iC2-Micro Frequency Converters

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1 Introduction and Safety

1.1 Purpose of this Application Guide

This application guide is intended for qualified personnel such as:

- Automation engineers

- Application and product specialists who have experience operating with parameters and basic knowledge of AC drives.

The application guide, which provides information on the parameters to configure and control the frequency converter, procedures to operate the user interfaces of the iC2-Micro Frequency Converters, typical application examples with recommended settings, and troubleshooting of faults and warnings that might occur.

1.2 Additional Resources

Following are the additional resources available to further understand the features, safely install, and operate the iC2-Micro Frequency Converters.

- The operating guide, which provides information about the installation, commissioning, and maintenance of iC2-Micro Frequency Converters.

- The design guide, which provides technical information to understand the capabilities of the iC2-Micro Frequency Converters for integration into motor control and monitoring systems.

1.3 Version History

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

The original language of this guide is in English.

Guide version	Remarks
AB413939445838, version 04	Information in this version of the guide applies to software version 1.30.

1.4 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

1.5 General Safety Considerations

When installing or operating the drive, pay attention to the safety information given in the instructions. For more information about safety guidelines for installation and operation, refer to the operating guide of the drive.

Safe operation guidelines

- The drive is not suitable as the only safety device in the system. Make sure that additional monitoring and protection devices on drives, motors, and accessories are installed according to the regional safety guidelines and accident prevention regulations.

- Before activating any automatic fault reset functions or changing limit values, make sure that no dangerous situations can occur after restart. If the auto reset function is activated, the motor starts automatically after an automatic fault reset.

- Keep all doors and covers closed and terminal boxes screwed on during operation of the drive and when mains is connected.

- Drive components and accessories can still be live and connected to mains, even after the operation indicators are no longer illuminated.

⚠ **WARNING**

LACK OF SAFETY AWARENESS

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

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

⚠ **WARNING**

HAZARDOUS VOLTAGE

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

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

> ⚠️ **WARNING**
>
> **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.
>
> - Stop the motor, disconnect AC mains, permanent magnet type motors, and remove DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
> - Wait for the capacitors to discharge fully and measure it before performing any service or repair work.
> - The minimum waiting time is specified in the table *Discharge time*.

Table 1: Discharge Time

Enclosure size	Minimum waiting time (minutes)
MA01c–MA02c and MA01a–MA03a	4
MA04a–MA05a	15

> ⚠️ **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.

> ⚠️ **CAUTION**
>
> **HOT SURFACES**
>
> The drive contains metal components that are still hot even after the drive has been powered off. Failure to observe the high-temperature symbol (yellow triangle) on the drive can result in serious burns.
>
> - Be aware that internal components, such as busbars, may be extremely hot even after the drive has been powered off.
> - Do not touch exterior areas that are marked by the high-temperature symbol (yellow triangle). These areas are hot while the drive is in use and immediately after being powered off.

1.6 Qualified Personnel

To allow trouble-free and safe operation of the unit, only qualified personnel with proven skills are allowed to transport, store, assemble, install, program, commission, maintain, and decommission this equipment.

Persons with proven skills:

- Are qualified electrical engineers or persons who have received training from qualified electrical engineers and are suitably experienced to operate devices, systems, plants, and machinery in accordance with pertinent laws and regulations.
- Are familiar with the basic regulations concerning health and safety/accident prevention.
- Have read and understood the safety guidelines given in all guides provided with the unit, especially the instructions given in the operating guide of the drive.
- Have good knowledge of the generic and specialist standards applicable to the specific application.

2 Application Software Overview

2.1 iC2-Micro Application Software Overview

The application software is the default and standard software delivered with the iC2-Micro Frequency Converters. The features are briefly described in the following sections:

- Basic Functions

- Controllers

- Protection Features

- Software Tools

2.2 Basic Functions

2.2.1 Basic Functions Overview

The application software consists of a wide range of basic features which enables the drive to control any application using the iC2-Micro drive.

2.2.2 Handling of reference

References from multiple sources, matching the needs to control the application, are freely definable.

Reference sources are:

- Analog inputs

- Digital inputs (can also be set as pulse input)

- Reference from a fieldbus

- Internal settings

- Local reference from control panel

- Built-in potentiometer on control panel

Reference signals can be added, which generates the reference to the frequency converter. The final reference is scaled from -100% to 100%.

2.2.3 Two Setups

The frequency converter offers 2 setups. Each setup can be parameterized independently to match various application needs.

Switching between setups is possible during operation, allowing fast changeover.

2.2.4 Ramps

Linear, Sine ramp, and Sine 2 ramps are supported in the frequency converter. The linear ramps provide a constant acceleration. The Sine ramps provides a non-linear acceleration with soft transition at start and end of the acceleration process.

2.2.5 Quick Stop

In some situations, it may be required to stop the application in a quick way. For this purpose, the drive supports a specific deceleration ramp time from the synchronous motor speed to 0 RPM.

2.2.6 Limit Rotation Direction

The rotational direction of the motor can be preset to run in 1 direction only (clockwise or counterclockwise), avoiding unintended rotation direction.

2.2.7 **Motor Phase Switch**

If motor phase cables have been installed in an incorrect order during installation, the rotation direction can be changed. This eliminates the need to change the order of motor phases.

2.2.8 **Inching with Jogging Modes**

The frequency converter has predefined speed settings for use during commissioning, maintenance, or service. The jogging-mode operation is set at preset speed.

2.2.9 **Frequency Bypass**

Specific motor frequencies can be bypassed during operation. The feature helps to minimize and avoid mechanical resonance of the machine, limiting vibration and noise of the system by using parameters of band low and high limits.

2.2.10 **Automatic Restart**

If there is a minor fault and trip, the drive can restart automatically, eliminating a manual reset of the drive. This enhances automated operation in remotely controlled systems. Make sure that dangerous situations cannot occur when using automatic restart.

2.2.11 **Flying Start**

Flying start enables the drive to synchronize to a freely spinning motor, before taking control of the motor. Taking over control of the motor at the actual speed minimizes mechanical stress to the system. For example, the feature is relevant in fan and centrifuge applications.

2.2.12 **Mains Dropout**

In case of mains dropout, where the drive cannot continue operation, it is possible to select predefined actions, for example, trip, coast, or performing a controlled ramp down.

2.2.13 **Kinetic Backup**

Kinetic backup enables the drive to remain in control if there is sufficient energy in the system, for example, as inertia or when lowering a load. This allows a controlled stop of the machine.

2.2.14 **Resonance Damping**

High-frequency motor resonance noise can be eliminated through the use of resonance damping. Both automatic and manually selected frequency damping are available.

2.2.15 **Mechanical Brake Control**

In applications like simple hoists, palletizers, stereoscopic warehouse, or downhill conveyors, a mechanical brake is used to keep the load at standstill, when the motor is not controlled by the drive or when power is turned off.

The mechanical brake control feature ensures a smooth transition between the mechanical brake and motor holding the load by controlling the activation and deactivation of the mechanical brake.

2.2.16 **Controllers**

The drive has 3 different controllers providing optimized control of the actual application. The controllers cover:

- Process control
- Speed control open loop
- Torque control open loop

Process controller

The process controller can control a process, for example, in a system where a constant pressure, flow, or temperature is needed. Feedback from the application is connected to the drive, providing the actual output value. The controller ensures that the output is matching the reference provided by controlling the motor speed. The reference source and the feedback signals are converted and scaled to the actual values controlled.

Speed controller

The open-loop speed control provides accurate control of the motors rotational speed.

In open-loop mode (without external feedback signal of the speed), there is no need for external sensors. The open-loop speed control makes installation and commissioning easier, and eliminates the risk of defective sensors.

Torque controller

A built-in torque controller provides optimized control of torque and supports open-loop control.

2.3 IO Control and Readouts

Depending on the hardware configuration of the drive, digital and analog inputs, digital and analog outputs, and relay outputs are available. The I/Os can be configured and used to control the application from the drive.

All I/Os can be used as remote I/O nodes, as they are all addressed by the fieldbus of the drive.

2.4 Motor Control Features

2.4.1 Motor Control Features Overview

The motor control feature covers a wide range of applications, from the most basic applications to applications requiring high-performance motor control.

2.4.2 Motor Types

The drive supports standard available motors like:

- Induction motors
- Permanent magnet motors

2.4.3 Load Characterstics

Different load characteristics are supported to match the actual application needs:

- **Variable torque:** Typical load characteristic of fans and centrifugal pumps, where the load is proportional to the square of the speed.
- **Constant torque:** Load characteristic used in machinery where torque is needed across the full speed range. Typical application examples are conveyors, extruders, decanters, compressors, and winches.

2.4.4 Motor Control Principle

Different control principles can be selected to control the motor, matching the application needs:

- U/f control for special control
- VVC+ control for the general-purpose application needs

2.4.5 Motor Nameplate and Catalog

Typical motor data for the actual drive are preset from factory, allowing operation of most motors. During commissioning, the actual motor data are entered in the settings of the drive, optimizing the motor control.

2.4.6 **Automatic Motor Adaptation (AMA)**

Automatic Motor Adaptation (AMA) provides optimization of motor parameters for improved shaft performance. Based on motor nameplate data and measurements of the motor at standstill, key motor parameters are being recalculated and used to fine tune the motor control algorithm.

2.4.7 **Automation Energy Optimization (AEO)**

The Automatic Energy Optimizer (AEO) feature optimizes the control with focus on lowering energy consumption at the actual load point.

2.5 **Braking of Load**

2.5.1 **Braking of Load Overview**

When braking the motor controlled by the drive, various functions can be used. The specific function is selected based on the application and the needs for how fast it should be stopped.

2.5.2 **Resistor Braking**

In applications where fast or continuous braking is required, a drive fit with a brake chopper is typically used. Excess energy generated by the motor during braking of the application will be dissipated in a connected brake resistor. Braking performance depends on the specific drive rating and selected brake resistor.

2.5.3 **Overvoltage Control (OVC)**

If braking time is not critical or the load is varying, the overvoltage control (OVC) feature is used to control the stopping of the application. The drive extends the ramp-down time when it is not possible to brake within the defined ramp-down period. Do not use OVC in hoisting applications, high-inertia systems, or where continuous braking is required.

2.5.4 **DC Brake**

When braking at low speed, the braking of the motor can be improved by using the DC brake feature. It adds a small DC current on top of the AC current, slightly increasing the brake capability.

2.5.5 **AC Brake**

In applications with non-cyclic operation of the motor, AC braking can be used to shorten the braking time and is only supported for induction motors. Excess energy is dissipated by increasing losses in the motor during braking.

2.5.6 **DC Hold**

DC hold provides a limited holding torque on the rotor at standstill.

2.5.7 **Load Sharing**

In some applications, 2 or more drives are controlling the application at the same time. If 1 of the drives is braking a motor, the excess energy can be fed to the DC link of a drive driving a motor, with a reduction of the total energy consumption. This feature is useful in, for examples, decanters and carding machines, where smaller power-sized drives operate in generator mode.

2.6 **Protection Features**

2.6.1 **Grid Protections**

The drive protects against conditions on the power grid that can affect proper operation.

The grid is monitored for phase imbalance and phase loss. If the imbalance exceeds internal limits, a warning is provided and the user can initiate proper actions.

In case of an under- or overvoltage on the grid, the drive will provide a warning and stop operation if the situation remains or exceeds critical limits.

2.6.2 Drive Protection Features

The drive is monitored and protected during operation.

Built-in temperature sensors measure the actual temperature and provide relevant information to protect the drive. If the temperature exceeds its nominal temperature conditions, derating is applied. If the temperature is outside the allowed operating range, the drive stops the operation.

The motor current is continuously monitored on all 3 phases. If there is a short circuit between 2 phases or a fault to the ground, the drive detects this and immediately turns off. If the output current is exceeding its nominal values during operation for longer periods than allowed, the drive stops and reports an overload fault.

The DC-link voltage of the drive is monitored. If it exceeds critical levels, a warning is issued and the drive stops. If the situation is not resolved, the drive issues a fault.

2.6.3 Motor Protection Features

The drive provides various features to protect the motor and the application.

The output current measurement provides information to protect the motor. Overcurrent, short circuit, ground faults, and lost motor phase connections can be detected and relevant protections initiated.

Monitoring of speed, current, and torque limits provides an additional protection of the motor and the application.

Locked rotor protection secures that the drive is not starting with a blocked rotor of the motor.

Motor thermal protection is provided either as a calculation of the motor temperature based on the actual load or by the means of external temperature sensors, for example PTC.

2.6.4 Protection of Externally Connected Components

Externally connected options like brake resistors can be monitored.

Brake resistors are monitored for thermal overload, short circuit, and missing connection.

2.6.5 Automatic Derating

Automatic derating of the drive allows continued operation even if the nominal operation conditions are exceeded. Typical factors affecting this are temperature, high DC-link voltage, high motor load, or operation close to 0 Hz. Derating is typically applied as a reduction in switching frequency or change in switching pattern, resulting in lower thermal losses.

2.7 Monitoring Features

2.7.1 Monitoring Features Overview

The drive offers a wide range of monitoring features providing information of operation conditions, grid conditions, and drive historical data. Access to this information helps out analyzing operational conditions and identification of faults.

2.7.2 Speed Monitoring

The motor speed can be monitored during operation. If the speed exceeds minimum and maximum limits, the user is notified and can initiate appropriate actions.

2.7.3 Event Log and Operational Counters

An event log provides access to the latest registered faults, providing relevant information for analysis of what occurred in the drive.

Operational counters offer information about the drive usage. Values like operation hours, running hours, kWh used, number of power-ups, overvoltages, and overtemperatures are examples of the readouts available.

2.8 Software Tools

2.8.1 Software Tools Overview

Danfoss offers a suite of desktop software tools which have been designed to provide easy operation and the highest level of customization of AC drives.

APIs and the Danfoss Device Interface enable integration of the tools into proprietary systems and business processes. The MyDrive® tools support the entire life cycle of the drive, from system design to service. Some of the tools are available free of charge, and some require a subscription.

For more information about the MyDrive® tools, see MyDrive documentation.

2.8.2 MyDrive® Select

MyDrive® Select performs frequency converter sizing based on calculated motor load currents, ambient temperature, and current limitations. The sizing results are available in graphical and numerical format, and include calculations of efficiency, power losses, and inverter load currents. The resulting documentation is available in .pdf or .xls format, and can be imported to MyDrive® Harmonics for evaluation of the harmonic distortion, or validation of compliance towards the most recognized harmonic norms and recommendations.

MyDrive® Select is available as a web-based tool at select.mydrive.danfoss.com and as a mobile device app that can be downloaded from app stores.

2.8.3 MyDrive® Harmonics

MyDrive® Harmonics estimate the benefits of adding harmonic mitigation solutions to an installation and calculates system harmonic distortion. The evaluation can be done both for new installations and when extending an existing installation.

The free version provides a fast overview of the expected general performance of the system. The expert version of MyDrive® Harmonics requires a subscription, which opens up more features, including the possibility to save and share harmonic projects, import projects from MyDrive® Select, and the possibility to add Danfoss harmonic mitigation products.

2.8.4 MyDrive® Energy

MyDrive® Energy combines drive system energy calculation and efficiency classification functionalities in 1 tool. It uses basic system parameters to generate efficiency metrics and estimate potential energy savings and CO_2 reduction for drive systems.

- The Efficiency Calculator (formerly MyDrive® ecoSmart) follows IEC 61800-9-2 standards for IE and IES class definitions, and calculates efficiency class and part load efficiency for Danfoss drives.
- The Energy Calculator enables system-level efficiency assessments, and analyzes energy consumption and savings. Additional parameters such as energy costs, CO_2 emissions, and system-specific load profiles can be added to obtain more precise results.

MyDrive® Energy is available as a web-based tool at https://energy.mydrive.danfoss.com/.

2.8.5 MyDrive® Insight

MyDrive® Insight is a software tool for commissioning, engineering, and monitoring drives. MyDrive® Insight can be used to configure parameters, upgrade software, and set up functional safety features and condition-based monitoring.

Making backups, restoring the system from a backup, and data logging within MyDrive® Insight support the use of a microSD card as storage device.

3 User Interfaces and How to Configure

3.1 Overview of User Interfaces

To interact with the iC2-Micro drive, use either control panel as the direct interface or MyDrive® Insight which is a PC tool for more advanced interaction with the drive.

The iC2-Micro drive has a control panel with a display, control buttons, and status indicators. Using MyDrive® Insight provides the ability to access the drive remotely.

3.2 Control Panel

3.2.1 Overview of Control Panel

The chapter provides an overview about the different control panels, the related elements, important features and functionalities, and quick guidance on how to use the control panel.

3.2.2 Control Panel and Control Panel 2.0 OP2

The drive has 2 types of control panels:

- **Control Panel:** It is built-in and by default delivered with the drive. The Control Panel buttons and indicators are described in 3.2.3 Control Panel Buttons and Indicators.

- **Control Panel 2.0 OP2:** An optional (accessory) control panel which provides a better user experience. This type of control panel enables easy setup of the drive via parameters, monitoring of the drive status, and visualization of event notifications. The Control Panel 2.0 OP2 buttons and indicators are described in 3.2.5 Control Panel 2.0 OP2 Buttons and Indicators.

Features of the Control Panel 2.0 OP2:

- 2.03" monochromatic user interface.

- Visual LEDs indicate drive status.

- Controls the drive and facilitates switching between local and remote operation.

- Multilingual display enhances clarity of parameters, selections, and status information.

- Parameter display supports alphanumeric, special characters, integers, floating points, choice lists, and commands to configure application data.

- Parameter settings can be easily copied to other drives for simplified commissioning.

- Control Panel 2.0 OP2 has an IP20 protection rating.

- Cabinet door installation with an optional mounting kit provides IP55 protection.

3.2.3 **Control Panel Buttons and Indicators**
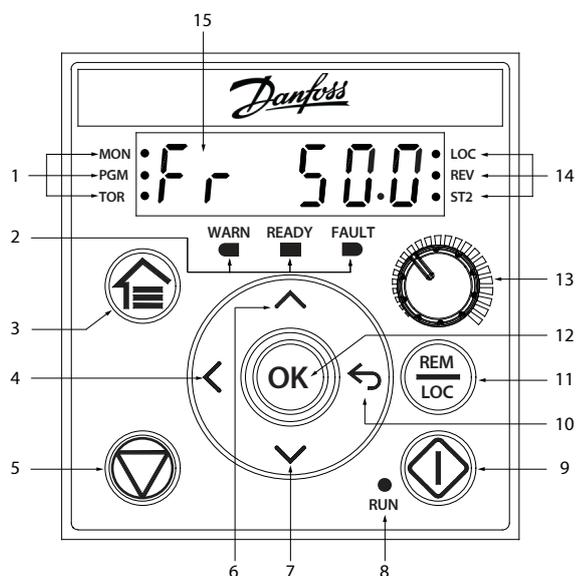
Figure 1: Control Panel

1	Status indicators	**2**	Operating indicators
3	Home/Menu	**4**	Left
5	Stop/Reset	**6**	Up
7	Down	**8**	Run indicator
9	Start	**10**	Back
11	Remote/Local	**12**	OK
13	Potentiometer	**14**	Status indicators
15	Main display		

Table 2: Operation Buttons and Potentiometer

Name	Function
Home/Menu	Toggles between status view and main menu. Long press to access the shortcut menu for quickly reading and editing parameters.
Up/Down	Switches status/parameter group/parameter numbers, and tunes the parameter values.
Left	Moves the cursor 1 bit to the left.
Back	Navigates to the previous step in the menu structure or cancels the setting during tuning parameter values.
OK	Confirms the operation.
Remote/Local	Toggles between the remote mode and local mode.
Start	Starts the drive in local mode.
Stop/Reset	Stops the drive in local mode. Resets the drive to clear a fault.
Potentiometer	Changes the reference value when the reference value is selected as potentiometer.

Table 3: Status Indicator Lights

Name	Function
MON	On: The main display is showing the drive status.
PGM	On: The drive is in programming status.
TOR	On: The drive is in torque mode.
	Off: The drive is in speed mode.
LOC	On: The drive is in local mode.
	Off: The drive is in remote mode.
REV	On: The drive is in reverse direction.
	Off: The drive is in forward direction.
ST2	Refer to Table 6.

Table 4: Operating Indicator Lights

Name	Function
WARN	Steadily lit when a warning occurs.
READY	Steadily lit when the drive is ready.
FAULT	Flashes when a fault occurs.

Table 5: Run Indicator Light

Name	Function
RUN	On: The drive is in normal operation.
	Off: The drive has stopped.
	Flash: In the motor-stopping process; or the drive received a *RUN* command, but no frequency output.

Table 6: Multiple Setups Indicator Light

ST2	Off	On	Flash	Flash quickly
Active setup[1]	Setup 1	Setup 2	Setup 1	Setup 2
Programming setup[2]	Setup 1	Setup 2	Setup 2	Setup 1

1) Select active setup in parameter *P 6.6.1 Active Setup*.

2) Select programming setup in parameter *P 6.6.2 Active Setup*.

3.2.4 Control Panel Basic Configuration

3.2.4.1 Overview of Control Panel Basic Configuration

Basic configurations of the control panel include:

- Readout status of the motor and the drive which includes warnings and faults.

- Navigate to the menus to view or change parameter settings for the drive.

After the drive is powered up, press the *Home/Menu* button to toggle between status display and main menu. Use the *Up/Down* buttons to select items, and press the *OK* button to confirm selection.

Figure 2: Operation with Control Panel
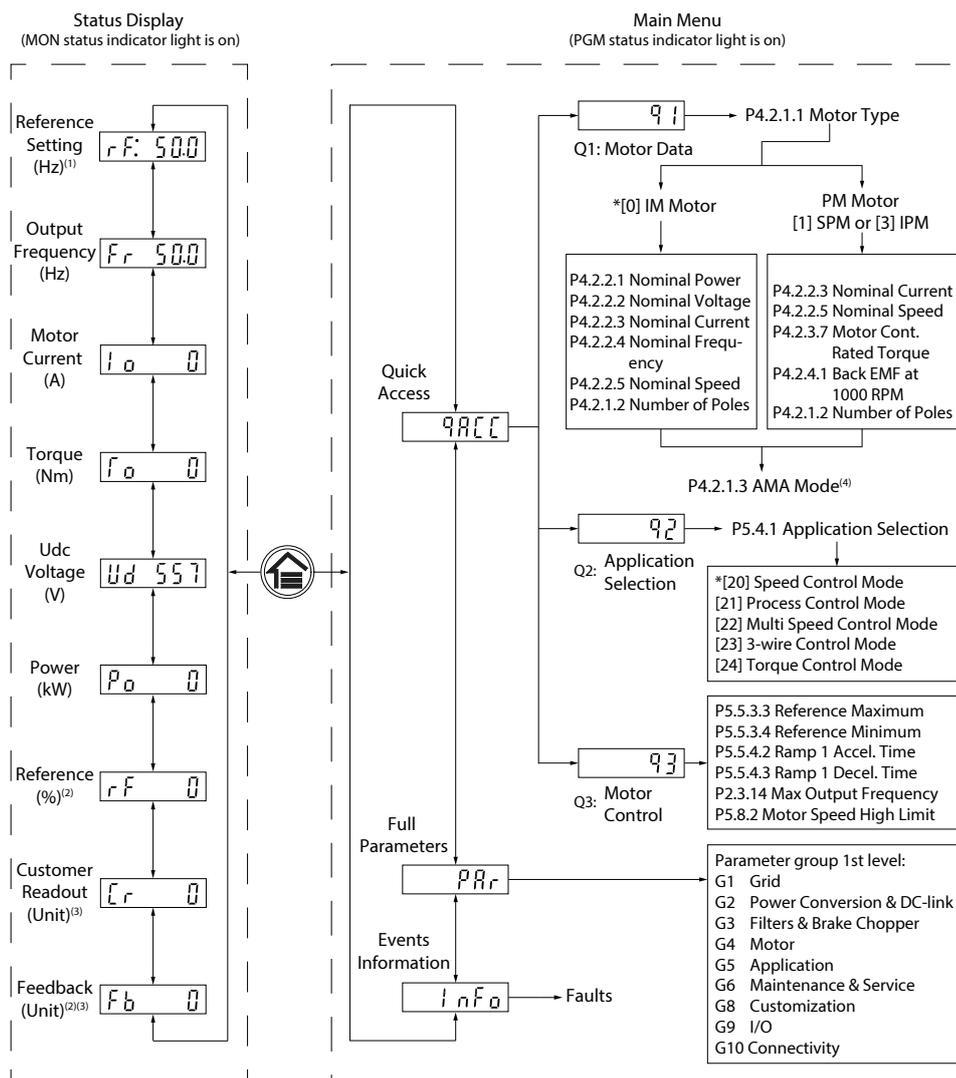
Note: (1) Local mode only. (2) Remote mode only. (3) The status is only shown when the corresponding function is enabled. (4) For AMA execution, refer to *chapter Automatic Motor Adaptation (AMA)*. If *parameter P5.4.3 Motor Control Principle* is set as *[0] U/f*, no need to execute AMA.

3.2.4.2 Understanding Readout Screens

When the drive is in ready state, the control panel display shows the *Home* screen in the main display. By default, as a factory setting, the *Home* screen shows the reference setting in local mode, as shown in the figure below.

Figure 3: Home Screen

Press the *Up/Down* buttons of the control panel to toggle between the readout items.

Readouts in Local mode: The following readouts can be accessed from the control panel status menu in *Local* mode.

- Reference Setting (Hz)

- Output Frequency (Hz)

- Motor Current (A)

- Torque (Nm)

- Udc Voltage (V)

- Power (kW)

- Customer Readout (Unit)[1]

Readouts in Remote mode: The following readouts cab be accessed from the control panel status menu in *Remote* mode.

- Output Frequency (Hz)

- Motor Current (A)

- Torque (Nm)

- Udc Voltage (V)

- Power (kW)

- Reference (%)

- Customer Readout (Unit)[1]

- Feedback (Unit)[1]

3.2.4.3 Menu Group Screen and Navigation

3.2.4.3.1 Overview of Menu Group Screen and Navigation

Press the *Home/Menu* button to toggle between readout screens and the parameter group screen.

The Menu consists of the following:

- **Quick Access:** A startup wizard to easy configuration of motor settings and starting the motor. Use quick access to set up motor data, application selection setups, and motor control settings in a step-by-step method.

- **All Parameters:** To view all the parameters in the iC2-Micro Frequency Converters.

- **Events Information:** To view all active and history events, such as faults, in the iC2-Micro Frequency Converters.
Press the *Up/Down* buttons of the control panel to select the menu functions, as shown in Figure 4.

| Quick Access | All Parameters | Events Information | e30bj955.11 |

Figure 4: Menu Functions

3.2.4.3.2 Quick Access Navigation

Quick Access consists of the following 3 functions for easily setting up the iC2-Micro Frequency Converters step by step.

- **q1 - Motor Data Setting:** Enables to first select motor type, followed by motor data entry based on the motor nameplate.

NOTICE
After completing the motor data settings, it is recommended to execute Automatic Motor Adaptation (AMA), if *P 5.4.3 Motor Control Principle* is set as *[1] VVC+*.

See the AMA procedure in 5.4.5 Automatic Motor Adaptation (AMA).

- **q2 - Application Selection:** Enables to select typical application configurations. The application selections are pre-configured parameter settings. 5 preset common applications are supported in iC2-Micro frequency converter, which are:

  o Speed control mode

  o Process control mode

---

1) *The status is only shown when the corresponding function is enabled.*

- o Multi-speed control mode

- o 3-wire control mode

- o Torque control mode

For more information, see 5.5.1 Application Selection Overview.

NOTICE
To optimize application configuration, configure essential changes to the parameter based on the required application selection.

- **q3 - Motor Control Setting:** Enables setting of the motor control data which influence motor operation performance, such as ramp-up time and ramp-down time, reference limit, and so on.

The following figure shows the setting procedure when using Quick Access to start the motor.
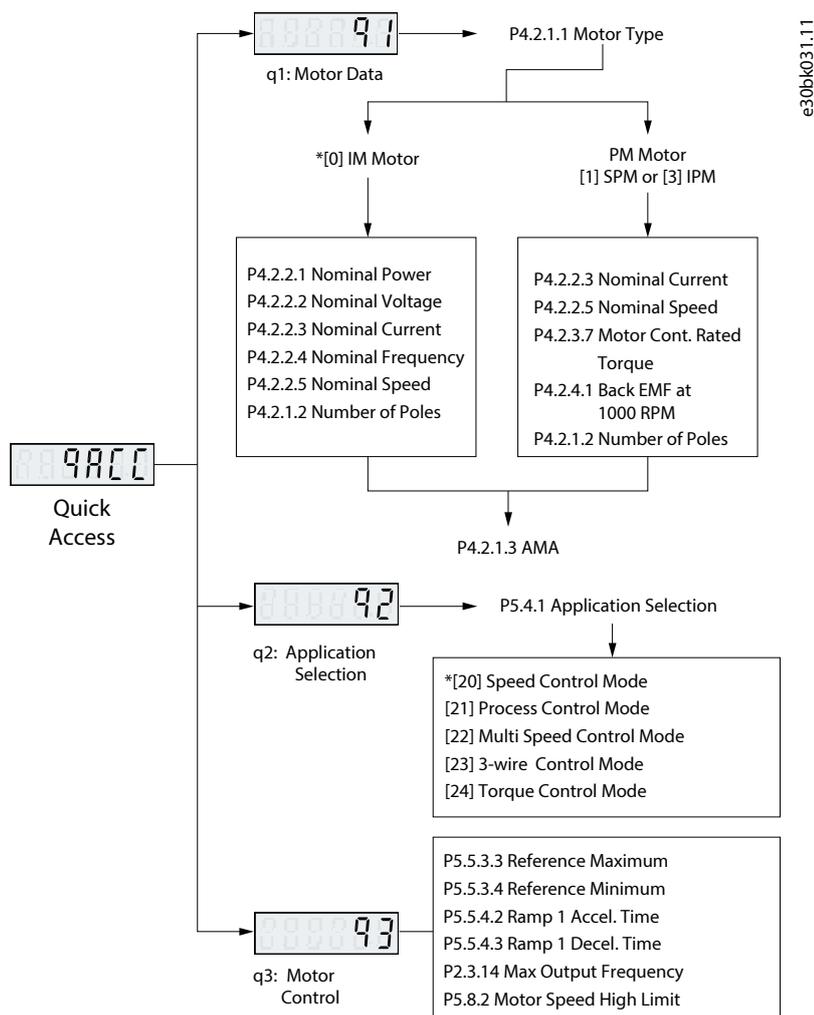
Figure 5: Quick Access Functions

3.2.4.3.3 Parameter Group Screen and Navigation

Overview

Press the *Up/Down* buttons to select the *All Parameters* menu. See overview of full parameters in 3.2.4.3.1 Overview of Menu Group Screen and Navigation. Press *OK* to enter the submenus.

To navigate through and within the different parameter groups, use the navigation buttons of the control panel.

- Use the *Up/Down* buttons of the control panel to navigate to different parameter groups.

- The *Back* button is used to navigate to a level higher, and the *OK* button to a level lower in the parameter/parameter group screens. Figure 6 shows how to navigate to a parameter. The example considered is *P 2.3.1 Overvoltage Controller Enable*.
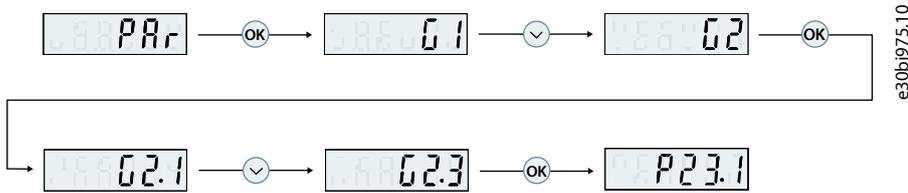
Figure 6: Parameter Navigation

Changing Selections in a Parameter

In this example, the *P 5.5.4.1 Ramp 1 Type Selector* is considered.

Figure 7 shows an overview of the relevant screens when changing the selections in a parameter.
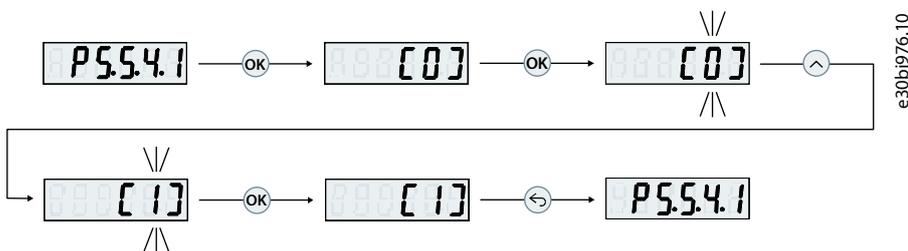
Figure 7: Changing Selections in a Parameter

1. Press the *Up/Down* buttons to go to the parameter.

2. Press *OK* to view the current selection setting.

3. Press *OK* to modify selection.

   ⟳ The selection numbers begin to flash.

4. Use the *Up/Down* buttons to browse through the selection numbers.

5. Press *OK* at the required selection number.

   ⟳ The flash stops.

Changing Parameter Value

In this example, the *P 5.5.4.2 Ramp 1 Accel. Time* is considered.

Figure 8 shows an overview of the relevant screens when changing the value of a parameter.
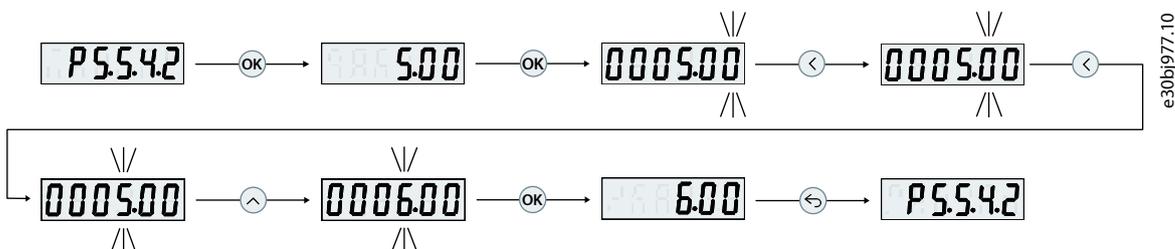
Figure 8: Changing Parameter Value

1. Press the *Up/Down* buttons to go to the parameter.

2. Press *OK* to view the current parameter value.

3. Press *OK* again to change the value of parameter.

> The last bit of the value flashes and shows the location of the cursor.

4. To move the cursor to the left, use the left arrow button of the control panel.

> The flashing indicates the active location of the cursor, at the digit.

5. Press the *Up/Down* buttons of the control panel to increase or decrease the value of the digit where the cursor is active.

6. Press *OK* button to confirm the changes.

3.2.4.4 Restoring Default Settings

3.2.4.4.1 Overview

Restoring the default parameter settings is done by initialization of the drive. Initialization is carried out via *P 6.6.8 Operation Mode* (recommended) or manually.

Recommended initialization via *P 6.6.8 Operation Mode* does not reset the following settings:

- Operating hours.
- Serial communication selections.
- Fault log.
- Other monitoring functions.
- *P 1.2.1 Regional Settings*.
- *P 4.4.1.4 Clockwise Direction*.

Manual initialization erases all data related to motor, programming, localization, monitoring, and restores factory default settings. Manual initialization does not reset the following information:

- *P 1.2.1 Regional Settings*.
- *P 4.4.1.4 Clockwise Direction*.
- *P 6.1.2 Operating hours*.
- *P 6.1.5 Power Up Times*.
- *P 6.1.6 Over Temp Times*.
- *P 6.1.7 Over Volt Times*.

3.2.4.4.2 Recommended Initialization (via parameters)

1. Select *P 6.6.8 Operation Mode* and press *OK*.

2. Select *[2] Initialisation* 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. *Fault 80, Drive initialised* to default value is shown.

6. Press *Stop/Reset* to return to operating mode.

3.2.4.4.3 Manual Initialization

1. Remove power to the unit and wait until the display turns off.

2. Press and hold the *Home/Menu* and *OK* buttons at the same time, while applying power to the unit.

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

3.2.5 **Control Panel 2.0 OP2 Buttons and Indicators**
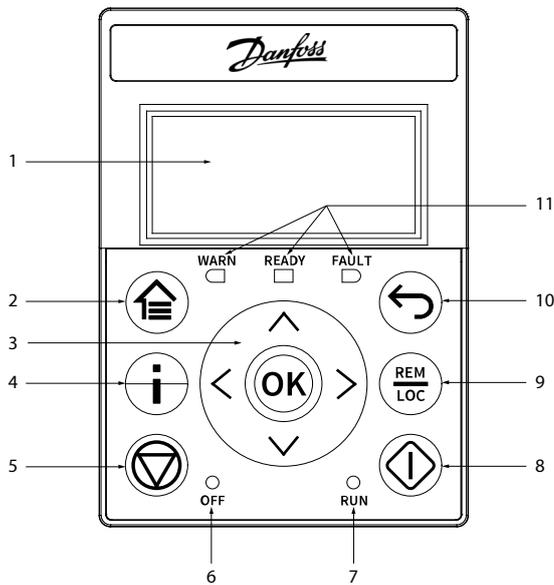
Figure 9: Control Panel 2.0 OP2 Overview

Table 7: Control Panel Elements Description

Legend	Name of element	Description
1	Display	Provides access to content and settings. The display provides detailed information about the status of the drive.
2	Home/Menu	• Toggles between status view and main menu. • Long press to access the shortcut menu for quickly reading and editing parameters.
3	Arrows and OK	• **Arrows**: Navigate within the different screens and menus, and tune the parameter values. • **[OK]**: Confirms selections and data in the control panel display.
4	Info	Provides drive information by pressing the *Info* button from the home screen, for example, the drive type, ordered model code, drive serial number, application version.
5	Stop/Reset	Stops the operation of the drive.

6	OFF LED	The indicator has the following states:
		• **Steady on:** The indicator is in this state when:
		  ◆ The drive is not modulating and the drive is coasted.
		  ◆ The stop or coast signal is applied. Ramp times, protections, and stopping functions might prolong this state.
		• **Off:** The drive is in operation, a start signal is applied, and the output is active. This also includes ramping, running on reference, and AMA.

7	RUN LED	The indicator has the following states:
		• **On:** The drive is in normal operation.
		• **Off:** The drive has stopped.
		• **Flash:** The indicator is in this state when:
		  ◆ In the motor-stopping process (ramp down).
		  ◆ The drive received a *RUN* command, but no frequency output.

8	Run	Starts the operation of the drive.
9	REM/LOC	Toggles the drive between remote and local operation.

Table 7: Control Panel Elements Description - (continued)

Legend	Name of element	Description
10	Back	Navigates to the previously viewed screen or a menu level above the current menu.
11	Drive Status Indicators	The related LEDs indicate the status of the drive. • **[WARN]**: A steady yellow light indicates a warning. • **[READY]**: A steady green light indicates that the drive is ready. • **[FAULT]**: A flashing red light indicates a fault.

3.2.6 Control Panel 2.0 OP2 Basic Configurations

3.2.6.1 Overview

Basic configurations of the control panel include:

• Readout status of the motor and the drive which includes warnings and faults.

• Navigate to the menus in order to view or change parameter settings for the drive.

3.2.6.2 Understanding Readout Screens

When the drive is in ready state, the control panel 2.0 OP2 display shows the *Home screen*. By default, as a factory setting, the *Home screen* is shown as follows.

Figure 10: Home Screen

1	• The front number indicates active setup.[1] • The number in brackets indicates the programming setup.[2]	2	• On *Readout Screens*, the value with unit after the setpoint icon is the reference setting data. • On *Menu Screens*, the value with unit (no setpoint icon) is the output data.
3	**Direction icon**: indicates the direction of motor rotation.	4	**LOC/REM**: indicates local or remote control mode. • LOC: local control mode. • REM: remote control mode.
5	**Middle value**: indicates the readouts value.	6	**Readout type**

1) Select active setup in parameter P 6.6.1 Active Setup.

2) Select programming setup in parameter P 6.6.2 Programming Setup.

**Readout type selection**

Press the *Up* or *Down* arrow button on the Control Panel 2.0 OP2 when in the *Readout Screen*. The control panel screen navigates to the readout items in order. See 3.2.4.2 Understanding Readout Screens.

Reference setting in local mode

In local mode, press the *OK* button on *Readout Screen* to enter the reference setting. The reference value is valid immediately via pressing *Up*, *Down*, or *Left* arrow buttons for setting.
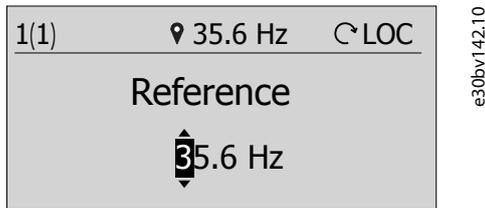
Figure 11: Setting the Reference Value

3.2.6.3 Menu Screen and Navigation

Use the *Home/Menu* button to toggle between *Readout Screen* and *Menu Screen*.
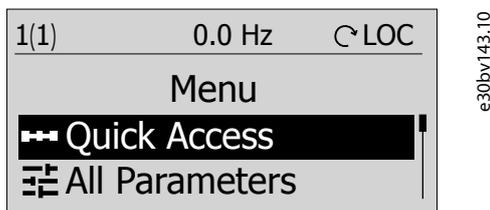
Figure 12: Menu Screen

The main *Menu* includes different functions which are shown in Table 8.

Table 8: Menu Screen

Menu	Function
Quick Access	Quick access for setting up a drive quickly. See 3.2.4.3.2 Quick Access Navigation.
All Parameters	View and set the parameters.
Events	Event list (including fault and warning that has occurred in the drive).
Display Setting	Set language and adjust the display backlight.
Backup & Restore	Backup and restore the drive information.

Basic navigation handling techniques

- To navigate through and within the different functionalities or parameter groups, use the navigation buttons of the Control Panel 2.0 OP2.

- Use the *Back* button to navigate to a higher level, and the *OK* button to navigate to a lower level.

3.2.6.4 Parameter Group Screens and Overall Navigation

The *All Parameters* menu includes all parameters for configuration. A typical parameter group screen is shown as below.
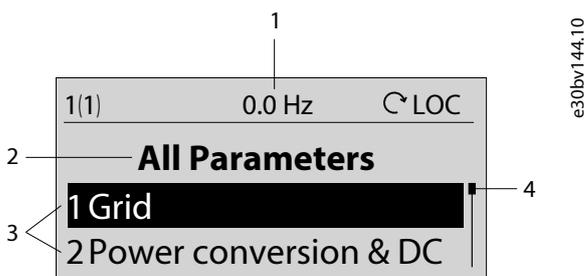
Figure 13: Parameter Group Screen

The following information is contained in the parameter group screen:

Table 9: Legend Table

Legend	Description
1	Control state of the drive. The value in the middle without setpoint icon shows the output frequency.
2	Name of the menu, group, and parameter that is currently active in the drive.
3	Group, sub-group, or parameter list.
4	Scrollbar

3.2.6.5 Changing Selections in a Parameter

In this example, the parameter *P 5.5.4.1 Ramp 1 Type Selector* is considered. When a parameter has selections, a black highlight is active on the parameter index and name, as shown.
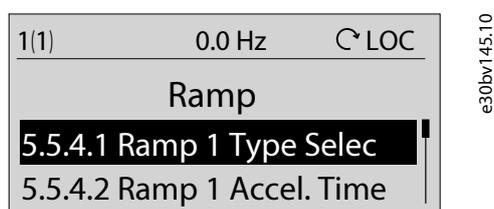
Figure 14: Changing Selections in a Parameter

1. To view the selections of the parameter, press the *OK* button. The selections available for the parameter are shown. A tick icon in the front of the selection indicates the selected choice.
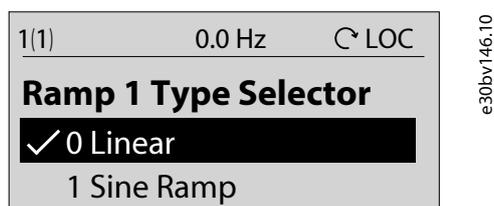
Figure 15: Selections in a Parameter (Example)

2. Use the *Up* or *Down* arrow button to browse through the selections.
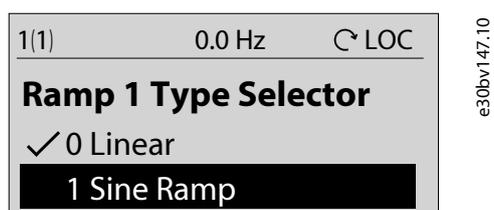
Figure 16: Browsing through the Selections (Example)

3. Press the *OK* button at the required selection. The tick icon is moved to this selection.
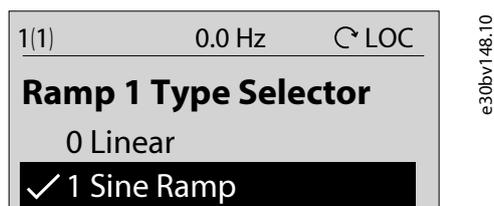
Figure 17: Confirming the Selections (Example)

3.2.6.6 **Changing Parameter Value**

In the example, parameter *P 5.5.4.2 Ramp 1 Accel. Time* is considered and Figure 18 shows the change of value from 3 s to 5 s.

1. Go to the parameter *P 5.5.4.2 Ramp 1 Accel. Time* and press the *OK* button.

2. Press the *OK* button again to enter value edit screen. To go to the values before or after the decimals, use the *Left* or *Right* arrow button. A black highlight on the digit indicates the location where the cursor is active.

3. Use the *Up* or *Down* arrow button of the Control Panel 2.0 OP2 to increase or decrease the value.

4. Press the *OK* button to confirm the changes.

Figure 18 shows all the screens relevant to change the value of a parameter.
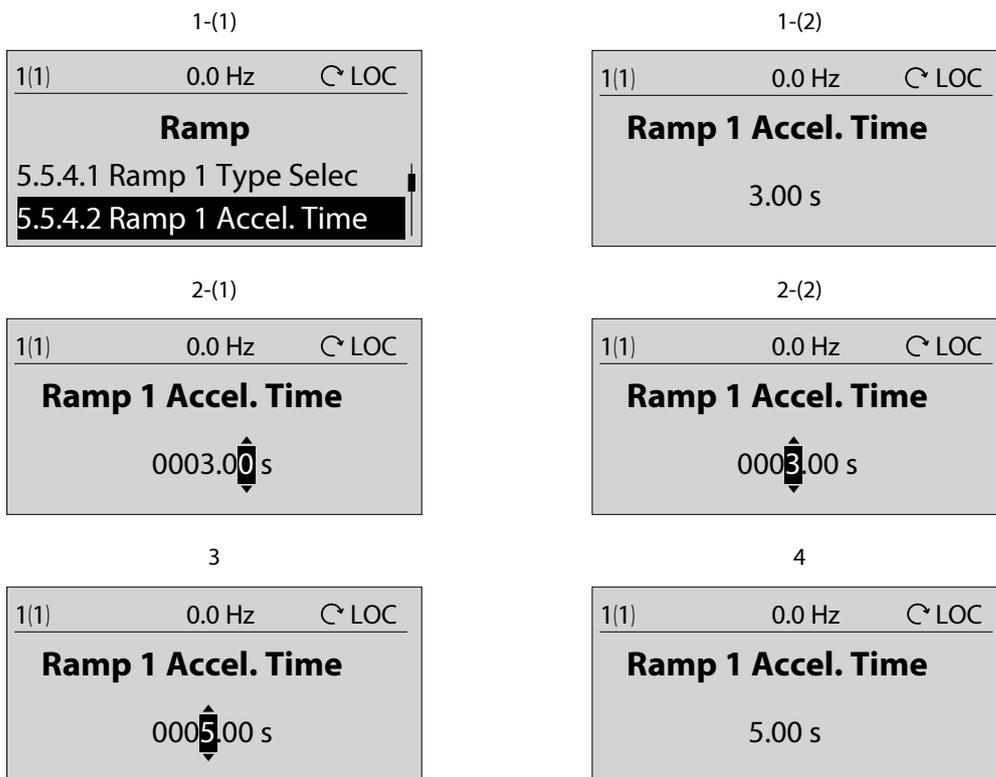
Figure 18: Changing Value in a Parameter

3.3 **MyDrive® Insight**

3.3.1 **Overview of MyDrive® Insight**

MyDrive® Insight is a platform-independent software tool that supports the commissioning, engineering, and monitoring of iC2-Micro Frequency Converters. Some of the key features include:

- Fast and easy configuration and commissioning.

- Monitor the drives as part of daily operations.

- Collect data and information for troubleshooting, maintenance, and service.

- Discovery of and access to multiple drives in a network.

- Intuitive user interface.

- Notifications and visualizations on real-time information and events about the drive.

- PC control to perform operations such as starting or stopping the drive, set references, set direction, reset, and coast of the drive.

- Perform updates on single drives.

- Backup and restore of parameter settings.
- Data logging and analyzing for troubleshooting.

NOTICE
The section is documented for MyDrive® Insight version 2.13.0 or above. Make sure to uninstall lower versions of MyDrive® Insight from your device to use the latest MyDrive® Insight functions.

NOTICE
The section MyDrive® Insight in the application guide covers basic information such as getting started with MyDrive® Insight, accessing, and viewing or changing the parameters, and PC control to operate the drive using MyDrive® Insight. For further information on the different MyDrive® screens, integrated help within MyDrive® Insight will be available in future releases.

3.3.2 Getting Started with MyDrive® Insight

As a prerequisite, ensure that MyDrive® Insight is installed on the device (PC or laptop). Download and install MyDrive® Insight from MyDrive® Suite available at https://suite.mydrive.danfoss.com/.

1. To establish a point-to-point connection between the drive and the device, use either of the following 2 methods:

   – Connect signal wires to RS-485 terminals as described on the backside of the cover plate. A conventional adapter can be used for connecting to device USB port.

   – Use the RJ45 port on the drive by using an accessory adapter and cable to connect the drive with the device USB port.

NOTICE
Via the 1st connection method, full functionalities from MyDrive® Insight are supported, including firmware upgrading and PC control for operations.

NOTICE
Via the 2nd connection method, only limited functionalities are available, for example, parameter configuration, parameter/ project backup and restore, commissioning, monitoring, and diagnosing.
• For the 2nd connection method, use the fixed baud rate 115200 and address 1.

2. After powering up the drive, and when the drive is in *Ready* state, open MyDrive® Insight on the device.

3. Click the *Direct Connect* icon, as shown.
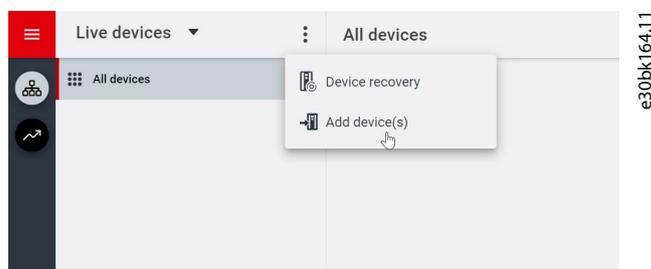
Figure 19: Establish Connection

4. Set the connection type to *Serial* and select the serial port that the drive was connected to. Use the correct baud rate and address that are set on the drive.
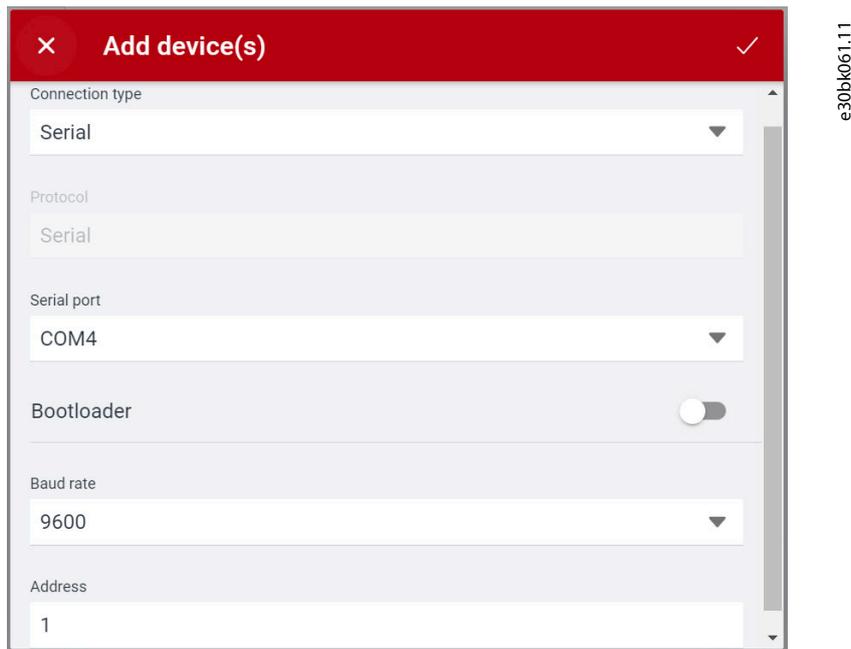
Figure 20: Serial Connection

> Once the connection is established, the *Device Info view* is shown.

3.3.3 Accessing Parameters and Understanding Parameter Screens in MyDrive® Insight

Accessing parameters

1. To access the parameters of the connected drive, click *Setup & Service*. This opens the menus related to *Setup & Service*.

