the feedback signal unchanged.

Option	Name
[0]	Linear
[1]	Square root

7-62 Feedback 2 Conversion

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

Select a conversion for the feedback 2 signal. Select ***[0] Linear*** to leave the feedback signal unchanged.

Option	Name
[0]	Linear
[1]	Square root

4.9 Parameter Group 8-** Comm. and Options

4.9.1 8-0* General Settings

8-00 Option A warning control

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

Enable or disable the installed options.

Option	Name
[0]	None
[1]	Disable Warning

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	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Control word only	Control by using the control word only.

8-02 Control Source

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

Select the source of the control word.

Option	Name	Description
[0]	None	
[1]	FC Port	
[2]	Option A	PROFIBUS, PROFINET, and EtherNet/IP

8-03 Control Timeout Time

Default value:	1.0 s	**Parameter type:**	Range (0.1 s–6000.0 s)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint16	**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 that is selected in parameter ***8-04 Control Timeout Function*** is then carried out.

8-04 Control Timeout Function

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

Select the timeout function. The timeout function activates when the control word fails to be updated within the time period specified in parameter ***8-03 Control Word Timeout Time***.

Option	Name	Description
[0]	Off	Resume control via fieldbus (fieldbus or standard), using the most recent control word.
[1]	Freeze output	Freeze output frequency until communication resumes.
[2]	Stop	Stop with auto restart until communication resumes.

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Option	Name	Description
[3]	Jogging	Run the motor at jog frequency until communication resumes.
[4]	Max. speed	Run the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stop the motor and trip, then reset the drive to restart: • Via fieldbus. • Via *[Reset]*. • Via a digital input.
[6]	Qstop and trip	
[26]	Trip	

8-07 Diagnosis Trigger

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

Enable or disable the sending extended diagnosis data (EDD) function.

Option	Name	Description
[0]	Disable	Send no extended diagnosis data (EDD).
[1]	Trigger on alarms	Send EDD via alarms.
[2]	Trigger alarm/warn.	Send EDD via alarms or warnings in parameter ***16-90 Alarm Word***, parameter ***9-53 PROFIBUS Warning Word***, or parameter ***16-92 Warning Word***.

4.9.2 8-1* Ctrl. Word Settings

8-10 Control Word Profile

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

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the installed fieldbus are visible in the LCP display.

Option	Name
[0]	FC profile
[1]	PROFIdrive profile
[5]	ODVA
[22]	PROFIdrive v4_2 profile

8-14 Configurable Control Word CTW

Default value:	[1] Profile default	**Parameter type:**	Option, Array [16]

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

The control word has 16 bits (0-15). Bits 10 and 12-15 are configurable.

Option	Name
[0]	None
[1]	Profile default
[2]	CTW Valid, active low
[4]	PID error inverse
[5]	PID resets I part
[6]	PID enable

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

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 for the integrated RS-485 port.

Option	Name	Description
[0]	FC	Communication according to the FC protocol.
[1]	Modbus RTU	Communication according to the Modbus RTU protocol.

8-31 Address

Default value:	1	**Parameter type:**	Range (0–247)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the address for the RS-485 port. Valid range: 1–126 for FC-bus, or 1–247 for Modbus.

8-32 Baud Rate

Default value:	Size related	**Parameter type:**	Option

Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the baud rate for the RS-485 port.

NOTICE

For some of the protocols, not all options are available.

Option	Name
[0]	2400 Baud
[1]	4800 Baud
[2]	9600 Baud
[3]	19200 Baud
[4]	38400 Baud
[5]	57600 Baud
[6]	76800 Baud
[7]	115200 Baud

8-33 Parity/Stop Bits

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

Parity and stop bits for the protocol using the FC Port. For some of the protocols, not all options are available.

Option	Name
[0]	Even Parity, 1 Stop Bit
[1]	Odd Parity, 1 Stop Bit
[2]	No Parity, 1 Stop Bit
[3]	No Parity, 2 Stop Bits

8-35 Minimum Response Delay

Default value:	0.010 s	**Parameter type:**	Range (0.001–0.500 s)
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Specify the minimum delay time between receiving a request and sending a response. This is used for overcoming modem turn-around delays.

8-36 Maximum Response Delay

Default value:	Size related	**Parameter type:**	Range (0.100–10.000 s)
Setup:	1 setup	**Conversion index:**	-3

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

Specify the maximum allowed delay time between receiving a request and sending the response. If this time is exceeded, no response is returned.

4.9.4 8-4* FC MC protocol set

8-42 PCD Write Configuration

Default value:	Size related	**Parameter type:**	Option, Array [16]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the parameters to be assigned to the PCD's telegrams. 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.

Enter up to 16 different preset mappings 0–15 in this parameter, using array programming. If this parameter is active, addresses 2810–2825 represent values of the 16 parameters. If this parameter is not active, addresses 2810 and 2811 are used as input-data-drive control word and bus reference. Addresses 2812–2825 are reserved.

Option	Name
[0]	None
[1]	[302] Minimum Reference
[2]	[303] Maximum Reference
[3]	[341] Ramp 1 Ramp up time
[4]	[342] Ramp 1 Ramp down time
[5]	[351] Ramp 2 Ramp up time
[6]	[352] Ramp 2 Ramp down time
[7]	[380] Jog Ramp Time
[8]	[381] Quick Stop Time
[9]	[412] Motor Speed Low Limit [Hz]
[10]	[414] Motor Speed High Limit [Hz]
[11]	[590] Digital & Relay Bus Control
[12]	[676] Terminal 45 Output Bus Control
[13]	[696] Terminal 42 Output Bus Control
[15]	FC Port CTW
[16]	FC Port REF
[18]	[311] Jog Speed [Hz]
[19]	[427] Torque limit bus control
[20]	[428] Speed limit bus control
[81]	User Define0
[82]	User Define1
[83]	User Define2

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Option	Name
[84]	User Define3
[85]	User Define4
[86]	User Define5
[87]	User Define6
[88]	User Define7

8-43 PCD Read Configuration

Default value:	Size related	**Parameter type:**	Option, Array [16]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**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.

Enter up to 16 different preset mapping 0-15 in this parameter, using array programming. If this parameter is active, addresses 2910–2925 represent values of the 16 parameters. If this parameter is not active, addresses 2910 and 2911 are used as status word register and main actual value. Addresses 2912–2925 are reserved.

Option	Name
[0]	None
[1]	[1500] Operation Hours
[2]	[1501] Running Hours
[3]	[1502] kWh Counter
[4]	[1600] Control Word
[5]	[1601] Reference [Unit]
[6]	[1602] Reference %
[7]	[1603] Status Word
[8]	[1605] Main Actual Value [%]
[9]	[1609] Custom Readout
[10]	[1610] Power [kW]
[11]	[1611] Power [hp]
[12]	[1612] Motor Voltage
[13]	[1613] Frequency
[14]	[1614] Motor Current
[15]	[1615] Frequency [%]
[16]	[1616] Torque [Nm]
[17]	[1618] Motor Thermal
[18]	[1630] DC Link Voltage
[19]	[1634] Heat sink Temp.
[20]	[1635] Inverter Thermal

Option	Name
[21]	[1638] SL Controller State
[22]	[1650] External Reference
[23]	[1652] Feedback [Unit]
[24]	[1660] Digital Input 18,19,27,33
[25]	[1661] Terminal 53 Switch Setting
[26]	[1662] Analog input 53
[27]	[1663] Terminal 54 Switch Setting
[28]	[1664] Analog input 54
[29]	[1665] Analog output 42 [mA]
[30]	[1671] Relay output
[31]	[1672] Counter A
[32]	[1673] Counter B
[33]	[1690] Alarm Word
[34]	[1692] Warning Word
[35]	[1694] Ext. Status Word
[38]	[1622] Torque [%]
[39]	[1691] Alarm Word 2
[40]	[1693] Warning Word 2
[41]	[1657] Feedback [RPM]
[42]	[1679] Analog Output 45 [mA]
[43]	[1617] Speed [RPM]
[44]	[1666] Digital Output
[54]	[1695] Ext. Status Word 2
[81]	User Define8
[82]	User Define9
[83]	User Define10
[84]	User Define11
[85]	User Define12
[86]	User Define13
[87]	User Define14
[88]	User Define15
[100]	[1605] Main Actual Value [N2]

8-44 PCD User Define

Default value:	0	**Parameter type:**	Range (0–65535), Array [16]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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Customize the User define X of parameter ***8-42 PCD Write Configuration*** or parameter ***8-43 PCD Read Configuration***, [0-7] is for PCD Write, [8-15] is for PCD Read.

4.9.5 8-5* Digital/Bus

Parameters for configuring the Digital/Bus merging.

NOTICE

These parameters are active only when parameter ***8-01 Control Site*** is set to ***[0] Digital and control word***.

8-50 Coasting Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select control of the coasting function via the terminals (digital input) and/or via the bus.

Option	Name	Description
[0]	Digital input	Activate coasting command via a digital input.
[1]	Bus	Activate coasting command via the serial communication port or fieldbus option.
[2]	Logic AND	Activate coasting command via the fieldbus/serial communication port and 1 extra digital input.
[3]	Logic OR	Activate coasting command via the fieldbus/serial communication port or via 1 of the digital inputs.

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 control of the quick stop function via the terminals (digital input) and/or via the bus.

Option	Name	Description
[0]	Digital input	Activate quick stop command via a digital input.
[1]	Bus	Activate quick stop command via the serial communication port or fieldbus option.
[2]	Logic AND	Activate quick stop command via the fieldbus/serial communication port and 1 extra digital input.
[3]	Logic OR	Activate quick stop command via the fieldbus/serial communication port or via 1 of the digital inputs.

8-52 DC Brake 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 DC brake via the terminals (digital input) and/or via the bus.

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 DC brake command via a digital input.
[1]	Bus	Activate DC brake command via the serial communication port or fieldbus option.
[2]	Logic AND	Activate DC brake command via the fieldbus/serial communication port and 1 extra digital input.
[3]	Logic OR	Activate DC brake command via the fieldbus/serial communication port or via 1 of the digital inputs.

8-53 Start Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the start function.

Option	Name	Description
[0]	Digital input	A digital input triggers the start function.
[1]	Bus	A serial communication port or the fieldbus triggers the start function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the start function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the start function.

8-54 Reversing Select

Default value:	[3] Logic OR	**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.

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Option	Name	Description
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the reversing function.

8-55 Set-up Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the setup selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the setup selection.
[1]	Bus	A serial communication port or the fieldbus triggers the setup selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the setup selection.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the setup selection.

8-56 Preset Reference Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the preset reference selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the fieldbus triggers the preset reference selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the preset reference selection.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the preset reference selection.

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	A digital input triggers the PROFIdrive OFF2 selection.
[1]	Bus	A serial communication port or the fieldbus triggers the PROFIdrive OFF2 selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the PROFIdrive OFF2 selection.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the PROFIdrive OFF2 selection.

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 (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	A digital input triggers the PROFIdrive OFF3 selection.
[1]	Bus	A serial communication port or the fieldbus triggers the PROFIdrive OFF3 selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the PROFIdrive OFF3 selection.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the PROFIdrive OFF3 selection.

4.9.6 8-7* Protocol SW Version

8-79 Protocol Firmware version

Default value:	Size related	**Parameter type:**	Range (0.00–655.00), Array [5]
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

Firmware revision for local bus protocols.

- FC is in index 0;
- Modbus is in index 1;
- Indexes 2–4 are reserved.

4.9.7 8-8* FC Port Diagnostics

These parameters are used for monitoring the bus communication via the drive port.

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8-80 Bus Message Count

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of valid telegrams detected on the bus.

8-81 Bus Error Count

Default value:	0	**Parameter type:**	Range (0–4294967295), Array [6]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of telegrams with faults (for example, CRC faults) detected on the bus.

8-82 Slave Messages Rcvd

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of valid telegrams sent by the drive to the slave.

8-83 Slave Error Count

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of error telegrams, which could not be executed by the drive.

8-84 Slave Messages Sent

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of messages sent from the slave.

8-85 Slave Timeout Errors

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Show the number of slave timeout errors.

8-88 Reset FC port Diagnostics

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Reset all FC port diagnostic counters.

Option	Name
[0]	Do not reset
[1]	Reset counter

4.9.8 8-9* Bus Feedback

Use the parameter group to configure the bus feedback.

8-90 Bus Jog 1 Speed

Default value:	100 RPM	**Parameter type:**	Range (0–1500 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the jog speed. This is a fixed jog speed activated via the serial port or fieldbus option.

8-91 Bus Jog 2 Speed

Default value:	200 RPM	**Parameter type:**	Range (0–1500 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the jog speed. This is a fixed jog speed activated via the serial port or fieldbus option.

4.10 Parameter Group 9-** PROFIdrive

For more information about PROFIBUS parameter descriptions, see the *VLT® AutomationDrive FC 360 PROFIBUS DP Programming Guide*.

For more information about PROFINET parameter descriptions, see the *VLT® AutomationDrive FC 360 PROFINET Programming Guide*.

NOTICE

Some parameters in this chapter are only for PROFIBUS, and some parameters are only for PROFINET.

9-00 Setpoint

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter receives a cyclic reference from a master class 2. If the control priority is set to master class 2, the reference for the drive is taken from this parameter, whereas the cyclic reference is ignored.

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9-07 Actual Value

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter delivers the MAV for a master class 2. The parameter is valid if the control priority is set to master class 2.

9-15 PCD Write Configuration

Default value:	Size related	**Parameter type:**	Option, Array [10]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see parameter ***9-22 Telegram Selection***.

Option	Name
[0]	None
[302]	Minimum Reference
[303]	Maximum Reference
[311]	Jog Speed [Hz]
[312]	Catch up/slow down value
[341]	Ramp 1 Ramp Up Time
[342]	Ramp 1 Ramp Down Time
[351]	Ramp 2 Ramp Up Time
[352]	Ramp 2 Ramp Down Time
[380]	Jog Ramp Time
[381]	Quick Stop Ramp Time
[412]	Motor Speed Low Limit [Hz]
[414]	Motor Speed High Limit [Hz]
[416]	Torque Limit Motor Mode
[417]	Torque Limit Generator Mode
[427]	Torque Limit Bus Control
[428]	Speed Limit Bus Control
[482]	Power Limit Motor Mode
[483]	Power Limit Generator Mode
[492]	Positive Speed Limit [Hz]
[494]	Negative Speed Limit [Hz]
[495]	Positive Torque limit
[496]	Negative Torque limit
[553]	Term. 29 High Ref./Feedb. Value

Option	Name
[558]	Term. 33 High Ref./Feedb. Value
[590]	Digital & Relay Bus Control
[593]	Pulse Out 27 Bus Control
[595]	Pulse Out 29 Bus Control
[615]	Terminal 53 High Ref./Feedb. Value
[625]	Terminal 54 High Ref./Feedb. Value
[676]	Terminal 45 Output Bus Control
[696]	Terminal 42 Output Bus Control
[733]	Process PID Proportional Gain
[734]	Process PID Integral Time
[735]	Process PID Differentiation Time
[748]	PCD Feed Forward
[890]	Bus Jog 1 Speed
[891]	Bus Jog 2 Speed
[1680]	Fieldbus CTW 1
[1682]	Fieldbus REF 1
[1688]	Fieldbus Torque FF.
[3401]	PCD 1 Write For Application
[3402]	PCD 2 Write For Application
[3403]	PCD 3 Write For Application
[3404]	PCD 4 Write For Application
[3405]	PCD 5 Write For Application
[3406]	PCD 6 Write For Application
[3407]	PCD 7 Write For Application
[3408]	PCD 8 Write For Application
[3409]	PCD 9 Write For Application
[3410]	PCD 10 Write For Application

9-16 PCD Read Configuration

Default value:	Size related	**Parameter type:**	Option, Array [10]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 contain the actual data values of the selected parameters.

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Option	Name
[0]	None
[1500]	Operating hours
[1501]	Running Hours
[1502]	kWh Counter
[1600]	Control Word
[1601]	Reference [Unit]
[1602]	Reference [%]
[1603]	Status Word
[1605]	Main Actual Value [%]
[1609]	Custom Readout
[1610]	Power [kW]
[1611]	Power [hp]
[1612]	Motor Voltage
[1613]	Frequency
[1614]	Motor current
[1615]	Frequency [%]
[1616]	Torque [Nm]
[1617]	Speed [RPM]
[1618]	Motor Thermal
[1620]	Motor Angle
[1622]	Torque [%]
[1624]	Calibrated Stator Resistance
[1630]	DC Link Voltage
[1633]	Brake Energy /2 min
[1634]	Heat sink Temp.
[1635]	Inverter Thermal
[1638]	SL Controller State
[1639]	Control Card Temp.
[1642]	Service Log Counter
[1644]	Speed Error [RPM]
[1648]	Speed Ref. After Ramp [RPM]
[1650]	External Reference
[1652]	Feedback[Unit]
[1653]	Digi Pot Reference
[1657]	Feedback [RPM]
[1660]	Digital Input
[1661]	Terminal 53 Setting

Option	Name
[1662]	Analog input 53
[1663]	Terminal 54 Setting
[1664]	Analog input 54
[1665]	Analog output 42 [mA]
[1666]	Digital Output
[1667]	Pulse input 29 [Hz]
[1668]	Pulse input 33 [Hz]
[1669]	Pulse output 27 [Hz]
[1670]	Pulse output 29 [Hz]
[1671]	Relay output
[1672]	Counter A
[1673]	Counter B
[1679]	Analog output 45 [mA]
[1684]	Comm. Option STW
[1685]	FC Port CTW 1
[1690]	Alarm Word
[1691]	Alarm Word 2
[1692]	Warning Word
[1693]	Warning Word 2
[1694]	Ext. Status Word
[1695]	Ext. Status Word 2
[1697]	Alarm Word 3
[1698]	Warning Word 3
[1837]	Temp. Input X48/4
[1838]	Temp. Input X48/7
[1839]	Temp. Input X48/10
[1855]	Active Alarm Number
[1856]	Active Warning Number
[1866]	Switching Frequency
[1888]	Motor current
[3421]	PCD 1 Read For Application
[3422]	PCD 2 Read For Application
[3423]	PCD 3 Read For Application
[3424]	PCD 4 Read For Application
[3425]	PCD 5 Read For Application
[3426]	PCD 6 Read For Application
[3427]	PCD 7 Read For Application

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Option	Name
[3428]	PCD 8 Read For Application
[3429]	PCD 9 Read For Application
[3430]	PCD 10 Read For Application

9-18 Node Address

Default value:	126	**Parameter type:**	Range (1–126)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the station address in this parameter or, alternatively, in the hardware switch. To adjust the station address in parameter ***9-18 Node Address***, set the hardware switch to 126 or 127 (that is all switches set to on). Otherwise, this parameter shows the actual setting of the switch.

9-19 Drive Unit System Number

Default value:	1037	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Manufacturer specific system ID.

9-22 Telegram Selection

Default value:	[100] None	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select a standard PROFIDRIVE telegram configuration for the drive as an alternative to the freely configurable telegrams in parameter ***9-15 PCD Write Configuration*** and parameter ***9-16 PCD Read Configuration***.

Option	Name
[1]	Standard telegram 1
[100]	None
[101]	PPO 1
[102]	PPO 2
[103]	PPO 3
[104]	PPO 4
[105]	PPO 5
[106]	PPO 6
[107]	PPO 7
[108]	PPO 8
[121]	FC telegram
[200]	Custom telegram 1

9-23 Parameters for Signals

Default value:	[0] None	**Parameter type:**	Option, Array [1000]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

This parameter contains a list of signals available for selection in parameter ***9-15 PCD Write Configuration*** and parameter ***9-16 PCD Read Configuration***.

Option	Name
[0]	None
[302]	Minimum Reference
[303]	Maximum Reference
[311]	Jog Speed [Hz]
[312]	Catch up/slow Down Value
[341]	Ramp 1 Ramp Up Time
[342]	Ramp 1 Ramp Down Time
[351]	Ramp 2 Ramp Up Time
[352]	Ramp 2 Ramp Down Time
[380]	Jog Ramp Time
[381]	Quick Stop Ramp Time
[412]	Motor Speed Low Limit [Hz]
[414]	Motor Speed High Limit [Hz]
[416]	Torque Limit Motor Mode
[417]	Torque Limit Generator Mode
[427]	Torque Limit Bus Control
[428]	Speed Limit Bus Control
[482]	Power Limit Motor Mode
[483]	Power Limit Generator Mode
[492]	Positive Speed Limit [Hz]
[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
[615]	Terminal 53 High Ref./Feedb. Value
[625]	Terminal 54 High Ref./Feedb. Value

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Option	Name
[676]	Terminal 45 Output Bus Control
[696]	Terminal 42 Output Bus Control
[733]	Process PID Proportional Gain
[734]	Process PID Integral Time
[735]	Process PID Differentiation Time
[748]	PCD Feed Forward
[890]	Bus Jog 1 Speed
[891]	Bus Jog 2 Speed
[1500]	Operating hours
[1501]	Running Hours
[1502]	kWh Counter
[1600]	Control Word
[1601]	Reference [Unit]
[1602]	Reference [%]
[1603]	Status Word
[1605]	Main Actual Value [%]
[1609]	Custom Readout
[1610]	Power [kW]
[1611]	Power [hp]
[1612]	Motor Voltage
[1613]	Frequency
[1614]	Motor current
[1615]	Frequency [%]
[1616]	Torque [Nm]
[1617]	Speed [RPM]
[1618]	Motor Thermal
[1620]	Motor Angle
[1622]	Torque [%]
[1624]	Calibrated Stator Resistance
[1630]	DC Link Voltage
[1633]	Brake Energy /2 min
[1634]	Heat sink Temp.
[1635]	Inverter Thermal
[1638]	SL Controller State
[1639]	Control Card Temp.
[1642]	Service Log Counter
[1644]	Speed Error [RPM]

Option	Name
[1648]	Speed Ref. After Ramp [RPM]
[1650]	External Reference
[1652]	Feedback[Unit]
[1653]	DigiPot Reference
[1657]	Feedback [RPM]
[1660]	Digital Input
[1661]	Terminal 53 Setting
[1662]	Analog input 53
[1663]	Terminal 54 Setting
[1664]	Analog input 54
[1665]	Analog output 42 [mA]
[1666]	Digital Output
[1667]	Pulse input 29 [Hz]
[1668]	Pulse input 33 [Hz]
[1669]	Pulse output 27 [Hz]
[1670]	Pulse output 29 [Hz]
[1671]	Relay output
[1672]	Counter A
[1673]	Counter B
[1679]	Analog output 45 [mA]
[1680]	Fieldbus CTW 1
[1682]	Fieldbus REF 1
[1684]	Comm. Option STW
[1685]	FC Port CTW 1
[1688]	Fieldbus Torque FF.
[1690]	Alarm Word
[1691]	Alarm Word 2
[1692]	Warning Word
[1693]	Warning Word 2
[1694]	Ext. Status Word
[1695]	Ext. Status Word 2
[1697]	Alarm Word 3
[1698]	Warning Word 3
[1837]	Temp. Input X48/4
[1838]	Temp. Input X48/7
[1839]	Temp. Input X48/10
[1855]	Active Alarm Number

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Option	Name
[1856]	Active Warning Number
[1866]	Switching Frequency
[1888]	Motor current
[3401]	PCD 1 Write For Application
[3402]	PCD 2 Write For Application
[3403]	PCD 3 Write For Application
[3404]	PCD 4 Write For Application
[3405]	PCD 5 Write For Application
[3406]	PCD 6 Write For Application
[3407]	PCD 7 Write For Application
[3408]	PCD 8 Write For Application
[3409]	PCD 9 Write For Application
[3410]	PCD 10 Write For Application
[3421]	PCD 1 Read For Application
[3422]	PCD 2 Read For Application
[3423]	PCD 3 Read For Application
[3424]	PCD 4 Read For Application
[3425]	PCD 5 Read For Application
[3426]	PCD 6 Read For Application
[3427]	PCD 7 Read For Application
[3428]	PCD 8 Read For Application
[3429]	PCD 9 Read For Application
[3430]	PCD 10 Read For Application

9-27 Parameter Edit

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	False

Enable or disable the function of editing parameters via PROFIBUS/PROFINET, the standard RS-485 interface, or the LCP.

