

Application Guide

iC2-Micro Frequency Converters



Contents

1	Introduction to the Application Guide	6
1.1	Manual Version	6
1.2	Purpose of this Application Guide	6
1.3	Additional Resources	6
2	Application Software Overview	7
2.1	iC2-Micro Application Software Overview	7
2.1.1	Basic Functions	7
2.1.2	IO Control and Readouts	8
2.1.3	Motor Control Features	9
2.1.4	Braking of Load	9
2.1.5	Protection Features	10
2.1.6	Monitoring Features	10
2.1.7	Software Tools	11
3	User Interfaces and How to Configure	12
3.1	Overview of User Interfaces	12
3.2	Control Panel	12
3.2.1	Control Panel and Control Panel 2.0 OP2	12
3.2.2	Control Panel Keys and Indicators	12
3.2.3	Control Panel Basic Configuration	14
3.2.4	Control Panel 2.0 OP2 Keys and Indicators	20
3.2.5	Control Panel 2.0 OP2 Basic Configurations	21
3.3	MyDrive® Insight	25
4	Application Software Structure and Overview	33
4.1	Understanding Application Software Structure	33
4.2	Parameter Groups, Related Content, and Settings	33
5	Configuration Set-up Examples	36
5.1	Introduction & Prerequisite	36
5.2	Basic Setup of a Drive	37
5.3	Setting up the Drive using Quick Access via Control Panel	38
5.4	Motor Configuration	38
5.4.1	Automatic Motor Adaptation (AMA)	40
5.5	Application Selection	41
5.5.1	Configuring Speed Control Mode	42
5.5.2	Configuring Process Control Mode	44

5.5.3	Configuring Multi-Speed Control Mode	46
5.5.4	Configuring Wire Control Mode	48
5.5.5	Configuring Torque Control Mode	50
5.6	Reference Handling	52
5.6.1	Local/Remote Reference	52
5.6.2	Reference Limits	53
5.6.3	Scaling of Preset References and Bus References	54
5.6.4	Scaling of Analog and Pulse References and Feedback	54
5.6.5	Dead Band Around Zero	55
6	RS485 Configurations	58
6.1	RS485 Installation and Set up	58
6.1.1	Connecting the Drive to the RS485 Network	59
6.1.2	Hardware Setup	59
6.1.3	Parameter Settings for RS485 Communication	59
6.1.4	EMC Precautions	60
6.1.5	FC Protocol Overview	61
6.1.6	Modbus RTU	68
6.1.7	Danfoss FC Control Profile	79
6.2	How to Control the Drive	84
6.2.1	Introduction	84
6.2.2	Function Codes Supported by Modbus RTU	84
6.2.3	Modbus Exception Codes	85
7	Parameter Descriptions	86
7.1	Reading the Parameter Table	86
7.2	Grid (Menu Index 1)	87
7.3	Power Conversion & DC-link (Menu Index 2)	88
7.4	Filters & Brake Chopper (Menu Index 3)	95
7.5	Motor (Menu Index 4)	96
7.6	Application (Menu Index 5)	111
7.7	Maintenance and Service (Menu Index 6)	142
7.8	Customization (Menu Index 8)	149
7.9	I/O (Menu Index 9)	150
7.10	Connectivity (Menu Index 10)	178
8	Troubleshooting	181
8.1	Introduction	181
8.2	Faults	181

8.3	Warnings	181
8.4	Warning/Fault Messages	181
8.5	Warning and Fault Events	182
8.6	Fault Words, Warning Words, and Extended Status Words	184
8.7	List of Faults and Warnings	186

1 Introduction to the Application Guide

1.1 Manual Version

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

The original language of this manual is in English.

Manual Version	Remarks
AB413939445838en, version 02	Information in this version of the manual applies to software version 1.10.

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

1.3 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 provides technical information to understand the capabilities of the iC2-Micro frequency converters for integration into motor control and monitoring systems.

Safety Symbols

The following symbols are used in this manual:

D A N G E R

Indicates a hazardous situation when not avoided, results in death or serious injury.

W A R N I N G

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

C A U T I O N

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

N O T I C E

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

2 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 converter. The features are briefly described in the following sections:

- Basic Functions
- Controllers
- Protection Features
- Software Tools

2.1.1 Basic Functions

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

2.1.1.1 Reference Handling

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

Reference sources are:

- Analog inputs
- Digital inputs either as pulse input.
- Reference from a field bus
- Internal settings
- Local reference from control panel
- Built-in potentiometer on control panel

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

2.1.1.2 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 change over.

2.1.1.3 Ramps

Linear, Sine ramp, 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.

2.1.1.4 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.

2.1.1.5 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.

2.1.1.6 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.

2.1.1.7 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.

2.1.1.8 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.

2.1.1.9 Automatic Restart

In case of a minor fault and trip, the drive can do an automatic restart, 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.

2.1.1.10 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.

2.1.1.11 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.

2.1.1.12 Kinetic Backup

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

2.1.1.13 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.

2.1.1.14 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.

2.1.1.15 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

2.1.1.15.1 Process Controller

The process controller can control a process, for example in a system where a constant pressure, flow, or temperature is needed. A 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.

2.1.1.15.2 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, making installation and commissioning very easy, and eliminating the risk of defective sensors.

2.1.1.15.3 Torque Controller

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

2.1.2 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/O can be configured and used to control the application from the drive.

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

2.1.3 Motor Control Features

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

2.1.3.1 Motor Types

The drive supports standard available motors like:

- Asynchronous motors
- Permanent magnet motors

2.1.3.2 Load Characteristics

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.

2.1.3.3 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

2.1.3.4 Motor Nameplate and Catalog

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

2.1.3.5 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.

2.1.3.6 Automation Energy Optimization (AEO)

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

2.1.4 Braking of Load

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.

2.1.4.1 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.

2.1.4.2 Overvoltage Control (OVC)

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

2.1.4.3 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.

2.1.4.4 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 asynchronous motors. Excess energy is dissipated by increasing losses in the motor during braking.

2.1.4.5 DC Hold

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

2.1.4.6 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.

2.1.5 Protection Features

2.1.5.1 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.

2.1.5.2 Drive Protection Features

The drive is monitored and protected during operation.

Inbuilt temperature sensors measure the actual temperature and provide relevant information to protect the drive. If the temperature exceeds its nominal temperature conditions, derating will be applied. If the temperature is outside the allowed operating range, the drive will stop operation.

The motor current is continuously monitored on all 3 phases. In case of a short circuit between 2 phases or a fault to ground, the drive will detect this and immediately turn off. If the output current is exceeding its nominal values during operation for longer periods than allowed, the drive will stop and report overload alarm.

The DC-link voltage of the drive is monitored. If it exceeds critical levels, a warning is issued and the drive will stop. If the situation is not resolved, the drive will issue an alarm.

2.1.5.3 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.

2.1.5.4 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.

2.1.5.5 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.

2.1.6 Monitoring Features

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.

2.1.6.1 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.

2.1.6.2 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.

2.1.7 Software Tools

MyDrive® Insight is a software tool for commissioning, engineering, and monitoring drives. MyDrive® Insight can be used to configure the parameters, upgrade software, and setup features.

3 User Interfaces and How to Configure

3.1 Overview of User Interfaces

To interact with the iC2-Micro frequency converter, 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 frequency converter has a control panel with a display, control keys, and status indicators. Using MyDrive® Insight provides the ability to access the drive remotely.

3.2 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

3.2.1 Control Panel and Control Panel 2.0 OP2

The drive has 2 types of control panels as follows:

- **Control Panel:** It is inbuilt and by default delivered with the drive. The Control Panel keys and indicators are described in [3.2.2 Control Panel Keys and Indicators](#).
- **Control Panel 2.0 OP2:** An optional (accessory) control panel which provides 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 keys and indicators are described in [3.2.4 Control Panel 2.0 OP2 Keys and Indicators](#).

A more detailed overview of Control Panel 2.0 OP2 is as follows:

- 2.03" monochromatic user interface.
- Visual LEDs to identify drive status.
- Control of the drive and easy switch between local and remote operations.
- Multilingual display which shows parameters, selections, and status more clearly.
- Parameter display supports alphanumeric, special characters, integers, floating points, choice lists, and commands to configure application data.
- Parameter settings of the drive can be copied to other drives for easy commissioning.
- Installation on a cabinet door using a mounting kit option.

3.2.2 Control Panel Keys and Indicators

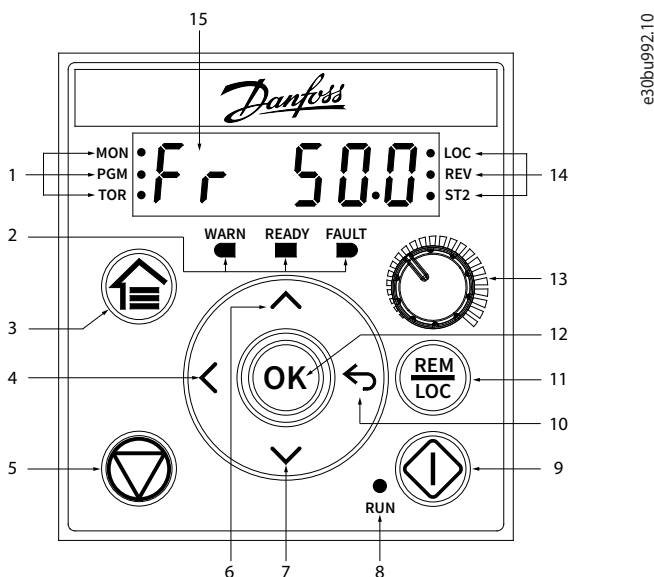


Illustration 1: Control Panel

Application Guide

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

Table 1: Operation Keys 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 2: 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 5 .

Application Guide

Table 3: 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 4: 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 <i>RUN</i> command, but no frequency output.

Table 5: 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 Programming Setup*.

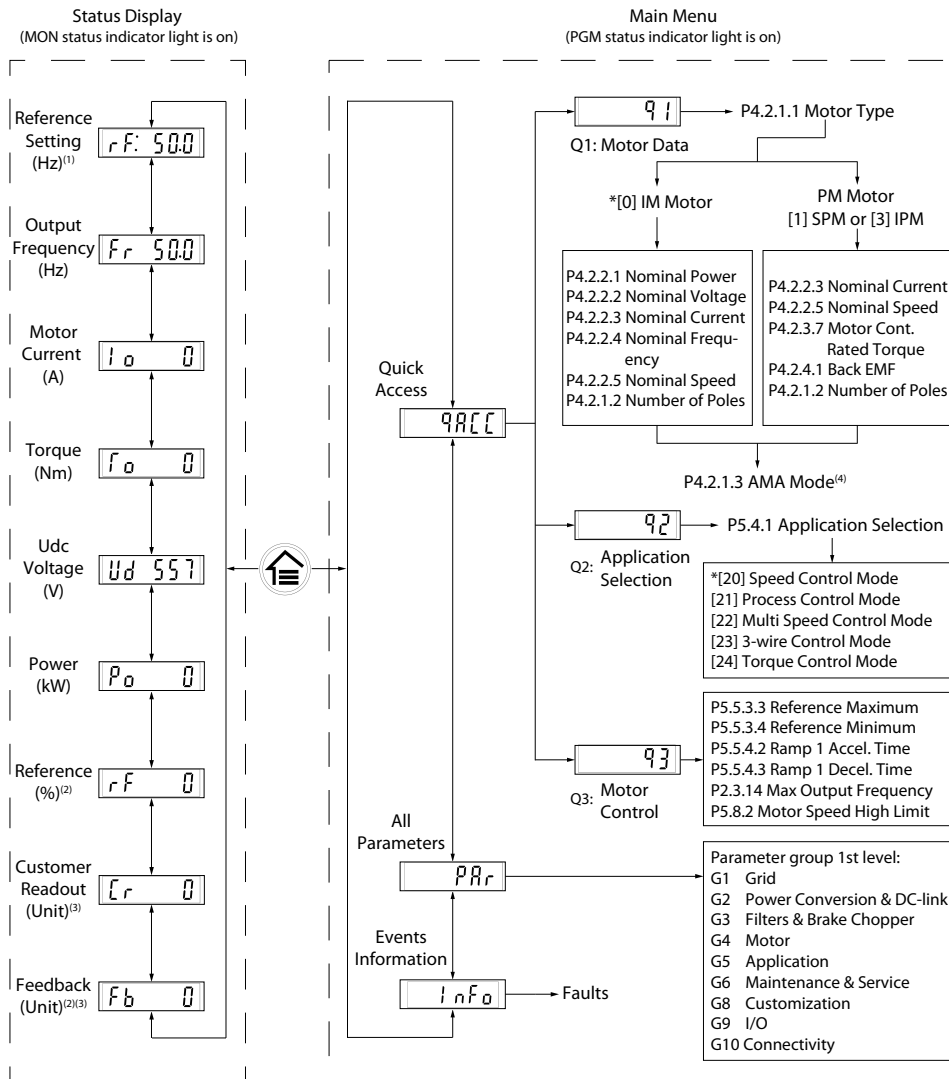
3.2.3 Control Panel Basic Configuration

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 *OK* button to confirm selection.

Application Guide



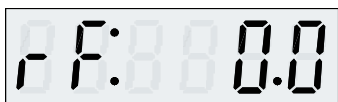
e30bv048.11

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.

Illustration 2: Operation with Control Panel

3.2.3.1 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.



e30bj954.10

Illustration 3: Home Screen

Press *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)

Application Guide

- Power (kW)
- Customer Readout (Unit)*

Readouts in Remote mode: The following readouts can 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)*
- Feedback (Unit)*

* indicates that the status is only shown when the corresponding function is enabled.

3.2.3.2 Menu Group Screen and Navigation

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

The Menu consists of the following:

- **Quick Access:** A start-up wizard to easy configuration of motor settings and starting the motor. Using quick access enables 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 converter.
- **Events Information:** To view all active and history events such as faults, in the iC2-Micro frequency converter.

Press the *Up/Down* button of the control panel to select the menu functions, as shown in the figure below.



Illustration 4: Menu Functions

3.2.3.2.1 Quick Access Navigation

Quick Access consists of the following 3 functions to set up the iC2-Micro frequency converter easily in a step-by-step prescribed manner.

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

N O T I C E

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 AMA procedure in [5.4.1 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
 - Speed control mode
 - Process control mode
 - Multi-speed control mode
 - 3-wire control mode
 - Torque control mode

For more information, see [5.5 Application Selection](#).

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 down time, reference limit, and so on.