2. Click *Parameters → Live*, as shown.
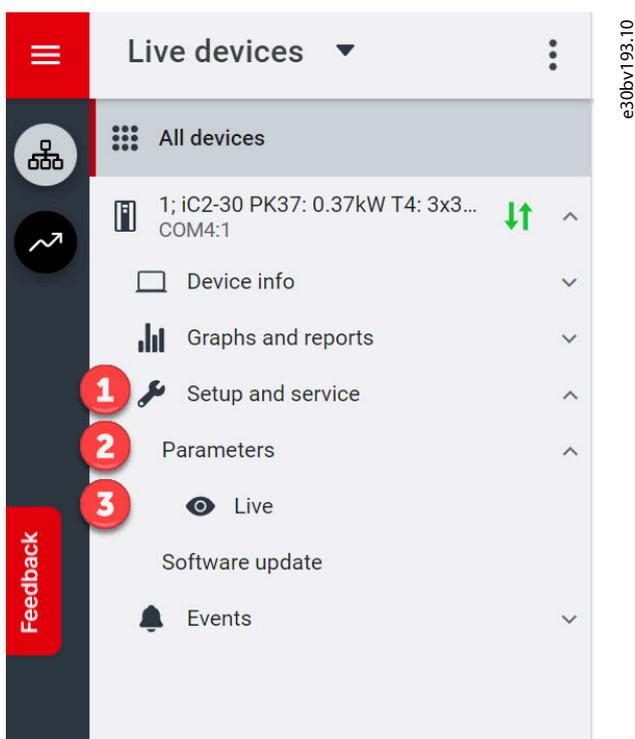
Figure 21: Setup & Service

Parameter screen overview

Following is an overview of the *Parameter (Live)* screen in MyDrive® Insight, which describes the *Parameter* screen.
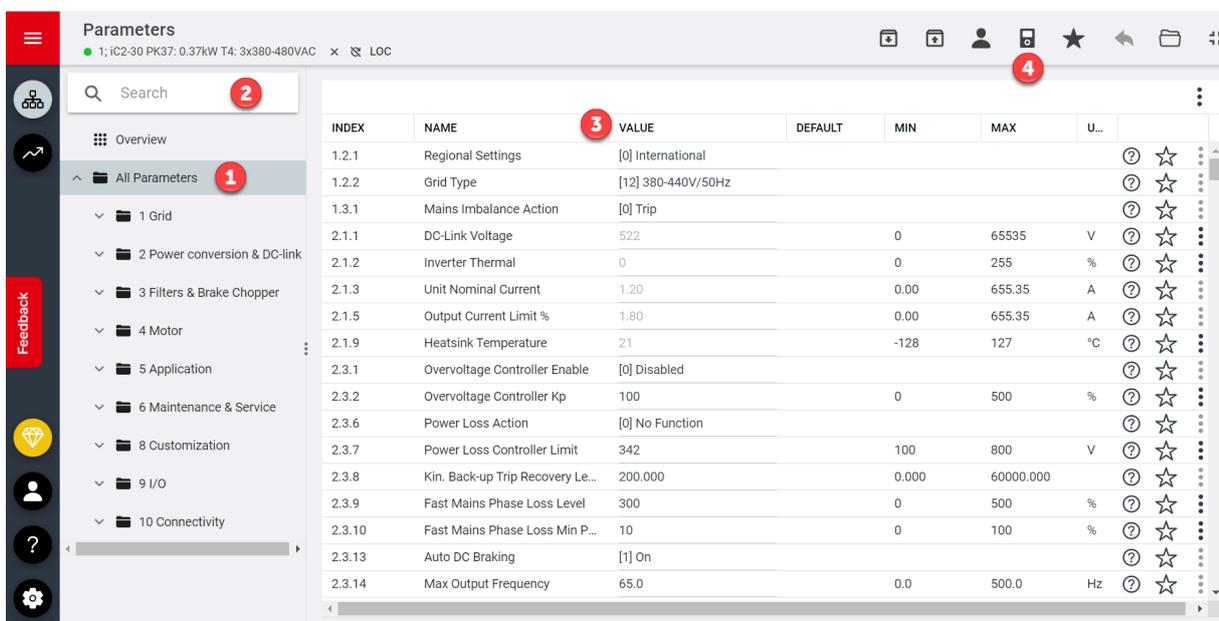
Figure 22: Parameter Screen

Table 10: Legend Table

Legend	Name	Description
1	Parameter group	Navigate through the different parameter groups in the drive.
2	Search button	To find a specific parameter.
3	Value field	View and change a parameter value or selection. On the Live screen, all the parameters for the drive are shown in MyDrive® Insight.
4	PC control button	Switch to PC control to start or stop the drive, using MyDrive® Insight.

Navigate through different parameter groups

In this example, *parameter group 4 Motor* is considered, as shown.
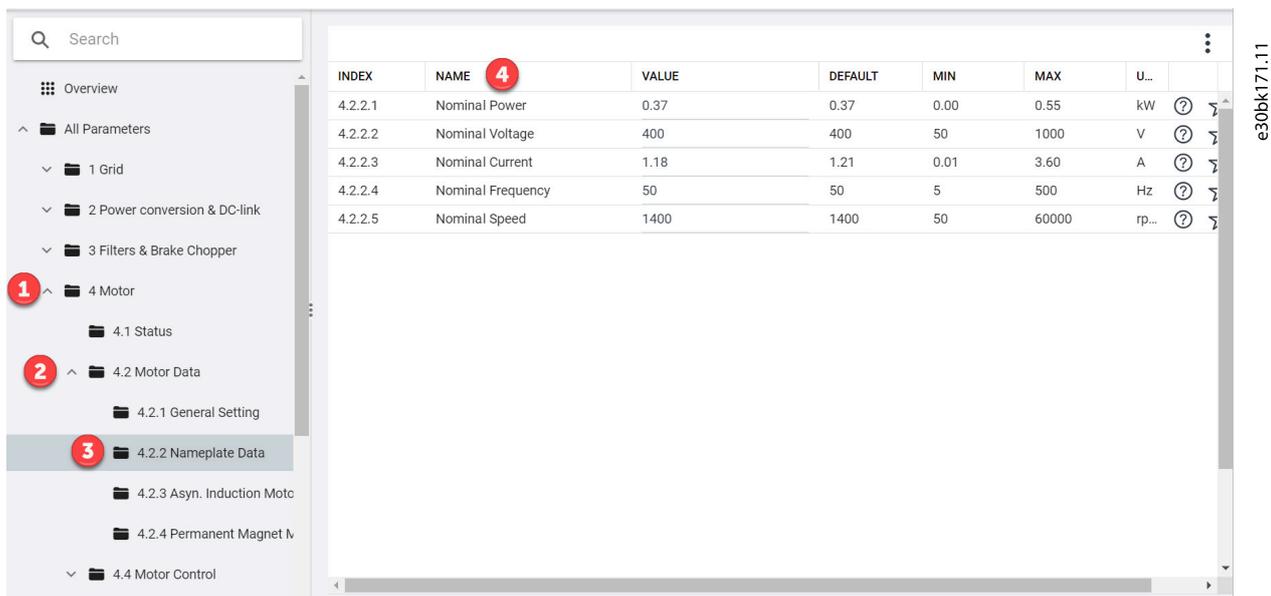
Figure 23: Navigating to a Parameter Group

1. Click the parameter group from *All Parameters* screen.

2. Click the parameter subgroup.

3. Repeat step 2, until the right level of the parameter subgroup is reached to find the specific parameters (4).

NOTICE
When in a specific parameter subgroup, only parameters relevant to the parameter subgroup can be accessed.

Searching for a specific parameter

1. In the *Search* field, type the required keyword. A keyword can be the name of a parameter group, a parameter subgroup, or a specific parameter name or parameter number.

In the example, motor control is considered. The parameter group and the specific parameter can be accessed from the search results.
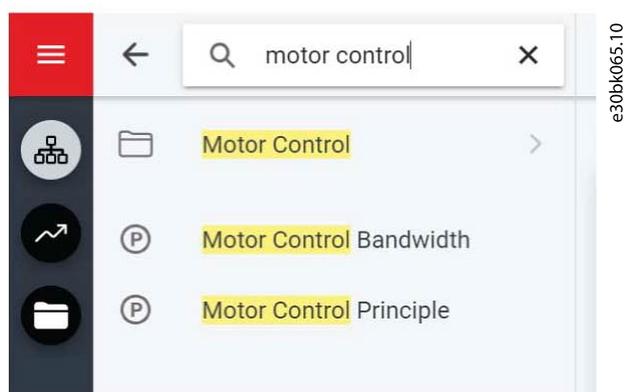
Figure 24: Search Button

3.3.4 Viewing and Changing Parameter Settings

When in a specific parameter group, all parameters related to the parameter group are shown. Depending on the access type of the parameter, there is a possibility to view the parameter setting or change the current selection or value of the parameter.

In the example, parameter group *4 Motor* is considered, as shown.

Figure 25: Parameter Overview

Table 11: Legend Table

Number	Field Name	Description
1	*Index*	Based on the parameter group structure, the index defines the location of the parameter. The index is not used as a unique identifier of a parameter.
2	*Name*	Name of the parameter.
3	Parameter status or value	Provides the current status or value of a parameter. The parameter which is shown in a light gray color cannot be changed.
4	Selection parameters	To see all selections available for the parameter, click the value in the *Value* field.
5	*Default*	The factory setting (default value) of the parameter.

Table 11: Legend Table - (continued)

Number	Field Name	Description
6	Range of parame-ters	The parameter value can be modified based on the ranges defined (maximum and minimum values).
7	*Unit*	When applicable, the user unit of the parameter is shown in the *Unit* field.
8	*Number*	Parameter number (PUN) is the unique identifier of a parameter for modbus registers. See 6.1.6.2.8 Parameter Number (PNU).
9	Help	Click the *?* button to see description about the parameter. For more detailed descriptions, see 7.1 Reading the Parameter Table.
10	Favorite	To add parameters to *Favorites*, click the button.
11	Edit and reset columns	Use the 3 dots icon to select the required column types or reset all columns. The columns sequence could be changed with click, hold, and drag.

3.3.5 PC Control to Operate the Drive using MyDrive® Insight

To operate the drive using PC control, click the control panel button in MyDrive® Insight. Figure 26 shows the different screens to operate the drive via MyDrive® Insight.
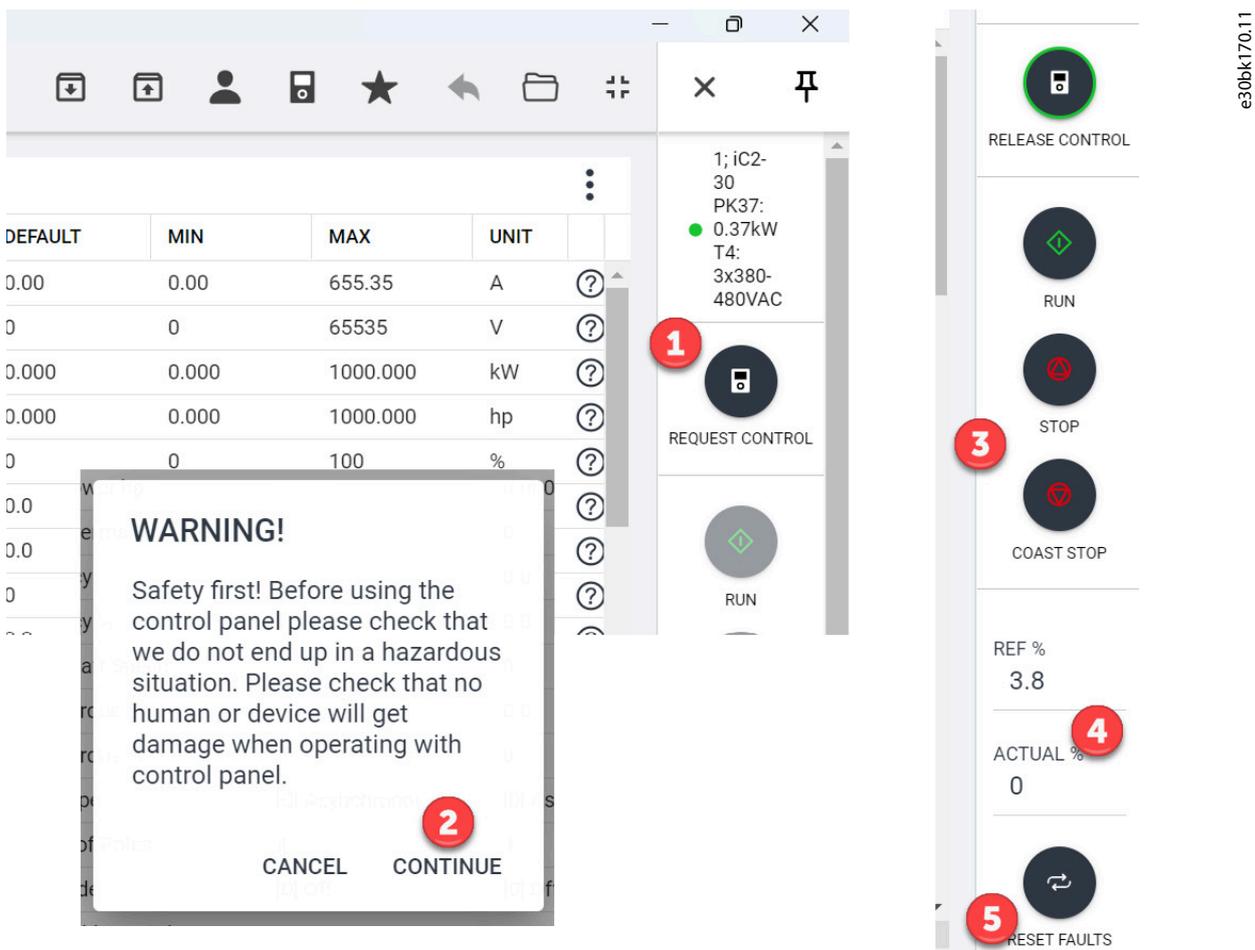
Figure 26: Operate Drive using MyDrive® Insight

To access PC Control in MyDrive® Insight and operate the drive, perform the following:

1. Click the *REQUEST CONTROL* button.

2. Click *Continue*, to confirm secure operation conditions, while controlling the drive using MyDrive® Insight.

3. Use the *START*, *STOP*, *STOP COAST* buttons to perform a drive operation.

4. Increase or decrease the reference speed.

5. In case of a fault event, click *RESET FAULTS* to reset a drive.

3.3.6 Backing Up the Drive

1. To back up the drive, select a drive, go to *Setup & Services → Parameters*.

   ⟳ The *Parameters Live* screen appears.

2. Click the icon as shown in the figure.
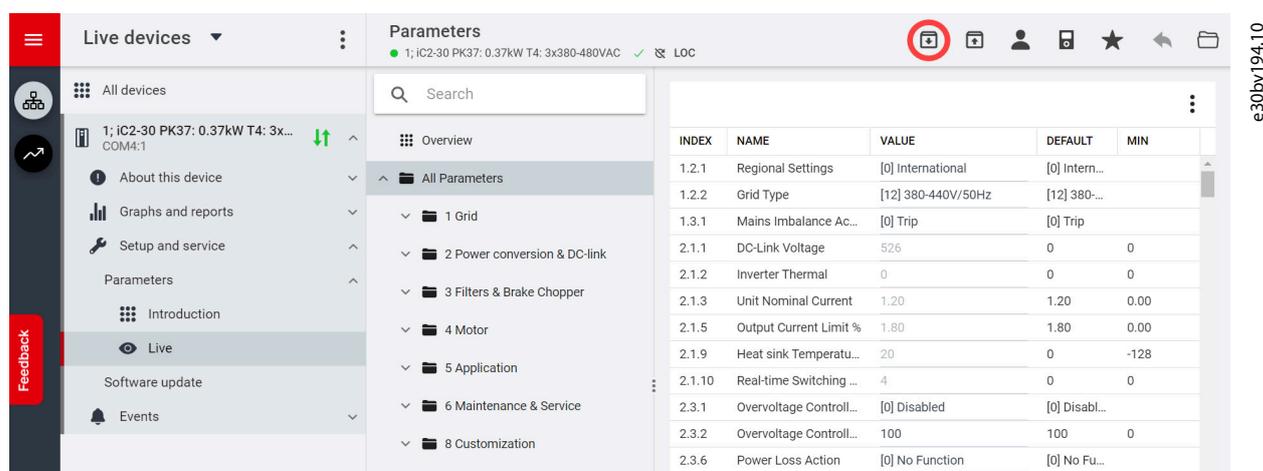
Figure 27: Backup Destination Icon

⟳ This opens a screen to select the backup destination. The destinations for backup are:

   o **Project:** Backup an existing project or a new project.
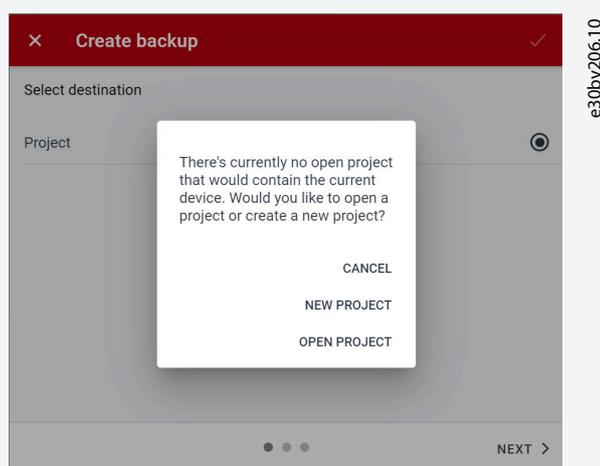
Figure 28: Backup Destination

3. Click *Next*. Using the screen, it is possible to specify a name for the backup file.

4. Click *Backup* to begin backup.

Once backup is completed, a screen appears with a notification. If a project backup is created, the backup is shown in the device menu under *Parameters*.
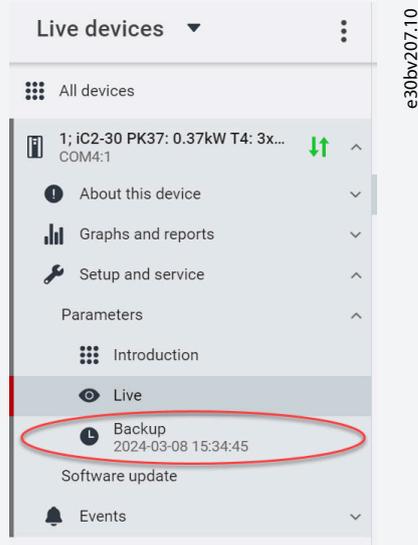
Figure 29: Backup File in the Menu

3.3.7 Restoring the Data to the Drive

1. To restore data to the drive, select a drive, go to *Setup & Service→Parameters*.

2. Click the icon as shown in the image below.
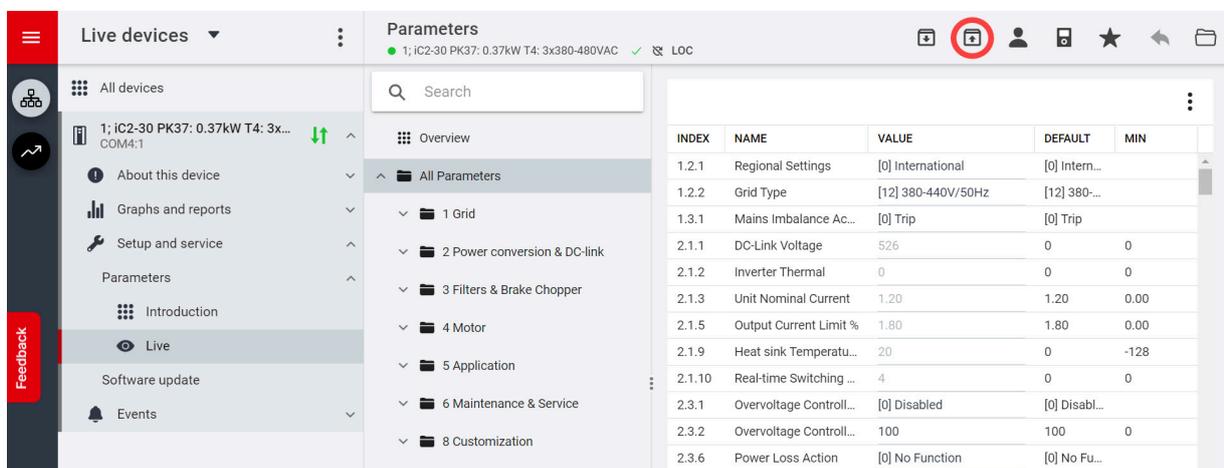
Figure 30: Restore Data Icon

3. Select the source project of the data which has to be restored to the drive.
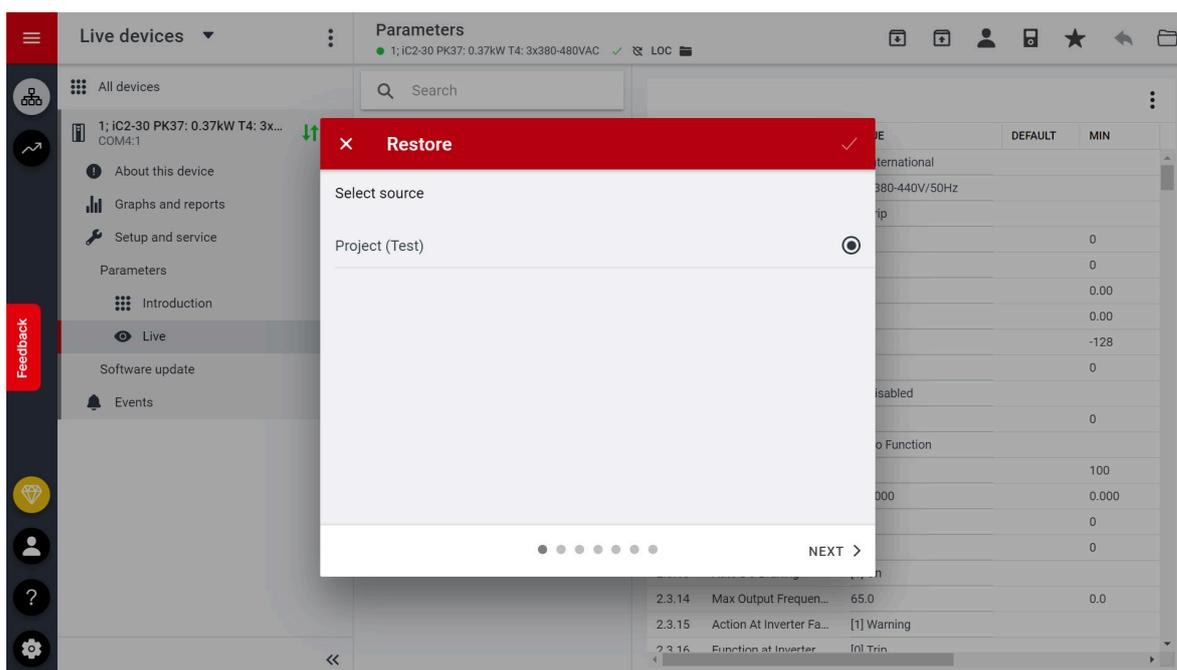
Figure 31: Source of Data for Restore

4. Click *Next*, and select a backup source drive.

5. Click *Next* and select a backup.

6. Select the content for restoring data into the drive, and click *Next*.

On successful restore of data, a message is shown.
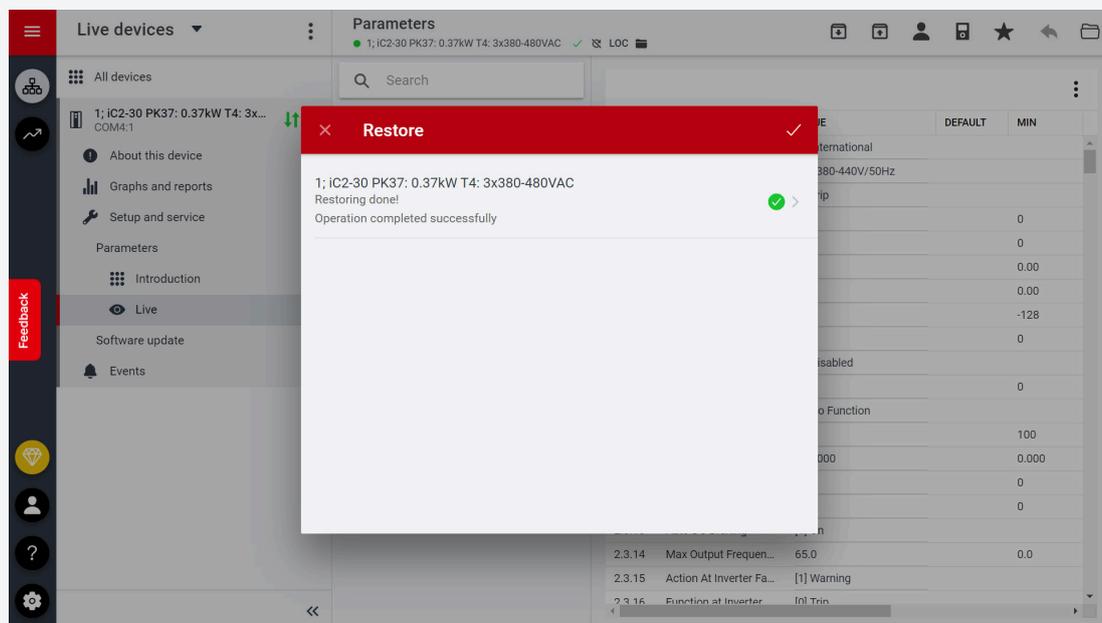
Figure 32: Restoring Done

4 Application Software Structure and Overview

4.1 Understanding Application Software Structure

The basic design principle of the application software structure and the related hierarchy refers to the setup of a typical iC2-Micro drive, as shown in the Figure 33.
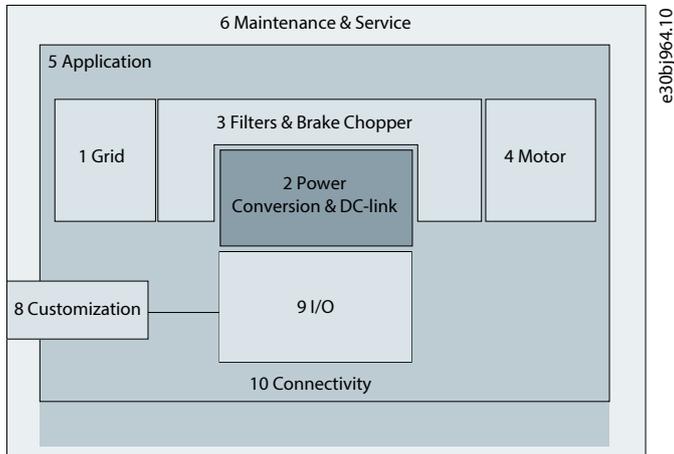
Figure 33: Application Menu Overview

4.2 Parameter Groups, Related Content, and Settings

- All generic settings such as Grid, Power Conversion and DC-link, Filters & Brake Chopper, and Motor are accessed via parameter groups (menu indexes) 1–4.

- Most of the application-specific parameters are accessed via parameter groups (menu index) 5 Application.

- Features and functions related to the application such as Maintenance & Service and Customization are in parameter groups (menu indexes) 6 and 8 respectively.

- The basic setup for external control signals and communication interfaces is done in parameter groups (menu indexes) 9 and 10 respectively.

- Features and related parameters are grouped in individual parameter groups. Each feature has a parameter group of its own.

- Status information for each parameter group is available separately for easy access.

The following table provides information about the parameter groups.

Menu index/Parameter group	Parameter group name	Description
1	Grid	Contains parameters for configuring, monitoring, and controlling the energy source of the drive system. Typically, the energy source is the grid. The menu also allows to configure grid protection settings and view the condition of the grid.
2	Power Conversion	Contains parameters to configure, monitor, and control the power conversion of the drive. The menu allows to configure protection settings of the power unit and settings for the rectifier, DC link, and inverter.
3	Filters & Brake Chopper	Contains parameters to configure, monitor, and control the filters, brake chopper, and brake resistors.
4	Motor	Contains parameters to configure motor, motor control, and motor protection.

Menu index/Parameter group	Parameter group name	Description
5	Application	Contains parameters for application-specific features such as process control, speed control, torque control, mechanical brake control, and many more.
6	Maintenance & Service	Contains parameters exclusively related to status, events, and service features.
8	Customization	Contains parameters to customize readouts.
9	I/O	Contains parameters to configure digital or analog I/O.
10	Connectivity	Parameters to configure the communication of the drive system.

Parameter group 1st level	Parameter group 2nd level
1 Grid	1.2 Grid Settings
	1.3 Grid Protection
2 Power Conversion & DC-link	2.1 Status
	2.3 Protection
	2.4 Modulation
	2.5 DC-Link Control
	2.7 Output Current Limit
3 Filters & Brake Chopper	3.1 Status
	3.2 Brake Chopper
	3.3 Brake Resistor

Parameter group 1st level	Parameter group 2nd level
4 Motor	4.1 Status
	4.2 Motor Data
	4.4 Motor Control
	4.6 Protection

Parameter group 1st level	Parameter group 2nd level
5 Application	5.1 Status
	5.2 Protection
	5.4 Operation Mode
	5.5 Control
	5.6 Start Settings
	5.7 Stop Settings
	5.8 Speed Control
	5.9 Inching
	5.10 Torque Control
	5.11 Mechanical Brake Control
	5.12 Process Control
	5.13 Digital Potentiometer
	5.27 Fieldbus Process Data

Parameter group 1st level	Parameter group 2nd level
6 Maintenance & Service	6.1 Status
	6.2 Software Information
	6.5 Cooling Fan
	6.6 Parameter Handling
	6.7 Drive Identification
8 Customization	8.1 Custom Readout
	8.4 Smart Logic Controller
9 I/O	9.3 I/O Status
	9.4 Digital Inputs/ Outputs
	9.5 Analog Inputs/ Outputs
10 Connectivity	10.1 FC Port Settings
	10.2 FC Port Diagnostics

e30bj943.12

Figure 34: Parameter Groups

5 Configuration Setup Examples

5.1 Introduction & Prerequisite

The section covers the basic configuration steps of a drive. Use the following topics as reference during the drive configuration/commissioning process:

- For control panel related information, see 3.2.4.1 Overview of Control Panel Basic Configuration.

- For information on using MyDrive® Insight, see 3.3.1 Overview of MyDrive® Insight.

- Detailed information about the parameters is described in *Chapter Parameter Descriptions*.

A typical wiring diagram for iC2-Micro Frequency Converters is shown.
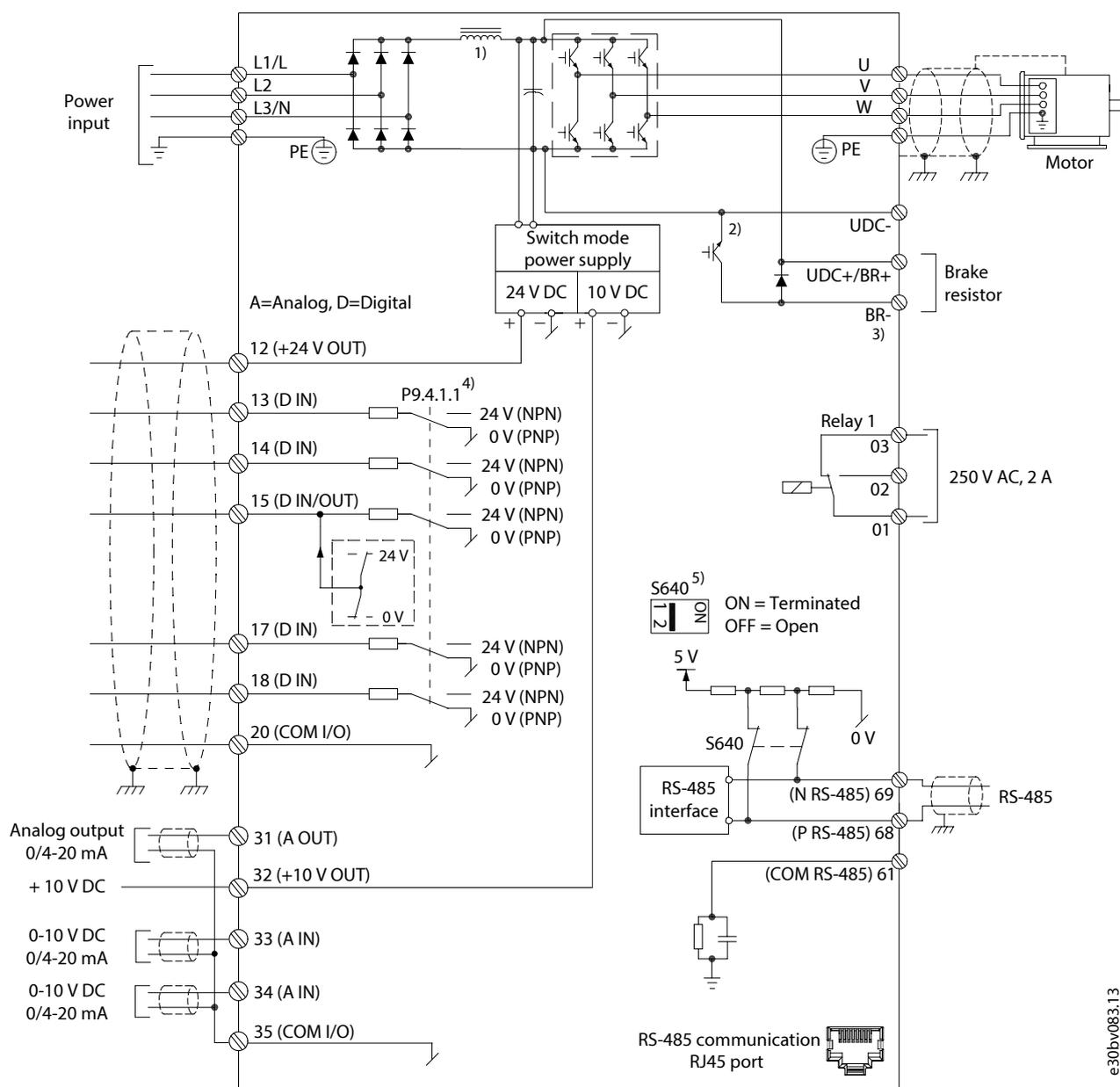
Figure 35: Wiring Diagram

1	Single DC choke in MA05a.
2	Built-in brake chopper is only applicable to drives in the power range of 3x380–480 V 2.2 kW (3.0 hp) and above, and 3x200–240 V 1.5 kW (2 hp) and above.
3	No BR terminals for 1x100–120 V, 1x200–240 V, 3x200–240 V 0.37–0.75 kW (0.5–1.0 hp), and 3x380-480 V 0.37-1.5 kW (0.5–2.0 hp) drives.
4	Select the PNP or NPN mode via parameter *P 9.4.1.1 Digital I/O mode* (PNP=Source, NPN=Sink).
5	Use switch S640 (bus terminal) to enable termination on the RS-485 port (terminals 68 and 69).

5.2 Basic Setup of a Drive

The procedure covers the basic set-up of a drive.

Prerequisite:

- Ensure that the drive is mounted safely as described in the *iC2-Micro Frequency Converters Operating Guide*.

- To use MyDrive® Insight for configuration, install MyDrive® Insight from MyDrive® Suite app.

The basic setup of a drive consists of the following configuration steps.

1. Configuring the grid and power unit settings (grid type and voltage class).
2. Setting the operation mode.
3. Configuring the control place.
4. Configuring the field communication, if applicable.

The steps described in detail are as follows:

1. Configure the grid settings using the following parameter.

Parameter index	Parameter name	Example setting	Parameter number
1.2.2	*Grid Type*	*[12] 380-440V/50Hz*	6

2. Configure the operation mode using the following parameter.

Parameter index	Parameter name	Example setting	Parameter number
5.4.2	*Operation Mode*	*[0] Speed Open Loop*	100

3. Configure the control place settings using the following parameters.

Parameter index	Parameter name	Example setting	Parameter number
5.5.1.1	*Control Site*	*[0] Digital and Ctrl. Word*	801
5.5.1.2	*Control Source*	*[1] FC Port*	802
5.5.3.5	*Reference Function*	*[0] Sum*	304
5.5.3.6	*Reference Site*	*[0] Linked to Loc/Rem*	313
5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
5.5.3.8	*Reference 2 Source*	*[2] Analog Input 34*	316
5.5.3.9	*Reference 3 Source*	*[11] Local Bus Reference*	317
5.5.2.1	*Coasting Select*	*[3] Logic OR*	850
5.5.2.2	*Quick Stop Select*	*[3] Logic OR*	851
5.5.2.4	*Start Select*	*[3] Logic OR*	853

Parameter index	Parameter name	Example setting	Parameter number
5.5.2.5	*Reversing Select*	*[3] Logic OR*	854
9.4.1.2	*T13 Digital Input*	*[8] Start*	510
9.4.1.3	*T14 Digital Input*	*[10] Reversing*	511
9.4.1.4	*T15 Digital Input*	*[1] Reset*	512
9.4.1.5	*T17 Digital Input*	*[14] Jog*	513

5.3 Setting up the Drive using Quick Access via Control Panel

The following steps shows the quick access setup.

1. Power up the drive.

2. Press the *Home/Menu* button on the control panel for accessing the menu structure.

3. Select *QACC*, and enter **q1 Motor Data** to first select the motor type using *P 4.2.1.1 Motor Type*.

4. Set the value of motor data parameters, in sequence, based on the selected motor type.

5. Execute Automatic Motor Adaptation (AMA), if needed. See 5.4.5 Automatic Motor Adaptation (AMA).

6. Select application type in **q2 Application Selection** and wiring I/O terminals accordingly. For more information, see 5.5.1 Application Selection Overview.

7. Enter **q3 Motor Control** to configure reference limitations, output limitations, and ramp time.

8. Press *REM/LOC*, to set the drive in remote operation.

9. Start the drive by I/O terminals.

5.4 Motor Configuration

5.4.1 Motor Configuration Overview

The setup examples in this chapter describe motor configuration.

NOTICE
The parameters specified in motor configuration, cannot be adjusted when the motor is running.

The configuration setup contains menu index, parameter name, recommended parameter setting, and parameter number. The parameter number is a unique identification reference for the parameter. For detailed description on a parameter, refer *Chapter Parameter Descriptions*.

5.4.2 Asynchronous Motor Setup

1. For asynchronous motor setup, set the following parameters:

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.2.1	*Nominal Power*	As shown on nameplate.	120
4.2.2.2	*Nominal Voltage*	As shown on nameplate.	122
4.2.2.4	*Nominal Frequency*	As shown on nameplate.	123
4.2.2.3	*Nominal Current*	As shown on nameplate.	124
4.2.2.5	*Nominal Speed*	As shown on nameplate.	125

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

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.3.1	*Stator Resistance (Rs)*	As shown on motor datasheet.	130
4.2.3.2	*Rotor Resistance (Rr)*	As shown on motor datasheet.	131
4.2.3.4	*Stator Leakage Reactance Xls*	As shown on motor datasheet.	133
4.2.3.6	*Magnetizing Reactance Xm*	As shown on motor datasheet.	135

> VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance. See 5.4.5 Automatic Motor Adaptation (AMA).

5.4.3 PM Motor Setup in VVC+

Prerequisites

1. Set *P 4.2.1.1 Motor Type* to the following options to activate PM motor operation:

   ○ *[1] PM, Non-salient SPM* or *[3] PM, Salient IPM*.

2. Select *[0] Speed Open Loop* in *P 5.4.2 Operation Mode*.

Procedure

1. Set the following parameters using the motor nameplate and motor datasheet.

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.2.3	*Nominal Current*	As shown on the motor datasheet.	124
4.2.3.7	*Motor Cont. Rated Torque*	As shown on the motor datasheet.	126
4.2.2.5	*Nominal Speed*	As shown on the motor datasheet.	125
4.2.1.2	*Number of Poles*	As shown on the motor datasheet.	139
4.2.3.1	*Stator Resistance (Rs)*	Enter line-to-common stator winding resistance (Rs). If only line-to-line data is available, divide the line-to-line value by 2 to achieve the line-to-common (starpoint) 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.	130

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.4.3	*d-axis Inductance (Ld)*	Enter line-to-common direct axis inductance of the PM motor. If only line-to-line data is available, divide the line-to-line value by 2 to achieve the line-to-common (starpoint) 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.	137
4.2.4.1	*Back EMF at 1000 RPM*	Enter the line-to-line back EMF of the PM motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no frequency converter 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: For example, if the back EMF at 1800 RPM is 320 V, the back EMF at 1000 RPM is: Back EMF=(Voltage/RPM)x1000=(320/1800)x1000=178.	140

> VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance. See 5.4.5 Automatic Motor Adaptation (AMA).

2. To test motor operation, start the motor at low speed (100–200 RPM). If the motor does not turn, check installation, general parameter configurations, and motor data.

3. Perform parking operation by setting *P 5.6.14 Sync. Motor Parking Current %* and *P 5.6.13 Sync. Motor Parking Time*. The factory setting values of the parameters can be adjusted and increased for applications with high inertia. Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. The following table shows recommendations in different applications.

Table 12: Recommendations in Different Applications

Application	Settings
Low-inertia applications I_{Load}/I_{Motor}<5	• Increase the value for *P 4.4.4.10 Voltage filter time const*. by factor 5–10. • Reduce the value for *P 4.4.4.7 Damping Gain*. • Reduce the value (<100%) for *P 4.4.4.14 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 for *P 4.4.4.7 Damping Gain*, *P 4.4.4.9 Low Speed Filter Time Const.*, and *P 4.4.4.8 High Speed Filter Time Const*.
High load at low speed <30% (rated speed)	Increase the value for *P 4.4.4.10 Voltage filter time const*. Increase the value for *P 4.4.4.14 Min. Current at Low Speed* (>100% for longer time can overheat the motor).

If the motor starts oscillating at a certain speed, increase *P 4.4.4.7 Damping Gain*. Increase the value in small steps. Starting torque can be adjusted in *P 4.4.4.14 Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

5.4.4 Speed Control Configuration with I/O Using Default

1. Go to parameter group *5 Application* and specify the following:

Parameter index	Parameter name	Recommended settings	Parameter number
5.4.3	*Motor Control Principle*	Use default: *[1] VVC+*. In most situations, selecting VVC+ provides optimum performance without further adjustments.	101
5.4.2	*Operation Mode*	Use default: *[0] Speed Open Loop*	100
9.4.1.2	*T13 Digital Input*	Use default: *[8] Start*	510
9.4.1.3	*T14 Digital Input*	Use default: *[10] Reversing*	511
9.4.1.4	*T15 Digital Input*	Use default: *[1] Reset*	512
9.4.1.5	*T17 Digital Input*	Use default: *[14] Jog*	513
5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
9.5.1.2	*T31 Analog Output*	Use default: *[100] Output Frequency*	691
9.4.3.1	*Function Relay*	Use default: *[9] Fault*	540
5.5.3.3	*Reference Maximum*	Use default: 50	303
5.5.3.4	*Reference Minimum*	Use default: 0	302
5.5.4.2	*Ramp 1 Accel. Time*	Set the value according to the real application.	341
5.5.4.3	*Ramp 1. Decel. Time*	Set the value according to the real application.	342

5.4.5 Automatic Motor Adaptation (AMA)

• Via running AMA in VVC+ mode, the drive builds a mathematical model of the motor to optimize compatibility between drive and motor, and thus enhances the motor control performance.

• Some motors may be unable to run the complete version of the test. In that case, select *[2] Enable Reduced AMA* in parameter *P 4.2.1.3 AMA Mode*.

- The AMA completes within 5 minutes. For best results, run the following procedure on a cold motor.

Procedure

1. Set motor data according to the motor nameplate.

2. If needed, set motor cable length in parameter *P 4.2.1.4 Motor Cable Length*.

3. Set *[1] Enable Complete AMA* or *[2] Enable Reduced AMA* for parameter *P 4.2.1.3 AMA Mode*, and the main display shows *To start AMA*.

4. Press the *Start* button, the test runs automatically and the main display indicates when it is completed.

5. When AMA is completed, press any button to exit and return to normal operation mode.
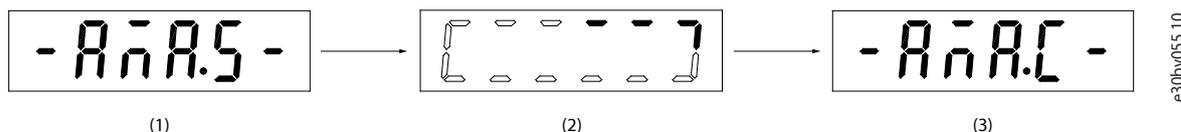
Figure 36: AMA Status Indications

1	To start AMA	2	AMA is running
3	AMA is completed		

5.5 Application Selection

5.5.1 Application Selection Overview

The application selection function can be used to quickly set up the drive for some of the most common application setups. It is possible to set the application selection using *Quick Access* or using *P 5.4.1 Application Selection* directly.

All pre-configured default parameter values for each application selection apply to a specific control configuration. The application selection is only applicable when the drive is in remote mode.

NOTICE
When an application is selected, relevant parameters are automatically set. Customer-specific configuration of all parameters based on specific requirements is possible.

NOTICE
Before setting an application selection, it is recommended to initialize the drive via parameter *P 6.6.8 Operation Mode* or 2-finger reset.

The iC2-Micro Frequency Converters have 5 standard modes which have pre-configured parameters and are set automatically. Table 13 contains a summary of the different modes and suitable applications.

Table 13: Standard Modes and Suitable Application

Application selection mode	Suitable application
Speed control mode	The default mode in iC2-Micro Frequency Converters application selection function. The mode is used in typical speed control applications for running at stable speed, the frequency converter is controlled by an analog input as reference signal.
Process control mode	The mode is suitable for applications which require monitoring and adjusting of, for example, temperature, pressure, speed, which must be kept at a desired level using sensor feedback.
Multi speed control mode	The mode is suitable for applications with 4 different speeds by using 2 digital inputs. By using 1 more digital input, 8 speeds are possible.

Table 13: Standard Modes and Suitable Application - (continued)

Application selection mode	Suitable application
3-wire control mode	The mode is suitable for typical speed control applications where start or stop is controlled with 2 push buttons.
Torque control mode	Suitable for torque control applications which require motor control via torque.

5.5.2 Configuring Speed Control Mode

The section describes the basic configuration for speed control mode.

- Speed control mode is the default application selection for the iC2-Micro drive.
- With default parameter settings and control connections, an I/O-controlled drive can be started with speed open loop quickly.
- This application selection is commonly used for pumps, fans, extruders, conveyors, and so on.
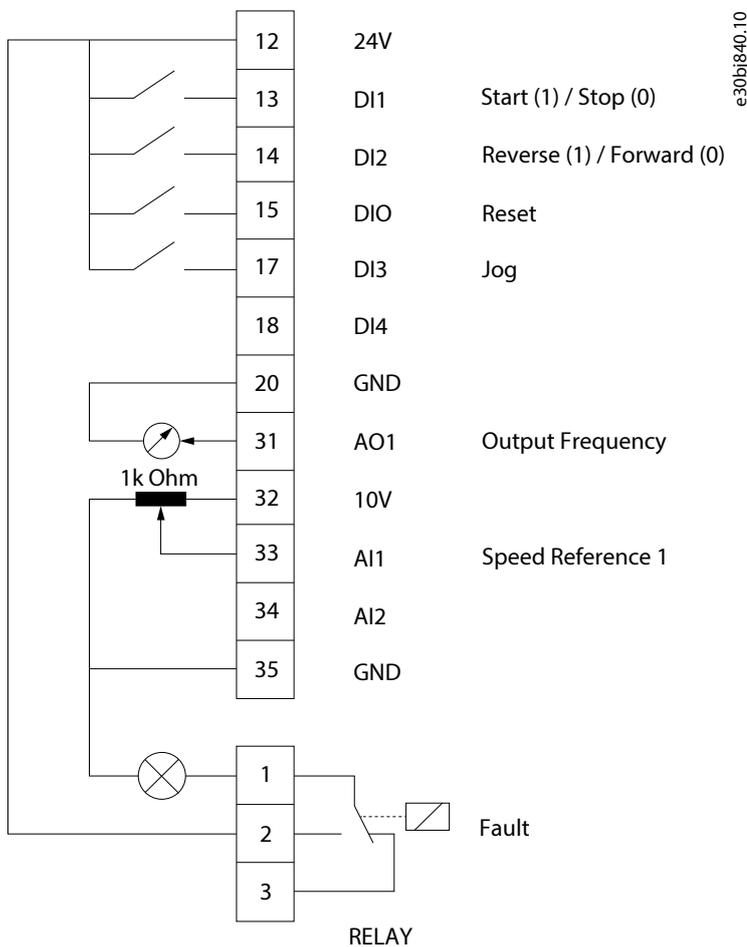
Figure 37: Default Connections

1. Set *P 5.4.1 Application Selection* to *[20] Speed Control Mode*.

   When *[20] Speed Control Mode* is selected, the following parameters are automatically set to the values shown in the table.

   Table 14: Default Settings

Category	Parameter index	Parameter name	Default setting	Parameter number
Operation Mode	5.4.2	*Operation Mode*	*[0] Speed Open Loop*	100
DI 1 - T13	9.4.1.2	*T13 Digital Input*	*[8] Start*	510

Table 14: Default Settings - (continued)

Category	Parameter index	Parameter name	Default setting	Parameter number
DI 2 - T14	9.4.1.3	*T14 Digital Input*	*[10] Reversing*	511
DI/O - T15	9.4.1.4	*T15 Digital Input*	*[1] Reset*	512
DI 3 - T17	9.4.1.5	*T17 Digital Input*	*[14] Jog*	513
DI 4 - T18	9.4.1.6	*T18 Digital Input*	*[0] No Operation*	515
AI1 - T33	9.5.2.1	*T33 mode*	*[1] Voltage Mode*	619
	9.5.2.2	*T33 High Voltage*	10 V	611
	9.5.2.3	*T33 Low Voltage*	0.07 V	610
	9.5.2.6	*T33 High Ref./Feedb. Value*	50	615
	9.5.2.7	*T33 Low Ref./Feedb. Value*	0	614
AO1 - T42	9.5.1.1	*T31 Mode*	*[0] 0-20mA*	690
	9.5.1.2	*T31 Analog Output*	*[100] Output Frequency*	691
Relay	9.4.3.1	*Function Relay*	*[9] Fault*	540
External reference	5.5.3.5	*Reference Function*	*[0] Sum*	304
	5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
	5.5.3.8	*Reference 2 Source*	*[2] Analog Input 34*	316
	5.5.3.9	*Reference 3 Source*	*[11] Local Bus Reference*	317
Jog	5.9.2	*Jog Reference*	* 5.0	311
	5.9.1	*Jog Ramp Time*	* 3s	380
Reference limits	5.5.3.3	*Reference Maximum*	50. If *[1] North America* is selected for *P 1.2.1 Regional Settings*, the default value is 60.)	303
	5.5.3.4	*Reference Minimum*	0	302

5.5.3 Configuring Process Control Mode

Process control mode is suitable for applications which require monitoring and adjusting of a process to give the desired output. With process control, the frequency converter is widely used to enable quality maintenance, improve performance, increase efficiency, and decrease cost.

NOTICE

In application and system requirements, make sure to set parameters *P 5.5.3.2 Reference/Feedback Unit*, *P 5.5.3.3 Reference Max*, *P 5.5.3.4 Reference Minimum*, *P 9.5.2.6 T33 High Ref./Feedb. Value*, *P 9.5.2.7 T33 Low, Ref./Feedb. Value*, *P 9.5.3.6 T34 High Ref./ Feedb. Value*, and *P 9.5.3.7 T34 Low Ref./Feedb. Value* properly. Set these parameters according to the application requirements.
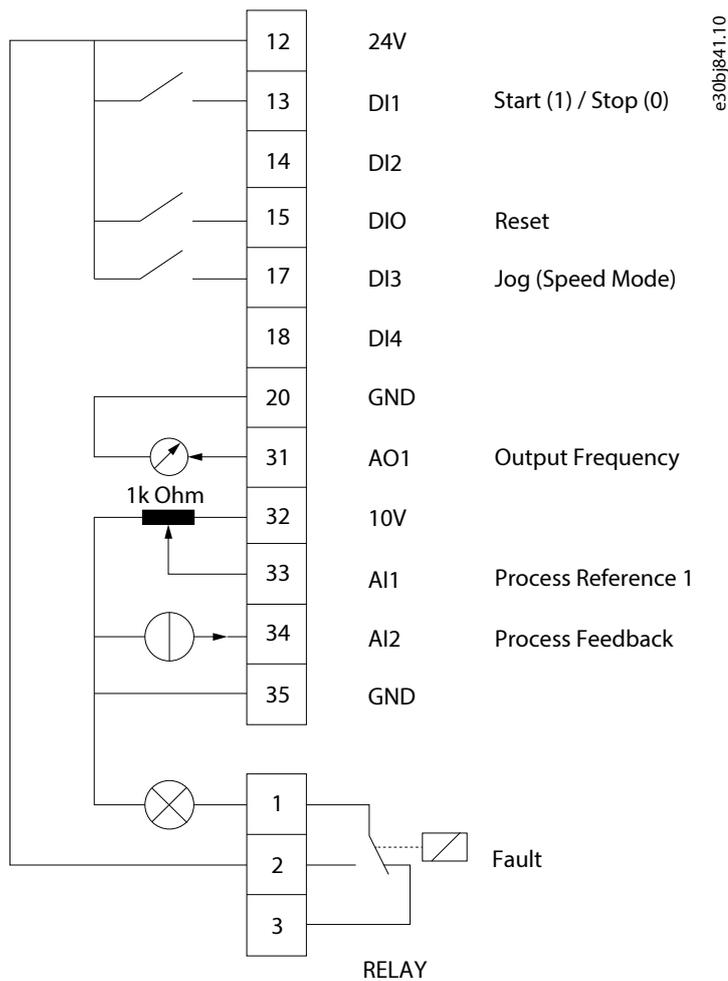
Figure 38: Default Connections for Process Control

1. Set **P 5.4.1 Application Selection** to **[21] Process Control Mode**.

   When **[21] Process Control Mode** is selected, the following parameters are automatically set to the values shown in the table.

   Table 15: Process Control Mode Default Settings

Category	Parameter index	Parameter name	Default setting	Parameter number
Operation Mode	5.4.2	**Operation Mode**	**[3] Process Close Loop**	100
DI 1 - T13	9.4.1.2	**T13 Digital Input**	**[8] Start**	510
DI 2 - T14	9.4.1.3	**T14 Digital Input**	**[0] No operation**	511
DI/O - T15	9.4.1.4	**T15 Digital Input**	**[1] Reset**	512
DI 3 - T17	9.4.1.5	**T17 Digital Input**	**[14] Jog**	513
DI 4 - T18	9.4.1.6	**T18 Digital Input**	**[0] No Operation**	515
AI1 - T33	9.5.2.1	**T33 mode**	**[1] Voltage Mode**	619
	9.5.2.2	**T33 High Voltage**	10 V	611
	9.5.2.3	**T33 Low Voltage**	0.07 V	610
	9.5.2.6	**T33 High Ref./Feedb. Value**	50	615
	9.5.2.7	**T33 Low Ref./Feedb. Value**	0	614

Table 15: Process Control Mode Default Settings - (continued)

Category	Parameter index	Parameter name	Default setting	Parameter number
AI2 - T34	9.5.3.1	*T34 mode*	*[0] Current Mode*	629
	9.5.3.4	*T34 High Current*	20.00 mA	623
	9.5.3.5	*T34 Low Current*	4.00 mA	622
	9.5.3.6	*T34 High Ref./Feedb. Value*	50. If *[1] North America* is selected for *P 1.2.1 Regional Settings*, the default value is 60.	625
	9.5.3.7	*T34 Low Ref./Feedb. Value*	0	624
AO1 - T42	9.5.1.1	*T31 Mode*	*[0] 0-20mA*	690
	9.5.1.2	*T31 Analog Output*	*[100] Output Frequency*	691
Relay	9.4.3.1	*Function Relay*	*[9] Fault*	540
PID	5.12.4.1	*Feedback 1 Resource*	*[2] Analog Input 34*	720
	5.12.5.7	*PID Normal / Inverse Control*	*[0] Normal*	730
Jog	5.9.2	*Jog Reference*	5.0	311
	5.9.1	*Jog Ramp Time*	3 s	380
External reference	5.5.3.5	*Reference Function*	*[0] Sum*	304
	5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
	5.5.3.8	*Reference 2 Source*	*[0] Function*	316
	5.5.3.9	*Reference 3 Source*	*[0] Function*	317

5.5.4 Configuring Multi-Speed Control Mode

Multi-speed control mode allows to use 2 digital inputs for 4 different speeds. By using 1 more digital input, 8 speeds are possible.
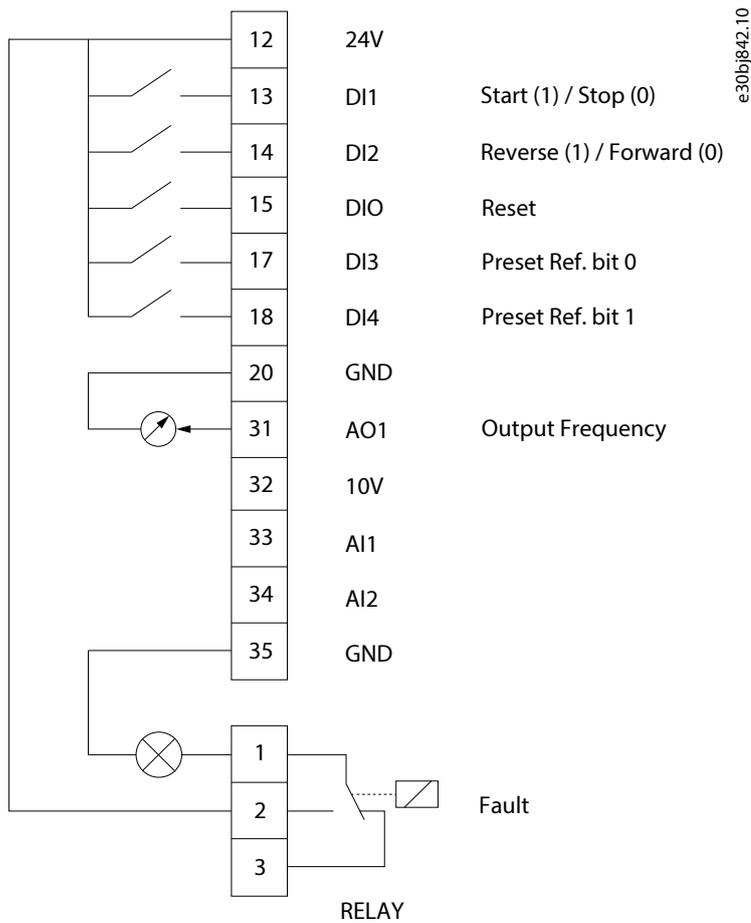
Figure 39: Default Connections

1. Set **P 5.4.1 Application Selection** to **[22] Multi-speed Control Mode**.

    When **[22] Multi-speed Control Mode** is selected, the following parameters are automatically set to the values shown in the table.