Option	Name
[0]	Disabled
[1]	Enabled

9-28 Process Control

Default value:	[1] Enable cyclic master	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

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

Process control (setting of control word, speed reference, and process data) is possible via either PROFIBUS or standard fieldbus, but not both simultaneously. Local control is always possible via the LCP. Control via process control is possible via either terminals or fieldbus depending on the settings in parameter ***8-50 Coasting Select*** to parameter ***8-56 Preset Reference Select***.

Option	Name	Description
[0]	Disable	Disable process control via PROFIBUS master class 1 and enables process control via standard fieldbus or PROFIBUS master class 2.
[1]	Enable cyclic master	Enable process control via PROFIBUS master class 1 and disables process control via standard fieldbus or PROFIBUS master class 2.

9-44 Fault Message Counter

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Show the number of error events stored in parameter ***9-45 Fault Code*** and parameter ***9-47 Fault Number***. The maximum buffer capacity is 8 error events. The buffer and counter are set to 0 after reset or power-up.

9-45 Fault Code

Default value:	0	**Parameter type:**	Range (0–0), Array [64]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-47 Fault Number

Default value:	0	**Parameter type:**	Range (0–0), Array [64]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-52 Fault Situation Counter

Default value:	0	**Parameter type:**	Range (0–1000)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Show the number of fault events that have occurred since the last reset or power-up.

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9-53 Profibus Warning Word

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	True

Show PROFIBUS/PROFINET communication warnings.

Bit	Description
0	Connection with DP master is lost.
1	Not used.
2	FDL (fieldbus data link layer) is not OK.
3	Clear data command received.
4	Actual value is not updated.
5	Baud rate search.
6	PROFIBUS ASIC is not transmitting.
7	Initializing of PROFIBUS is not OK.
8	Drive is tripped.
9	Internal CAN error.
10	Wrong configuration data from PLC.
11	Wrong ID sent by PLC.
12	Internal fault occurred.
13	Not configured.
14	Timeout active.
15	Warning 34 active.

9-63 Actual Baud Rate

Default value:	[255] No baudrate found	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Show the actual PROFIBUS baud rate. The PROFIBUS master automatically sets the baud rate.

Option	Name
[0]	9,6 kbit/s
[1]	19,2 kbit/s
[2]	93,75 kbit/s
[3]	187,5 kbit/s
[4]	500 kbit/s
[6]	1500 kbit/s
[7]	3000 kbit/s

Option	Name
[8]	6000 kbit/s
[9]	12000 kbit/s
[10]	31,25 kbit/s
[11]	45,45 kbit/s
[255]	No baudrate found

9-64 Device Identification

Default value:	0	**Parameter type:**	Range (0–0), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The device identification parameter. The data type is array [n] of unsigned16. The assignment of the 1st sub-indexes is defined and shown in the following table.

This parameter is only visible via PROFINET.

Table 19: Device Identification 1st Sub-index Assignment

Index	Content	Value
0	Manufacturer	128
1	Device type	1
2	Version	xxyy
3	Firmware date year	yyyy
4	Firmware date month	ddmm
5	No. of axes	Variable
6	Vendor specific: PB/PN Version	xxyy
7	Vendor specific: Database Version	xxyy
8	Vendor specific: AOC Version	xxyy
9	Vendor specific: MOC Version	xxyy

9-65 Profile Number

Default value:	0	**Parameter type:**	Range (0–0)
Setup:	All setups	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

This parameter contains the profile identification. Byte 1 contains the profile number and byte 2 the version number of the profile.

9-67 Control Word 1

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	True

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This parameter accepts the control word from a master class 2 in the same format as PCD 1.

9-68 Status Word 1

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	V2	**Change during operation:**	True

This parameter delivers the status word for a master class 2 in the same format as PCD 2.

9-70 Edit Set-up

Default value:	[9] Active Set-up	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the setup in which programming (change of data) is performed during operation. It is possible to program the 2 setups independently of the setup selected as active setup. Parameter access from each master is directed to the setup selected by the individual master (cyclic, acyclic MCL1, 1st acyclic MCL2, 2nd acyclic MCL2, 3rd acyclic MCL2).

Option	Name
[1]	Set-up 1
[2]	Set-up 2
[9]	Active Set-up

9-71 Profibus Save Data Values

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

Parameter values changed via RS-485 are not automatically stored in a non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down.

Option	Name	Description
[0]	Off	Deactivate the non-volatile storage function.
[1]	Store all setups	Store all parameter values in the setup selected in parameter ***9-70 Edit Set-up*** in the non-volatile memory. The selection returns to ***[0] Off*** when all values are stored.

9-72 ProfibusDriveReset

Default value:	[0] No action	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Reset the PROFIBUS or PROFINET.

Option	Name	Description
[0]	No action	No action.
[1]	Power-on reset	Reset the drive after power-up, as for power cycle.
[2]	Power-on reset prep	
[3]	Comm option reset	When reset, the drive disappears from the fieldbus, which may cause a communication error from the master.

9-75 DO Identification

Default value:	0	**Parameter type:**	Range (0–65535), Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Provide information about the DO (drive object). This parameter is for PROFINET only.

9-80 Defined Parameters (1)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-81 Defined Parameters (2)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-82 Defined Parameters (3)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-83 Defined Parameters (4)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-84 Defined Parameters (5)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-85 Defined Parameters (6)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the defined drive parameters.

9-90 Changed Parameters (1)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the drive parameters deviating from default setting.

9-91 Changed Parameters (2)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the drive parameters deviating from default setting.

9-92 Changed Parameters (3)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the drive parameters deviating from default setting.

9-93 Changed Parameters (4)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the drive parameters deviating from default setting.

9-94 Changed Parameters (5)

Default value:	0	**Parameter type:**	Range (0–9999), Array [116]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Show a list of all the drive parameters deviating from default setting.

9-99 Profibus Revision Counter

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Readout of revision count.

4.11 Parameter Group 12-** Ethernet

4.11.1 More Information

For more information about Ethernet parameter descriptions, see the *VLT® AutomationDrive FC 360 PROFINET Programming Guide*.

NOTICE

Parameter Group 12-** Ethernet is only valid when PROFINET/EtherNet IP is used.

4.11.2 12-0* IP Settings

12-00 IP Address Assignment

Default value:	[10] DCP	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the IP address assignment method.

Option	Name	Description
[0]	MANUAL	IP address can be set in parameter ***12-01 IP Address***.
[1]	DHCP	IP address is assigned via DHCP server.
[2]	BOOTP	IP address is assigned via BOOTP server.
[10]	DCP	DCP is assigned via the DCP protocol.
[20]	From node ID	

12-01 IP Address

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

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Configure the IP address of the option. Read-only if parameter ***12-00 IP Address Assignment*** is set to ***[1] DHCP***, ***[2] BOOTP***, or via DIP switches.

12-02 Subnet Mask

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

Configure the IP subnet mask of the option. Read-only if parameter ***12-00 IP Address Assignment*** is set to ***[1] DHCP*** or ***[2] BOOTP***.

12-03 Default Gateway

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

Configure the IP default gateway of the option. Read-only if parameter ***12-00 IP Address Assignment*** is set to ***[1] DHCP*** or ***[2] BOOTP***.

12-04 DHCP Server

Default value:	0	**Parameter type:**	Range (0–2147483647)
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

Read-only. Shows the IP address of the found DHCP or BOOTP server.

NOTICE

A power cycle is necessary after setting the IP parameters manually.

12-05 Lease Expires

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	All setups	**Conversion index:**	0
Data type:	TimD	**Change during operation:**	True

Read-only. Shows the lease time left for the current DHCP-assigned IP address.

12-06 Name Servers

Default value:	0	**Parameter type:**	Range (0–4294967295), Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr	**Change during operation:**	True

IP addresses of domain name servers. Can be automatically assigned when using DHCP.

12-07 Domain Name

Default value:	0	**Parameter type:**	Range (1–48)

Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	True

Domain name of the attached network. Can be automatically assigned when using DHCP network.

12-08 Host Name

Default value:	0	**Parameter type:**	Range (1–48)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	True

Logical (given) name of option.

12-09 Physical Address

Default value:	0	**Parameter type:**	Range (0–17)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	True

Read-only. Show the physical (MAC) address of the option.

4.11.3 12-1* Ethernet Link Parameters

12-10 Link Status

Default value:	[0] No Link	**Parameter type:**	Option, Array [2]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Show the link status of the Ethernet ports.

Option	Name	Description
[0]	No Link	
[1]	Link	Show the link status of the Ethernet ports.

12-11 Link Duration

Default value:	Size related	**Parameter type:**	Range (0–0), Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	TimD	**Change during operation:**	True

Show the duration of the present link on each port in dd:hh:mm:ss.

12-12 Auto Negotiation

Default value:	[1] On	**Parameter type:**	Option, Array [2]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

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Configure auto negotiation of Ethernet link parameters for each port: ON or OFF.

Option	Name	Description
[0]	Off	Link speed and link duplex can be configured in parameter ***12-13 Link Speed*** and parameter ***12-14 Link Duplex***.
[1]	On	

12-13 Link Speed

Default value:	[0] None	**Parameter type:**	Option, Array [2]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Forces the link speed for each port in 10 Mbps or 100 Mbps. If parameter ***12-12 Auto Negotiation*** is set to ***[1] On***, this parameter is read-only and shows the actual link speed. If no link is present, ***[0] None*** is shown.

Option	Name
[0]	None
[1]	10 Mbps
[2]	100 Mbps

12-14 Link Duplex

Default value:	[1] Full Duplex	**Parameter type:**	Option, Array [2]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Forces the duplex for each port to full or half duplex. If parameter ***12-12 Auto Negotiation*** is set to ***[1] On***, this parameter is read-only.

Option	Name
[0]	Half Duplex
[1]	Full Duplex

12-18 Supervisor MAC

Default value:	0	**Parameter type:**	Range (0–2147483647), Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[6]	**Change during operation:**	True

MAC addresses of currently active supervisors.

12-19 Supervisor IP Addr.

Default value:	0	**Parameter type:**	Range (0–2147483647), Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

IP addresses of currently active supervisors.

4.11.4 12-2* Process Data

12-20 Control Instance

Default value:	Size related	**Parameter type:**	Range (0–255)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter is read-only. It shows the connection to the master.

- In EtherNet/IP: If no CIP connection is present, *None* is shown.

12-21 Process Data Config Write

Default value:	[0] None	**Parameter type:**	Option, Array [10]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Configuration of writable process data.

Option	Name
[0]	None
[302]	Minimum Reference
[303]	Maximum Reference
[311]	Jog Speed [Hz]
[312]	Catch Up/Slow Down Value
[341]	Ramp 1 Ramp Up Time
[342]	Ramp 1 Ramp Down Time
[351]	Ramp 2 Ramp Up Time
[352]	Ramp 2 Ramp Down Time
[380]	Jog Ramp Time
[381]	Quick Stop Ramp Time
[412]	Motor Speed Low Limit [Hz]
[414]	Motor Speed High Limit [Hz]
[416]	Torque Limit Motor Mode
[417]	Torque Limit Generator Mode
[427]	Torque Limit Bus Control
[428]	Speed Limit Bus Control
[482]	Power Limit Motor Mode
[483]	Power Limit Generator Mode
[492]	Positive Speed Limit [Hz]
[494]	Negative Speed Limit [Hz]

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Option	Name
[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
[615]	Terminal 53 High Ref./Feedb. Value
[625]	Terminal 54 High Ref./Feedb. Value
[676]	Terminal 45 Output Bus Control
[696]	Terminal 42 Output Bus Control
[733]	Process PID Proportional Gain
[734]	Process PID Integral Time
[735]	Process PID Differentiation Time
[748]	PCD Feed Forward
[890]	Bus Jog 1 Speed
[891]	Bus Jog 2 Speed
[1680]	Fieldbus CTW 1
[1682]	Fieldbus REF 1
[1688]	Fieldbus Torque FF.
[3401]	PCD 1 Write For Application
[3402]	PCD 2 Write For Application
[3403]	PCD 3 Write For Application
[3404]	PCD 4 Write For Application
[3405]	PCD 5 Write For Application
[3406]	PCD 6 Write For Application
[3407]	PCD 7 Write For Application
[3408]	PCD 8 Write For Application
[3409]	PCD 9 Write For Application
[3410]	PCD 10 Write For Application

12-22 Process Data Config Read

Default value:	[0] None	**Parameter type:**	Option, Array [10]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Configuration of readable process data.

Option	Name
[0]	None
[1500]	Operating Hours
[1501]	Running Hours
[1502]	kWh Counter
[1600]	Control Word
[1601]	Reference [Unit]
[1602]	Reference [%]
[1603]	Status Word
[1605]	Main Actual Value [%]
[1609]	Custom Readout
[1610]	Power [kW]
[1611]	Power [hp]
[1612]	Motor Voltage
[1613]	Frequency
[1614]	Motor Current
[1615]	Frequency [%]
[1616]	Torque [Nm]
[1617]	Speed [RPM]
[1618]	Motor Thermal
[1620]	Motor Angle
[1622]	Torque [%]
[1624]	Calibrated Stator Resistance
[1630]	DC Link Voltage
[1633]	Brake Energy /2 min
[1634]	Heat Sink Temp.
[1635]	Inverter Thermal
[1638]	SL Controller State
[1639]	Control Card Temp.
[1642]	Service Log Counter
[1644]	Speed Error [RPM]
[1648]	Speed Ref. After Ramp [RPM]
[1650]	External Reference
[1652]	Feedback[Unit]
[1653]	DigiPot Reference
[1657]	Feedback [RPM]
[1660]	Digital Input
[1661]	Terminal 53 Setting

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Option	Name
[1662]	Analog Input 53
[1663]	Terminal 54 Setting
[1664]	Analog Input 54
[1665]	Analog Output 42 [mA]
[1666]	Digital Output
[1667]	Pulse Input 29 [Hz]
[1668]	Pulse Input 33 [Hz]
[1669]	Pulse Output 27 [Hz]
[1670]	Pulse Output 29 [Hz]
[1671]	Relay Output
[1672]	Counter A
[1673]	Counter B
[1679]	Analog Output 45 [mA]
[1684]	Comm. Option STW
[1685]	FC Port CTW 1
[1690]	Alarm Word
[1691]	Alarm Word 2
[1692]	Warning Word
[1693]	Warning Word 2
[1694]	Ext. Status Word
[1695]	Ext. Status Word 2
[1697]	Alarm Word 3
[1698]	Warning Word 3
[1837]	Temp. Input X48/4
[1838]	Temp. Input X48/7
[1839]	Temp. Input X48/10
[1855]	Active Alarm Number
[1856]	Active Warning Number
[1866]	Switching Frequency
[1888]	Motor Current
[3421]	PCD 1 Read For Application
[3422]	PCD 2 Read For Application
[3423]	PCD 3 Read For Application
[3424]	PCD 4 Read For Application
[3425]	PCD 5 Read For Application
[3426]	PCD 6 Read For Application
[3427]	PCD 7 Read For Application

Option	Name
[3428]	PCD 8 Read For Application
[3429]	PCD 9 Read For Application
[3430]	PCD 10 Read For Application

12-23 Process Data Config Write Size

Default value:	16	**Parameter type:**	Range (8–32), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Use this parameter to configure the PCD write size in bits. Only values of multiples of 8 are valid.

12-24 Process Data Config Read Size

Default value:	16	**Parameter type:**	Range (8–32), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Use this parameter to configure the PCD read size in bits. Only values of multiples of 8 are valid.

12-28 Store Data Values

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

This parameter activates a function that stores all parameter values in the non-volatile memory (EEPROM) thus retaining parameter values at power-down.

Option	Name	Description
[0]	Off	The store function is inactive.
[2]	Store all setups	All parameter values are stored in the non-volatile memory in all setups. The parameter returns to ***[0] Off***.

12-29 Store Always

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

This parameter activates a function that always stores received parameter data in the non-volatile memory (EEPROM).

Option	Name	Description
[0]	Off	The store function is inactive.
[1]	On	The store function is active.

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4.11.5 12-3* EtherNet/IP

12-30 Warning Parameter

Default value:	0	**Parameter type:**	Range (0–2147483647)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is read-only. It shows the EtherNet/IP-specific 16-bit status word.

Table 20: 16-Bit Status Word, EtherNet/IP

Bit	Description
0	Owned
1	Not used
2	Configured
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used
8	Minor recoverable fault
9	Minor unrecoverable fault
10	Major recoverable fault
11	Major unrecoverable fault
12	Not used
13	Not used
14	Not used
15	Not used

12-31 Net Reference

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

Shows the reference source in instance 21/71.

Option	Name	Description
[0]	Off	Reference from the network is not active.
[1]	On	Reference from the network is active.

12-32 Net Control

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

Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Shows the control source in instance 21/71.

Option	Name	Description
[0]	Off	Control via the network is not active.
[1]	On	Control via the network is active.

12-33 CIP Revision

Default value:	Size related	**Parameter type:**	Range (0–65535), Array [2]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the CIP version of the option software.

12-34 CIP Product Code

Default value:	Size related	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter is read-only. It shows the CIP product code.

12-35 EDS Parameter

Default value:	0	**Parameter type:**	Readout, Array [1000]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is used to configure the drive via DeviceNet and build the EDS file.

12-37 COS Inhibit Timer

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Read-only change-of-state inhibit timer. If the option is configured for COS operation, this inhibit timer can be configured in the forward open telegram to avoid the continuously changing PCD data from generating extensive network traffic. The inhibit time is in ms. 0 = disabled.

12-38 COS Filter

Default value:	0	**Parameter type:**	Range (0–65535), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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Change-of-state PCD filters. Sets up a filter mask for each word of process data when operating in COS mode. Single bits in the PCDs can be filtered in/out.

4.11.6 12-4* Fieldbus Extension

12-49 Ethernet Extended Status

Default value:	0	**Parameter type:**	Range (0–4294967295), Array [20]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter provides extra information from Ethernet-based communication.

4.11.7 12-8* Other Ethernet Services

12-80 FTP Server

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

Enable or disable the built-in FTP server.

Option	Name
[0]	Disabled
[1]	Enabled

12-81 HTTP Server

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

Enable or disable the built-in HTTP server.

Option	Name
[0]	Disabled
[1]	Enabled

12-82 SMTP Service

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

Enable or disable the SMTP (e-mail) service on the option.

Option	Name
[0]	Disabled
[1]	Enabled

12-83 SNMP Agent

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

Use this parameter to either enable or disable the SNMP agent.

Option	Name
[0]	Disabled
[1]	Enabled

12-84 Address Conflict Detection

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

Use this parameter to detect and resolve IP address conflict.

Option	Name
[0]	Disabled
[1]	Enabled

12-89 Transparent Socket Channel Port

Default value:	4000	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Configure the TCP port number for the transient socket channel. This enables FC telegrams to be sent transiently on Ethernet via TCP. Default value is 4000 which indicates disabled.

4.11.8 12-9* Advanced Ethernet Services

12-90 Cable Diagnostic

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

Enable or disable the advanced cable diagnosis function. If enabled, the distance to cable errors can be read out in parameter ***12-93 Cable Error Length***. The parameter resumes to the default setting ***[0] Disabled*** after the diagnostics have finished.

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NOTICE

The cable diagnostics function is only issued on ports where there is no link (see parameter ***12-10 Link Status***).

Option	Name
[0]	Disabled
[1]	Enabled

12-91 Auto Cross Over

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

Enable or disable the auto-crossover function.

NOTICE

Disabling of the auto-crossover function requires crossed Ethernet cables for daisy chaining the options.

Option	Name
[0]	Disabled
[1]	Enabled

12-92 IGMP Snooping

Default value:	[1] Enabled	**Parameter type:**	Option, Array [2]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enable or disable the IGMP Snooping function. This avoids flooding of the Ethernet protocol stack by only forwarding multicast packets to ports that are a member of the multicast group.

Option	Name
[0]	Disabled
[1]	Enabled

12-93 Cable Error Length

Default value:	0	**Parameter type:**	Range (0–65535), Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

If cable diagnostics is enabled in parameter ***12-90 Cable Diagnostic***, the built-in switch is possible via time domain reflectometry (TDR). This is a measurement technique which detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is shown in meters with an accuracy of ±2 m (6.6 ft). The value 0 means that no errors were detected.

12-94 Broadcast Storm Protection

Default value:	-1%	**Parameter type:**	Range (-1%–20%)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

The built-in switch can protect the switch system from receiving too many broadcast packages, which can use up network resources. The value indicates a percentage of the total bandwidth that is allowed for broadcast messages.

Example:

OFF means that the filter is disabled - all broadcast messages are passed through. The value 0% means that no broadcast messages are passed through. A value of 10% means that 10% of the total bandwidth is allowed for broadcast messages. If the number of broadcast messages exceeds the 10% threshold, they are blocked.

12-95 Inactivity timeout

Default value:	120	**Parameter type:**	Range (0–3600)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Specifies the number of seconds a TCP connection can be inactive before it is closed.

12-96 Port Config

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

Enable or disable the port mirroring function.

Option	Name
[0]	Normal
[1]	Mirror Port 1 to 2
[2]	Mirror Port 2 to 1
[10]	Port 1 disabled
[11]	Port 2 disabled
[254]	Mirror Int. Port to 1
[255]	Mirror Int. Port to 2

12-97 QoS Priority

Default value:	Size related	**Parameter type:**	Range (0–63), Array [7]
Setup:	1 setup	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

Each index sets the DSCP value of different types of QoS prioritized messages.

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12-98 Interface Counters

Default value:	4000	**Parameter type:**	Range (0–4294967295), Array [11]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

12-99 Media Counters

Default value:	0	**Parameter type:**	Range (0–4294967295), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

4.12 Parameter Group 13-** Smart Logic

4.12.1 Smart Logic Control

Smart logic control (SLC) is a sequence of user-defined actions (see parameter ***13-52 SL Controller Action***) executed by the SLC when the associated user-defined event (see parameter ***13-51 SL Controller 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 shown in Figure 39.