The following figure shows the setting procedure when using Quick Access to start the motor.

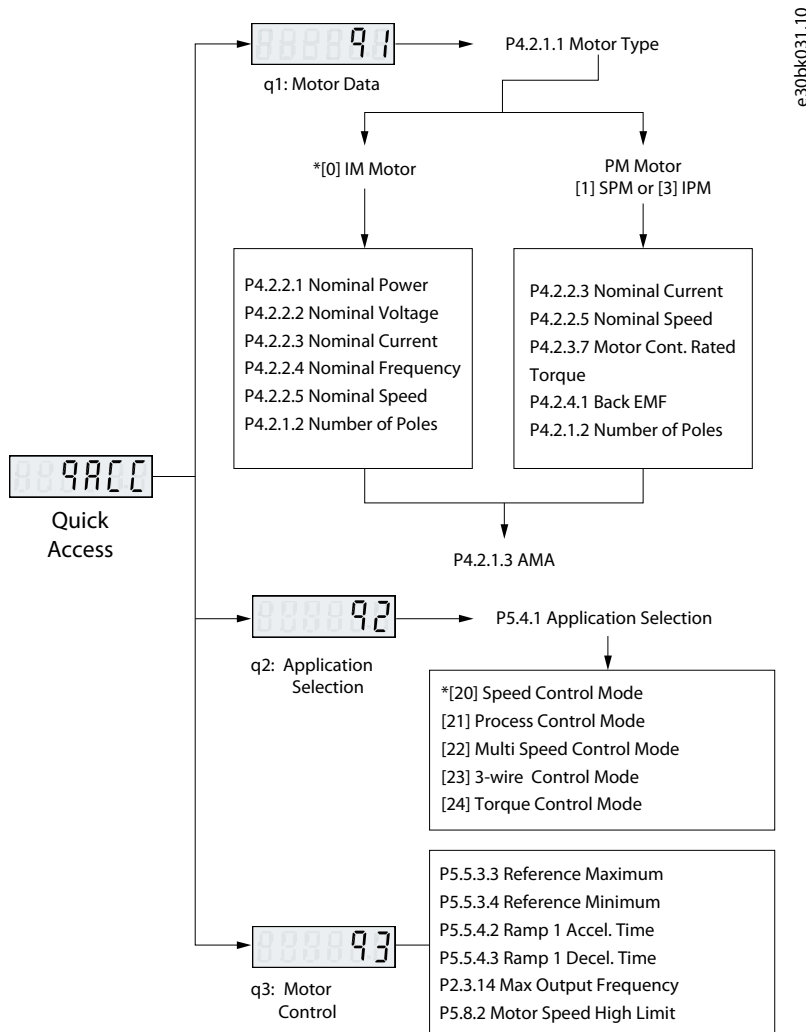


Illustration 5: Quick Access Functions

3.2.3.2.2 Parameter Group Screen and Navigation

Press the *Up/Down* buttons to select the all parameters menu. See overview of full parameters in [3.2.3.2 Menu Group Screen and Navigation](#). Press *OK* to enter the sub-menus.

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

- Use the *Up/Down* button 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.

The following illustration shows how to navigate to a parameter and the example considered is *P2.3.1 Overvoltage Controller Enable*.

Application Guide

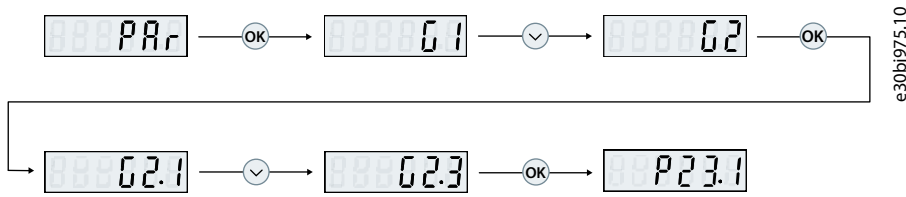


Illustration 6: Parameter Navigation

3.2.3.2.2.1 Changing Selections in a Parameter

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

The following illustrations shows an overview of the relevant screens when changing the selections in a parameter.

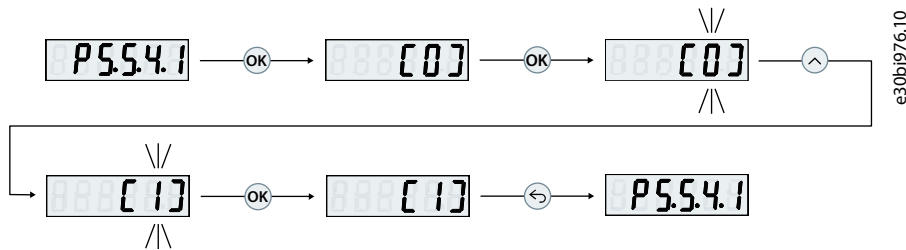


Illustration 7: Changing Selections in a Parameter

Procedure

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* button to browse through the selection numbers.
5. Press *OK* at the required selection number.

The flash stops.

3.2.3.2.2.2 Changing Parameter Value

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

The following illustrations show an overview of the relevant screens when changing the value of a parameter.

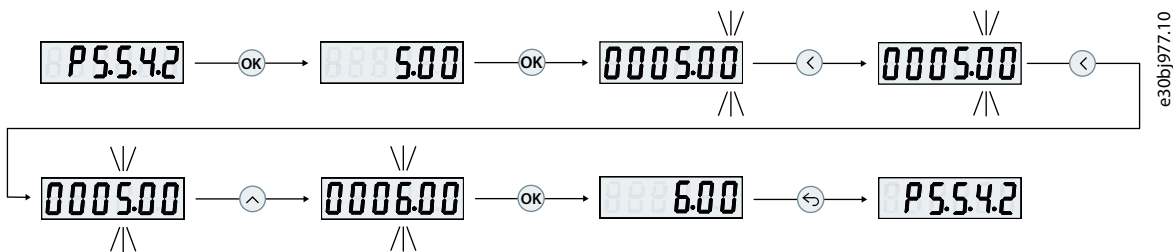


Illustration 8: Changing Parameter Value

Procedure

1. Press the *Up/Down* button 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.

Application Guide

5. Use 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* to confirm the changes.

3.2.3.3 Restoring Default Settings

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's*.
- *P 6.1.6 Over Temp's*.
- *P 6.1.7 Over Volt's*.

3.2.3.3.1 Recommended Initialization (via parameters)

Procedure

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.

3.2.3.3.2 Manual Initialization

Procedure

1. Remove power to the unit and wait until the display turns off.
2. Press and hold *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.

3.2.4 Control Panel 2.0 OP2 Keys and Indicators

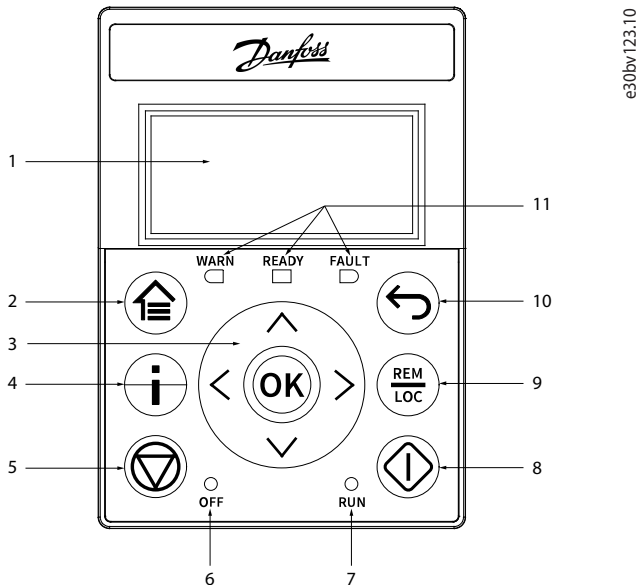


Illustration 9: Control Panel 2.0 OP2 Overview

Table 6: 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	<ul style="list-style-type: none"> Toggles between status view and main menu. Long press to access the shortcut menu for quickly reading and editing parameters.
3	Arrows and [OK]	<ul style="list-style-type: none"> Arrows: Navigates within the different screens and menus, and tunes the parameter values. [OK]: Confirms selections and data in the control panel display.
4	Info	Provides drive information by pressing the <i>Info</i> 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: <ul style="list-style-type: none"> Steady on: The indicator is in this state when: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> On: The drive is in normal operation. Off: The drive has stopped. Flash: The indicator is in this state when:

Application Guide

Legend	Name of Element	Description
		<ul style="list-style-type: none"> - In the motor-stopping process (ramp down). - The drive received a <i>RUN</i> command, but no frequency output.
8	Run	Starts the operation of the drive.
9	REM/LOC	Toggles the drive between remote and local operation.
10	Back	Navigates to previously viewed screen or a menu level above the current menu.
11	Drive Status Indicators	The related LEDs indicate the status of the drive. <ul style="list-style-type: none"> • [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.

3.2.5 Control Panel 2.0 OP2 Basic Configurations

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.

3.2.5.1 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.

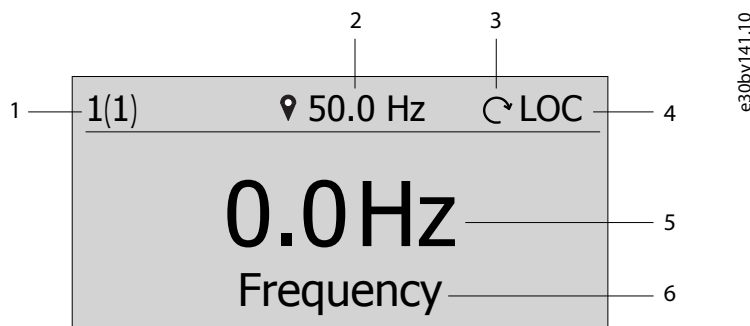


Illustration 10: Home Screen

The following are the legends and description of the *Home screen*.

Table 7: Legend Table

Legend	Description
1	<ul style="list-style-type: none"> • The front number indicates active setup.⁽¹⁾ • The number in brackets indicates the programming setup.⁽²⁾
2	<ul style="list-style-type: none"> • On <i>Readout Screens</i>, the value with unit after the setpoint icon is the reference setting data. • On <i>Menu Screens</i>, 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.

Application Guide

Legend	Description
	<ul style="list-style-type: none"> • LOC: local control mode. • REM: remote control mode.
5	Middle value: indicates the readouts value.
6	Readout type

¹ Select active setup in P 6.6.1 Active Setup.

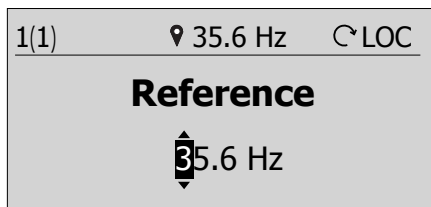
² Select programming setup in P 6.6.2 Programming Setup.

Readout type selection

Press the *up* and *down* arrow on the Control Panel 2.0 OP2 when in the *Readout Screen*. The control panel screen navigates to the readout items in order. See [3.2.3.1 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*, and *left* arrows for setting.

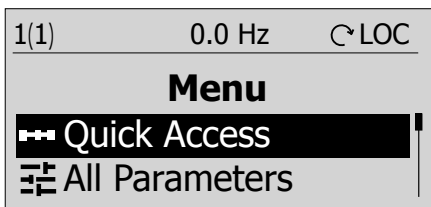


e30bv142.10

Illustration 11: Setting the Reference Value

3.2.5.2 Menu Screen and Navigation

Use the *Home/Menu* button to toggle between *Readouts Screen* and *Menu Screen*.



e30bv143.10

Illustration 12: Menu Screen

Main menu includes different functions which are shown in the following table.

Table 8: Menu Screen

Menu	Function
Quick Access	Quick access for setting up a drive quickly. See 3.2.3.2.1 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

Application Guide

- To navigate through and within the different functionalities or parameter groups, use the navigation keys 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.

3.2.5.3 Parameter Group Screens and Overall Navigation

All Parameters menu includes all parameters for configuration. A typical parameter group screen is shown as below.

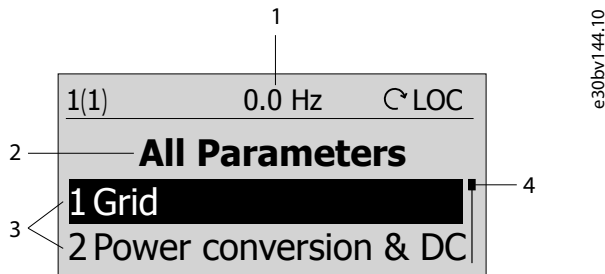


Illustration 13: Parameter Group Screen

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

3.2.5.4 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.

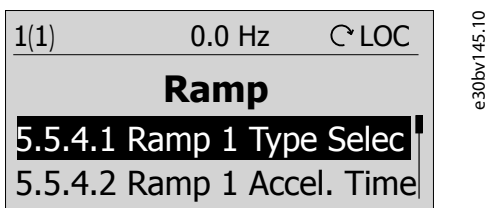


Illustration 14: Changing Selections in a Parameter

1. To view the selections of the parameter, press *OK*. The selections available for the parameter is shown. A tick icon in the front of the selection indicates the selected choice.

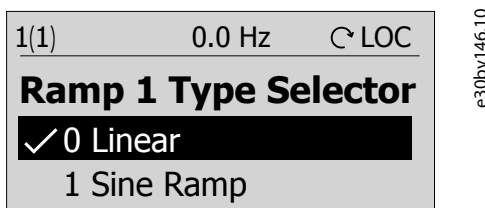


Illustration 15: Selections in a Parameter (Example)

2. Use the *up* or *down* arrow to browse through the selections.

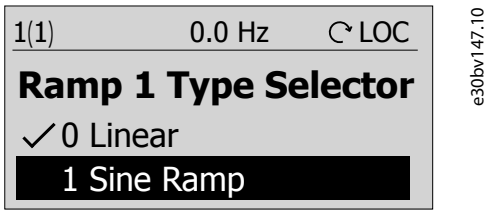


Illustration 16: Browsing through the Selections (Example)

3. Press *OK* at the required selection. The tick icon is moved to this selection.

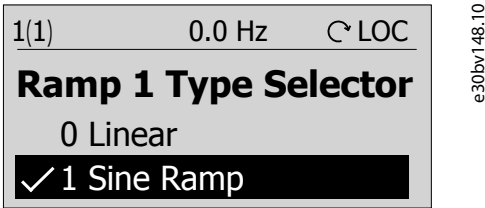


Illustration 17: Confirming the Selections (Example)

3.2.5.5 Changing Parameter Value

In the example, the *parameter P 5.5.4.2 Ramp 1 Accel. Time* is considered and the illustrations show 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 *OK* to confirm the changes.