Table 16: Default Settings

Category	Parameter index	Parameter name	Default setting	Parameter number
Operation mode	5.4.2	*Operation Mode*	*[0] Speed Open Loop*	100
DI 1 - T13	9.4.1.2	*T13 Digital Input*	*[8] Start*	510
DI 2 - T14	9.4.1.3	*T14 Digital Input*	*[10] Reversing*	511
DI/O - T15	9.4.1.4	*T15 Digital Input*	*[1] Reset*	512
DI 3 - T17	9.4.1.5	*T17 Digital Input*	*[16] Preset Ref. Bit 0*	513
DI 4 - T18	9.4.1.6	*T18 Digital Input*	*[17] Preset Ref. Bit 1*	515
AO1 - T42	9.5.1.1	*T31 Mode*	*[0] 0–20 mA*	690
	9.5.1.2	*T31 Analog Output*	*[100] Output Frequency*	691
Relay	9.4.3.1	*Function Relay*	*[9] Fault*	540
External reference	5.5.3.7	*Reference 1 Source*	*[0] No Function*	315
	5.5.3.8	*Reference 2 Source*	*[0] No Function*	316
	5.5.3.9	*Reference 3 Source*	*[0] No Function*	317

Table 16: Default Settings - (continued)

Category	Parameter index	Parameter name	Default setting	Parameter number
Preset refer.	5.5.3.10	*Preset Reference*	**Note:** Set as array type Table 17.	310
Jog	5.9.2	*Jog Reference*	5.0	311
	5.9.1	*Jog Ramp Time*	3 s	380
Reference limits	5.5.3.3	*Reference Maximum*	50. If *[1] North America* is selected for *P 1.2.1 Regional Settings*, the default value is 60.	303
	5.5.3.4	*Reference Minimum*	0	302

Table 17: *Parameter P 5.5.3.10 Preset Reference* **Setting (Array Type)**

Reference	DI4 (Terminal 18) *[17] Preset Ref Bit [1]*	DI3 (Terminal 17) *[16] Preset Ref Bit [0]*
Preset Reference 0	0	0
Preset Reference 1	0	1
Preset Reference 2	1	0
Preset Reference 3	1	1

5.5.5 Configuring Wire Control Mode

3-Wire Control Mode of the drive enables to imitate the common contactor control circuit to control the motor. This is possible by using 2 momentary push-buttons to control motor start and motor stop. Reversing is controlled by 1 digital input.

e30bj843.10

12	24V	
13	DI1	Start (pulse ⌐)
14	DI2	Reverse (1) / Forward (0)
15	DIO	Reset
17	DI3	Jog
18	DI4	Stop (pulse ⌐)
20	GND	
31	AO1	Output Frequency
32	10V	
33	AI1	Speed Reference 1
34	AI2	
35	GND	

1k Ohm

1	
2	Fault
3	

RELAY
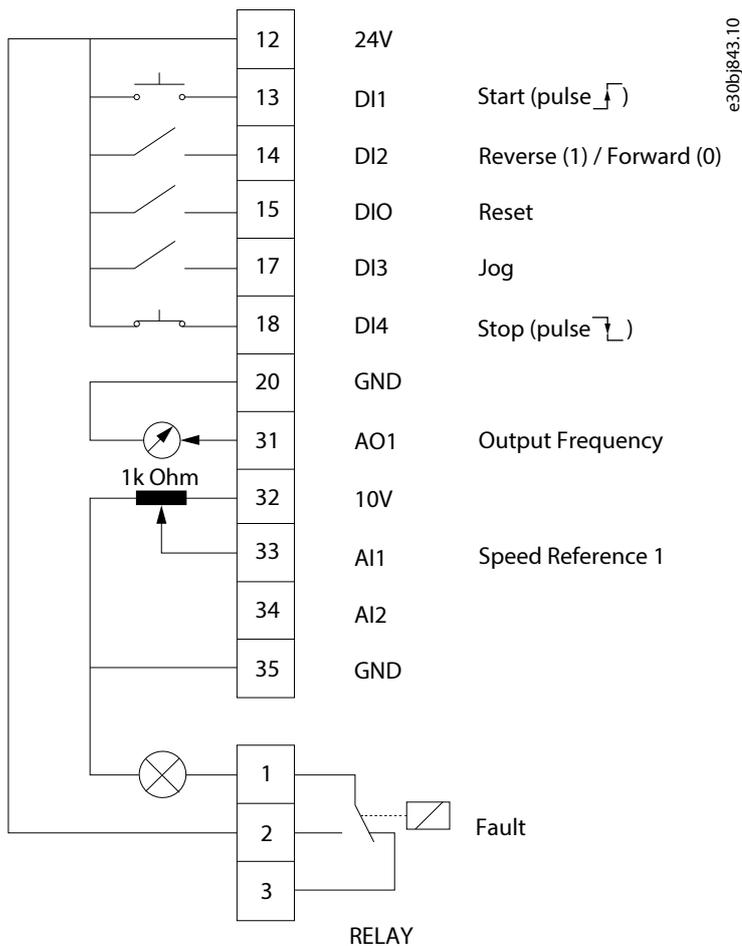
Figure 40: Default Connections

1. Set **P 5.4.1 Application Selection** to **[23] 3-Wire Control Mode**.

   When **[23] 3-Wire Control Mode** is selected, the following parameters are automatically set to the values shown in the table.

Table 18: Default Settings

Category	Parameter index	Parameter name	Default setting	Parameter number
Operation mode	5.4.2	*Operation Mode*	*[0] Speed Open Loop*	100
DI 1 - T13	9.4.1.2	*T13 Digital Input*	*[9] Latched start*	510
DI 2 - T14	9.4.1.3	*T14 Digital Input*	*[10] Reversing*	511
DI/O - T15	9.4.1.4	*T15 Digital Input*	*[1] Reset*	512
DI 3 - T17	9.4.1.5	*T17 Digital Input*	*[14] Jog*	513
DI 4 - T18	9.4.1.6	*T18 Digital Input*	*[6] Stop inverse*	515
AI1 - T33	9.5.2.1	*T33 Mode*	*[1] Voltage Mode*	619
	9.5.2.2	*T33 High Voltage*	10 V	611
	9.5.2.3	*T33 Low Voltage*	0.07 V	610
	9.5.2.6	*T33 High Ref./Feedb. Value*	50	615
	9.5.2.7	*T33 Low Ref./Feedb. Value*	0	614

Table 18: Default Settings - (continued)

Category	Parameter index	Parameter name	Default setting	Parameter number
AO1 - T42	9.5.1.1	*T31 Mode*	*[0] 0-20mA*	690
	9.5.1.2	*T31 Analog Output*	*[100] Output Frequency*	691
Relay	9.4.3.1	*Function Relay*	*[9] Fault*	540
External reference	5.5.3.5	*Reference Function*	*[0] Sum*	304
	5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
	5.5.3.8	*Reference 2 Source*	*[0] No Function*	316
	5.5.3.9	*Reference 3 Source*	*[0] No Function*	317
Jog	5.9.2	*Jog Reference*	5.0	311
	5.9.1	*Jog Ramp Time*	3 s	380
Reference limits	5.5.3.3	*Reference Maximum*	50. If *[1] North America* is selected for *P 1.2.1 Regional Settings*, the default value is 60.	303
	5.5.3.4	*Reference Minimum*	0	302

Figure 41: Example

5.5.6 **Configuring Torque Control Mode**

In torque control mode, the pre-configured parameter settings require to control the motor via torque. The motor torque follows a torque reference given by an analog input to the frequency converter. Analog input 1 is used as torque reference; analog input 2 is used as maximum speed limitation source for torque control.

Note the following:

- Torque control mode is supported in VVC+ control only, and only for *[0] Asynchronous Induction Motor, IM* selected in *P 4.2.1.1 Motor Type* control.

- Torque reference value for *P 5.5.3.3 Reference Maximum* is calculated automatically based on the motor data entered according to motor nameplate.

- Make sure *P 9.5.2.6 T33 High Ref./Feedb. Value* is set according to the application requirement. Typically, the value in *P 9.5.2.6 T33 High Ref./Feedb. Value* is equal to the value in *P 5.5.3.3 Reference Maximum*.

- If the operation does not require speed limit under torque control, set *P 5.10.3 Speed Limit Mode Torque Ctrl.* to *[0] No Function*.
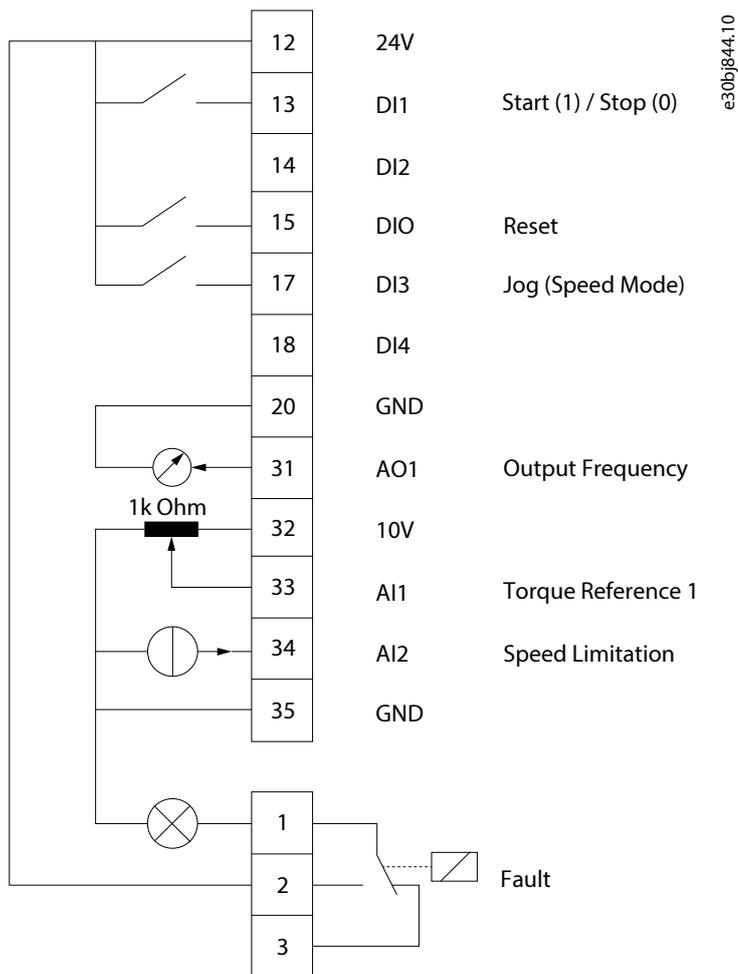
Figure 42: Default Connections

1. Set **P 5.4.1 Application Selection** to **[24] Torque Control Mode**.

   When **[24] Torque Control Mode** is selected, the following parameters are automatically set to the values shown in the table.

   Table 19: Default Settings

Category	Parameter index	Parameter name	Default setting	Parameter number
Operation mode	5.4.2	*Operation Mode*	*[4] Torque Open Loop*	100
DI 1 - T13	9.4.1.2	*T13 Digital Input*	*[8] Start*	510
DI 2 - T14	9.4.1.3	*T14 Digital Input*	*[0] No operation*	511
DI/O - T15	9.4.1.4	*T15 Digital Input*	*[1] Reset*	512
DI 3 - T17	9.4.1.5	*T17 Digital Input*	*[14] Jog*	513
DI 4 - T18	9.4.1.6	*T18 Digital Input*	*[0] No Operation*	515

Table 19: Default Settings - (continued)

Category	Parameter index	Parameter name	Default setting	Parameter number
AI1 - T33	9.5.2.1	*T33 Mode*	*[1] Voltage Mode*	619
	9.5.2.2	*T33 High Voltage*	10V	611
	9.5.2.3	*T33 Low Voltage*	0.07V	610
	9.5.2.6	*T33 High Ref./Feedb. Value*	The value should be set manually according to application requirement.	615
	9.5.2.7	*T33 Low Ref./Feedb. Value*	0	614
AI2 - T34	9.5.3.1	*T34 Mode*	*[0] Current Mode*	629
	9.5.3.4	*T34 High Current*	20.00 mA	623
	9.5.3.5	*T34 Low Current*	4.00 mA	622
	9.5.3.6	*T34 High Ref./Feedb. Value*	50. If *[1] North America* is selected for *P 1.2.1 Regional Settings*, the default value is 60.	625
	9.5.3.7	*T34 Low Ref./Feedb. Value*	0	624
AO1 - T42	9.5.1.1	*T31 Mode*	*[0] 0-20 mA*	690
	9.5.1.2	*T31 Analog Output*	*[100] Output Frequency*	691
Relay	9.4.3.1	*Function Relay*	*[9] Fault*	540
External reference	5.5.3.5	*Reference Function*	*[0] Sum*	304
	5.5.3.7	*Reference 1 Source*	*[1] Analog Input 33*	315
	5.5.3.8	*Reference 2 Source*	*[0] No Function*	316
	5.5.3.9	*Reference 3 Source*	*[11] No Function*	317
Speed Limit	5.10.3	*Speed Limit Mode Torque Ctrl.*	*[0] No Function*	421
Jog	5.9.2	*Jog Reference*	5.0 Hz	311
	5.9.1	*Jog Ramp Time*	3s	380
Reference limits	5.5.3.3	*Reference Maximum*	Value is automatically calculated according to motor data.	303
	5.5.3.4	*Reference Minimum*	0	302

5.6 Reference Handling

5.6.1 Local/Remote Reference

Local reference

The local reference is active when the drive is operated and adjusted by the *Up* and *Down* buttons of the control panel.

Remote reference

The reference handling system for calculating the remote reference is shown in the Figure 43.
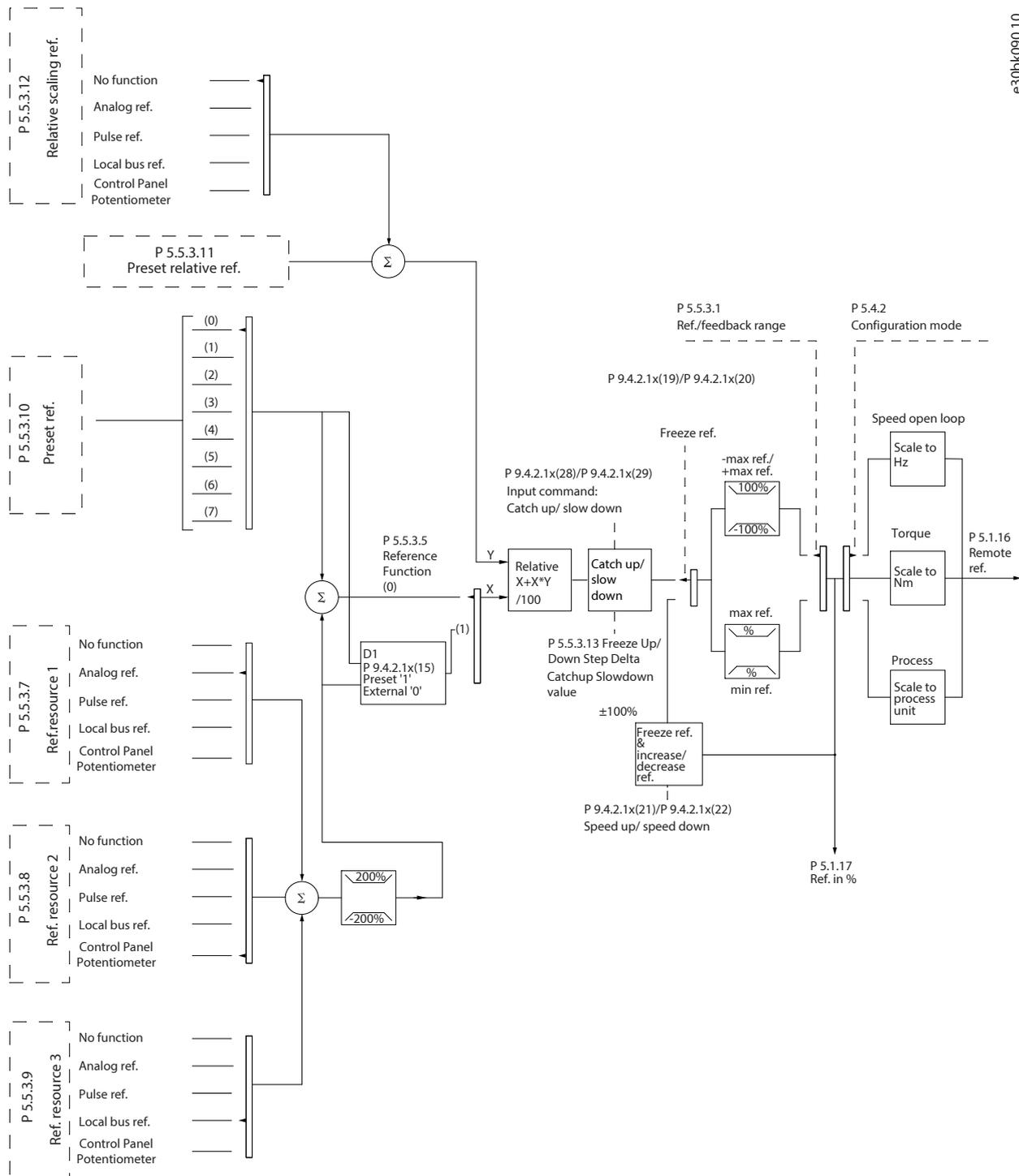
Figure 43: Remote Reference

The remote reference is calculated once in every scan interval and initially consists of 2 types of reference inputs:

- X (the external reference): A sum (see *P 5.5.3.5 T34 Low Current*) of up to 4 externally selected references, comprising any combination (determined by the setting of *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source*) of a fixed preset reference (*P 5.5.3.10 Preset Reference*), variable analog references, variable digital pulse references, and various fieldbus references in any unit the drive is monitoring ([Hz], [RPM], [Nm], and so on).

- Y (the relative reference): A sum of 1 fixed preset reference (*P 5.5.3.11 Preset Relative Reference*) and 1 variable analog reference (*P 5.5.3.12 Relative Scaling Reference Resource*) in [%].

The 2 types of reference inputs are combined in the following formula:

Remote reference=X+X*Y/100%

If relative reference is not used, set *P 5.5.3.12 Relative Scaling Reference Resource* to *[0] No function* and *P 5.5.3.11 Preset Relative Reference* to 0%. The digital inputs on the drive can activate both the catch up/slow down function and the freeze reference function.

5.6.2 **Reference Limits**

The reference range, minimum reference, and maximum reference define the allowed range of the sum of all references. The sum of all references is clamped when necessary. The relation between the resulting reference (after clamping) and the sum of all references are shown in Figure 44 and Figure 45.

Reference range = Minimum to maximum
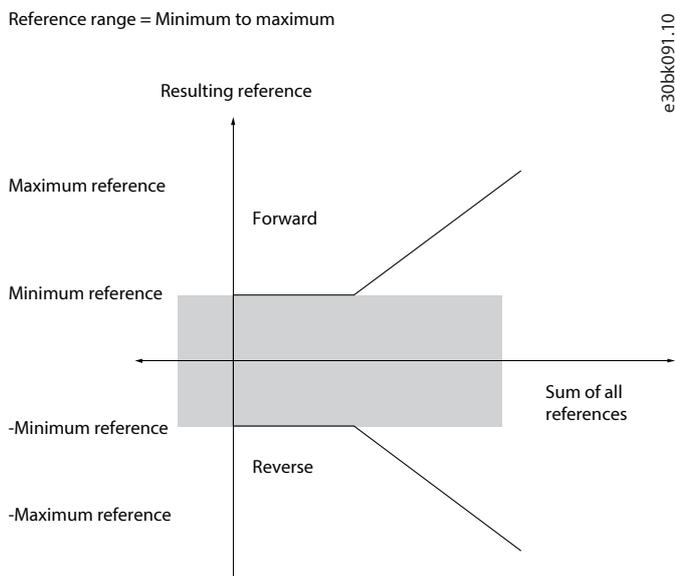
Figure 44: Reference Range is Set to 0
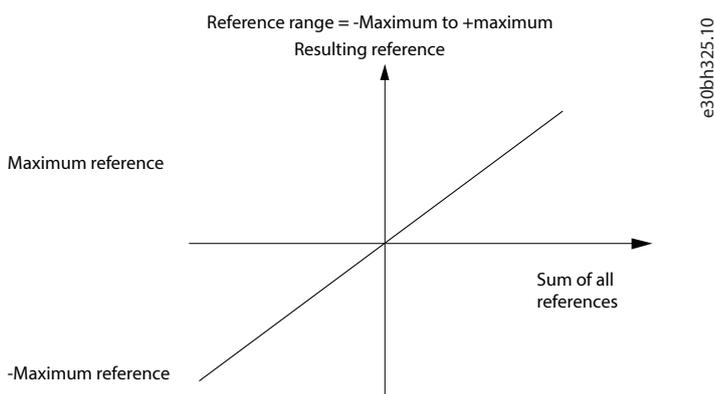
Figure 45: Reference Range is Set to 1

The minimum reference cannot be set to less than 0, unless the configuration mode is set to Process. In that case, the following relations between the resulting reference (after clamping) and the sum of all references are as shown in Figure 46.
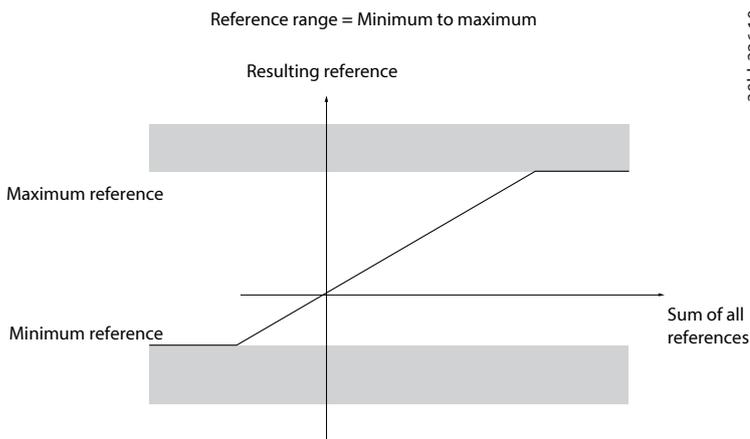
Figure 46: Sum of all References when Configuration Mode is set to Process

5.6.3 Scaling of Preset References and Bus References

Preset references are scaled according to the following rules:

- When *P 5.5.3.1 Reference Range* is set to *[0] Min–Max*, 0% reference equals 0 [unit] where unit can be any unit, for example RPM, m/s, and bar. 100% reference equals the maximum (absolute value of *P 5.5.3.3 Reference Maximum*, absolute value of *P 5.5.3.4 Reference Minimum*).

- When *P 5.5.3.3 Reference Range* is set to *[1] -Max–+Max*, 0% reference equals 0 [unit], and 100% reference equals maximum reference.

Bus references are scaled according to the following rules:

- When *P 5.5.3.1 Reference Range* is set to *[0] Min–Max*, 0% reference equals minimum reference and 100% reference equals maximum reference.

- When *P 5.5.3.1 Reference Range* is set to *[1] -Max–+Max*, -100% reference equals -maximum reference, and 100% reference equals maximum reference.

5.6.4 Scaling of Analog and Pulse References and Feedback

References and feedback are scaled from analog and pulse inputs in the same way. The only difference is that a reference above or below the specified minimum and maximum endpoints (P1 and P2 in the Figure 47) are clamped while feedbacks above or below are not.
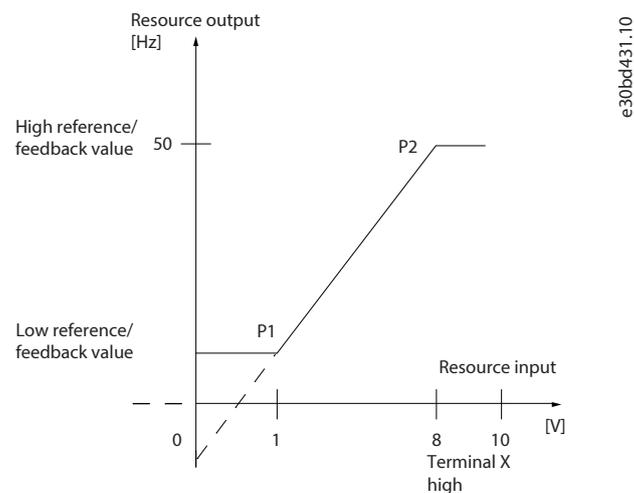
Figure 47: Minimum and Maximum Endpoints

The endpoints P1 and P2 are defined in the Table 20 depending on the choice of input.

Table 20: P1 and P2 Endpoints

Input	AI 33 voltage mode	AI 34 voltage mode	AI 34 current mode	Pulse input 18
P1=(Minimum input value, minimum reference value)				
Minimum reference value	*P 9.5.2.7 T33 Low Ref./ Feedb. Value*	*P 9.5.3.7 T34 Low Ref./ Feedb. Value*	*P 9.5.3.7 T34 Low Ref./ Feedb. Value*	*P 9.4.4.4 T18 Low Ref./ Feedb. Value*
Minimum input value	*P 9.5.2.3 T33 Low Voltage*	*P 9.5.3.3 T34 Low Voltage*	*P 9.5.3.5 T34 Low Current*	*P 9.4.4.2 T18 Low Frequency*
P2=(Maximum input value, maximum reference value)				
Maximum reference value	*P 9.5.2.6 T33 High Ref./ Feedb. Value*	*P 9.5.3.6 T34 High Ref./ Feedb. Value*	*P 9.5.3.6 T34 High Ref./ Feedb. Value*	*P 9.4.4.3 T18 High Ref./ Feedb. Value*
Maximum input value	*P 9.5.2.2 T33 High Voltage*	*P 9.5.3.2 T34 High Voltage*	*P 9.5.3.4 T34 High Current*	*P 9.4.4.1 T18 High Frequency*

5.6.5 Dead Band Around Zero

Sometimes, the reference (in rare cases also the feedback) should have a dead band around 0 to ensure that the machine is stopped when the reference is near 0.

To make the dead band active and to set the amount of dead band, do the following:

- Set either the minimum reference value (see the table in Table 20 for relevant parameter) or maximum reference value at 0. In other words, either P1 or P2 must be on the X-axis in the Figure 48.
- Ensure that both points defining the scaling graph are in the same quadrant.

P1 or P2 defines the size of the dead band as shown in the Figure 48.
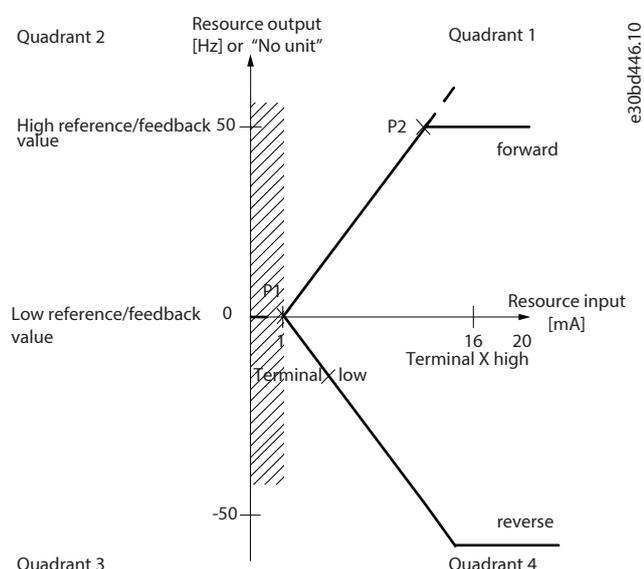
Figure 48: Size of Dead Band

Case 1: Positive reference with dead band, digital input to trigger reverse, part I

Figure 49 shows how reference input with limits inside minimum to maximum limits clamps.

e30bk092.10

General Reference parameters:
Reference Range: Min - Max
Minimum Reference: 0 Hz (0,0%)
Maximum Reference: 20 Hz (100,0%)

Limited to: -200%- +200%
(-40 Hz- +40 Hz)

General Motor parameters:
Motor speed direction:Both directions
Motor speed Low limit: 0 Hz
Motor speed high limit: 8 Hz

AI 33
Low reference 0 Hz
High reference 20 Hz
Low voltage 1 V
High voltage 10 V

Ext. Reference
Absolute
0 Hz 1 V
20 Hz 10V

Ext. reference
Range:
0.0% (0 Hz)
100.0% (20 Hz)

Reference algorithm

Limited to:
0%- +100%
(0 Hz- +20 Hz)

Ext. source 1
Range:
0.0% (0 Hz)
100.0% (20 Hz)

Reference
Range:
0.0% (0 Hz)
100.0% (20 Hz)

Reference is scaled according to min max reference giving a speed.!!!

Dead band

Scale to speed

DI 14
Low   No reversing
High Reversing

Digital input

Speed setpoint
Range:
-20 Hz
+20 Hz

Limits Speed Setpoint according to min max speed.!!!

Motor PID

Motor control

Range:
-8 Hz
+8 Hz

Motor

Figure 49: Clamping of Reference Input with Limits inside Minimum to Maximum

Case 2: Positive reference with dead band, digital input to trigger reverse, part II

Figure 50 shows how reference input with limits outside -maximum to +maximum limits clamps to the input low and high limits before adding to external reference, and how the external reference is clamped to -maximum to +maximum by the reference algorithm.

General Reference
parameters:
Reference Range: -Max - Max
Minimum Reference: Don't care
Maximum Reference: 20 Hz (100.0%)

Limited to: -200%- +200%
(-40 Hz- +40 Hz)

General Motor
parameters:
Motor speed direction: Both directions
Motor speed Low limit: 0 Hz
Motor speed high limit: 10 Hz

e30bk093.10

AI 33
Low reference 0 Hz
High reference 20 Hz
Low voltage 1 V
High voltage 10 V

Ext. reference
Range:
0.0% (0 Hz)
150.0% (30 Hz)

Reference
algorithm

Limited to:
-100%- +100%
(-20 Hz- +20 Hz)

Ext. Reference
Absolute
0 Hz 1 V
30 Hz 10 V

Ext. source 1
Range:
0.0% (0 Hz)
150.0% (30 Hz)

Reference is scaled
according to
max reference giving a
speed.!!!

Reference
Range:
0.0% (0 Hz)
100.0% (20 Hz)

Dead band

30 Hz

V

1   10

Scale to
speed

20 Hz

V

1   10

-20 Hz

Speed
setpoint
Range:
-20 Hz
+20 Hz

Digital input

DI 14
Low   No reversing
High Reversing

Limits Speed Setpoint
according to min max speed.!!!

Motor PID

Motor
control

Range:
–10 Hz
+10 Hz

Motor

Figure 50: Clamping of Reference Input with Limits outside -Maximum to +Maximum

6 RS-485 Configurations

6.1 RS-485 Installation and Set up

6.1.1 Introduction

RS-485 is a 2-wire bus interface compatible with multi-drop network topology. The nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to 1 network segment. Repeaters divide network segments, see Figure 51.
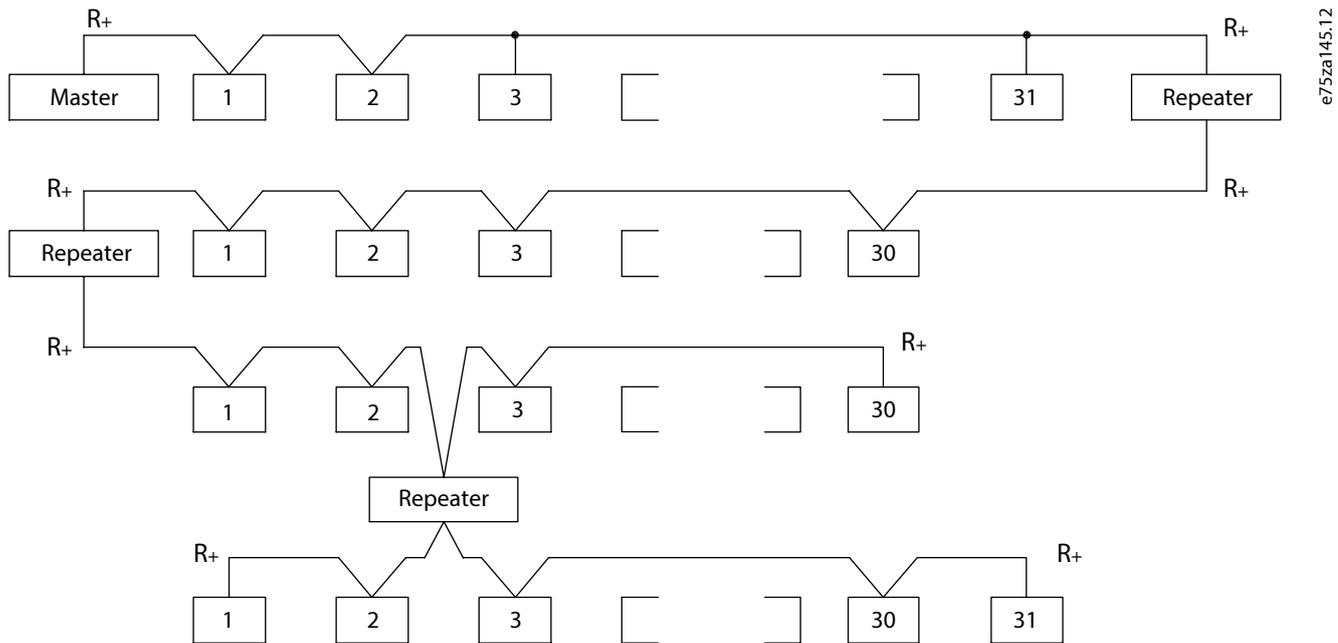
Figure 51: RS-485 Bus Interface

NOTICE
Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments.

Terminate each segment at both ends, using either the termination switch (S801) of the drives or a biased termination resistor network. Always use shielded twisted pair (STP) cable for bus cabling and follow good common installation practice.

Low-impedance ground connection of the shield at every node is important, including at high frequencies. Thus, connect a large surface of the shield to the ground, for example, with a cable clamp or a conductive cable gland. Sometimes, it is necessary to apply potential-equalizing cables to maintain the same ground potential throughout the network, particularly in installations with long cables.

To avoid impedance mismatch, use the same type of cable throughout the entire network. When connecting a motor to the drive, always use a shielded motor cable.

Table 21: Cable Specifications

Cable	Shielded twisted pair (STP)
Impedance [Ω]	120
Cable length [m (ft)]	Maximum 1200 (3937) (including drop lines). Maximum 500 (1640) station-to-station.

6.1.2 **Connecting the Drive to the RS-485 Network**

1. Connect signal wires to terminal 68 (P+) and terminal 69 (N-) on the main control board of the drive.
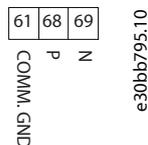
Figure 52: Network Connection

2. Connect the cable shield to the cable clamps.

NOTICE

To reduce noise between conductors, use shielded, twisted-pair cables.

6.1.3 **Hardware Setup**

To terminate the RS-485 bus, use the terminator switch on the main control board of the drive. The factory setting for the switch is OFF.
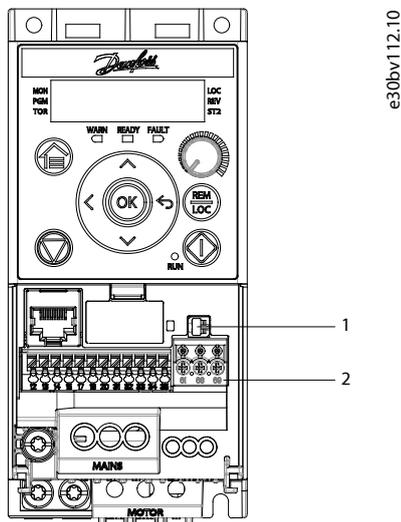
Figure 53: Terminator Switch Factory Setting

1	RS-485 termination switch (ON=RS-485 terminated, OFF=Open)	2	RS-485 terminals

6.1.4 **Parameter Settings for RS-485 Communication**

Two communication protocols are internal to the frequency converter.

- Danfoss FC

- Modbus RTU

Functions can be programmed remotely using the protocol software and RS-485 connection, or in parameter group 10.

Table 22: RS-485 Communication Parameter Settings

Parameter	Function
P 10.1.1 Protocol	Select the application protocol to run for the RS-485 interface.
P 10.1.2 Address	Set the node address. **NOTICE** The address range depends on the protocol selected in *P 10.1.1 Protocol*.
P 10.1.3 Baud Rate	Set the baud rate. **NOTICE** The default baud rate depends on the protocol selected in *P 10.1.1 Protocol*.
P 10.1.4 Parity/Stop Bits	Set the parity and number of stop bits. **NOTICE** The default selection depends on the protocol selected in *P 10.1.1 Protocol*.
P 10.1.6 Minimum Response Delay	Specify a minimum delay time between receiving a request and sending a response. This function is for overcoming modem turnaround delays.
P 10.1.5 Maximum Response Delay	Specify a maximum delay time between sending a request and receiving a response.

6.1.5 EMC Precautions

To achieve interference-free operation of the RS-485 network, Danfoss recommends the following EMC precautions.

NOTICE

Observe relevant national and local regulations, for example, regarding protective ground connection. Failure to ground the cables properly can result in communication degradation and equipment damage. To avoid coupling of high-frequency noise between the cables, keep the RS-485 communication cable away from motor and brake resistor cables. Normally, a distance of 200 mm (8 in) is sufficient. Maintain the greatest possible distance between the cables, especially where cables run in parallel over long distances. When crossing is unavoidable, the RS-485 cable must cross motor and brake resistor cables at an angle of 90°.
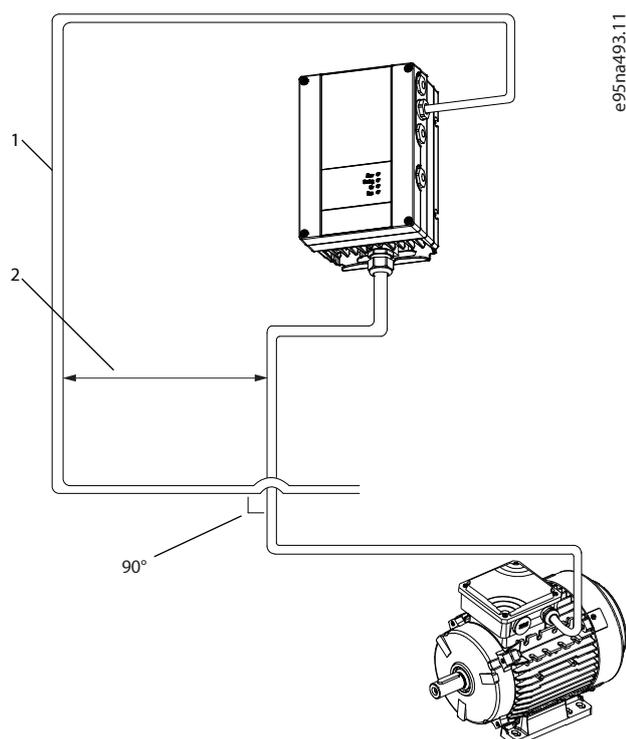
Figure 54: Minimum Distance between Communication and Power Cables

1	Fieldbus cable	**2**	Minimum 200 mm (8 in) distance

6.1.6 FC Protocol

6.1.6.1 FC Protocol Overview

The FC protocol, also referred to as FC bus or standard bus, is the Danfoss standard fieldbus. It defines an access technique according to the master/follower principle for communications via a fieldbus.

One master and a maximum of 126 followers can be connected to the bus. The master selects the individual followers via an address character in the telegram. A follower itself can never transmit without first being requested to do so, and direct telegram transfer between the individual followers is not possible. Communications occur in the halfduplex mode.

The master function cannot be transferred to another node (a single-master system).

The physical layer is RS-485, thus using the RS-485 port built into the drive. The FC protocol supports different telegram formats:

- A short format of 8 bytes for processing data.

- A long format of 16 bytes that also includes a parameter channel.

- A format used for texts.

The FC protocol provides access to the control word and bus reference of the drive.

The control word allows the master to control several important functions of the drive:

- Start.

- Stop of the drive in various ways:

    o Coast stop.

    o Quick stop.

    o DC brake stop.

    o Normal (ramp) stop.

- Reset after a fault trip.

- Run at various preset speeds.

- Run in reverse.

- Change of the active setup.

- Control of the 2 relays built into the drive.

The bus reference is commonly used for speed control. It is also possible to access the parameters, read their values, and where possible, write values to them. Accessing the parameters offers a range of control options, including controlling the setpoint of the drive when its internal PI controller is used.

6.1.6.2 FC Protocol Message Framing Structure

6.1.6.2.1 Content of a Character (byte)

Each character transferred begins with a start bit. Then 8 data bits are transferred, corresponding to a byte. Each character is secured via a parity bit. This bit is set at 1 when it reaches parity. Parity is when there is an equal number of 1s in the 8 data bits and the parity bit in total. A stop bit completes a character, consisting of 11 bits in all.

Figure 55: Content of a Character

6.1.6.2.2 Telegram Structure

Each telegram has the following structure:

- Start character (STX) = 02 hex.

- A byte denoting the telegram length (LGE).

- A byte denoting the drive address (ADR).

Several data bytes (variable, depending on the type of telegram) follow.

A data control byte (BCC) completes the telegram.

Figure 56: Telegram Structure

6.1.6.2.3 Telegram Length (LGE)

The telegram length is the number of data bytes plus the address byte ADR and the data control byte BCC.

Table 23: Length of Telegrams

4 data bytes	LGE=4+1+1=6 bytes
12 data bytes	LGE=12+1+1=14 bytes
Telegrams containing texts	10+n bytes

1) The 10 represents the fixed characters, while the n is variable (depending on the length of the text).

6.1.6.2.4 **Drive Address (ADR)**

Address format 1–126:

- Bit 7 = 1 (address format 1–126 active).
- Bit 0–6 = drive address 1–126.
- Bit 0–6 = 0 broadcast.

The follower returns the address byte unchanged to the master in the response telegram.

6.1.6.2.5 **Data Control Byte (BCC)**

The checksum is calculated as an XOR-function. Before the 1st byte in the telegram is received, the calculated checksum is 0.

6.1.6.2.6 **The Data Field**

The structure of data blocks depends on the type of telegram. There are 3 telegram types, and the type applies for both control telegrams (master->follower) and response telegrams (follower->master).

The 3 types of telegram are:

- Process block (PCD).
- Parameter block.
- Text block.

Process block (PCD)

The PCD is made up of a data block of 4 bytes (2 words) and contains:

- Control word and reference value (from master to follower).
- Status word and present output frequency (from follower to master).
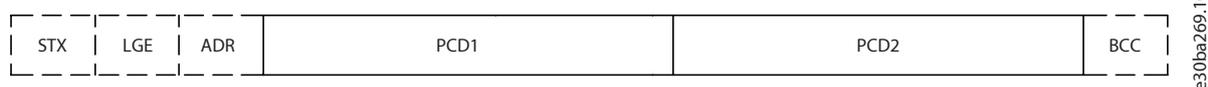
Figure 57: Process Block

Parameter block

The parameter block is used to transfer parameters between master and follower. The data block is made up of 12 bytes (6 words) and also contains the process block.
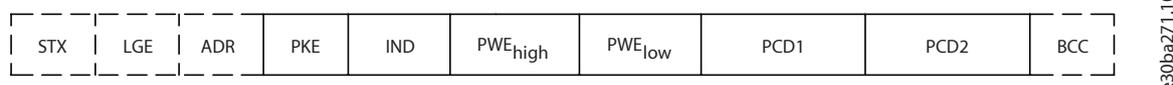
Figure 58: Parameter Block

Text block

The text block is used to read or write texts via the data block.
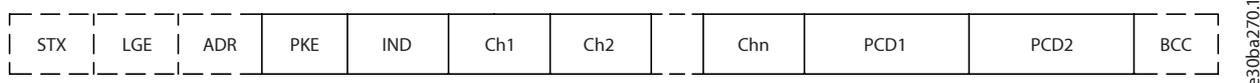
Figure 59: Text Block

6.1.6.2.7 **The PKE Field**

The PKE field contains 2 subfields:

- Parameter command and response (AK)

- Parameter number (PNU)
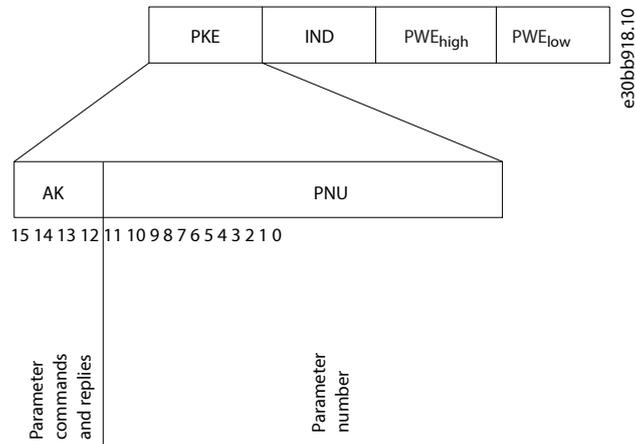
Figure 60: PKE Field

Bits 12–15 transfer parameter commands from master to follower and return processed follower responses to the master.

Table 24: Parameter Commands

Parameter commands master->follower				
Bit number				**Parameter command**
15	14	13	12	
0	0	0	0	No command.
0	0	0	1	Read parameter value.
0	0	1	0	Write parameter value in RAM (word).
0	0	1	1	Write parameter value in RAM (double word).
1	1	0	1	Write parameter value in RAM and EEPROM (double word).
1	1	1	0	Write parameter value in RAM and EEPROM (word).
1	1	1	1	Read text.

Table 25: Response

Response follower->master				
Bit number				**Response**
15	14	13	12	
0	0	0	0	No response.
0	0	0	1	Parameter value transferred (word).
0	0	1	0	Parameter value transferred (double word).
0	1	1	1	Command cannot be performed.
1	1	1	1	Text transferred.

If the command cannot be performed, the follower sends *0111 Command cannot be performed* response and issues the following fault reports in the Table 26.

Table 26: Follower Report

Fault code	FC specification
0	Illegal parameter number.
1	Parameter cannot be changed
2	Upper or lower limit is exceeded.
3	Subindex is corrupted.
4	No array.
5	Wrong data type.
6	Not used.
7	Not used.
9	Description element is not available.
11	No parameter write access.
15	No text available.
17	Not applicable while running.
18	Other errors.
100	–
>100	–
130	No bus access for this parameter.
131	Write to factory set-up is not possible.
132	No control panel access.
252	Unknown viewer.
253	Request is not supported.
254	Unknown attribute.
255	No error.

6.1.6.2.8 Parameter Number (PNU)

Bits 0–11 transfer parameter numbers. The parameter number is the unique identifier of a parameter for modbus registers. As an example, consider write to *P 5.4.2 Operation Mode*, the register is 999. The register is the Parameter Number * 10-1. In *P 5.4.2 Operation Mode*, the parameter number is 100. For more information on parameter number, see 7.1 Reading the Parameter Table.

6.1.6.2.9 Index (IND)

The index is used with the parameter number to read/write access parameters with an index, for example, *P 6.1.1 Latest Fault Number*. The index consists of 2 bytes: a low byte and a high byte. Only the low byte is used as an index.

6.1.6.2.10 Parameter Value (PWE)

The parameter value block consists of 2 words (4 bytes), and the value depends on the defined command (AK). The master prompts for a parameter value when the PWE block contains no value. To change a parameter value (write), write the new value in the PWE block and send from the master to the follower.

When a follower responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master. If a parameter contains several data options, select the data value by entering the value in the PWE block. Serial communication is only capable of reading parameters containing data type 9 (text string).

P 6.7.1 FC Type to *P 6.7.9 Power Card Serial Number* contain data type 9. For example, read the unit size and mains voltage range in *P 6.7.1 FC Type*. When a text string is transferred (read), the length of the telegram is variable, and the texts are of different lengths. The telegram length is defined in the 2nd byte of the telegram (LGE). When using text transfer, the index character indicates whether it is a read or a write command.

To read a text via the PWE block, set the parameter command (AK) to F hex. The index character high-byte must be 4.

6.1.6.2.11 Data Types Supported by the Drive

Table 27: Data Types

Data types	Description
3	Integer 16
4	Integer 32
5	Unsigned 8[1]
6	Unsigned 16[1]
7	Unsigned 32[1]
9	Text string
10	Byte string
13	Time difference
33	Reserved
35	Bit sequence

1) Unsigned means that there is no operational sign in the telegram.

6.1.6.2.12 Conversion

The application guide contains the descriptions of attributes of each parameter. Parameter values are transferred as whole numbers only. Conversion factors are used to transfer decimals.

P 5.8.3 Motor Speed Low Limit [Hz] has a conversion factor of 0.1. To preset the minimum frequency to 10 Hz, transfer the value 100. A conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 is thus perceived as 10.0.

Table 28: Conversion

Conversion index	Conversion factor
74	3600
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001

6.1.6.2.13 **Process Words (PCD)**

The block of process words is divided into 2 blocks of 16 bits, which always occur in the defined sequence.

Table 29: Process Words (PCD)

PCD 1	PCD 2
Control telegram (master->follower control word)	Reference value
Control telegram (follower->master) status word	Present output frequency

6.1.6.3 **Examples**

6.1.6.3.1 **Overview of Examples**

Bits 0–11 transfer parameter numbers. For more information on parameter number, see 7.1 Reading the Parameter Table. As an example, for *P 5.4.2 Operation Mode*, the parameter number is 100.

6.1.6.3.2 **Writing a Parameter Value**

Change *P 5.8.2 Motor Speed High Limit [Hz]* to 100 Hz.

Write the data in EEPROM.

PKE = E19E hex - Write single word in *P 5.8.2 Motor Speed High Limit [Hz]*. The parameter number is 414.

- IND = 0000 hex.
- PWE_{HIGH} = 0000 hex.
- PWE_{LOW} = 03E8 hex.

Data value 1000, corresponding to 100 Hz, see 6.1.6.2.12 Conversion.

The telegram looks like the Figure 61.

| E19E | H | 0000 | H | 0000 | H | 03E8 | H |
| PKE | | IND | | PWE_high | | PWE_low | |

e30ba092.10
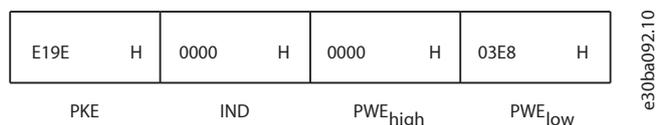
Figure 61: Telegram

NOTICE
P 5.8.2 Motor Speed High Limit [Hz] is a single word, and the parameter command for write in EEPROM is E. *P 5.8.2 Motor Speed High Limit [Hz]* is 19E in hexadecimal. The parameter number is 414.

The response from the follower to the master is shown in the Figure 62.

| 119E | H | 0000 | H | 0000 | H | 03E8 | H |
| PKE | | IND | | PWE_high | | PWE_low | |

e30ba093.10
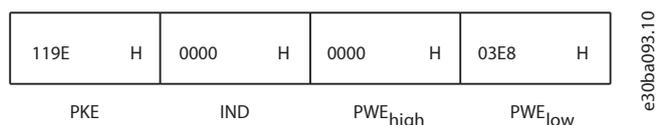
Figure 62: Response from Master

6.1.6.3.3 **Reading a Parameter Value**

Read the value in *P 5.5.4.2 Ramp 1 Ramp Up Time*.

PKE = 1155 hex - Read parameter value in *P 5.5.4.2 Ramp 1 Ramp Up Time*. The parameter number is 341.

- IND = 0000 hex.

- PWE$_{HIGH}$ = 0000 hex.

- PWE$_{LOW}$ = 0000 hex.
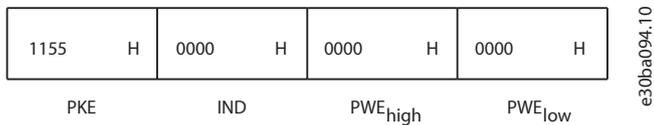
Figure 63: Telegram

If the value in *P 5.5.4.2 Ramp 1 Ramp Up Time* is 10 s, the response from the follower to the master is shown in the Figure 64.
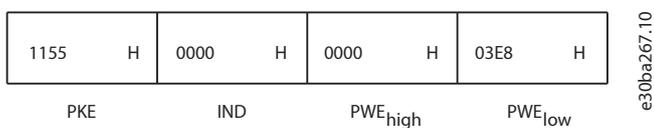
Figure 64: Response

3E8 hex corresponds to 1000 decimal. The conversion index for *P 5.5.4.2 Ramp 1 Ramp Up Time* is -2, that is, 0.01.

P 5.5.4.2 Ramp 1 Ramp Up Time is of the type Unsigned 32. The parameter number is 341.

6.1.7 Modbus RTU

6.1.7.1 Modbus RTU Introduction

Prerequisite knowledge

Danfoss assumes that the installed controller supports the interfaces in this manual, and strictly observes all requirements and limitations stipulated in the controller and drive. The built-in Modbus RTU (remote terminal unit) is designed to communicate with any controller that supports the interfaces defined in this guide. It is assumed that the user has full knowledge of the capabilities and limitations of the controller.

Modbus RTU overview

Regardless of the type of physical communication networks, this section describes the process that a controller uses to request access to another device. This process includes how the Modbus RTU responds to requests from another device, and how errors are detected and reported. It also establishes a common format for the layout and contents of telegram fields.