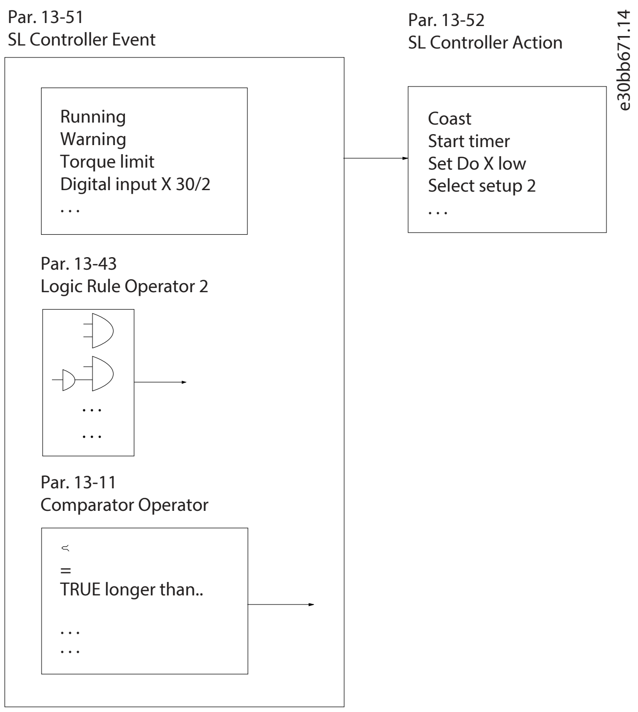

Figure 39: Smart Logic Control (SLC)

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 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. The following illustration shows an example with 3 events/actions:

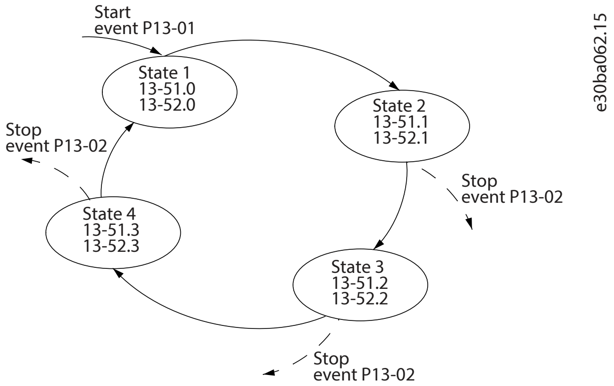

Figure 40: Events and Actions

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 (if ***[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.

4.12.2 13-0* SLC Settings

Use the SLC settings to activate, deactivate, and reset the smart logic control sequence. The logic functions and comparators are always running in the background, which opens for separate control of digital inputs and outputs.

13-00 SL Controller Mode

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

Enable or disable the smart logic controller.

Option	Name
[0]	Off
[1]	On

13-01 Start Event

Default value:	[39] Start command	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the condition (TRUE or FALSE) which activates the Smart Logic Controller.

Option	Name
[0]	False
[1]	True
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I 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
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[50]	Comparator 4
[51]	Comparator 5

Option	Name
[60]	Logic rule 4
[61]	Logic rule 5
[83]	Broken Belt

13-02 Stop Event

Default value:	[40] Drive stopped	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the condition (TRUE or FALSE) which deactivates the Smart Logic Controller.

Option	Name
[0]	False
[1]	True
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I high
[16]	Thermal warning
[17]	Mains out of range
[18]	Reversing
[19]	Warning
[20]	Alarm (trip)
[21]	Alarm (trip lock)
[22]	Comparator 0
[23]	Comparator 1
[24]	Comparator 2
[25]	Comparator 3
[26]	Logic rule 0
[27]	Logic rule 1
[28]	Logic rule 2
[29]	Logic rule 3
[30]	SL Time-out 0
[31]	SL Time-out 1
[32]	SL Time-out 2
[33]	Digital input DI18

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[34]	Digital input DI19
[35]	Digital input DI27
[36]	Digital input DI29
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[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
[83]	Broken Belt

13-03 Reset SLC

Default value:	[0] Do not reset SLC	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Reset all parameters in parameter group ***13-** Smart Logic*** to default settings.

Option	Name	Description
[0]	Do not reset SLC	Do not reset the parameters in parameter group ***13-** Smart Logic***.
[1]	Reset SLC	Reset all parameters in parameter group ***13-** Smart Logic*** to default settings.

4.12.3 13-1* Comparators

Comparators are used for comparing continuous variables (that is output frequency, output current, analog input, and so on.) to fixed preset values.

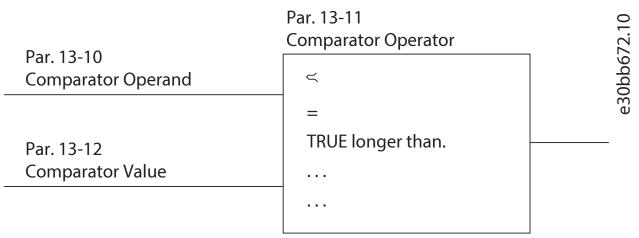

Figure 41: Comparators

There are digital values that are compared to fixed time values. See 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 to 5. Select index 0 to program comparator 0, select index 1 to program comparator 1, and so on.

13-10 Comparator Operand

Default value:	[0] Disabled	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the variable to be monitored by the comparator. This is an array parameter containing comparators 0 to 5.

Option	Name
[0]	Disabled
[1]	Reference %
[2]	Feedback %
[3]	Motor speed
[4]	Motor Current
[6]	Motor power
[7]	Motor voltage
[8]	DC-link voltage
[12]	Analog input AI53
[13]	Analog input AI54
[18]	Pulse input FI29
[19]	Pulse input FI33
[20]	Alarm number
[30]	Counter A
[31]	Counter B

13-11 Comparator Operator

Default value:	[1] Approx. Equal (~)	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**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 to 5.

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Option	Name	Description
[0]	Less Than (<)	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]	Approx. Equal (~)	The result of the evaluation is true when the variable speed selected in parameter ***13-10 Comparator Operand*** is approximately equal to the fixed value in parameter ***13-12 Comparator Value***.
[2]	Greater Than (>)	Inverse logic of ***[0] Less Than (<)***.

13-12 Comparator Value

Default value:	0.000	**Parameter type:**	Range (-9999.000–9999.000), Array [6]
Setup:	1 setup	**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 0–5.

4.12.4 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 to 2. Select index 0 to program timer 0, select index 1 to program timer 1, and so on.

13-20 SL Controller Timer

Default value:	0.00 s	**Parameter type:**	Range (0.00–3600.00 s), Array [8]
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint32	**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 (for example, ***[29] Start timer 1***) and until the given timer value has elapsed.

4.12.5 13-4* Logic Rules

Combine up to 3 boolean inputs (true/false inputs) from timers, comparators, digital inputs, status bits, and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in parameter ***13-40 Logic Rule Boolean 1***, parameter ***13-42 Logic Rule Boolean 2***, and parameter ***13-44 Logic Rule Boolean 3***. Define the operators used to logically combine the selected inputs in parameter ***13-41 Logic Rule Operator 1*** and parameter ***13-43 Logic Rule Operator 2***.

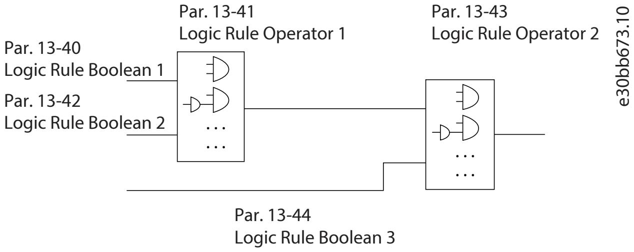

Figure 42: Logic Rules

Priority of calculation

The results of parameter ***13-40 Logic Rule Boolean 1***, parameter ***13-41 Logic Rule Operator 1***, and parameter ***13-42 Logic Rule Boolean 2*** are calculated first. The outcome (true/false) of this calculation is combined with the settings of parameter ***13-43 Logic Rule Operator 2*** and parameter ***13-44 Logic Rule Boolean 3***, yielding the final result (true/false) of the logic rule.

13-40 Logic Rule Boolean 1

Default value:	[0] False	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 1st boolean (true or false) input for the selected logic rule. See parameter ***13-01 Start Event*** ([0]–[61]) and parameter ***13-02 Stop Event*** ([70]– [74]) for further description.

Option	Name
[0]	False
[1]	True
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I 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

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Option	Name
[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
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[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
[83]	Broken Belt

13-41 Logic Rule Operator 1

Default value:	[0] Disabled	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**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***.

Option	Name	Description
[0]	Disabled	Ignore parameter ***13-42 Logic Rule Boolean 2***, parameter ***13-43 Logic Rule Operator 2***, and parameter ***13-44 Logic Rule Boolean 3***.
[1]	AND	Evaluate the expression [13-40] AND [13-42].
[2]	OR	Evaluate the expression [13-40] OR [13-42].
[3]	AND NOT	Evaluate the expression [13-40] AND NOT [13-42].
[4]	OR NOT	Evaluate the expression [13-40] OR NOT [13-42].

Option	Name	Description
[5]	NOT AND	Evaluate the expression NOT [13-40] AND [13-42].
[6]	NOT OR	Evaluate the expression NOT [13-40] OR [13-42].
[7]	NOT AND NOT	Evaluate the expression NOT [13-40] AND NOT [13-42].
[8]	NOT OR NOT	Evaluate the expression NOT [13-40] OR NOT [13-42].

13-42 Logic Rule Boolean 2

Default value:	[0] False	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 2nd boolean (true or false) input for the selected logic rule. See parameter ***13-01 Start Event*** ([0]–[61]) and parameter ***13-02 Stop Event*** ([70]– [74]) for further description.

Option	Name
[0]	False
[1]	True
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I high
[16]	Thermal warning
[17]	Mains out of range
[18]	Reversing
[19]	Warning
[20]	Alarm (trip)
[21]	Alarm (trip lock)
[22]	Comparator 0
[23]	Comparator 1
[24]	Comparator 2
[25]	Comparator 3
[26]	Logic rule 0
[27]	Logic rule 1
[28]	Logic rule 2
[29]	Logic rule 3
[30]	SL Time-out 0
[31]	SL Time-out 1

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Option	Name
[32]	SL Time-out 2
[33]	Digital input DI18
[34]	Digital input DI19
[35]	Digital input DI27
[36]	Digital input DI29
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[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
[83]	Broken Belt

13-43 Logic Rule Operator 2

Default value:	[0] Disabled	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**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*** and parameter ***13-42 Logic Rule Boolean 2*** and the boolean input coming from parameter ***13-42 Logic Rule Boolean 2***. Parameter ***13-42 Logic Rule Boolean 2*** signifies the boolean input of parameter ***13-40 Logic Rule Boolean 1***, and parameter ***13-42 Logic Rule Boolean 2*** signify the boolean input calculated in parameter ***13-40 Logic Rule Boolean 1***, parameter ***13-41 Logic Rule Operator 1***, and parameter ***13-42 Logic Rule Boolean 2***.

Option	Name	Description
[0]	Disabled	Ignore parameter ***13-44 Logic Rule Boolean 3***.
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	

Option	Name	Description
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-44 Logic Rule Boolean 3

Default value:	[0] False	**Parameter type:**	Option, Array [6]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 3rd boolean (true or false) input for the selected logic rule. See parameter ***13-40 Logic Rule Boolean 1***, parameter ***13-41 Logic Rule Operator 1***, and parameter ***13-42 Logic Rule Boolean 2*** and the boolean input. See parameter ***13-01 Start Event***([0]– [61]) and parameter ***13-02 Stop Event***([70]–[74]) for further description.

Option	Name
[0]	False
[1]	TRUE
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I high
[16]	Thermal warning
[17]	Mains out of range
[18]	Reversing
[19]	Warning
[20]	Alarm (trip)
[21]	Alarm (trip lock)
[22]	Comparator 0
[23]	Comparator 1
[24]	Comparator 2
[25]	Comparator 3
[26]	Logic rule 0
[27]	Logic rule 1
[28]	Logic rule 2
[29]	Logic rule 3
[30]	SL Time-out 0
[31]	SL Time-out 1
[32]	SL Time-out 2
[33]	Digital input DI18

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Option	Name
[34]	Digital input DI19
[35]	Digital input DI27
[36]	Digital input DI29
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[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
[83]	Broken Belt

4.12.6 13-5* States

13-51 SL Controller Event

Default value:	[0] False	**Parameter type:**	Option, Array [20]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the 3rd boolean (true or false) input for the selected logic rule. See parameter ***13-40 Logic Rule Boolean 1***, parameter ***13-41 Logic Rule Operator 1***, parameter ***13-42 Logic Rule Boolean 2***, and the boolean input. See parameter ***13-01 Start Event*** ([0]–[61]) and parameter ***13-02 Stop Event*** ([70]– [74]) for further description.

Option	Name
[0]	False
[1]	True
[2]	Running
[3]	In range
[4]	On reference
[7]	Out of current range
[8]	Below I low
[9]	Above I high
[16]	Thermal warning
[17]	Mains out of range

Option	Name
[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
[39]	Start command
[40]	Drive stopped
[42]	Auto Reset Trip
[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
[83]	Broken Belt

13-52 SL Controller Action

Default value:	[0] Disabled	**Parameter type:**	Option, Array [20]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

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Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter ***13-51 SL Controller Event***) is evaluated as TRUE. This is an array parameter containing SLC actions 0 to 19.

Option	Name	Description
[0]	Disabled	Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter ***13-51 SL Controller Event***) is evaluated as true.
[1]	No action	No action
[2]	Select set-up 1	Change 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	Change the active setup (parameter ***0-10 Active Set-up***) to 2. 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	Select 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	Select 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	Select 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	Select 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	Select 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	Select 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	Select 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	Select 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	Select ramp 1.
[19]	Select ramp 2	Select ramp 2.
[22]	Run	Issue a start command to the drive.
[23]	Run reverse	Issue a start reverse command to the drive.
[24]	Stop	Issue a stop command to the drive.
[25]	Qstop	Issue a quick stop command to the drive.
[26]	DC Brake	Issue a DC brake command to the drive.

Option	Name	Description
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freeze the output of the drive.
[29]	Start timer 0	See parameter ***13-20 SL Controller Timer*** for further description.
[30]	Start timer 1	See parameter ***13-20 SL Controller Timer*** for further description.
[31]	Start timer 2	See parameter ***13-20 SL Controller Timer*** for further description.
[32]	Set digital out A low	Any output with SL output A is low.
[33]	Set digital out B low	Any output with SL output B is low.
[34]	Set digital out C low	Any output with SL output C is low.
[35]	Set digital out D low	Any output with SL output D is low.
[38]	Set digital out A high	Any output with SL output A is high.
[39]	Set digital out B high	Any output with SL output B is high.
[40]	Set digital out C high	Any output with SL output C is high.
[41]	Set digital out D high	Any output with SL output D is high.
[60]	Reset Counter A	Reset Counter A to zero.
[61]	Reset Counter B	Reset Counter B to zero.
[70]	Start Timer 3	See parameter ***13-20 SL Controller Timer*** for further description.
[71]	Start Timer 4	See parameter ***13-20 SL Controller Timer*** for further description.
[72]	Start Timer 5	See parameter ***13-20 SL Controller Timer*** for further description.
[73]	Start Timer 6	See parameter ***13-20 SL Controller Timer*** for further description.
[74]	Start Timer 7	See parameter ***13-20 SL Controller Timer*** for further description.

4.13 Parameter Group 14-** Special Functions

4.13.1 14-0* Inverter Switching

Parameters for configuring the inverter switching.

14-01 Switching Frequency

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

Select the inverter switching frequency. Changing the switching frequency helps to reduce acoustic noise from the motor.

Option	Name	Description
[0]	Ran3	3 kHz true random PWM (white noise modulation).
[1]	Ran5	5 kHz true random PWM (white noise modulation).
[2]	2.0 kHz	
[3]	3.0 kHz	

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Option	Name	Description
[4]	4.0 kHz	
[5]	5.0 kHz	
[6]	6.0 kHz	
[7]	8.0 kHz	
[8]	10.0 kHz	
[9]	12.0 kHz	
[10]	16.0 kHz	

14-03 Overmodulation

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

Enable or disable the overmodulation function.

NOTICE

Overmodulation leads to increased torque ripple as harmonics are increased.

Option	Name	Description
[0]	Off	To avoid torque ripple on the motor shaft, select ***[0] Off*** for no overmodulation of the output voltage. 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. Select this setting when it is required that the output voltage is >95% of the input voltage (typically when running oversynchronously). The output voltage is increased according to the degree of overmodulation.
[3]	Limit Output Voltage	To maximize system efficiency, the drive limits the motor voltage according to its nameplate data. This avoids excessive iron losses and reduced efficiency that can occur when the supply voltage from various grids exceeds the motor's rating. This voltage-limiting logic is implemented for both IPM and SPM motors with VVC+ and Flux Sensorless controls.

14-04 Acoustic Noise Reduction

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

Enable or disable the acoustic noise reduction function.

Option	Name	Description
[0]	Off	Disable the function.
[1]	On	Select ***[1] On*** to transform the acoustic motor switching noise from a clear ring tone into a less audible white noise.

14-05 PWM Generation

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

Select for PWM generation.

Option	Name	Description
[0]	Standard	Standard setting.
[1]	Double Update	Mainly for high speed applications.

14-07 Dead Time Compensation Level

Default value:	Size related	**Parameter type:**	Range (0–100)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Level of applied dead time compensation in percentage.

- A high level (>90%) optimizes the dynamic motor response.
- A level of 50–90% is good for both motor-torque-ripple minimization and the motor dynamics.
- A 0-level turns off the dead time compensation.

14-08 Damping Gain Factor

Default value:	Size related	**Parameter type:**	Range (0–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Damping factor for DC-link voltage compensation.

14-09 Dead Time Bias Current Level

Default value:	Size related	**Parameter type:**	Range (0–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set a bias signal (in [%]) to add to the current-sense signal for dead time compensation.

4.13.2 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.

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14-10 Mains Failure

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

Parameter ***14-10 Mains Failure*** is typically used where short mains interruptions (voltage dips) are present. At 100% load and a short voltage interruption, the DC voltage on the main capacitors drops quickly. For larger drives, it only takes a few milliseconds before the DC level is down to about 373 V DC and the IGBTs cut off and lose 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 to which the drive must act when the threshold in parameter ***14-11 Mains Fault Voltage Level*** has been 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 the motor is lost within milliseconds to seconds. Trip lock is the result.
[1]	Ctrl. ramp-down	The drive retains control of the motor and does 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 might take down the output frequency to 0 RPM, and when the mains is restored, the application is ramped up from 0 RPM to the previous reference speed via the normal ramp up). If the energy in the DC link disappears before the motor is ramped to 0, the motor is coasted.
[2]	Ctrl. ramp-down, trip	This selection is similar to selection ***[1] Ctrl. ramp-down***, except that in ***[2] Ctrl. ramp-down, trip*** a reset is necessary for starting up after power-up.
[3]	Coasting	Centrifuges can run for an hour without a power 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.

Option	Name	Description
[4]	Kinetic backup	Kinetic backup 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 thereby 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. The DC-level during ***[4] Kinetic backup***is parameter ***14-11 Mains Fault Voltage Level*** x 1.35. If the mains does not return, UDC is maintained as long as possible by ramping the speed down towards 0 RPM. Finally, the drive coasts. If mains returns while in kinetic backup, UDC increases above parameter ***14-11 Mains Fault Voltage Level*** x 1.35. This is detected in 1 of the following ways: • If UDC >parameter ***14-11 Mains Fault Voltage Level*** x 1.35 x 1.05. • If the speed is above the reference. This is relevant if mains comes back at a lower level than before, for example, parameter ***14-11 Mains Fault Voltage Level*** x 1.35 x 1.02. This does not fulfill the preceding criterion, and the drive tries to reduce UDC to parameter ***14-11 Mains Fault Voltage Level*** x 1.35 by increasing the speed. This does not succeed as mains cannot be lowered. • If running motoric. The same mechanism as in the previous point, but where the inertia avoids the speed from going above the reference speed. This leads to the motor running motoric until the speed is above the reference speed, and the preceding situation occurs. Instead of waiting for that, the present criterion is introduced.
[5]	Kinetic backup, trip	The difference between kinetic backup with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains return or not. The function is made so that it does not even detect if mains return. This is the reason for the relatively high level on the DC link during ramp down.
[6]	Alarm	

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Option	Name	Description
[7]	Kin. backup, trip w recovery	Kinetic backup with recovery combines the features of kinetic backup and kinetic backup with trip. This feature makes it possible to select between kinetic backup and kinetic backup with trip based on a recovery speed, which is configurable in parameter ***14-15 Kin. Back-up Trip Recovery Level*** to enable detection of mains returning. If the mains does not return, the drive ramps down to 0 RPM and trips. If mains return while kinetic backup is at a speed above the value set 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] Kinetic back-up*** is parameter ***14-11 Mains Fault Voltage Level*** x 1.35. If mains return while kinetic backup is 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.
[10]	Quick ramp-down	The purpose of this function is to handle mains drop in low inertia applications, where the drive must continue running to make a ride-through by reducing the speed until the grid returns to full voltage. During the voltage drop, the speed ramps down using parameter ***3-81 Quick Stop Ramp Time*** until voltage returns. After that, normal ramp up is used. The DC link is not regulated since this is not possible in a low-inertia application without any generative power in the motor/load. The selection is valid for IPM and SPM motors in Flux. To ensure that the function is activated, set parameter ***14-11 Mains Failure Voltage Level*** higher than the expected voltage drop level. The quick ramp down must be set fast enough to endure a significant load drop to allow the control to run at reduced voltage, and it must be slow enough not to reach standstill before voltage returns - if possible. If speed reaches 0, it stays there until voltage returns and ramps up. If an alarm is required at standstill, it can be programmed in the SLC.

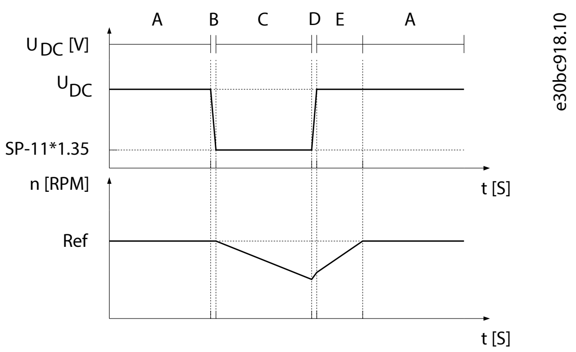

Figure 43: Kinetic Backup

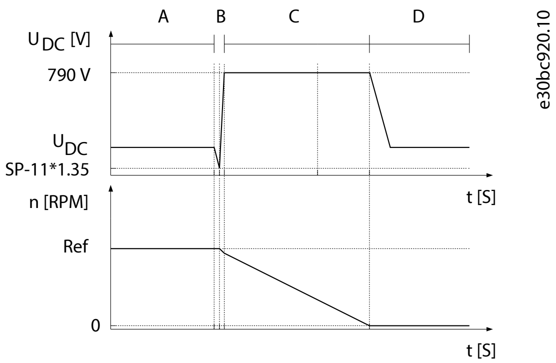

Figure 44: Kinetic Backup Trip

14-11 Mains Fault Voltage Level

Default value:	342 V	**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 selected function in parameter ***14-10 Mains Failure*** is activated. Based on the supply quality, consider selecting 90% of the nominal mains as the detection level. For a supply of 380 V, parameter ***14-11 Mains Fault Voltage Level*** should be set to 342 V. This results in a DC detection level of 462 V (parameter ***14-11 Mains Fault Voltage Level*** x 1.35).

14-12 Response to Mains Imbalance

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

Operation under severe mains imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (for example, a pump or fan running near full speed).

Option	Name	Description
[0]	Trip	Trip the drive.
[1]	Warning	Issue a warning.
[2]	Disabled	No action is taken.
[3]	Derate	Derate the drive.
[4]	Fast Trip	Enable the fast detection to trip the drive. This option is related to parameter ***14-17 Fast Mains Phase Loss Level*** and parameter ***14-18 Fast Mains Phase Loss Min Power***.
[5]	Fast Warning	Enable the fast detection to issue a warning. This option is related to parameter ***14-17 Fast Mains Phase Loss Level*** and parameter ***14-18 Fast Mains Phase Loss Min Power***.