The following illustration shows all the screens relevant to change the value of a parameter.

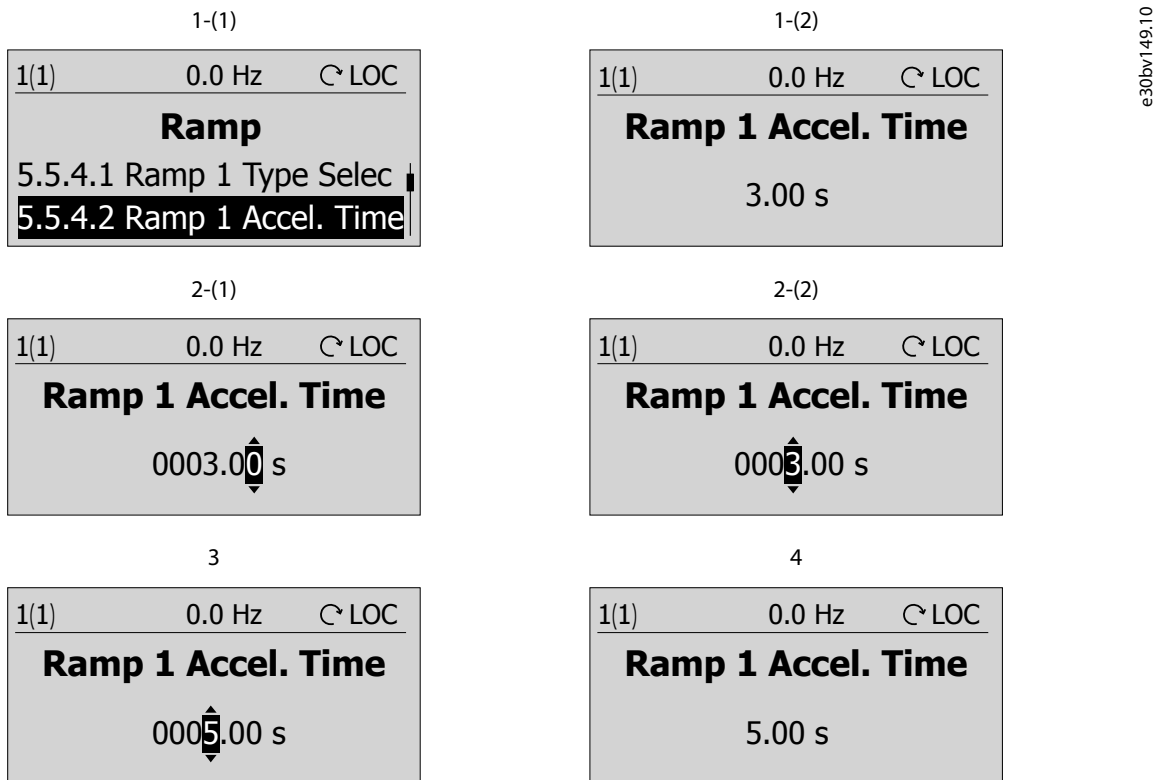


Illustration 18: Changing Value in a Parameter

3.3 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 trouble shooting.

NOTICE

The section is documented for MyDrive® Insight version 2.10 or above. Make sure to uninstall lower versions of MyDrive® Insight from your device to utilize 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.

3.3.1 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 RS485 connector 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.

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

3. Click *Direct Connect* icon, as shown.

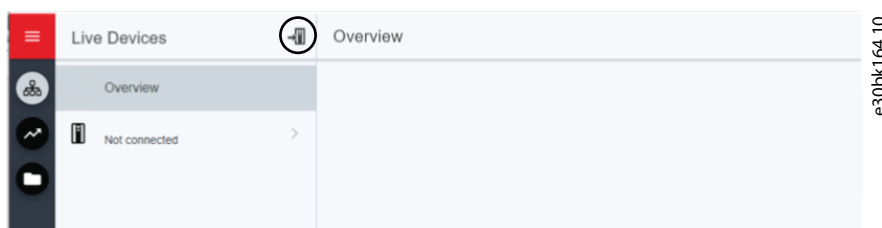


Illustration 19: Establish Connection

4. Set the connection type to **Serial** and select the serial port that the drive was connected to. Use the Baud rate and address that are set on the drive, by default the *Baud rate* is **9600** and *address* **1**.

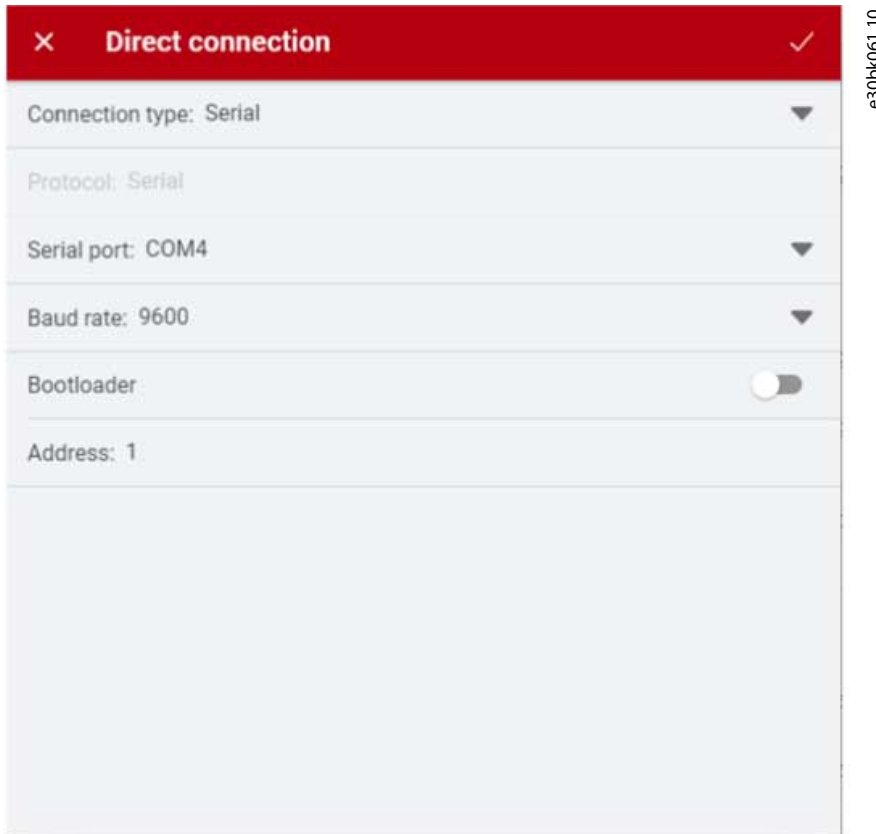


Illustration 20: Serial Connection

5. Once the connection is established, the Device Info view is displayed.

3.3.2 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.

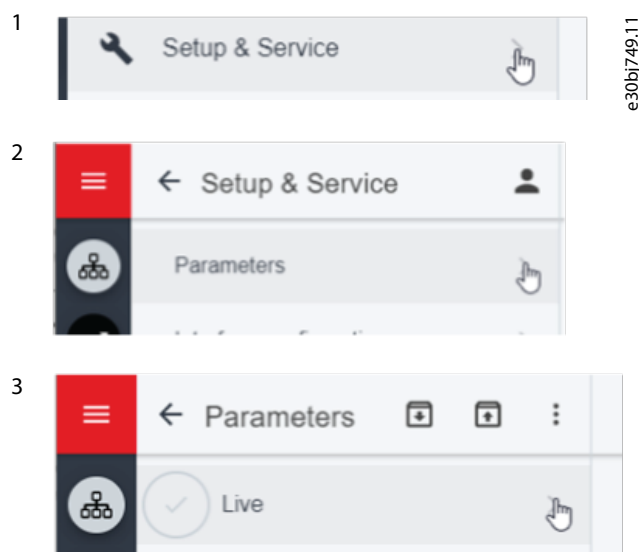


Illustration 21: Setup & Service

Parameter screen overview

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

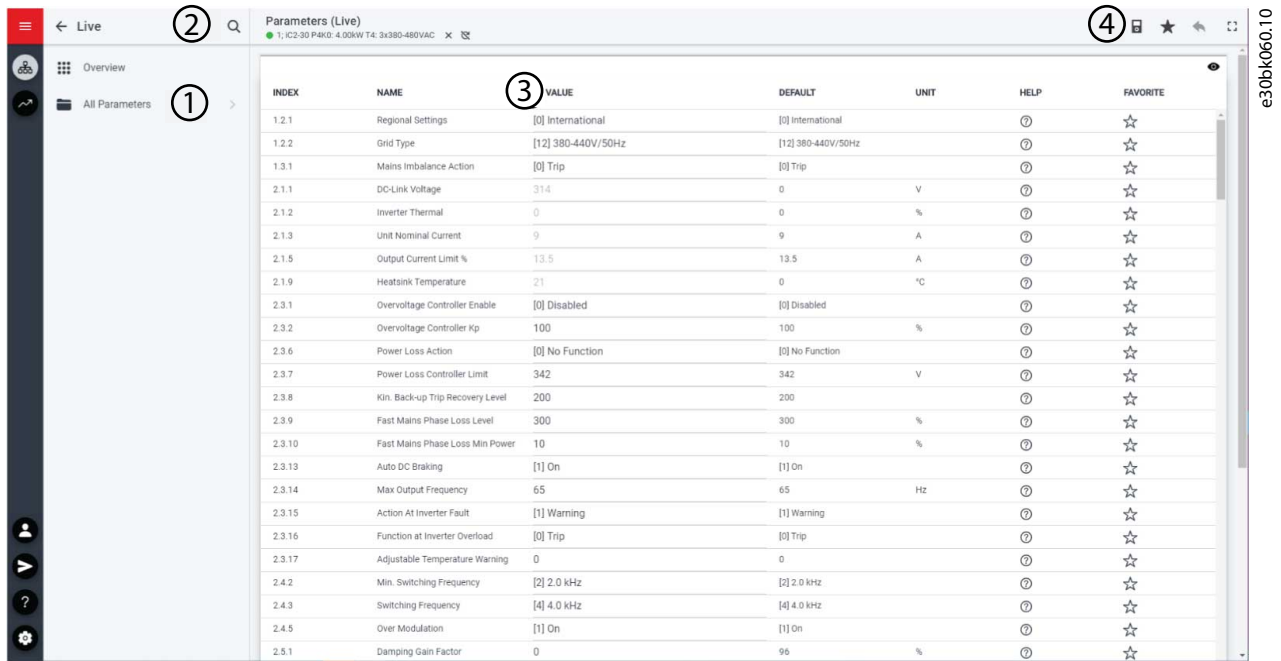


Illustration 22: Parameter Screen

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.

Application Guide

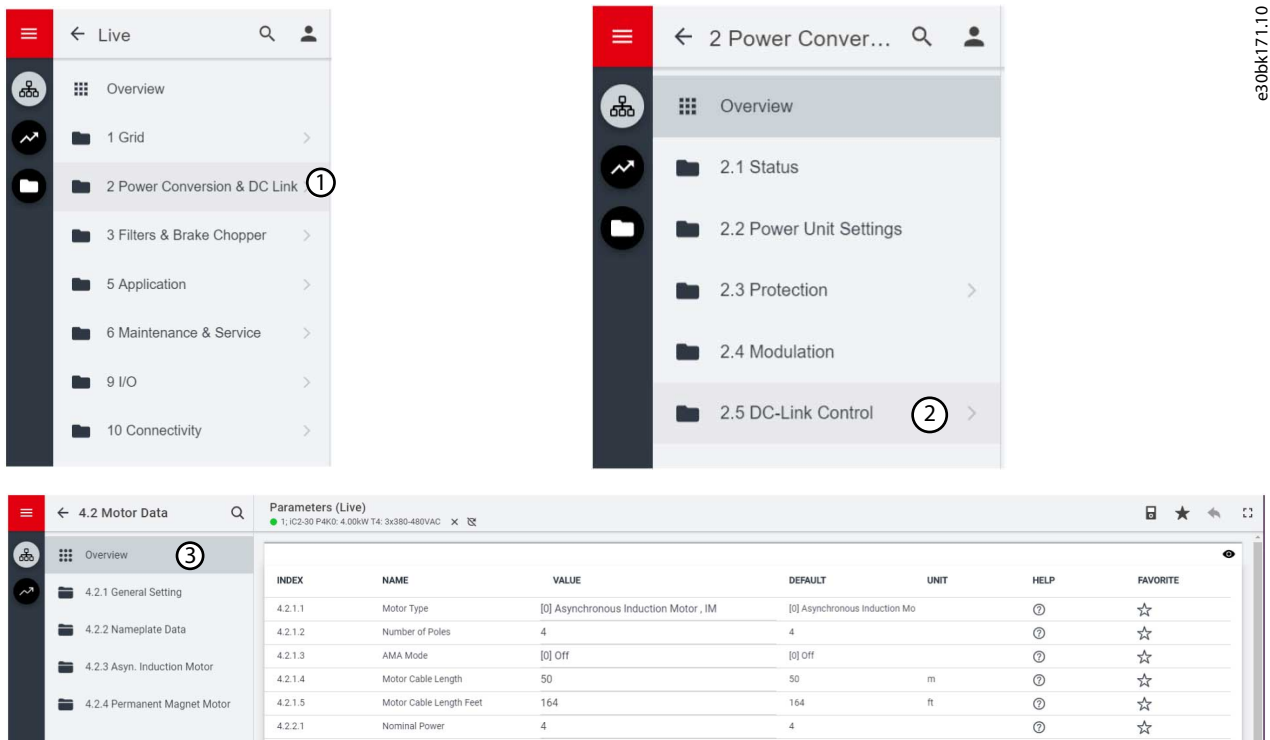


Illustration 23: Navigating to a Parameter Group

1. Click the parameter group from *All Parameters* screen.
2. Click the parameter subgroup.
3. Repeat step 2, until the right level of parameter subgroup is reached to find the specific parameters.

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.