During communications over a Modbus RTU network, the protocol:

- determines how each controller learns its device address.

- recognizes a telegram addressed to it.

- determines which actions to take.

- extracts any data or other information contained in the telegram.

If a reply is required, the controller constructs the reply telegram and sends it. Controllers communicate using a master/follower technique in which only the master can initiate transactions (called queries). Followers respond by supplying the requested data to the master, or by acting as requested in the query. The master can address individual followers, or initiate a broadcast telegram to all followers. Followers return a response to queries that are addressed to them individually. No responses are returned to broadcast queries from the master.

The Modbus RTU protocol establishes the format for the master query by providing the following information:

- The device (or broadcast) address.

- A function code defining the requested action.

- Any data to be sent.

- An error-checking field.

The response telegram of the follower device is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error-checking field. If an error occurs in receipt of the telegram, or if the follower is unable to perform the requested action, the follower constructs and sends an error message. Alternatively, a timeout occurs.

6.1.7.2 **Drive with Modbus RTU**

The drive communicates in Modbus RTU format over the built-in RS-485 interface. Modbus RTU provides access to the control word and bus reference of the drive.

The control word allows the Modbus master to control several important functions of the drive:

- Start.

- Various stops:

  - Coast stop.

  - Quick stop.

  - DC brake stop.

  - Normal (ramp) stop.

- Reset after a fault trip.

- Run at various preset speeds.

- Run in reverse.

- Change the active setup.

- Control built-in relay of the drive.

The bus reference is commonly used for speed control. It is also possible to access the parameters, read their values, and, where possible, write values to them. Accessing the parameters offers a range of control options, including controlling the setpoint of the drive when its internal PI controller is used.

6.1.7.3 **Network Configuration**

To enable the FC protocol for the drive, set the following parameters.

Table 30: Parameters to Enable the Protocol

Parameter	Setting
P 10.1.1 Protocol	Modbus
P 10.1.2 Address	1–247
P 10.1.3 Baud Rate	2400–115200
P 10.1.4 Parity/Stop Bits	Even parity, 1 stop bit (default)

6.1.7.4 **Modbus RTU Message Framing Structure**

6.1.7.4.1 **Modbus RTU Message Byte Format**

The controllers are set up to communicate on the Modbus network using RTU (remote terminal unit) mode, with each byte in a telegram containing 2 4-bit hexadecimal characters. The format for each byte is shown in the following tables.

Table 31: Format for Each Byte

Start bit	Data byte									Stop/ par-ity	Stop

Table 32: Byte Details

Coding system	8-bit binary, hexadecimal 0–9, A–F. 2 hexadecimal characters contained in each 8-bit field of the telegram.
Bits per byte	• 1 start bit. • 8 data bits, least significant bit sent first. • 1 bit for even/odd parity; no bit for no parity. • 1 stop bit if parity is used; 2 bits if no parity.
Error check field	Cyclic redundancy check (CRC).

6.1.7.4.2 Modbus RTU Telegram Structure

The transmitting device places a Modbus RTU telegram into a frame with a known beginning and ending point. This allows receiving devices to begin at the start of the telegram, read the address portion, determine which device is addressed (or all devices, if the telegram is broadcast), and to recognize when the telegram is completed. Partial telegrams are detected and errors set as a result. Characters for transmission must be in hexadecimal 00–FF format in each field. The drive continuously monitors the network bus, also during silent intervals. When the 1st field (the address field) is received, each drive or device decodes it to determine which device is being addressed. Modbus RTU telegrams addressed to 0 are broadcast telegrams. No response is allowed for broadcast telegrams. A typical telegram frame is shown in the following table.

Table 33: Typical Modbus RTU Telegram Structure

Start	Address	Function	Data	CRC check	End
T1-T2-T3- T4	8 bits	8 bits	N x 8 bits	16 bits	T1-T2-T3- T4

6.1.7.4.3 Start/Stop Field

Telegrams start with a silent period of at least 3.5 character intervals. The silent period is implemented as a multiple of character intervals at the selected network baud rate (shown as Start T1-T2-T3-T4). The 1st field to be transmitted is the device address. Following the last transmitted character, a similar period of at least 3.5 character intervals marks the end of the telegram. A new telegram can begin after this period.

Transmit the entire telegram frame as a continuous stream. If a silent period of more than 1.5 character intervals occurs before completion of the frame, the receiving device flushes the incomplete telegram and assumes that the next byte is the address field of a new telegram. Similarly, if a new telegram begins before 3.5 character intervals after a previous telegram, the receiving device considers it a continuation of the previous telegram. This behavior causes a timeout (no response from the follower), since the value in the final CRC field is not valid for the combined telegrams.

6.1.7.4.4 Address Field

The address field of a telegram frame contains 8 bits. Valid follower device addresses are in the range of 0–247 decimal. The individual follower devices are assigned addresses in the range of 1–247. 0 is reserved for broadcast mode, which all followers recognize. A master addresses a follower by placing the follower address in the address field of the telegram. When the follower sends its response, it places its own address in this address field to let the master know which follower is responding.

6.1.7.4.5 Function Field

The function field of a telegram frame contains 8 bits. Valid codes are in the range of 1–FF. Function fields are used to send telegrams between master and follower. When a telegram is sent from a master to a follower device, the function code field tells the follower what kind of action to perform. When the follower responds to the master, it uses the function code field to indicate either a normal (error free) response, or that some kind of error occurred (called an exception response).

For a normal response, the follower simply echoes the original function code. For an exception response, the follower returns a code that is equivalent to the original function code with its most significant bit set to logic 1. In addition, the follower places a unique code into the data field of the response telegram. This code tells the master what kind of error occurred, or the reason for the exception. Also refer to 6.2.2 Function Codes Supported by Modbus RTU and 6.2.3 Modbus Exception Codes.

6.1.7.4.6 Data Field

The data field is constructed using sets of 2 hexadecimal digits, in the range of 00–FF hexadecimal. These digits are made up of 1 RTU character. The data field of telegrams sent from a master to a follower device contains additional information which the follower must use to perform accordingly.

The information can include items such as:

- Coil or register addresses.

- The quantity of items to be handled.

- The count of actual data bytes in the field.

6.1.7.4.7 CRC Check Field

Telegrams include an error-checking field, operating based on a cyclic redundancy check (CRC) method. The CRC field checks the contents of the entire telegram. It is applied regardless of any parity check method used for the individual characters of the telegram. The transmitting device calculates the CRC value and appends the CRC as the last field in the telegram. The receiving device recalculates a CRC during receipt of the telegram and compares the calculated value to the actual value received in the CRC field. 2 unequal values result in bus timeout. The error-checking field contains a 16-bit binary value implemented as 2 8-bit bytes. After the implementation, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte sent in the telegram.

6.1.7.4.8 Coil Register Addressing

Introduction

In Modbus, all data is organized in coils and holding registers. Coils hold a single bit, whereas holding registers hold a 2 byte word (that is 16 bits). All data addresses in Modbus telegrams are referenced to 0. The 1st occurrence of a data item is addressed as item number 0. For example: The coil known as coil 1 in a programmable controller is addressed as coil 0000 in the data address field of a Modbus telegram. Coil 127 decimal is addressed as coil 007Ehex (126 decimal).

Holding register 40001 is addressed as register 0000 in the data address field of the telegram. The function code field already specifies a holding register operation. Therefore, the 4XXXX reference is implicit. Holding register 40108 is addressed as register 006Bhex (107 decimal).

Coil Register

Table 34: Coil Register

Coil number	Description	Signal direction
1–16	Drive control word.	Master to follower
17–32	Drive speed or setpoint reference range 0x0– 0xFFFF (-200% ... ~200%).	Master to follower
33–48	Drive status word.	Follower to master

Table 34: Coil Register - (continued)

Coil number	Description	Signal direction
49–64	Open-loop mode: Drive output frequency. Closed-loop mode: Drive feedback signal.	Follower to master
65	Parameter write control (master to follower).	Master to follower
	0 = Parameter changes are written to the RAM of the drive.	
	1 = Parameter changes are written to the RAM and EEPROM of the drive.	
66–65536	Reserved.	–

Drive Control Word (FC Profile)

Table 35: Drive Control Word (FC Profile)

Coil	0	1
01	Preset reference lsb	
02	Preset reference msb	
03	DC brake	No DC brake
04	Coast stop	No coast stop
05	Quick stop	No quick stop
06	Freeze frequency	No freeze frequency
07	Ramp stop	Start
08	No reset	Reset
09	No jog	Jog
10	Ramp 1	Ramp 2
11	Data not valid	Data valid
12	Relay 1 off	Relay 1 on
13	Reserved	
14	Set up LSB	
15	Reserved	
16	No reversing	Reversing

Drive Status Word (FC Profile)

Table 36: Drive Status Word (FC Profile)

Coil	0	1
33	Control not ready	Control ready
34	Drive not ready	Drive ready
35	Coast stop	Safety closed
36	No fault	Fault
37	Not used	Not used
38	Not used	Not used
39	Not used	Not used

Table 36: Drive Status Word (FC Profile) - (continued)

Coil	0	1
40	No warning	Warning
41	Not at reference	At reference
42	Local mode	Remote mode
43	Out of frequency range	In frequency range
44	Stopped	Running
45	Not used	Not used
46	No voltage warning	Voltage warning
47	Not in current limit	Current limit
48	No thermal warning	Thermal warning

Address/Registers

Table 37: Address/Registers

Bus address	Bus register	PLC register	Content	Access	Description
0	1	40001	Reserved	–	Reserved for legacy drives
1	2	40002	Reserved	–	Reserved for legacy drives
2	3	40003	Reserved	–	Reserved for legacy drives
3	4	40004	Free	–	–
4	5	40005	Free	–	–
5	6	40006	Modbus configuration	Read/Write	TCP only. Reserved for Modbus TCP
6	7	40007	Last fault code	Read only	Fault code received from parameter database
7	8	40008	Last error register	Read only	Address of register with which last error occurred.
8	9	40009	Index pointer	Read/Write	Subindex of parameter to be accessed.
9	10	40010		Dependent on parameter access	20 bytes space reserved for parameter in Modbus map.
29	30	40030		Dependent on parameter access	20 bytes space reserved for parameter in Modbus map.

1) Value written in the Modbus RTU telegram must be 1 or less than the register number. For example, Read Modbus Register 1 by writing value 0 in the telegram.

6.1.7.5 **How to Access Parameters**

6.1.7.5.1 **Parameter Handling**

The PNU (parameter number) is translated from the register address contained in the Modbus read or write telegram. The parameter number is translated to Modbus as (10 * parameter number-1) decimal.

Examples

Reading *P 5.5.3.13 Freeze Up/Down Step Delta* (16 bit): The parameter numbers is 312, and the register address is 3119 holding the parameters value. A value of 1252 (decimal), means that the parameter is set to 12.52%.

Reading *P 5.5.3.11 Preset Relative Reference* (32 bit): Parameter numbers is 341, and the holding registers are 3409 and 3410 holding the parameter values. A value of 11300 (decimal), means that the parameter is set to 113.00.

6.1.7.5.2 **Storage of Data**

The coil 65 decimal determines whether data written to the drive is stored in EEPROM and RAM (coil 65 = 1), or only in RAM (coil 65 = 0).

6.1.7.5.3 **IND (Index)**

Some parameters in the drive are array parameters, for example *P 5.5.3.10 Preset Reference*. Since the Modbus does not support arrays in the holding registers, the drive has reserved the holding register 9 as pointer to the array. Before reading or writing an array parameter, set the holding register 9. Setting holding register to the value of 2 causes all following read/write to array parameters to be to the index 2.

6.1.7.5.4 **Text Blocks**

Parameters stored as text strings are accessed in the same way as the other parameters. The maximum text block size is 20 characters. If a read request for a parameter is for more characters than the parameter stores, the response is truncated. If the read request for a parameter is for fewer characters than the parameter stores, the response is space filled.

6.1.7.5.5 **Conversion Factor**

A parameter value can only be transferred as a whole number. To transfer decimals, use a conversion factor.

6.1.7.5.6 **Parameter Values**

Standard data types

Standard data types are int 16, int 32, uint 8, uint 16, and uint 32. They are stored as 4x registers (40001–4FFFF). The parameters are read using function 03 hex read holding registers. Parameters are written using the function 6 hex preset single register for 1 register (16 bits), and the function 10 hex preset multiple registers for 2 registers (32 bits). Readable sizes range from 1 register (16 bits) up to 10 registers (20 characters).

Non-standard data types

Non-standard data types are text strings and are stored as 4x registers (40001–4FFFF). The parameters are read using function 03 hex read holding registers and written using function 10 hex preset multiple registers. Readable sizes range from 1 register (2 characters) up to 10 registers (20 characters).

6.1.7.6 **Examples**

6.1.7.6.1 **Read Coil Status (01 hex)**

Description

This function reads the ON/OFF status of discrete outputs (coils) in the drive. Broadcast is never supported for reads.

Query

The query telegram specifies the starting coil and quantity of coils to be read. Coil addresses start at 0, that is, coil 33 is addressed as 32. Example of a request to read coils 33–48 (status word) from follower device 01.

Table 38: Query

Field name	Example (hex)
Follower address	01 (drive address)
Function	01 (read coils)
Starting address HI	00
Starting address LO	20 (32 decimals) coil 33
Number of points HI	00
Number of points LO	10 (16 decimals)
Error check (CRC)	–

Response

The coil status in the response telegram is packed as 1 coil per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The lsb of the 1st data byte contains the coil addressed in the query. The other coils follow toward the high-order end of this byte, and from low order to high order in subsequent bytes.

If the returned coil quantity is not a multiple of 8, the remaining bits in the final data byte are padded with values 0 (toward the high-order end of the byte). The byte count field specifies the number of complete bytes of data.

Table 39: Response

Field name	Example (hex)
Follower address	01 (drive address)
Function	01 (read coils)
Byte count	02 (2 bytes of data)
Data (coils 40–33)	07
Data (coils 48–41)	06 (STW = 0607hex)
Error check (CRC)	–

NOTICE

Coils and registers are addressed explicitly with an offset of -1 in Modbus. For example, coil 33 is addressed as coil 32.

6.1.7.6.2 Read Holding Registers (03 hex)

Description

This function reads the contents of holding registers in the follower.

Query

The query telegram specifies the starting register and quantity of registers to be read. Register addresses start at 0, that is, registers 1–4 are addressed as 0–3.

Example: Read *P 5.5.3.3 Reference Maximum*, register 3029. The parameter number is 303.

Table 40: Query

Field name	Example (hex)
Follower address	01
Function	03 (Read holding registers)
Starting address HI	0B (Register address 3029)
Starting address LO	D5 (Register address 3029)
Number of points HI	00
Number of points LO	02 – (P 5.5.3.3 Reference Maximum is 32 bits long, that is, 2 registers)
Error check (CRC)	–

Response

The register data in the response telegram is packed as 2 bytes per register, with the binary contents right justified within each byte. For each register, the 1st byte contains the high-order bits, and the 2nd contains the low-order bits.

Example: hex 000088B8 = 35.000 = 35 Hz.

Table 41: Response

Field name	Example (hex)
Follower address	01
Function	03
Byte count	04
Data HI (register 3030)	00
Data LO (register 3030)	00
Data HI (register 3031)	88
Data LO (register 3031)	B8
Error check (CRC)	–

6.1.7.6.3 Force/Write Single Coil (05 hex)

Description

This function forces the coil to either ON or OFF. When broadcast, the function forces the same coil references in all attached followers.

Query

The query telegram specifies the coil 65 (parameter write control) to be forced. Coil addresses start at 0, that is, coil 65 is addressed as 64. Force data = 00 00 hex (OFF) or FF 00 hex (ON).

Table 42: Query

Field name	Example (hex)
Follower address	01 (drive address)
Function	05 (write single coil)
Coil address HI	00
Coil address LO	40 (64 decimal) Coil 65
Force data HI	FF

Table 42: Query - (continued)

Field name	Example (hex)
Force data LO	00 (FF 00 = ON)
Error check (CRC)	–

Response

The normal response is an echo of the query, returned after the coil state has been forced.

Table 43: Response

Field name	Example (hex)
Follower address	01
Function	05
Force data HI	FF
Force data LO	00
Quantity of coils HI	00
Quantity of coils LO	01
Error check (CRC)	–

6.1.7.6.4 **Preset Single Register (06 hex)**

Description

This function presets a value into a single holding register.

Query

The query telegram specifies the register reference to be preset. Register addresses start at 0, that is, register 1 is addressed as 0.

For example, write to *P 5.4.2 Operation Mode*, register 999. Register 999 is parameter number * 10-1, as the parameter number is 100 for *P 5.4.2 Operation Mode*.

Table 44: Query

Field name	Example (hex)
Follower address	01
Function	06
Starting address HI	03 (register address 999)
Starting address LO	E7 (register address 999)
Preset data HI	00
Preset data LO	01
Error check (CRC)	–

Response

The normal response is an echo of the query, returned after the register contents have been passed.

Table 45: Response

Field name	Example (hex)
Follower address	01
Function	06
Register address HI	03
Register address LO	E7
Preset data HI	00
Preset data LO	01
Error check (CRC)	–

6.1.7.6.5 Preset Multiple Registers (10 hex)

Description

This function presets values into a sequence of holding registers.

Query

The query telegram specifies the register references to be preset. Register addresses start at 0, that is, register 1 is addressed as 0.
Example of a request to preset 2 registers (set *P 4.2.2.3 Nominal Current* to 738 (7.38 A). The parameter number is 124.

Table 46: Query

Field name	Example (hex)
Follower address	01
Function	10
Starting address HI	04
Starting address LO	D7
Number of registers HI	00
Number of registers LO	02
Byte count	04
Write data HI (Register 4: 1049)	00
Write data LO (Register 4: 1049)	00
Write data HI (Register 4: 1050)	02
Write data LO (Register 4: 1050)	E2
Error check (CRC)	–

Response

The normal response returns the follower address, function code, starting address, and quantity of registers preset.

Table 47: Response

Field name	Example (hex)
Follower address	01
Function	10
Starting address HI	04
Starting address LO	19

Table 47: Response - (continued)

Field name	Example (hex)
Number of registers HI	00
Number of registers LO	02
Error check (CRC)	–

6.1.7.6.6 Force/Write Multiple Coils (0F hex)

Description

This function forces each coil in a sequence of coils to either on or off. When broadcasting, the function forces the same coil references in all attached followers.

Query

The query telegram specifies the coils 17–32 (speed setpoint) to be forced.

NOTICE
Coil addresses start at 0, that is, coil 17 is addressed as 16.

Table 48: Query

Field name	Example (hex)
Follower address	01 (drive address)
Function	0F (write multiple coils)
Coil address HI	00
Coil address LO	10 (coil address 17)
Quantity of coils HI	00
Quantity of coils LO	10 (16 coils)
Byte count	02
Force data HI (Coils 8–1)	20
Force data LO (Coils 16–9)	00 (reference = 2000 hex)
Error check (CRC)	–

Response

The normal response returns the follower address, function code, starting address, and quantity of coils forced.

Table 49: Response

Field name	Example (hex)
Follower address	01 (drive address)
Function	0F (write multiple coils)
Coil address HI	00
Coil address LO	10 (coil address 17)
Quantity of coils HI	00
Quantity of coils LO	10 (16 coils)
Error check (CRC)	–

6.1.8 Danfoss FC Control Profile

6.1.8.1 Control Word According to FC Profile

Modbus Holding Register numbers for Input data – CTW and REF – and output data – STW and MAV – are defined in Table 50:

Table 50: Modbus Holding Register Numbers for Input and Output Data

50000 input data	Frequency converter control word register (CTW)
50010 input data	Bus reference register (REF)
50200 output data	Frequency converter status word register (STW)
50210 output data	Frequency converter main value register (MAV)

The input/output data is also available in a lower holding register area:

Table 51: Lower Register Numbers for Input and Output Data

02810 input data	Frequency converter control word register (CTW)
02811 input data	Bus reference register (REF)
02910 output data	Frequency converter status word register (STW)
02911 output data	Frequency converter main value register (MAV)
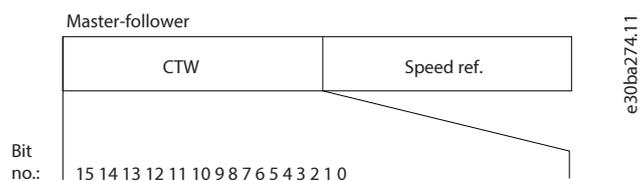
Figure 65: Control Word According to FC Profile

Table 52: Control Word According to FC Profile

Bit	Bit value = 0	Bit value = 1
00	Reference value	External selection lsb
01	Reference value	External selection msb
02	DC brake	Ramp
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold output frequency	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data invalid	Data valid
11	Relay 01 open	Relay 01 active
12	Reserved	Reserved
13	Parameter setup	Selection lsb

Table 52: Control Word According to FC Profile - (continued)

Bit	Bit value = 0	Bit value = 1
14	Reserved	Reserved
15	No function	Reverse

6.1.8.2 Explanation of Control Word Bit

Bits 00/01

Bits 00 and 01 are used to select among the 4 reference values, which are preprogrammed in *P 5.5.3.10 Preset Reference* according to the following table.

Table 53: Control Bits

Programmed reference value	Parameter	Bit 01	Bit 00
1	*P 5.5.3.10 Preset Reference* [0]	0	0
2	*P 5.5.3.10 Preset Reference* [1]	0	1
3	*P 5.5.3.10 Preset Reference* [2]	1	0
4	*P 5.5.3.10 Preset Reference* [3]	1	1

NOTICE

In *P 5.5.2.7 Preset Reference Select*, define how bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC Brake

Bit 02=0: Leads to DC braking and stop. Set braking current and duration in *P 5.7.4 DC Brake Current %* and *P 5.7.3 DC BrakeTime*.

Bit 02=1: Leads to ramping.

Bit 03, Coasting

Bit 03=0: The drive immediately releases the motor (the output transistors are shut off), and it coasts to a standstill.

Bit 03=1: If the other starting conditions are met, the drive starts the motor.

In *P 5.5.2.1 Coasting Select*, define how bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick Stop

Bit 04=0: Makes the motor speed ramp down to stop (set in *P 5.7.7 Quick Stop Ramp Time*).

Bit 05, Hold Output Frequency

Bit 05=0: The present output frequency (in Hz) freezes. Change the frozen output frequency only with the digital inputs programmed to *[21] Speed up* and *[22] Speed down*(*P 9.4.1.2 T13 Digital Input* to *P 9.4.1.5 T17 Digital Input*).

NOTICE

If freeze output is active, the drive can only be stopped in 1 of the following ways:

- Bit 03 coast stop.
- Bit 02 DC brake.
- Digital input programmed to *[5] DC brake inverse*, *[2] Coast inverse*, or *[3] Coast and reset inv* (*P 9.4.1.2 T13 Digital Input* to *P 9.4.1.5 T17 Digital Input*).

Bit 06, Ramp Stop/Start

Bit 06=0: Causes a stop and makes the motor speed ramp down to stop via the selected ramp-down parameter.

Bit 06=1: Allows the drive to start the motor if the other starting conditions are met.

In *P 5.5.2.4 Start Select*, define how bit 06 ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset

Bit 07=0: No reset.

Bit 07=1: Resets a trip. Reset is activated on the leading signal edge, that is, when changing from logic 0 to logic 1.

Bit 08, Jog

Bit 08=1: P 5.9.2 Jog Speed [Hz] determines the output frequency.

Bit 09, Selection of Ramp 1/2

Bit 09=0: Ramp 1 is active (*P 5.5.4.2 Ramp 1 Ramp Up Time* to *P 5.5.4.3 Ramp 1 Ramp Down Time*).

Bit 09=1: Ramp 2 is active (*P 5.5.4.2 Ramp 2 Ramp Up Time* to *P 5.5.4.3 Ramp 2 Ramp Down Time*).

Bit 10, Data Not Valid/Data Valid

Tell the drive whether to use or ignore the control word.

Bit 10=0: The control word is ignored.

Bit 10=1: The control word is used. This function is relevant because the telegram always contains the control word, regardless of the telegram type. If the control word is not needed when updating or reading parameter, turn it off.

Bit 11, Relay 01

Bit 11=0: Relay 01 not activated.

Bit 11=1: Relay 01 activated if *[36] Control word bit 11* is selected in *P 9.4.3.1 Function Relay*.

Bit 13, Setup Selection

Use bit 13 to select from the 2 setups according to the following table.

The function is only possible when *[9] Multi set-ups* is selected in *P 6.6.1 Active Set-up*.

Table 54: Setup selection

Setup	Bit 13
1	0
2	1

NOTICE
To define how bit 13 gates with the corresponding function on the digital inputs, use *P 5.5.2.6 Set-up Select*.

Bit 14, Torque OK/Limit Exceeded

Bit 14=0: The motor current is lower than the current limit selected in *P 2.7.1 Output Current Limit %*.

Bit 14=1: The current limit in *P 2.7.1 Output Current Limit %* is exceeded.

Bit 15, Reverse

Bit 15=0: No reversing.

Bit 15=1: Reversing. In the default setting, reversing is set to *[0] Digital input* in *P 5.5.2.5 Reversing Select*. Bit 15 causes reversing only when *[1] Bus*, *[2] Logic AND*, or *[3] Logic OR* is selected.

6.1.8.3 Status Word According to FC Profile (STW)

Set *P 10.1.1 Protocol* to *[0] FC*.
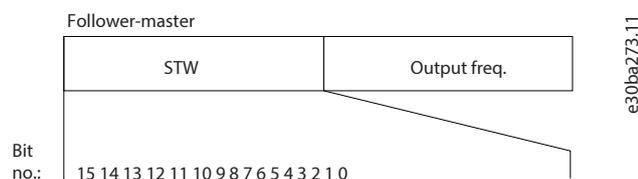
Figure 66: Status Word

Table 55: Status Word According to FC Profile

Bit	Bit = 0	Bit = 1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	No error	Error (no trip)
05	Reserved	–
06	No error	Triplock
07	No warning	Warning
08	Speed≠reference	Speed=reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit OK
11	No operation	In operation
12	Drive OK	Stopped, auto start
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

6.1.8.4 Explanation of Status Word Bit

Bit 00, Control Not Ready/Ready

Bit 00=0: The drive trips.

Bit 00=1: The drive controls are ready but the power component does not necessarily receive any supply (if there is 24 V external supply to controls).

Bit 01, Drive Ready

Bit 01=0: The drive is not ready.

Bit 01=1: The drive is ready for operation, but the coasting command is active via the digital inputs or via serial communication.

Bit 02, Coast Stop

Bit 02=0: The drive releases the motor.

Bit 02=1: The drive starts the motor with a start command.

Bit 03, No Error/Trip

Bit 03=0: The drive is not in fault mode.

Bit 03=1: The drive trips. To re-establish operation, press *[Reset]*.

Bit 04, No Error/Error (No Trip)

Bit 04=0: The drive is not in fault mode.

Bit 04=1: The drive shows an error but does not trip.

Bit 05, Not Used

Bit 05 is not used in the status word.

Bit 06, No Error/Trip lock

Bit 06=0: The drive is not in fault mode.

Bit 06=1: The drive is tripped and locked.

Bit 07, No Warning/Warning

Bit 07=0: There are no warnings.

Bit 07=1: A warning has occurred.

Bit 08, Speed ≠ Reference/Speed=Reference

Bit 08=0: The motor runs, but the present speed is different from the preset speed reference. It might happen when the speed ramps up/down during start/stop.

Bit 08=1: The motor speed matches the preset speed reference.

Bit 09, Local Operation/Bus Control

Bit 09=0: *[Stop/Reset]* is activated on the control unit or *[2] Local* in *P 5.5.3.6 Reference Site* is selected. It is not possible to control the drive via serial communication.

Bit 09=1: It is possible to control the drive via the fieldbus/serial communication.

Bit 10, Out of Frequency Limit

Bit 10=0: The output frequency has reached the value in *P 5.8.3 Motor Speed Low Limit [Hz]* or *P 5.8.2 Motor Speed High Limit [Hz]*.

Bit 10=1: The output frequency is within the defined limits.

Bit 11, No Operation/In Operation

Bit 11=0: The motor is not running.

Bit 11=1: The drive has a start signal or the output frequency is greater than 0 Hz.

Bit 12, Drive OK/Stopped, Auto Start

Bit 12=0: There is no temporary overtemperature on the drive.

Bit 12=1: The drive stops because of overtemperature but the unit does not trip and resumes operation once the overtemperature normalizes.

Bit 13, Voltage OK/Limit Exceeded

Bit 13=0: There are no voltage warnings.

Bit 13=1: The DC voltage in the drive's DC link is too low or too high.

Bit 14, Torque OK/Limit Exceeded

Bit 14=0: The motor current is lower than the current limit selected in *P 2.7.1 Output Current Limit %*.

Bit 14=1: The current limit in **P 2.7.1 Output Current Limit %** is exceeded.

Bit 15, Timer OK/Limit Exceeded

Bit 15=0: The timers for motor thermal protection and thermal protection are not exceeded 100%.

Bit 15=1: 1 of the timers exceeds 100%.

6.1.8.5 Bus Speed Reference Value

Speed reference value is transmitted to the drive in a relative value in %. The value is transmitted in the form of a 16-bit word. The integer value 16384 (4000 hex) corresponds to 100%. Negative figures are formatted using 2's complement. The actual output frequency (MAV) is scaled in the same way as the bus reference.
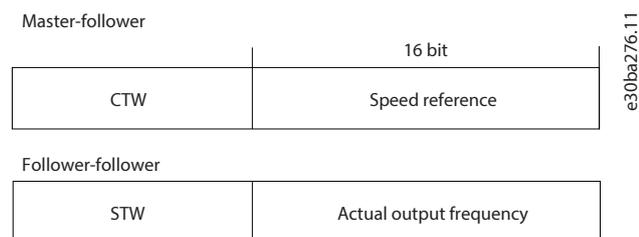
Figure 67: Actual Output Frequency (MAV)

The reference and MAV are scaled as follows:
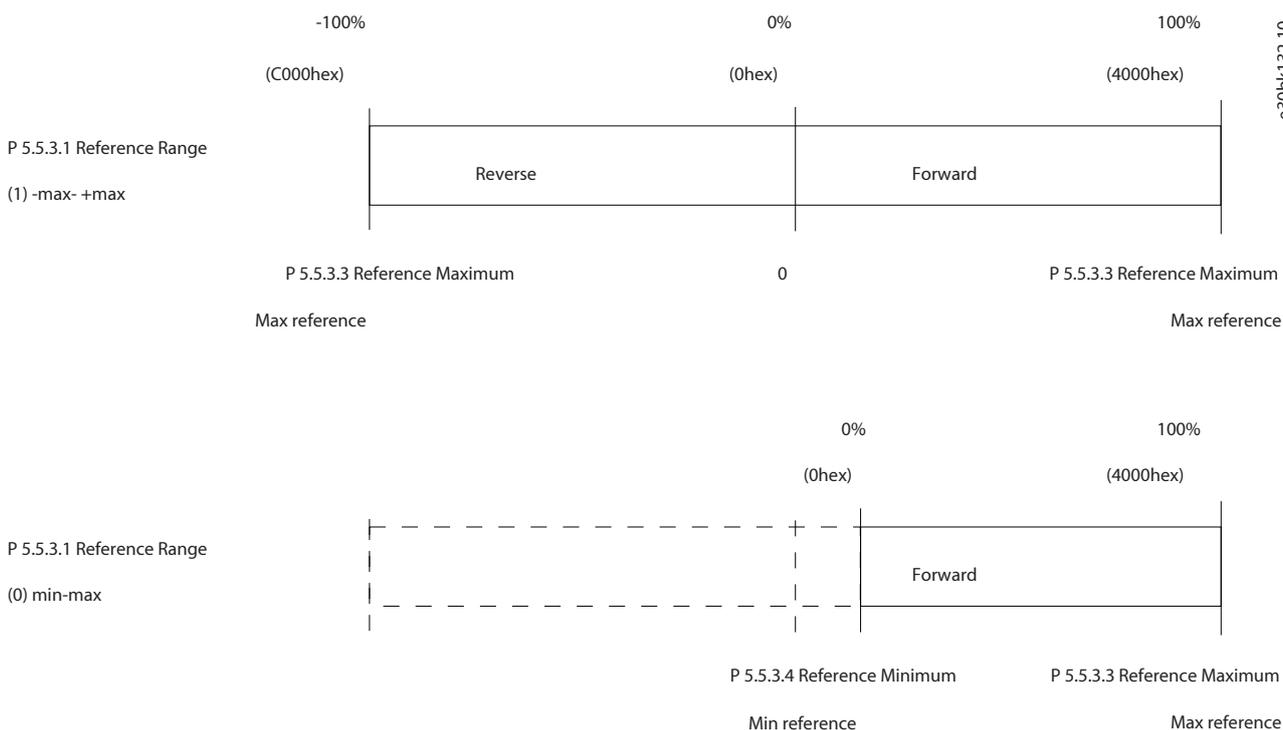
Figure 68: Reference and MAV

6.2 How to Control the Drive

6.2.1 Introduction

This section describes codes which can be used in the function and data fields of a Modbus RTU telegram.

6.2.2 Function Codes Supported by Modbus RTU

Modbus RTU supports use of the following function codes in the function field of a telegram:

Table 56: Function Codes

Function	Function code (hex)
Read coils	1
Read holding registers	3
Write single coil	5
Write single register	6
Write multiple coils	F
Write multiple registers	10
Get comm. event counter	B
Report follower ID	11
Read write multiple registers	17

Table 57: Function Codes

Function	Function code	Subfunction code	Subfunction
Diagnostics	8	1	Restart communication.
		2	Return diagnostic register.
		10	Clear counters and diagnostic register.
		11	Return bus message count.
		12	Return bus communication error count.
		13	Return follower error count.
		14	Return follower message count.

6.2.3 Modbus Exception Codes

For a full explanation of the structure of an exception code response, refer to 6.1.7.4.5 Function Field.

Table 58: Modbus Exception Codes

Code	Name	Meaning
1	Illegal function	The function code received in the query is not an allowable action for the server (or follower). This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the server (or follower) is in the wrong state to process a request of this type, for example, because it is not configured and is being asked to return register values.
2	Illegal data address	The data address received in the query is not an allowable address for the server (or follower). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 succeeds, while a request with offset 96 and length 5 generates exception 02.

Table 58: Modbus Exception Codes - (continued)

Code	Name	Meaning
3	Illegal data value	A value contained in the query data field is not an allowable value for server (or follower). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any value of any register.
4	Follower device failure	An unrecoverable error occurred while the server (or follower) was attempting to perform the requested action.

7 Parameter Descriptions

7.1 Reading the Parameter Table

The application guide includes the parameter tables. The following descriptions explain how to read the parameters.

1 — P 2.1.1 DC-Link Voltage			
2 — View the DC Link voltage in the drive			
3 — Default value:	0	6 — Parameter type:	Range (0–65535)
4 — Parameter number:	1630	7 — Unit:	V
5 — Data type:	uint 32	8 — Access type:	Read

e30bk172.11

Figure 69: Reading the Parameter Table

1 indicates the parameter name and parameter index, and starts with a P.

2 indicates the parameter description which is visible in MyDrive® Insight help text.

3 indicates the default setting from the factory.

4 indicates the unique parameter number which is relevant for modbus registers. See 6.1.6.2.8 Parameter Number (PNU) and 6.1.7.5.1 Parameter Handling.

5 indicates the data type of the parameter. See 7.1.2 Understanding Data Types.

6 indicates the type of parameter. Parameters have either defined ranges or selections. See 7.1.1 Understanding Parameter Types.

7 indicates the unit of the parameter.

8 indicates the access type of the parameter. See 7.1.3 Understanding Access Types.

7.1.1 Understanding Parameter Types

Following are the different types of parameter information.

Table 59: Parameter Types and Description

Parameter Type	Description
Selection	The parameter provides a list of selections for the user to select.
Range (0–255)	The value of the parameter is within the specified range. In the example specified, any value 0–255 can be set for the parameter.

7.1.2 Understanding Data Types

Following is an overview of the data types used in iC2 application software.

Table 60: Overview on data type

Data type	Description	Type	Range
enum	Enumeration		0,1,2....
int	Integer	8, 16, 32	-32768...32767
uint	Unsigned integer	8, 16, 32	0 up to 65535
visStr	Visible string		All strings

7.1.3 Understanding Access Types

Following are the access types of parameters and descriptions.

Table 61: Access Types and Descriptions

Access type	Descriptions
Read/Write	The setting of the parameter is readable or changeable.
Read	The parameter information is only readable.

7.2 Grid (Menu Index 1)

7.2.1 Grid Settings (Menu Index 1.2)

P 1.2.1 Regional Settings

Use the parameter to configure regional settings. Select *[0] International* to set *P 4.2.2.4 Nominal Frequency* to 50 Hz. Select *[1] North America* to set *P 4.2.2.4 Nominal Frequency* to 60 Hz.

Default value:	0 [International]	**Parameter type:**	Selection
Parameter number:	3	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	International	Default value of *P 4.2.2.4 Nominal Frequency* is set to 50 Hz.
1	North America	Default value of *P 4.2.2.4 Nominal Frequency* is set to 60 Hz.

P 1.2.2 Grid Type

Select the supply voltage, frequency, and type.

Default value:	12 [380-440V/50Hz]	**Parameter type:**	Selection
Parameter number:	6	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	200-240V/50Hz/IT-grid
1	200-240V/50Hz/Delta
2	200-240V/50Hz
5	100-110V/50Hz/IT-grid
6	100-110V/50Hz/Delta
7	100-110V/50Hz
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

Selection number	Selection name
22	440-480V/50Hz
100	200-240V/60Hz/IT-grid
101	200-240V/60Hz/Delta
102	200-240V/60Hz
105	100-110V/60Hz/IT-grid
106	100-110V/60Hz/Delta
107	100-110V/60Hz
110	380-440V/60Hz/IT-grid
111	380-440V/60Hz/Delta
112	380-440V/60Hz
120	440-480V/60Hz/IT-grid
121	440-480V/60Hz/Delta
122	440-480V/60Hz

7.2.2 Grid Protection (Menu Index 1.3)

P 1.3.1 Mains Imbalance Action

Select an action for the frequency converter to take on detecting a severe mains imbalance. Operation during severe mains imbalance reduces the lifetime of the frequency converter. When selecting *[4] Fast Trip* or *[5] Fast Warning*, *P 1.2.1 Regional settings* must match the frequency of actual grid to avoid false faults.

Conditions are considered severe if the motor is operated continuously near nominal load (for example, a pump or fan running near full speed).

Default value:	0 [Trip]	**Parameter type:**	Selection
Parameter number:	1412	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Trip	Trips the frequency converter.
1	Warning	Issue a warning.
2	Disabled	No action is taken.
4	Fast Trip	Enable the fast detection to trip the frequency converter. The option is related to *P 2.3.9 Fast Mains Phase Loss Level* and *P 2.3.10 Fast Mains Phase Loss Min Power*.
5	Fast Warning	Enable the fast detection to issue a warning. The option is related to *P 2.3.9 Fast Mains Phase Loss Level* and *P 2.3.10 Fast Mains Phase Loss Min Power*.

7.3 Power Conversion & DC-link (Menu Index 2)

7.3.1 Status (Menu Index 2.1)

P 2.1.1 DC-Link voltage

View the DC-link voltage in the drive.

Default value:	0	Parameter type:	Range (0–65535)
Parameter number:	1630	Unit:	V
Data type:	uint32	Access type:	Read

P 2.1.2 Inverter Thermal

View the percentage of thermal load on the frequency converter.

Default value:	0	Parameter type:	Range (0–255)
Parameter number:	1635	Unit:	%
Data type:	uint8	Access type:	Read

P 2.1.3 Unit Nominal Current

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.

Default value:	Size Related	Parameter type:	Range (0.00–655.35)
Parameter number:	1636	Unit:	A
Data type:	uint16	Access type:	Read

P 2.1.5 Output Current Limit

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 protection.

Default value:	Size Related	Parameter type:	Range (0.00–655.35)
Parameter number:	1637	Unit:	A
Data type:	uint16	Access type:	Read

P 2.1.9 Heatsink Temperature

View the frequency converter heat sink temperature.

Default value:	0	Parameter type:	Range (-128–127)
Parameter number:	1634	Unit:	°C
Data type:	int8	Access type:	Read

P 2.1.10 Real-time Switching Frequency

View the actual switching frequency. The actual switching frequency could not be same with the set value in *P 2.4.3 Switching Frequency* due to internal derating.

Default value:	0	Parameter type:	Range (0–32)
Parameter number:	1866	Unit:	kHz

Data type:	int8	Access type:	Read

7.3.2 Protection (Menu Index 2.3)

P 2.3.1 Overvoltage Controller Enable

Select to enable or disable Overvoltage Control (OVC) to reduce the risk of the frequency converter to trip due to an overvoltage on the DC link caused by generative power from load.

Default value:	0	Parameter type:	Selection
Parameter number:	217	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	No OVC is required.
1	Enabled (not at stop)	Activate OVC except when using a stop signal to stop the frequency converter.
2	Enable	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.

P 2.3.2 Overvoltage Controller Kp

This parameter enables to fine-tune the overvoltage gain for *P 2.3.1 Overvoltage Control*. It is not necessary to change this parameter for normal applications.

Default value:	100	Parameter type:	Range (0–1000)
Parameter number:	219	Unit:	%
Data type:	uint16	Access type:	Read/Write

P 2.3.6 Power Loss Action

Select the action of frequency converter when the mains voltage drops below the limit set in *P 2.3.7 Power Loss Controller Limit*.

Default value:	0 [No function]	Parameter type:	Selection
Parameter number:	1410	Unit:	–
Data type:	enum	Access type:	Read/Write

This parameter 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 frequency converters, 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. *P 2.3.6 Power Loss Action* can be programmed to avoid this situation. Select the function to which the frequency converter must act when the threshold in *P 2.3.6 Power Loss Action* at mains fault has been reached.

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Function	The frequency converter 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 frequency converter retains control of the motor and does a controlled ramp down from *P 2.3.7 Power Loss Controller Limit*. The ramp follows the setting in *P 5.7.7 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 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.

Selection number	Selection name	Selection description
4	Kinetic Backup	Kinetic backup ensures that the frequency converter 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 frequency converter 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 *P 2.3.7 Power Loss Controller Limit* 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 frequency converter coasts. If mains returns while in kinetic backup, UDC increases above *P 2.3.7 Power Loss Controller Limit* x 1.35. This is detected in 1 of the following ways: • If UDC > *P 2.3.7 Power Loss Controller Limit* 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, *P 2.3.7 Power Loss Controller Limit* x 1.35 x 1.02. This does not fulfill the preceding criterion, and the frequency converter tries to reduce UDC to *P 2.3.7 Power Loss Controller Limit* 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	Fault	

Selection number	Selection name	Selection description
7	Kin. Backup, Trip with 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 *P 2.3.8 Kin. Back-up Trip Recovery Level* to enable detection of mains returning. If the mains does not return, the frequency converter ramps down to 0 RPM and trips. If mains return while kinetic backup is at a speed above the value set in *P 2.3.8 Kin. Backup Trip Recovery Level*, normal operation is resumed. This is equal to *[4] Kinetic Backup*. The DC level during *[7] Kinetic backup* is *P 2.3.7 Power Loss Controller Limit* x 1.35. If mains return while kinetic backup is at a speed below *P 2.3.8 Kin. Backup Trip Recovery Level*, the frequency converter 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 *P 5.7.7 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. To ensure that the function is activated, set *P 2.3.7 Power Loss Controller Limit* 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 the voltage returns and ramps up. If a fault is required at standstill, it can be programmed in the SLC.
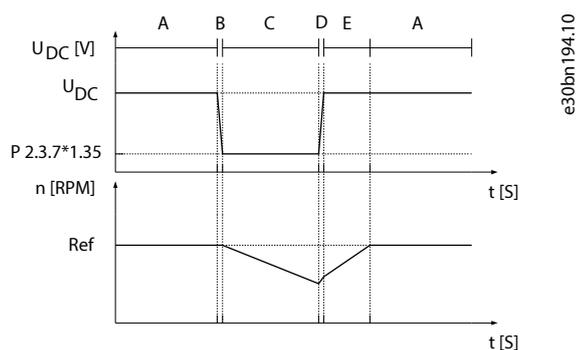
Figure 70: **Kinetic Backup**
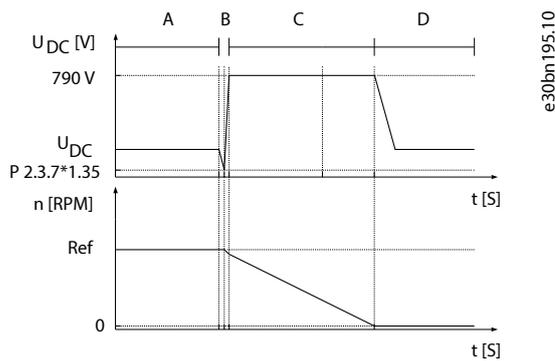
Figure 71: Kinetic Backup Trip

P 2.3.7 Power Loss Controller Limit

Enter the mains voltage at which the function selected in *P 2.3.6 Power Loss Action* is activated. This parameter defines the threshold voltage at which the selected function in *P 2.3.6 Power Loss Action* is activated. Based on the supply quality, consider to select 90% of the nominal mains as the detection level. For a supply of 380 V, *P 2.3.7 Power Loss Controller Limit* should be set to 342 V. This results in a DC detection level of 462 V (*P 2.3.7 Power Loss Controller Limit* x 1.35).

Default value:	Size Related	**Parameter type:**	Range (100–800)
Parameter number:	1411	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

P 2.3.8 Kin. Backup Trip Recovery Level

Enter the kinetic backup trip recovery level for the application. This recovery level is the minimum speed of the motor at which the frequency converter is to ramp up the speed.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	1415	**Unit:**	Hz
Data type:	uint32	**Access type:**	Read/Write

P 2.3.9 Fast Mains Phase Loss Level

Tuning the parameter to a smaller value makes the detection more sensitive and tuning the parameter to a larger value makes the detection to be less sensitive.

Default value:	300	**Parameter type:**	Range (0–500)
Parameter number:	1417	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 2.3.10 Fast Mains Phase Loss Min. Power

Fast detection is not activated if the actual power is lower than the value specified in the parameter.

Default value:	10	**Parameter type:**	Range (0–100)
Parameter number:	1418	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 2.3.13 Auto DC Braking

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 *P 1.2.2 Grid Type*.

Default value:	1 [On]	Parameter type:	Selection
Parameter number:	7	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Off	The function is not active.
1	On	The function is active.

P 2.3.14 Max Output Frequency

Enter the maximum output frequency value. *P 2.3.14 Max Output Frequency* specifies the absolute limit on the frequency converter output frequency for improved safety in applications where accidental over-speeding must be avoided. This absolute limit applies to all configurations and is independent of the setting in *P 5.4.2 Configuration Mode*.

Default value:	Size Related	Parameter type:	Range (0–500)
Parameter number:	419	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

> **NOTICE**
>
> The parameter cannot be adjusted while the motor is running. Maximum output frequency cannot exceed 10% of the inverter switching frequency in *P 2.4.3 Switching Frequency*.

P 2.3.15 Action at Inverter Fault

Select how the frequency converter reacts when an overvoltage, overcurrent, short circuit, or grounding fault occurs.

Default value:	1 [Warning]	Parameter type:	Selection
Parameter number:	1427	Unit:	V
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Trip	Disable the protection filters and trip at the 1st fault.
1	Warning	Run the protection filters normally.

P 2.3.16 Function at Inverter Overload

When the frequency converter issues an inverter overload warning, select whether to continue and probably trip the frequency converter or derate the output current.

Default value:	0 [Trip]	Parameter type:	Selection
Parameter number:	1461	Unit:	–

Data type:	enum	Access type:	Read/Write

Selection number		Selection name	
0		Trip	
1		Derate	

P 2.3.17 Adjustable Temperature Warning

This parameter is used to warn about the heat sink temperature is high, that is, high ambient temperature or higher load. A trip could happen if the condition is not rectified. When *P 2.1.9 Heat Sink Temperature* plus the value set in the parameter exceed the maximum value, HEATSINK_CLEAN_WARNING - bit 29 is set in *P 5.1.10 Ext. Status Word*. The control panel warning indicator light is not turned on when the specified limit of the parameter is reached.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	442	Unit:	–
Data type:	uint8	Access type:	Read/Write

7.3.3 Modulation (Menu Index 2.4)

P 2.4.2 Min. Switching Frequency

Set the lowest switching frequency allowed by the application.

Default value:	2 [2.0 kHz]	Parameter type:	Selection
Parameter number:	1463	Unit:	–
Data type:	enum	Access type:	Read/Write

Selection number		Selection 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	

P 2.4.3 Switching Frequency

Adjust the switching frequency to find a suitable balance between the acoustic noise from the motor and thermal losses in the frequency converter. Increasing the switching frequency reduces the noise, but increases thermal losses.

Default value:	4 [4.0 kHz]	Parameter type:	Selection
Parameter number:	1401	Unit:	–
Data type:	enum	Access type:	Read/Write

Selection number	Selection name (Size Related)
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

NOTICE

The actual open switching frequency selections depend on the specific drive model.

P 2.4.5 Over Modulation

Use the parameter to enable or disable overmodulation of the output voltage. Select *[1] On* to obtain extra DC-link voltage and torque on the motor shaft. Select *[0] Off* to avoid torque ripple on the motor shaft.

The drive offers a feature to enhance system efficiency by regulating the maximum output voltage to the nominal rating of the motor. This function is essential because drives may be powered by various supply grids. If the applied voltage exceeds the motor rating—for instance, applying more than 380 V to a 380 V motor—it increases iron losses, therefore decreasing the efficiency of the motor and the entire system. Select *[3] Limit Output Voltage* to ensure that the output voltage of the drive does not exceed the value specified in the *Nominal Motor Voltage* setting of the motor.

Default value:	1 [On]	**Parameter type:**	Selection
Parameter number:	1403	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Following are the selections for the parameter:

Selection number	Selection name	Selection 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.

> **NOTICE**
>
> Overmodulation leads to increased torque ripple as harmonics are increased.

Selection number	Selection name	Selection description
3	Limit Output Voltage	Select *[3] Limit Output Voltage* to ensure that the output voltage of the drive does not exceed the value specified in the *Nominal Motor Voltage* setting of the motor.

7.3.4 DC-Link Control (Menu Index 2.5)

P 2.5.1 Damping Gain Factor

Damping factor for DC-link voltage compensation. See *P 2.5.2 DC-Link Voltage Compensation*.

Default value:	Size Related	**Parameter type:**	Range (0–100)
Parameter number:	1408	**Unit:**	%
Data type:	uint8	**Access type:**	Read/Write

P 2.5.2 DC-Link Voltage Compensation

Enable DC-link compensation to reduce ripple in the DC-link voltage (recommended for most applications).

Default value:	Size Related	**Parameter type:**	Selection
Parameter number:	1451	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name
0	Off
1	On

7.3.5 Output Current Limit (Menu Index 2.7)

P 2.7.1 Output Current Limit %

Enter the current limit for motor and generator operation. The parameter is changed automatically if *P 4.2.2.3 Nominal Motor Current* is updated.

Default value:	Size Related	**Parameter type:**	Range (0–1000)
Parameter number:	418	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

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.

P 2.7.2 Current Limit K_p

Enter the proportional gain for the current limit controller. Selecting a higher value makes the controller react faster but may reduce stability.

Default value:	100	Parameter type:	Range (0–500)
Parameter number:	1430	Unit:	%
Data type:	uint16	Access type:	Read/Write

P 2.7.3 Current Limit T_i

Enter the integration time for the current limit controller. Selecting a lower value makes the controller react faster but may reduce stability.

Default value:	0.02	Parameter type:	Range (0.002–2.000)
Parameter number:	1431	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 2.7.4 Current Lim Ctrl, Filter Time

Enter the filter time period for the low-pass filter of the current limit control. The filter uses the average value over the period. Setting a shorter period makes the control react faster to changes in current.

Default value:	5	Parameter type:	Range (1.0–100.0)
Parameter number:	1432	Unit:	ms
Data type:	uint16	Access type:	Read/Write

P 2.7.5 Trip Delay at Current Limit

When the output current reaches the current limit (*P 2.7.1 Output Current Limit %*), a warning is triggered. If the current limit warning is continuously present for the period specified in this parameter, the frequency converter trips. Enter 60 s = OFF to disable the feature.

Default value:	60	Parameter type:	Range (0–60)
Parameter number:	1424	Unit:	s
Data type:	uint8	Access type:	Read/Write

7.4 Filters & Brake Chopper (Menu Index 3)

7.4.1 Status (Menu Index 3.1)

P 3.1.1 Brake Energy

View the brake power transmitted to an external brake resistor. The mean power is calculated on an average basis for the most recent 120 s.

Default value:	0	Parameter type:	Range (0.000–10000.000)
Parameter number:	1633	Unit:	kW
Data type:	uint32	Access type:	Read

7.4.2 **Brake Chopper (Menu Index 3.2)**

P 3.2.1 Enable Brake Chopper

Select method for dissipation of excess brake energy.

Default value:	0 [Disable]	**Parameter type:**	Selection
Parameter number:	215	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	**Selection name**
0	Disable
1	Enable

P 3.2.2 Brake Chopper Voltage Reduce

This parameter can reduce the DC voltage where the brake resistor is active. It is only valid for T4 unit.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	214	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

7.4.3 **Brake Resistor (Menu Index 3.3)**

P 3.3.2 Brake Resistor Value

Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor. *P 3.3.2 Brake Resistor Value* is only active in frequency converters with an integral dynamic brake. Use this parameter for values without decimals.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	211	**Unit:**	Ω
Data type:	uint16	**Access type:**	Read/Write

P 3.3.3 Brake Resistor Power Limit

Set the monitoring limit of the brake power transmitted to the resistor. This parameter is only active in drives with an integral dynamic brake.

Default value:	Size Related	**Parameter type:**	Range (0.001–2000)
Parameter number:	212	**Unit:**	kW
Data type:	uint32	**Access type:**	Read/Write

To calculate the value of the *P 3.3.3 Brake Power Limit*, the following formula can be used.

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

The following are the elements of the formula:

- $P_{br,\,avg}$ 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 **P 3.2.2 Brake Chopper 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, readout **P 3.1.1 Brake Energy**, and then enter this value + 20% in **P 3.3.3 Brake Resistor Power Limit**.

Selection of a low value reduces energy loss in the motor but can also reduce resistance to sudden load changes. **P 4.4.1.3 Torque Characteristic** must be set to AEO.

7.5 Motor (Menu Index 4)

7.5.1 Status (Menu Index 4.1)

P 4.1.1 Motor Current

View the motor current measured as a mean value, I$_{rms}$.

Default value:	0.00	Parameter type:	Range (0.00–655.35)
Parameter number:	1614	Unit:	A
Data type:	uint16	Access type:	Read

P 4.1.2 Motor Voltage

View the motor voltage, a calculated value used for controlling the motor.

Default value:	0	Parameter type:	Range (0–65535)
Parameter number:	1612	Unit:	V
Data type:	uint32	Access type:	Read

P 4.1.3 Motor Electrical Power

Motor power consumption in kW. The value shown is calculated on the basis of the actual DC-link voltage and DC-link current.