14-15 Kin. Back-up Trip Recovery Level

Default value:	Size related	**Parameter type:**	Range (0.000–500.000 ReferenceFeedbackUnit)
Setup:	All setups	**Conversion index:**	-3

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

This parameter specifies the kinetic backup trip recovery level.

14-17 Fast Mains Phase Loss Level

Default value:	300%	**Parameter type:**	Range (0–1000%)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set this parameter to a lower value makes the detection more sensitive. Set this parameter to a higher value is opposite. This parameter is only active when parameter ***14-12 Response to Mains Imbalance*** selects option ***[4] Fast Trip*** or ***[5] Fast Warning***.

14-18 Fast Mains Phase Loss Min Power

Default value:	10%	**Parameter type:**	Range (0–100%)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

The fast detection does not activate if the actual power is lower than the percentage of parameter ***14-18 Fast Mains Phase Loss Min Power*** x $P_{M, N}$. This parameter is only active when parameter ***14-12 Response to Mains Imbalance*** selects option ***[4] Fast Trip*** or ***[5] Fast Warning***.

4.13.3 14-2* Reset Functions

Parameters for configuring auto reset handling, special trip handling, and control card self-test, or initialization.

14-20 Reset Mode

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

Select the reset function after tripping. Once reset, the drive can be restarted.

WARNING

UNINTENDED START

When the drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage.

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

NOTICE

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*** reverts to the original selection. If the number of automatic resets is 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…x 20*** to perform1–20 automatic resets after tripping.
[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 ***[13] Infinite Automatic Reset*** for continuous resetting after tripping.
[14]	Reset at power-up	

14-21 Automatic Restart Time

Default value:	10 s	**Parameter type:**	Range (0–600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the time interval from trip to start of the automatic reset function. This parameter is active when parameter ***14-20 Reset Mode*** is set to ***[1]–[13] Automatic reset***.

14-22 Operation Mode

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

Select the operation mode.

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Option	Name	Description
[0]	Normal operation	Normal operation with motor selected.
[2]	Initialization	Reset parameter values to default settings. The drive resets during the next power-up.
[5]	Clear service logs	The drive clears service log file in the file system during the next power-up.

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 seconds. 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 = Off. Thermal monitoring of the drive remains active.

14-25 Trip Delay at Torque Limit

Default value:	60 s	**Parameter type:**	Range (0–60 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the torque limit trip delay in seconds. When the output torque reaches the torque limits (parameter ***4-16 Torque Limit Motor Mode*** and parameter ***4-17 Torque Limit Generator Mode***), a warning is triggered. When the torque limit warning has been continuously present for the period specified in this parameter, the drive trips. Disable the trip delay by setting the parameter to 60 s = Off. Thermal monitoring of the drive remains active.

14-27 Action At Inverter Fault

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

Select how the drive reacts when an overvoltage, overcurrent, short circuit, or grounding fault occurs.

Option	Name	Description
[0]	Trip	Disable the protection filters and trips at the first fault.
[1]	Warning	Run the protection filters normally.

14-28 Production Settings

Default value:	[0] No action	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

For use by service technicians only.

Option	Name
[0]	No action
[1]	Service reset
[3]	Software Reset

14-29 Service Code

Default value:	0	**Parameter type:**	Range (0–4294967295)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

For use by service technicians only.

4.13.4 14-3* Current Limit Ctrl.

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.

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:**	True

Enter the proportional gain value for the current limit controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability.

14-31 Current Lim Ctrl, Integration Time

Default value:	Size related	**Parameter type:**	Range (0.002–2 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Control the current limit control integration time. Setting it to a lower value makes it react faster. A setting too low leads to control instability.

14-32 Current Lim Ctrl, Filter Time

Default value:	5.0 ms	**Parameter type:**	Range (1.0–100.0 ms)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a time constant for the current limit controller low-pass filter.

14-34 Stall Protection Adjustment Factor

Default value:	100%	**Parameter type:**	Range (50%–200%)

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

Define the stall protection adjustment factor.

14-35 Stall Protection

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

Enable or disable the stall protection function.

Option	Name	Description
[0]	Disabled	Disable the stall protection function.
[1]	Enabled	Enable the stall protection when field weakening mode and Flux mode are active.

14-36 Field-weakening Function

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

Select the field weakening function mode in Flux mode.

Option	Name	Description
[0]	Auto	The drive calculates the optimal torque output.
[1]	1/x	The drive reduces torque output. Magnetizing reference is set inversely proportional to the speed using a static curve.

14-37 Fieldweakening Speed

Default value:	Size related	**Parameter type:**	Range (10–60000 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the start speed for option *[1] 1/x* in parameter ***14-36 Field-weakening Function***.

14-38 Field Weakening Controller Gain

Default value:	20%	**Parameter type:**	Range (0–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the integral gain for field weakening controller.

4.13.5 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***.

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

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.

NOTICE

This parameter is not active when parameter ***1-10 Motor Construction*** is set to options that enable PM motor mode.

14-41 AEO Minimum Magnetization

Default value:	40%	**Parameter type:**	Range (10%–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the minimum allowable magnetization for AEO. Selection of a low value reduces energy loss in the motor, but can also reduce resistance to sudden load changes.

14-42 Minimum AEO Frequency

Default value:	Size related	**Parameter type:**	Range (0–255 Hz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Enter the minimum frequency at which the automatic energy optimization (AEO) is active.

14-44 d-axis current optimization for IPM

Default value:	100%	**Parameter type:**	Range (0–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

This parameter is available only when parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***. Normally, VVC+ PM control automatically optimizes d-axis demagnetizing current based on d-axis and q-axis settings. When parameter ***1-10 Motor Construction*** is set to ***[3] PM, salient IPM***, use this parameter to compensate the saturation effect at high load. Usually, decreasing this value improves the efficiency. However, 0% means no optimization and the d-axis current is 0 (not recommended).

4.13.6 14-5* Environment

NOTICE

Perform a power cycle after changing any of the parameters in parameter group ***14-5* Environment***.

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These parameters help the drive to operate under special environmental conditions.

14-50 RFI Filter

Default value:	[2] Grid Type	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the RFI filter.

Option	Name	Description
[0]	Off	Select ***[0] Off*** only when the drive is connected to an isolated mains source (IT mains).
[1]	On	Select ***[1] On*** to turn on the RFI filter. The RFI filter ensures that the drive complies with EMC standards.
[2]	Grid Type	

14-51 DC-Link Voltage Compensation

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

Enable or disable the DC-link voltage compensation.

Option	Name
[0]	Off
[1]	On

14-52 Fan Control

Default value:	[5] Constant-on mode	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the fan control mode.

Option	Name
[5]	Constant-on mode
[6]	Constant-off mode
[7]	On-when-Inverter-is-on-else-off mode
[8]	Variable-speed mode

14-55 Output Filter

Default value:	[0] No Filter	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

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

Select the type of output filter connected.

Option	Name
[0]	No filter
[1]	Sine-wave filter

4.13.7 14-6* Auto Derate

Use this parameter group to configure automatic derating for the output current of the drive.

14-61 Function at Inverter Overload

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

When the drive issues a drive overload warning, select whether to continue and trip the drive, or derate the output current.

Option	Name
[0]	Trip
[1]	Derate

14-63 Min Switch Frequency

Default value:	[2] 2.0 kHz	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Set the minimum switching frequency allowed by the output filter.

Option	Name
[2]	2.0 kHz
[3]	3.0 kHz
[4]	4.0 kHz
[5]	5.0 kHz
[6]	6.0 kHz
[7]	8.0 kHz
[8]	10.0 kHz
[9]	12.0 kHz
[10]	16.0 kHz

14-64 Dead Time Compensation Zero Current Level

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–

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

Select *[1]* ***Enabled*** to minimize the motor torque ripple when using a long motor cable.

Option	Name
[0]	Disabled
[1]	Enabled

14-65 Speed Derate Dead Time Compensation

Default value:	Size related	**Parameter type:**	Range (20–1000 Hz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Deadtime compensation level is reduced linearly versus output frequency from the maximum level set in parameter ***14-07 Dead Time Compensation Level*** to a minimum level set in this parameter.

4.13.8 14-7* Compatibility

14-70 Compatibility Selections

Default value:	[0] No Function	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Select the compatibility mode for the drive.

Option	Name
[0]	No Function
[10]	Status Par. VLT 5000
[11]	Status Par. and MAV VLT 5000
[31]	Customize Converter 1
[32]	Customize Converter 2
[33]	Customize Converter 3

14-75 Customize Converter Readout

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

A readout parameter to show which converter is running.

4.13.9 14-8* Options

14-89 Option Detection

Default value:	[0] Protect Option Config.	**Parameter type:**	Option

Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the behavior when an option change is detected. This parameter returns to ***[0] Protect Option Config.*** after an option change.

Option	Name	Description
[0]	Protect Option Config.	Freeze the current settings and avoid unwanted changes when missing or defective options are detected.
[1]	Enable Option Change	Settings can be changed when the system configuration is being modified.

4.13.10 14-9* Fault Settings

Use the parameters to configure the fault settings.

14-90 Fault Level

Default value:	[3] Trip Lock	**Parameter type:**	Option, Array [32]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Use this parameter to customize fault levels. The type of the parameter is index, see Table 21.

Option	Name	Description
[0]	Off	
[1]	Warning	
[2]	Trip	
[3]	Trip Lock	Alarm is set to trip lock.
[4]	Trip w. delayed reset	Alarm is configured into trip alarm, which can be reset after a delay time. For example, if ***alarm 13, Overcurrent*** is configured to this option, it can be reset 3 minutes after the alarm. This option uses index [7] to control the fault level of ***alarm 13, Overcurrent***.
[5]	Fly start	At start-up, the drive tries to catch a spinning motor. If this option is selected, parameter ***1-73 Flying Start*** is forced to ***[1] Enabled***. This option uses index [7] to control the fault level of ***alarm 13, Overcurrent***.

Table 21: Table for Selection of Action when Selected Alarm Appears (Parameter *14-90 Fault Level*)

Failure	Alarm	Element in parameter *14-90 Fault Level*	Off	Warning	Trip	Trip lock	Trip with delayed reset	Fly start
Voltage limit	64	1490.3	X	D	–	–	–	–
Earth fault(1)	14	1490.4	X	–	–	D	–	–
Overcurrent	13	1490.7	–	–	–	D	X	X
Motor phase U missing	30	1490.16	–	–	X	D	–	–

Table 21: Table for Selection of Action when Selected Alarm Appears (Parameter *14-90 Fault Level*) - (continued)

Failure	Alarm	Element in parameter *14-90 Fault Level*	Off	Warning	Trip	Trip lock	Trip with delayed reset	Fly start
Motor phase V missing	31	1490.16	–	–	X	D	–	–
Motor phase W missing	32	1490.16	–	–	X	D	–	–

1) *Only for drive of power size 30–75 kW (40–100 hp). If **[0] Off** is selected, the earth fault protection is disabled only for the earth fault which happens during running and the short-circuit current to ground is lower than 200%.*

D = Default setting

X = Possible selection

NOTICE

Disabling the ground fault may damage the drive and void the warranty.

4.14 Parameter Group 15-** Drive Information

4.14.1 15-0* Operating Data

15-00 Operating hours

Default value:	0 h	**Parameter type:**	Range (0–2147483647 h)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View how many hours the drive has run. The value is saved when the drive is turned off.

15-01 Running Hours

Default value:	0 h	**Parameter type:**	Range (0–2147483647 h)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View how many hours the motor has run. Reset the counter in parameter ***15-07 Reset Running Hours Counter***. The value is saved when the drive is turned off.

15-02 kWh Counter

Default value:	0 kWh	**Parameter type:**	Range (0–2147483647 kWh)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the output power of the DC bus in kWh as an average value over 1 hour. Reset the counter in parameter ***15-06 Reset kWh Counter***.

15-03 Power Up's

Default value:	0	**Parameter type:**	Range (0–2147483647)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the number of times the drive has been powered up.

15-04 Over Temp's

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the number of drive temperature faults.

15-05 Overvolt's

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the number of drive overvoltages.

15-06 Reset kWh Counter

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select to reset the kWh counter to zero.

Option	Name	Description
[0]	Do not reset	Do not reset the counter.
[1]	Reset counter	Press *[OK]* to reset the kWh counter to 0 (see parameter ***15-02 kWh Counter***).

15-07 Reset Running Hours Counter

Default value:	[0] Do not reset	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select to reset the running hours counter to zero.

Option	Name	Description
[0]	Do not reset	Do not reset the counter.
[1]	Reset counter	Press *[OK]* to reset the running hours counter to 0 (see parameter ***15-01 Running Hours***).

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4.14.2 15-1* Data Log Settings

15-15 Info Message: "Service Log Full"

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

Use this parameter when the service log is full.

Option	Name	Description
[0]	Disabled	There is no message about clearing service log when the service log is full.
[1]	Enabled	A message about clearing service log on LCP is shown when the service log is full.

15-17 Service Log Trigger Alarm

Default value:	0	**Parameter type:**	Range (0–9999)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Enter the alarm number that triggers the service log write to flash. By default, the service log logs motor specific data during motor related alarms. Using display line parameters ***0-20 Display Line 1.1 Small***, ***0-21 Display Line 1.2 Small***, and ***0-22 Display Line 1.3 small*** with current parameter, the service log can be configured for custom data logging events.

15-18 Service Log Trigger SLC

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

The service log can be used for troubleshooting. The SLC operands trigger the service log when an event occurs. The maximum numbers of service logs is 24. To clear the service logs, use parameter ***14-22 Operation Mode***followed by a power cycle.

Option	Name
[0]	False
[18]	Reversing
[19]	Warning
[22]	Comparator 0
[23]	Comparator 1
[24]	Comparator 2
[25]	Comparator 3
[26]	Logic rule 0
[27]	Logic rule 1
[28]	Logic rule 2

Option	Name
[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
[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

4.14.3 15-3* Alarm Log

15-30 Alarm Log: Error Code

Default value:	0	**Parameter type:**	Range (0–255), Array [10]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the error code and look up its meaning in the *chapter Troubleshooting*.

15-31 InternalFaultReason

Default value:	0	**Parameter type:**	Range (-32767–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View an extra description of the error. This parameter is mostly used with *alarm 38, Internal Fault*.

15-32 Alarm Log: Time

Default value:	0 s	**Parameter type:**	Range (0–2147483647 s), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

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View the time when the logged event occurred. Time is measured in seconds from drive start-up.

4.14.4 15-4* Drive Identification

Parameters containing read-only information about the hardware and software configuration of the drive.

15-40 FC Type

Default value:	0	**Parameter type:**	Range (0–7)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the drive type. The readout is identical to the power field of the type code definition, characters 1–6.

15-41 Power Section

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the power size of the drive. The readout is identical to the power field of the type code definition, characters 7–10.

15-42 Voltage

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the mains voltage of the drive. The readout is identical to the power field type of the type code definition, characters 11–12.

15-43 Software Version

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the combined software version (or package version) consisting of power software and control software.

15-44 Ordered Type Code

Default value:	0	**Parameter type:**	Range (0–41)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the type code string used for reordering the drive in its original configuration.

15-45 Actual Typecode String

Default value:	0	**Parameter type:**	Range (0–40)
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the actual type code.

15-46 Drive Ordering No

Default value:	0	**Parameter type:**	Range (0–9)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the 8-digit code number used for reordering the drive in its original configuration.

15-48 LCP Id No

Default value:	0	**Parameter type:**	Range (0–21)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the LCP ID number.

15-49 SW ID Control Card

Default value:	0	**Parameter type:**	Range (0–21)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the control card software version number.

15-50 SW ID Power Card

Default value:	0	**Parameter type:**	Range (0–21)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the power card software version number.

15-51 Drive Serial Number

Default value:	0	**Parameter type:**	Range (0–13)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the drive serial number.

15-53 Power Card Serial Number

Default value:	0	**Parameter type:**	Range (0–21)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the power card serial number.

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4.14.5 15-6* Option Ident

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A, B, C0, and C1.

15-60 Option Mounted

Default value:	Size related	**Parameter type:**	Range (0–30), Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the installed option type.

15-61 Option SW Version

Default value:	Size related	**Parameter type:**	Range (0–20), Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the software version of the installed option.

15-62 Option Ordering No

Default value:	Size related	**Parameter type:**	Range (0–8), Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

Show the code number for the installed options.

15-63 Option Serial No

Default value:	Size related	**Parameter type:**	Range (0–18), Array [8]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the serial number of the installed option.

15-70 Option in Slot A

Default value:	0	**Parameter type:**	Range (0–30)
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the type code string for the option installed in slot A and a translation of the type code string.

15-71 Slot A Option SW Version

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

View the software version for the option installed in slot A.

4.14.6 15-9* Parameter Info

Use this parameter group to view information about available parameters for the drive.

15-92 Defined Parameters

Default value:	0	**Parameter type:**	Range (0–2000), Array [44]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View a list of all defined parameters in the drive. The list ends with 0.

15-98 Drive Identification

Default value:	0	**Parameter type:**	Range (0–56)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

This parameter contains data used by the MCT 10 software.

15-99 Parameter Metadata

Default value:	0	**Parameter type:**	Range (0–9999), Array [36]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter contains data used by the MCT 10 software.

4.15 Parameter Group 16-** Data Readouts

4.15.1 16-0* General Status

16-00 Control Word

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the control word sent from the drive via the serial communication port in hex code.

16-01 Reference [Unit]

Default value:	0.000 ReferenceFeedbackUnit	**Parameter type:**	Range (-4999.000–4999.000 ReferenceFeedbackUnit)
Setup:	1 setup	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

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***.

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16-02 Reference [%]

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references, plus catch up and slow down.

16-03 Status Word

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the status word sent from the drive via the serial communication port in hex code.

16-05 Main Actual Value [%]

Default value:	0.00%	**Parameter type:**	Range (-200.00–200.00%)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	True

View the 2 byte word sent with the status word to the bus master reporting the main actual value.

16-09 Custom Readout

Default value:	0.00 CustomReadoutUnit	**Parameter type:**	Range (0.00–9999.00 CustomReadoutUnit)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Int32	**Change during operation:**	True

View the custom readout from parameter ***0-30 Custom Readout Unit*** to parameter ***0-32 Custom Readout Max Value***.

4.15.2 16-1* Motor Status

16-10 Power [kW]

Default value:	0.000 kW	**Parameter type:**	Range (0.000–1000.000 kW)
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

Show motor power in kW. The calculated value shown is based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 300 ms 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.

16-11 Power [hp]

Default value:	0.000 hp	**Parameter type:**	Range (0.000–1000.000 hp)
Setup:	1 setup	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

View the motor power in hp. The value shown is calculated on the basis of the actual motor voltage and motor current. The value is filtered, and therefore approximately 300 ms may pass from when an input value changes to when the data readout values change.

16-12 Motor Voltage

Default value:	0 V	**Parameter type:**	Range (0–65535 V)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the motor voltage. A calculated value is used for controlling the motor.

16-13 Frequency

Default value:	0.0 Hz	**Parameter type:**	Range (0.0–6553.5 Hz)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

View the motor frequency, without resonance damping.

16-14 Motor current

Default value:	0.00 A	**Parameter type:**	Range (0.00–655.35 A)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

View the motor current measured as an average value, I_{RMS}. The value is filtered, and approximately 200 ms may pass from when an input value changes to when the data readout values change.

16-15 Frequency [%]

Default value:	0.0%	**Parameter type:**	Range (0.0–6553.5%)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

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***.

16-16 Torque [Nm]

Default value:	0.0 Nm	**Parameter type:**	Range (-30000.0–30000.0 Nm)
Setup:	All setups	**Conversion index:**	-1
Data type:	Int32	**Change during operation:**	False

View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. As a result, the minimum value and the maximum value depend on the maximum motor current as well as the motor used.

16-17 Speed [RPM]

Default value:	0 RPM	**Parameter type:**	Range (-30000–30000 RPM)
Setup:	All setups	**Conversion index:**	0

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Data type:	Int32	**Change during operation:**	False

View the actual motor RPM. In open loop or closed loop process control, the motor RPM is estimated. In Speed closed loop modes, the motor RPM is measured.

16-18 Motor Thermal

Default value:	0%	**Parameter type:**	Range (0–100%)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the calculated thermal load on the motor. The cutout limit is 100%. The basis for calculation is the ETR function selected in parameter ***1-90 Motor Thermal Protection***.

16-20 Motor Angle

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the current encoder/resolver angle offset relative to the index position. The value range of 0–65535 corresponds to 0–2*pi (radians).

16-22 Torque [%]

Default value:	0%	**Parameter type:**	Range (-200–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	False

View the torque in percent of nominal torque, with sign, applied to the motor shaft.

16-24 Calibrated Stator Resistance

Default value:	0.0000 Ohm	**Parameter type:**	Range (0.0000–100.0000 Ohm)
Setup:	All setups	**Conversion index:**	-4
Data type:	Uint32	**Change during operation:**	True

View the calibrated stator resistance.

4.15.3 16-3* Drive Status

16-30 DC Link Voltage

Default value:	0 V	**Parameter type:**	Range (0–65535 V)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View a measured value. The value is filtered with a 128 ms time constant.

16-33 Brake Energy/2 min

Default value:	0.000 kW	**Parameter type:**	Range (0.000–10000.000 kW)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	False

View the brake power sent to an external brake resistor. The average power is calculated on an average level based on the latest 120 s.

16-34 Heat sink Temp.

Default value:	0 °C	**Parameter type:**	Range (-128–127 °C)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

View the drive heat sink temperature. The cutout limit is 90 ±5 °C [194 °F], and the motor cuts back in at 60 ±5 °C [140 °F].

16-35 Inverter Thermal

Default value:	0%	**Parameter type:**	Range (0–255%)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the percentage load on the inverter.

16-36 Inv. Nom. Current

Default value:	0.00 A	**Parameter type:**	Range (0.00–655.35 A)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

View the inverter nominal current, which should match the nameplate data on the connected motor. The data is used for calculation of torque and motor overload protection.

16-37 Inv. Max. Current

Default value:	0.00 A	**Parameter type:**	Range (0.00–655.35 A)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

View the inverter maximum current, which should match the nameplate data on the connected motor. The data is used for calculation of torque and motor overload protection.

16-38 SL Controller State

Default value:	0	**Parameter type:**	Range (0–20)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

View the state of the event under execution by the SL Controller.

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16-39 Control Card Temp.

Default value:	0 °C	**Parameter type:**	Range (0–65535 °C)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the temperature on the control card, stated in °C.

16-40 Logging Buffer Full

Default value:	[0] No	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

View whether the logging buffer is full (see parameter group ***15-1* Data Log Settings***).

Option	Name
[0]	No
[1]	Yes

16-42 Service Log Counter

Default value:	0	**Parameter type:**	Range (0–24)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Shows the number of service logs stored in the ServiceLog file. If the ServiceLog file is full, clear the logged data by selecting option ***[5] Clear service logs*** in parameter ***14-22 Operation Mode***. The logged data is deleted on the next power-up.

16-44 Speed Error [RPM]

Default value:	0.000 RPM	**Parameter type:**	Range (-60000.000–600000000 RPM)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Select the speed error [RPM].