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

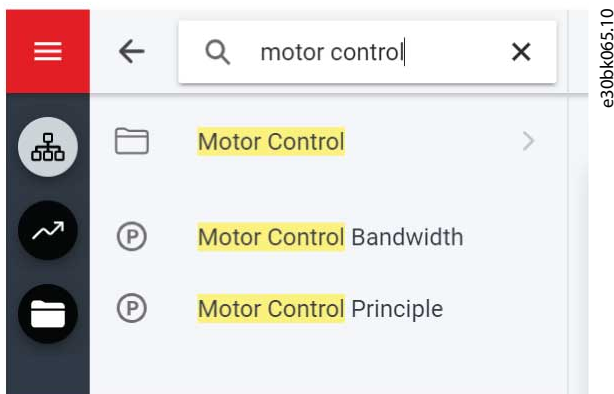


Illustration 24: Search Button

3.3.3 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.

Application Guide

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

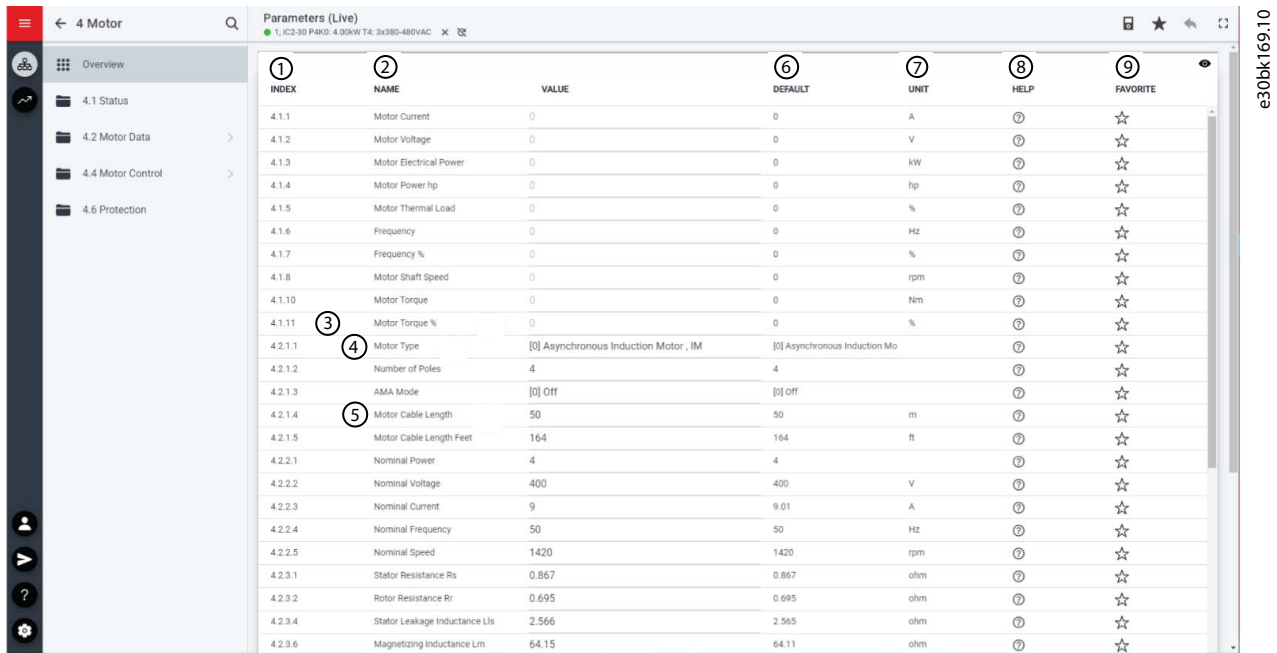


Illustration 25: Parameter Overview

Table 11: Legend Table

Number	Field Name	Description
1	<i>Index</i>	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	<i>Name</i>	Name of the parameter.
3	Status parameter	Provides the current status or value of a parameter. The parameter is shown in a light gray color and cannot be changed.
4	Selection parameters	To see all selections available for the parameter, click the value in the <i>Value</i> field.
5	Range parameters	The parameter value can be modified based on the ranges defined (maximum and minimum values).
6	<i>Default</i>	The factory setting (default value) of the parameter.
7	<i>Unit</i>	When applicable, the user unit of the parameter is shown in the <i>Unit</i> field.
8	<i>Help</i>	Click the ? button to see description about the parameter. For more detailed descriptions, see 7.1 Reading the Parameter Table .
9	Favorite	To add parameters to Favorites, click the button.

3.3.4 PC Control to Operate the Drive using MyDrive® Insight

To operate the drive using PC control, click control panel button in MyDrive® Insight. The following illustration shows the different screens to operate the drive via MyDrive® Insight.

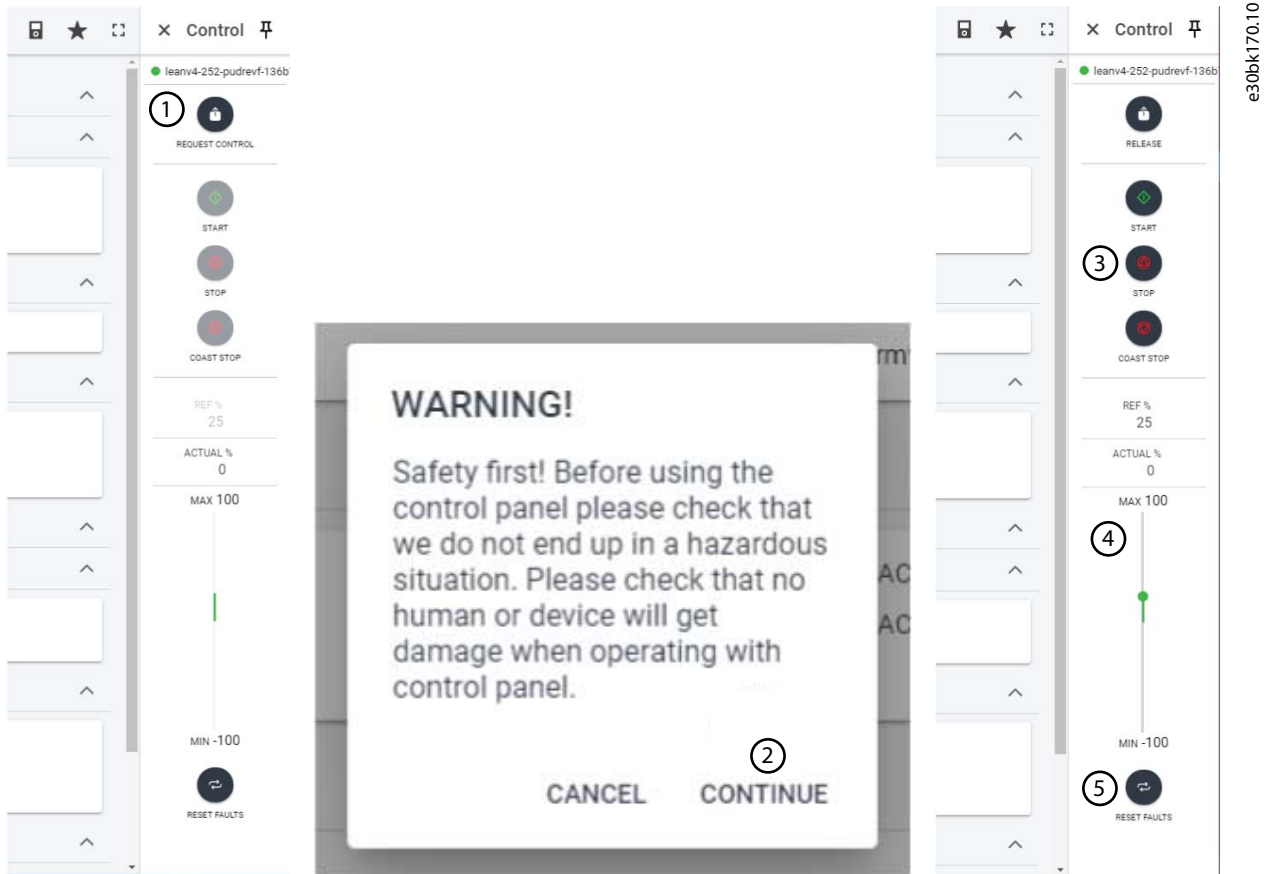


Illustration 26: Operate Drive using MyDrive® Insight

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. Use the slider to increase or decrease the reference speed.
5. In case of a fault event, click *RESET FAULTS* to reset a drive.

3.3.5 Backup of the Drive

Procedure

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.

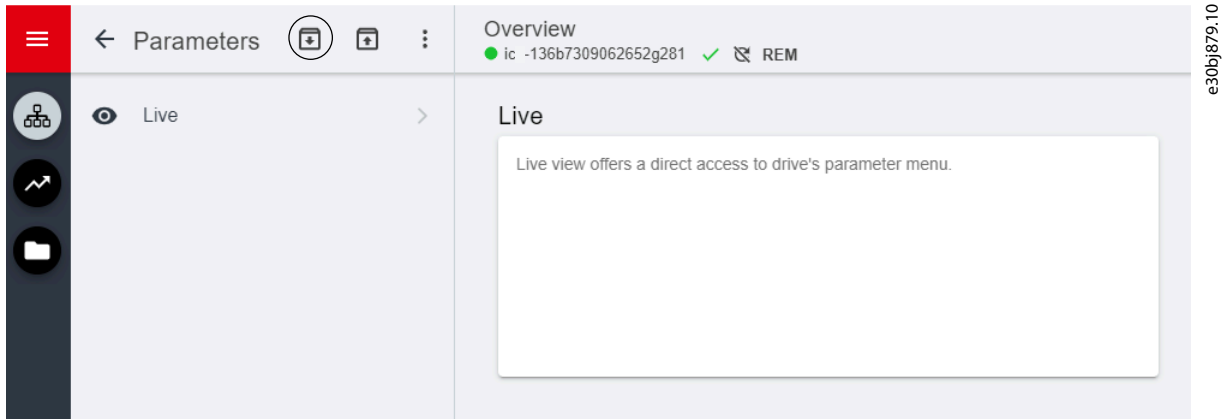


Illustration 27: Back-up Destination Icon

➡ This opens a screen to select the back-up destination. The destinations for backup are:

- **Project:** Back up an existing project or a new project.

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.

3.3.6 Restore of data to the Drive

Procedure

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.

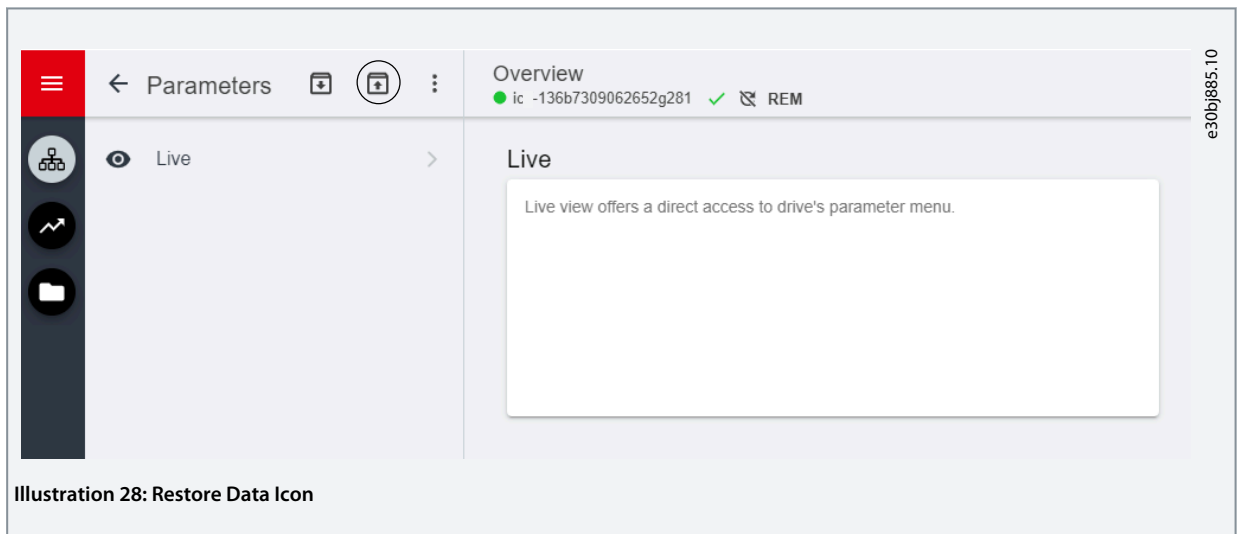


Illustration 28: Restore Data Icon

3. Select the source project of the data which has to be restored to the drive.

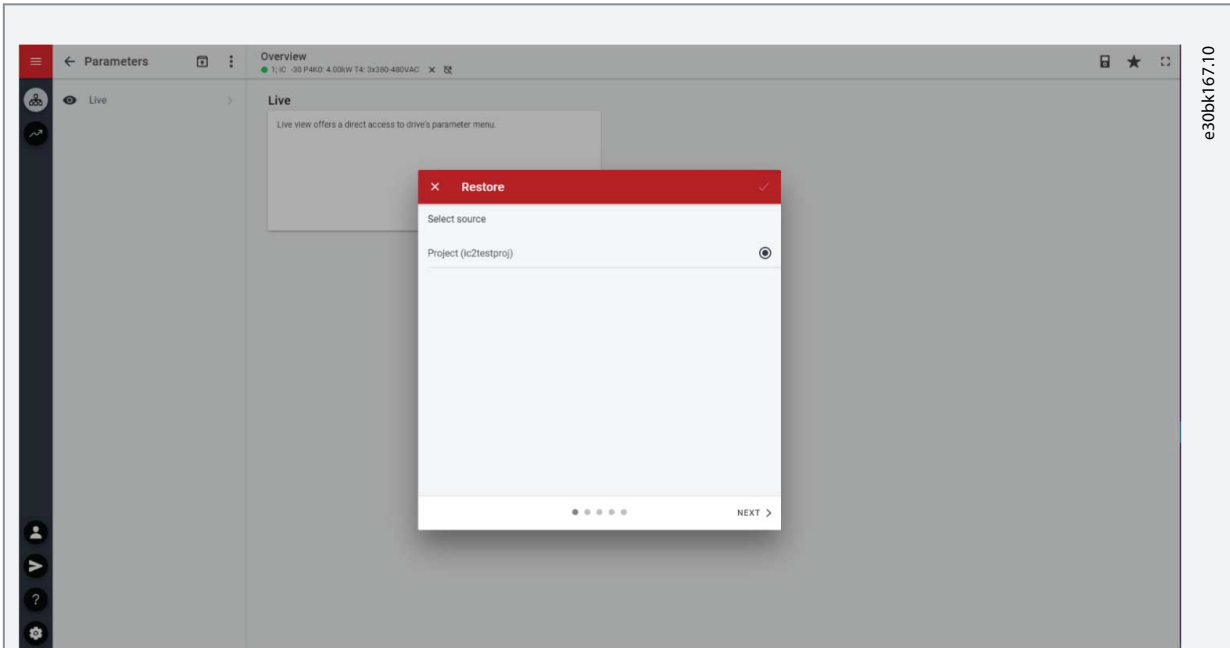


Illustration 29: Source of Data for Restore

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, as shown in the figure below, and click *Next*.