Default value:	0.000	Parameter type:	Range (0.000–1000.000)
Parameter number:	1610	Unit:	kW
Data type:	uint32	Access type:	Read

P 4.1.4 Motor Power Hp

Motor power consumption in hp. The value shown is calculated on basis of the actual DC-link voltage and DC-link current.

Default value:	0.000	Parameter type:	Range (0.000–1000.000)
Parameter number:	1611	Unit:	Hp
Data type:	uint32	Access type:	Read

P 4.1.5 Motor Thermal Load

View the calculated motor temperature in percentage of the allowed maximum. At 100% a trip occurs, if the ETR function selected in **P 4.6.7 Motor Thermal Protection**.

Default value:	0	Parameter type:	Range (0–100)
Parameter number:	1618	Unit:	%

Data type:	uint8	Access type:	Read

P 4.1.6 Frequency

View the actual motor frequency value.

Default value:	0.0	Parameter type:	Range (0.0–6553.5)
Parameter number:	1613	Unit:	Hz
Data type:	uint32	Access type:	Read

P 4.1.7 Frequency %

View the actual motor frequency as a percentage of *P 5.8.2 Motor Speed High Limit*.

Default value:	0.0	Parameter type:	Range (0–6553.5)
Parameter number:	1615	Unit:	%
Data type:	uint16	Access type:	Read

P 4.1.8 Motor Shaft Speed

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.

Default value:	0	Parameter type:	Range (-30000.0–30000.0)
Parameter number:	1617	Unit:	RPM
Data type:	int32	Access type:	Read

P 4.1.10 Motor Torque

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 and the motor used.

Default value:	0.0	Parameter type:	Range (-30000.0–30000.0)
Parameter number:	1616	Unit:	Nm
Data type:	int32	Access type:	Read

P 4.1.11 Motor Torque %

View the torque in percent of nominal torque, with sign, applied to the motor shaft.

Default value:	0	Parameter type:	Range (-200–200)
Parameter number:	1622	Unit:	%
Data type:	int16	Access type:	Read

7.5.2 Motor Data (Menu Index 4.2)

7.5.2.1 General Settings (Menu Index 4.2.1)

P 4.2.1.1 Motor Type

Select the motor type. Select *[0] Asynchronous Induction Motor, IM* for asynchronous motors. Select *[1] PM, Non-salient SPM* or *[3] PM, Salient IPM* for salient or non-salient PM motors. PM motors are divided into 2 groups, with either surface mounted (non-salient) or interior (salient) magnets.

Default value:	0 [Asynchronous Induction Motor, IM]	Parameter type:	Selection
Parameter number:	110	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Asynchronous Induction Motor, IM	For asynchronous Induction Motor, IM.
1	PM, Non-salient SPM	For permanent magnet (PM) motors with surface-mounted (non-salient) magnets. Refer to *P 4.4.4.7 Damping Gain* to *P 4.4.4.10 Voltage filter time const.* for details about optimizing the motor operation.
3	PM, Salient IPM	For permanent magnet (PM) motors with interior (salient) magnets.

P 4.2.1.2 Number of Pole

Enter the number of motor poles.

Default value:	4	Parameter type:	Range (2–100)
Parameter number:	139	Unit:	–
Data type:	uint8	Access type:	Read/Write

The dependency of the motor's synchronous speed ns in RPM of the frequency f of the supply in Hz (*P 1.1.1 Grid Frequency*) and the number of pole pairs p in *P 4.2.1.2 Nameplate Data* are given by the following formula:

P 4.2.2.4 Nominal Frequency*120/*P 4.2.2.5 Nominal Speed*

For example, for a motor with 2-pole pairs (4 poles) and a frequency of the power supply of 50 Hz, the synchronous speed of the motor is 1500 RPM. The following table shows the number of pole pairs for normal speed ranges of various motor types.

Pole pairs	~nn@ 50 Hz	~nn@ 60 Hz
1	2700–2880	3250–3460
2	1350–1450	1625–1730
3	700–960	840–1153

P 4.2.1.3 AMA Mode

Select type of AMA. The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters. Select either *[0] No Function*, *[1] Enable Complete AMA*, *[2] Enable Reduced AMA.*

Default value:	0 [Off]	Parameter type:	Selection
Parameter number:	129	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Off	No Function.
1	Enable Complete AMA	Depending on the option selected in *P 4.2.1.1 Motor Type*, the AMA is performed on different parameters. • If *[0] Asynchronous Induction Motor, IM* is selected, the AMA is performed on: *P 4.2.3.1 Stator Resistance (Rs)*, *P 4.2.3.2 Rotor Resistance (Rr)*, *P 4.2.3.4 Stator Leakage Reactance Xls*, and *P 4.2.3.6 Magnetizing Reactance Xm*. • If *[1] PM, non-salient SPM* is selected, the AMA is performed on: *P 4.2.3.1 Stator Resistance (Rs)* and *P 4.2.4.3 daxis Inductance (Ld)*. • If *[3] PM, Salient IPM* is selected, the AMA is performed on: *P 4.2.3.1 Stator Resistance (Rs)*, *P 4.2.4.3 daxis Inductance (Ld)*, *P 4.2.4.7 qaxis Inductance (Lq)*, *P 4.2.4.4 daxis Inductance Sat. (LdSat)*, and *P 4.2.4.8 qaxis Inductance Sat. (LqSat)*.
2	Enable Reduced AMA	Perform a reduced AMA of the stator resistance Rs. *P 4.2.3.1 Stator Resistance (Rs)* in the system only. (This option is only for asynchronous motors). Perform AMA on cold motor.

NOTICE

The parameter automatically switches back to *Off* after the AMA has been performed.

P 4.2.1.4 Motor Cable Length

Enter the length of the motor cable in unit meters.

Default value:	50	**Parameter type:**	Range (0–100)
Parameter number:	142	**Unit:**	m
Data type:	uint8	**Access type:**	Read/Write

P 4.2.1.5 Motor Cable Length Feet

Motor cable length.

Default value:	164	**Parameter type:**	Range (0–328)
Parameter number:	143	**Unit:**	Ft
Data type:	uint16	**Access type:**	Read/Write

In some products, depending on the EMC configuration, this parameter may adjust the allowable switching frequency automatically to achieve optimum performance of the drive system.

7.5.2.2 Nameplate Data (Menu Index 4.2.2)

P 4.2.2.1 Nominal Power

Set the nominal motor power from the motor nameplate data.

NOTICE

Changing this parameter affects the settings of other parameters.

Default value:	Size Related	**Parameter type:**	Range (Size Related)

Parameter number:	120	Unit:	kW
Data type:	uint16	Access type:	Read/Write

P 4.2.2.2 Nominal Voltage

Set the nominal motor voltage from the motor nameplate data.

NOTICE
Changing this parameter affects the settings of other parameters.

Default value:	Size Related	Parameter type:	Range (50–1000)
Parameter number:	122	Unit:	V
Data type:	uint16	Access type:	Read/Write

P 4.2.2.3 Nominal Current

Enter the nominal motor current value from the motor nameplate data.

NOTICE
Changing this parameter affects the settings of other parameters.

Default value:	Size Related	Parameter type:	Range (0.01–1000.00)
Parameter number:	124	Unit:	A
Data type:	uint32	Access type:	Read/Write

P 4.2.2.4 Nominal Frequency

Select the motor frequency value from the motor nameplate data.

NOTICE
Changing this parameter affects the settings of other parameters.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	123	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 4.2.2.5 Nominal Speed

Enter the nominal motor speed value from the motor nameplate data.

NOTICE
Changing this parameter affects the settings of other parameters.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	125	Unit:	RPM
Data type:	uint16	Access type:	Read/Write

7.5.2.3 Async. Induction Motor (Menu Index 4.2.3)

P 4.2.3.1 Stator Resistance Rs

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

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	130	Unit:	Ω
Data type:	uint32	Access type:	Read/Write

P 4.2.3.2 Rotor Resistance Rr

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

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	131	Unit:	Ω
Data type:	uint32	Access type:	Read/Write

P 4.2.3.4 Stator Leakage Reactance Xls

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

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	133	Unit:	Ω
Data type:	uint32	Access type:	Read/Write

P 4.2.3.6 Magnetizing Reactance Xm

Set the main reactance value. Enter the value from a motor datasheet or perform an AMA on a cold motor. The default setting is calculated by the drive from motor nameplate data.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	135	Unit:	Ω
Data type:	uint32	Access type:	Read/Write

P 4.2.3.7 Motor Cont. Rated Torque

Enter the value from the motor nameplate data. This parameter is available only when *P 4.2.1.1 Motor Type* is set to *[1] PM, Non-salient PM*.

Note: Changing this parameter affects the settings of other parameters.

Default value:	Size Related	Parameter type:	Range (0.1–10000.0)
Parameter number:	126	Unit:	Nm
Data type:	uint32	Access type:	Read/Write

7.5.2.4 Permanent Magnet Motor (Menu Index 4.2.4)

P 4.2.4.1 Back EMF at 1000 RPM

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 frequency converter 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 as 1000 RPM: Back EMF = (Voltage/RPM)*1000 = (320/1800)*1000 = 178.

This parameter is only active when **P 4.2.1.1 Motor Construction** is set to options that enable PM (Permanent Magnet) motors.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	140	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

<table>
<tr><td colspan="2" align="center">NOTICE</td></tr>
<tr><td colspan="2">When using PM motors, it is recommended to use brake resistors.</td></tr>
</table>

P 4.2.4.3 d-axis Inductance Ld

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

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	137	**Unit:**	mH
Data type:	int32	**Access type:**	Read/Write

P 4.2.4.4 d-axis Inductance LdSat

This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as **P 4.2.2.3 Nominal Current**. However, if motor supplier provides an inductance curve, the inductance value at 100% of **P 4.2.2.3 Nominal Current** should be entered here.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	144	**Unit:**	mH
Data type:	int32	**Access type:**	Read/Write

P 4.2.4.6 Ld Current Point

Specify the saturation curve of the d-axis inductance values. The d-axis inductance value is linearly approximated to **P 4.2.4.3 d-axis Inductance Ld**.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	148	**Unit:**	%
Data type:	int16	**Access type:**	Read/Write

P 4.2.4.7 q-axis Inductance Lq

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

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	138	**Unit:**	mH
Data type:	int32	**Access type:**	Read/Write

P 4.2.4.8 q-axis Inductance LqSat

This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as **P 4.2.4.7 q-axis Inductance Lq**. When the motor supplier provides an inductance curve, the inductance value at 100% of **P 4.2.2.3 Nominal Current** should be specified.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	145	Unit:	mH
Data type:	int32	Access type:	Read/Write

P 4.2.4.10 Lq Current Point

Specify the saturation curve of the q-axis inductance values. The q-axis inductance value is linearly approximated to **P 4.2.4.7 q-axis Inductance Lq** and **P 4.2.4.8 q-axis Inductance LqSat**.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	149	Unit:	%
Data type:	uint16	Access type:	Read/Write

7.5.3 Motor Control (Menu Index 4.4)

7.5.3.1 General Settings (Menu Index 4.4.1)

P 4.4.1.2 AEO Minimum Magnetization

Enter the minimum allowed magnetization for the automatic energy optimization (AEO) mode. Selecting a low value reduces energy loss in the motor, but also reduces resistance to sudden load changes.

Default value:	40	Parameter type:	Range (10–100)
Parameter number:	1441	Unit:	%
Data type:	uint8	Access type:	Read/Write

P 4.4.1.3 Torque Characteristic

Select the torque characteristic. Variable Torque and Auto Energy Optim. CT are both energy saving operations.

Default value:	0 [Constant Torque]	Parameter type:	Selection
Parameter number:	103	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection 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 **P 4.4.4.13 VT Level**.
2	Auto Energy Optim. CT	Automatically optimizes energy consumption by minimizing magnetization and frequency via **P 4.4.1.2 AEO Minimum Magnetisation**.

P 4.4.1.4 Clockwise Direction

This parameter defines the term clockwise corresponding to the control panel direction arrow. The parameter is used to easily change direction of shaft rotation without swapping motor wires.

Default value:	0 [Normal]	Parameter type:	Selection
Parameter number:	106	Unit:	–

Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Normal	The motor shaft turns in clockwise direction when frequency converter is connected U⇒U; V⇒V; and W⇒W to motor.
1	Inverse	The motor shaft turns in counterclockwise direction when frequency converter is connected U⇒U; V⇒V; and W⇒W to motor.

P 4.4.1.5 Motor Control Bandwidth

Select type of motor control bandwidth.

Default value:	1 [Medium]	Parameter type:	Selection
Parameter number:	108	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	High	For high dynamic response.
1	Medium	Optimized for smooth steady state operation.
2	Low	Optimized 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	Focuses on low-inductance PM motors. This option is an alternative to *[3] Adaptive 1*.

7.5.3.2 AC-Brake (Menu Index 4.4.2)

P 4.4.2.1 Enable AC Brake

Select the method for dissipation of excess brake energy.

Default value:	0 [Disable]	Parameter type:	Selection
Parameter number:	210	Unit:	–
Data type:	enum	Access type:	Read/Write

Selection number	Selection name
0	Disable
1	Enable

P 4.4.2.2 AC Brake, Max current

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

Default value:	100	Parameter type:	Range (0–160)
Parameter number:	216	Unit:	%

Data type:	uint16	Access type:	Read/Write

NOTICE

The parameter is only available for induction motors.

P 4.4.2.3 AC Brake Voltage Control Kp

Use the parameter to set AC brake power capability (set ramp-down time when inertia is constant). If the DC-link voltage is not higher than the DC-link voltage warning value, the generator torque can be adjusted with this parameter. The higher the AC-brake gain is, the stronger the brake capability is. If it equals 1.0, there is no AC-brake capability.

Default value:	1.4	Parameter type:	Range (1.0–2.0)
Parameter number:	188	Unit:	–
Data type:	uint16	Access type:	Read/Write

NOTICE

If there is continuous generator torque, there is a higher risk of causing a high motor current which leads to a hot motor. Use *P 4.4.2.2 AC Brake, Max current* to protect the motor from overheating.

7.5.3.3 U/f Curve (Menu Index 4.4.3)

P 4.4.3.1 Voltage Point

Enter the voltage at each frequency point to manually form a U/f characteristic matching the motor. The frequency points are defined in *P 4.4.3.2 Frequency Point*.

Default value:	Size Related	Parameter type:	Range (0–1000)
Parameter number:	155	Unit:	V
Data type:	uint16	Access type:	Read/Write

P 4.4.3.2 Frequency Point

Enter the frequency points to manually form a U/f characteristic matching the motor. The voltage at each point is defined in *P 4.4.3.1 Voltage Point*.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	156	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

Make a U/f characteristic based on 6 definable voltages and frequencies. See Figure 72.
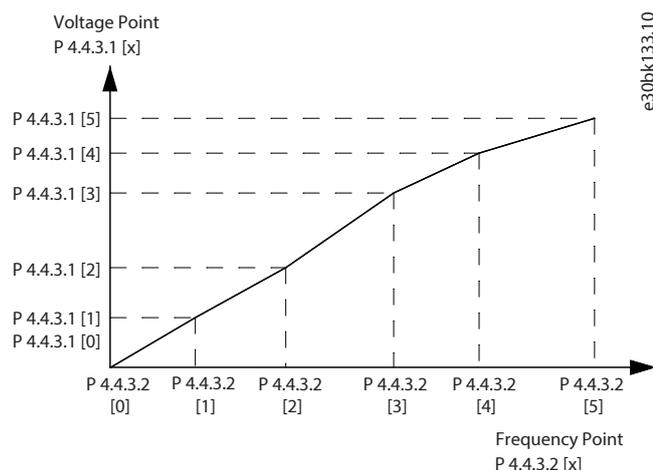
Figure 72: Example of U/f Characteristic

7.5.3.4 Dependent Setting (Menu Index 4.4.4)

P 4.4.4.1 Slip Comp. Gain

Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, that is, based on the rated motor speed $n_{M,N}$. This function is not active when *P 5.4.2 Configuration Mode* is set to *[1] Speed closed loop*, *[2] Torque closed loop*, or *[4] Torque open loop*, or when *P 5.4.3 Motor Control Principle* is set to *[0] U/f*, or when *P 4.2.1.1 Motor Type* is set to *[1] PM, Non-salient SPM* or *[3] PM, Salient IPM*.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	162	Unit:	%
Data type:	int16	Access type:	Read/Write

P 4.4.4.2 Slip Comp. Time Constant

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.

Default value:	0.10	Parameter type:	Range (0.05–5.00)
Parameter number:	163	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 4.4.4.3 High Speed Load Comp.

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

Default value:	100	Parameter type:	Range (0–300)
Parameter number:	161	Unit:	%
Data type:	int16	Access type:	Read/Write

P 4.4.4.4 Low Speed Load Comp.

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

Default value:	100	Parameter type:	Range (0–300)
Parameter number:	160	Unit:	%

Data type:	int16	**Access type:**	Read/Write

P 4.4.4.5 Res. Damp Gain

Enter the resonance damping value. Use the parameter and *P 4.4.4.6 Res. Damp High Pass Time Constant* to help eliminate high frequency resonance problems. To reduce resonance oscillation, increase the value of *P 4.4.4.5 Res. Damp Gain*.

Default value:	Size Related	**Parameter type:**	Range (0–500)
Parameter number:	164	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 4.4.4.6 Res. Damp High Pass Time Constant

Set the parameter and *P 4.4.4.5 Res. Damp Gain* to help eliminate high frequency resonance problems. Enter the time constant that provides the best dampening.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	165	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 4.4.4.7 Damping Gain

The damping gain stabilizes the PM machine to run the PM machine smooth and stable. The value of damping gain controls the dynamic performance of the PM machine. High damping gain gives low dynamic performance and low damping gain give high dynamic performance. The dynamic performance is related to the machine data and load type. When the damping gain is too high or low the control becomes unstable.

Default value:	120	**Parameter type:**	Range (Size Related)
Parameter number:	114	**Unit:**	%
Data type:	int16	**Access type:**	Read/Write

P 4.4.4.8 High Speed Filter Time Const.

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 gets unstable.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	116	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 4.4.4.9 Low Speed Filter Time Const.

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 gets unstable.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	115	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 4.4.4.10 Voltage Filter Time Const.

Use this parameter to reduce 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.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	117	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 4.4.4.11 Variable Torque Zero Speed Magnetization

Use this parameter along with *P 4.4.4.12 Min Speed Normal Magnetizing [Hz]* to obtain a different magnetizing current on the motor when running at low speed. Enter a percentage value of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

Default value:	100	Parameter type:	Range (0–300)
Parameter number:	150	Unit:	%
Data type:	uint16	Access type:	Read/Write
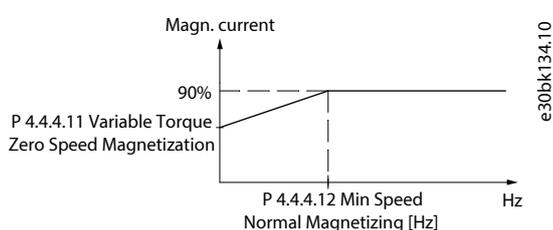
Figure 73: Motor Magnetization

P 4.4.4.12 Min Speed Normal Magnetizing [Hz]

Set the required frequency for normal magnetizing current. Use this parameter along with *P 4.4.4.11 Variable Torque Zero Speed Magnetization*.

Default value:	1.0	Parameter type:	Range (Size Related)
Parameter number:	152	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 4.4.4.13 VT Level

Enter the level of motor magnetization at low speed. Selecting a low value reduces energy loss in the motor but also reduces load capability.

Default value:	66	Parameter type:	Range (40–90)
Parameter number:	1440	Unit:	%
Data type:	uint8	Access type:	Read/Write

NOTICE

This parameter is not active when *P 4.2.1.1 Motor Type* is set to options that enable PM motor mode.

P 4.4.4.14 Min. Current at Low Speed

Enter the minimum motor current at low speed. Increasing this current improves motor torque at low speed. The parameter is only enabled for PM motors.

Default value:	Size Related	Parameter type:	Range (Size Related)
Parameter number:	166	Unit:	%
Data type:	uint32	Access type:	Read/Write

7.5.3.5 Dead Time Compensation (Menu Index 4.4.4.5)

P 4.4.5.1 Dead Time Compensation Level

Applied dead-time compensation level (%). A high level (>90%) optimizes the dynamic motor response, a level from 50–90% is good for both motor-torque ripple minimization and the motor dynamics, a zero level turns off the dead-time compensation.

Default value:	Size Related	**Parameter type:**	Range (0–100)
Parameter number:	1407	**Unit:**	–
Data type:	uint8	**Access type:**	Read/Write

P 4.4.5.2 Dead Time Bias Current Level

Set a bias signal (in [%]) to add to the current-sense signal for dead-time compensation.

Default value:	Size Related	**Parameter type:**	Range (0–100)
Parameter number:	1409	**Unit:**	%
Data type:	uint8	**Access type:**	Read/Write

P 4.4.5.3 Dead Time Compensation Zero Current Level

Setting this parameter to *[1] Enabled* at a long motor cable minimizes the motor-torque ripple.

Default value:	[0] Disabled	**Parameter type:**	Selection
Parameter number:	1464	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	The function is not active.
1	Enabled	When a long motor cable is used, select this option to minimize the motor-torque ripple.

P 4.4.5.4 Speed Derate Dead Time Compensation

Dead-time compensation level is reduced linearly versus output frequency from the maximum level set by *P 4.4.5.1 Dead Time Compensation Level* to a minimum level set in this parameter.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	1465	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

7.5.4 Protection (Menu Index 4.6)

P 4.6.1 Warning Freq. High

Use this parameter to set a high limit for the frequency range. When the motor speed is above this limit, warning bit 9 is set in *P 5.1.9 Ext. Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this parameter set limit is reached.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	441	**Unit:**	Hz

Data type:	uint16	**Access type:**	Read/Write

P 4.6.2 Warning Freq. Low

When the motor speed falls below this limit, warning bit 10 is set in *P 5.1.9 Ext. Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this parameter set limit is reached.

Default value:	0	**Parameter type:**	Range (Size Related)
Parameter number:	440	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 4.6.3 Warning Current High

Enter the I-high value. When the motor current exceeds this limit, a bit in the drives status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	451	**Unit:**	A
Data type:	uint32	**Access type:**	Read/Write

P 4.6.4 Warning Current Low

Enter the I-low value. When the motor current falls below this limit, a bit in the drives status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

Default value:	0.00	**Parameter type:**	Range (Size Related)
Parameter number:	450	**Unit:**	A
Data type:	uint32	**Access type:**	Read/Write

P 4.6.7 Motor Thermal Protection

Motor thermal protection can be implemented via a PTC sensor in the motor windings connected to 1 of the analog or digital inputs (*P 4.6.8 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 fault.

Default value:	0 [No Protection]	**Parameter type:**	Selection
Parameter number:	190	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	No Protection	Continuously overloaded motor, when no warning or trip of the frequency converter is required.
1	Thermistor Warning	Activates a warning when the connected thermistor in the motor reacts to a motor overtemperature.
2	Thermistor Trip	Stops (trips) the frequency converter 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.

Selection number	Selection name	Selection description
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 frequency converter 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 frequency converter trips (thermal warning)
22	ETR Trip - Extended Detection	
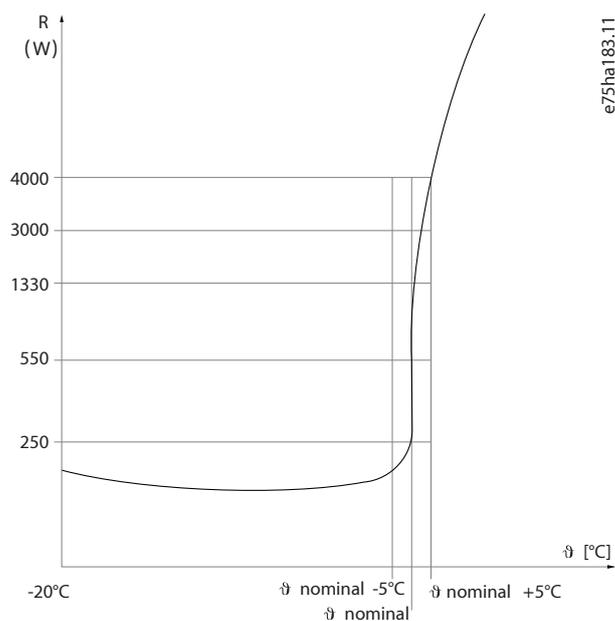
Figure 74: PTC Profile

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

- Set *P 4.6.7 Motor Thermal Protection* to *[2] Thermistor Trip*.

- Set *P 4.6.8 Thermistor Source* to *[6] Digital Input 18*.
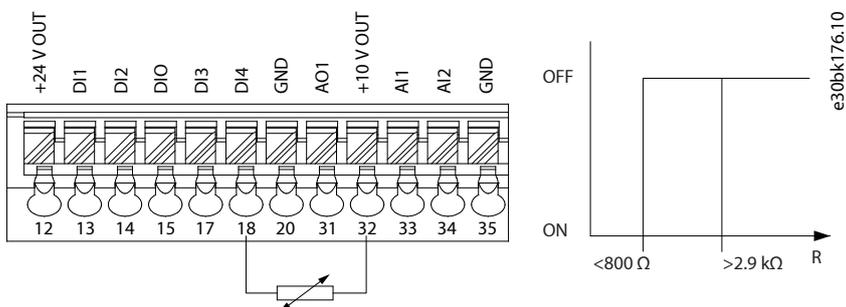
Figure 75: PTC Thermistor Connection - Digital Input

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

- Set *P 4.6.7 Motor Thermal Protection* to *[2] Thermistor Trip*.

- Set *P 4.6.8 Thermistor Source* to *[2] Analog Input 34*.
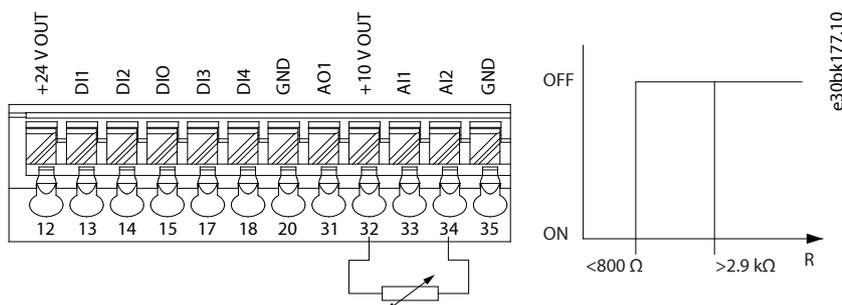
Figure 76: PTC Thermistor Connection - Analog Input

Table 62: 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.

P 4.6.8 Thermistor Source

Select the input at which the thermistor (PTC sensor) should be connected. When using an analog input, the same analog input cannot be used for any other purpose such as reference or feedback source.

Default value:	0 [None]	**Parameter type:**	Selection
Parameter number:	193	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name
0	None
1	Analog Input 33
2	Analog Input 34
3	Digital Input 13
4	Digital Input 14
6	Digital Input 18

NOTICE

Set the digital input to *[0] PNP - Active* at 24 V in Digital Input Mode.

P 4.6.9 Motor External Fan

Select whether an external fan to the motor is required.

Default value:	0 [No]	**Parameter type:**	Selection
Parameter number:	191	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	No	An external fan is required and the motor is derated at low speed.
1	Yes	Apply an external motor fan (external ventilation), so that derating of the motor is not required at low speed.

P 4.6.12 Missing Motor Phase Function

Select *[1] Trip 10 s* to show a fault in the event of a missing motor phase. Select *[0] Off* for no missing motor phase fault. The setting *[1] Trip 10 s* is recommended to avoid motor damage.

Default value:	1 [Yes]	**Parameter type:**	Selection
Parameter number:	458	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	Off	No fault is shown if a missing motor phase occurs.
1	Trip 10 s	A fault is shown if a missing motor phase occurs.

P 4.6.13 Fault Level

Use this parameter to customize fault levels.

Default value:	3 [Trip Lock]	**Parameter type:**	Selection
Parameter number:	1490	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
3	Trip Lock	Fault is set to trip lock.
4	Trip with Delayed Reset	Fault is configured into a trip fault, which can be reset after a delay time. For example, if *Fault 13, Overcurrent* is configured to this option, it can be reset 3 minutes after the fault. This option uses the 8th element to control the fault level of *Fault 13, Overcurrent*.
5	Fly start	At startup, the frequency converter tries to catch a spinning motor. If this option is selected, *P 5.6.3 Enable Flying Start* is forced to *[1] Enabled*. This option uses the 8th element to control the fault level of *Fault 13, Overcurrent*.

Table 63: Selection of Action when Selected Fault Appears

Index	Fault	Trip lock	Trip with delay	Fly start
0	Reserved	–	–	–
1	Reserved	–	–	–
2	Reserved	–	–	–
3	Reserved	–	–	–
4	Reserved	–	–	–
5	Reserved	–	–	–

Table 63: Selection of Action when Selected Fault Appears - (continued)

Index	Fault	Trip lock	Trip with delay	Fly start
6	Reserved	–	–	–
7	Overcurrent	D	X	X

D indicates Default Setting and X indicates Possible Selection.

P 4.6.14 Sync. Locked Rotor Protection

Locked rotor detection for PM motor.

Default value:	0 [Off]	**Parameter type:**	Selection
Parameter number:	3022	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	Off	The function is not active.
1	On	The locked rotor protection for PM motors.

P 4.6.15 Sync. Locked Rotor Detection Time [s]

Locked rotor detection time for PM motor.

Default value:	0.10	**Parameter type:**	Range (0.05–1.0)
Parameter number:	3023	**Unit:**	s
Data type:	uint8	**Access type:**	Read/Write

7.6 Application (Menu Index 5)

7.6.1 Status (Menu Index 5.1)

P 5.1.1 Fault Word 1

Use this parameter to view fault word 1 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1690	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.2 Fault Word 2

Use this parameter to view fault word 2 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1691	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.3 Fault Word 3

Use this parameter to view fault word 3 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)

		Unit:	–
Parameter number:	1697		
Data type:	uint32	**Access type:**	Read

P 5.1.4 Warning Word 1

Use this parameter to view the warning word 1 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1692	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.5 Warning Word 2

Use this parameter to view the warning word 2 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1693	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.6 Warning Word 3

Use this parameter to view the warning word 3 in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1698	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.7 Active Control Word

Use this parameter to view the control word sent from the drive in hex code.

Default value:	0	**Parameter type:**	Range (0–65535)
Parameter number:	1600	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 5.1.8 Drive Status Word

Use this parameter to view the status word sent from the drive via bus.

Default value:	0	**Parameter type:**	Range (0–65535)
Parameter number:	1603	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 5.1.9 Ext. Status Word

Use this parameter to view the extended status word in hex code.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1694	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 5.1.10 Ext. Status Word 2

Use this parameter to view the extended status word 2 in hex code.

Default value:	0	Parameter type:	Range (0–4294967295)
Parameter number:	1695	Unit:	–
Data type:	uint32	Access type:	Read

P 5.1.11 Active Fault Number

This parameter contains an array of up to 20 faults that are currently active. The value 0 means no fault.

Default value:	0	Parameter type:	Range (0–65535)
Parameter number:	1855	Unit:	–
Data type:	uint16	Access type:	Read

P 5.1.12 Active Warning Number

This parameter contains an array of up to 20 warnings that are currently active. The value 0 means no warning.

Default value:	0	Parameter type:	Range (0–65535)
Parameter number:	1856	Unit:	–
Data type:	uint16	Access type:	Read

P 5.1.16 Reference [Unit]

Use this parameter to view the present value of reference applied in the drive calculated from the configuration in *P 5.4.2 Operation Mode*.

Default value:	0.000	Parameter type:	Range (-4999.000–4999.000)
Parameter number:	1601	Unit:	ReferenceFeedbackUnit
Data type:	int32	Access type:	Read

P 5.1.17 Reference [%]

Use this parameter to view the total reference.

Default value:	0.0	Parameter type:	Range (-200.0–200.0)
Parameter number:	1602	Unit:	%
Data type:	int16	Access type:	Read

P 5.1.18 External Reference

Use this parameter to view the sum of all external reference sources defined in *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source*.

Default value:	0.0	Parameter type:	Range (-200.0–200.0)
Parameter number:	1650	Unit:	%
Data type:	int16	Access type:	Read

P 5.1.19 Main Actual Value [%]

Use this parameter to view the Main Actual Value sent from the drive via bus.

Default value:	0.00	Parameter type:	Range (-200.00–200.00)
Parameter number:	1605	Unit:	%
Data type:	int16	Access type:	Read

P 5.1.20 Speed Error [RPM]

Select the speed error.

Default value:	0	Parameter type:	Range (-60000.000–60000.000)
Parameter number:	1644	Unit:	RPM
Data type:	int32	Access type:	Read

P 5.1.21 Speed Ref. After Ramp [RPM]

This parameter specifies the reference given to the drive after the speed ramp in RPM.

Default value:	0	Parameter type:	Range (-30000–30000)
Parameter number:	1648	Unit:	RPM
Data type:	int32	Access type:	Read

P 5.1.26 FC Port CTW 1

Use this parameter to view the 2-byte control word (CTW) received from the bus master.

Default value:	1084	Parameter type:	Range (0–65535)
Parameter number:	1685	Unit:	–
Data type:	uint16	Access type:	Read

P 5.1.27 FC Port REF 1

Use this parameter to view the last received reference from the FC port.

Default value:	0	Parameter type:	Range (-32768–32767)
Parameter number:	1686	Unit:	–
Data type:	int16	Access type:	Read

7.6.2 Protection (Menu Index 5.2)

P 5.2.1 Warning Reference High

Use this parameter to set the high limit for the reference range. When the actual reference exceeds this limit, warning bit 19 is set in *P 5.1.9 Ext. Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

Default value:	4999.000	Parameter type:	Range (-4999.000–4999.000)
Parameter number:	455	Unit:	–
Data type:	int32	Access type:	Read/Write

P 5.2.2 Warning Reference Low

Use this parameter to set the low limit for the reference range. When the actual reference exceeds this limit, warning bit 20 is set in *P 5.1.9 Ext. Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

Default value:	-4999.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	454	**Unit:**	–
Data type:	int32	**Access type:**	Read/Write

P 5.2.3 Warning Feedback High

Use this parameter to set the high limit for the feedback range. When the feedback exceeds this limit, warning bit 5 is set in *P 5.1.9 Ext.Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

Default value:	4999.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	457	**Unit:**	ProcessCtrlUnit
Data type:	int32	**Access type:**	Read/Write

P 5.2.4 Warning Feedback Low

Use this parameter to set the low limit for the feedback range. When the feedback exceeds this limit, warning bit 6 is set in *P 5.1.9 Ext.Status Word*. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

Default value:	-4999.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	456	**Unit:**	ProcessCtrlUnit
Data type:	int32	**Access type:**	Read/Write

P 5.2.9 Lost Load Function

Select an action if lost load is detected.

Default value:	0 [Off]	**Parameter type:**	Selection
Parameter number:	2260	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Off	The function is not active.
1	Warning	The frequency converter continues to run, but activates a warning. A frequency converter digital output or a serial communication bus communicates a warning to other equipment.
2	Trip	The frequency converter stop running and activates a fault. A frequency converter digital output or a serial communication bus communicates a fault to other equipment.

P 5.2.10 Lost Load Detection Torque Level

Set the minimum allowed torque level in percent to motor nominal torque. The lost load detection can be activated below this level.

Default value:	10	**Parameter type:**	Range (5–100)
Parameter number:	2261	**Unit:**	%
Data type:	uint8	**Access type:**	Read/Write

P 5.2.11 Lost Load Detection Delay

Set the minimum duration that the torque has to be below detection limit before activating the lost load exception.

Default value:	10	**Parameter type:**	Range (0–600)
Parameter number:	2262	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.2.16 Watchdog Response

Use this parameter to select the timeout function. The timeout function activates when the control word fails to be updated within the time period specified in *P 5.2.17 Watchdog Delay*.

Default value:	0 [Off]	**Parameter type:**	Selection
Parameter number:	804	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Off
1	Freeze Output
2	Stop
3	Jogging
4	Max. Speed
5	Stop and Trip
6	Qstop and Trip
7	Select Setup 1
8	Select Setup 2
26	Trip

P 5.2.17 Watchdog Delay

Use this parameter to 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, and the function selected in *P 5.2.16 Watchdog Response* is then carried out.

Default value:	1.0	**Parameter type:**	Range (0.5–6000.0)
Parameter number:	803	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

7.6.3 Operation Mode (Menu Index 5.4)

P 5.4.1 Application Selection

Use this parameter to select integrated application functions. When an application is selected, a set of its related parameters is set automatically.

Default value:	20 [Speed Control Mode]	**Parameter type:**	Selection
Parameter number:	16	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
20	Speed Control Mode
21	Process Control Mode
22	Multi Speed Control Mode
23	Three Wire Control Mode
24	Torque Control Mode

P 5.4.2 Operation Mode

Use this parameter to select the application control principle to be used.

Default value:	0 [Speed Open Loop]	**Parameter type:**	Selection
Parameter number:	100	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Speed Open Loop	Enable speed control (without feedback signal from the motor) with automatic slip compensation for almost constant speed at varying loads. Compensations are active and can be disabled.
3	Process Closed Loop	Enable the use of process control in the frequency converter.
4	Torque Open Loop	Enable the use of torque open loop in the frequency converter

P 5.4.3 Motor Control Principle

Use this parameter to select U/f mode or VVC+ mode as the motor control principle.

Default value:	1 [VVC+]	**Parameter type:**	Selection
Parameter number:	101	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	U/f	When running U/f, control slip and load compensations are not included. The control is used for parallel-connected motors and/or special motor applications
1	VVC+	Normal running mode, including slip and load compensations.

NOTICE

When *P 4.2.1.1 Motor Type* is set to PM enabled options, only VVC+ option is available.

P 5.4.4 Local Mode Configuration

This parameter is only relevant when *P 5.4.2 Operation Mode* is set to *[3] Process Closed Loop*. The parameter is used for determining the reference or setpoint handling when changing from remote mode to local mode on the control panel.

Default value:	2 [As configuration in Operation Mode]	**Parameter type:**	Selection
Parameter number:	105	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Speed Open Loop	In local mode, the drive always runs in open-loop configuration regardless of the setting in *P 5.4.2 Operation Mode*. Local potentiometer (if present) or *Up/Down* buttons determine output frequency limited by the motor speed high/low limit (*P 5.8.2 Motor Speed High Limit [Hz]* and *P 5.8.3 Motor Speed Low Limit [Hz]*).
2	As configuration in Operation Mode	If *P 5.4.2 Operation Mode* is set to *[0] Speed Open Loop*, the function is as described above. If *P 5.4.2 Operation Mode* is set to *[3] Process Closed Loop*, changing from remote mode to local mode results in a setpoint change via local potentiometer or *Up/Down* buttons. The change is limited by reference max/min (*P 5.5.3.3 Reference Maximum* and *P 5.5.3.4 Reference Minimum*).

7.6.4 Control (Menu Index 5.5)

7.6.4.1 General Settings (Menu Index 5.5.1)

P 5.5.1.1 Control Place Selection

Use this parameter to select the control place of the unit.

Default value:	0 [Digital and Ctrl. word]	**Parameter type:**	Selection
Parameter number:	801	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital and Ctrl. word	Use both the digital input and the control word.
1	Digital only	Use the digital input only.
2	Control word only	Use the control word only.

P 5.5.1.2 Control Source

Use this parameter to select the source of the control word.

Default value:	1 [FC Port]	Parameter type:	Selection
Parameter number:	802	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	None
1	FC Port

P 5.5.1.6 Configurable Status Word STW

Use this parameter to configure status word bits. Bits 5 and 12–15 of the STW are configurable for various drive status signals.

Default value:	1 [Profile Default]	Parameter type:	Selection
Parameter number:	813	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
1	Profile default
10	T13 DI status
11	T14 DI status
12	T15 DI status
13	T17 DI status
15	T18 DI status
21	Thermal warning
30	Brake fault (IGBT)
40	Out of reference range
54	Running
59	On reference

P 5.5.1.7 Configurable Control Word CTW

Use this parameter to configure control word bits. The control word has 16 bits (0–15). Bits 10 and 12–15 are configurable.

Default value:	1 [Profile Default]	Parameter type:	Selection

Parameter number:	814	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	None
1	Profile default
2	CTW valid, active low

P 5.5.1.10 Operating State at Power-up

Select the operating mode for restart upon reconnection of the drive to mains voltage after power down. This function is active in Local mode only.

Default value:	1 [Forced stop, ref = old]	**Parameter type:**	Selection
Parameter number:	4	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Resume	Restart the frequency converter, maintaining the start or stop settings using *START* or *STOP* button, selected before power-down of the frequency converter.
1	Forced Stop, Ref.=old	Restart the frequency converter with a saved local reference after mains voltage reappears, after pressing *START*.
2	Forced Stop, Ref.=0	Reset the local reference to 0 upon restarting the frequency converter.

P 5.5.1.15 [REM/LOC] Button

Use this parameter to select the function of the REM/LOC button. To avoid accidental LOC/REM change of the drive, select *[0] Disabled*. The setting can be locked by *P 6.6.20 Password*.

Default value:	1 [Enabled]	**Parameter type:**	Selection
Parameter number:	46	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Disabled
1	Enabled

P 5.5.1.16 [Stop/Reset] Button

Use this parameter to select the function of the *Stop/Reset* button. To avoid accidental stop or reset of the drive from control panel, select *[0] Disabled*. The setting can be locked by *P 6.6.20 Password*.

Default value:	1 [Enabled]	**Parameter type:**	Selection

Parameter number:	44	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Disabled
1	Enabled
7	Reset Only Enabled

7.6.4.2 Digital/Bus (Menu Index 5.5.2)

P 5.5.2.1 Coasting Select

Use this parameter to select whether the coasting function is controlled via the terminals (digital input) and/or via the bus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	Parameter type:	Selection
Parameter number:	850	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	Activate the coasting command via a digital input
1	Bus	Activate the coasting command via the serial communication port or fieldbus option.
2	Logic AND	Activate the coasting command via the fieldbus/serial communication port and 1 extra digital input.
3	Logic OR	Activate the coasting command via the fieldbus/serial communication port or via 1 of the digital inputs.

P 5.5.2.2 Quick Stop Select

Use this parameter to select whether the Quick Stop function is controlled via the terminals (digital input) and/or via the bus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	Parameter type:	Selection
Parameter number:	851	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	Activate the quick stop command via a digital input.
1	Bus	Activate the quick stop command via the serial communication port or fieldbus option.
2	Logic AND	Activate the quick stop command via the fieldbus/serial communication port and also via 1 of the digital inputs.
3	Logic OR	Activate the quick stop command via the fieldbus/serial communication port or via 1 of the digital inputs.

P 5.5.2.3 DC Brake Select

Use this parameter to select whether the DC brake is controlled via the terminals (digital input) and/or via the fieldbus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	Parameter type:	Selection
Parameter number:	852	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	Activate the DC-brake command via a digital input.
1	Bus	Activate the DC-brake command via the serial communication port or fieldbus option.
2	Logic AND	Activate the DC-brake command via the fieldbus/serial communication port and additionally via 1 of the digital inputs.
3	Logic OR	Activate the DC-brake command via the fieldbus/serial communication port or via 1 of the digital inputs.

P 5.5.2.4 Start Select

Use this parameter to select whether the drive start function is controlled via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	Parameter type:	Selection
Parameter number:	853	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	A digital input triggers the start function.
1	Bus	A serial communication port or the fieldbus triggers the start function.

Selection number	Selection name	Selection description
2	Logic AND	The fieldbus/serial communication port and a digital input trigger the start function.
3	Logic OR	The fieldbus/serial communication port or a digital input triggers the start function.

P 5.5.2.5 Reversing Select

Use this parameter to select whether the drive reverse function is controlled via the terminals (digital input) and/or via the fieldbus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	**Parameter type:**	Selection
Parameter number:	854	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	A digital input triggers the reversing function.
1	Bus	A serial communication port or the fieldbus triggers the reversing function.
2	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
3	Logic OR	The fieldbus/serial communication port or a digital input triggers the reversing function.

P 5.5.2.6 Set-up Select

Use this parameter to select whether the drive setup selection is controlled via the terminals (digital input) and/or via the fieldbus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	**Parameter type:**	Selection
Parameter number:	855	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Digital input	A digital input triggers the setup selection.
1	Bus	A serial communication port or the fieldbus triggers the setup selection.

Selection number	Selection name	Selection description
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.

P 5.5.2.7 Preset Reference Select

Use this parameter to select whether the drive Preset Reference selection is controlled via the terminals (digital input) and/or via the fieldbus.

NOTICE
This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to *[0] Digital and control word*.

Default value:	3 [Logic OR]	**Parameter type:**	Selection
Parameter number:	856	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection 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.

7.6.4.3 Reference (Menu Index 5.5.3)

P 5.5.3.1 Reference Range

Use this parameter to select the range of the reference signal and the feedback signal.

Default value:	0 [Min–Max]	**Parameter type:**	Selection
Parameter number:	300	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection 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 *P 5.8.1 Rotation Direction*.

P 5.5.3.2 Reference/Feedback Unit

Use this parameter to select the unit to be used in Process PID Control references and feedback.

Default value:	3 [Hz]	**Parameter type:**	Selection
Parameter number:	301	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	None
1	%
2	RPM
3	Hz
4	Nm
5	PPM
10	l/min
12	Pulse/s
20	l/s
21	l/min
22	l/h
23	m³/s
24	m³/min
25	m³/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

Selection number	Selection name
123	gal/h
124	CFM
125	ft³/s
126	ft³/min
127	ft³/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/in²
172	in WG
173	ft WG
180	HP

P 5.5.3.3 Reference Maximum

Use this parameter to set the maximum reference. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the configuration in *P 5.4.2 Configuration Mode*.

Default value:	Size Related	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	303	**Unit:**	Reference Feedback Unit
Data type:	int32	**Access type:**	Read/Write

P 5.5.3.4 Reference Minimum

Use this parameter to set the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when *P 5.5.3.1 Reference Range* is set to *[0] Min.- Max.* The minimum reference unit matches the choice of configuration in *P 5.4.2 Configuration Mode*.

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	302	**Unit:**	Reference Feedback Unit
Data type:	int32	**Access type:**	Read/Write

P 5.5.3.5 Reference Function

Use this parameter to select which reference source to use. To sum both external and preset reference sources, select *[0] Sum*. To use either the preset or the external reference source, select *[1] External/Preset*.

Default value:	0 [Sum]	**Parameter type:**	Selection
Parameter number:	304	**Unit:**	–

Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection 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.

P 5.5.3.6 Reference Site

Use this parameter to select which reference site to activate. To use the local reference in Local mode, or the remote reference in Remote mode, select *[0] Linked to Loc/Rem*. To use the same reference in both Remote and Local modes, select *[1] Remote* or *[2] Local* respectively.

Default value:	0 [Linked to Loc/Rem]	Parameter type:	Selection
Parameter number:	313	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Linked to Loc/Rem
1	Remote
2	Local

P 5.5.3.7 Reference 1 Source

Use this parameter to select the input for the 1st reference signal. The parameters *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Default value:	1 [Analog Input 33]	Parameter type:	Selection
Parameter number:	315	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
8	Frequency Input 18
11	Local bus reference
20	Digital pot.meter
21	Potentiometer

P 5.5.3.8 Reference 2 Source

Use this parameter to select the input for the 2nd reference signal. The parameters *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Default value:	2 [Analog Input 34]	**Parameter type:**	Selection
Parameter number:	316	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
8	Frequency Input 18
11	Local Bus reference
20	Digital pot.meter
21	Potentiometer

P 5.5.3.9 Reference 3 Source

Use this parameter to select the input for the 3rd reference signal. *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Default value:	11 [Local bus reference]	**Parameter type:**	Selection
Parameter number:	317	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
8	Frequency Input 18
11	Local bus reference
20	Digital pot.meter
21	Potentiometer

P 5.5.3.10 Preset Reference

Use this parameter, an array [8], to define preset references. Enter up to 8 different preset references. To activate a preset reference, use digital input and select from *[16] Preset reference bit 0*, *[17] Preset reference bit 1*, or *[18] Preset reference bit 2*, in the corresponding parameter in *parameter group P 9.4.1 Digital Input*.

Default value:	0.00	**Parameter type:**	Range (-100.00–100.00)
Parameter number:	310	**Unit:**	%

Data type:	int16	Access type:	Read/Write

P 5.5.3.11 Preset Relative Reference

Use this parameter, an array [8], to define a fixed value to be added to the variable value defined in *P 5.5.3.12 Relative Scaling Reference Resource*. Their sum is multiplied by the actual reference. This product is then added to the actual reference to give the resulting actual reference.

Default value:	0.00	Parameter type:	Range (-100.00–100.00)
Parameter number:	314	Unit:	%
Data type:	int16	Access type:	Read/Write
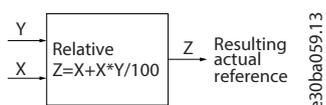
Figure 77: Preset Relative Reference
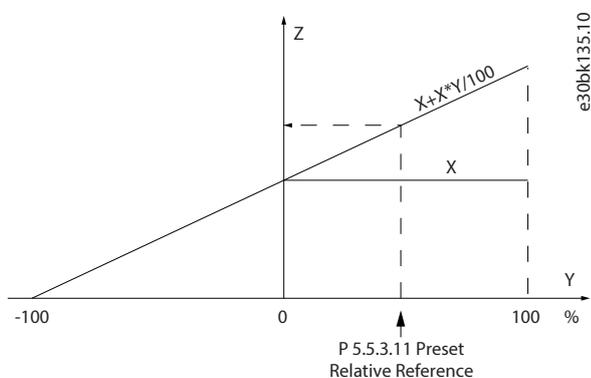
Figure 78: Actual Reference

P 5.5.3.12 Relative Scaling Reference Resource

Use this parameter to define a variable value to be added to the fixed value defined in *P 5.5.3.11 Preset Relative Reference*. Their sum is multiplied by the actual reference. This product is then added to the actual reference to give the resulting actual reference.

Default value:	0	Parameter type:	Selection
Parameter number:	318	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
8	Frequency Input 18
11	Local bus reference
21	Potentiometer

P 5.5.3.13 Freeze Up/Down Step Delta

Use this parameter to enter a percentage value (relative) to be either added to or deducted from the actual reference for catch up or slow down, respectively.

Default value:	0.00	**Parameter type:**	Range (0.00–100.00)
Parameter number:	312	**Unit:**	%
Data type:	int16	**Access type:**	Read/Write

P 5.5.3.14 On Reference Window

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

Default value:	0.100	**Parameter type:**	Range (0.000–999999.999)
Parameter number:	305	**Unit:**	ReferenceFeedbackUnit
Data type:	int32	**Access type:**	Read/Write

P 5.5.3.20 Enable Potentiometer

Use this parameter to enable or disable the potentiometer. The setting can be locked with *P 6.6.20 Password*.

Default value:	0 [Disabled]	**Parameter type:**	Selection
Parameter number:	45	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Disabled
1	Enabled

7.6.4.4 Ramp (Menu Index 5.5.4)

P 5.5.4.1 Ramp 1 Type Selector

Use this parameter to select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp provides constant acceleration during ramping. Sine Ramp and Sine 2 Ramp provide non-linear acceleration.

Default value:	0 [Linear]	**Parameter type:**	Selection
Parameter number:	340	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Linear	
1	Sine Ramp	
2	Sine 2 Ramp	S-ramp based on the values set in *P 5.5.4.2 Ramp 1 Accel. Time* and *P 5.5.4.3 Ramp 1 Decel. Time* (Only to be used with speed-control mode).

P 5.5.4.2 Ramp 1 Accel. Time

Use this parameter to enter acceleration time. The values range from 0 Hz to the motor frequency defined in *P 4.2.2.4 Nominal Frequency*. Select a ramp-up time such that the output current does not exceed the current limit in *P 2.7.1 Output Current Limit %* during ramping.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	341	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

P 5.5.4.3 Ramp 1 Decel. Time

Use this parameter to enter the deceleration time. The values range from the motor frequency defined in *P 4.2.2.4 Nominal Frequency* to 0 Hz. Select a ramp down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *P 2.7.1 Output Current Limit %*.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	342	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

P 5.5.4.8 Ramp 2 Type Selector

Use this parameter to select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp provides constant acceleration during ramping. Sine Ramp and Sine 2 Ramp provide non-linear acceleration.

Default value:	0 [Linear]	**Parameter type:**	Selection
Parameter number:	350	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Linear	
1	Sine Ramp	
2	Sine 2 Ramp	S-ramp based on the values set in *P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time* (Only to be used with speed-control mode).

P 5.5.4.9 Ramp 2 Accel. Time

Use this parameter to enter acceleration time. The values range from 0 Hz to the motor frequency defined in *P 4.2.2.4 Nominal Frequency*. Select a ramp-up time such that the output current does not exceed the current limit in *P 2.7.1 Output Current Limit %* during ramping.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	351	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

P 5.5.4.10 Ramp 2 Decel. Time

Use this parameter to enter the deceleration time. The values range from the motor frequency defined in *P 4.2.2.4 Nominal Frequency* to 0 Hz. Select a ramp-down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *P 2.7.1 Output Current Limit %*.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	352	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

7.6.5 Start Settings (Menu Index 5.6)

P 5.6.1 Start Zero Speed Time

Use this parameter to define a delay of the starting time. The frequency converter begins with the start function selected in *P 5.6.2 Start Function*. Set the start delay time until acceleration is to begin.

Default value:	0.0	**Parameter type:**	Range (0.0–25.5)
Parameter number:	171	**Unit:**	s
Data type:	uint8	**Access type:**	Read/Write

P 5.6.2 Start Function

Use this parameter to select the start function during start delay if a non-zero value is set in *P 5.6.1 Start Zero Speed Time*.

Default value:	2 [Coast/delay time]	**Parameter type:**	Selection
Parameter number:	172	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	DC Hold/delay time	Energize motor with a DC hold current (*P 5.7.6 DC Hold Current %*) during the start delay time.
1	DC-Brake/delay time	Energize motor with a DC-break current (*P 5.7.4 DC Brake Current %*) during the start delay time.
2	Coast/delay time	The motor is coasted during the start delay time (inverter off).
3	Start speed clockwise	Only possible with VVC+. Regardless of the value applied by the reference signal, the output speed applies the setting of the start speed in *P 5.6.4 Start Speed [Hz]*, and the output current corresponds to the setting of the start current in *P 5.6.5 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 *P 5.6.4 Start Speed [Hz]* and *P 5.6.5 Start Current* during the start delay time. The motor rotates in the reference direction. If the reference signal equals 0, *P 5.6.4 Start Speed [Hz]* is ignored and the output speed equals 0. The output current corresponds to the setting of the start current in *P 5.6.5 Start Current*.
5	VVC+ clockwise	The start current is calculated automatically. This function uses the start speed in the start delay time only.

P 5.6.3 Enable Flying Start

Use this parameter to control the flying start function. This function makes it possible to catch a motor which is spinning freely due to a mains dropout.