16-48 Speed Ref. After Ramp [RPM]

Default value:	0 RPM	**Parameter type:**	Range (-30000–30000 RPM)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Define the reference given to the drive after the speed ramp in RPM.

4.15.4 16-5* Ref. & Feedb.

16-50 External Reference

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	True

View the total reference, the sum of digital, analog, preset, bus, and freeze references, plus catch up and slow down.

16-52 Feedback[Unit]

Default value:	0.000 ProcessCtrlUnit	**Parameter type:**	Range (-4999.000–4999.000 ProcessCtrlUnit)
Setup:	1 setup	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

View the feedback unit calculated 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***.

16-53 Digi Pot Reference

Default value:	0.00	**Parameter type:**	Range (-200.00–200.00)
Setup:	All setups	**Conversion index:**	-2
Data type:	Int16	**Change during operation:**	False

View the contribution of the digital potentiometer to the actual reference.

16-57 Feedback [RPM]

Default value:	0 RPM	**Parameter type:**	Range (-30000–30000 RPM)
Setup:	All setups	**Conversion index:**	0
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***.

4.15.5 16-6* Inputs & Outputs

16-60 Digital Input

Default value:	0	**Parameter type:**	Range (0–4095)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the actual state of the digital inputs 18, 19, 27, and 29.

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Table 22: Bits Definition

Bits	Definition
Bit 0	Digital input terminal 33
Bit 1	Digital input terminal 32
Bit 2	Digital input terminal 29
Bit 3	Digital input terminal 27
Bit 4	Digital input terminal 19
Bit 5	Digital input terminal 18
Bit 10	Digital input terminal 31

16-61 Terminal 53 Setting

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

View the setting of input terminal 53.

Option	Name
[0]	Current mode
[1]	Voltage mode

16-62 Analog input 53

Default value:	1.00	**Parameter type:**	Range (0.00–20.00)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

View the actual value at input 53.

16-63 Terminal 54 Setting

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

View the setting of input terminal 54.

Option	Name
[0]	Current mode
[1]	Voltage mode

16-64 Analog input 54

Default value:	1.00	**Parameter type:**	Range (0.00–20.00)
Setup:	1 setup	**Conversion index:**	-2

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

View the actual value at input 54.

16-65 Analog output 42 [mA]

Default value:	0.00 mA	**Parameter type:**	Range (0.00–20.00 mA)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

View the actual value at output 42. The value shown reflects the selections in parameter ***6-90 Terminal 42 Mode*** and parameter ***6-91 Terminal 42 Analog Output***.

16-66 Digital Output

Default value:	0	**Parameter type:**	Range (0–63)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the binary value of all digital outputs.

Table 23: Bits Definition

Bits	Definition
Bit 2	Digital input terminal 29
Bit 3	Digital input terminal 27
Bit 4	Digital input terminal 45
Bit 5	Digital input terminal 42

16-67 Pulse input 29 [Hz]

Default value:	0	**Parameter type:**	Range (0–130000)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual frequency rate on terminal 29.

16-68 Pulse input 33 [Hz]

Default value:	0	**Parameter type:**	Range (0–130000)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual value of the frequency applied at terminal 33 as an impulse input.

16-69 Pulse output 27 [Hz]

Default value:	0	**Parameter type:**	Range (0–40000)
Setup:	All setups	**Conversion index:**	0

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Data type:	Int32	**Change during operation:**	False

View the actual value of impulses applied to terminal 27 in digital output mode.

16-70 Pulse output 29 [Hz]

Default value:	0	**Parameter type:**	Range (0–40000)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

View the actual value of pulses to terminal 29 in digital output mode.

16-71 Relay output

Default value:	0	**Parameter type:**	Range (0–31)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the settings of all relays.

Table 24: Bits Definition

Bits	Definition
Bit 3	User relay 02
Bit 4	User relay 01

16-72 Counter A

Default value:	0	**Parameter type:**	Range (-32768–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the present value of counter A. Counters are useful as comparator operands, see parameter ***13-10 Comparator Operand***. The value can be reset or changed either via digital inputs (parameter group ***5-1* Digital Inputs***) or by using an SLC action (parameter ***13-52 SL Controller Action***).

16-73 Counter B

Default value:	0	**Parameter type:**	Range (-32768–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

View the present value of counter B. Counters are useful as comparator operands, see parameter ***13-10 Comparator Operand***. The value can be reset or changed either via digital inputs (parameter group ***5-1* Digital Inputs***) or by using an SLC action (parameter ***13-52 SL Controller Action***).

16-79 Analog output 45 [mA]

Default value:	0.00 mA	**Parameter type:**	Range (0.00–20.00 mA)
Setup:	1 setup	**Conversion index:**	-2

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

View the actual value at output 45 in mA. The value shown reflects the selection in parameter ***6-70 Terminal 45 Mode*** and parameter ***6-71 Terminal 45 Analog Output***.

4.15.6 16-8* Fieldbus & FC Port

Parameters for reporting the bus references and control words.

16-80 Fieldbus CTW 1

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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 manuals.

16-82 Fieldbus REF 1

Default value:	0	**Parameter type:**	Range (-32768–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

To set the reference value, view the 2-byte word sent with the control word from the bus master. For more information, refer to the relevant fieldbus manual.

16-84 Comm. Option STW

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

View the extended fieldbus communication option status word. For more information, refer to the relevant fieldbus manual.

16-85 FC Port CTW 1

Default value:	1084	**Parameter type:**	Range (0–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

View the 2-byte control word (CTW) received from the bus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in parameter ***8-10 Control Word Profile***.

16-86 FC Port REF 1

Default value:	0	**Parameter type:**	Range (-32768–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

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View the last received reference from the FC port.

16-88 Fieldbus Torque FF.

Default value:	0	**Parameter type:**	Range (-32768–32767)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Set the fieldbus torque feedforward.

4.15.7 16-9* Diagnosis Readouts

Use the parameters to show alarm, warning, and extended status words.

16-90 Alarm Word

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the alarm word sent via the serial communication port in hex code.

16-91 Alarm Word 2

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the alarm word 2 sent via the serial communication port in hex code.

16-92 Warning Word

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the warning word sent via the serial communication port in hex code.

16-93 Warning Word 2

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the warning word 2 sent via the serial communication port in hex code.

16-94 Ext. Status Word

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the extended status word in hex code.

16-95 Ext. Status Word 2

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the extended status word 2 in hex code.

16-97 Alarm Word 3

Default value:	0	**Parameter type:**	Range (0–0xFFFFFFFFUL)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

View the alarm word 3 sent via the serial communication port in hex code.

4.16 Parameter Group 17-** Feedback Options

4.16.1 17-0* Encoder Interface

NOTICE

This parameter group is only valid when VLT® Encoder Input MCB 102 is installed.

17-00 Encoders Connected

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

Select 1 or 2 encoders connected.

Option	Name
[0]	One Encoder
[1]	Two Encoders

4.16.2 17-1* Inc.Enc.Interface

NOTICE

This parameter group is only valid when VLT® Encoder Input MCB 102 is installed.

17-10 Signal Type

Default value:	[1] RS422 (5 V TTL)	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

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Select the incremental type (A/B channel) of the encoder in use. Find the information on the encoder datasheet.

Option	Name
[0]	None
[1]	RS422 (5 V TTL)
[2]	Sinusoidal 1Vpp

17-11 Resolution (PPR)

Default value:	1024	**Parameter type:**	Range (10–16384)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Enter the resolution of the incremental track, which is the number of pulses or periods per revolution.

4.16.3 17-2* Abs. Enc. Interface

NOTICE

This parameter group is only valid when VLT® Encoder Input MCB 102 is installed.

17-20 Protocol Selection

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

Select the appropriate type of connected absolute encoder. If an incremental encoder is used, set parameter ***17-10 Signal Type***.

Option	Name
[0]	None
[4]	SSI

17-21 Resolution (Positions/Rev)

Default value:	Size related	**Parameter type:**	Range (4–1073741824)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Select the resolution of the absolute encoder, that is, the number of counts per revolution.

17-22 Multiturn Revolutions

Default value:	1	**Parameter type:**	Range (1–16777216)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Set the number of multi-turn revolutions. Selecting '1' means that the encoder is a single-turn type.

17-24 SSI Data Length

Default value:	13	**Parameter type:**	Range (1–32)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set number of bits for the SSI telegram.

17-25 Clock Rate

Default value:	260 kHz	**Parameter type:**	Range (100–260 kHz)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Set the clock rate for the SSI clock. When having long cables, the clock rate must be reduced.

17-26 SSI Data Format

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

Set the data format of the SSI data.

Option	Name
[0]	Gray code
[1]	Binary code

4.16.4 17-5* Resolver Interface

NOTICE

This parameter group is only valid when VLT® Resolver Option MCB 103 is installed.

17-50 Poles

Default value:	2	**Parameter type:**	Range (2–2)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	False

Set the pole numbers for the resolver.

17-51 Input Voltage

Default value:	7.0 V	**Parameter type:**	Range (2.0–8.0 V)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	False

Set the input voltage for the resolver.

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17-52 Input Frequency

Default value:	10.0 kHz	**Parameter type:**	Range (2.0–15.0 kHz)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	False

Set the input frequency for the resolver.

17-53 Transformation Ratio

Default value:	0.5	**Parameter type:**	Range (0.1–1.1)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	False

Set the transformation ratio for the resolver.

17-56 Encoder Sim. Resolution

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

Set the encoder simulation resolution.

Option	Name
[0]	Disabled
[1]	512
[2]	1024
[3]	2048
[4]	4096

17-59 Resolver Interface

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

Enable or disable the carrier signal to the resolver. Set parameter ***17-50 Poles*** to parameter ***17-53 Transformation Ratio*** correctly according to the used resolver type before enabling this function.

Option	Name
[0]	Disabled
[1]	Enabled

4.16.5 17-6* Monitoring and App.

17-60 Feedback Direction

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

Change the detected encoder/resolver direction (revolution) without changing the wires to the HW.

Option	Name
[0]	Clockwise
[1]	Counterclockwise

17-61 Feedback Signal Monitoring

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

Select which reaction the drive should take in case an encoder/resolver fault is detected.

Option	Name
[0]	Disabled
[1]	Warning
[2]	Trip
[3]	Jog
[4]	Freeze Output
[5]	Max Speed
[6]	Switch to Open Loop

4.16.6 17-7* Position Scaling

17-72 Position Unit Numerator

Default value:	1	**Parameter type:**	Range (-16777215–16777215)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Set the position unit numerator.

17-73 Position Unit Denominator

Default value:	1	**Parameter type:**	Range (-16777215–16777215)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

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Set the position unit denominator.

17-74 Position Offset

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

Set the position offset.

4.17 Parameter Group 18-** Data Readouts 2

4.17.1 18-1* Parameter Log

18-13 Parameter Number

Default value:	0	**Parameter type:**	Range (0–65535), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Shows which parameter was last changed. Index 0 shows the latest change. Index 9 shows the 10th change.

18-14 Parameter Index

Default value:	0	**Parameter type:**	Range (0–65535), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

This parameter shows the index of the parameter which was changed.

18-16 Operating Hours

Default value:	0	**Parameter type:**	Range (0–2147483647), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows operating hours of the drive at the instance when the parameter was changed.

18-17 Running Hours

Default value:	0	**Parameter type:**	Range (0–2147483647), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

Shows running hours of the motor when the parameter is changed.

18-18 Value Before Change as Integer

Default value:	0	**Parameter type:**	Range (-2147483647–2147483647), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	False

Shows the previous value of the parameter as integer, without scaling or unit conversion. The parameter only shows integer data.

18-19 Value before change

Default value:	Size related	**Parameter type:**	Range (0-30), Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	VisStr[30]	**Change during operation:**	False

Shows the previous value of the parameter with units. Only applicable for integer values.

4.17.2 18-3* Analog ReadOuts

18-37 Temp. Input X48/4

Default value:	0	**Parameter type:**	Range (-500–500)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Show the temperature measured at input X48/4.

18-38 Temp. Input X48/7

Default value:	0	**Parameter type:**	Range (-500–500)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Show the temperature measured at input X48/7.

18-39 Temp. Input X48/10

Default value:	0	**Parameter type:**	Range (-500–500)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Show the temperature measured at input X48/10.

4.17.3 18-5* Active Alarm/Warning Number

18-55 Active Alarm Number

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

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This parameter contains a highest priority alarm number that is active. The value 0 means no alarm.

18-56 Active Warning Number

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter contains a highest priority warning number that is active. The value 0 means no warning.

4.17.4 18-6* Motor Status 2

18-66 Switching Frequency

Default value:	0 kHz	**Parameter type:**	Range (0–32 kHz)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

Show the actual switching frequency. The actual switching frequency could not be same with the set value in parameter ***14-01 Switching Frequency*** due to internal derating.

4.17.5 18-8* Compatibility

18-87 Inv. Max. Current

Default value:	0.00 A	**Parameter type:**	Range (0.00–9999.99 A)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

View the inverter maximum current, which should match the nameplate data on the connected motor. The data are used for calculation of torque, motor overload protection, and so on.

18-88 Motor current

Default value:	0.00 A	**Parameter type:**	Range (0.00–9999.99 A)
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

View the motor current measured as a mean 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.

4.17.6 18-9* PID Readouts

18-90 Process PID Error

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

Give the present error value used by the process PID controller.

18-91 Process PID Output

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

Give the present raw output value from the process PID controller.

18-92 Process PID Clamped Output

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

Give the present output value from the process PID controller after the clamp limits have been observed.

18-93 Process PID Gain Scaled Output

Default value:	0.0%	**Parameter type:**	Range (-200.0–200.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Int16	**Change during operation:**	False

Give the present output value from the process PID controller after the clamp limits have been observed, and the calculated value has been gain scaled.

4.18 Parameter Group 21-** Ext. Closed Loop

4.18.1 21-0* Ext. CL Autotuning

21-09 Extended PID Enable

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

Select the extended CL PID controller that is to be autotuned.

Option	Name
[0]	Disabled
[1]	Enabled Ext CL1 PID

4.18.2 21-1* Ext. CL 1 Ref./Fb.

21-11 Ext. 1 Minimum Reference

Default value:	0.000 ExtPID1Unit	**Parameter type:**	Range (-999999.999–999999.999 ExtPID1Unit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

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Set the minimum value that can be obtained by the sum of the setpoint and reference.

21-12 Ext. 1 Maximum Reference

Default value:	100.000 ExtPID1Unit	**Parameter type:**	Range (-999999.999–999999.999 ExtPID1Unit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Set the maximum value that can be obtained by the sum of the setpoint and reference.

21-13 Ext. 1 Reference Source

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

Define which input on the drive should be treated as the source of the reference signal.

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33

21-14 Ext. 1 Feedback Source

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

Define which input on the drive should be treated as the source of the feedback signal.

Option	Name
[0]	No function
[1]	Analog Input 53
[2]	Analog Input 54
[7]	Frequency input 29
[8]	Frequency input 33

21-15 Ext. 1 Setpoint

Default value:	0.000 ExtPID1Unit	**Parameter type:**	Range (-999999.99 ExtPID1Unit–999999.999 ExtPID1Unit)
Setup:	All setups	**Conversion index:**	-3

Data type:	Int32	**Change during operation:**	True

This parameter is used as the reference for comparing feedback values. The setpoint can be offset with digital, analog, or bus references.

21-17 Ext. 1 Reference [Unit]

Default value:	0.000 ExtPID1Unit	**Parameter type:**	Range (-999999.999–999999.999 ExtPID1Unit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Return the resulting reference value.

21-18 Ext. 1 Feedback [Unit]

Default value:	0.000 ExtPID1Unit	**Parameter type:**	Range (-999999.999–999999.999 ExtPID1Unit)
Setup:	All setups	**Conversion index:**	-3
Data type:	Int32	**Change during operation:**	True

Return the feedback value.

21-19 Ext. 1 Output [%]

Default value:	0%	**Parameter type:**	Range (0–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Return the extended closed loop 1 PID controller output value.

4.18.3 21-2* Ext. CL 1 PID

21-20 Ext. 1 Normal/Inverse Control

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

Select the normal or inverse control.

Option	Name	Description
[0]	Normal	Select ***[0] Normal*** if the controller output should be reduced when the feedback is higher than the reference.
[1]	Inverse	Select ***[1] Inverse*** if the output should be increased when the feedback is higher than the reference.

21-21 Ext. 1 Proportional Gain

Default value:	0.01	**Parameter type:**	Range (0.00–10.00)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

21-22 Ext. 1 Integral Time

Default value:	10000.00 s	**Parameter type:**	Range (0.01–10000.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint32	**Change during operation:**	True

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.

21-23 Ext. 1 Differentiation Time

Default value:	0.00 s	**Parameter type:**	Range (0.00 s–10.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

The differentiator does not react to a constant error. It only provides a gain when the error changes. The quicker the error changes, the stronger the gain from the differentiator.

21-24 Ext. 1 Dif. Gain Limit

Default value:	5.0	**Parameter type:**	Range (1.0–50.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain at slow changes and a constant differentiator gain where quick changes occur.

4.19 Parameter Group 22-** Appl. Functions

4.19.1 22-0* Miscellaneous

22-02 Sleepmode CL Control Mode

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

Set whether the feedback is detected for entering sleep mode in process closed loop.

Option	Name	Description
[0]	Feed. and Speed	Feedback is detected together with the speed.
[1]	Speed	Feedback is not detected, only sleep speed and time are checked.
[2]	Feedback	Only feedback is detected.

4.19.2 22-4* Sleep Mode

The sequence when running sleep mode in open loop:

1. The motor speed is less than parameter ***22-47 Sleep Speed [Hz]*** and the motor has been running longer than parameter ***22-40 Minimum Run Time***.
2. The drive ramps the motor speed down to parameter ***1-82 Min Speed for Function at Stop [Hz]***.
3. The drive activates parameter ***1-80 Function at Stop***. The drive is now in sleep mode.
4. The drive compares the speed setpoint with parameter ***22-43 Wake-Up Speed [Hz]*** to detect wake-up situation.
5. The speed setpoint is greater than parameter ***22-43 Wake-Up Speed [Hz]*** and the sleep condition has lasted for more than parameter ***22-41 Minimum Sleep Time***. The drive is now out of sleep mode.
6. Go back to speed open loop control (ramp motor speed up to the speed setpoint).

The sequence when running sleep mode in closed loop:

1. If parameter ***20-81 PI Normal/ Inverse Control*** = ***[0] Normal***. When the error between reference and feedback is greater than parameter ***22-44 Wake-Up Ref./FB Diff***, the drive enters boost status. If parameter ***22-45 Setpoint Boost*** is not set, the drive enters sleep mode.
2. After parameter ***22-46 Maximum Boost Time***, the drive ramps the motor speed down to parameter ***1-82 Min Speed for Function at Stop [Hz]***.
3. The drive activates parameter ***1-80 Function at Stop***. The drive is now in sleep mode.
4. When the error between reference and feedback is greater than parameter ***22-44 Wake-Up Ref./FB Diff***, and the condition lasts more than parameter ***22-41 Minimum Sleep Time***, the drive is out of sleep mode.
5. The drive reverts to closed loop control.

NOTICE

Sleep mode is not active when local reference is active (set speed manually with navigation keys on the LCP). Does not work in hand-on mode. Auto setup in open loop must be carried out before setting input/output in closed loop.

22-40 Minimum Run Time

Default value:	10 s	**Parameter type:**	Range (0–600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the wanted minimum running time for the motor after a start command (digital input or bus) before entering sleep mode.

22-41 Minimum Sleep Time

Default value:	10 s	**Parameter type:**	Range (0–600 s)
Setup:	All setups	**Conversion index:**	0

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

Set the minimum time for staying in sleep mode. This time overrides any wake-up conditions.

22-43 Wake-Up Speed [Hz]

Default value:	10.0	**Parameter type:**	Range (0.0–500.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Only to be used if parameter ***1-00 Configuration Mode*** is set to ***[0] Open loop***, and an external controller applies speed reference. Set the reference speed at which the sleep mode should be deactivated. The wake-up speed must not exceed the setting in parameter ***4-14 Motor Speed High Limit [Hz]***.

22-44 Wake-Up Ref./FB Diff

Default value:	10%	**Parameter type:**	Range (0–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Only to be used if parameter ***1-00 Configuration Mode*** is set to ***[1] Speed closed loop***, and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (P_{set}) before canceling the sleep mode.

22-45 Setpoint Boost

Default value:	0%	**Parameter type:**	Range (-100–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

Only to be used if parameter ***1-00 Configuration Mode*** is set to ***[1] Speed closed loop***, and the integrated PI controller is used. In systems with, for example, constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This extends the time in which the motor is stopped and helps to avoid frequent start/stop. Set the desired overpressure/temperature in percentage of setpoint for the pressure (P_{set})/ temperature before entering the sleep mode. If set to 5%, the boost pressure is P_{set} x 1.05. The negative values can be used for cooling tower control where a negative change is needed.

22-46 Maximum Boost Time

Default value:	60 s	**Parameter type:**	Range (0–600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Only to be used if parameter ***1-00 Configuration Mode*** is set to ***[1] Speed closed loop***, and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode is allowed. If the set time is exceeded, sleep mode is entered, not waiting for the set boost pressure to be reached.

22-47 Sleep Speed [Hz]

Default value:	0.0	**Parameter type:**	Range (0.0–500.0)
Setup:	All setups	**Conversion index:**	-1

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

Set the speed below which the drive goes into sleep mode. The sleep speed must not exceed the setting in parameter ***22-43 Wake-Up Speed [Hz]***.

22-48 Sleep Delay Time

Default value:	0 s	**Parameter type:**	Range (0–3600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the delay time that the motor waits before entering sleep mode when the condition to enter sleep mode is met.

22-49 Wake-Up Delay Time

Default value:	0 s	**Parameter type:**	Range (0–3600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the delay time that the motor waits before waking up from sleep mode when the condition to wake up is met.

4.19.3 22-6* Broken Belt Detection

Use broken-belt detection in both closed loop systems and open loop systems for pumps and fans. If the estimated motor torque (current) is below the broken-belt torque (current) value (parameter ***22-61 Broken Belt Torque***), and the drive output frequency is above or equal to 15 Hz, parameter ***22-60 Broken Belt Function*** is performed.

22-60 Broken Belt Function

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

Select the actions to be performed if the broken-belt condition is detected.

Option	Name	Description
[0]	Off	The function is disabled.
[1]	Warning	The drive continues to run, but activates ***Warning 95, Broken belt***. A drive digital output or a serial communication bus communicates a warning to other equipment.
[2]	Trip	The drive stops running and activates ***Alarm 95, Broken belt***. A drive digital output or a serial communication bus communicates an alarm to other equipment.

22-61 Broken Belt Torque

Default value:	10%	**Parameter type:**	Range (5–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the broken-belt torque as a percentage of the rated motor torque.

22-62 Broken Belt Delay

Default value:	10 s	**Parameter type:**	Range (0–600 s)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the time for which the broken-belt conditions must be active before carrying out the action selected in parameter ***22-60 Broken Belt Function***.

4.20 Parameter Group 30-** Special Features

4.20.1 30-2* Adv. Start Adjust

30-20 High Starting Torque Time [s]

Default value:	Size related	**Parameter type:**	Range (0.00–60.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	True

High starting torque time for PM motors in VVC+ mode without feedback.