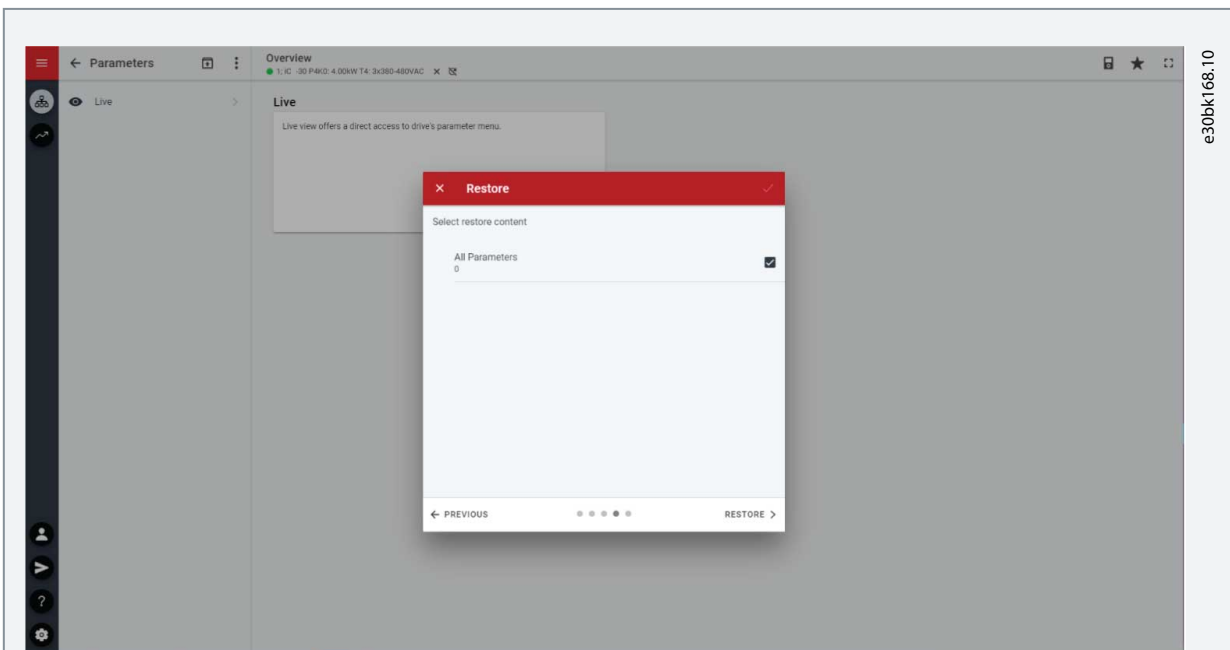


Illustration 30: Restore Parameters

➔ On successful restore of data, a message is shown.

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 frequency converter, as shown in the figure below.

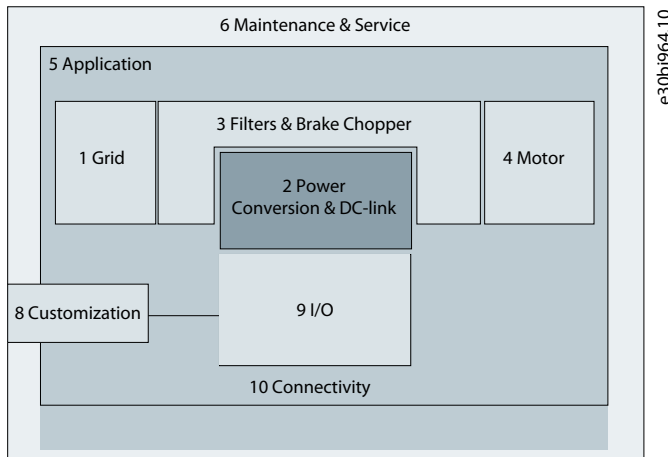


Illustration 31: Application Menu Overview

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.
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.

Application Guide

Menu index/ Parameter group	Parameter group name	Description
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.

Illustration 32: Parameter Groups

Application Guide

Parameter group 1st level	Parameter group 2nd level	Parameter group 1st level	Parameter group 2nd level	Parameter group 1st level	Parameter group 2nd level	Parameter group 1st level	Parameter group 2nd level
1 Grid	1.2 Grid Settings 1.3 Grid Protection	4 Motor	4.1 Status 4.2 Motor Data 4.4 Motor Control 4.6 Protection	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 5.27 Fieldbus Process Data	6 Maintenance & Service	6.1 Status 6.2 Software Information 6.5 Cooling Fan 6.6 Parameter Handling 6.7 Drive Identification
2 Power Conversion & DC-link	2.1 Status 2.3 Protection 2.4 Modulation 2.5 DC-Link Control 2.7 Output Current Limit	8 Customization	8.1 Custom Readout	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
3 Filters & Brake Chopper	3.1 Status 3.2 Brake Chopper 3.3 Brake Resistor						

e30b943.10

5 Configuration Set-up 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 [3.2.3 Control Panel Basic Configuration](#) .
- For information on using MyDrive® Insight, see [3.3 MyDrive® Insight](#).
- Detailed information about the parameters is described in [7 Parameter Descriptions](#).

A typical wiring schematic for iC2-Micro frequency converter is shown.

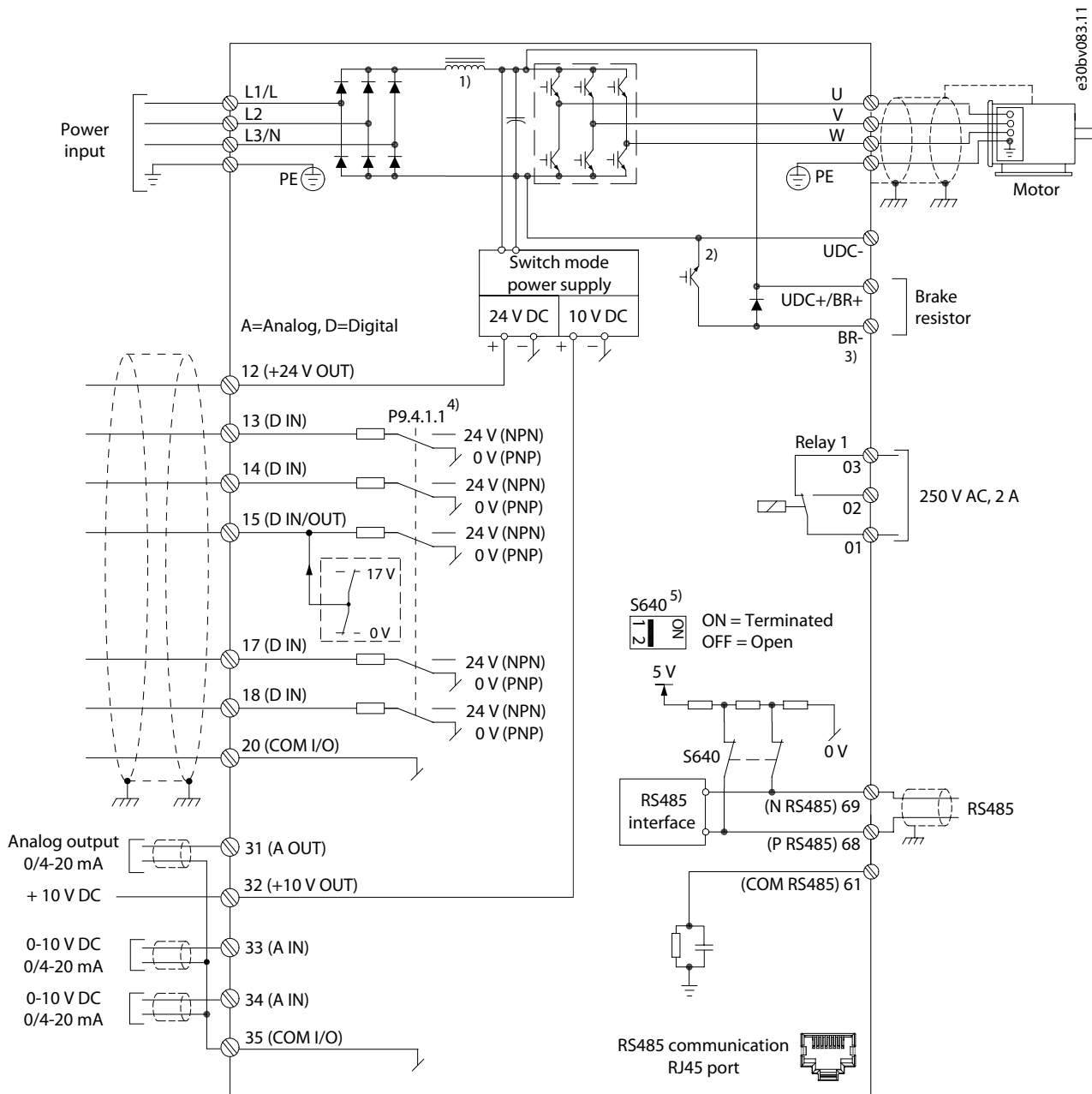


Illustration 33: Wiring Diagram

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
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.

Procedure

1. Power up the drive.
2. Press *Home/Menu* button on the control panel, for accessing the menu structure.
3. Select *QACC*, and enter **q1 Motor Data** to first select 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 [5.4.1 Automatic Motor Adaptation \(AMA\)](#).
6. Select application type in **q2 Application Selection** and wiring I/O terminals accordingly. For more information, see [5.5 Application Selection](#).
7. Enter **q3 Motor Control** to configure reference limitations, output limitiaions, and ramp time.
8. Press *REM/LOC*, to set the drive in remote operation.
9. To start the drive by I/O terminals.

5.4 Motor Configuration

This setup example describes motor configuration.

N O T I C E

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 [7 Parameter Descriptions](#).

Asynchronous motor setup

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

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.2.1	<i>Nominal Power</i>	As shown on nameplate.	120
4.2.2.2	<i>Nominal Voltage</i>	As shown on nameplate.	122
4.2.2.4	<i>Nominal Frequency</i>	As shown on nameplate.	123
4.2.2.3	<i>Nominal Current</i>	As shown on nameplate.	124
4.2.2.5	<i>Nominal Speed</i>	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	<i>Stator Resistance (Rs)</i>	As shown on motor datasheet.	130
4.2.3.2	<i>Rotor Resistance (Rr)</i>	As shown on motor datasheet.	131
4.2.3.4	<i>Stator Leakage Reactance X1</i>	As shown on motor datasheet.	133
4.2.3.6	<i>Main Reactance Xh</i>	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 [5.4.1 Automatic Motor Adaptation \(AMA\)](#).

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*.
- 1. Set the following parameters using the motor name plate and motor data sheet.

Parameter index	Parameter name	Recommended setting	Parameter number
4.2.2.3	<i>Nominal Current</i>	As shown on motor datasheet.	124
4.2.3.7	<i>Motor Cont. Rated Torque</i>	As shown on motor datasheet.	126
4.2.2.5	<i>Nominal Speed</i>	As shown on motor datasheet.	125
4.2.1.2	<i>Number of Poles</i>	As shown on motor datasheet.	139
4.2.3.1	<i>Stator Resistance (Rs)</i>	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
4.2.4.3	<i>d-axis Inductance (Ld)</i>	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	<i>Back EMF</i>	Enter 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 back EMF at 1800 RPM is 320 V, the back EMF at 1000 RPM is: Back EMF=(Voltage/ RPM)×1000=(320/1800)×1000=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 [5.4.1 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 ILoad/IMotor <5	<ul style="list-style-type: none"> - 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>ILoad/IMotor >5	Keep calculated values.
High inertia applications ILoad/IMotor >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.

Speed control configuration with I/O using default

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

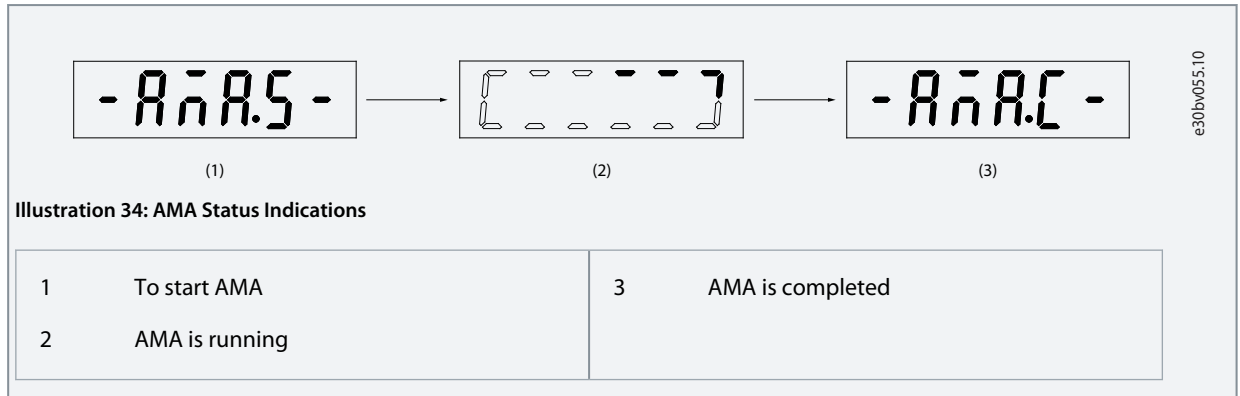
Parameter index	Parameter name	Recommended settings	Parameter number
5.4.3	Motor Control Principle	Use default: [1] VVC+. In most situations, selecting VVC+ provides optimum performance without further adjustments.	101
5.4.2	Operation Mode	Use default: [0] Speed Open Loop	100
9.4.1.2	T13 Digital Input	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 value according to real application.	341
5.5.4.3	Ramp 1. Decel. Time	Set value according to real application.	342

5.4.1 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* key, the test runs automatically and the main display indicates when it is completed.
5. When AMA is completed, press any key to exit and return to normal operation mode.



5.5 Application Selection

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 converter has 5 standard modes which have pre-configured parameters and set automatically. The following table contains a summary of the different modes and suitable applications.