Default value:	0 [Disabled]	**Parameter type:**	Selection
Parameter number:	173	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	No function.
1	Enabled	Enable the frequency converter to catch and control a spinning motor. When *P 5.6.3 Enable Flying Start* is enabled, *P 5.6.1 Start Zero Speed Time*, and *P 5.6.2 Start Function* have no function.
2	Enabled Always	Enable flying start at every start command.
3	Enabled Reference Direction	Enable the frequency converter to catch and control a spinning motor. The search is performed only in the reference direction.
4	Enabled Always Reference Direction	Enable flying start at every start command. The search is performed only in the reference direction.

P 5.6.4 Start Speed [Hz]

Use this parameter to set the motor start speed. After the start signal the output speed leaps to the set value. This parameter can be used for vertical movement applications (such as cone rotor). Set the start function in *P 5.6.2 Start Function* to *[3] Start Speed Clockwise*, *[4] Horizontal Operation*, or *[5] VVC+ Clockwise*, and set a start delay time in *P 5.6.1 Start Zero Speed Time*.

Default value:	Size Related	**Parameter type:**	Range (0.0–500.0)
Parameter number:	175	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.6.5 Start Current

Use this parameter to set the boost current for the motor. Some motors, for example, cone-rotor motors, need extra current or starting speed to disengage the rotor. To obtain this boost, set the required current in *P 5.6.5 Start Current*. Set the start speed with *P 5.6.4 Start Speed [Hz]*. Set parameter *P 5.6.2 Start Function* to *[3] Start Speed Clockwise* or *[4] Horizontal Operation*, and set a start delay time in *P 5.6.1 Start Zero Speed Time*.

Default value:	Size Related	**Parameter type:**	Range (0.00–1000.00)
Parameter number:	176	**Unit:**	A
Data type:	uint32	**Access type:**	Read/Write

P 5.6.6 Breakaway Current Boost

Use this parameter to set the breakaway current boost. The frequency converter provides higher current than normal current levels to enhance breakaway-torque capacity.

Default value:	0 [Off]	**Parameter type:**	Selection
Parameter number:	422	**Unit:**	–

Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Off
1	On

P 5.6.7 Start Max Speed [Hz]

Use this parameter to enable high starting torque. The time from the moment 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 motor torque limit are set to the maximum value for the frequency converter-motor combination. Setting the parameter value to zero disables the function.

Default value:	0.0	Parameter type:	Range (0.0–500.00)
Parameter number:	178	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 5.6.8 Start Max Time to Trip

Use this parameter to define the maximum start time. The time from the moment the start signal is given until the speed exceeds the speed set in *P 5.6.7 Start Max Speed [Hz]* must not exceed the time set in this parameter. Otherwise, the frequency converter stops with *fault 18, Start Failed*.

Default value:	5.0	Parameter type:	Range (0.0–10.0)
Parameter number:	179	Unit:	s
Data type:	uint8	Access type:	Read/Write

P 5.6.9 Starting Ramp Up Time

The starting ramp-up time is the acceleration time from 0 RPM to the nominal motor speed set in *P 4.2.2.5 Nominal Speed* when the high starting torque is active.

Default value:	15.00	Parameter type:	Range (0.01–3600.00)
Parameter number:	382	Unit:	s
Data type:	uint32	Access type:	Read/Write

P 5.6.11 Sync. Motor Start Mode

Use this parameter to select the motor startup mode. This is done to initialize the VVC+ control core for a previously free-running motor. This parameter is active for motors in VVC+ only if the motor is stopped (or running at low speed).

Default value:	0 [Rotor Detection]	Parameter type:	Selection
Parameter number:	170	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Rotor Detection	Estimates the electrical angle of the rotor and uses that as a starting point. This is the standard selection for automation drive applications. If flying start detects that the motor is running at low speed or is stopped, the drive can detect the rotor position (the angle), and start the motor from there.
1	Parking	The Parking function applies DC current across the stator winding and rotates the rotor to electrical zero position. This selection is typically selected for pump and fan applications. If flying start detects that the motor is running at low speed or is stopped, the drive sends out a DC current to make the motor park at an angle and then start the motor from.
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 the rotor at stop and starts the motor directly without rotor detection and angle calculation. When in the situation of a non-controlled stop and power cycle, the drive needs to detect the rotor position. This option can be used for fast restart application. Start may fail if the rotor position has been changed.

P 5.6.12 Sync. Motor Detection Current %

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

Default value:	100	Parameter type:	Range (Size Related)
Parameter number:	146	Unit:	%
Data type:	uint16	Access type:	Read/Write

P 5.6.13 Sync. Motor Parking Time

Use this parameter to set the duration of the parking current set in *P 5.6.14 Sync. Motor Parking Current %*, once activated.

Default value:	3.0	Parameter type:	Range (0.1–60.0)
Parameter number:	207	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 5.6.14 Sync. Motor Parking Current %

Use this parameter to set current as percentage of the rated motor current, set with *P 4.2.2.3 Nominal Current*. Is used when *[1] Parking* is selected in *P 5.6.11 Sync. Motor Start Mode*.

Default value:	100	Parameter type:	Range (0–150)
Parameter number:	206	Unit:	%
Data type:	uint16	Access type:	Read/Write

P 5.6.15 Sync. High Starting Torque Time [s]

Use this parameter to set the high starting torque time for a PM motor in VVC+ mode.

Default value:	Size Related	Parameter type:	Range (0.00–60.00)

Parameter number:	3020	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 5.6.16 Sync. High Starting Torque Current [%]

Use this parameter to set the high starting torque current for a PM Motor in VVC+ mode.

Default value:	Size Related	Parameter type:	Range (0.0–200.0)
Parameter number:	3021	Unit:	%
Data type:	uint 32	Access type:	Read/Write

7.6.6 Stop Settings (Menu Index 5.7)

P 5.7.1 Function at Stop

Use this parameter to select the drive function after a stop command or after the speed is ramped down to the level set in *P 5.7.2 Min Speed for Function at Stop [Hz]*.

Default value:	0 [Coast]	Parameter type:	Selection
Parameter number:	180	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Coast	Leaves the motor in free mode
1	DC Hold/Motor Preheat	Energizes the motor with a DC-hold current (see *P 5.7.6 DC Hold 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 pre-magnetize the machine for the 1st start command:
		Solution 1:
		• 1. Start the frequency converter with a 0 RPM reference.
		• 2. Wait 2–4 rotor time constants (see the following formula) before increasing the speed reference.
		Solution 2:
		• 1. Set *P 5.6.1 Start Zero Speed Time* to the premagnetize time (2–4 rotor time constants).
		• 2. Set *P 5.6.2 Start Function* to *[0] DC hold*.
		• 3. Set the DC hold current magnitude (*P 5.7.6 DC Hold Current %* to be equal to Ipre-mag = Unom/(1.73 x Xh).
		Sample rotor time constants = (Xh+X2)/(6.3*Freq_nom*Rr) 1 kW = 0.2 s 10 kW = 0.5 s 100 kW = 1.7 s).

Selection number	Selection name	Selection description
10	Coast With Stop at Low Reference	When a stop command is given, or a start command is removed, and the reference is below *P 5.7.2 Min Speed for Function at Stop [Hz]*, the motor is disconnected from the drive.
11	DC Hold With Stop at Low Reference	When a stop command is given, or a start command is removed, and the reference is below *P 5.7.2 Min Speed for Function at Stop [Hz]*, energizes the motor with a DC-hold current (see *P 5.7.6 DC Hold Current %*).

P 5.7.2 Min Speed for Function at Stop [Hz]

Use this parameter to set the output frequency at which to activate *P 5.7.1 Function at Stop*.

Default value:	0.0	**Parameter type:**	Range (Size Related)
Parameter number:	182	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.7.3 DC Brake Time

Set the duration of the DC-brake current set in *P 5.7.4 DC Brake Current %*, once activated.

Default value:	10.0	**Parameter type:**	Range (0.0–60.0)
Parameter number:	202	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.7.4 DC Brake Current %

Use this parameter to enter a value for current as a percentage of the rated motor current. See *P 4.2.2.3 Nominal Current*. When the speed is lower than the limit set in *P 5.7.5 DC Brake Frequency*, or when the DC-brake Inverse function is active, (in *parameter group 9.4.1. Digital Inputs* set to *[5] DC-brake Inverse*; or via the serial port), a DC-brake current is applied on a stop command. See *P 5.7.3 DC Brake Time* for duration.

Default value:	50	**Parameter type:**	Range (0–150)
Parameter number:	201	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

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.

P 5.7.5 DC Brake Frequency

Use this parameter to set the DC-brake cut-in speed for activation of the DC-brake current set in *P 5.7.4 DC Brake Current*, together with a stop command.

Default value:	0.0	**Parameter type:**	Range (Size Related)
Parameter number:	204	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.7.6 DC Hold Current %

Use this parameter to set the holding current as a percentage of the rated motor current, see *P 4.2.2.3 Nominal Current*). The parameter holds the motor function (holding torque) or preheats the motor. This parameter is active if DC hold is selected in *P 5.6.2 Start Function* as *[0] DC Hold/Delay Time* or *P 5.7.1 Function at Stop* as *[1] DC Hold/Motor Preheat*.

Default value:	50	**Parameter type:**	Range (0–160)
Parameter number:	200	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

<table>
<tr><td align="center">NOTICE</td></tr>
<tr><td>The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor.</td></tr>
</table>

P 5.7.7 Quick Stop Ramp Time

Use this parameter to enter the quick-stop ramp-down time, which is the deceleration time from the nominal 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 *P 2.7.1 Current Limit*). Activate quick stop with a signal on a selected digital input, or via the serial communication port.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	381	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

7.6.7 Speed Control (Menu Index 5.8)

P 5.8.1 Rotation Direction

Use this parameter to select the motor speed directions required. Use this parameter to prevent unwanted reversing.

Default value:	2 [Both directions]	**Parameter type:**	Selection
Parameter number:	410	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Clockwise	Only operation in a clockwise direction is allowed.
2	Both directions	Operation in both clockwise and counterclockwise directions are allowed.

P 5.8.2 Motor Speed High Limit [Hz]

Use this parameter to enter the maximum limit for motor speed. The parameter can be set to match the maximum motor speed recommended by the manufacturer. The motor speed high limit must exceed the value in *P 5.8.3 Motor Speed Low Limit [Hz]*. The output frequency must not exceed 1/10 of the switching frequency.

Default value:	65.0	**Parameter type:**	Range (Size Related)
Parameter number:	414	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.8.3 Motor Speed Low Limit [Hz]

Use this parameter to 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 *P 5.8.2 Motor Speed High Limit*.

Default value:	0.0	Parameter type:	Range (Size Related)
Parameter number:	412	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 5.8.4 Directional Limit Mode

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

Default value:	0 [Disabled]	Parameter type:	Selection
Parameter number:	490	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Disabled
1	Speed

P 5.8.5 Positive Speed Limit [Hz]

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

Default value:	50.0	Parameter type:	Range (0.0–500.0)
Parameter number:	492	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 5.8.6 Negative Speed Limit [Hz]

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

Default value:	50.0	Parameter type:	Range (0.0–500.0)
Parameter number:	494	Unit:	Hz
Data type:	uint16	Access type:	Read/Write

P 5.8.8 Torque Limit Mode Speed Ctrl

Use this parameter to select an analog input for scaling the settings in *P 5.10.1 Torque Limit Motor Mode* and *P 5.10.2 Torque Limit Generator Mode* 0–100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling. This parameter is only active when *P 5.4.2 Configuration Mode* is in speed mode.

Default value:	0 [No Function]	Parameter type:	Selection
Parameter number:	420	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No function
2	Analog in 33
4	Analog in 33 inverted
6	Analog in 34
8	Analog in 34 inverted

P 5.8.11 Band, High Limit

Some systems call for avoiding certain output speeds due to resonance problems in the system. Specific motor frequencies can be bypassed during operation. Use this parameter, an array [4], to enter the upper limits of the speeds to be avoided.

Default value:	0.0	**Parameter type:**	Range (Size Related)
Parameter number:	463	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.8.12 Band, Low Limit

Some systems call for avoiding certain output speeds due to resonance problems in the system. Specific motor frequencies can be bypassed during operation. Use this parameter, an array [4], to enter the lower limits of the speeds to be avoided.

Default value:	0.0	**Parameter type:**	Range (Size Related)
Parameter number:	461	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

7.6.8 Inching (Menu Index 5.9)

P 5.9.1 Jog Ramp Time

Use this parameter to enter the jog ramp time, which is the acceleration/deceleration time between 0 Hz and the rated motor frequency *P 4.2.2.4 Nominal Frequency*. Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in *P 2.7.1 Current Limit*.

Default value:	Size Related	**Parameter type:**	Range (0.01–3600.00)
Parameter number:	380	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write
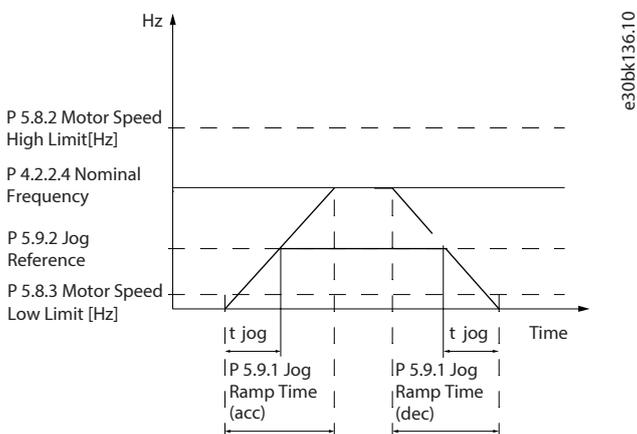
Figure 79: Jog Ramp Time

P 5.9.2 Jog Reference

Use this parameter to set the jog speed. The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated.

Default value:	5.0	**Parameter type:**	Range (0.0–500.0)
Parameter number:	311	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

7.6.9 Torque Control (Menu Index 5.10)

P 5.10.1 Motor Torque Limit

Use this parameter to enter the maximum torque limit for motor operation. This function limits the torque on the shaft to protect the mechanical installation.

Default value:	Size Related	**Parameter type:**	Range (Size Related)
Parameter number:	416	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 5.10.2 Regenerative Torque Limit

Use this parameter to enter the maximum torque limit for generator mode operation. This function limits the torque on the shaft to protect the mechanical installation.

Default value:	100	**Parameter type:**	Range (Size Related)
Parameter number:	417	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 5.10.3 Speed Limit Mode Torque Ctrl.

Use this parameter to select an analog input for scaling the settings in *P 2.3.14 Max Output Frequency* 0–100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling. This parameter is only active when *P 5.4.2 Operation Mode* is in torque mode.

Default value:	0 [No function]	**Parameter type:**	Selection
Parameter number:	421	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	No function
2	Analog in 33
4	Analog in 33 inverted
6	Analog in 34
8	Analog in 34 inverted

P 5.10.4 Torque PID Proportional Gain

Use this parameter to 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.

Default value:	100	**Parameter type:**	Range (0–500)
Parameter number:	712	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 5.10.5 Torque PID Integration Time

Use this parameter to 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.

Default value:	0.020	**Parameter type:**	Range (0.002–2.000)
Parameter number:	713	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.10.6 Trip Delay at Torque Limit

Use this parameter to define the delay for tripping the torque warning. When the output torque reaches the torque limit, a warning is triggered. If the torque limit warning is continuously present for the period specified in this parameter, the frequency converter trips. To disable the feature, enter the value of 60 s.

Default value:	60	**Parameter type:**	Range (0–60)
Parameter number:	1425	**Unit:**	s
Data type:	uint8	**Access type:**	Read/Write

7.6.10 Mechanical Brake Control (Menu Index 5.11)

P 5.11.1 Brake Closing Speed

Use this parameter to set the motor frequency when the mechanical brake activates, when a stop condition is present.

Default value:	0.0	**Parameter type:**	Range (0.0–400.0)
Parameter number:	222	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.11.2 Brake Close Time

Use this parameter to enter the brake delay time for the coast after ramp-down time. The shaft is held at zero speed with full holding torque. Ensure that the mechanical brake has locked the load before the motor enters coast mode.

Default value:	0.0	**Parameter type:**	Range (0.0–5.0)
Parameter number:	223	**Unit:**	s
Data type:	uint8	**Access type:**	Read/Write

P 5.11.3 Release Brake Current

Use this parameter to set the motor current for release of the mechanical brake, when a start condition is present. The upper limit is specified with *P 2.1.5 Output Current Limit*.

Default value:	0.00	**Parameter type:**	Range (0.00–100.00)

Parameter number:	220	Unit:	A
Data type:	uint32	Access type:	Read/Write

> **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.

P 5.11.4 Mech. Brake w/ dir. Change

Use this parameter to select whether to use the mechanical brake in direction changes. Select *[1] On* if the mechanical brake must engage when the shaft changes direction. The speed at which the mechanical brake engages is selected in *P 5.11.1 Brake Closing Speed*.

Default value:	0 [Off]	Parameter type:	Selection
Parameter number:	239	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections of the parameter:

Selection number	Selection name
0	Off
1	On
2	On with start delay

7.6.11 Process Control (Menu Index 5.12)

7.6.11.1 Status (Menu Index 5.12.1)

P 5.12.1.1 Process PID Error

This parameter shows the error value in the process PID controller.

Default value:	0.0	Parameter type:	Range (-200.0–200.0)
Parameter number:	1890	Unit:	%
Data type:	int16	Access type:	Read

P 5.12.1.2 Process PID Output

This parameter shows the raw output value from the process PID controller.

Default value:	0.0	Parameter type:	Range (-200.0–200.0)
Parameter number:	1891	Unit:	%
Data type:	int16	Access type:	Read

P 5.12.1.3 Process PID Clamped Output

This parameter shows the output value from the process PID controller after reaching a clamp limit.

Default value:	0.0	Parameter type:	Range (-200.0–200.0)
Parameter number:	1892	Unit:	%
Data type:	int16	Access type:	Read

P 5.12.1.4 Process PID Gain Scaled Output

This parameter shows the output value from the process PID controller after reaching a clamp limit and scaling the resulting value with consideration to the gain.

Default value:	0.0	**Parameter type:**	Range (-200.0–200.0)
Parameter number:	1893	**Unit:**	%
Data type:	int16	**Access type:**	Read

P 5.12.1.5 Feedback Value

Use this parameter to view the feedback resulting from the selection of scaling in *P 5.5.3.1 Reference Range*, *P 5.5.3.3 Reference Maximum*, and *P 5.5.3.4 Reference Minimum*.

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	1652	**Unit:**	Process Ctrl Unit
Data type:	int32	**Access type:**	Read

7.6.11.2 **Feedback (Menu Index 5.12.4)**

P 5.12.4.1 Feedback 1 Resource

Use this parameter to select which drive input is treated as the feedback source.

Default value:	0 [No function]	**Parameter type:**	Selection
Parameter number:	720	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
4	Frequency Input 18

P 5.12.4.2 Feedback 2 Resource

Use this parameter to select which drive input is treated as the source of the feedback.

Default value:	0 [No function]	**Parameter type:**	Selection
Parameter number:	722	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	No function
1	Analog Input 33
2	Analog Input 34
4	Frequency Input 18

P 5.12.4.3 Feedback 1 Conversion

Use this parameter to select a conversion for the Feedback 1 signal. To leave the feedback signal unchanged, select *[0] Linear*.

Default value:	0 [Linear]	Parameter type:	Selection
Parameter number:	760	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Linear
1	Square root

P 5.12.4.4 Feedback 2 Conversion

Use this parameter to select a conversion for the Feedback 2 signal. To leave the feedback signal unchanged, select *[0] Linear*.

Default value:	0 [Linear]	Parameter type:	Selection
Parameter number:	762	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Linear
1	Square root

7.6.11.3 PID Controller (Menu Index 5.12.5)

P 5.12.5.1 PID Proportional Gain

Use this parameter to enter the process controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable.

Default value:	0.01	Parameter type:	Range (0.0–10.00)
Parameter number:	733	Unit:	–
Data type:	uint16	Access type:	Read/Write

P 5.12.5.2 PID Integral Time

Use this parameter to enter the process controller integral time. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action.

Default value:	9999.00	Parameter type:	Range (0.10–9999.00)
Parameter number:	734	Unit:	s
Data type:	uint32	Access type:	Read/Write

P 5.12.5.4 Antiwindup Enabled

Use this parameter to control error regulation. To continue regulation of an error even when the output frequency cannot be increased or decreased, select *[0] Off*. To cease regulation of an error when the output frequency can no longer be adjusted, select *[1] On*.

Default value:	1 [On]	**Parameter type:**	Selection
Parameter number:	731	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Off
1	On

P 5.12.5.5 PID Differentiation Time

Use this parameter to enter the process controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the process feedback. Setting this parameter to zero disables the differentiator.

Default value:	0.00	**Parameter type:**	Range (0.00–20.00)
Parameter number:	735	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.12.5.6 PID Diff. Gain Limit

Use this parameter to 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.

Default value:	5.0	**Parameter type:**	Range (1.0–50.0)
Parameter number:	736	**Unit:**	–
Data type:	uint16	**Access type:**	Read/Write

P 5.12.5.7 PID Normal/Inverse Control

Use this parameter to select output speed change during errors. To set the process control to increase the output speed when the process error is positive, select *[0] Normal*. To reduce the output speed when the process error is positive, select *[1] Inverse*.

Default value:	0 [Normal]	**Parameter type:**	Selection
Parameter number:	730	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Normal
1	Inverse

P 5.12.5.8 PID Start Speed

Use this parameter to enter the motor speed to be attained as a start signal for starting PID control. Upon power-up, the drive operates using speed open loop control. When the Process PID start speed is reached, the drive changes to PID control.

Default value:	0	**Parameter type:**	Range (0–6000)
Parameter number:	732	**Unit:**	RPM

Data type:	uint16	Access type:	Read/Write

P 5.12.5.9 On Reference Bandwidth

Use this parameter to enter the On Reference bandwidth. When the PI Control Error (the difference between the reference and the feedback) is greater than the value of this parameter, then the On Reference status bit is set to 0.

Default value:	5	Parameter type:	Range (0–200)
Parameter number:	739	Unit:	%
Data type:	uint8	Access type:	Read/Write

7.6.11.4 Feed Forward (Menu Index 5.12.6)

P 5.12.6.1 PID Feed Forward Factor

Use this parameter to enter the PID feed forward factor. The feed forward factor sends a constant fraction of the reference signal to bypass PID control, so the PID only has an effect on the remaining fraction of the control signal. This function increases dynamic performance.

Default value:	0	Parameter type:	Range (0–200)
Parameter number:	738	Unit:	%
Data type:	uint16	Access type:	Read/Write

7.6.11.5 Sleep Mode (Menu Index 5.12.7)

The sequence when running sleep mode in open loop ([1] Speed is selected in P 5.12.7.1 Sleep Mode in Process Closed-loop Mode)

1. The motor speed is less than *P 5.12.7.8 Sleep Speed [Hz]* and the motor has been running longer than *P 5.12.7.2 Minimum Run Time*.

2. The drive ramps the motor speed down to *P 5.7.2 Min Speed for Function at Stop [Hz]*.

3. The drive activates *P 5.7.1 Function at Stop*. The drive is now in sleep mode.

4. The drive compares the speed setpoint with *P 5.12.7.4 Wake-Up Speed [Hz]* to detect wake-up situation.

5. The speed setpoint is greater than *P 5.12.7.4 Wake-Up Speed [Hz]* and the sleep condition has lasted for more than *P 5.12.7.3 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 ([0] Feed. and Speed is selected in P 5.12.7.1 Sleep Mode in Process Closed-loop Mode)

1. When the error between reference and feedback is greater than *P 5.12.7.5 Wake-Up Reference/Feedback Difference*, and the output speed is less than the sleep mode speed, the drive enters boost status. If *P 5.12.7.6 Setpoint Boost* is not set, the drive enters sleep mode.

2. After *P 5.12.7.7 Maximum Boost Time*, the drive ramps the motor speed down to *P 5.7.2 Min Speed for Function at Stop [Hz]*.

3. The drive activates *P 5.7.1 Function at Stop*. The drive is now in sleep mode.

4. When the error between reference and feedback is greater than *P 5.12.7.5 Wake-Up Reference/Feedback Difference*, and the condition lasts more than *P 5.12.7.3 Minimum Sleep Time*, the drive is out of sleep mode.

5. The drive reverts to closed-loop control.

The sequence when running sleep mode in closed loop ([2] Feedback is selected in P 5.12.7.1 Sleep Mode in Process Closed-loop Mode)

1. When the error between reference and feedback is greater than *P 5.12.7.5 Wake-Up Reference/Feedback Difference*, the drive enters boost status. If *P 5.12.7.6 Setpoint Boost* is not set, the drive enters sleep mode.

2. After **P 5.12.7.7 Maximum Boost Time**, the drive ramps the motor speed down to **P 5.7.2 Min Speed for Function at Stop [Hz]**.

3. The drive activates **P 5.7.1 Function at Stop**. The drive is now in sleep mode.

4. When the error between reference and feedback is greater than **P 5.12.7.5 Wake-Up Reference/Feedback Difference**, and the condition lasts more than **P 5.12.7.3 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 buttons on the control panel). Does not work in Local mode. Remote setup in an open loop must be carried out before setting input/output in a closed loop.

P 5.12.7.1 Sleep Mode in Process Closed-loop Mode

This parameter is for sleep mode running in process closed loop. Use this parameter to set whether the feedback is detected for entering sleep mode.

Default value:	0	**Parameter type:**	Selection
Parameter number:	2202	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection 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	Feedback is detected only.

P 5.12.7.2 Minimum Run Time

Set the minimum running time for the motor after a start command (digital input or bus) before entering the sleep mode.

Default value:	10	**Parameter type:**	Range (0–600)
Parameter number:	2240	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.3 Minimum Sleep Time

Set the minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

Default value:	10	**Parameter type:**	Range (0–600)
Parameter number:	2241	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.4 Wake-Up Speed [Hz]

This parameter is used when **P 5.4.2 Operation Mode** is set for open loop, and the speed reference is from an external controller. Set the reference speed when the Sleep Mode is deactivated.

Default value:	100	**Parameter type:**	Range (0–4000)
Parameter number:	2243	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.5 Wake-Up Reference/Feedback Difference

This parameter is used when *P 5.4.2 Operation Mode* is set for process closed loop. Set the allowed pressure drop in percentage of setpoint for the pressure (P_{set}) before canceling the sleep mode.

Default value:	10	**Parameter type:**	Range (0–100)
Parameter number:	2244	**Unit:**	%
Data type:	uint8	**Access type:**	Read/Write

P 5.12.7.6 Setpoint Boost

This parameter is used when *P 5.4.2 Operation Mode* is set for process closed loop. 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 when the motor is stopped and help to avoid frequent start/stop. Set the overpressure/temperature in percentage of setpoint for the pressure (P_{set})/temperature before entering sleep mode. If setting for 5%, the boost pressure is P_{set}*1.05. The negative values can be used for, for example, cooling tower control where a negative change is needed.

Default value:	0	**Parameter type:**	Range (-100–100)
Parameter number:	2245	**Unit:**	%
Data type:	int8	**Access type:**	Read/Write

P 5.12.7.7 Maximum Boost Time

This parameter is used when *P 5.4.2 Operation Mode* is set for process closed loop. Set the maximum time of the boost mode. If the set time exceeds, the drive does not wait for the set boost pressure to be reached and enters the sleep mode.

Default value:	60	**Parameter type:**	Range (0–600)
Parameter number:	2246	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.8 Sleep Speed [Hz]

Set the sleep speed. When the drive speed is below the sleep speed, the drive enters the sleep mode.

Default value:	0	**Parameter type:**	Range (0–4000)
Parameter number:	2247	**Unit:**	Hz
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.9 Sleep Delay Time

Set the delay time for the motor to wait before entering the sleep mode when the condition of entering sleep mode is met.

Default value:	0	**Parameter type:**	Range (0–3600)
Parameter number:	2248	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 5.12.7.10 Wake-Up Delay Time

Set the delay time for the motor to wait before waking up from sleep mode when the condition of waking up is met.

Default value:	0	**Parameter type:**	Range (0–3600)
Parameter number:	2249	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

7.6.12 Digital Potentiometer (Menu Index 5.13)

7.6.12.1 Digital Potentiometer Status (Menu Index 5.13.1)

The digital potentiometer enables increase or decrease of the actual reference by adjusting the setup of the digital inputs using the functions increase, decrease, or clear. To activate the function, set at least 1 digital input to increase or decrease.
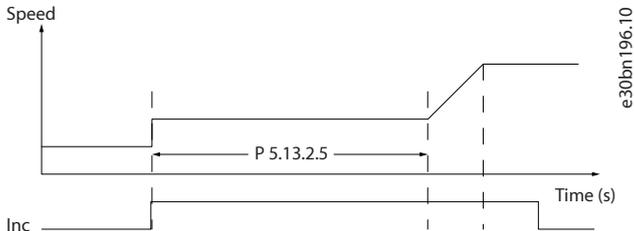
Figure 80: Increase Actual Reference
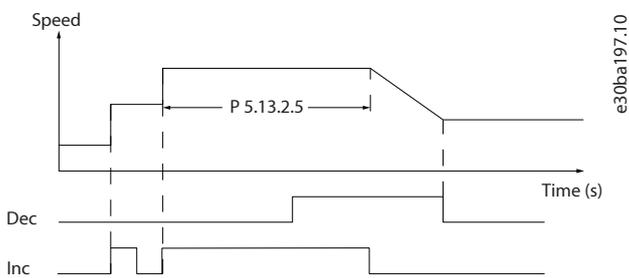
Figure 81: Increase/Decrease Actual Reference

P 5.13.1.1 Digital Pot Reference

This parameter shows the contribution of the digital potentiometer to the actual reference.

Default value:	0.00	**Parameter type:**	Range (-200.00–200.00)
Parameter number:	1653	**Unit:**	–
Data type:	int16	**Access type:**	Read

7.6.12.2 Digital Potentiometer Control (Menu Index 5.13.2)

P 5.13.2.1 Step Size

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

Default value:	0.10	**Parameter type:**	Range (0.01–200.00)
Parameter number:	390	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 5.13.2.2 Power Restore

Reset or restore the digital potentiometer reference.

Default value:	0 [Off]	**Parameter type:**	Selection
Parameter number:	392	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name	Selection description
0	Off	Resets the digital potentiometer reference to 0% after power-up.
1	On	Restores the most recent digital potentiometer reference at power-up.

P 5.13.2.3 Maximum Limit

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.

Default value:	100	**Parameter type:**	Range (-200–200)
Parameter number:	393	**Unit:**	%
Data type:	int16	**Access type:**	Read/Write

P 5.13.2.4 Minimum Limit

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.

Default value:	-100	**Parameter type:**	Range (-200–200)
Parameter number:	394	**Unit:**	%
Data type:	int16	**Access type:**	Read/Write

P 5.13.2.5 Ramp Delay

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.

Default value:	1000	**Parameter type:**	Range (0–3600000)
Parameter number:	395	**Unit:**	ms
Data type:	uint32	**Access type:**	Read/Write

7.6.13 Fieldbus Process Data (Menu Index 5.27)

P 5.27.1 PCD Write Selection

Use this parameter to select the parameters to be assigned to the telegrams of the PCD. The number of available PCDs depends on the telegram type. The values in the PCDs are then written to the selected parameters as data values.

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.

Default value:	0 [None]	**Parameter type:**	Selection
Parameter number:	842	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	None
1	Minimum Reference

Selection number	Selection name
2	Maximum Reference
3	Ramp 1 Ramp Up Time
4	Ramp 1 Ramp Down Time
5	Ramp 2 Ramp Up Time
6	Ramp 2 Ramp Down Time
7	Jog Ramp Time
8	Quick Stop Time
9	Motor Speed Low Limit [Hz]
10	Motor Speed High Limit [Hz]
11	Digital & Relay Bus Control
13	Terminal 31 Output Bus Control
15	FC Port CTW
16	FC Port REF
81	User Define 0
82	User Define 1
83	User Define 2
84	User Define 3
85	User Define 4
86	User Define 5
87	User Define 6
88	User Define 7

P 5.27.2 PCD Read Selection

Use this parameter to 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 mappings 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.

Default value:	0 [None]	Parameter type:	Selection
Parameter number:	843	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	None
1	Operation Hours
2	Running Hours
3	kWh Counter

Selection number	Selection name
4	Control Word
5	Reference [Unit]
6	Reference %
7	Status Word
8	Main Actual Value [%]
9	Custom Readout
10	Power [kW]
11	Power [hp]
12	Motor Voltage
13	Frequency
14	Motor Current
15	Frequency [%]
16	Torque [Nm]
17	Motor Thermal
18	DC Link Voltage
19	Heat Sink Temperature
20	Inverter Thermal
22	External Reference
23	Feedback [Unit]
24	Digital Input 13, 14, 15, 17, 18
25	Terminal 33 Switch Setting
26	Analog Input 33
27	Terminal 34 Switch Setting
28	Analog Input 34
29	Analog Output 31 [mA]
30	Relay Output
33	Fault Word
34	Warning Word
35	External Status Word
39	Fault Word 2
40	Warning Word 2
43	Speed [RPM]
44	Digital Output
54	External Status Word 2
55	Fault Word 3
56	Warning Word 3
81	User Define 8

Selection number	Selection name
82	User Define 9
83	User Define 10
84	User Define 11
85	User Define 12
86	User Define 13
87	User Define 14
88	User Define 15
100	Main Actual Value [N2]

P 5.27.3 PCD User Define

Customize the User define X of Parameter PCD Write Configuration or PCD Read Configuration, [0–7] for PCD Write, [8–15] for PCD Read.

Default value:	0	Parameter type:	Range (0–65535)
Parameter number:	844	Unit:	–
Data type:	uint16	Access type:	Read/Write

7.7 Maintenance and Service (Menu Index 6)

7.7.1 Status (Menu Index 6.1)

P 6.1.1 Latest Fault Number

Use this parameter to view the fault logs. 10 fault logs can be viewed. 0 contains the most recent logged fault, and 9 has the oldest logged fault.

Default value:	0	Parameter type:	Range (0–255)
Parameter number:	1530	Unit:	–
Data type:	uint8	Access type:	Read

P 6.1.2 Operating Hours

Use this parameter to view how many hours the frequency converter has run. The value is saved when the drive is turned off.

Default value:	0	Parameter type:	Range (0–2147483647)
Parameter number:	1500	Unit:	h
Data type:	uint32	Access type:	Read

P 6.1.3 Running Hours

Use this parameter to view how many hours the motor has run. Reset the counter with *P 6.1.9 Reset Running Hours Counter*. The value is saved when the drive is turned off.

Default value:	0	Parameter type:	Range (0–2147483647)
Parameter number:	1501	Unit:	h
Data type:	uint32	Access type:	Read

P 6.1.4 kWh Counter

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in *P 6.1.8 Reset kWh Counter*.

Default value:	0	**Parameter type:**	Range (0–2147483647)
Parameter number:	1502	**Unit:**	kWh
Data type:	uint32	**Access type:**	Read

P 6.1.5 Power Up Times

Use this parameter to view the number of times the frequency converter has been powered up.

Default value:	0	**Parameter type:**	Range (0–2147483647)
Parameter number:	1503	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 6.1.6 Over Temp Times

Use this parameter to view the number of frequency converter temperature faults that have occurred since production.

Default value:	0	**Parameter type:**	Range (0–65535)
Parameter number:	1504	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 6.1.7 Over Volt Times

Use this parameter to view the number of frequency converter overvoltages that have occurred since production.

Default value:	0	**Parameter type:**	Range (0–65535)
Parameter number:	1505	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 6.1.8 Reset kWh Counter

Use this parameter to reset the kWh counter to zero (see *P 6.1.4 kWh Counter*).

Default value:	0 [Do not reset]	**Parameter type:**	Selection
Parameter number:	1506	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the available selections for the parameter.

Selection number	Selection name
0	Do Not Reset
1	Reset Counter

P 6.1.9 Reset Running Hours Counter

Use this parameter to reset the Running Hours counter to zero (see *P 6.1.3 Running Hours*).

Default value:	0 [Do not reset]	**Parameter type:**	Selection
Parameter number:	1507	**Unit:**	–

Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Do Not Reset
1	Reset Counter

P 6.1.10 Internal Fault Reason

Use this parameter to view a description of the error. This parameter is used in combination with *fault 38 Internal Fault*.

Default value:	0	Parameter type:	Range (-32767–32767)
Parameter number:	1531	Unit:	–
Data type:	int16	Access type:	Read

P 6.1.11 Fault Log: Time

Use this parameter to view the time when the logged event occurred. Time is measured in seconds from drive startup.

Default value:	0	Parameter type:	Range (0–2147483647)
Parameter number:	1532	Unit:	s
Data type:	uint32	Access type:	Read

7.7.2 Software Information (Menu Index 6.2)

P 6.2.1 Application Version

Use this parameter to view the combined software version consisting of power software and control software.

Default value:	–	Parameter type:	–
Parameter number:	1543	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.2.2 SW ID Control Card

Use this parameter to view the control board software version number.

Default value:	–	Parameter type:	–
Parameter number:	1549	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.2.3 SW ID Power Card

Use this parameter to view the power card software version number.

Default value:	–	Parameter type:	–
Parameter number:	1550	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.2.7 ECP SW Version

View the ECP ID number.

Default value:	–	Parameter type:	–
Parameter number:	1548	Unit:	–
Data type:	VisibleString	Access type:	Read

7.7.3 Cooling Fan (Menu Index 6.5)

P 6.5.1 Fan Control Mode

Use this parameter to select the fan control mode.

Default value:	7 [On when Inverter is on, otherwise off]	Parameter type:	Selection
Parameter number:	1452	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
5	Constant-on Mode
6	Constant-off Mode
7	On-when-inverter-is-on-else-off Mode

7.7.4 Parameter Handling (Menu Index 6.6)

P 6.6.1 Active Set-up

Use this parameter to select the setup to control the drive functions. Use Multi setup for remote selection.

Default value:	1	Parameter type:	Selection
Parameter number:	10	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
1	Set-up 1
2	Set-up 2
9	Multi Set-up

P 6.6.2 Programming Set-up

Use this parameter to select the setup to be edited. The setup is configured by control panel when it is accessed by control panel, and by RS-485 when accessed by RS-485.

Default value:	9	Parameter type:	Selection
Parameter number:	11	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
1	Set-up 1
2	Set-up 2
9	Active Set-up

P 6.6.3 Link Setups

Use this parameter to link or unlink setups. The link ensures synchronizing of the parameters that cannot be changed while the motor is running. When setups are linked, it is possible to shift from 1 setup to another during operation. When selecting linked, the parameter values of *Edit Set-up* are overwritten with the values of the other setup.

Default value:	20	**Parameter type:**	Selection
Parameter number:	12	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Not linked
20	Linked

P 6.6.4 Set-up Copy

Use this parameter to copy parameters between set-ups.

Default value:	0	**Parameter type:**	Selection
Parameter number:	51	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No copy
1	Copy from Set-up 1
2	Copy from Set-up 2
9	Copy from Factory Set-up

P 6.6.6 Reset Mode

Use this parameter to define whether the frequency converter waits for a manual reset, or resets itself automatically after tripping. In manual reset mode, press the *Stop/Reset* button or use digital inputs to reset the frequency converter.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1420	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

NOTICE

In automatic reset mode, the motor can start without a warning.

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Manual reset	Perform a reset via *Stop/Reset* button or via the digital inputs.
1	Automatic reset x 1	
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 for continuous resetting after tripping.
14	Reset at power-up	

NOTICE

If the specified number of automatic resets is reached within 10 minutes, the frequency converter enters *[0] Manual Reset Mode*. After the manual reset is performed, the setting of *P 6.6.6 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.

P 6.6.7 Automatic Restart Time

Use this parameter to enter the time interval from the trip event to the automatic reset. This parameter is active when *P 6.6.6 Reset Mode* is set to a selection between [1]–[13].

Default value:	10	**Parameter type:**	Range (0–600)
Parameter number:	1421	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

NOTICE

A value of 0s cannot be set when *P 6.6.6 Reset Mode* is set to *[13] Infinite auto reset*.

P 6.6.8 Operation Mode

Use this parameter to select the drive operation mode. To reset drive parameter values to default, select *[2] Initialization*. The communication related parameters remain unchanged. The frequency converter resets during the next power-up.

Default value:	0 [Normal operation]	**Parameter type:**	Selection

---

Parameter number:	1422	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Normal operation
2	Initialization

P 6.6.9 Service Code

This parameter is intended for use by service technicians only.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	1429	**Unit:**	–
Data type:	uint32	**Access type:**	Read/Write

P 6.6.12 ECP Copy

Use this parameter to select the ECP copy functions.

Default value:	0	**Parameter type:**	Selection
Parameter number:	50	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No copy	Do not copy any parameter.
1	All to ECP	Copy all parameters in all setups from drive to ECP.
2	All from ECP	Copy all parameters in all setups from ECP to drive.
3	Size indep. from ECP	Copy only parameters which are independent of motor size, w/o disturbing motor data already set.

P 6.6.20 Password

Use this parameter to define the password for access to the *Main Menu* via the *Home* button. Setting the value to 0 disables the password function.

Default value:	0	**Parameter type:**	Range (0–999)
Parameter number:	60	**Unit:**	–
Data type:	uint16	**Access type:**	Read/Write

P 6.6.26 Language

Use this parameter to define the language to be used in the display.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	English
10	中文

7.7.5 Drive Identification (Menu Index 6.7)

P 6.7.1 Drive Type

Use this parameter to view the product type of the drive. The readout is identical to the frequency converter series power field of the model code definition, characters 1–6.

Default value:	–	Parameter type:	–
Parameter number:	1540	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.2 Power Section

Use this parameter to view the current rating of the drive. The readout is identical to the frequency converter series power field of the model code definition, characters 7–10.

Default value:	–	Parameter type:	–
Parameter number:	1541	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.3 Voltage

Use this parameter to view the mains voltage of the drive. The readout is identical to the frequency converter series power field of the model code definition.

Default value:	–	Parameter type:	–
Parameter number:	1542	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.4 Ordered Model Code

Use this parameter to view the model code string used for reordering the frequency converter in its original configuration.

Default value:	–	Parameter type:	–
Parameter number:	1544	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.6 Drive Ordering No

Use this parameter to view the code number used for reordering the drive in its original configuration.

Default value:	–	Parameter type:	–
Parameter number:	1546	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.7 Drive Serial Number

Use this parameter to view the serial number of the frequency converter.

Default value:	–	Parameter type:	–
Parameter number:	1551	Unit:	–
Data type:	VisibleString	Access type:	Read

P 6.7.9 Power Card Serial Number

Use this parameter to view the serial number of the power card.

Default value:	–	Parameter type:	–
Parameter number:	1553	Unit:	–
Data type:	VisibleString	Access type:	Read

7.8 Customization (Menu Index 8)

7.8.1 Custom Readout (Menu Index 8.1)

P 8.1.1 Custom Readout

View the user-defined readouts as defined in parameters *P 8.1.2 Custom Readout Unit*, *P 8.1.3 Custom Readout Min Value*, and *P 8.1.4 Custom Readout Max Value*.

Default value:	0.00	Parameter type:	Range (0.00–9999.00)
Parameter number:	1609	Unit:	CustomReadoutUnit
Data type:	int32	Access type:	Read

P 8.1.1 Custom Readout Unit

Set the user-defined readouts unit.

Default value:	1 [%]	Parameter type:	Selection
Parameter number:	30	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the available selections for the parameter.

Selection number	Selection name
0	None
1	%
5	PPM
10	1/min
11	RPM
12	Pulse/s
20	l/s
21	l/min
22	l/h

Selection number	Selection name
23	m³/s
24	m³/min
25	m³/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
127	ft³/h
140	ft/s
141	ft/min
160	°F
170	psi
171	lb/in2
172	in WG
173	ft WG
180	HP

P 8.1.3 Custom Readout Min Value

Set the custom readout value that corresponds to zero speed.

Default value:	0.00	**Parameter type:**	Range (0.00–999999.99)
Parameter number:	31	**Unit:**	CustomReadoutUnit

Data type:	int32	Access type:	Read/Write

P 8.1.4 Custom Readout Max Value

Set the custom readout value that corresponds to motor high speed limit.

Default value:	100.00	Parameter type:	Range (0.00–999999.99)
Parameter number:	32	Unit:	CustomReadoutUnit
Data type:	int32	Access type:	Read/Write

7.8.2 Smart Logic Controller (Menu Index 8.4)

7.8.2.1 Overview of Smart Logic Controller

The Smart Logic Controller, also called SLC, is a logic controller which can be used together with logical operations of the drive.

The Smart Logic Controller manages sequences via an event/action handling. Events and actions are each numbered and linked in pairs (states), which means if an event is evaluated as true, the linked action in each state is executed. After this, the next event is evaluated and its belonging action is executed, and so on. Only 1 event is evaluated at a time. No matter in which state the sequence stops the last time, the sequence always starts at state 0. If an event is evaluated as false, the SLC takes no action during the scan interval and no other events are evaluated. It is possible to program up to 20 states in the controller. When the last event/action is executed, the sequence starts again from event/action 0. See Figure 82.

- Set *P 8.4.2.1 Enable Controller* to *[1] On* to enable the sequence controller of the SLC.
- Set *P 8.4.2.2 Start Controller* to start the sequence controller function.
- Set *P 8.4.2.3 Stop Controller* or disable the SLC in *P 8.4.2.1 Enable Controller* to stop the sequence.
- To reset all SLC parameters, select *[1] Reset SLC* in *P 8.4.2.4 Reset Controller* and start programming from scratch.

The controller is common for all setups. If setups are changed during the execution of the sequence, the sequence continues from the last state.
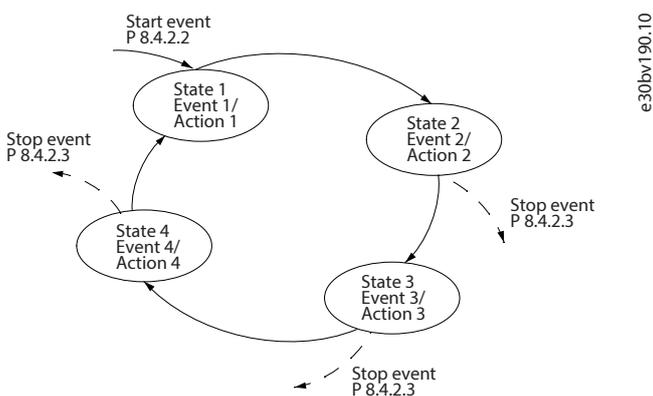
Figure 82: Example with Events/Actions

<div style="background:#1a3a6b;color:white;text-align:center">NOTICE</div>

SLC is only active in Remote mode, not in Local mode.

7.8.2.2 Status (Menu Index 8.4.1)

P 8.4.1.1 Controller State

View the actual state of the Smart Logic Controller (SLC).

Default value:	0	Parameter type:	Range (0–20)
Parameter number:	1638	Unit:	–
Data type:	uint8	Access type:	Read

P 8.4.1.2 Counter A

View the present value of Counter A. Counters are useful as comparator operands, see *P 8.4.3.1 Comparator Operand*. The value can be reset or changed either via digital inputs (*parameter group P 9.4 Digital Inputs/Outputs*) or by using an SLC action (*P 8.4.6.2 Action*).

Default value:	0	Parameter type:	Range (-32768–32767)
Parameter number:	1672	Unit:	–
Data type:	int16	Access type:	Read

P 8.4.1.3 Counter B

View the present value of Counter B. Counters are useful as comparator operands, see *P 8.4.3.1 Comparator Operand*. The value can be reset or changed either via digital inputs (*parameter group P 9.4 Digital Inputs/Outputs*) or by using an SLC action (*P 8.4.6.2 Action*).

Default value:	0	Parameter type:	Range (-32768–32767)
Parameter number:	1673	Unit:	–
Data type:	int16	Access type:	Read

7.8.2.3 SLC Settings (Menu Index 8.4.2)

Use SLC settings to activate, deactivate, and reset the Smart Logic Control.

P 8.4.2.1 Enable Controller

Enable or disable the Smart Logic Control.

Default value:	0	Parameter type:	Selection
Parameter number:	1300	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Off	Enable the start of Smart Logic Control when a start command is present, for example, via a digital input.
1	On	Disable the Smart Logic Control.

P 8.4.2.2 Start Controller

Select the condition (TRUE or FALSE) to activate the Smart Logic Controller.

Default value:	39	Parameter type:	Selection
Parameter number:	1301	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
33	Digital input T13	Use the value of DI1 in logic rule.
34	Digital input T14	Use the value of DI2 in logic rule.
35	Digital input T15	Use the value of DIO in logic rule.
36	Digital input T17	Use the value of DI3 in logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
83	Lost Load	Lost load is performed.

P 8.4.2.3 Stop Controller

Select the condition (TRUE or FALSE) to deactivate the Smart Logic Controller.

Default value:	40	**Parameter type:**	Selection
Parameter number:	1302	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
30	SL Time-out 0	Use the result of timer 0 in the logic rule.
31	SL Time-out 1	Use the result of timer 1 in the logic rule.
32	SL Time-out 2	Use the result of timer 2 in the logic rule.
33	Digital input T13	Use the value of DI1 in logic rule.
34	Digital input T14	Use the value of DI2 in logic rule.
35	Digital input T15	Use the value of DIO in logic rule.
36	Digital input T17	Use the value of DI3 in logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).

Selection number	Selection name	Selection description
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
70	SL Time-out 3	Use the result of timer 3 in the logic rule.
71	SL Time-out 4	Use the result of timer 4 in the logic rule.
72	SL Time-out 5	Use the result of timer 5 in the logic rule.
73	SL Time-out 6	Use the result of timer 6 in the logic rule.
74	SL Time-out 7	Use the result of timer 7 in the logic rule.
83	Lost Load	Lost load is performed.

P 8.4.2.4 Reset Controller

Select to reset parameters to default settings.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1303	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Do not reset SLC	Do not reset SLC.
1	Reset SLC	Reset all SLC parameters to default settings.

7.8.2.4 Comparators (Menu Index 8.4.3)

Comparators are used for comparing continuous variables (output frequency, output current, analog input, and so on) to fixed preset values.
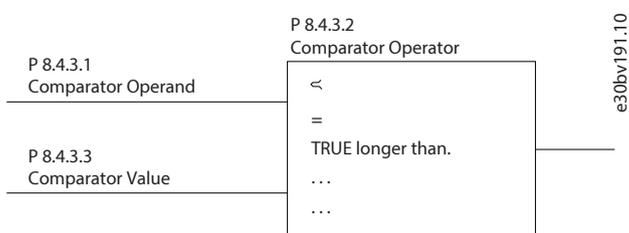
Figure 83: Comparator Parameters

In addition, there are digital values which are compared to fixed time values. See explanation in *P 8.4.3.1 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 0–5. Select index 0 to program Comparator 0, select index 1 to program Comparator 1, and so on.

P 8.4.3.1 Comparator Operand

Select the variable to be monitored by the comparator. This is an array parameter containing comparators 0–5.

Default value:	1	**Parameter type:**	Selection
Parameter number:	1310	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	Comparator is disabled.
1	Reference	Resulting remote reference (not local) as a percentage.
2	Feedback	Feedback in [Hz].
3	Motor speed	Motor speed in [Hz].
4	Motor Current	Motor current in [A].
6	Motor power	Motor power in either [kW] or [hp].
7	Motor voltage	Motor voltage in [V].
8	DC-link voltage	DC-link voltage in [V].
12	Analog input AI33	Expressed as actual value.
13	Analog input AI34	Expressed as actual value.
19	Pulse input FI18	Expressed as actual value.
20	Fault number	Shows number of the fault.
30	Counter A	Number of counts.
31	Counter B	Number of counts.

P 8.4.3.2 Comparator Operator

Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1311	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Less Than (<)	Result of evaluation is True if variable selected in *P 8.4.3.1 Comparator Operand* is smaller than fixed value in *P 8.4.3.3 Comparator Value*. Result is False if variable selected in *P 8.4.3.1 Comparator Operand* is greater than fixed value in *P 8.4.3.3 Comparator Value*.
1	Approx. Equal (~)	Result of evaluation is True if variable selected in *P 8.4.3.1 Comparator Operand* is approximately equal to fixed value in *P 8.4.3.3 Comparator Value*.
2	Greater Than (>)	Inverse logic of selection 0.

P 8.4.3.3 Comparator Value

Enter the "trigger level" for the variable which is monitored by this comparator. This is an array parameter containing comparator values 0–5.

Default value:	0	**Parameter type:**	Range (-9999000–9999000)
Parameter number:	1312	**Unit:**	–
Data type:	int32	**Access type:**	Read/Write

7.8.2.5 Timers (Menu Index 8.4.4)

Use the timer results to define an event (*P 8.4.6.1 Event*) or as boolean input in a logic rule (*P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.3 Logic Rule Boolean 2*, or *P 8.4.5.5 Logic Rule Boolean 3*).

When timer value has elapsed timer changes state from False to True.

P 8.4.4.1 Timer

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 (see *P 8.4.6.2 Action* [29–31] and *P 8.4.6.2 Action* [70–74] Start timer X) and until the timer value has elapsed. This is an array parameter containing timers 0–7.

Default value:	0	**Parameter type:**	Range (0–360000)
Parameter number:	1320	**Unit:**	s
Data type:	uint32	**Access type:**	Read/Write

7.8.2.6 Logic Rules (Menu Index 8.4.5)

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 *P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.3 Logic Rule Boolean 2*, and *P 8.4.5.5 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *P 8.4.5.2 Logic Rule Operator 1* and *P 8.4.5.4 Logic Rule Operator 2*.
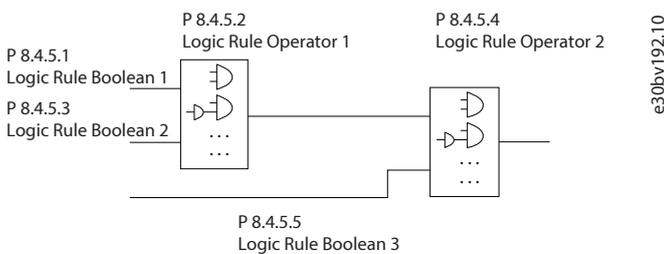
Figure 84: Parameters for Logic Rules

Priority of calculation

The results of *P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.2 Logic Rule Operator 1*, and *P 8.4.5.3 Logic Rule Boolean 2* are calculated first. The outcome (TRUE/FALSE) of this calculation is combined with the settings of *P 8.4.5.4 Logic Rule Operator 2* and *P 8.4.5.5 Logic Rule Boolean 3*, yielding the final result (TRUE/FALSE) of the logic rule.

P 8.4.5.1 Logic Rule Boolean 1

Select the 1st boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1340	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
30	SL Time-out 0	Use the result of timer 0 in the logic rule.
31	SL Time-out 1	Use the result of timer 1 in the logic rule.
32	SL Time-out 2	Use the result of timer 2 in the logic rule.
33	Digital input T13	Use the value of DI1 in a logic rule.
34	Digital input T14	Use the value of DI2 in a logic rule.
35	Digital input T15	Use the value of DIO in a logic rule.
36	Digital input T17	Use the value of DI3 in a logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.