30-21 High Starting Torque Current [%]

Default value:	Size related	**Parameter type:**	Range (0.0–200.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

High starting torque current for PM motors in VVC+ mode without feedback.

30-22 Locked Rotor Protection

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

Locked rotor detection for PM motor.

Option	Name
[0]	Off
[1]	On

30-23 Locked Rotor Detection Time [s]

Default value:	0.10 s	**Parameter type:**	Range (0.05–1.00 s)
Setup:	All setups	**Conversion index:**	-2
Data type:	Uint8	**Change during operation:**	True

Locked rotor detection time for PM motor.

4.20.2 30-5* Unit Configuration

30-56 License Installed

Default value:	–	**Parameter type:**	Range (0–40), Array [3]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

Show the installed license. Index 0: Feature; Index 1: Maintenance; Index 2: Application.

30-57 License Code

Default value:	XXXX-XXXX-XXXX-XXXX	**Parameter type:**	Range (0–19)
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr	**Change during operation:**	False

Enter the license code. The length of the license code is 19, for example: 1234-ABCD-5678-EFGH.

4.20.3 30-7* Power Monitoring

30-70 Power Low Monitoring

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

Power Low Monitoring (PLM) blocked the rotor detection function.

Option	Name
[0]	Disabled
[1]	Enabled

30-71 PLM Detection Time

Default value:	10.0 s	**Parameter type:**	Range (4.0–100.0 s)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Power Low Monitoring (PLM) detection time window for power integration.

30-72 PLM Minimum Speed

Default value:	25%	**Parameter type:**	Range (10–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Power Low Monitoring (PLM) minimum detection speed above which the PLM algorithm is active.

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30-73 PLM Detection Factor

Default value:	5.0	**Parameter type:**	Range (2.0–100.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Power Low Monitoring (PLM) detection sensitivity factor. A blocked rotor is detected when the energy throughout the PLM detection time is lower than the copper loss energy multiplied by this factor.

4.21 Parameter Group 32-** Motion Control Basic Settings

4.21.1 32-1* User Unit

32-11 User Unit Denominator

Default value:	1	**Parameter type:**	Range (1–4294967295)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

All target positions are made in user units and are converted to quad-counts internally. By selecting scaling units, it is possible to work with any measurement unit (for example, mm). This factor consists of a numerator and denominator.

32-12 User Unit Numerator

Default value:	1	**Parameter type:**	Range (1–4294967295)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	False

All target positions are made in user units and are converted to quad-counts internally. By selecting scaling units, it is possible to work with any measurement unit (for example, mm). This factor consists of a numerator and denominator.

4.21.2 32-6* PID

32-60 Proportional Gain

Default value:	30	**Parameter type:**	Range (0–100000)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the motion controller proportional gain.

32-61 Derivative Time

Default value:	0	**Parameter type:**	Range (0–100000)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the motion control PID derivative time.

32-62 Integral Time

Default value:	0	**Parameter type:**	Range (0–100000)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Enter the motion controller integral time.

32-63 Limit Value For Integral Sum [%]

Default value:	100.0%	**Parameter type:**	Range (0.0–100.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This parameter limits the integral sum in percentage of set value to avoid instability and PID wind-up if there is a feedback error.

32-64 PID Bandwidth [%]

Default value:	100.0%	**Parameter type:**	Range (0.0–100.0%)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

This parameter limits the PID output value in percentage of the set value.

32-65 Velocity Feed-Forward

Default value:	1.000	**Parameter type:**	Range (0.000–100.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint32	**Change during operation:**	True

Velocity Feed-forward is a scaling factor which is multiplied by the derivative of the setpoint position (the velocity of the setpoint). The result is added to the overall control signal to give a more dynamic controller.

32-66 Acceleration Feed-Forward

Default value:	0.028	**Parameter type:**	Range (0.000–50.000)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Acceleration Feed-forward is multiplied by the 2nd derivative of the setpoint position (the acceleration of the setpoint), the result is added to the control signal to give an extra boost during acceleration.

32-67 Max. Tolerated Position Error

Default value:	20000	**Parameter type:**	Range (1–1073741823)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

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Define the maximum error allowed between the actual position and the calculated command position. If the actual error exceeds the value set in this parameter, the position-control-fault alarm is triggered.

32-68 Reverse Behavior for Slave

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

Set the reverse behavior.

Option	Name
[0]	Reversing allowed
[1]	Reversing follow master
[2]	Reversing blocked

32-69 PID Sample Time

Default value:	16 ms	**Parameter type:**	Range (1–1000 ms)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

PID sample time of position control. Increase the time if the controller is unstable because of a low-resolution feedback signal or very high load inertia.

32-71 Size of the Control Window (Activation)

Default value:	0	**Parameter type:**	Range (0–1073741823)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Define the size of the control window (activation).

32-72 Size of the Control Window (Deactiv.)

Default value:	0	**Parameter type:**	Range (0–1073741823)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Define the size of the control window (deactivation).

32-73 Integral limit filter time

Default value:	0 ms	**Parameter type:**	Range (-10000–10000 ms)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Time (ms) which is used to increase or decrease integral limit.

32-74 Position error filter time

Default value:	0 ms	**Parameter type:**	Range (0–10000 ms)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Position error is only activated if the position error value is exceeded for a time which is longer than this setting.

4.21.3 32-8* Velocity & Acceleration

32-80 Maximum Allowed Velocity

Default value:	Size related	**Parameter type:**	Range (1–30000 RPM)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	False

Define the maximum velocity in RPM during motion control.

32-81 Shortest Ramp Time

Default value:	1000 ms	**Parameter type:**	Range (50–3600000 ms)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Define the quick stop ramp time from the maximum allowed velocity to 0 for motion control.

4.22 Parameter Group 33-** Motion Control Adv. Settings

4.22.1 33-0* Home Motion

33-00 Homing Mode

Default value:	[0] Not Needed	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the homing mode.

Option	Name	Description
[0]	Not Needed	If selected, homing operation does not need to be carried out.
[1]	In Specified Direction	If selected, homing operation has to be carried out before positioning. In this mode, the homing direction should be specified by the sign of parameter ***33-03 Homing Velocity***. It means that the user must know that the home position is at forward or backward direction relative to the current position before homing.

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Option	Name	Description
[2]	Auto-Reverse Between HW Limits	If selected, homing operation also has to be carried out before positioning. In this mode, homing operation should work together with HW limit switches, otherwise the homing behavior is the same as selection ***[1] Forced manual homing***. In this mode, the homing motion starts with the velocity set in parameter ***33-03 Homing Velocity***, once any 1 of the HW limit switches is probed, the homing direction is reversed until the home switch is probed. If the home switch was still not probed after both HW Neg. and Pos. limit switches were probed, the alarm *Position Ctrl. Fault* is reported with fault reason *Cannot find home position*, which is shown in parameter ***37-18 Pos. Ctrl Fault Reason***.
[3]	Once with store	If selected, homing operation does not need to be carried out. In this mode, the position is set to 0 when enabling the homing. When enabling the homing for the 1st time, the homing flag is set to 1 and stored. (This means after the 1st time enabled, the homing flag will always be set to 1.)

33-01 Home Offset

Default value:	0	**Parameter type:**	Range (-1073741824–1073741824)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Use this parameter to set an offset of 0 (home position) compared to the position after homing.

33-02 Home Ramp Time

Default value:	1000 ms	**Parameter type:**	Range (50–5000 ms)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

This parameter defines the ramp time (in ms) from standstill to the value set in parameter ***32-80 Maximum Allowed Velocity***.

33-03 Homing Velocity

Default value:	100 RPM	**Parameter type:**	Range (-1500–1500 RPM)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

This parameter defines the velocity of homing. It must not exceed the parameter ***32-80 Maximum Allowed Velocity***.

33-04 Homing Behavior

Default value:	[1] Reverse no index	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Define the behavior when the home switch is found: Reversing without index (0 pulse) search, or forwarding without index search.

Option	Name
[1]	Reverse no index
[3]	Forward no index

4.22.2 33-4* Limit Handling

33-41 Negative Software Limit

Default value:	-500000	**Parameter type:**	Range (-1073741824–1073741824)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

This parameter is active only during positioning if parameter ***33-43 Negative Software Limit Active*** is set to ***[1] Active***. When parameter ***34-50 Actual Position***reaches below the negative software limit set in this parameter, a *position control fault* alarm is reported.

33-42 Positive Software Limit

Default value:	500000	**Parameter type:**	Range (-1073741824–1073741824)
Setup:	1 setup	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

This parameter is active only during positioning if parameter ***33-44 Positive Software Limit Active*** is set to ***[1] Active***. When parameter ***34-50 Actual Position***reaches above the positive software limit set in this parameter, a *position control fault* alarm is reported.

33-43 Negative Software Limit Active

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

When this parameter is set to active, the drive continuously checks whether the target position is below the negative software limit. If it occurs, an error is issued and the drive control is switched off.

Option	Name
[0]	Inactive
[1]	Active

33-44 Positive Software Limit Active

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

When this parameter is set to active, the drive continuously checks whether the target position is above the positive software limit. If it occurs, an error is issued and the drive control is switched off.

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Option	Name
[0]	Inactive
[1]	Active

33-45 Time in Target Window

Default value:	32 ms	**Parameter type:**	Range (1 ms–255 ms)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

Set the time in target window to determine whether the target position has been reached. This parameter works with parameter ***33-47 Size of Target Window***. A position is only viewed as reached when the actual position is within the target window.

33-46 Limit Value Of Delta Position In Target Window

Default value:	4	**Parameter type:**	Range (1–10000)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Define the limit value of delta position between adjacent sampling cycles to determine whether the target position has been reached. This parameter works with parameter ***33-45 Time in Target Window*** and parameter ***33-47 Size of Target Window***. A position is only viewed as reached when the actual position is within the target window longer than the time set in parameter ***33-45 Time in Target Window***. Furthermore, the delta position between adjacent sampling cycles must not be bigger than the limit value set in parameter ***33-46 Limit Value Of Delta Position In Target Window*** during this time.

33-47 Size of Target Window

Default value:	512	**Parameter type:**	Range (1–65535)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Define the size of the target window with user unit. This parameter works with parameter ***33-45 Time in Target Window***. A position is only viewed as reached when the actual position is within this target window.

4.22.3 33-8* Global Parameters

33-83 Behavior After Error

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

Define the action in case of an error during motion control.

Option	Name
[0]	Coast
[2]	Controlled stop

4.23 Parameter Group 34-** Motion Control Data Readouts

4.23.1 34-0* PCD Write Par.

Parameters for readout of fieldbus data received from fieldbus master.

34-01 PCD 1 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 1 of fieldbus telegram.

34-02 PCD 2 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 2 of fieldbus telegram.

34-03 PCD 3 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 3 of fieldbus telegram.

34-04 PCD 4 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 4 of fieldbus telegram.

34-05 PCD 5 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 5 of fieldbus telegram.

34-06 PCD 6 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0

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

Value received in PCD 6 of fieldbus telegram.

34-07 PCD 7 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 7 of fieldbus telegram.

34-08 PCD 8 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 8 of fieldbus telegram.

34-09 PCD 9 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 9 of fieldbus telegram.

34-10 PCD 10 Write For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value received in PCD 10 of fieldbus telegram.

4.23.2 34-2* PCD Read Par.

Parameters for readout of fieldbus data sent to the fieldbus master.

34-21 PCD 1 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 1 of fieldbus telegram.

34-22 PCD 2 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)

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

Value sent in PCD 2 of fieldbus telegram.

34-23 PCD 3 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 3 of fieldbus telegram.

34-24 PCD 4 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 4 of fieldbus telegram.

34-25 PCD 5 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 5 of fieldbus telegram.

34-26 PCD 6 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 6 of fieldbus telegram.

34-27 PCD 7 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 7 of fieldbus telegram.

34-28 PCD 8 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0

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

Value sent in PCD 8 of fieldbus telegram.

34-29 PCD 9 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 9 of fieldbus telegram.

34-30 PCD 10 Read For Application

Default value:	0	**Parameter type:**	Range (0–65535)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Value sent in PCD 10 of fieldbus telegram.

4.23.3 34-5* Process Data

Readout of process data for motion control.

34-50 Actual Position

Default value:	0	**Parameter type:**	Range (-1073741824–1073741824)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

The actual position in user unit.

34-56 Track Error

Default value:	0	**Parameter type:**	Range (-2147483647–2147483647)
Setup:	All setups	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

Readout of the error between calculated command position and actual position in user unit.

4.24 Parameter Group 35-** Sensor Input Option

4.24.1 More Information

NOTICE

Parameter Group 35-** Sensor Input Option is only valid when VLT® Sensor Input MCB 114 is installed.

4.24.2 35-0* Temp. Input Mode

35-01 Term. X48/4 Input Type

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

View the temperature sensor type detected at input X48/4.

Option	Name
[0]	Not Connected
[1]	PT100 2-wire
[3]	PT1000 2-wire
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-03 Term. X48/7 Input Type

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

View the temperature sensor type detected at input X48/7.

Option	Name
[0]	Not Connected
[1]	PT100 2-wire
[3]	PT1000 2-wire
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-05 Term. X48/10 Input Type

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

View the temperature sensor type detected at input X48/10.

Option	Name
[0]	Not Connected
[1]	PT100 2-wire
[3]	PT1000 2-wire

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Option	Name
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-06 Temperature Sensor Alarm Function

Default value:	[5] Stop and trip	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the alarm function.

Option	Name
[0]	Off
[2]	Stop
[5]	Stop and trip

4.24.3 35-1* Temp. Input X48/4

35-14 Term. X48/4 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range (0.005–10.000 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/4. A high time constant value improves dampening but also increases the time delay through the filter.

35-15 Term. X48/4 Temp. Monitor

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

This parameter gives the possibility of enabling or disabling the temperature monitor for terminal X48/4. The temperature limits can be set in parameter ***35-16 Term. X48/4 Low Temp. Limit***/parameter ***35-17 Term. X48/4 High Temp. Limit***.

Option	Name
[0]	Disabled
[1]	Enabled

35-16 Term. X48/4 Low Temp. Limit

Default value:	-50	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

35-17 Term. X48/4 High Temp. Limit

Default value:	204	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

4.24.4 35-2* Temp. Input X48/7

35-24 Term. X48/7 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range (0.005–10.000 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/7. A high time constant value improves dampening but also increases the time delay through the filter.

35-25 Term. X48/7 Temp. Monitor

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

This parameter gives the possibility of enabling or disabling the temperature monitor for terminal X48/7. The temperature limits can be set in parameter ***35-26 Term. X48/7 Low Temp. Limit***/parameter ***35-27 Term. X48/7 High Temp. Limit***.

Option	Name
[0]	Disabled
[1]	Enabled

35-26 Term. X48/7 Low Temp. Limit

Default value:	-50	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

35-27 Term. X48/7 High Temp. Limit

Default value:	204	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

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4.24.5 35-3* Temp. Input X48/10

35-34 Term. X48/10 Filter Time Constant

Default value:	0.005 s	**Parameter type:**	Range (0.005–10.000 s)
Setup:	All setups	**Conversion index:**	-3
Data type:	Uint16	**Change during operation:**	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/10. A high time constant value improves dampening but also increases the time delay through the filter.

35-35 Term. X48/10 Temp. Monitor

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

This parameter gives the possibility of enabling or disabling the temperature monitor for terminal X48/10. The temperature limits can be set in parameter ***35-36 Term. X48/10 Low Temp. Limit***/parameter ***35-37 Term. X48/10 High Temp. Limit***.

Option	Name
[0]	Disabled
[1]	Enabled

35-36 Term. X48/10 Low Temp. Limit

Default value:	-50	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

35-37 Term. X48/10 High Temp. Limit

Default value:	204	**Parameter type:**	Range (-50–204)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

4.25 Parameter Group 37-** Application Settings

4.25.1 37-0* Application Mode

37-00 Application Mode

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

Set the application mode.

Option	Name
[0]	Drive mode
[2]	Position Control
[4]	Position Control with Laser Encoder

4.25.2 37-1* Position Control

37-01 Pos. Feedback Source

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

Select position feedback source.

Option	Name
[0]	24 V Encoder
[1]	MCB102
[2]	MCB103
[3]	MCB102_ABS

37-02 Pos. Target

Default value:	0	**Parameter type:**	Range (-1073741824–1073741824), Array [8]
Setup:	1 setup	**Conversion index:**	0
Data type:	Int32	**Change during operation:**	True

If parameter ***37-03 Pos. Type*** is set to ***[0] Absolute***, the target position is an absolute position (relative to home position). If the parameter ***37-03 Pos. Type*** is set to ***[1] Relative*** and the last position was obtained through jogging, the target position is relative to that position. If the last position was reached as a result of a positioning command, then the target position is relative to the last target position regardless of being reached or not.

37-03 Pos. Type

Default value:	[0] Absolute	**Parameter type:**	Option, Array [8]
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	False

Define the target position type.

Option	Name
[0]	Absolute
[1]	Relative

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37-04 Pos. Velocity

Default value:	300 RPM	**Parameter type:**	Range (1–30000 RPM), Array [8]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Define the velocity during positioning. The maximum value must not exceed the value specified in parameter ***32-80 Maximum Allowed Velocity***.

37-05 Pos. Ramp Up Time

Default value:	5.00 s	**Parameter type:**	Range (0.01–600.00 s), Array [8]
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

It is defined as the time in milliseconds that it takes to ramp from standstill to parameter ***32-80 Maximum Allowed Velocity***.

37-06 Pos. Ramp Down Time

Default value:	5.00 s	**Parameter type:**	Range (0.01–600.00 s), Array [8]
Setup:	1 setup	**Conversion index:**	-2
Data type:	Uint16	**Change during operation:**	False

It is defined as the time in milliseconds that it takes to ramp from parameter ***32-80 Maximum Allowed Velocity*** to standstill.

37-07 Pos. Behavior After Reached

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

When the automatic brake control function is disabled, the drive controls the application also at standstill. When the automatic brake control function is enabled, the mechanical brake is automatically activated every time the application is at standstill for a time period specified in parameter ***37-08 Pos. Hold Delay***.

Option	Name
[0]	Coast & Brake
[1]	Zero Speed Hold

37-08 Pos. Max Zero Speed Holding Time

Default value:	120.0 s	**Parameter type:**	Range (0.1–3600.0 s)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint16	**Change during operation:**	True

Use this parameter with the automatic brake control function. The hold delay is a waiting period in which the brake is not activated even though the application is at standstill.

37-09 Pos. Max Tuning Time

Default value:	1.0 s	**Parameter type:**	Range (0.1–10.0 s)
Setup:	1 setup	**Conversion index:**	-1
Data type:	Uint8	**Change during operation:**	True

After the speed ramping down, the position is turned into the target window. In this state, if the time set in parameter ***37-09 Pos. Max Tuning Time*** is exceeded, ***ALARM 120, Position Control Fault*** is reported and the reason shown in parameter ***37-18 Pos. Ctrl Fault Reason*** is ***[25] Tuning Timeout***.

37-11 Pos. Brake Wear Limit

Default value:	0	**Parameter type:**	Range (0–1073741824)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Set this parameter to a positive value. While the brake is activated, if the drive moves more than the limit in user unit set in this parameter, the drive reports an alarm *POSITION CTRL FAULT* with fault reason *Brake Wear Limit Exceeded*.

37-14 Pos. Ctrl. Source

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

Select the control source for positioning control.

Option	Name
[0]	DI
[1]	Fieldbus

37-15 Pos. Direction Block

Default value:	[0] No Blocking	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Configure whether to block a direction, and the direction to be blocked.

Option	Name
[0]	No Blocking
[1]	Block Reverse
[2]	Block Forward

37-17 Pos. Ctrl Fault Behavior

Default value:	[0] Control Stop & Brake	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–

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

Determine the behavior of the drive after a fault is detected.

Option	Name
[0]	Control Stop & Brake
[1]	Brake Directly

37-18 Pos. Ctrl Fault Reason

Default value:	[0] No Fault	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

(READ-ONLY PARAMETER) The current fault reason of the alarm. *POSITION CTRL FAULT* is shown in this parameter.

Option	Name	Description
[0]	No Fault	No fault has occurred.
[1]	Homing Needed	If ***[1] In Specified Direction*** or ***[2] Auto-Reverse Between HW Limits*** is selected in parameter ***33-00 Homing Mode***, but there is not a complete homing, this reason is reported.
[2]	Positive HW Limit Exceeded	Check the positive hardware limit position, set ***[155] HW Limit Positive Inv*** in DI (digital input) option.
[3]	Negative HW Limit Exceeded	Check the negative hardware limit position, set ***[156] HW Limit Negative Inv*** in DI (digital input) option.
[4]	Positive SW Limit Exceeded	Check if the value in parameter ***34-50 Actual Position*** exceeds the value in parameter ***33-42 Positive Software Limit***, move in the opposite position.
[5]	Negative SW Limit Exceeded	Check if the value in parameter ***34-50 Actual Position*** exceeds the value in parameter ***33-41 Negative Software Limit***, move in the opposite position.
[7]	Brake Wear Limit Exceeded	If the motor is stopped and the brake is closed, but the value in parameter ***34-50 Actual Position*** has a move exceeded the value in parameter ***37-11 Pos. Brake Wear Limit***, check the mechanical brake.
[8]	Quick Stop	Set by command from DI or bus.
[9]	Tracking Error Limit Exceeded	Command position and parameter ***34-50 Actual Position*** difference is greater than parameter ***32-67 Max. Tolerated Position Error***. Increase the value of parameter ***32-67 Max. Tolerated Position Error*** or check the settings about position feedback.
[12]	Reverse Operation	Check if parameter ***37-15 Pos. Direction Block*** has been set to ***[1] Block Reverse***, move in the opposite position or set parameter ***37-15 Pos. Direction Block*** to ***[0] No Blocking***.
[13]	Forward Operation	Check if parameter ***37-15 Pos. Direction Block*** has been set to ***[2] Block Forward***, move in the opposite position or set parameter ***37-15 Pos. Direction Block*** to ***[0] No Blocking***.

Option	Name	Description
[20]	Home Position Not Found	The home position is not found.
[25]	Tuning Timeout	After the speed ramping down, the position is turned into the target window. In this state, if the time set in parameter ***37-09 Pos. Max Tuning Time*** is exceeded, ***ALARM 120, Position Control Fault*** is reported and the reason shown here is ***[25] Tuning Timeout***.

37-19 Pos. New Index

Default value:	0	**Parameter type:**	Range (0–255)
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint8	**Change during operation:**	True

The currently latched index number.

4.26 Parameter Group 40-** Special Settings

4.26.1 40-5* Advanced Control Settings

40-50 Flux Basic Sensorless Model Shift

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

Enable or disable the model shift when running at low speed.

Option	Name
[0]	Off
[1]	On

40-51 Flux Basic Sensorless Corr. Gain

Default value:	Size related	**Parameter type:**	Range (0.1–200.0)
Setup:	All setups	**Conversion index:**	-1
Data type:	Uint32	**Change during operation:**	True

Adjust the flux basic sensorless correction gain used at low speed.

40-52 Speed PID Anti Windup Gain

Default value:	100%	**Parameter type:**	Range (0–500%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Set the speed PID anti windup gain. When set to 0 (default) the function is not active. When activating the gain, setting at 100% is recommended as starting point, and increase in steps of 20% . If the parameter is set too high, there is a risk of instability in the control.