Table 13: Standard Modes and Suitable Application

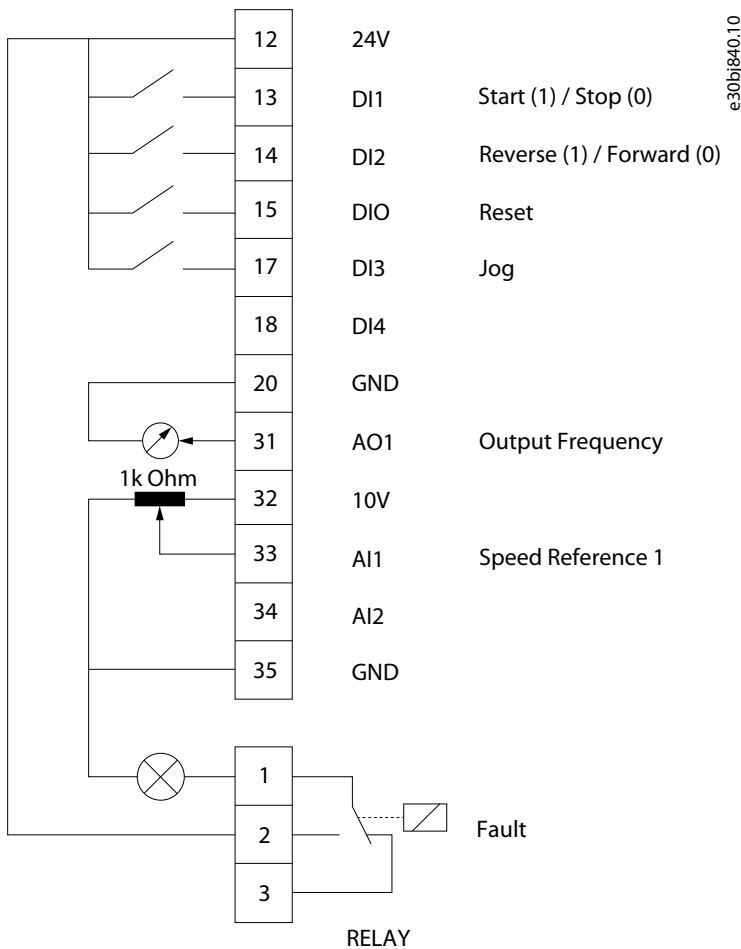
Application selection mode	Suitable application
Speed control mode	The default mode in iC2-Micro frequency converter application selection function. The mode is used in typical speed control applications for running at stable speed, the frequency converter is controlled by an analog input as reference 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.
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.

5.5.1 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 frequency converter.
- 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.

Illustration 35: Default Connections



Procedure

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
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

Category	Parameter index	Parameter name	Default setting	Parameter number
AI1 - T33	9.5.2.1	<i>T33 mode</i>	[1] <i>Voltage Mode</i>	619
	9.5.2.2	<i>T33 High Voltage</i>	10V	611
	9.5.2.3	<i>T33 Low Voltage</i>	0.07V	610
	9.5.2.6	<i>T33 High Ref./Feedb. Value</i>	50	615
	9.5.2.7	<i>T33 Low Ref./Feedb. Value</i>	0	614
AO1 - T42	9.5.1.1	<i>T31 Mode</i>	[0] 0-20mA	690
	9.5.1.2	<i>T31 Analog Output</i>	*[100] Output Frequency	691
Relay	9.4.3.1	<i>Function Relay</i>	[9] Fault	540
External reference	5.5.3.5	<i>Reference Function</i>	[0] Sum	304
	5.5.3.7	<i>Reference 1 Source</i>	[1] Analog Input 33	315
	5.5.3.8	<i>Reference 2 Source</i>	[2] Analog Input 34	316
	5.5.3.9	<i>Reference 3 Source</i>	[11] Local Bus Reference	317
Jog	5.9.2	<i>Jog Reference</i>	* 5.0	311
	5.9.1	<i>Jog Ramp Time</i>	* 3s	380
Reference limits	5.5.3.3	<i>Reference Maximum</i>	50. If [1] <i>North America</i> is selected for <i>P 1.2.1 Regional Settings</i> , the default value is 60.)	303
	5.5.3.4	<i>Reference Minimum</i>	0	302

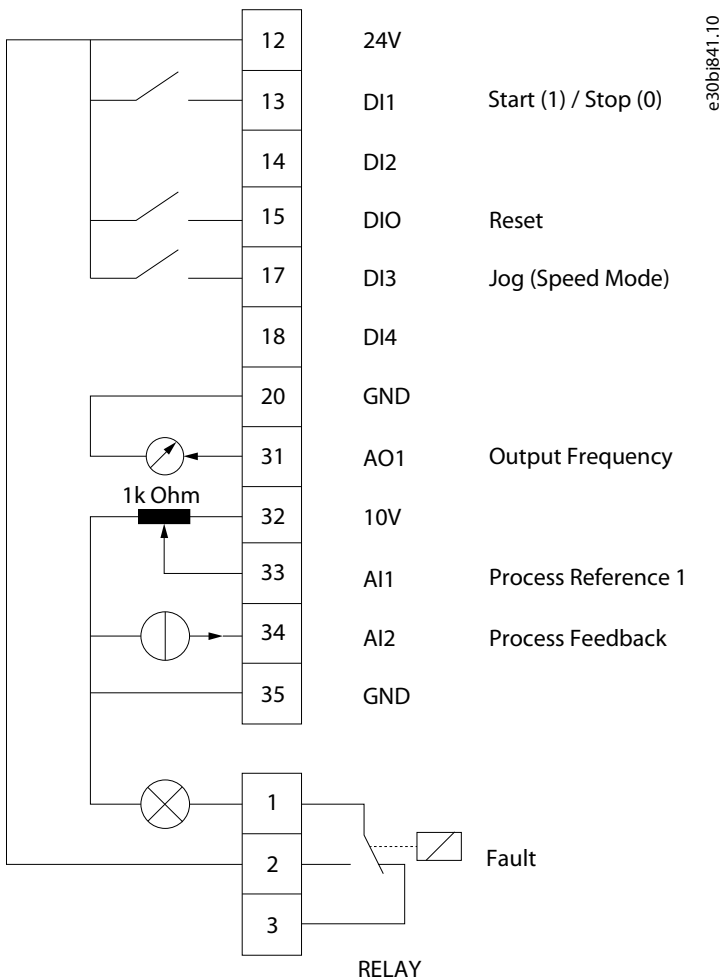
5.5.2 Configuring Process Control Mode

Process control mode is suitable for applications which requires 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. These parameters must be set according to the application's requirements by the operator.

Illustration 36: Default Connections for Process Control



Procedure

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.

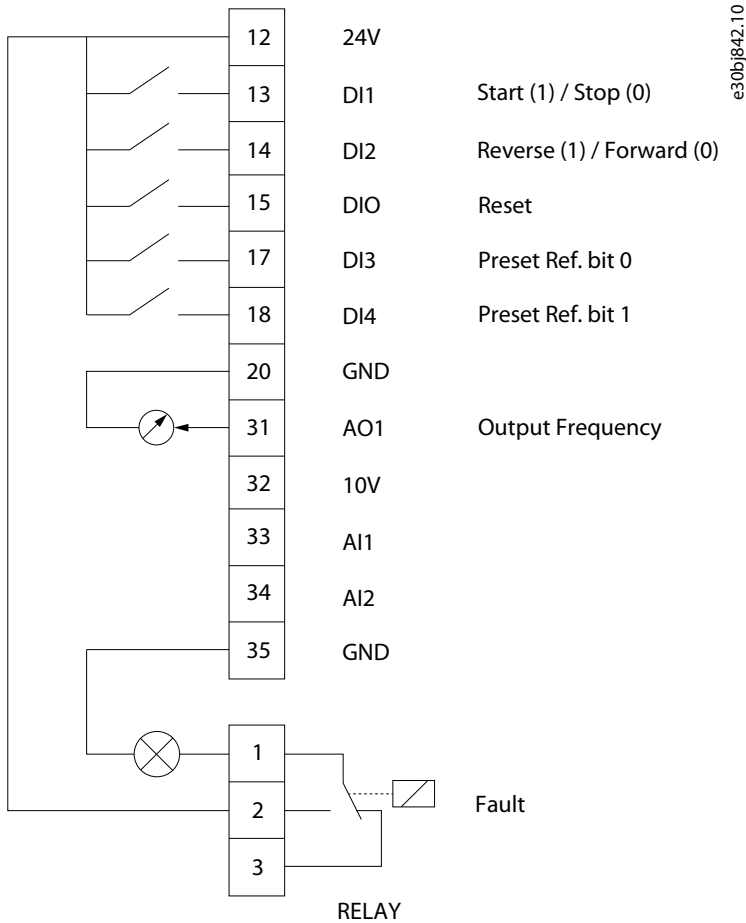
Category	Parameter index	Parameter name	Default setting	Parameter number
Operation Mode	5.4.2	Operation Mode	[3] Process Close Loop	100
DI 1 - T13	9.4.1.2	T13 Digital Input	[8] Start	510

Category	Parameter index	Parameter name	Default setting	Parameter number
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	10V	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
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	3s	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

5.5.3 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.

Illustration 37: Default Connections



Procedure

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] 0-20mA	690
	9.5.1.2	T31 Analog Output	[100] Output Frequency	691

Category	Parameter index	Parameter name	Default setting	Parameter number
Relay	9.4.3.1	<i>Function Relay</i>	[9] Fault	540
External reference	5.5.3.7	<i>Reference 1 Source</i>	[0] No Function	315
	5.5.3.8	<i>Reference 2 Source</i>	[0] No Function	316
	5.5.3.9	<i>Reference 3 Source</i>	[0] No Function	317
Preset refer.	5.5.3.10	<i>Preset Reference</i>	Note: Set as array type Table 17 .	310
Jog	5.9.2	<i>Jog Reference</i>	5.0	311
	5.9.1	<i>Jog Ramp Time</i>	3 s	380
Reference limits	5.5.3.3	<i>Reference Maximum</i>	50. If [1] North America is selected for P 1.2.1 Regional Settings, the default value is 60.	303
	5.5.3.4	<i>Reference Minimum</i>	0	302

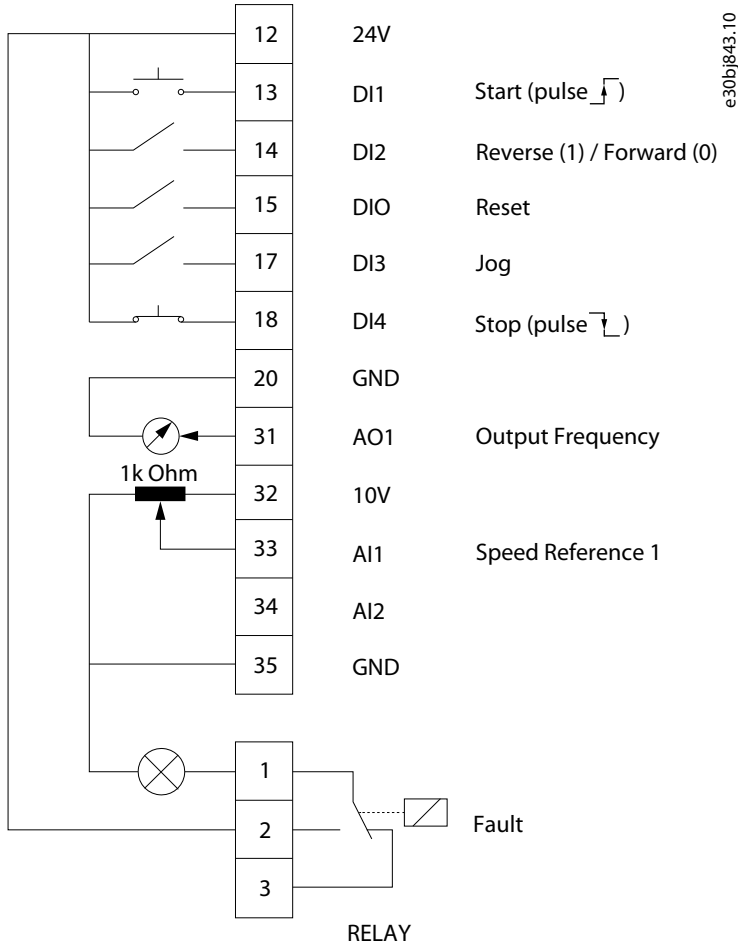
Table 17: Parameter P 5.5.3.10 Preset Reference Setting (ArrayType)

Reference	DI4 (Terminal 18)	DI3 (Terminal 17)
	[17] Preset Ref Bit [1]	[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

5.5.4 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.

Illustration 38: Default Connections



Procedure

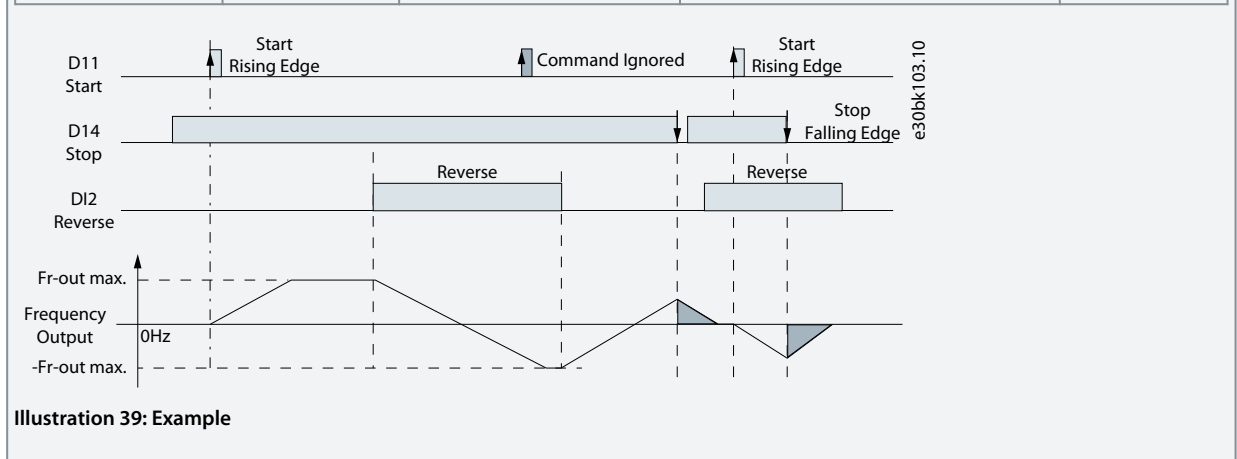
1. Set P 5.4.1 Application Selection to [23] 3-Wire Control Mode.