Selection number	Selection name	Selection description
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
70	SL Time-out 3	Use the result of timer 3 in the logic rule.
71	SL Time-out 4	Use the result of timer 4 in the logic rule.
72	SL Time-out 5	Use the result of timer 5 in the logic rule.
73	SL Time-out 6	Use the result of timer 6 in the logic rule.
74	SL Time-out 7	Use the result of timer 7 in the logic rule.
83	Lost Load	Lost load is performed.

P 8.4.5.2 Logic Rule Operator 1

Select the 1st logical operator to use on the Boolean inputs from *P 8.4.5.1 Logic Rule Boolean 1* and *P 8.4.5.3 Logic Rule Boolean 2*. This is an array parameter containing logical operators 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1341	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	Ignores *P 8.4.5.3 Logic Rule Boolean 2*, *P 8.4.5.4 Logic Rule Operator 2*, and *P 8.4.5.5 Logic Rule Boolean 3*.
1	AND	Evaluates expression *P 8.4.5.1 Logic Rule Boolean 1* AND *P 8.4.5.3 Logic Rule Boolean 2*.
2	OR	Evaluates expression *P 8.4.5.1 Logic Rule Boolean 1* OR *P 8.4.5.3 Logic Rule Boolean 2*.
3	AND NOT	Evaluates expression *P 8.4.5.1 Logic Rule Boolean 1* AND NOT *P 8.4.5.3 Logic Rule Boolean 2*.
4	OR NOT	Evaluates expression *P 8.4.5.1 Logic Rule Boolean 1* OR NOT *P 8.4.5.3 Logic Rule Boolean 2*.
5	NOT AND	Evaluates expression NOT *P 8.4.5.1 Logic Rule Boolean 1* AND *P 8.4.5.3 Logic Rule Boolean 2*.
6	NOT OR	Evaluates expression NOT *P 8.4.5.1 Logic Rule Boolean 1* OR *P 8.4.5.3 Logic Rule Boolean 2*.
7	NOT AND NOT	Evaluates expression NOT *P 8.4.5.1 Logic Rule Boolean 1* AND NOT *P 8.4.5.3 Logic Rule Boolean 2*.
8	NOT OR NOT	Evaluates expression NOT *P 8.4.5.1 Logic Rule Boolean 1* OR NOT *P 8.4.5.3 Logic Rule Boolean 2*.

P 8.4.5.3 Logic Rule Boolean 2

Select the 2nd boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1342	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
30	SL Time-out 0	Use the result of timer 0 in the logic rule.
31	SL Time-out 1	Use the result of timer 1 in the logic rule.
32	SL Time-out 2	Use the result of timer 2 in the logic rule.
33	Digital input T13	Use the value of DI1 in a logic rule.
34	Digital input T14	Use the value of DI2 in a logic rule.
35	Digital input T15	Use the value of DIO in a logic rule.
36	Digital input T17	Use the value of DI3 in a logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.

Selection number	Selection name	Selection description
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
70	SL Time-out 3	Use the result of timer 3 in the logic rule.
71	SL Time-out 4	Use the result of timer 4 in the logic rule.
72	SL Time-out 5	Use the result of timer 5 in the logic rule.
73	SL Time-out 6	Use the result of timer 6 in the logic rule.
74	SL Time-out 7	Use the result of timer 7 in the logic rule.
83	Lost Load	Lost load is performed.

P 8.4.5.4 Logic Rule Operator 2

Select the 2nd logical operator to be used on the Boolean input calculated in *P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.2 Logic Rule Operator 1*, and *P 8.4.5.3 Logic Rule Boolean 2*, and the boolean input coming from *P 8.4.5.5 Logic Rule Boolean 3*. This is an array parameter containing logical operators 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1343	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	Ignores *P 8.4.5.5 Logic Rule Boolean 3*.
1	AND	Evaluates expression [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] AND *P 8.4.5.5 Logic Rule Boolean 3*.
2	OR	Evaluates expression [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] OR *P 8.4.5.5 Logic Rule Boolean 3*.
3	AND NOT	Evaluates expression [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] AND NOT *P 8.4.5.5 Logic Rule Boolean 3*.
4	OR NOT	Evaluates expression [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] OR NOT *P 8.4.5.5 Logic Rule Boolean 3*.
5	NOT AND	Evaluates expression NOT [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] AND *P 8.4.5.5 Logic Rule Boolean 3*.
6	NOT OR	Evaluates expression NOT [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] OR *P 8.4.5.5 Logic Rule Boolean 3*.
7	NOT AND NOT	Evaluates expression NOT [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] AND NOT *P 8.4.5.5 Logic Rule Boolean 3*.
8	NOT OR NOT	Evaluates expression NOT [*P 8.4.5.1 Logic Rule Boolean 1*/*P 8.4.5.3 Logic Rule Boolean 2*] OR NOT *P 8.4.5.5 Logic Rule Boolean 3*.

P 8.4.5.5 Logic Rule Boolean 3

Select the 3rd boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1344	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
30	SL Time-out 0	Use the result of timer 0 in the logic rule.
31	SL Time-out 1	Use the result of timer 1 in the logic rule.
32	SL Time-out 2	Use the result of timer 2 in the logic rule.
33	Digital input T13	Use the value of DI1 in a logic rule.
34	Digital input T14	Use the value of DI2 in a logic rule.
35	Digital input T15	Use the value of DIO in a logic rule.
36	Digital input T17	Use the value of DI3 in a logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.

Selection number	Selection name	Selection description
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
70	SL Time-out 3	Use the result of timer 3 in the logic rule.
71	SL Time-out 4	Use the result of timer 4 in the logic rule.
72	SL Time-out 5	Use the result of timer 5 in the logic rule.
73	SL Time-out 6	Use the result of timer 6 in the logic rule.
74	SL Time-out 7	Use the result of timer 7 in the logic rule.
83	Lost Load	Lost load is performed.

7.8.2.7 States (Menu Index 8.4.6)

P 8.4.6.1 Event

Select the boolean input (TRUE or FALSE) to define the Smart Logic Controller event. This is an array parameter containing SLC events 0–19.

Default value:	0	Parameter type:	Selection
Parameter number:	1351	Unit:	–
Data type:	enum	Access type:	Read/Write

Selection number	Selection name	Selection description
0	FALSE	Enters False in logic rule.
1	TRUE	Enters True in logic rule.
2	Running	See *P 9.4.3.1 Function Relay [5]* for description.
3	In range	See *P 9.4.3.1 Function Relay [7]* for description.
4	On reference	See *P 9.4.3.1 Function Relay [8]* for description.
7	Out of current range	See *P 9.4.3.1 Function Relay [12]* for description.
8	Below I low	See *P 9.4.3.1 Function Relay [13]* for description.
9	Above I high	See *P 9.4.3.1 Function Relay [14]* for description.
16	Thermal warning	See *P 9.4.3.1 Function Relay [21]* for description.
17	Mains out of range	The mains voltage is outside the specified voltage range.
18	Reversing	See *P 9.4.3.1 Function Relay [25]* for description.
19	Warning	A warning is active.
20	Fault (trip)	A trip fault is active.
21	Fault (trip lock)	A trip lock fault is active.
22	Comparator 0	Use the result of comparator 0 in the logic rule.
23	Comparator 1	Use the result of comparator 1 in the logic rule.
24	Comparator 2	Use the result of comparator 2 in the logic rule.
25	Comparator 3	Use the result of comparator 3 in the logic rule.
26	Logic rule 0	Use the result of logic rule 0 in logic rule.
27	Logic rule 1	Use the result of logic rule 1 in logic rule.
28	Logic rule 2	Use the result of logic rule 2 in logic rule.

Selection number	Selection name	Selection description
29	Logic rule 3	Use the result of logic rule 3 in logic rule.
30	SL Time-out 0	Use the result of timer 0 in the logic rule.
31	SL Time-out 1	Use the result of timer 1 in the logic rule.
32	SL Time-out 2	Use the result of timer 2 in the logic rule.
33	Digital input T13	Use the value of DI1 in a logic rule.
34	Digital input T14	Use the value of DI2 in a logic rule.
35	Digital input T15	Use the value of DIO in a logic rule.
36	Digital input T17	Use the value of DI3 in a logic rule.
39	Start command	This event is True, if the frequency converter is started by any means (digital input or other).
40	Drive stopped	This event is True, if the frequency converter is stopped or coasted by any means (digital input or other).
42	Auto Reset Trip	An auto reset is performed.
50	Comparator 4	Use the result of comparator 4 in the logic rule.
51	Comparator 5	Use the result of comparator 5 in the logic rule.
60	Logic rule 4	Use the result of logic rule 4 in logic rule.
61	Logic rule 5	Use the result of logic rule 5 in logic rule.
70	SL Time-out 3	Use the result of timer 3 in the logic rule.
71	SL Time-out 4	Use the result of timer 4 in the logic rule.
72	SL Time-out 5	Use the result of timer 5 in the logic rule.
73	SL Time-out 6	Use the result of timer 6 in the logic rule.
74	SL Time-out 7	Use the result of timer 7 in the logic rule.
83	Lost Load	Lost load is performed.

P 8.4.6.2 Action

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in *P 8.4.6.1 Event*) is evaluated as TRUE. This is an array parameter containing SLC actions 0–19.

Default value:	0	**Parameter type:**	Selection
Parameter number:	1352	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Disabled	Function is disabled.
1	No action	No action is taken.
2	Select set-up 1	Changes active setup to setup 1.
3	Select set-up 2	Changes active setup to setup 2.
10	Select preset ref 0	Selects preset reference 0.

Selection number	Selection name	Selection description
11	Select preset ref 1	Selects preset reference 1.
12	Select preset ref 2	Selects preset reference 2.
13	Select preset ref 3	Selects preset reference 3.
14	Select preset ref 4	Selects preset reference 4.
15	Select preset ref 5	Selects preset reference 5.
16	Select preset ref 6	Selects preset reference 6.
17	Select preset ref 7	Selects preset reference 7.
18	Select ramp 1	Selects ramp 1.
19	Select ramp 2	Selects ramp 2.
22	Run	Issues start command to drive.
23	Run reverse	Issues start reverse command to drive.
24	Stop	Issues stop command to drive.
25	Qstop	Issues a quick stop command to drive.
26	DC Brake	Issues DC brake command to drive.
27	Coast	The drive coasts immediately. All stop commands including coast command stop the SLC.
28	Freeze output	Freezes output frequency.
29	Start timer 0	Starts timer 0.
30	Start timer 1	Starts timer 1.
31	Start timer 2	Starts timer 2.
32	Set digital out A low	Set Digital output A low.
33	Set digital out B low	Set Digital output B low.
38	Set digital out A high	Set Digital output A high.
39	Set digital out B high	Set Digital output B high.
60	Reset Counter A	Resets counter A to 0.
61	Reset Counter B	Resets counter B to 0.
70	Start Timer 3	Starts timer 3.
71	Start Timer 4	Starts timer 4.
72	Start Timer 5	Starts timer 5.
73	Start Timer 6	Starts timer 6.
74	Start Timer 7	Starts timer 7.
100	Reset Fault	Reset the fault.

7.9 I/O (Menu Index 9)

7.9.1 I/O (Menu Index 9.3)

7.9.1.1 I/O Status (Menu Index 9.3)

P 9.3.1 Digital Input Status

View actual state of the digital inputs. The value should be analyzed using binary type. 0=no signal, 1=connected signal. From the right side to the left, bit 0, 2, 3, 4, 5 represent DI 18, 17, 15, 14, 13, respectively.

Default value:	0	**Parameter type:**	Range (0–4095)
Parameter number:	1660	**Unit:**	–
Data type:	uint16	**Access type:**	Read

The following are the bit descriptions.

Bit number	Bit description
Bit 0	Digital input terminal 18
Bit 2	Digital input terminal 17
Bit 3	Digital input terminal 15
Bit 4	Digital input terminal 14
Bit 5	Digital input terminal 13

P 9.3.2 Digital Output Status

View the binary value of all digital outputs. (0=low output, 1=high output, '_'=Not digital output configuration). From the right side to the left, bit 3 represent DO 15.

Default value:	0	**Parameter type:**	Range (0–63)
Parameter number:	1666	**Unit:**	–
Data type:	uint16	**Access type:**	Read

The following are the bit descriptions.

Bit number	Bit description
Bit 3	Digital output terminal 15

P 9.3.3 T31 Analog Output [mA]

View the actual value at output 31 in mA. The value shown reflects the selection in *P 9.5.1.1 T31 Mode* and *P 9.5.1.2 T31 Analog Output*.

Default value:	0.00	**Parameter type:**	Range (0.00–20.00)
Parameter number:	1665	**Unit:**	mA
Data type:	uint16	**Access type:**	Read

P 9.3.4 T33 Setting

View the setting of input terminal 33 (current or voltage).

Default value:	1 [Voltage mode]	**Parameter type:**	Selection
Parameter number:	1661	**Unit:**	–
Data type:	enum	**Access type:**	Read

The following are the selections for the parameter.

Selection number	Selection name
0	Current mode
1	Voltage mode

P 9.3.5 T33 Analog Input

View actual input on analog input 33.

Default value:	1.00	**Parameter type:**	Range (0.00–20.00)
Parameter number:	1662	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 9.3.6 T34 Setting

View the setting of input terminal 34 (current or voltage).

Default value:	1 [Voltage mode]	**Parameter type:**	Selection
Parameter number:	1663	**Unit:**	–
Data type:	enum	**Access type:**	Read

The following are the selections for the parameter.

Selection number	Selection name
0	Current mode
1	Voltage mode

P 9.3.7 T34 Analog Input

View actual input on analog input 34 (current or voltage).

Default value:	1.00	**Parameter type:**	Range (0.00–20.00)
Parameter number:	1664	**Unit:**	–
Data type:	uint16	**Access type:**	Read

P 9.3.8 T18 Pulse Input [Hz]

View the actual value of the frequency applied at terminal 18 as an impulse input.

Default value:	0	**Parameter type:**	Range (0–130000)
Parameter number:	1668	**Unit:**	–
Data type:	int32	**Access type:**	Read

P 9.3.9 T15 Pulse Output [Hz]

View the actual value of impulses applied to terminal 15 in digital output mode.

Default value:	0	**Parameter type:**	Range (0–40000)
Parameter number:	1669	**Unit:**	–
Data type:	int32	**Access type:**	Read

P 9.3.10 Relay Output

View the state of the relay outputs. The value should be analyzed using binary type. (0=off, 1=on). From the far right to left, corresponding to bit 4 is Relay Output 1.

Default value:	0	**Parameter type:**	Range (0–31)
Parameter number:	1671	**Unit:**	–
Data type:	uint16	**Access type:**	Read

7.9.2 Digital Inputs/Outputs (Menu Index 9.4)

7.9.2.1 Digital Input Setting (Menu Index 9.4.1)

P 9.4.1.1 Digital I/O mode

For digital I/O: Select *[0] PNP* for action on positive directional pulses. PNP is pulled down to GND. Select *[1] NPN* systems for action on negative directional pulses. NPN is pulled up to +24 V, inside the drive.

Default value:	0 [PNP]	**Parameter type:**	Selection
Parameter number:	500	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	PNP	Action on positive directional pulses (0). PNP systems are pulled down to the ground (GND).
1	NPN	Action on negative directional pulses (1). NPN systems are pulled up to +24 V internally in the frequency converter.

P 9.4.1.2 T13 Digital Input

Select the function from the available digital input range.

Default value:	8 [Start]	**Parameter type:**	Selection
Parameter number:	510	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/fault. Not all faults can be reset.
2	Coast Inverse	Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic 0⇒coasting stop.
3	Coast and Reset Inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic 0⇒coasting stop. Logic 1 to Logic 0⇒reset.
4	Quick Stop Inverse	Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in *P 5.7.7 Quick Stop Ramp Time*. When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop.

Selection number	Selection name	Selection description
5	DC-brake Inverse	Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See *P 5.7.4 DC Brake Current %* to *P 5.7.5 DC Brake Frequency*. The function is only active when the value in *P 5.7.3 DC Brake Time* is different from 0. Logic 0⇒DC braking.
6	Stop Inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (*P 5.5.4.3 Ramp 1 Decel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*). **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and 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.
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 *P 5.8.1 Rotation 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 for the clockwise direction.
13	Enable Start Reverse	Disengage the clockwise movement and allows for the counterclockwise direction.
14	Jog	Use to activate jog speed. See *P 5.9.2 Jog Reference 1*.
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *P 5.5.3.5 Reference Function*. Logic 0 = external reference active; logic 1=1 of the preset references is active.
16	Preset Ref. Bit 0	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range *P 5.5.3.3 Reference Maximum*.

Selection number	Selection name	Selection description
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 4.2.2.4 Nominal Frequency*. **Note:** When *[20] Freeze output* is active, the frequency converter cannot be stopped by setting the signal on *[8] Start* to low. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.
21	Speed Up	Select *[21] Speed up* and *[22] Speed down* 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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*.
22	Speed Down	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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*.
23	Set-up Select Bit 0	Select *[23] Set-up select bit 0* to select 1 of the 2 set-ups. Set *P 6.6.1 Active Set-up* to *[9] Multi Set-up*.
25	Start and Coast	Select *[25] Start and Coast* for a start command or coast stop. Logic 1=start, logic 0=coast stop.
28	Catch Up	Increase reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
29	Slow Down	Reduce reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
34	Ramp Bit 0	Enable a selection from the 2 ramps available.
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 frequency converter. This fault is treated as an internally generated fault.
55	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
56	DigiPot decrease	Decrease signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
57	DigiPot clear	Clear the digital potentiometer reference described in parameter group *5.13 Digital Potentiometer*.

Selection number	Selection name	Selection description
60	Counter A (up)	Input for increment counting in the SLC counter A.
61	Counter A (down)	Input for decrement counting in the SLC counter A.
62	Reset Counter A	Input for reset of counter A.
63	Counter B (up)	Input for increment counting in the SLC counter B.
64	Counter B (down)	Input for decrement counting in the SLC counter B.
65	Reset Counter B	Input for reset of counter B.
101	Sleep	A signal applied puts the frequency converter into sleep mode.

Table 64: 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 65: 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

P 9.4.1.3 T14 Digital Input

Select the function from the available digital input range.

Default value:	10 [Reversing]	Parameter type:	Selection
Parameter number:	511	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/fault. Not all faults can be reset.
2	Coast Inverse	Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic 0⇒coasting stop.

Selection number	Selection name	Selection description
3	Coast and Reset Inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic 0⇒coasting stop. Logic 1 to Logic 0⇒reset.
4	Quick Stop Inverse	Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in *P 5.7.7 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 braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See *P 5.7.4 DC Brake Current* to *P 5.7.5 DC Brake Frequency*. The function is only active when the value in *P 5.7.3 DC Brake Time* is different from 0. Logic 0⇒DC braking.
6	Stop Inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*).
		Note: When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and 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.
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 *P 5.8.1 Rotation 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 for the clockwise direction.
13	Enable Start Reverse	Disengage the clockwise movement and allows for the counterclockwise direction.
14	Jog	Use to activate jog speed. See *P 5.9.2 Jog Reference 1*.
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *P 5.5.3.5 Reference Function*. Logic 0 = external reference active; logic 1=1 of the 8 preset references is active.
16	Preset Ref. Bit 0	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 64.

Selection number	Selection name	Selection description
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 5.5.3.3 Reference Maximum*.
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 4.2.2.4 Nominal Frequency*. **Note:** When *[20] Freeze output* is active, the frequency converter cannot be stopped by setting the signal on *[8] Start* to low. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.
21	Speed Up	Select *[21] Speed up* and *[22] Speed down* 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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
22	Speed Down	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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
23	Set-up Select Bit 0	Select *[23] Set-up select bit 0* to select 1 of the 2 set-ups. Set *P 6.6.1 Active Set-up* to *[9] Multi Set-up*.
25	Start and Coast	Select *[25] Start and Coast* for a start command or coast stop. Logic 1=start, logic 0=coast stop.
28	Catch Up	Increase reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
29	Slow Down	Reduce reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
34	Ramp Bit 0	Enable a selection from the 2 ramps available.
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 frequency converter. This fault is treated as an internally generated fault.
55	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.

Selection number	Selection name	Selection description
56	DigiPot decrease	Decrease signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
57	DigiPot clear	Clear the digital potentiometer reference described in parameter group *5.13 Digital Potentiometer*.
60	Counter A (up)	Input for increment counting in the SLC counter A.
61	Counter A (down)	Input for decrement counting in the SLC counter A.
62	Reset Counter A	Input for reset of counter A.
63	Counter B (up)	Input for increment counting in the SLC counter B.
64	Counter B (down)	Input for decrement counting in the SLC counter B.
65	Reset Counter B	Input for reset of counter B.
101	Sleep	A signal applied puts the frequency converter into sleep mode.

P 9.4.1.4 T15 Digital Input

Select the function from the available digital input range.

Default value:	1 [Reset]	**Parameter type:**	Selection
Parameter number:	512	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/fault. Not all faults can be reset.
2	Coast Inverse	Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic 0⇒coasting stop.
3	Coast and Reset Inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic 0⇒coasting stop. Logic 1 to Logic 0⇒reset.
4	Quick Stop Inverse	Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in *P 5.7.7 Quick Stop Ramp Time*. When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop. **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and stop and connect this digital output to a digital input that is configured as coast.
5	DC-brake Inverse	Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See *P 5.7.4 DC Brake Current %* to *P 5.7.5 DC Brake Frequency*. The function is only active when the value in *P 5.7.3 DC Brake Time* is different from 0. Logic 0⇒DC braking.

Selection number	Selection name	Selection description
6	Stop Inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*). **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and 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.
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 *P 5.8.1 Rotation 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 for the clockwise direction.
13	Enable Start Reverse	Disengage the clockwise movement and allows for the counterclockwise direction.
14	Jog	Use to activate jog speed. See *P 5.9.2 Jog Reference 1*.
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *P 5.5.3.5 Reference Function*. Logic 0 = external reference active; logic 1=1 of the 8 preset references is active.
16	Preset Ref. Bit 0	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See [Table 64](#).
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See [Table 64](#).
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See [Table 64](#).
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0– *P 5.5.3.3 Maximum Reference*.

Selection number	Selection name	Selection description
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 4.2.2.4 Nominal Frequency*. **Note:** When *[20] Freeze output* is active, the frequency converter cannot be stopped by setting the signal on *[8] Start* to low. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.
21	Speed Up	Select *[21] Speed up* and *[22] Speed down* 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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
22	Speed Down	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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
23	Set-up Select Bit 0	Select *[23] Set-up select bit 0* to select 1 of the 2 set-ups. Set *P 6.6.1 Active Set-up* to *[9] Multi Set-up*.
25	Start and Coast	Select *[25] Start and Coast* for a start command or coast stop. Logic 1=start, logic 0=coast stop.
28	Catch Up	Increase reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
29	Slow Down	Reduce reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
34	Ramp Bit 0	Enable a selection from the 2 ramps available.
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 frequency converter. This fault is treated as an internally generated fault.
55	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
56	DigiPot decrease	Decrease signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
57	DigiPot clear	Clear the digital potentiometer reference described in parameter group *5.13 Digital Potentiometer*.

Selection number	Selection name	Selection description
60	Counter A (up)	Input for increment counting in the SLC counter A.
61	Counter A (down)	Input for decrement counting in the SLC counter A.
62	Reset Counter A	Input for reset of counter A.
63	Counter B (up)	Input for increment counting in the SLC counter B.
64	Counter B (down)	Input for decrement counting in the SLC counter B.
65	Reset Counter B	Input for reset of counter B.
101	Sleep	A signal applied puts the frequency converter into sleep mode.

P 9.4.1.5 T17 Digital Input

Select the function from the available digital input range.

Default value:	14 [Jog]	**Parameter type:**	Selection
Parameter number:	513	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/fault. Not all faults can be reset.
2	Coast Inverse	Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic 0⇒coasting stop.
3	Coast and Reset Inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic 0⇒coasting stop. Logic 1 to Logic 0⇒reset.
4	Quick Stop Inverse	Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in *P 5.7.7 Quick Stop Ramp Time*. When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop. **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and stop and connect this digital output to a digital input that is configured as coast.
5	DC-brake Inverse	Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See *P 5.7.4 DC Brake Current %* to *P 5.7.5 DC Brake Frequency*. The function is only active when the value in *P 5.7.3 DC Brake Time* is different from 0. Logic 0⇒DC braking.

Selection number	Selection name	Selection description
6	Stop Inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*). **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and 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.
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 *P 5.8.1 Rotation 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 for the clockwise direction.
13	Enable Start Reverse	Disengage the clockwise movement and allows for the counterclockwise direction.
14	Jog	Use to activate jog speed.
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *P 5.5.3.5 Reference Function*. Logic 0 = external reference active; logic 1=1 of the 8 preset references is active.
16	Preset Ref. Bit 0	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0– *P 5.5.3.3 Reference Maximum*.

Selection number	Selection name	Selection description
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0– *P 4.2.2.4 Nominal Frequency*. **Note:** When *[20] Freeze output* is active, the frequency converter cannot be stopped by setting the signal on *[8] Start* to low. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.
21	Speed Up	Select *[21] Speed up* and *[22] Speed down* 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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
22	Speed Down	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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
23	Set-up Select Bit 0	Select *[23] Set-up select bit 0* to select 1 of the 2 set-ups. Set *P 6.6.1 Active Set-up* to *[9] Multi Set-up*.
25	Start and Coast	Select *[25] Start and Coast* for a start command or coast stop. Logic 1=start, logic 0=coast stop.
28	Catch Up	Increase reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
29	Slow Down	Reduce reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
34	Ramp Bit 0	Enable a selection from the 2 ramps available.
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 frequency converter. This fault is treated as an internally generated fault.
55	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
56	DigiPot decrease	Decrease signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
57	DigiPot clear	Clear the digital potentiometer reference described in parameter group *5.13 Digital Potentiometer*.

Selection number	Selection name	Selection description
60	Counter A (up)	Input for increment counting in the SLC counter A.
61	Counter A (down)	Input for decrement counting in the SLC counter A.
62	Reset Counter A	Input for reset of counter A.
63	Counter B (up)	Input for increment counting in the SLC counter B.
64	Counter B (down)	Input for decrement counting in the SLC counter B.
65	Reset Counter B	Input for reset of counter B.
101	Sleep	A signal applied puts the frequency converter into sleep mode.

P 9.4.1.6 T18 Digital Input

Select the function from the available digital input range.

Default value:	0 [No Operation]	**Parameter type:**	Selection
Parameter number:	515	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	Action on positive directional pulses (0). PNP systems are pulled down to the ground (GND).
1	Reset	Resets the frequency converter after a trip/fault. Not all faults can be reset.
2	Coast Inverse	Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic 0⇒coasting stop.
3	Coast and Reset Inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic 0⇒coasting stop. Logic 1 to Logic 0⇒reset.
4	Quick Stop Inverse	Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in *P 5.7.7 Quick Stop Ramp Time*. When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop. **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and stop and connect this digital output to a digital input that is configured as coast.
5	DC-brake Inverse	Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See *P 5.7.4 DC Brake Current %* to *P 5.7.5 DC Brake Frequency*. The function is only active when the value in *P 5.7.3 DC Brake Time* is different from 0. Logic 0⇒DC braking.

Selection number	Selection name	Selection description
6	Stop Inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logic 1 to logic 0. The stop is performed according to the selected ramp time (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*). **Note:** When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit* and 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.
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 *P 5.8.1 Rotation 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 for the clockwise direction.
13	Enable Start Reverse	Disengage the clockwise movement and allows for the counterclockwise direction.
14	Jog	Use to activate jog speed. See *P 5.9.2 Jog Reference 1*.
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *P 5.5.3.5 Reference Function*. Logic 0 = external reference active; logic 1=1 of the 8 preset references is active.
16	Preset Ref. Bit 0	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 65.
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 5.5.3.3 Reference Maximum*.

Selection number	Selection name	Selection description
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 (*P 5.5.4.9 Ramp 2 Accel. Time* and *P 5.5.4.10 Ramp 2 Decel. Time*) in the range 0–*P 4.2.2.4 Nominal Frequency*. **Note:** When *[20] Freeze output* is active, the frequency converter cannot be stopped by setting the signal on *[8] Start* to low. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.
21	Speed Up	Select *[21] Speed up* and *[22] Speed down* 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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
22	Speed Down	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/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down *P 5.5.4.9 Ramp 2 Accel. Time*/*P 5.5.4.10 Ramp 2 Decel. Time*. See Table 65.
23	Set-up Select Bit 0	Select *[23] Set-up select bit 0* or *[1] Set-up select bit 1* to select 1 of the 2 set-ups. Set *P 6.6.1 Active Set-up* to *[9] Multi Set-up*.
25	Start and Coast	Select *[25] Start and Coast* for a start command or coast stop. Logic 1=start, logic 0=coast stop.
28	Catch Up	Increase reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
29	Slow Down	Reduce reference value by percentage (relative) set in *P 5.5.3.13 Freeze Up/Down Step Delta*. See Table 65.
32	Pulse Input	The motor starts to run reverse when a pulse is applied for minimum 4 ms. The motor stops when stop commands are given.
34	Ramp bit 0	This function makes it possible to give an external fault to the frequency converter. This fault is treated as an internally generated fault.
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.
46	Pulse PWM Input	To enable a variable duty cycle pulse signal as the reference.
51	External Interlock	This function makes it possible to give an external fault to the frequency converter. This fault is treated as an internally generated fault.

Selection number	Selection name	Selection description
55	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
56	DigiPot decrease	Decrease signal to the digital potentiometer function described in parameter group *5.13 Digital Potentiometer*.
57	DigiPot clear	Clear the digital potentiometer reference described in parameter group *5.13 Digital Potentiometer*.
60	Counter A (up)	Input for increment counting in the SLC counter A.
61	Counter A (down)	Input for decrement counting in the SLC counter A.
62	Reset Counter A	Input for reset of counter A.
63	Counter B (up)	Input for increment counting in the SLC counter B.
64	Counter B (down)	Input for decrement counting in the SLC counter B.
65	Reset Counter B	Input for reset of counter B.
101	Sleep	A signal applied puts the frequency converter into sleep mode.

Figure 85: Duration between Pulse Flanks

7.9.2.2 T15 as Digital Output (Menu Index 9.4.2)

P 9.4.2.1 T15 Mode

Select *[0] Input* to define terminal 15 as a digital input. Select *[1] Output* to define terminal 15 as a digital output.

Default value:	0 [Input]	Parameter type:	Selection
Parameter number:	501	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	Input	Defines terminal 15 as a digital input.
1	Output	Defines terminal 15 as a digital output.

P 9.4.2.2 T15 Digital Output

Select the function to control the digital output.

Default value:	0 [No Operation]	Parameter type:	Selection
Parameter number:	530	Unit:	–

Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	Default for all digital outputs.
1	Control Ready	The control card is ready.
2	Drive Ready	The frequency converter is ready for operation and applies a supply signal on the control board.
3	Drive Ready/Remote Mode	The frequency converter is ready for operation and is in Remote 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 Warning	The motor is running within the programmed current and speed ranges set in *P 4.6.4 Warning Current Low* to *P 4.6.3 Warning Current High*. There are no warnings.
8	Run on Ref./No Warning	The motor runs at reference speed. No warnings.
9	Fault	A fault activates the output.
10	Fault or Warning	A fault or a warning activates the output.
11	At Torque Limit	The torque limit set in *P 5.10.1 Motor Torque Limit* or *P 5.10.2 Regenerative Torque Limit* has been exceeded.
12	Out of Current Range	The motor current is outside the range set in *P 2.7.1 Output Current Limit %*.
13	Below Current, Low	The motor current is lower than set in *P 4.6.4 Warning Current Low*.
14	Above Current, High	The motor current is higher than set in *P 4.6.3 Warning Current High*.
15	Out of Frequency Range	The output frequency is outside the frequency range.
16	Below Frequency, Low	The output speed is lower than the setting in *P 4.6.2 Warning Freq. Low*.
17	Above Frequency, High	The output speed is higher than the setting in *P 4.6.1 Warning Freq. High*.
18	Out of Feedback Range	The feedback is outside the range set in *P 5.2.4 Warning Feedback Low* and *P 5.2.3 Warning Feedback High*.
19	Below Feedback, Low	The feedback is below the limit set in *P 5.2.4 Warning Feedback Low*.
20	Above Feedback, High	The feedback is above the limit set in *P 5.2.3 Warning Feedback High*.
21	Thermal Warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.

Selection number	Selection name	Selection description
22	Ready, No Thermal Warning	The frequency converter is ready for operation, and there is no overtemperature warning.
23	Remote, Ready, No TW	The frequency converter is ready for operation and is in Remote mode. There is no overtemperature warning.
24	Ready, No Over/under-voltage	The frequency converter is ready for operation and the mains voltage is within the specified voltage range.
25	Reverse	The motor runs (or is ready to run) clockwise when logic=0 and counterclockwise when logic=1. The output changes 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 frequency converter 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 frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the frequency converter.
32	Mech. Brake Control	Enable control of an external mechanical brake.
36	Control Word Bit 11	Bit 11 in the control word controls the relay.
37	Control Word Bit 12	Bit 12 in the control word controls the relay.
40	Out of Ref. Range	This option is active when the actual speed is outside the settings in *P 5.2.2 Warning Reference Low* to *P 5.2.1 Warning Reference High*.
41	Below Reference, Low	This option is active when the actual speed is below the speed reference setting.
42	Above Refefence, High	This option is active when the actual speed is above the speed reference setting.
45	Bus Control	Control output via fieldbus. The state of the output is set in *P 9.4.6.1 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 *P 9.4.6.1 Digital & Relay Bus Control*. When bus timeout occurs, the output state is set high (On).
47	Bus Control, Timeout: Off	Control output via fieldbus. The state of the output is set in *P 9.4.6.1 Digital & Relay Bus Control*. When bus timeout occurs, the output state is set low (Off).
55	Pulse Output	Use terminal 15 as the pulse output.
56	Heat Sink Cleaning Warning, High	Activated when the heat sink temperature is not lower than the calculated value. The calculated value is equal to the maximum value of *P 2.1.9 Heat Sink Temperature* minus the current value of *P 2.1.9 Heat Sink Temperature*.

Selection number	Selection name	Selection description
60	Comparator 0	Use the result of comparator 0 in the logic rule.
61	Comparator 1	Use the result of comparator 1 in the logic rule.
62	Comparator 2	Use the result of comparator 2 in the logic rule.
63	Comparator 3	Use the result of comparator 3 in the logic rule.
64	Comparator 4	Use the result of comparator 4 in the logic rule.
65	Comparator 5	Use the result of comparator 5 in the logic rule.
70	Logic rule 0	Use the result of logic rule 0 in logic rule.
71	Logic rule 1	Use the result of logic rule 1 in logic rule.
72	Logic rule 2	Use the result of logic rule 2 in logic rule.
73	Logic rule 3	Use the result of logic rule 3 in logic rule.
74	Logic rule 4	Use the result of logic rule 4 in logic rule.
75	Logic rule 5	Use the result of logic rule 5 in logic rule.
80	SL digital output A	See *P 8.4.6.2 Action*. The output goes high whenever the smart logic action *[38] Set digital out A high* is executed. The output goes low whenever the smart logic action *[32] Set digital out A low* is executed.
81	SL digital output B	See *P 8.4.6.2 Action*. The output goes high whenever the smart logic action *[39] Set digital out B high* is executed. The output goes low whenever the smart logic action *[33] Set digital out B low* is executed.
160	No Fault	The output is high when no fault is present.
161	Running Reverse	The output is high when the frequency converter is running counterclockwise (the logical product of the status bits Running AND Reverse).
165	Local Ref. Active	The output is high when the local reference is activated.
166	Remote Ref. Active	The output is high when remote reference is activated.
167	Start Command Active	The output is high when there is an active start command, and no stop command is active.
168	Drive in Local Mode	The output is high when the frequency converter is in Local mode.
169	Drive in Remote Mode	The output is high when the frequency converter is in Remote mode.
193	Sleep Mode	The frequency converter/system has entered sleep mode.
194	Lost Load Function	A lost-load condition is detected.

P 9.4.2.3 T15 DO ON-Delay

Enter the digital output on delay time.

Default value:	0.01	**Parameter type:**	Range (0.00–600.00)
Parameter number:	534	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 9.4.2.4 T15 DO OFF-Delay

Enter the digital output Off delay time.

Default value:	0.01	**Parameter type:**	Range (0.00–600.00)
Parameter number:	535	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

7.9.2.3 Relay (Menu Index 9.4.3)

P 9.4.3.1 Function Relay

Select the function to control the output relays.

Default value:	9	**Parameter type:**	Selection
Parameter number:	540	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	No Operation	Default for all digital outputs.
1	Control Ready	The control card is ready.
2	Drive Ready	The frequency converter is ready for operation and applies a supply signal on the control board.
3	Drive Ready/Remote Mode	The frequency converter is ready for operation and is in Remote 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 Warning	The motor is running within the programmed current and speed ranges set in *P 4.6.4 Warning Current Low* to *P 4.6.3 Warning Current High*. There are no warnings.
8	Run on Ref./No Warning	The motor runs at reference speed. No warnings.
9	Fault	A fault activates the output.
10	Fault or Warning	A fault or a warning activates the output.
11	At Torque Limit	The torque limit set in *P 5.10.1 Motor Torque Limit* or *P 5.10.2 Regenerative Torque Limit* has been exceeded.
12	Out of Current Range	The motor current is outside the range set in *P 2.7.1 Output Current Limit %*.
13	Below Current, Low	The motor current is lower than set in *P 4.6.4 Warning Current Low*.
14	Above Current, High	The motor current is higher than set in *P 4.6.3 Warning Current High*.
15	Out of Frequency Range	The output frequency is outside the frequency range.
16	Below Frequency, Low	The output speed is lower than the setting in *P 4.6.2 Warning Freq. Low*.

Selection number	Selection name	Selection description
17	Above Frequency, High	The output speed is higher than the setting in *P 4.6.1 Warning Freq. High*.
18	Out of Feedback Range	The feedback is outside the range set in *P 5.2.4 Warning Feedback Low* and *P 5.2.3 Warning Feedback High*.
19	Below Feedback, Low	The feedback is below the limit set in *P 5.2.4 Warning Feedback Low*.
20	Above Feedback, High	The feedback is above the limit set in *P 5.2.3 Warning Feedback High*.
21	Thermal Warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
22	Ready, No Thermal Warning	The frequency converter is ready for operation, and there is no overtemperature warning.
23	Remote, Ready, No TW	The frequency converter is ready for operation and is in Remote mode. There is no overtemperature warning.
24	Ready, No Over/under-voltage	The frequency converter is ready for operation and the mains voltage is within the specified voltage range.
25	Reverse	The motor runs (or is ready to run) clockwise when logic=0 and counterclockwise when logic=1. The output changes 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 frequency converter 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 frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the frequency converter.
32	Mech. Brake Control	Enable control of an external mechanical brake.
36	Control Word Bit 11	Bit 11 in the control word controls the relay.
37	Control Word Bit 12	Bit 12 in the control word controls the relay.
40	Out of Ref. Range	This option is active when the actual speed is outside the settings in *P 5.2.2 Warning Reference Low* to *P 5.2.1 Warning Reference High*.
41	Below Reference, Low	This option is active when the actual speed is below the speed reference setting.
42	Above Refefence, High	This option is active when the actual speed is above the speed reference setting.

Selection number	Selection name	Selection description
45	Bus Control	Control output via fieldbus. The state of the output is set in *P 9.4.6.1 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 *P 9.4.6.1 Digital & Relay Bus Control*. When bus timeout occurs, the output state is set high (On).
47	Bus Control, Timeout: Off	Control output via fieldbus. The state of the output is set in *P 9.4.6.1 Digital & Relay Bus Control*. When bus timeout occurs, the output state is set low (Off).
55	Pulse Output	Use terminal 15 as the pulse output.
56	Heat Sink Cleaning Warning, High	Activated when the heat sink temperature is not lower than the calculated value. The calculated value is equal to the maximum value of *P 2.1.9 Heat Sink Temperature* minus the current value of *P 2.1.9 Heat Sink Temperature*.
60	Comparator 0	Use the result of comparator 0 in the logic rule.
61	Comparator 1	Use the result of comparator 1 in the logic rule.
62	Comparator 2	Use the result of comparator 2 in the logic rule.
63	Comparator 3	Use the result of comparator 3 in the logic rule.
64	Comparator 4	Use the result of comparator 4 in the logic rule.
65	Comparator 5	Use the result of comparator 5 in the logic rule.
70	Logic rule 0	Use the result of logic rule 0 in logic rule.
71	Logic rule 1	Use the result of logic rule 1 in logic rule.
72	Logic rule 2	Use the result of logic rule 2 in logic rule.
73	Logic rule 3	Use the result of logic rule 3 in logic rule.
74	Logic rule 4	Use the result of logic rule 4 in logic rule.
75	Logic rule 5	Use the result of logic rule 5 in logic rule.
80	SL digital output A	See *P 8.4.6.2 Action*. The output goes high whenever the smart logic action *[38] Set digital out A high* is executed. The output goes low whenever the smart logic action *[32] Set digital out A low* is executed.
81	SL digital output B	See *P 8.4.6.2 Action*. The output goes high whenever the smart logic action *[39] Set digital out B high* is executed. The output goes low whenever the smart logic action *[33] Set digital out B low* is executed.
160	No Fault	The output is high when no fault is present.
161	Running Reverse	The output is high when the frequency converter is running counterclockwise (the logical product of the status bits Running AND Reverse).
165	Local Ref. Active	The output is high when the local reference is activated.
166	Remote Ref. Active	The output is high when remote reference is activated.
167	Start Command Active	The output is high when there is an active start command, and no stop command is active.

Selection number	Selection name	Selection description
168	Drive in Local Mode	The output is high when the frequency converter is in Local mode.
169	Drive in Remote Mode	The output is high when the frequency converter is in Remote mode.
193	Sleep Mode	The frequency converter/system has entered sleep mode.
194	Lost Load Function	A lost-load condition is detected.

P 9.4.3.2 Relay ON-Delay

Enter the delay of the relay cut-in time.

Default value:	0.01		**Parameter type:**	Range (0.00–600.00)
Parameter number:	541		**Unit:**	s
Data type:	uint16		**Access type:**	Read/Write
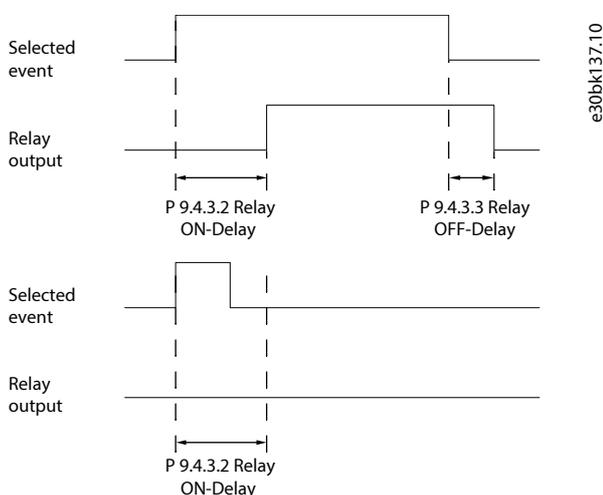
Figure 86: On Delay, Relay

P 9.4.3.3 Relay OFF-Delay

Enter the delay of the relay cut-out time. See **P 9.4.3.1 Function Relay**. If the selected-event condition changes before a delay timer expires, the relay output is unaffected.

Default value:	0.01		**Parameter type:**	Range (0.00–600.00)
Parameter number:	542		**Unit:**	s
Data type:	uint16		**Access type:**	Read/Write
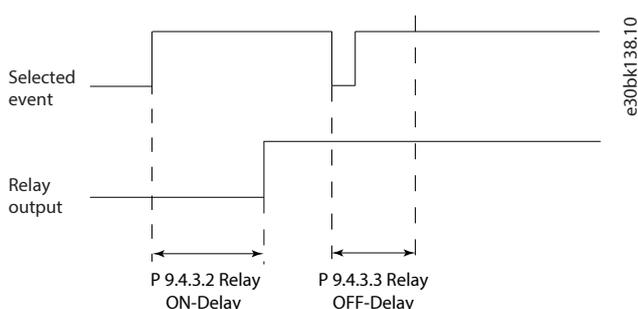
Figure 87: Off Delay, Relay

7.9.2.4 **T18 as Pulse Input (Menu Index 9.4.4)**

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 18 act as frequency reference inputs. Set terminal 18 (*P 9.4.1.6 T18 Digital Input*) to *[32] Pulse input*.
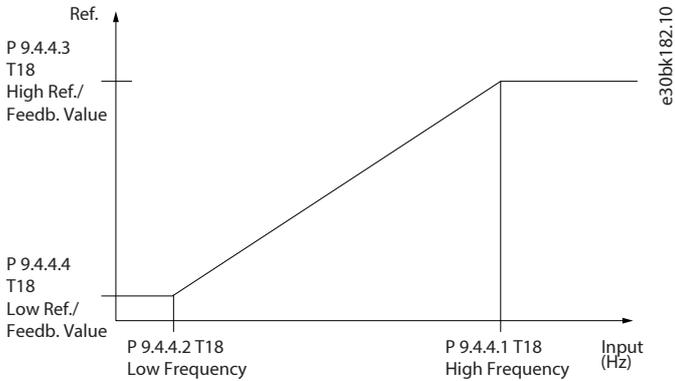
Figure 88: Pulse Input

P 9.4.4.1 T18 High Frequency

Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in *P 9.4.4.3 Term. 18 High Ref./Feedb. Value*.

Default value:	32000	**Parameter type:**	Range (1–32000)
Parameter number:	556	**Unit:**	Hz
Data type:	uint 32	**Access type:**	Read/Write

P 9.4.4.2 T18 Low Frequency

Enter the low frequency corresponding to the low motor shaft speed (that is low reference value) in *P 9.4.4.4 Term. 18 Low Ref./Feedb. Value*.

Default value:	4	**Parameter type:**	Range (0–31999)
Parameter number:	555	**Unit:**	Hz
Data type:	uint32	**Access type:**	Read/Write

P 9.4.4.3 T18 High Ref./Feedb. Value

Enter the high reference value for the motor shaft speed and the high feedback value.

Default value:	Size Related	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	558	**Unit:**	Hz
Data type:	int32	**Access type:**	Read/Write

P 9.4.4.4 T18 Low Ref./Feedb. Value

Enter the low reference value for the motor shaft speed and the low feedback value.

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter number:	557	**Unit:**	Hz
Data type:	int32	**Access type:**	Read/Write

P 9.4.4.5 T18 Pulse Filter Time Constant

Enter the pulse filter time constant. The low-pass filter reduces the influence on and dampens oscillations on the feedback signal from the control. This is an advantage, for example, if there is a great amount on noise in the system.

Default value:	100	**Parameter type:**	Range (1–1000)
Parameter number:	559	**Unit:**	ms
Data type:	uint16	**Access type:**	Read/Write

Variable duty cycle pulse signal as input

The normal pulse input has fixed 50% duty cycle. To enable variable duty cycle pulse signal as the reference, the terminal 18 must be set for variable duty cycle pulse signal as input. *P 9.4.1.6 T18 Digital Input* should be set as *[46] Pulse PWM Input*. The related parameters for reference source *P 5.5.3.x* should be selected as *[8] Frequency Input 18*. The frequency range of pulse input is from 1 Hz to 1 kHz.

Parameter *P 9.4.4.6 T18 PWM Polarity* is for selecting the polarity of pulse input signal. Select *[0] Positive* for positive direction pulses. Select *[1] Negative* for negative direction pulses. *P 9.4.4.7 T18 High Duty* is the duty cycle of pulse corresponding to the high reference value in *P 9.4.4.3 Term. 18 High Ref./Feedb. Value*. *P 9.4.4.8 T18 Low Duty* is the duty cycle of pulse corresponding to the low reference value in *P 9.4.4.4 Term. 18 Low Ref./Feedb. Value*.

P 9.4.4.6 T18 PWM Polarity

When setting the variable duty cycle pulse signal as the reference, use this parameter to select the activated PWM polarity. Select *[0] Positive*, for positive direction pulses. Select *[1] Negative*, for negative direction pulses.

Default value:	0	**Parameter type:**	Selection
Parameter number:	505	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

Selection number	Selection name
0	Positive
1	Negative

P 9.4.4.7 T18 High Duty

When setting variable duty cycle pulse signal as the reference, use this parameter to enter the pulse PWM input high duty (%) that corresponds to the high reference value in *P 9.4.4.3 Term. 18 High Ref./Feedb. Value*.

Default value:	5000	**Parameter type:**	Range (100–10000)
Parameter number:	507	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 9.4.4.8 T18 Low Duty

When setting variable duty cycle pulse signal as the reference, use this parameter to enter the pulse PWM input low duty (%) that corresponds to the low reference value in *P 9.4.4.4 Term. 18 Low Ref./Feedb. Value*.

Default value:	0	**Parameter type:**	Range (0–9900)
Parameter number:	506	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

7.9.2.5 T15 as Pulse Output (Menu Index 9.4.5)

P 9.4.5.1 T15 Pulse Output Variable

Select the desired output on terminal 15.

Default value:	0	Parameter type:	Selection
Parameter number:	560	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No Operation
45	Bus Control
48	Bus Control, Timeout
100	Output Frequency
101	Reference
102	Process Feedback
103	Motor Current
104	Torque Relate to Limit
105	Torque Relate to Rated
106	Power
107	Speed
109	Max Out Frequency
113	PID Clamped Output

P 9.4.5.2 T15 Pulse Output Max. Freq

Set the maximum frequency for terminal 15, corresponding to the output variable selected in parameter *9.4.5.1 T15 Pulse Output Variable*.

Default value:	5000	Parameter type:	Range (4–32000)
Parameter number:	562	Unit:	Hz
Data type:	uint32	Access type:	Read/Write

7.9.2.6 Bus Control (Menu Index 9.4.6)

P 9.4.6.1 Digital & Relay Bus Control

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

Default value:	0	Parameter type:	Range (0–4294967295)
Parameter number:	590	Unit:	–
Data type:	uint32	Access type:	Read

Table 66: Bit Description

Bit	Bit name
Bit 0	Digital Output Terminal 15
Bit 1-3	Reserved
Bit 4	Relay 1 Output Terminal

Table 66: Bit Description - (continued)

Bit	Bit name
Bit 6-23	Reserved
Bit 24	Reserved
Bit 26-31	Reserved

P 9.4.6.2 T15 Pulse Out Bus Control

Set the output frequency transferred to the output terminal 15 when the terminal is configured as *[45] Bus Control* in *P 9.4.5.1 T15 Pulse Output Variable*.

Default value:	0	**Parameter type:**	Range (0.00–100.00)
Parameter number:	593	**Unit:**	%
Data type:	uint16	**Access type:**	Read

P 9.4.6.3 T15 Pulse Out Timeout Preset

Set the output frequency transferred to the output terminal 15 when the terminal is configured as *[48] Bus Control, Timeout* in *P 9.4.5.1 T15 Pulse Output Variable* and a timeout is detected.

Default value:	0	**Parameter type:**	Range (0.00–100.00)
Parameter number:	594	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

7.9.3 Analog Inputs/Outputs (Menu Index 9.5)

7.9.3.1 Output Terminal 31 (Menu Index 9.5.1)

P 9.5.1.1 T31 Mode

Set terminal 31 analog output range.

Default value:	0 [0–20 mA]	**Parameter type:**	Selection
Parameter Number	690	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	0–20 mA
1	4–20 mA

P 9.5.1.2 T31 Analog Output

Select the function of Terminal 31.

Default value:	100 [Output Frequency]	**Parameter type:**	Selection
Parameter Number	691	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	No Operation
100	Output Frequency
101	Reference
102	Process Feedback
103	Motor Current
104	Torque Relate to Limit
105	Torque Relate to Rated
106	Power
107	Speed
109	Max Out Freq
113	PID Clamped Output
139	Bus Control
254	DC Link Voltage

P 9.5.1.3 T31 Output Max Scale

Scale for the maximum output (20 mA) of the analog signal at terminal 31. Set the value to be the percentage of the full range of the variable selected in *P 9.5.1.2 Terminal 31 Analog Output*.

Default value:	100.00	**Parameter type:**	Range (0.00–200.00)
Parameter Number	694	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write
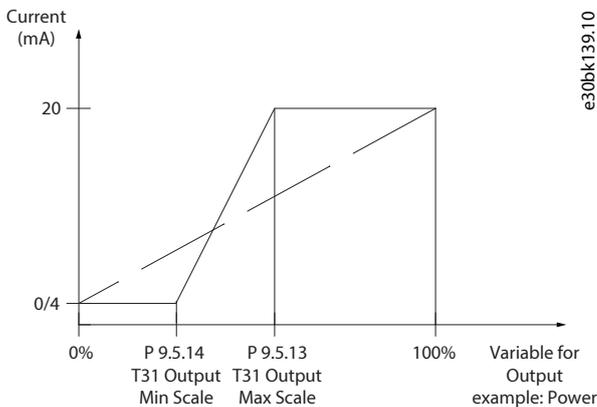
Figure 89: Output Scale versus Current

P 9.5.1.4 T31 Output Min Scale

Scale for the maximum output (20 mA) of the analog signal at terminal 31. Set the value to be the percentage of the full range of the variable selected in *P 9.5.1.2 Terminal 31 Analog Output*.

Default value:	0	**Parameter type:**	Range (0.00–200.00)
Parameter Number	693	**Unit:**	%
Data type:	uint16	**Access type:**	Read/Write

P 9.5.1.5 T31 Output Bus Control

Holds the analog level of Output 31 if controlled by bus.

Default value:	0	**Parameter type:**	Range (0–16384)
Parameter Number	696	**Unit:**	–
Data type:	uint16	**Access type:**	Read/Write

7.9.3.2 Input Terminal 33 (Menu Index 9.5.2)

P 9.5.2.1 T33 Mode

Select the working mode of terminal 33.

Default value:	1 [Voltage Mode]	**Parameter type:**	Selection
Parameter Number	619	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Current Mode
1	Voltage Mode

P 9.5.2.2 T33 High Voltage

Enter the voltage (V) that corresponds to the high reference value, as set in *P 9.5.2.6 T33 High Ref./Feedb. Value*.

Default value:	10.00	**Parameter type:**	Range (0.00–10.00)
Parameter Number	611	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.3 T33 Low Voltage

Enter the voltage (V) that corresponds to the low reference value (set in *P 9.5.2.7 T33 Low Ref./Feedb.Value*). The value must be set at >1 V to activate the Live Zero Timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

Default value:	0.07	**Parameter type:**	Range (0.00–10.00)
Parameter Number	610	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.4 T33 High Current

Enter the current (mA) that corresponds to the high reference value (set in *P 9.5.2.6 T33 High Ref./Feedb. Value*).

Default value:	20.00	**Parameter type:**	Range (0.00–20.00)
Parameter Number	613	**Unit:**	mA
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.5 T33 Low Current

Enter the current (mA) that corresponds to the low reference value (set in *P 9.5.2.7 T33 Low Ref./Feedb.Value*). The value must be set at >2 mA to activate the Live Zero Timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

Default value:	4.00	**Parameter type:**	Range (0.00–20.00)

Parameter Number	612	**Unit:**	mA
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.6 T33 High Ref./Feedb. Value

Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.2.2 T33 High Voltage/ P 9.5.2.4 T33 High Current*.