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40-53 Current PID Anti Windup Gain

Default value:	100%	**Parameter type:**	Range (0–500%)
Setup:	All setups	**Conversion index:**	0
Data type:	Int16	**Change during operation:**	True

Set the current PID anti windup gain. When set to 0 (default) the function is not active. When activating the gain, setting at 100% is recommended as starting point, and increase in steps of 20% . If the parameter is set too high, there is a risk of instability in the control.

40-54 Flux Basic/w Feedback Dynamic Mode

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

Select dynamic mode to run speed and position controller at the control time, which is 143~us to 500~us depending on switching frequency.

Option	Name
[0]	Off
[1]	On

40-56 Rotor Position Estimation Gain

Default value:	100%	**Parameter type:**	Range (10%–100%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the rotor position estimation gain.

40-57 Low Speed Flux Basic Compensation Gain

Default value:	100%	**Parameter type:**	Range (1%–200%)
Setup:	All setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Set the low speed flux basic compensation gain.

5 Troubleshooting

5.1 Warnings and Alarms

5.1.1 Overview

When the drive fault circuitry detects a fault condition or a pending fault, a warning or alarm is issued. A flashing display on the LCP indicates an alarm or warning condition and the associated number code on line 2. Sometimes a warning precedes an alarm.

5.1.2 Alarms

An alarm causes the drive to trip (suspend operation). The drive has 3 trip conditions, which are shown in line 1:

Trip (auto restart)

The drive is programmed to restart automatically after the fault is removed. The number of automatic reset attempts can be continuous or limited to a programmed number of attempts. If the selected number of automatic reset attempts is exceeded, the trip condition changes to trip (reset).

Trip (reset)

Requires resetting of the drive before operation after a fault is cleared. To reset the drive manually, press *[Reset]* or use a digital input or a fieldbus command. For NLCP, stop and reset are the same key, *[Off/Reset]*. If *[Off/Reset]* is used to reset the drive, press *[Start]* to initiate a run command in either hand-on mode or auto-on mode.

Trip lock (disc>mains)

Disconnect the mains AC input power to the drive long enough for the display to go blank. Remove the fault condition and reapply power. Following power-up, the fault indication changes to trip (reset) and allows for manual, digital, or fieldbus reset.

5.1.3 Warnings

During a warning, the drive remains operational, although the warning flashes for as long as the condition exists. The drive could, however, reduce the warning condition. For example, if the warning shown was ***warning 12, Torque Limit***, the drive reduces speed to compensate for the overcurrent condition. Sometimes, if the condition is not corrected or worsens, an alarm condition is activated and the drive stops output to the motor terminals. Line 1 identifies the warning in plain language, and line 2 identifies the warning number.

5.1.4 Warning/Alarm Messages

The LEDs on the front of the drive and a code in the display signal a warning or an alarm.

Table 25: LED indication

Warning	Yellow
Alarm	Flashing red

A warning indicates a condition that requires attention, or a trend that would eventually require attention. A warning remains active until the cause is no longer present. Under some circumstances, motor operation could continue.

An alarm triggers a trip. The trip removes power to the motor. It can be reset after the condition has been cleared by pressing [*Reset*] or through a digital input (parameter group ***5-1* Digital Inputs***). The event that caused an alarm cannot damage the drive or cause a dangerous condition. Alarms must be reset to restart operation once their cause has been rectified.

The reset can be done in 3 ways:

- Press [*Reset*].
- A digital reset input.
- Serial communication/optional fieldbus reset signal.

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NOTICE

After a manual reset pressing [*Reset*], press [*Auto On*] to restart the motor.

A warning precedes an alarm.

A trip lock is an action when an alarm occurs which can damage the drive or connected equipment. Power is removed from the motor. A trip lock can only be reset after a power cycle has cleared the condition. Once the problem has been rectified, only the alarm continues flashing until the drive is reset.

5.1.5 Warnings and Alarms Code List

The warnings and alarms are explained in the following table.

Table 26: Warnings and Alarms Code List

Number	Description	Warning	Alarm	Trip lock	Cause
2	Live zero error	X	X	–	Signal on terminal 53 or 54 is less than 50% of the values set in parameter ***6-10 Terminal 53 Low Voltage***, parameter ***6-12 Terminal 53 Low Current***, parameter ***6-20 Terminal 54 Low Voltage***, and parameter ***6-22 Terminal 54 Low Current***.
3	No motor	X	–	–	No motor has been connected to the output of the drive, or 1 motor phase is missing.
4	Mains phase loss(1)	X	X	X	Missing phase on the supply side, or the voltage imbalance is too high. Check the supply voltage.
7	DC overvolt.(1)	X	X	–	DC-link voltage exceeds the limit.
8	DC undervolt(1)	X	X	–	DC-link voltage drops below the voltage warning low limit.
9	Inverter overloaded	X	X	–	More than 100% load for too long.
10	Motor ETR overtemperature	X	X	–	Motor is too hot due to more than 100% load for too long.
11	Motor thermistor overtemperature	X	X	–	Thermistor or thermistor connection is disconnected, or the motor is too hot.
12	Torque limit	X	X	–	Torque exceeds value set in either parameter ***4-16 Torque Limit Motor Mode*** or parameter ***4-17 Torque Limit Generator Mode***.
13	Overcurrent	X	X	X	Inverter peak current limit is exceeded. For J1–J6 units, if this alarm occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
14	Ground fault	–	X	X	Discharge from output phases to ground.
16	Short circuit	–	X	X	Short circuit in motor or on motor terminals. For J7 units, if this alarm occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
17	Control word timeout	X	X	–	No communication to the drive.
18	Start failed	–	X	–	–
20	Temp. input error	X	X	–	The temperature detected by VLT® Sensor Input Option MCB 114 exceeds the limit.
22	Hoist mech. brake	X	X	–	The torque reference was not reached before timeout.

Table 26: Warnings and Alarms Code List - (continued)

Number	Description	Warning	Alarm	Trip lock	Cause
25	Brake resistor short-circuited	–	X	X	Brake resistor is short-circuited, thus the brake function is disconnected.
26	Brake overload	X	X	–	The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.
27	Brake IGBT/Brake chopper short-circuited	–	X	X	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake check	–	X	–	The brake resistor is not connected/working.
30	U phase loss	–	X	X	Motor phase U is missing. Check the phase.
31	V phase loss	–	X	X	Motor phase V is missing. Check the phase.
32	W phase loss	–	X	X	Motor phase W is missing. Check the phase.
34	Fieldbus fault	X	X	–	PROFIBUS communication issues have occurred.
35	Option fault	–	X	–	Fieldbus or option B detects internal faults.
36	Mains failure	X	X	–	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***.
38	Internal fault	–	X	X	Contact the local supplier.
40	Overload T27	X	–	–	Check the load connected to terminal 27 or remove short circuit connection.
41	Overload T29	X	–	–	Check the load connected to terminal 29 or remove short circuit connection.
46	Gate drive voltage fault	–	X	X	–
47	24 V supply low	X	X	X	24 V DC may be overloaded.
49	Speed limit	X	X	–	The speed is outside of the specified range in parameter ***4-12 Motor Speed Low Limit [Hz]*** and parameter ***4-14 Motor Speed High Limit [Hz]***.
50	AMA calibration	–	X	–	–
51	AMA check U_{nom} and I_{nom}	–	X	–	Wrong setting for motor voltage and/or motor current.
52	AMA low I_{nom}	–	X	–	Motor current is too low. Check the settings.
53	AMA big motor	–	X	–	The power size of the motor is too large for the AMA to operate.
54	AMA small motor	–	X	–	The power size of the motor is too small for the AMA to operate.
55	AMA parameter range	–	X	–	The parameter values of the motor are outside of the acceptable range. AMA does not run.
56	AMA interrupt	–	X	–	The AMA is interrupted.
57	AMA timeout	–	X	–	–
58	AMA internal	–	X	–	Contact the local supplier.
59	Current limit	X	X	–	The drive is overloaded.
60	External interlock	–	X	–	–

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Table 26: Warnings and Alarms Code List - (continued)

Number	Description	Warning	Alarm	Trip lock	Cause
61	Encoder loss	X	X	–	–
62	Output freq limit	X	X	–	Refer to the *chapter List of Warnings and Alarms*.
63	Mechanical brake low	–	X	–	The actual motor current has not exceeded the release brake current within start delay time window.
64	Voltage limit	X	–	–	The load and speed combination demands a motor voltage higher than the actual DC-link voltage.
65	Control card temp	X	X	X	The cutout temperature of the control card is 80 °C (176 °F).
67	Option module configuration has changed	–	X	–	One or more options have either been added or removed since the last power-down.
69	Power card temp	X	X	X	–
70	Illegal FC config	–	X	X	–
80	Drive initialized to default value	–	X	–	All parameter settings are initialized to default settings.
87	Auto DC brake	X	–	–	Occurs in IT mains when the drive coasts and the DC voltage is higher than 830 V. Energy on DC-link is consumed by the motor. This function can be enabled/disabled in parameter ***0-07 Auto DC Braking***.
88	Option detection	–	X	–	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. • To apply the change, enable option layout changes in parameter ***14-89 Option Detection***. • Alternatively, restore the correct option configuration.
89	Mechanical brake sliding	X	–	–	The motor speed feedback is bigger than 10 RPM during torque building time before brake is open.
90	Feedback monitor	X	X	–	A feedback fault is detected by option B.
95	Broken belt	X	X	–	–
99	Locked rotor	–	X	–	–
102	Speed monitor	X	X	–	A speed fault is detected when the motor overspeeds. This is only available in flux basic mode. This function can be enabled/disabled in parameter ***4-43 Speed Monitor Function***.
120	Position control fault	–	X	–	–
127	Back EMF too high(2)	X	–	–	Try to start PM motor which is rotating in an abnormal high speed.
157	Power Limit Motor	X	–	–	The output power exceeds the value defined in parameter ***4-82 Power Limit Motor Mode***.
158	Power Limit Generator	X	–	–	The output power exceeds the value defined in parameter ***4-83 Power Limit Generator Mode***.

Table 26: Warnings and Alarms Code List - (continued)

Number	Description	Warning	Alarm	Trip lock	Cause
250	New spare part	–	X	X	–
251	New type code	–	X	X	–

1) These faults may be caused by mains distortions. Installing a Danfoss line filter may rectify this problem.

2) For enclosure size J7, the warning can also be caused by high UDC voltage.

5.1.6 Alarm Word, Warning Word, and Extended Status Word

For diagnosis, read out the alarm words, warning words, and extended status words, which can be accessed via fieldbus or optional fieldbus.

Table 27: Description of Alarm Word

Bit	Hex	Dec	Alarm word	Alarm word 2	Alarm word 3
			Parameter *16-90 Alarm Word*	Parameter *16-91 Alarm Word 2*	Parameter *16-97 Alarm Word 3*
0	00000001	1	Brake check (A28)	–	STO function fault
1	00000002	2	Pwr.card temp (A69)	Gate drive voltage fault	Memory module fault
2	00000004	4	Earth fault (A14)	Service trip, typecode/spare part	Internal fan error
3	00000008	8	Ctrl.card temp (A65)	Spare part	Sync. fault
4	00000010	16	Ctrl. word TO (A17)	IllegalFCConfig	OPM fault
5	00000020	32	Overcurrent (A13)	–	Speed monitor
6	00000040	64	Torque limit (A12)	–	PROFIBUS converter invalid
7	00000080	128	Motor th over (A11)	–	User alert alarm
8	00000100	256	Motor ETR over (A10)	Broken belt	No motor
9	00000200	512	Inverter overld. (A9)	–	Output freq limit
10	00000400	1024	DC under volt (A8)	Start failed	Hoist mech brake
11	00000800	2048	DC over volt (A7)	Speed limit	Temp input error
12	00001000	4096	Short circuit (A16)	External interlock	–
13	00002000	8192	–	–	–
14	00004000	16384	Mains ph. loss (A4)	–	–
15	00008000	32768	AMA not OK	–	–
16	00010000	65536	Live zero error (A2)	Earth fault DESAT	–
17	00020000	131072	Internal fault (A38)	–	–
18	00040000	262144	Brake overload (A26)	Fans error	–
19	00080000	524288	U phase loss (A30)	–	–
20	00100000	1048576	V phase loss (A31)	Option detection	–
21	00200000	2097152	W phase loss (A32)	Option fault	–
22	00400000	4194304	Fieldbus fault (A34)	Locked rotor	–
23	00800000	8388608	24 V supply low (A47)	Position control fault	–
24	01000000	16777216	Mains failure (A36)	–	–

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Table 27: Description of Alarm Word - (continued)

Bit	Hex	Dec	Alarm word	Alarm word 2	Alarm word 3
			Parameter *16-90 Alarm Word*	Parameter *16-91 Alarm Word 2*	Parameter *16-97 Alarm Word 3*
25	02000000	33554432	–	Current limit (A59)	–
26	04000000	67108864	Brake resistor (A25)	–	–
27	08000000	134217728	Brake IGBT (A27)	–	–
28	10000000	268435456	Option change (A67)	Feedback fault	–
29	20000000	536870912	Drive initialized (A80)	Encoder loss (A90)	–
30	40000000	1073741824	Safe stop (A68)	–	–
31	80000000	2147483648	Mech. brake low (A63)	–	–

Table 28: Description of Warning Word

Bit	Hex	Dec	Warning word	Warning word 2	Warning word 3
			Parameter *16-92 Warning Word*	Parameter *16-93 Warning Word 2*	Parameter *16-98 Warning Word 3*
0	00000001	1	Brake check (W28)	Start delayed	–
1	00000002	2	Pwr.card temp (A69)	Stop delayed	–
2	00000004	4	Earth fault (W14)	–	–
3	00000008	8	Ctrl.card temp (W65)	–	–
4	00000010	16	Ctrl. word TO (W17)	Check valve failure	–
5	00000020	32	Overcurrent (W13)	–	Speed monitor
6	00000040	64	Torque limit (W12)	–	PROFIBUS converter time warning
7	00000080	128	Motor th over (W11)	–	User alert warning
8	00000100	256	Motor ETR over (W10)	Broken belt	–
9	00000200	512	Inverter overld (W9)	–	–
10	00000400	1024	DC under volt (W8)	–	Hoist mech brake
11	00000800	2048	DC over volt (W7)	–	Temp input error
12	00001000	4096	–	–	–
13	00002000	8192	–	–	–
14	00004000	16384	Mains ph. loss (W4)	Safe option warning	–
15	00008000	32768	No motor (W3)	Auto DC brake	–
16	00010000	65536	Live zero error (W2)		–
17	00020000	131072	–	–	–
18	00040000	262144	Brake overload (W26)	Fans warn	–
19	00080000	524288	Brake resistor (W25)	–	–
20	00100000	1048576	Brake IGBT (W27)	T27 overload	–
21	00200000	2097152	Speed limit (W49)	T29 overload	–

Table 28: Description of Warning Word - (continued)

Bit	Hex	Dec	Warning word	Warning word 2	Warning word 3
			Parameter *16-92 Warning Word*	Parameter *16-93 Warning Word 2*	Parameter *16-98 Warning Word 3*
22	00400000	4194304	Fieldbus fault (W34)	Memory module	–
23	00800000	8388608	24 V supply low (W47)	–	–
24	01000000	16777216	Mains failure (W36)	–	–
25	02000000	33554432	Current limit (W59)	Power limit motor	–
26	04000000	67108864	Low temp (W66)	Power limit generator	–
27	08000000	134217728	Voltage limit (W64)	–	–
28	10000000	268435456	Encoder loss (W90)	Feedback fault	–
29	20000000	536870912	Output freq. lim. (W62)	Back EMF too high	–
30	40000000	1073741824	Safe stop (W68)	–	–
31	80000000	2147483648	–	–	–

Table 29: Description of Extended Status Word

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter *16-94 Ext. Status Word*	Parameter *16-95 Ext. Status Word 2*	Parameter *16-99 Ext. Status Word 3*
0	00000001	1	Ramping	Off	–
1	00000002	2	AMA running	Hand/auto	–
2	00000004	4	Start CW/CCW Start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the refer-ence sign	PROFIBUS OFF1 active	–
3	00000008	8	Slow down Slow down command active, for example, via CTW bit 11 or DI	PROFIBUS OFF2 active	–
4	00000010	16	Catch up Catch up command active, for example, via CTW bit 12 or DI	PROFIBUS OFF3 active	–
5	00000020	32	Feedback high Feedback > parameter ***4-57 Warning Feedback High***	–	–
6	00000040	64	Feedback low Feedback < parameter ***4-56 Warning Feedback Low***	–	–
7	00000080	128	Output current high Current > parameter ***4-51 Warning Current High***	Control ready	–

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Table 29: Description of Extended Status Word - (continued)

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter *16-94 Ext. Status Word*	Parameter *16-95 Ext. Status Word 2*	Parameter *16-99 Ext. Status Word 3*
8	00000100	256	Output current low Current < parameter *4-50 Warning Current Low*	Drive ready	–
9	00000200	512	Output freq high Speed > parameter *4-53 Warning Speed High*	Quick stop	–
10	00000400	1024	Output freq low Speed < parameter *4-52 Warning Speed Low*	DC brake	–
11	00000800	2048	Brake check OK Brake test NOT OK	Stop	–
12	00001000	4096	Braking max. Brake power > parameter *2-12 Brake Power Limit (kW)*	Latched	–
13	00002000	8192	Braking	Freeze output request	–
14	00004000	16384	–	Freeze output	–
15	00008000	32768	OVC active	Jog request	–
16	00010000	65536	AC brake	Jog	–
17	00020000	131072	–	Start request	–
18	00040000	262144	–	Start	–
19	00080000	524288	Reference high Reference > parameter *4-55 Warning Reference High*	–	–
20	00100000	1048576	Reference low Reference < parameter *4-54 Warning Reference Low*	Start delay	–
21	00200000	2097152	Local reference Reference site = REMOTE -> auto on pressed & active	Sleep	–
22	00400000	4194304	–	Sleep boost	–
23	00800000	8388608	–	Running/pipe filling	–
24	01000000	16777216	–	Drive bypass	–
25	02000000	33554432	–	–	–
26	04000000	67108864	–	External interlock	–
27	08000000	134217728	–	–	–
28	10000000	268435456	Power Unit Off	FlyStart active	–
29	20000000	536870912	24 V Backup Plugged in	–	–

Table 29: Description of Extended Status Word - (continued)

Bit	Hex	Dec	Ext. status word	Ext. status word 2	Ext. status word 3
			Parameter *16-94 Ext. Status Word*	Parameter *16-95 Ext. Status Word 2*	Parameter *16-99 Ext. Status Word 3*
30	40000000	1073741824	–	–	–
31	80000000	2147483648	DB busy	–	–

5.2 List of Warnings and Alarms

WARNING/ALARM 2, Live Zero Error

Cause

This warning or alarm only appears if programmed in parameter ***6-01 Live Zero Timeout Function***. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform the input terminal signal test.

WARNING 3, No Motor

Cause

No motor is connected to the output of the drive.

Troubleshooting

- Check the cable connection between the drive and the motor.

WARNING/ALARM 4, Mains Phase Loss

Cause

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in parameter ***14-12 Response to Mains Imbalance***.

Troubleshooting

- Check the supply voltage and supply currents to the drive.

WARNING/ALARM 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.

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WARNING/ALARM 8, DC Under Voltage

Cause

If the DC-link voltage (DC-link) drops below the undervoltage limit, the drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the drive voltage.
- Perform the input voltage test.
- Perform the soft charge circuit test.

WARNING/ALARM 9, Inverter Overload

Cause

The drive is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 90% and trips at 100%, while giving an alarm. The drive cannot be reset until the counter is below 90%.

The fault occurs when the drive has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the LCP with the drive rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Show the thermal drive load on the LCP and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor ETR Overtemperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the drive issues a warning or an alarm when the counter reaches 100% in parameter ***1-90 Motor Thermal Protection***. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in parameter ***1-24 Motor Current*** is correct.
- Ensure that the motor data in parameter ***1-20 Motor Power*** to parameter ***1-25 Motor Nominal Speed*** is set correctly.
- Running AMA in parameter ***1-29 Automatic Motor Adaptation (AMA)*** tunes the drive to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor Thermistor Overtemperature

Cause

Check whether the thermistor is disconnected. Select whether the drive issues a warning or an alarm in parameter ***1-90 Motor Thermal Protection***.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.

- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that parameter ***1-93 Thermistor Resource*** selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in parameter ***1-93 Thermistor Resource***.

WARNING/ALARM 12, Torque Limit

Cause

The torque has exceeded the value in parameter ***4-16 Torque Limit Motor Mode*** or the value in parameter ***4-17 Torque Limit Generator Mode***. Parameter ***14-25 Trip Delay at Torque Limit*** can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 5 s, then the drive trips and issues an alarm. Shock loading or fast acceleration with high-inertia loads can cause this fault.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check parameter ***1-20 Motor Power*** to parameter ***1-25 Motor Nominal Speed*** for correct motor data.

ALARM 14, Ground Fault

Cause

There is current from the output phases to ground, either in the cable between the drive and the motor or in the motor itself.

Troubleshooting

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a meg-ohmmeter.

ALARM 16, Short Circuit

Cause

There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove power to the drive and repair the short circuit.

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WARNING/ALARM 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when parameter ***8-04 Control Word Timeout Function***is NOT set to ***[0] Off***. If parameter ***8-04 Control Word Timeout Function*** is set to ***[5] Stop and Trip***, a warning appears. The drive then ramps down until it trips, while giving an alarm. Parameter ***8-03 Control Timeout Time*** could possibly be increased.

Troubleshooting

- Check connections on the serial communication cable.
- Increase parameter ***8-03 Control Word Timeout Time***.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 18, Start Failed

Cause

The speed cannot exceed the value set in parameter ***1-78 Compressor Start Max Speed [Hz]*** during start within the allowed time, which is set in parameter ***1-79 Compressor Start Max Time to Trip***. The alarm may be caused by a blocked motor.

Troubleshooting

- Check if the motor is blocked.
- Check if the start maximum speed is set higher than the working speed after ramp up.
- Check if the start maximum time to trip is set shorter than the normal ramp up time.

WARNING/ALARM 20, Temp. Input Error

Cause

The temperature detected by VLT® Sensor Input Option MCB 114 exceeds the limit.

This warning/alarm is only active when ***[5] Stop and trip*** is selected in parameter ***35-06 Temperature Sensor Alarm Function***.

Troubleshooting

- Check the settings of the following parameters:
  a. Parameter group ***35-1* Temp. Input X48/4***.
  b. Parameter group ***35-2* Temp. Input X48/7***.
  c. Parameter group ***35-3* Temp. Input X48/10***.
- Check the feedback temperature from the following parameters:
  a. Parameter ***18-37 Temp. Input X48/4***.
  b. Parameter ***18-38 Temp. Input X48/7***.
  c. Parameter ***18-39 Temp. Input X48/10***.

ALARM 22, Hoist Mechanical Brake

Cause

This alarm occurs when the torque reference was not reached before timeout (parameter ***2-27 Torque Ramp Up Time***).

Troubleshooting

- Check if mechanical brake is broken or opened before start.

- Check if parameter ***2-27 Torque Ramp Up*** Time is too short.

WARNING 25, Brake Resistor Short-circuited

Cause

The brake resistor is monitored during start-up. If a short circuit occurs, the brake function is disabled and the alarm appears. The drive is tripped.

Troubleshooting

- Remove the power to the drive and check the connection of the brake resistor.