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

Category	Parameter index	Parameter name	Default setting	Parameter number
	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	[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	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



5.5.5 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 by user according to motor nameplate.
- P 9.5.2.6 *T33 High Ref./Feedb. Value* must be set by the operator according to 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*.

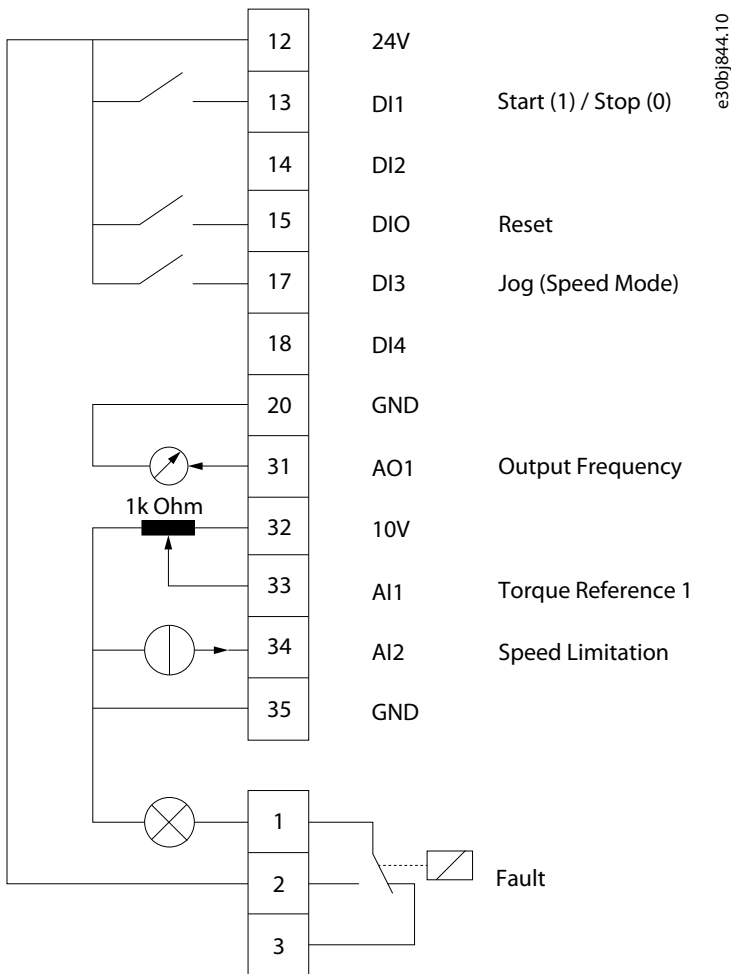


Illustration 40: Default Connections

Procedure

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	<i>Operation Mode</i>	[4] Torque Open Loop	100
DI 1 - T13	9.4.1.2	<i>T13 Digital Input</i>	[8] Start	510
DI 2 - T14	9.4.1.3	<i>T14 Digital Input</i>	[0] No operation	511
DI/O - T15	9.4.1.4	<i>T15 Digital Input</i>	[1] Reset	512
DI 3 - T17	9.4.1.5	<i>T17 Digital Input</i>	[14] Jog	513
DI 4 - T18	9.4.1.6	<i>T18 Digital Input</i>	[0] No Operation	515
AI1 - T33	9.5.2.1	<i>T33 Mode</i>	[1] Voltage Mode	619
	9.5.2.2	<i>T33 High Voltage</i>	10V	611
	9.5.2.3	<i>T33 Low Voltage</i>	0.07V	610
	9.5.2.6	<i>T33 High Ref./Feedb. Value</i>	The value should be set manually according to application requirement.	615
	9.5.2.7	<i>T33 Low Ref./Feedb. Value</i>	0	614
AI2 - T34	9.5.3.1	<i>T34 Mode</i>	[0] Current Mode	629
	9.5.3.4	<i>T34 High Current</i>	20.00 mA	623
	9.5.3.5	<i>T34 Low Current</i>	4.00 mA	622
	9.5.3.6	<i>T34 High Ref./Feedb. Value</i>	50. If [1] North America is selected for P 1.2.1 Regional Settings, the default value is 60.	625
	9.5.3.7	<i>T34 Low Ref./Feedb. Value</i>	0	624
AO1 - T42	9.5.1.1	<i>T31 Mode</i>	[0] 0-20mA	690
	9.5.1.2	<i>T31 Analog Output</i>	[100] Output Frequency	691
Relay	9.4.3.1	<i>Function Relay</i>	[9] Fault	540
External reference	5.5.3.5	<i>Reference Function</i>	[0] Sum	304
	5.5.3.7	<i>Reference 1 Source</i>	[1] Analog Input 33	315
	5.5.3.8	<i>Reference 2 Source</i>	[0] No Function	316
	5.5.3.9	<i>Reference 3 Source</i>	[11] No Function	317
Speed Limit	5.10.3	<i>Speed Limit Mode Torque Ctrl.</i>	[0] No Function	421
Jog	5.9.2	<i>Jog Reference</i>	5.0 Hz	311
	5.9.1	<i>Jog Ramp Time</i>	3s	380
Reference limits	5.5.3.3	<i>Reference Maximum</i>	Value is automatically calculated according to motor data.	303
	5.5.3.4	<i>Reference Minimum</i>	0	302

5.6 Reference Handling

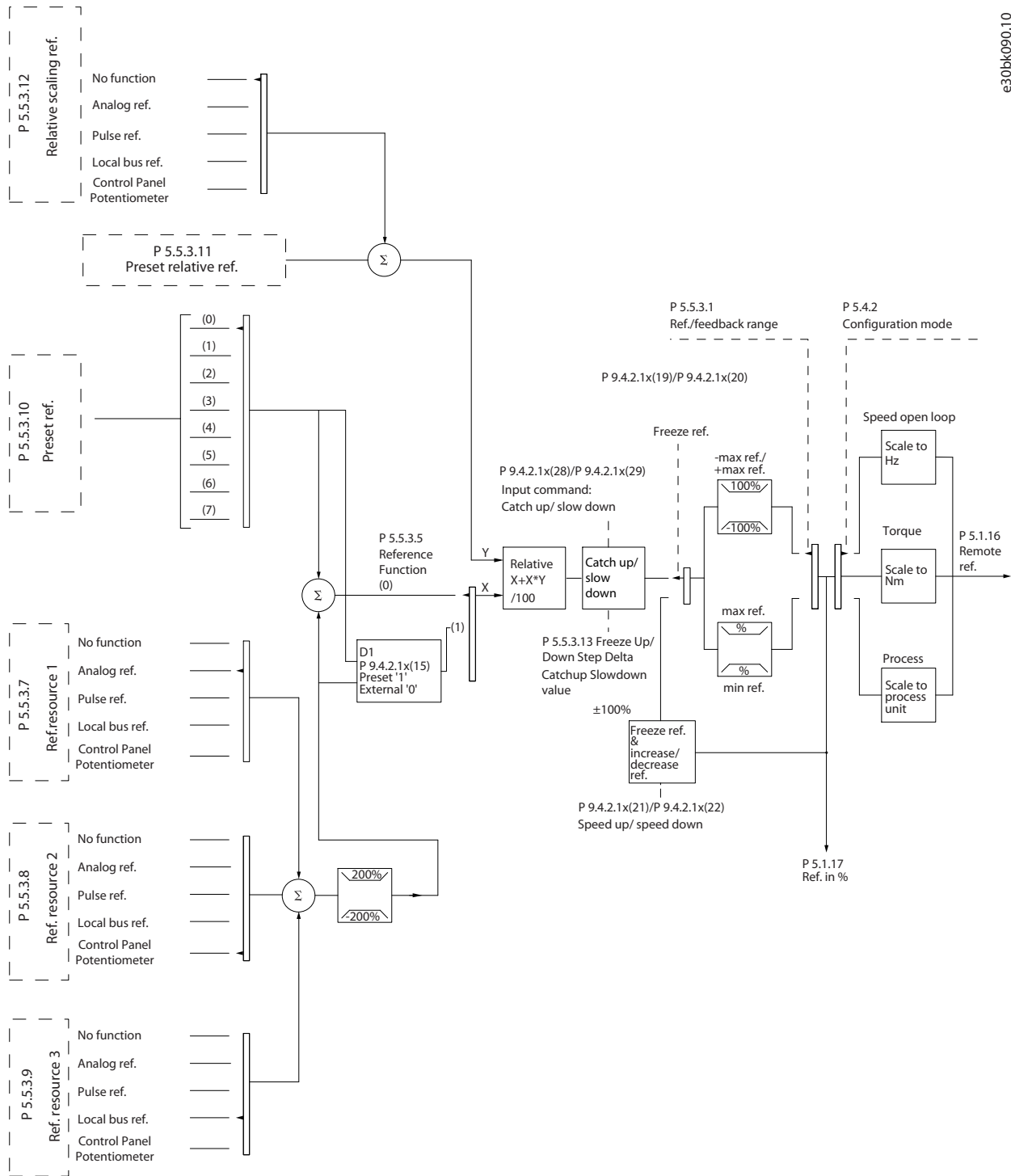
5.6.1 Local/Remote Reference

Local reference

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

Remote reference

The reference handling system for calculating the remote reference is shown in the following illustration.



e30bk090.10

Illustration 41: 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 field-bus 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:

$$\text{Remote reference} = X + X * Y / 100\%$$

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 [Illustration 42](#) and [Illustration 43](#).

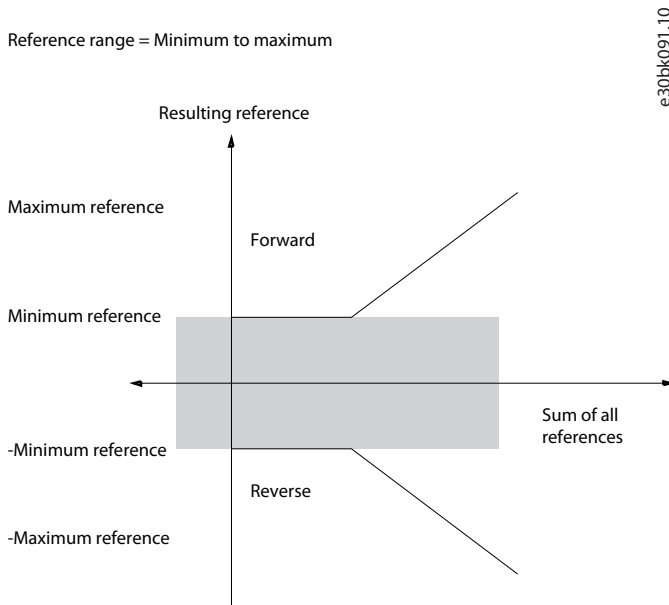


Illustration 42: Reference Range is Set to 0

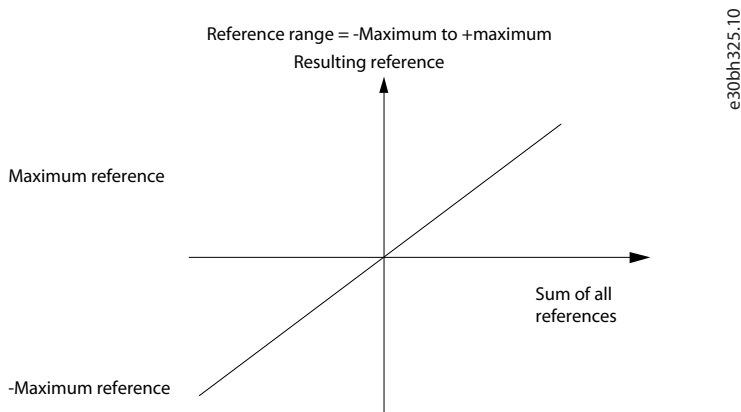


Illustration 43: Reference Range is Set to 1

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 [Illustration 44](#).

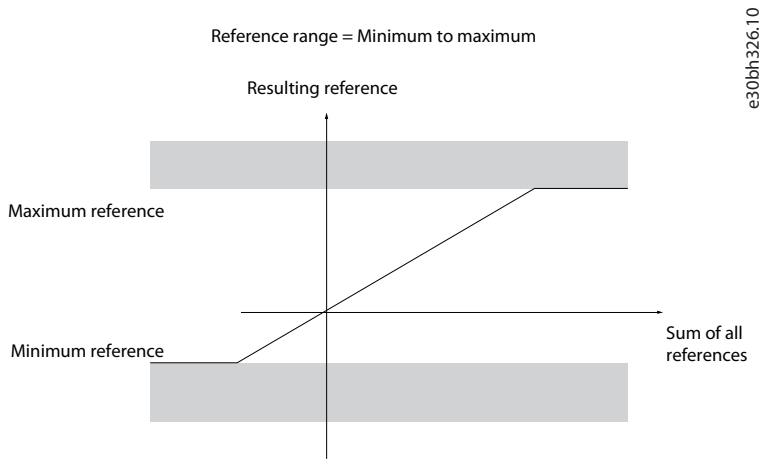


Illustration 44: Sum of all References when Configuration Mode is set to Process

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 following illustration) are clamped while feedbacks above or below are not.

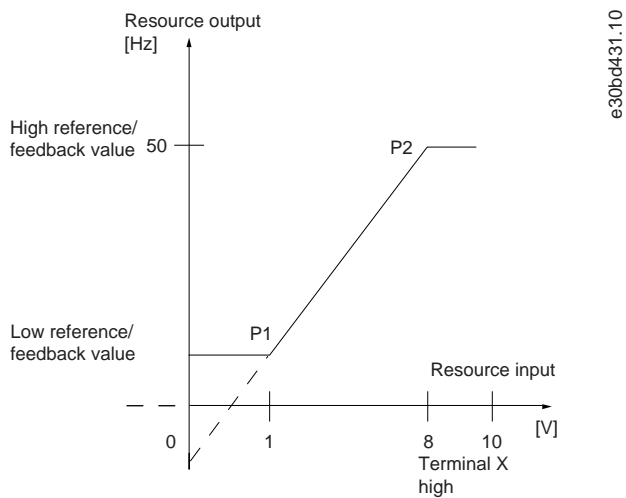


Illustration 45: Minimum and Maximum Endpoints

The endpoints P1 and P2 are defined in the following table 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 following illustration.
- 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 following illustration.