Default value:	Size Related	**Parameter type:**	Range (-4999.000–4999.000)
Parameter Number	615	**Unit:**	–
Data type:	int 32	**Access type:**	Read/Write

P 9.5.2.7 T33 Low Ref./Feedb. Value

Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.2.3 T33 Low Voltage / P 9.5.2.5 T33 Low Current*.

Default value:	0.000	**Parameter type:**	Range (-4999.000–4999.000)
Parameter Number	614	**Unit:**	–
Data type:	int 32	**Access type:**	Read/Write

P 9.5.2.8 T33 Filter Time Constant

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 33. A high time constant value improves dampening but also increases the time delay through the filter.

Default value:	0.01	**Parameter type:**	Range (0.01–10.00)
Parameter Number	616	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.9 T33 Voltage Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of *P 9.5.2.9 T33 Voltage Dead Zone Scale*.

Default value:	0	**Parameter type:**	Range (0–500)
Parameter Number	617	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

P 9.5.2.10 T33 Current Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of *P 9.5.2.10 T33 Current Dead Zone Scale*.

Default value:	0	**Parameter type:**	Range (0–1000)
Parameter Number	618	**Unit:**	mA
Data type:	uint16	**Access type:**	Read/Write

Dead-zone function

- A non-zero value for the parameter *Voltage/Current Dead Zone Scale* enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal.

- The bandwidth of dead zone is the double value of the *Voltage/Current Dead Zone Scale*.

- Dead-zone band central point is the mid-value of the High and Low value of the voltage or current.

- When *Low Ref./feedb. Value* is a negative value, and the parameter of AI minimum value *Low Voltage/Current* set as 0, if the analog input signal is lost (AI input value = 0), the motor runs at the value of *Low Ref./feedb. Value* without expectation. This would cause uncertainty risk or danger. Therefore, the parameters of AI *Low Voltage/Current* should be set as a non-zero value, like 2 V or 4 mA.

- Figure 90 is an example of using T33 analog input (voltage mode, 2–10 V) for dead-zone function to control motor running between the speed from -50 Hz to 50 Hz.
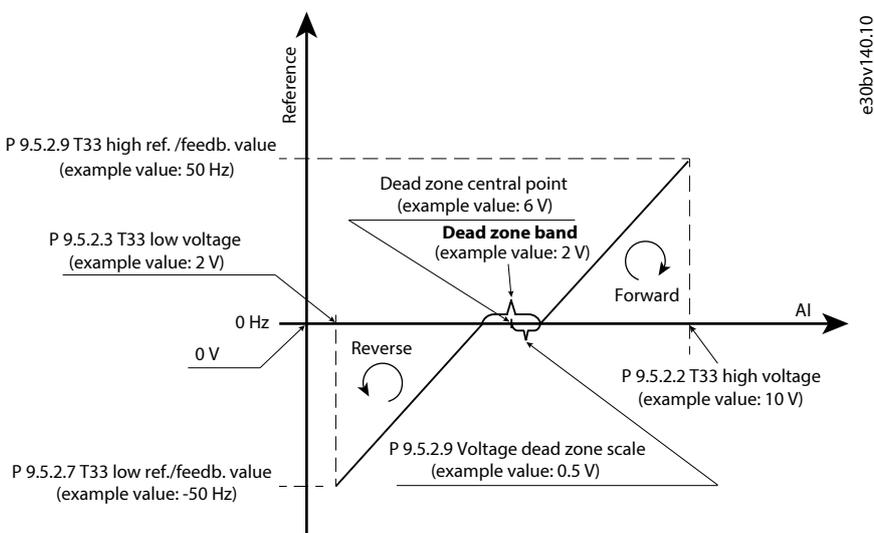
Figure 90: Dead-zone Function Example

The typcial parameter settings for the examples are shown in the following tables.

Table 67: Data for Dead-zone Funtion Key Parameters

Parameter	Data	Parameter number
P 9.5.2.1 T33 Mode	*[1] Voltage Mode*	619
P 9.5.2.2 T33 High Voltage	10.00 V	611
P 9.5.2.3 T33 Low Voltage	2.00 V	610
P 9.5.2.6 T33 High Ref./Feedb. Value	50.000	615
P 9.5.2.7 T33 Low Ref./Feedb. Value	-50.000	614
P 9.5.2.9 T33 Voltage Dead Zone Scale	0.5 V	617

Table 68: Data for Relevant Parameters

Parameter	Data	Parameter number
P 5.5.3.1 Reference Range	*[1] -Max~+Max*	300
P 5.5.3.3 Reference Maximum	50.00	303
P 5.5.3.7 Reference 1 Source	*[1] Analog Input 33*	315
P 5.5.3.8 Reference 2 Source	*[0] No function*	316

Table 68: Data for Relevant Parameters - (continued)

Parameter	Data	Parameter number
P 5.5.3.9 Reference 3 Source	*[0] No function*	317
P 5.8.1 Rotation Direction	*[2] Both Directions*	410

P 9.5.2.15 T33 Live Zero

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).

Default value:	1 [Enabled]	**Parameter type:**	Selection
Parameter number:	603	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Disabled
1	Enabled

7.9.3.3 Input Terminal 34 (Menu Index 9.5.3)

P 9.5.3.1 T34 Mode

Select if terminal 34 is used for current or voltage input.

Default value:	1 [Voltage Mode]	**Parameter type:**	Selection
Parameter number:	629	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Current Mode
1	Voltage Mode

P 9.5.3.2 T34 High Voltage

Enter the voltage (V) that corresponds to the high reference value, as set in *P 9.5.3.6 T34 High Ref./Feedb. Value*.

Default value:	10.00	**Parameter type:**	Range (0.00–10.00)
Parameter number:	621	**Unit:**	V
Data type:	uint16	**Access type:**	Read/Write

P 9.5.3.3 T34 Low Voltage

Enter the voltage (V) that corresponds to the low reference value (set in *P 9.5.3.7 T34 Low Ref./Feedb. Value*). The value must be set at >1 V in order to activate the live zero timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

Default value:	0.07	**Parameter type:**	Range (0.00–10.00)
Parameter number:	620	**Unit:**	V

Data type:	uint16	Access type:	Read/Write

P 9.5.3.4 T34 High Current

Enter the current (mA) that corresponds to the high reference value (set in *P 9.5.3.6 T34 High Ref./Feedb. Value*).

Default value:	20.00	Parameter type:	Range (0.00–20.00)
Parameter number:	623	Unit:	mA
Data type:	uint16	Access type:	Read/Write

P 9.5.3.5 T34 Low Current

Enter the current (mA) that corresponds to the low reference value, set in *P 9.5.3.7 T34 Low Ref./Feedb. Value*. The value must be set at >2 mA in order to activate the Live Zero Timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

Default value:	4.00	Parameter type:	Range (0.00–20.00)
Parameter number:	622	Unit:	mA
Data type:	uint16	Access type:	Read/Write

P 9.5.3.6 T34 High Ref./Feedb. Value

Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.3.2 T34 High Voltage* or *P 9.5.3.4 T34 High Current*.

Default value:	Size Related	Parameter number:	Range (-4999.000–4999.000)
Parameter number:	625	Unit:	–
Data type:	int 32	Access type:	Read/Write

P 9.5.3.7 T34 Low Ref./Feedb. Value

Enter the reference or feedback value that corresponds to the voltage or current set in parameter *P 9.5.3.3 T34 High Voltage* or *P 9.5.3.5 T34 High Current*.

Default value:	0	Parameter number:	Range (-4999.000–4999.000)
Parameter number:	624	Unit:	–
Data type:	int 32	Access type:	Read/Write

P 9.5.3.8 T34 Filter Time Constant

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

Default value:	0.01	Parameter type:	Range (0.01–10.00)
Parameter number:	626	Unit:	s
Data type:	uint16	Access type:	Read/Write

P 9.5.3.9 T34 Voltage Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of *P 9.5.3.9 T34 Voltage Dead Zone Scale*.

Default value:	0	Parameter type:	Range (0–500)

Parameter number:	627	Unit:	V
Data type:	uint16	Access type:	Read/Write

P 9.5.3.10 T34 Current Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of *P 9.5.3.10 T34 Current Dead Zone Scale*.

Default value:	0	Parameter type:	Range (0–1000)
Parameter number:	628	Unit:	mA
Data type:	uint16	Access type:	Read/Write

P 9.5.3.15 T34 Live Zero

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).

Default value:	1 [Enabled]	Parameter type:	Selection
Parameter number:	604	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Disabled
1	Enabled

7.9.3.4 Potentiometer Reference (Menu Index 9.5.4)

P 9.5.4.1 Potentiometer High Ref.

Set the reference value to correspond to the maximum position of the control panel potentiometer.

Default value:	50.000	Parameter type:	Range (-4999.000–4999.000)
Parameter Number	682	Unit:	–
Data type:	int32	Access type:	Read/Write

P 9.5.4.2 Potentiometer Low Ref.

Set the reference value to correspond to the minimum position of the control panel potentiometer.

Default value:	0.000	Parameter type:	Range (-4999.000–4999.000)
Parameter Number	681	Unit:	–
Data type:	int32	Access type:	Read/Write

7.9.3.5 Live Zero (Menu Index 9.5.6)

P 9.5.6.1 Live Zero Response

Enter the timeout time. The function set in *P 9.5.6.2 Live Zero Timeout Function* is activated when the input signal on the terminal is below 50% of the minimal value (for example, the minimal value for Terminal 33 voltage mode is *P 9.5.2.3 T33 Low Voltage*) for a time period defined in the parameter.

Default value:	10	Parameter type:	Range (1–99)
Parameter Number	600	Unit:	s
Data type:	uint8	Access type:	Read/Write

P 9.5.6.2 Live Zero Timeout Function

Select the timeout function. The function set in the parameter is activated when the input signal on the terminal is below 50% of the minimal value (for example, the minimal value for Terminal 33 voltage mode is *P 9.5.2.3 T33 Low Voltage*) for a time period defined in *P 9.5.6.1 Live Zero Response*.

Default value:	0 [Off]	Parameter type	Selection
Parameter Number	601	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Off
1	Freeze Output
2	Stop
3	Jogging
4	Max Speed
5	Stop and Trip

7.10 Connectivity (Menu Index 10)

7.10.1 FC Port Settings (Menu Index 10.1)

P 10.1.1 Protocol

Select the protocol for the integrated RS-485 port.

Default value:	0 [FC]	Parameter type:	Selection
Parameter number:	830	Unit:	–
Data type:	enum	Access type:	Read/Write

The following are the selections for the parameter.

Selection number	Selection name	Selection description
0	FC	Communication according to the FC protocol.
2	Modbus RTU	Communication according to the Modbus RTU protocol.
26	Modbus RTU Legacy FC 51	Communication according to the Modbus RTU protocol, and converts the selected parameters as the format of VLT® Micro Drive FC 51.

P 10.1.2 Address

Enter the address for the RS-485 port. Valid range: 1–126 for FC-bus or 1–247 for Modbus.

Default value:	1	Parameter type:	(0–247)

Parameter number:	831	**Unit:**	–
Data type:	uint8	**Access type:**	Read/Write

P 10.1.3 Baud Rate

Select the baud rate for the RS-485 port.

Default value:	2 [9600]	**Parameter type:**	Selection
Parameter number:	832	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection 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

P 10.1.4 Parity/Stop Bits

Parity and stop bits for the protocol using the FC port. For some of the protocols, not all options are available.

Default value:	0 [Even Parity, 1 Stop Bit]	**Parameter type:**	Selection
Parameter number:	833	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection 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

P 10.1.5 Maximum Response Delay

Specify the maximum allowed delay time between receiving a request and transmitting the response. If this time is exceeded, no response is returned.

Default value:	Size Related	**Parameter type:**	Range (0.100–10.000)
Parameter number:	836	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

P 10.1.6 Minimum Response Delay

Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

Default value:	0.010	**Parameter type:**	Range (1–500)
Parameter number:	835	**Unit:**	s
Data type:	uint16	**Access type:**	Read/Write

7.10.2 FC Port Diagnostics (Menu Index 10.2)

P 10.2.1 Bus Message Count

This parameter shows the number of valid telegrams detected on the bus.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	880	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.1 Bus Error Count

This parameter shows the number of telegrams with faults (for example, CRC fault), detected on the bus.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	881	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.3 Slave Messaged Rcvd

This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	882	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.4 Slave Error Count

This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	883	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.5 Slave Messages Sent

This parameter shows the number of messages sent from the slave.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	884	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.6 Slave Timeout Errors

This parameter shows the number of slave timeout errors.

Default value:	0	**Parameter type:**	Range (0–4294967295)
Parameter number:	885	**Unit:**	–
Data type:	uint32	**Access type:**	Read

P 10.2.7 Reset FC Port Diagnostics

Reset all FC port diagnostic counters.

Default value:	0	**Parameter type:**	Selection
Parameter number:	888	**Unit:**	–
Data type:	enum	**Access type:**	Read/Write

The following are the selections for the parameter.

Selection number	Selection name
0	Do not reset
1	Reset counter

8 Troubleshooting

8.1 Introduction

When the drive fault circuitry detects a fault condition or a pending fault, an event that occurs in the drive is signaled by LED indicators on the control panel. The event types in iC2-Micro Frequency Converters include warning or fault.

8.2 Faults

A fault 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 configured 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 the *Stop/Reset* button or use a digital input, or a fieldbus command.

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.

8.3 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 would reduce speed to compensate for the overcurrent condition. Sometimes, if the condition is not corrected or worsens, a fault condition is activated and the drive stops the output to the motor terminals.

8.4 Warning/Fault Messages

The LEDs on the front of the drive and a code in the display signal a warning or a fault.

Table 69: LED Indication

WARN	Steadily lit when a warning occurs.
READY	Steadily lit when the drive is ready.
FAULT	Flashes when a fault occurs.

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.

A fault triggers a trip. The trip removes power to the motor. It can be reset after the condition has been cleared by pressing the *Stop/Reset* button, or through a digital input (See *P 9.4.1 Digital Input Setting*). The event that caused a fault cannot damage the drive, or cause a dangerous condition. Faults must be reset to restart operation once their cause has been rectified.

The reset can be done in 3 ways:

- Press the *Stop/Reset* button.
- A digital reset input.
- Serial communication/optional fieldbus reset signal.

NOTICE
After a manual reset pressing the *Stop/Reset* button, press the *Start* button to restart the motor.

A warning precedes a fault.

A trip lock is an action when a fault 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 fault continues flashing until the drive is reset.

The fault words, warning words, and extended status words can be accessed via fieldbus or optional fieldbus for diagnosis.

8.5 Warning and Fault Events

Table 70: Warning and Fault Events Summary

Number	Description	Warning	Fault	Trip lock	Cause
2	Live Zero Error	X	X	–	Signal on terminal 33 or 34 is less than 50% of the value set in *P 9.5.2.3 T33 Low Voltage*, *P 9.5.2.5 T33 Low Current*, *P 9.5.3.3 T34 Low Voltage*, and *P 9.5.3.5 T34 Low Current*.
3	No Motor	X	X	–	No motor has been connected to the output of the drive.
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 Over Voltage[1]	X	X	–	DC-link voltage exceeds the limit.
8	DC Under Voltage[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 the value set in either *P 5.10.1 Motor Torque Limit* or *P 5.10.2 Regenerative Torque Limit*.
13	Over Current	X	X	X	Inverter peak current limit is exceeded. If this fault occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
14	Earth Fault	X	X	X	Discharge from output phases to ground.
16	Short Circuit	–	X	X	Short circuit in motor or on motor terminals.
17	Control Word Timeout	X	X	–	No communication to the drive.
18	Start Failed	–	X	–	May be caused by a blocked motor.
25	Brake Resistor Short	–	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	X	Brake resistor is not connected/working.

Table 70: Warning and Fault Events Summary - (continued)

Number	Description	Warning	Fault	Trip lock	Cause
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.
36	Mains Failure	X	X	–	This warning/fault is only active if the supply voltage to the drive is less than the value set in *P 2.3.7 Power Loss Controller Limit*, and *P 2.3.6 Power Loss Action* is NOT set to *[0] No Function*.
38	Internal Fault	–	X	X	Contact the local supplier.
40	Overload T15	X	–	–	Check the load connected to terminal 15 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.
50	AMA calibration failed	–	X	–	A calibration error has occurred.
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	–	External interlock has been activated.
61	Feedback Error	X	X	–	–
63	Mechanical Brake Low	–	X	–	Actual motor current has not exceeded release brake current within start delay time window.
69	Power Card Temp	X	X	X	The cutout temperature of the power card has exceeded the upper limit.
80	Drive Initialized	–	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 for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in *P 2.3.13 Auto DC Braking*.
95	Lost load detected	X	X	–	–
99	Locked Rotor	–	X	–	Rotor is blocked.

Table 70: Warning and Fault Events Summary - (continued)

Number	Description	Warning	Fault	Trip lock	Cause
126	Motor Rotating	–	X	–	PM motor is rotating when AMA is performed.
127	Back EMF too High	X	–	–	The back EMF of PM motor is too high before starting.
Err. 89	Parameter read only	–	–	–	Parameters cannot be changed.
Err. 95	Not while running	–	–	–	Parameters can only be changed when the motor is stopped.
Err. 96	A wrong password was entered	–	–	–	Occurs when using a wrong password for changing a password-protected parameter.

1) These faults may be caused by mains distortions. Installing a line filter may rectify this problem.

8.6 Fault Words, Warning Words, and Extended Status Words

For diagnosis, read out the fault words, warning words, and extended status words.

Table 71: Description of Fault Word, Warning Word, and Extended Status Word

Bit	Hex	Dec	Fault word	Fault word 2	Fault word 3	Warning word	Warning word 2	Extended status word	Extended status word 2
0	00000001	1	Brake check	Reserved	Reserved	Reserved	Reserved	Ramping	Off
1	00000002	2	Pwr. card temp	Gate drive voltage fault	Reserved	Pwr. card temp	Reserved	AMA tuning	Local/Remote
2	00000004	4	Earth fault	Reserved	Reserved	Earth Fault	Reserved	Start CW/CCW	Reserved
3	00000008	8	Reserved	Reserved	Reserved	Reserved	Reserved	Slowdown	Reserved
4	00000010	16	Ctrl. word TO	Reserved	Reserved	Ctrl. word TO	Reserved	Catchup	Reserved
5	00000020	32	Overcurrent	Reserved	Reserved	Overcurrent	Reserved	Feedback high	Reserved
6	00000040	64	Torque limit	Reserved	Reserved	Torque limit	Reserved	Feedback low	Reserved
7	00000080	128	Motor Th. over	Reserved	Reserved	Motor Th. over	Reserved	Output current high	Control ready
8	00000100	256	Motor ETR over	Lost Load	No Motor	Motor ETR over	Lost Load	Output current low	Drive ready
9	00000200	512	Inverter overld.	Reserved	Reserved	Inverter overld.	Reserved	Output freq. high	Quick stop
10	00000400	1024	DC undervolt.	Start failed	Reserved	DC undervolt.	Reserved	Output freq. low	DC brake
11	00000800	2048	DC overvolt.	Reserved	Reserved	DC overvolt.	Reserved	Brake check OK	Stop
12	00001000	4096	Short circuit	External interlock	Reserved	Reserved	Reserved	Braking max	Reserved
13	00002000	8192	Reserved	Reserved	Reserved	Reserved	Reserved	Braking	Reserved

Table 71: Description of Fault Word, Warning Word, and Extended Status Word - (continued)

Bit	Hex	Dec	Fault word	Fault word 2	Fault word 3	Warning word	Warning word 2	Extended status word	Extended status word 2
14	00004000	16384	Mains ph. loss	Reserved	Reserved	Mains ph. loss	Reserved	Reserved	Freeze output
15	00008000	32768	AMA not OK	Reserved	Reserved	No motor	Auto DC braking	OVC active	Reserved
16	00010000	65536	Live zero error	Earth Fault DESAT	Reserved	Live zero error	Reserved	AC brake	Jog
17	00020000	131072	Internal fault	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
18	00040000	262144	Brake overload	Reserved	Reserved	Brake resistor power limit	Reserved	Reserved	Start
19	00080000	524288	U phase loss	Reserved	Reserved	Reserved	Reserved	Reference high	Reserved
20	00100000	1048576	V phase loss	Reserved	Reserved	Reserved	Overload T27	Reference low	Start delay
21	00200000	2097152	W phase loss	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
22	00400000	4194304	Reserved	Locked rotor	Reserved	Reserved	Reserved	Reserved	Reserved
23	00800000	8388608	24 V supply low	Reserved	Reserved	24 V supply low	Reserved	Reserved	Running
24	01000000	16777216	Mains failure	Reserved	Reserved	Mains failure	Reserved	Reserved	Reserved
25	02000000	33554432	Reserved	Current limit	Reserved	Current limit	Reserved	Reserved	Reserved
26	04000000	67108864	Brake resistor	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
27	08000000	134217728	Brake IGBT/ Brake Chopper Start	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
28	10000000	268435456	Reserved	Feedback error	Reserved	Feedback Error	Reserved	Reserved	FlyStart active
29	20000000	536870912	Drive initialized	Reserved	Reserved	Reserved	Back EMF too high	Reserved	Heat sink clean warning
30	40000000	1073741824	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
31	80000000	2147483648	Mech. brake low	Reserved	Reserved	Reserved	Reserved	Database busy	Reserved

8.7 List of Faults and Warnings

WARNING/FAULT 2, Live Zero Error

Cause

This warning or fault only appears if programmed in *P 9.5.6.2 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 33 and 34 for signals, terminal 35 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

WARNING/FAULT 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 *P 1.3.1 Mains Imbalance Function*.

Troubleshooting

- Check the supply voltage and supply currents to the drive.

WARNING/FAULT 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.

WARNING/FAULT 8, DC Under Voltage

Cause

If the DC-link voltage (DC) 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/FAULT 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 a FAULT. The drive cannot be reset until the counter is below 0%.

The fault occurs when the drive has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the control panel with the drive rated current.

- Compare the output current shown on the control panel with measured motor current.

- Show the thermal drive load on the control panel 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/FAULT 10, Motor Overload Temperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the drive issues a warning or a fault when the counter reaches 100% in *P 4.6.7 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check if the motor is overheating.

- Check if the motor is mechanically overloaded.

- Check that the motor current set in *P 4.2.2.3 Nominal Current* is correct.

- Ensure that the motor data in *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed* is set correctly.

- Running AMA in *P 4.2.1.3 AMA Mode* tunes the drive to the motor more accurately and reduces thermal loading.

WARNING/FAULT 11, Motor Thermistor Overtemp

Cause

Check whether the thermistor is disconnected. Select whether the drive issues a warning or an fault in *P 4.6.7 Motor Thermal Protection*.

Troubleshooting

- Check for motor overheating.

- Check if the motor is mechanically overloaded.

- When using terminal 33 or 34, check that the thermistor is connected correctly between either terminal 33 or 34 (analog voltage input) and terminal 32 (+10 V supply). Also check that the terminal switch for 33 or 34 is set for voltage. Check that *P 4.6.8 Thermistor Resource* selects terminal 33 or 34.

- When using terminal 13, 14, or 18 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 32. Select the terminal to use in *P 4.6.8 Thermistor Resource*.

WARNING/FAULT 12, Torque Limit

Cause

The torque has exceeded the value in *P 5.10.1 Motor Torque Limit* or the value in *P 5.10.2 Regenerative Torque Limit*. *P 5.10.6 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by a fault.

Troubleshooting

- If the motor torque limit is exceeded during the ramp-up, extend the ramp-up time.

- If the generator torque limit is exceeded during ramp-down time, extend the ramp-down time.

- If a 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/FAULT 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 fault. 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 *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed* for correct motor data.

FAULT 14, Earth (Ground) Fault

Cause

There is a discharge from the output phases to the ground, either in the cable between the drive and the motor or in the motor itself.

Troubleshooting

- Turn off the drive and remove the ground fault.

- Measure the resistance to ground, the motor cables, and the motor with a megohmmeter to check for ground faults in the motor.

FAULT 16, Short Circuit

Cause

There is short-circuiting in the motor or motor wiring.

Troubleshooting

-

⚠️ WARNING	
⚡	**HIGH VOLTAGE** AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury. - Only qualified personnel are allowed to perform installation, start-up, and maintenance.

  Disconnect power before proceeding.

- Remove the power to the drive and repair the short circuit.

WARNING/FAULT 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when *P 5.2.16 Watchdog Response* is NOT set to *[0] Off*. If *P 5.2.16 Watchdog Response* is set to *[5] Stop and trip*, a warning appears, and the drive ramps down to a stop and shows an fault.

Troubleshooting

- Check the connections on the serial communication cable.

- Increase *P 5.2.17 Watchdog Delay*.

- Check the operation of the communication equipment.

- Verify that proper EMC installation was performed.

FAULT 18, Start Falied

Cause

The speed cannot exceed the value set in *P 5.6.7 Start Max Speed [Hz]* during start within the start time which is set in *P 5.6.8 Start Max Time to Trip*. The fault may be caused by a blocked motor.

Troubleshooting

- Check if the motor is blocked.

- Check if the start max speed is set higher than the working speed after ramp up.

- Check if the start max time to trip is set shorter than the normal ramp up time.

FAULT 25, Brake Resistor Short Circuit

Cause

The brake resistor is monitored during start-up. If a short circuit occurs, the brake function is disabled and the fault appears. The drive is tripped.

Troubleshooting

- Remove the power to the drive and check the connection of the brake resistor.

WARNING/FAULT 26, Brake Resistor Power Limit

Cause

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in *P 3.3.2 Brake Resistor Value*. The warning is active when the dissipated braking power is higher than the value set in *P 3.3.3 Brake Resistor Power Limit*. The drive trips if the warning persists for 1200 s.

Troubleshooting

- Decrease brake energy via lower speed or longer ramp time.

FAULT 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 fault is issued. The drive is tripped.

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

FAULT 28, Brake Check

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check if the brake resistor is connected or it is too large for the drive.

FAULT 30, Motor Phase U Missing

Cause

Motor phase U between the drive and the motor is missing.

Troubleshooting

- Turn off the drive and check motor phase U.

FAULT 31, Motor Phase V Missing

Cause

Motor phase V between the drive and the motor is missing.

Troubleshooting

- Turn off the drive and check motor phase V.

FAULT 32, Motor Phase W Missing

Cause

Motor phase W between the drive and the motor is missing.

Troubleshooting

- Turn off the drive and check motor phase W.

WARNING/FAULT 36, Mains Failure

Cause

This warning/fault is only active if the supply voltage to the drive is lost and *P 2.3.7 Power Loss Controller Limit* is not set to *[0] No Function*.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

FAULT 38, Internal Fault

Cause

When an internal fault occurs, a code number is shown.

Troubleshooting

- See Table 72 for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

Table 72: 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 checksum 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 fault 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.

Table 72: Internal Fault List - (continued)

Fault number	Cause	Solution
4608	Drive power size error.	Upgrade the software in the drive to the latest version. If the fault occurs again, contact a Danfoss supplier.
Other	Other internal faults.	Power cycle the drive. If the fault occurs again, contact a Danfoss supplier.

WARNING 40, Overload of Digital Output Terminal 15

Troubleshooting

- Check the load connected to terminal 15 or remove the short-circuit connection.

- Check *P 9.4.1.1 Digital I/O Mode* and *P 9.4.2.1 T 15 Mode*.

FAULT 46, Gate Drive Voltage

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/FAULT 47, 24 V Supply Low

Cause

The 24 V DC is measured on the control card. This fault appears when the detected voltage of terminal 12 is lower than 18 V.

Troubleshooting

- Check for a defective control card.

FAULT 50, AMA Calibration Failed

Troubleshooting

- Contact the Danfoss supplier or service department.

FAULT 51, AMA Check Unom and Inom

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check settings in *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed*.

FAULT 52, AMA Low Inom

Cause

The motor current is too low.

Troubleshooting

- Check the settings in *P 4.2.2.3 Nominal Current*.

FAULT 53, AMA Big Motor

Cause

The motor is too big for the AMA to operate.

FAULT 54, AMA Small Motor

Cause

The motor is too small for the AMA to operate.

FAULT 55, AMA Parameter Range

Cause

The AMA cannot run because the paramenter values of the motor are out of the acceptable range.

FAULT 56, AMA Interrupt

Cause

The AMA is manually interrupted.

FAULT 57, AMA Timeout

Troubleshooting

- Try to restart the AMA. Repeated restarts can overheat the motor.

FAULT 58, AMA Internal

Troubleshooting

- Contact the Danfoss supplier.

WARNING/FAULT 59, Current Limit

Cause

The current is higher than the value in *P 2.7.1 Output Current Limit %*.

Troubleshooting

- Ensure that the motor data in *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed* is set correctly.
- Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

FAULT 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.

FAULT 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

WARNING/FAULT 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 the fan operation.
- Check the power card.

FAULT 80, Drive Initialized to Default Value

Cause

Parameter settings are initialized to default settings after a manual reset.

Troubleshooting

- To clear the fault, reset the unit.

WARNING 87, Auto DC-Braking

Cause

Occurs in IT mains when the drive coasts, and the DC voltage is higher than 830 V for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in *P 2.3.13 Auto DC Braking*.

WARNING/FAULT 95, Lost Load Detected

Cause

Torque is below the torque level set for no load, indicating a lost load detection. *P 5.2.9 Lost Load Function* is set for fault.

Troubleshooting

- Troubleshoot the system.
- Reset the drive after the fault is cleared.

FAULT 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 *P 2.1.5 Output Current Limit*.
- Check if it increases the value in *P 4.6.15 Sync. Locked Rotor Detection Time [s]*.

FAULT 126, Motor Rotating

Cause

During AMA start-up, the motor is rotating. It is only valid for PM motor.

Troubleshooting

- Check if the motor is rotating before starting the AMA.

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 normal level within 5 s, this warning is reported. The warning remains until the back EMF returns to a normal level.

9 Appendix

9.1 Parameter Lists

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
1	Grid				
1.2	Grid Settings				
		1.2.1	Regional Settings	3	enum
		1.2.2	Grid Type	6	enum
1.3	Grid Protection				
		1.3.1	Mains Imbalance Action	1412	enum
2	Power conversion & DC-link				
2.1	Status				
		2.1.1	DC-Link Voltage	1630	uint32
		2.1.2	Inverter Thermal	1635	uint8
		2.1.3	Unit Nominal Current	1636	uint16
		2.1.5	Output Current Limit	1637	uint16
		2.1.9	Heat sink Temperature	1634	int8
		2.1.10	Real-time Switching Frequency	1866	int8
2.3	Protection				
		2.3.1	Overvoltage Controller Enable	217	enum
		2.3.2	Overvoltage Controller Kp	219	uint16
		2.3.6	Power Loss Action	1410	enum
		2.3.7	Power Loss Controller Limit	1411	uint16
		2.3.8	Kin. Back-up Trip Recovery Level	1415	uint32
		2.3.9	Fast Mains Phase Loss Level	1417	uint16
		2.3.10	Fast Mains Phase Loss Min Power	1418	uint16
		2.3.13	Auto DC Braking	7	enum
		2.3.14	Max Output Frequency	419	uint16
		2.3.15	Action At Inverter Fault	1427	enum
		2.3.16	Function at Inverter Overload	1461	enum
		2.3.17	Adjustable Temperature Warning	442	uint8
2.4	Modulation				
		2.4.2	Min. Switching Frequency	1463	enum
		2.4.3	Switching Frequency	1401	enum
		2.4.5	Over Modulation	1403	enum
2.5	DC-Link Control				
		2.5.1	Damping Gain Factor	1408	uint8
		2.5.2	DC-Link Voltage Compensation	1451	enum

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
2.7	Output Current Limit				
		2.7.1	Output Current Limit %	418	uint16
		2.7.2	Current Limit Kp	1430	uint16
		2.7.3	Current Limit Ti	1431	uint16
		2.7.4	Current Lim Ctrl, Filter Time	1432	uint16
		2.7.5	Trip Delay at Current Limit	1424	uint8
3	Filters & Brake Chopper				
3.1	Status				
		3.1.1	Brake Energy	1633	uint32
3.2	Brake Chopper				
		3.2.1	Enable Brake Chopper	215	enum
		3.2.2	Brake Chopper Voltage Reduce	214	uint16
3.3	Brake Resistor				
		3.3.2	Brake Resistor Value	211	uint16
		3.3.3	Brake Resistor Power Limit	212	uint32
4	Motor				
4.1	Status				
		4.1.1	Motor Current	1614	uint16
		4.1.2	Motor Voltage	1612	uint32
		4.1.3	Motor Electrical Power	1610	uint32
		4.1.4	Motor Power hp	1611	uint32
		4.1.5	Motor Thermal Load	1618	uint8
		4.1.6	Frequency	1613	uint32
		4.1.7	Frequency %	1615	uint16
		4.1.8	Motor Shaft Speed	1617	int32
		4.1.10	Motor Torque	1616	int32
		4.1.11	Motor Torque %	1622	int16
4.2	Motor Data				
4.2.1	General Setting				
		4.2.1.1	Motor Type	110	enum
		4.2.1.2	Number of Poles	139	uint8
		4.2.1.3	AMA Mode	129	enum
		4.2.1.4	Motor Cable Length	142	uint8
		4.2.1.5	Motor Cable Length Feet	143	uint16
4.2.2	Nameplate Data				
		4.2.2.1	Nominal Power	120	uint16
		4.2.2.2	Nominal Voltage	122	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		4.2.2.3	Nominal Current	124	uint32
		4.2.2.4	Nominal Frequency	123	uint16
		4.2.2.5	Nominal Speed	125	uint16
4.2.3	Asyn. Induction Motor				
		4.2.3.1	Stator Resistance Rs	130	uint32
		4.2.3.2	Rotor Resistance Rr	131	uint32
		4.2.3.4	Stator Leakage Reactance Xls	133	uint32
		4.2.3.6	Magnetizing Reactance Xm	135	uint32
		4.2.3.7	Motor Cont. Rated Torque	126	uint32
4.2.4	Permanent Magnet Motor				
		4.2.4.1	Back EMF at 1000 RPM	140	uint16
		4.2.4.3	d-axis Inductance Ld	137	int32
		4.2.4.4	d-axis Inductance LdSat	144	int32
		4.2.4.6	Ld Current Point	148	int16
		4.2.4.7	q-axis Inductance Lq	138	int32
		4.2.4.8	q-axis Inductance LqSat	145	int32
		4.2.4.10	Lq Current Point	149	uint16
4.4	Motor Control				
4.4.1	General Settings				
		4.4.1.2	AEO Minimum Magnetization	1441	uint8
		4.4.1.3	Torque Characteristic	103	enum
		4.4.1.4	Clockwise Direction	106	enum
		4.4.1.5	Motor Control Bandwidth	108	enum
4.4.2	AC-Brake				
		4.4.2.1	Enable AC-Brake	210	enum
		4.4.2.2	AC Brake, Max current	216	uint16
		4.4.2.3	AC-Brake Voltage Control Kp	188	uint16
4.4.3	U/F Curve				
		4.4.3.1	Voltage Point	155	uint16
		4.4.3.2	Frequency Point	156	uint16
4.4.4	Dependent Setting				
		4.4.4.1	Slip Comp. Gain	162	int16
		4.4.4.2	Slip Comp. Time Constant	163	uint16
		4.4.4.3	High Speed Load Comp.	161	int16
		4.4.4.4	Low Speed Load Comp.	160	int16
		4.4.4.5	Res. Damp Gain	164	uint16
		4.4.4.6	Res. Damp High Pass Time Constant	165	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		4.4.4.7	Damping Gain	114	int16
		4.4.4.8	High Speed Filter Time Const.	116	uint16
		4.4.4.9	Low Speed Filter Time Const.	115	uint16
		4.4.4.10	Voltage Filter Time Const.	117	uint16
		4.4.4.11	Variable Torque Zero Speed Magnetization	150	uint16
		4.4.4.12	Min Speed Normal Magnetizing [Hz]	152	uint16
		4.4.4.13	VT Level	1440	uint8
		4.4.4.14	Min. Current at Low Speed	166	uint32
4.4.5	Dead Time Compensation				
		4.4.5.1	Dead Time Compensation Level	1407	uint8
		4.4.5.2	Dead Time Bias Current Level	1409	uint8
		4.4.5.3	Dead Time Compensation Zero Current Level	1464	enum
		4.4.5.4	Speed Derate Dead Time Compensation	1465	uint16
4.6	Protection				
		4.6.1	Warning Freq. High	441	uint16
		4.6.2	Warning Freq. Low	440	uint16
		4.6.3	Warning Current High	451	uint32
		4.6.4	Warning Current Low	450	uint32
		4.6.7	Motor Thermal Protection	190	enum
		4.6.8	Thermistor Source	193	enum
		4.6.9	Motor External Fan	191	enum
		4.6.12	Missing Motor Phase Function	458	enum
		4.6.13	Fault Level	1490	enum
		4.6.14	Sync. Locked Rotor Protection	3022	enum
		4.6.15	Sync. Locked Rotor Detection Time [s]	3023	uint8
5	Application				
5.1	Status				
		5.1.1	Fault Word 1	1690	uint32
		5.1.2	Fault Word 2	1691	uint32
		5.1.3	Fault Word 3	1697	uint32
		5.1.4	Warning Word 1	1692	uint32
		5.1.5	Warning Word 2	1693	uint32
		5.1.6	Warning Word 3	1698	uint32
		5.1.7	Active Control Word	1600	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		5.1.8	Drive Status Word	1603	uint16
		5.1.9	Ext. Status Word	1694	uint32
		5.1.10	Ext. Status Word 2	1695	uint32
		5.1.11	Active Fault Number	1855	uint16
		5.1.12	Active Warning Number	1856	uint16
		5.1.16	Reference [Unit]	1601	int32
		5.1.17	Reference [%]	1602	int16
		5.1.18	External Reference	1650	int16
		5.1.19	Main Actual Value [%]	1605	int16
		5.1.20	Speed Error [RPM]	1644	int32
		5.1.21	Speed Ref. After Ramp [RPM]	1648	int32
		5.1.26	FC Port CTW 1	1685	uint16
		5.1.27	FC Port REF 1	1686	int16
5.2	Protection				
		5.2.1	Warning Reference High	455	int32
		5.2.2	Warning Reference Low	454	int32
		5.2.3	Warning Feedback High	457	int32
		5.2.4	Warning Feedback Low	456	int32
		5.2.9	Lost Load Function	2260	enum
		5.2.10	Lost Load Detection Torque Level	2261	uint8
		5.2.11	Lost Load Detection Delay	2262	uint16
		5.2.16	Watchdog Response	804	enum
		5.2.17	Watchdog Delay	803	uint16
5.4	Operation Mode				
		5.4.1	Application Selection	16	enum
		5.4.2	Operation Mode	100	enum
		5.4.3	Motor Control Principle	101	enum
		5.4.4	Local Mode Configuration	105	enum
5.5	Control				
5.5.1	General Setting				
		5.5.1.1	Control Place Selection	801	enum
		5.5.1.2	Control Source	802	enum
		5.5.1.6	Configurable Status Word STW	813	enum
		5.5.1.7	Configurable Control Word CTW	814	enum
		5.5.1.10	Operating State at Power-up	4	enum
		5.5.1.15	[REM/LOC] Button	46	enum
		5.5.1.16	[Stop/Reset] Button	44	enum

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
5.5.2	Digital/Bus				
		5.5.2.1	Coasting Select	850	enum
		5.5.2.2	Quick Stop Select	851	enum
		5.5.2.3	DC Brake Select	852	enum
		5.5.2.4	Start Select	853	enum
		5.5.2.5	Reversing Select	854	enum
		5.5.2.6	Set-up Select	855	enum
		5.5.2.7	Preset Reference Select	856	enum
5.5.3	Reference				
		5.5.3.1	Reference Range	300	enum
		5.5.3.2	Reference/Feedback Unit	301	enum
		5.5.3.3	Reference Maximum	303	int32
		5.5.3.4	Reference Minimum	302	int32
		5.5.3.5	Reference Function	304	enum
		5.5.3.6	Reference Site	313	enum
		5.5.3.7	Reference 1 Source	315	enum
		5.5.3.8	Reference 2 Source	316	enum
		5.5.3.9	Reference 3 Source	317	enum
		5.5.3.10	Preset Reference	310	int16
		5.5.3.11	Preset Relative Reference	314	int16
		5.5.3.12	Relative Scaling Reference Resource	318	enum
		5.5.3.13	Freeze Up/Down Step Delta	312	int16
		5.5.3.14	On Reference Window	305	int32
		5.5.3.20	Enable Potentiometer	45	enum
5.5.4	Ramp				
		5.5.4.1	Ramp 1 Type Selector	340	enum
		5.5.4.2	Ramp 1 Accel. Time	341	uint32
		5.5.4.3	Ramp 1 Decel. Time	342	uint32
		5.5.4.8	Ramp 2 Type Selector	350	enum
		5.5.4.9	Ramp 2 Accel. Time	351	uint32
		5.5.4.10	Ramp 2 Decel. Time	352	uint32
5.6	Start Settings				
		5.6.1	Start Zero Speed Time	171	uint8
		5.6.2	Start Function	172	enum
		5.6.3	Enable Flying Start	173	enum
		5.6.4	Start Speed [Hz]	175	uint16
		5.6.5	Start Current	176	uint32

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		5.6.6	Breakaway Current Boost	422	enum
		5.6.7	Start Max Speed [Hz]	178	uint16
		5.6.8	Start Max Time to Trip	179	uint8
		5.6.9	Starting Ramp Up Time	382	uint32
		5.6.11	Sync. Motor Start Mode	170	enum
		5.6.12	Sync. Motor Detection Current %	146	uint16
		5.6.13	Sync. Motor Parking Time	207	uint16
		5.6.14	Sync. Motor Parking Current %	206	uint16
		5.6.15	Sync. High Starting Torque Time [s]	3020	uint16
		5.6.16	Sync. High Starting Torque Current [%]	3021	uint32
5.7	Stop Settings				
		5.7.1	Function at Stop	180	enum
		5.7.2	Min Speed for Function at Stop [Hz]	182	uint16
		5.7.3	DC Brake Time	202	uint16
		5.7.4	DC Brake Current %	201	uint16
		5.7.5	DC Brake Frequency	204	uint16
		5.7.6	DC Hold Current %	200	uint16
		5.7.7	Quick Stop Ramp Time	381	uint32
5.8	Speed Control				
		5.8.1	Rotation Direction	410	enum
		5.8.2	Motor Speed High Limit [Hz]	414	uint16
		5.8.3	Motor Speed Low Limit [Hz]	412	uint16
		5.8.4	Directional Limit Mode	490	enum
		5.8.5	Positive Speed Limit [Hz]	492	uint16
		5.8.6	Negative Speed Limit [Hz]	494	uint16
		5.8.8	Torque Limit Mode Speed Ctrl	420	enum
		5.8.11	Band, High Limit	463	uint16
		5.8.12	Band, Low Limit	461	uint16
5.9	Inching				
		5.9.1	Jog Ramp Time	380	uint32
		5.9.2	Jog Reference 1	311	uint16
5.10	Torque Control				
		5.10.1	Motor Torque Limit	416	uint16
		5.10.2	Regenerative Torque Limit	417	uint16
		5.10.3	Speed Limit Mode Torque Ctrl.	421	enum
		5.10.4	Torque PID Proportional Gain	712	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		5.10.5	Torque PID Integration Time	713	uint16
		5.10.6	Trip Delay at Torque Limit	1425	uint8
5.11	Mechanical Brake Control				
		5.11.1	Brake Closing Speed	222	uint16
		5.11.2	Brake Close Time	223	uint8
		5.11.3	Release Brake Current	220	uint32
		5.11.4	Mech. Brake w/ dir. Change	239	enum
5.12	Process Control				
5.12.1	Status				
		5.12.1.1	Process PID Error	1890	int16
		5.12.1.2	Process PID Output	1891	int16
		5.12.1.3	Process PID Clamped Output	1892	int16
		5.12.1.4	Process PID Gain Scaled Output	1893	int16
		5.12.1.5	Feedback Value	1652	int32
5.12.4	Feedback				
		5.12.4.1	Feedback 1 Resource	720	enum
		5.12.4.2	Feedback 2 Resource	722	enum
		5.12.4.3	Feedback 1 Conversion	760	enum
		5.12.4.4	Feedback 2 Conversion	762	enum
5.12.5	PID Controller				
		5.12.5.1	PID Proportional Gain	733	uint16
		5.12.5.2	PID Integral Time	734	uint32
		5.12.5.4	Antiwindup Enabled	731	enum
		5.12.5.5	PID Differentiation Time	735	uint16
		5.12.5.6	PID Diff. Gain Limit	736	uint16
		5.12.5.7	PID Normal/ Inverse Control	730	enum
		5.12.5.8	PID Start Speed	732	uint16
		5.12.5.9	On Reference Bandwidth	739	uint8
5.12.6	Feed Forward				
		5.12.6.1	PID Feed Forward Factor	738	uint16
5.12.7	SleepMode				
		5.12.7.1	Sleep Mode in Process Closed-loop Mode	2202	enum
		5.12.7.2	Minimum Run Time	2240	uint16
		5.12.7.3	Minimum Sleep Time	2241	uint16
		5.12.7.4	Wake-Up Speed [Hz]	2243	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		5.12.7.5	Wake-Up Reference/Feedback Difference	2244	uint8
		5.12.7.6	Setpoint Boost	2245	int8
		5.12.7.7	Maximum Boost Time	2246	uint16
		5.12.7.8	Sleep Speed [Hz]	2247	uint16
		5.12.7.9	Sleep Delay Time	2248	uint16
		5.12.7.10	Wake-Up Delay Time	2249	uint16
5.13	Digital Potentiometer				
5.13.1	Digital Potentiometer Status				
		5.13.1.1	Digital Pot Reference	1653	int16
5.13.2	Digital Potentiometer Control				
		5.13.2.1	Step Size	390	uint16
		5.13.2.2	Power Restore	392	enum
		5.13.2.3	Maximum Limit	393	int16
		5.13.2.4	Minimum Limit	394	int16
		5.13.2.5	Ramp Delay	395	uint32
5.27	Fieldbus Process Data				
		5.27.1	PCD Write Selection	842	enum
		5.27.2	PCD Read Selection	843	enum
		5.27.3	PCD User Define	844	uint16
6	Maintenance & Service				
6.1	Status				
		6.1.1	Latest Fault Number	1530	uint8
		6.1.2	Operating Hours	1500	uint32
		6.1.3	Running Hours	1501	uint32
		6.1.4	kWh Counter	1502	uint32
		6.1.5	Power Up's	1503	uint32
		6.1.6	Over Temp's	1504	uint16
		6.1.7	Overvolt's	1505	uint16
		6.1.8	Reset kWh Counter	1506	enum
		6.1.9	Reset Running Hours Counter	1507	enum
		6.1.10	Internal Fault Reason	1531	int16
		6.1.11	Fault Log: Time	1532	uint32
6.2	Software Information				
		6.2.1	Application Version	1543	VisibleString

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		6.2.2	SW ID Control Card	1549	VisibleString
		6.2.3	SW ID Power Card	1550	VisibleString
		6.2.7	ECP SW Version	1548	VisibleString
6.5	Cooling Fan				
		6.5.1	Fan Control Mode	1452	enum
6.6	Parameter Handling				
		6.6.1	Active Set-up	10	enum
		6.6.2	Programming Set-up	11	enum
		6.6.3	Link Setups	12	enum
		6.6.4	Set-up Copy	51	enum
		6.6.6	Reset Mode	1420	enum
		6.6.7	Automatic Restart Time	1421	uint16
		6.6.8	Operation Mode	1422	enum
		6.6.9	Service Code	1429	uint32
		6.6.12	ECP Copy	50	enum
		6.6.20	Password	60	uint16
		6.6.21	Production Settings	1428	enum
		6.6.22	Defined Parameters	1592	uint16
		6.6.23	Drive Identification	1598	VisibleString
		6.6.26	Language	1	enum
6.7	Drive Identification				
		6.7.1	Drive Type	1540	VisibleString
		6.7.2	Power Section	1541	VisibleString
		6.7.3	Voltage	1542	VisibleString
		6.7.4	Ordered Model Code	1544	VisibleString
		6.7.6	Drive Ordering No	1546	VisibleString
		6.7.7	Drive Serial Number	1551	VisibleString
		6.7.9	Power Card Serial Number	1553	VisibleString
8	Customization				

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
8.1	Custom Readout				
		8.1.1	Custom Readout	1609	int32
		8.1.2	Custom Readout Unit	30	enum
		8.1.3	Custom Readout Min Value	31	int32
		8.1.4	Custom Readout Max Value	32	int32
8.4	Smart Logic Controller				
8.4.1	Status				
		8.4.1.1	Controller State	1638	uint8
		8.4.1.2	Counter A	1672	int16
		8.4.1.3	Counter B	1673	int16
8.4.2	SLC Settings				
		8.4.2.1	Enable Controller	1300	enum
		8.4.2.2	Start Controller	1301	enum
		8.4.2.3	Stop Controller	1302	enum
		8.4.2.4	Reset Controller	1303	enum
8.4.3	Comparators				
		8.4.3.1	Comparator Operand	1310	enum
		8.4.3.2	Comparator Operator	1311	enum
		8.4.3.3	Comparator Value	1312	int32
8.4.4	Timers				
		8.4.4.1	Timer	1320	uint32
8.4.5	Logic Rules				
		8.4.5.1	Logic Rule Boolean 1	1340	enum
		8.4.5.2	Logic Rule Operator 1	1341	enum
		8.4.5.3	Logic Rule Boolean 2	1342	enum
		8.4.5.4	Logic Rule Operator 2	1343	enum
		8.4.5.5	Logic Rule Boolean 3	1344	enum
8.4.6	States				
		8.4.6.1	Event	1351	enum
		8.4.6.2	Action	1352	enum
9	I/O				
9.3	I/O Status				
		9.3.1	Digital Input Status	1660	uint16
		9.3.2	Digital Output Status	1666	uint16
		9.3.3	T31 Analog Output [mA]	1665	uint16
		9.3.4	T33 Setting	1661	enum
		9.3.5	T33 Analog Input	1662	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		9.3.6	T34 Setting	1663	enum
		9.3.7	T34 Analog Input	1664	uint16
		9.3.8	T18 Pulse Input [Hz]	1668	int32
		9.3.9	T15 Pulse Output [Hz]	1669	int32
		9.3.10	Relay Output	1671	uint16
9.4	Digital Inputs/Outputs				
9.4.1	Digital Input Setting				
		9.4.1.1	Digital I/O mode	500	enum
		9.4.1.2	T13 Digital Input	510	enum
		9.4.1.3	T14 Digital Input	511	enum
		9.4.1.4	T15 Digital Input	512	enum
		9.4.1.5	T17 Digital Input	513	enum
		9.4.1.6	T18 Digital Input	515	enum
9.4.2	T15 as Digital Output				
		9.4.2.1	T15 Mode	501	enum
		9.4.2.2	T15 Digital Output	530	enum
		9.4.2.3	T15 DO ON-Delay	534	uint16
		9.4.2.4	T15 DO OFF-Delay	535	uint16
9.4.3	Relay				
		9.4.3.1	Function Relay	540	enum
		9.4.3.2	Relay ON-Delay	541	uint16
		9.4.3.3	Relay OFF-Delay	542	uint16
9.4.4	T18 as Pulse Input				
		9.4.4.1	T18 High Frequency	556	uint32
		9.4.4.2	T18 Low Frequency	555	uint32
		9.4.4.3	T18 High Ref./Feedb. Value	558	int32
		9.4.4.4	T18 Low Ref./Feedb. Value	557	int32
		9.4.4.5	T18 Pulse Filter Time Constant	559	uint16
		9.4.4.6	T18 PWM Polarity	505	enum
		9.4.4.7	T18 High Duty	507	uint16
		9.4.4.8	T18 Low Duty	506	uint16
9.4.5	T15 as Pulse Output				
		9.4.5.1	T15 Pulse Output Variable	560	enum
		9.4.5.2	T15 Pulse Output Max Freq	562	uint32
9.4.6	Bus Control				
		9.4.6.1	Digital & Relay Bus Control	590	uint32
		9.4.6.2	T15 Pulse Out Bus Control	593	uint16

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		9.4.6.3	T15 Pulse Out Timeout Preset	594	uint16
9.5	Analog Inputs/Outputs				
9.5.1	Output Terminal 31				
		9.5.1.1	T31 Mode	690	enum
		9.5.1.2	T31 Analog Output	691	enum
		9.5.1.3	T31 Output Max Scale	694	uint16
		9.5.1.4	T31 Output Min Scale	693	uint16
		9.5.1.5	T31 Output Bus Control	696	uint16
9.5.2	Input Terminal 33				
		9.5.2.1	T33 Mode	619	enum
		9.5.2.2	T33 High Voltage	611	uint16
		9.5.2.3	T33 Low Voltage	610	uint16
		9.5.2.4	T33 High Current	613	uint16
		9.5.2.5	T33 Low Current	612	uint16
		9.5.2.6	T33 High Ref./Feedb. Value	615	int32
		9.5.2.7	T33 Low Ref./Feedb. Value	614	int32
		9.5.2.8	T33 Filter Time Constant	616	uint16
		9.5.2.9	T33 Voltage Dead Zone Scale	617	uint16
		9.5.2.10	T33 Current Dead Zone Scale	618	uint16
		9.5.2.15	T33 Live Zero	603	enum
9.5.3	Input Terminal 34				
		9.5.3.1	T34 Mode	629	enum
		9.5.3.2	T34 High Voltage	621	uint16
		9.5.3.3	T34 Low Voltage	620	uint16
		9.5.3.4	T34 High Current	623	uint16
		9.5.3.5	T34 Low Current	622	uint16
		9.5.3.6	T34 High Ref./Feedb. Value	625	int32
		9.5.3.7	T34 Low Ref./Feedb. Value	624	int32
		9.5.3.8	T34 Filter Time Constant	626	uint16
		9.5.3.9	T34 Voltage Dead Zone Scale	627	uint16
		9.5.3.10	T34 Current Dead Zone Scale	628	uint16
		9.5.3.15	T34 Live Zero	604	enum
9.5.4	Potentiometer Reference				
		9.5.4.1	Potentiometer High Ref.	682	int32
		9.5.4.2	Potentiometer Low Ref.	681	int32
9.5.6	Live Zero				
		9.5.6.1	Live Zero Response	600	uint8

Group index	Group name	Parameter index	Parameter name	Parameter number	Type
		9.5.6.2	Live Zero Timeout Function	601	enum
10	Connectivity				
10.1	FC Port Settings				
		10.1.1	Protocol	830	enum
		10.1.2	Address	831	uint8
		10.1.3	Baud Rate	832	enum
		10.1.4	Parity / Stop Bits	833	enum
		10.1.5	Maximum Response Delay	836	uint16
		10.1.6	Minimum Response Delay	835	uint16
10.2	FC Port Diagnostics				
		10.2.1	Bus Message Count	880	uint32
		10.2.2	Bus Error Count	881	uint32
		10.2.3	Slave Messages Rcvd	882	uint32
		10.2.4	Slave Error Count	883	uint32
		10.2.5	Slave Messages Sent	884	uint32
		10.2.6	Slave Timeout Errors	885	uint32
		10.2.7	Reset FC port Diagnostics	888	enum

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