WARNING/ALARM 26, Brake Resistor Power Limit

Cause

The power transmitted to the brake resistor is calculated as an average value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in parameter ***2-11 Brake Resistor (ohm)***. The warning is active when the dissipated braking power is higher than the value set in parameter ***2-12 Brake Power Limit (kW)***. The drive trips if the warning persists for 1200 s.

Troubleshooting

- Decrease brake energy via lower speed or longer ramp time.

ALARM 27, Brake IGBT/Brake Chopper Short-circuited

Cause

The brake transistor is monitored during start-up. If a short circuit occurs, the brake function is disabled, and an alarm is issued. The drive is tripped.

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

ALARM 28, Brake Check

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check if brake resistor is connected or it is too large for the drive.

ALARM 30, Motor Phase U Missing

Cause

WARNING

HAZARDOUS VOLTAGE

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

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

Motor phase U between the drive and the motor is missing.

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Troubleshooting

- Disconnect power from the drive and check motor phase U.

ALARM 31, Motor Phase V Missing

Cause

⚠ WARNING

HAZARDOUS VOLTAGE

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

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

Motor phase V between the drive and the motor is missing.

Troubleshooting

- Disconnect power from the drive and check motor phase V.

ALARM 32, Motor Phase W Missing

Cause

⚠ WARNING

HAZARDOUS VOLTAGE

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

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

Motor phase W between the drive and the motor is missing.

Troubleshooting

- Disconnect power from the drive and check motor phase W.

WARNING/ALARM 34, Fieldbus Fault

Cause

The fieldbus on the communication option card is not working.

Troubleshooting

- Check the fieldbus communication option card.

ALARM 35, Option Fault

Cause

Fieldbus or option B detects internal faults.

Troubleshooting

- Contact the local supplier.

WARNING/ALARM 36, Mains Failure

Cause

This warning/alarm is only active if the supply voltage to the drive is lost and parameter ***14-10 Mains Failure*** is not set to ***[0] No function***.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number is shown.

Table 30: Internal Fault List

Fault number	Cause	Solution
140–142	Power board EEPROM data error	Upgrade the software in the drive to the latest version.
176	The firmware in the drive does not match the drive.	Upgrade the software in the drive to the latest version.
256	Flash ROM check-sum error.	Upgrade the software in the drive to the latest version.
2304	Firmware mismatch between the control card and the power card.	Upgrade the software in the drive to the latest version.
2560	Communication error between the control card and the power card.	Upgrade the software in the drive to the latest version. If the alarm occurs again, check the connection between the control card and the power card.
3840	Serial flash version error.	Upgrade the software in the drive to the latest version.
4608	Drive power size error.	Upgrade the software in the drive to the latest version. If the alarm occurs again, contact a Danfoss supplier.
5632	Option hardware version error.	The hardware version of the option or the fieldbus variant is not compatible with the drive software.
5888	Option software version error.	The software version of the option or the fieldbus variant is not compatible with the drive software. Change either the fieldbus software or the drive software.
6144	The option is not supported.	Check if the product supports this option.
6400	Option combination error.	Remove the option.
Other	Other internal faults.	Power cycle the drive. If the alarm occurs again, contact a Danfoss supplier.

Troubleshooting

- See the above table for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

WARNING 40, Overload T27

Troubleshooting

- Check the load connected to terminal 27 or remove the short-circuit connection.
- Check parameter ***5-00 Digital I/O Mode*** and parameter ***5-01 Terminal 27 Mode***.

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WARNING 41, Overload T29

Troubleshooting

- Check the load connected to terminal 29 or remove the short-circuit connection.
- Check parameter ***5-00 Digital I/O Mode*** and parameter ***5-02 Terminal 29 Mode***.

ALARM 46, Gate Drive Voltage Fault

Cause

The supply for the gate drive on the power card is out of range. It is generated by the switch mode supply (SMPS) on the power card.

Troubleshooting

- Check for a defective power card.

WARNING/ALARM 47, 24 V Supply Low

Cause

The 24 V DC is measured on the control card.

Troubleshooting

- Check for a defective control card.

WARNING 49, Speed Limit

Cause

The warning is shown when the speed is outside of the specified range in parameter ***4-12 Motor Speed Low Limit [Hz]*** and parameter ***4-14 Motor Speed High Limit [Hz]***.

Troubleshooting

- Check if the system ran outside of the speed range.
- Check if parameter ***4-12 Motor Speed Low Limit [Hz]*** and parameter ***4-14 Motor Speed High Limit [Hz]*** are set correctly.

ALARM 50, AMA Calibration

Cause

A calibration error has occurred.

Troubleshooting

- Contact a Danfoss supplier or the Danfoss service department.

ALARM 51, AMA check U_{nom} and I_{nom}

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check the settings in parameter ***1-20 Motor Power*** to parameter ***1-25 Motor Nominal Speed***.

ALARM 52, AMA Low I_{nom}

Cause

The motor current is too low.

Troubleshooting

- Check the setting in parameter ***1-24 Motor Current***.

ALARM 53, AMA Big Motor

Cause

The power size of the motor is too large for the AMA to operate.

Troubleshooting

- Check the settings in parameter group ***1-2* Motor Data***.

ALARM 54, AMA Small Motor

Cause

The power size of the motor is too small for the AMA to operate.

Troubleshooting

- Check the settings in parameter group ***1-2* Motor Data***.

ALARM 55, AMA Parameter Range

Cause

The parameter values of the motor are outside of the acceptable range. The AMA does not run.

Troubleshooting

- Check the settings in parameter group ***1-2* Motor Data***.

ALARM 56, AMA Interrupted

Cause

The AMA is manually interrupted.

Troubleshooting

- Re-run the AMA calibration.

ALARM 57, AMA Timeout

Cause

AMA timeout.

Troubleshooting

- Try to restart the AMA. Repeated restarts can overheat the motor.

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ALARM 58, AMA Internal Fault

Cause

An AMA internal fault occurs.

Troubleshooting

- Contact a local Danfoss supplier.

WARNING/ALARM 59, Current Limit

Cause

The current is higher than the value in parameter ***4-18 Current Limit***.

Troubleshooting

- Ensure that the motor data in parameter ***1-20 Motor Power*** to parameter ***1-25 Motor Nominal Speed*** is set correctly.
- Possibly increase the current limit.
- Be sure that the system can operate safely at a higher limit.

ALARM 60, External Interlock

Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

WARNING/ALARM 61, Feedback Error

Cause

An error between calculated speed and speed measurement from feedback device.

Troubleshooting

- Check the settings for warning/alarm/disabling in parameter ***4-30 Motor Feedback Loss Function***.
- Set the tolerable error in parameter ***4-31 Motor Feedback Speed Error***.
- Set the tolerable feedback loss time in parameter ***4-32 Motor Feedback Loss Timeout***.

WARNING/ALARM 62, Output Frequency Limit

Cause for Flux Basic Mode

If the output frequency reaches the value set in parameter ***4-19 Max Output Frequency***, the drive issues a warning. The warning ceases when the output drops below the maximum limit. If the drive is unable to limit the frequency, it trips and issues an alarm. The latter may happen in flux basic mode if the drive loses control of the motor.

Troubleshooting for Flux Basic Mode

- Check the application for possible causes. The load torque could be too significant to drag the motor run to a high speed.
- Increase the output frequency limit. Ensure that the system can operate safely at a higher output frequency.

Cause for VVC TCL Mode

The output speed limit is reached, and the torque reference is derated. If the system is designed to reduce the speed by speed limit function, the warning only means that the speed limit is active.

Troubleshooting for VVC TCL Mode

- The system speed exceeds the speed limit, in this case, adjust the system speed or adjust the speed limit.
- If the speed limit function is used to control system speed, the warning can be ignored.

ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

WARNING 64, Voltage Limit

Cause

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

Troubleshooting

- Check if the mains input is not high enough.
- Check if the output frequency is too high above motor nominal frequency.

WARNING/ALARM 65, Control Card Over Temperature

Cause

The cutout temperature of the control card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check the fan operation.
- Check the control card.

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.

WARNING/ALARM 69, Power Card Temperature

Cause

The cutout temperature of the power card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check fan operation.
- Check the power card.

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ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the Danfoss supplier with the type code from the unit nameplate and the part numbers on the cards.

ALARM 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.

WARNING 87, Auto DC Brake

Cause

Occurs in IT mains when the drive coasts and the DC voltage is higher than 830 V. The motor consumes energy on the DC link. This function can be enabled/disabled in parameter ***0-07 Auto DC Braking***.

ALARM 88, Option Detection

Cause

A new option configuration has been detected.

Troubleshooting

- Set parameter ***14-89 Option Detection*** to ***[1] Enable Option Change***, and power cycle the drive to accept the new configuration.

WARNING 89, Hoist Brake Sliding

Cause

This warning occurs when the motor speed feedback is bigger than 10 RPM during torque building time before the brake is open (parameter ***2-27 Torque Ramp Up Time***).

Troubleshooting

- Check if the mechanical brake is broken or opened before start.
- Check that the feedback is not zero before opening the brake.

WARNING/ALARM 90, Feedback Monitor

Cause

A feedback fault is detected by option B.

Troubleshooting

- Contact the local supplier.

WARNING/ALARM 95, Broken Belt

Cause

Torque is below the torque level set for no load, indicating a broken belt. Parameter ***22-60 Broken Belt Function*** is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the drive after clearing the fault.

ALARM 99, Locked Rotor

Cause

The rotor is blocked. It is only enabled for PM motor control.

Troubleshooting

- Check if the motor shaft is locked.
- Check if the start current triggers the current limit set in parameter ***4-18 Current Limit***.
- Check if it increases the value in parameter ***30-23 Locked Rotor Detection Time [s]***.

WARNING/ALARM 102, Speed Monitor

Cause

A speed fault is detected when the motor overspeeds. This is only available in flux basic mode.

Troubleshooting

- This function can be enabled/disabled in parameter ***4-43 Speed Monitor Function***.

ALARM 120, Position Control Fault

Cause

When this alarm occurs, the reason is shown in parameter ***37-18 Pos. Ctrl Fault Reason***.

Troubleshooting

- Refer to the option descriptions in parameter ***37-18 Pos. Ctrl Fault Reason***.

WARNING 127, Back EMF too High

Cause

This warning applies to PM motors only. When the back EMF exceeds 90% x U_{invmax} (overvoltage threshold) and does not drop to a normal level within 5 s, this warning is reported. The warning remains until the back EMF returns to a normal level.

Troubleshooting

- Check the settings in parameter group ***1-2* Motor Data***.

WARNING 157, Power Limit Mot

Cause

The output power exceeds the value defined in parameter ***4-82 Power Limit Motor Mode***.

Troubleshooting

- Check if parameter ***4-82 Power Limit Motor Mode*** is set too small to fit the application.

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- Check if actual motoric load is bigger than parameter ***4-82 Power Limit Motor Mode***.

WARNING 158, Power Limit Gen

Cause

The output power exceeds the value defined in parameter ***4-83 Power Limit Generator Mode***.

Troubleshooting

- Check if parameter ***4-83 Power Limit Generator Mode*** is set too small to fit the application.
- Check if actual generic load is bigger than parameter ***4-83 Power Limit Generator Mode***.

ALARM 250, New Spare Part

Cause

The power or switch mode supply has been exchanged.

Troubleshooting

- Contact the local supplier.

ALARM 251, New Type Code

Cause

The drive has a new type code.

Troubleshooting

- Contact the local supplier.

6 Appendix

6.1 Abbreviations and Symbols

Table 31: Abbreviations and Symbols

60° AVM	60° asynchronous vector modulation
A	Ampere/AMP
AC	Alternating current
ACP	Application control processor
AD	Air discharge
AEO	Automatic energy optimization
AI	Analog input
AIC	Ampere interrupting current
AMA	Automatic motor adaptation
AWG	American wire gauge
°C	Degrees Celsius
CB	Circuit breaker
CD	Constant discharge
CDM	Complete Drive Module: The drive, feeding section, and auxiliaries.
CE	European conformity (European safety standards)
CM	Common-mode
CT	Constant torque
DC	Direct current
DI	Digital input
DM	Differential mode
D-TYPE	Drive dependent
EEPROM	Electrically erasable programmable read-only memory
EMC	Electromagnetic compatibility
EMF	Electromotive force
EMI	Electromagnetic interference
ESD	Electrostatic discharge
ETR	Electronic thermal relay
°F	Degrees Fahrenheit
f_{JOG}	Motor frequency when jog function is activated.
f_M	Motor frequency
f_{MAX}	Maximum output frequency that the drive applies on its output.
f_{MIN}	Minimum motor frequency from the drive.
$f_{M, N}$	Nominal motor frequency
FC	Frequency converter (drive)

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Table 31: Abbreviations and Symbols - (continued)

FSP	Fixed-speed pump
g	Gram
HO	High overload
Hp	Horse power
HW	Hardware
Hz	Hertz
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
IGBT	Insulated-gate bipolar transistor
IP	Ingress protection
kHz	Kilohertz
LCP	Local control panel
LED	Light-emitting diode
L_d	Motor d-axis inductance
L_q	Motor q-axis inductance
Lsb	Least significant bit
m	Meter
mA	Milliampere
MCM	Mille circular mil
MCP	Motor control processor
MCT	Motion control tool
mH	Inductance in milli Henry
min	Minute
mm	Millimeter
ms	Millisecond
Msb	Most significant bit
η_{VLT}	Efficiency of the drive defined as ratio between power output and power input.
NEMA	National Electrical Manufacturers Association
nF	Capacitance in nano Farad
NLCP	Numerical local control panel
Nm	Newton meter
NO	Normal overload
n_s	Synchronous motor speed
On/Offline parameters	Changes to online parameters are activated immediately after the data value is changed

Table 31: Abbreviations and Symbols - (continued)

$P_{br, cont.}$	Rated power of the brake resistor (average power during continuous braking)
PCB	Printed circuit board
PCD	Process data
PDS	Power drive system: CDM and a motor
PE	Protective earth
PELV	Protective extra low voltage
P_m	Drive nominal output power as high overload
$P_{M, N}$	Nominal motor power
PM motor	Permanent magnet motor
Process PID	Proportional integrated differential regulator that maintains the speed, pressure, temperature, and so on.
PWM	Pulse width modulation
$R_{br, nom}$	Nominal resistor value that ensures a brake power on the motor shaft of 150/160% for 1 minute.
RCD	Residual current device
Regen	Regenerative terminals
RFI	Radio frequency interference
R_{min}	Minimum allowed brake resistor value by the drive
RMS	Root average square
RPM	Revolutions per minute
R_{rec}	Recommended brake resistor resistance of Danfoss brake resistors
R_s	Stator resistance
s	Second
SCR	Silicon controlled rectifier
SCCR	Short-circuit current rating
SFAVM	Stator flux-oriented asynchronous vector modulation
STW	Status word
SMPS	Switch mode power supply
THD	Total harmonic distortion
T_{LIM}	Torque limit
TTL	TTL encoder (5 V) pulses - transistor logic
$U_{M, N}$	Nominal motor voltage
UL	Underwriters Laboratories (US organization for the safety certification)
V	Volts
VSP	Variable-speed pump
VT	Variable torque
VVC+	Voltage vector control plus
X_h	Motor main reactance

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6.2 Definitions

6.2.1 AC Drive

Coast

The motor shaft is in free mode. No torque on the motor.

$I_{VLT, MAX}$

Maximum output current.

$I_{VLT, N}$

Rated output current supplied by the drive.

$U_{VLT, MAX}$

Maximum output voltage.

6.2.2 Input

Control commands

Start and stop the connected motor with the LCP and digital inputs.

Functions are divided into 2 groups. Functions in group 1 have higher priority than functions in group 2.

Table 32: Function Groups

Group 1	Coast stop, reset and coast stop, quick stop, DC braking, stop, and [OFF].
Group 2	Start, latched start, start reversing, jog, freeze output, and [Hand On].

6.2.3 Motor

Motor running

Torque generated on the output shaft and speed from 0 RPM to maximum speed on the motor.

f_{JOG}

Motor frequency when the jog function is activated (via digital terminals or bus).

f_M

Motor frequency.

f_{MAX}

Maximum motor frequency.

f_{MIN}

Minimum motor frequency.

$f_{M, N}$

Rated motor frequency (nameplate data).

I_M

Motor current (actual).

$I_{M, N}$

Nominal motor current (nameplate data).

$n_{M, N}$

Nominal motor speed (nameplate data).

n_s

Synchronous motor speed. $n_S = \frac{2 \times \text{Parameter1} - 23 \times 60s}{\text{Parameter1} - 39}$

n_{slip}

Motor slip.

$P_{M, N}$

Rated motor power (nameplate data in kW or hp).

$T_{M, N}$

Rated torque (motor).

U_M

Instantaneous motor voltage.

$U_{M, N}$

Rated motor voltage (nameplate data).

Break-away torque

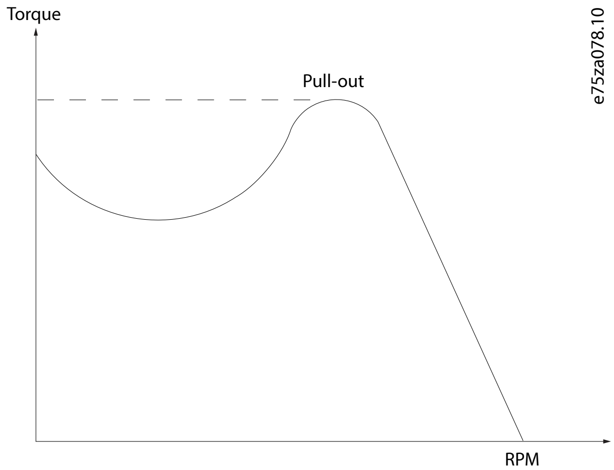

Figure 45: Break-away Torque

η_{VLT}

The efficiency of the drive is defined as the ratio between the power output and the power input.

Start-disable command

A start-disable command belonging to the control commands in group 1. See the table in the *chapter Input* for more details.

Stop command

A stop command belonging to the control commands in group 1. See the table in the *chapter Input* for more details.

6.2.4 References

Analog reference

A signal transmitted to the analog inputs 53 or 54 can be voltage or current.

Binary reference

A signal transmitted via the serial communication port.

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. Selection of 4 preset references via the bus.

Pulse reference

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A pulse frequency signal transmitted to the digital inputs (terminal 29 or 33).

Ref_{MAX}

Determines the relationship between the reference input at 100% full-scale value (typically 10 V, 20 mA) and the resulting reference. The maximum reference value is set in parameter ***3-03 Maximum Reference***.

Ref_{MIN}

Determines the relationship between the reference input at 0% value (typically 0 V, 0 mA, 4 mA) and the resulting reference. The minimum reference value is set in parameter ***3-02 Minimum Reference***.

6.2.5 Miscellaneous

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: 0–10 V DC.

Analog outputs

The analog outputs can supply a signal of 0–20 mA or 4–20 mA.

Automatic motor adaptation, AMA

The AMA algorithm determines the electrical parameters for the connected motor at standstill.

Brake resistor

The brake resistor is a module capable of absorbing the brake power generated in regenerative braking. This regenerative brake power increases the DC-link voltage and a brake chopper ensures that the power is transmitted to the brake resistor.

CT characteristics

Constant torque characteristics used for all applications such as conveyor belts, displacement pumps, and cranes.

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.

ETR

Electronic thermal relay is a thermal load calculation based on present load and time. Its purpose is to estimate the motor temperature.

FC standard bus

Includes RS-485 bus with FC protocol or MC protocol. See parameter ***8-30 Protocol***.

Initializing

If initializing is carried out (parameter ***14-22 Operation Mode***), the drive returns to the default setting.

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.

LCP

The local control panel makes up a complete interface for control and programming of the drive. The LCP is detachable. With the installation kit option, the LCP can be installed up to 3 m (9.8 ft) from the drive in a front panel.

GLCP

The graphic local control panel interface for control and programming of the drive. The display is graphic and the panel is used to show process values. The GLCP has storing and copy functions.

NLCP

The numerical local control panel interface for control and programming of the drive. The display is numerical and the panel is used to show process values. The NLCP has storing and copy functions.

lsb

Least significant bit.

msb

Most significant bit.

MCM

Short for mille circular mil, an American measuring unit for cable cross-section. 1 MCM = 0.5067 mm^2.

On-line/off-line parameters

Changes to on-line parameters are activated immediately after the data value is changed. To activate changes to offline parameters, press [*OK*].

Process PID

The PID control maintains speed, pressure, and temperature by adjusting the output frequency to match the varying load.

PCD

Process control data.

Power cycle

Switch off the mains until the display (LCP) is dark, then turn power on again.

Power factor

The power factor is the relation between I_1 and I_{RMS}.

$$\mathrm{Powerfactor} = \frac{\sqrt{3} \times U \times I_1 \cos\varphi 1}{\sqrt{3} \times U \times I_{\mathrm{RMS}}}$$

For this drive, $\cos\varphi 1 = 1$, therefore: $\mathrm{Powerfactor} = \frac{I_1 \times \cos\varphi 1}{I_{\mathrm{RMS}}} = \frac{I_1}{I_{\mathrm{RMS}}}$

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.

$$I_{\mathrm{RMS}} = \sqrt{I_1^2 + I_5^2 + I_7^2 + \square\square\square + I_n^2}$$

In addition, a high power factor indicates that the different harmonic currents are low.

The built-in DC coils produce a high power factor, minimizing the imposed load on the mains supply.

Pulse input/incremental encoder

An external, digital pulse transmitter used for feeding back information on motor speed. The encoder is used in applications where great accuracy in speed control is required.

RCD

Residual current device.

Setup

Save parameter settings in 2 setups. Change between the 2 parameter setups and edit 1 setup while the other setup is active.

SFAVM

Acronym describing the switching pattern stator flux-oriented asynchronous vector modulation.

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.

Smart logic control (SLC)

The SLC is a sequence of user-defined actions executed when the associated user-defined events are evaluated as true by the SLC. (Parameter group ***13-** Smart Logic***).

STW

Status word.

THD

Total harmonic distortion states the total contribution of harmonic distortion.

Thermistor

A temperature-dependent resistor placed where the temperature is to be monitored (drive or motor).

Trip

A state entered in fault situations, for example, if the drive is subject to overvoltage or when it is protecting the motor, process, or mechanism. Restart is prevented until the cause of the fault has disappeared, and the trip state is canceled by activating reset or, sometimes, by being programmed to reset automatically. Do not use trip for personal safety.

Trip lock

Trip lock is a state entered in fault situations when the drive is protecting itself and requiring physical intervention. An example causing a trip lock is the drive being subject to a short circuit on the output. A locked trip can only be canceled by cutting off 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 trip lock for personal safety.

VT characteristics

Variable torque characteristics for pumps and fans.

VVC+

If compared with standard voltage/frequency ratio control, Voltage Vector Control (VVC+) improves the dynamics and stability, both when the speed reference is changed and in relation to the load torque.

60° AVM

Refers to the switching pattern 60° asynchronous vector modulation.

6.3 Conventions

- Numbered lists indicate procedures.
- Bulleted and dashed lists indicate listings of other information where the order of the information is not relevant.
- Bolded text indicates important information and section headings.
- Italicized text indicates the following:
  - Cross-reference.
  - Link.
  - Footnote.
  - Alarms/warnings
- Bolded and italicized text indicates the following:
  - Parameter name.
  - Parameter option.
  - Parameter group name.
- All dimensions in drawings are in metric values (imperial values in brackets).

- An asterisk (*) indicates the default setting of a parameter.

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