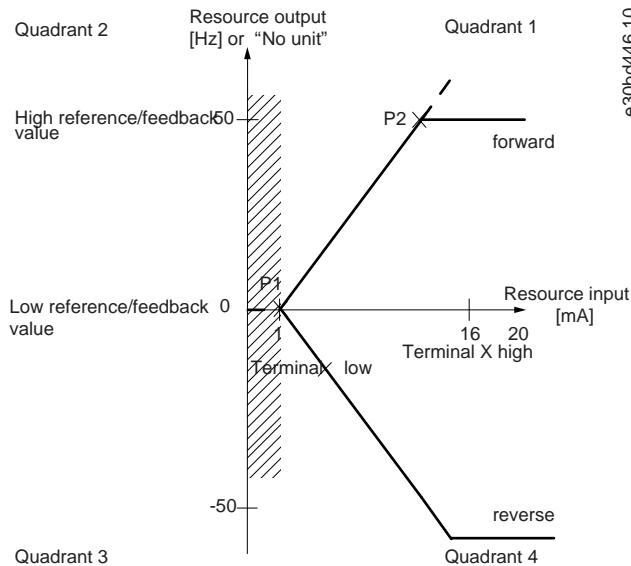
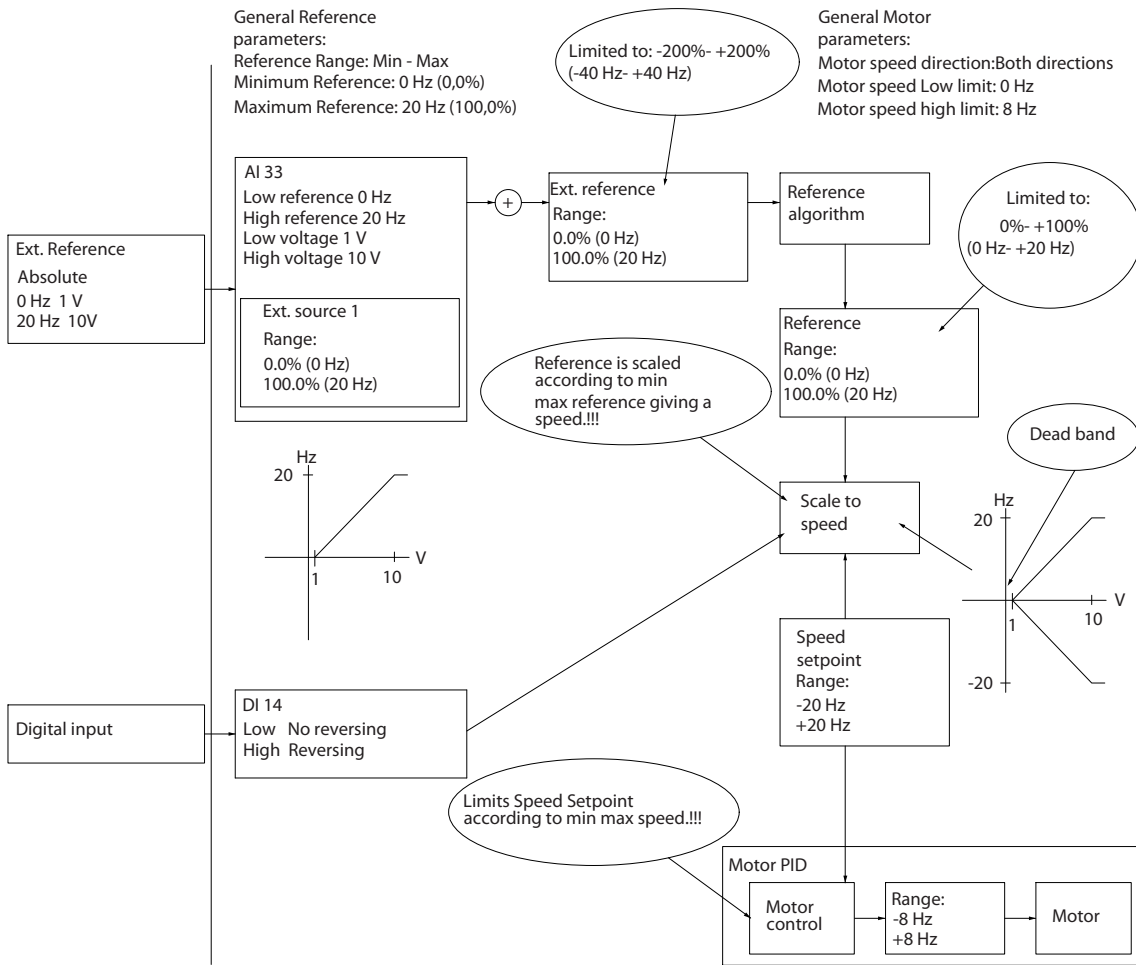


Illustration 46: Size of Dead Band

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

The following illustration shows how reference input with limits inside minimum to maximum limits clamps.

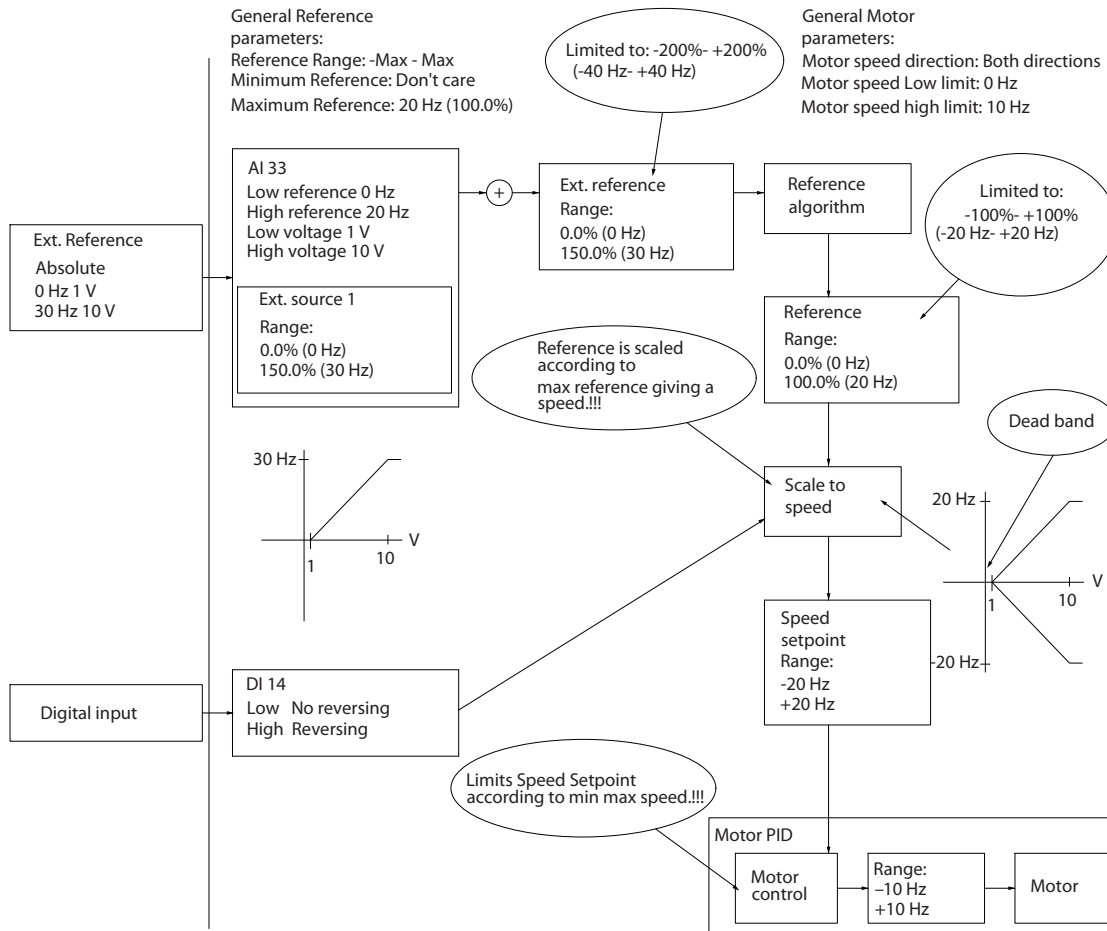


e=30bk092.10

Illustration 47: Clamping of Reference Input with Limits inside Minimum to Maximum

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

The following illustration 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.



e30bk093.10

Illustration 48: Clamping of Reference Input with Limits outside -Maximum to +Maximum

6 RS485 Configurations

6.1 RS485 Installation and Set up

RS485 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 the following illustration.

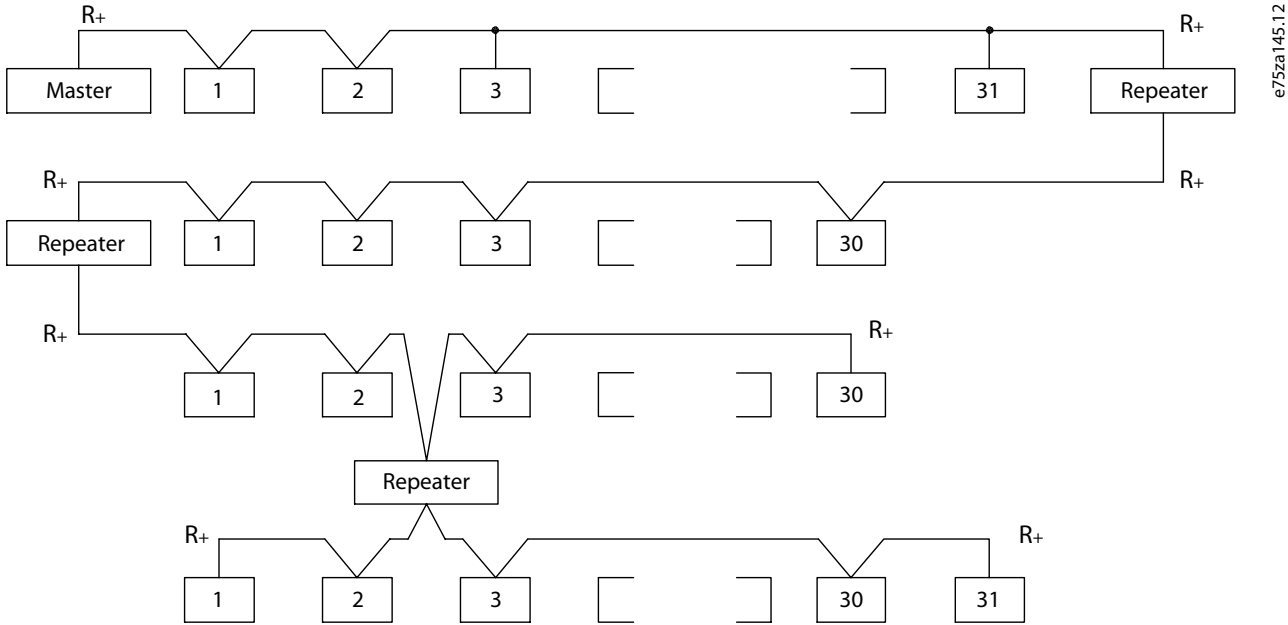


Illustration 49: RS485 Bus Interface

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

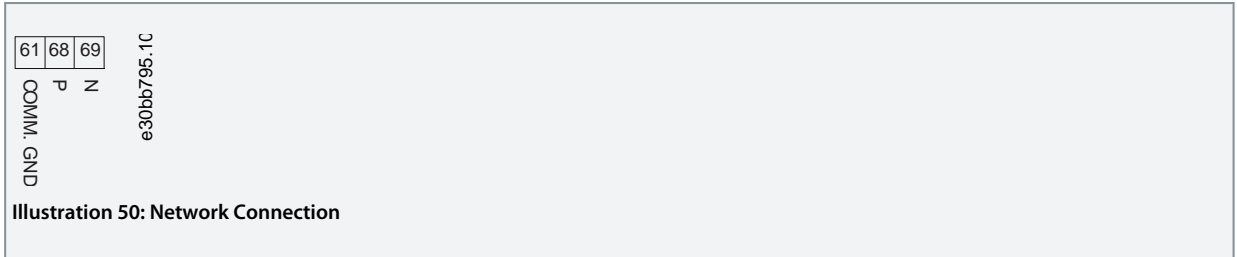
Table 21: Cable Specifications

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

6.1.1 Connecting the Drive to the RS485 Network

Procedure

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



2. Connect the cable shield to the cable clamps.

NOTICE

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

6.1.2 Hardware Setup

To terminate the RS485 bus, use the terminator switch on the main control board of the drive.

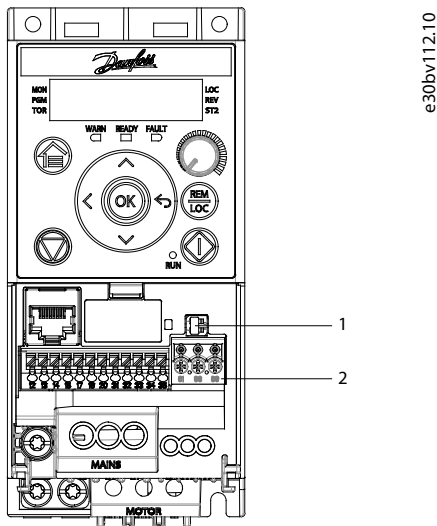


Illustration 51: Terminator Switch Factory Setting

Table 22: Legend Table

Legend	Description
1	RS485 termination switch (ON=RS485 terminated, OFF=Open)
2	RS485 terminals

The factory setting for the switch is OFF.

6.1.3 Parameter Settings for RS485 Communication

Table 23: RS485 Communication Parameter Settings

Parameter	Function
P 10.1.1 Protocol	Select the application protocol to run for the RS485 interface.
P 10.1.2 Address	Set the node address.

Parameter	Function
	<p style="text-align: center;">N O T I C E</p> <p>The address range depends on the protocol selected in <i>P 10.1.1 Protocol</i>.</p>
<i>P 10.1.3 Baud Rate</i>	<p>Set the baud rate.</p> <p style="text-align: center;">N O T I C E</p> <p>The default baud rate depends on the protocol selected in <i>P 10.1.1 Protocol</i>.</p>
<i>P 10.1.4 Parity / Stop Bits</i>	<p>Set the parity and number of stop bits.</p> <p style="text-align: center;">N O T I C E</p> <p>The default selection depends on the protocol selected in <i>P 10.1.1 Protocol</i>.</p>
<i>P 10.1.6 Minimum Response Delay</i>	<p>Specify a minimum delay time between receiving a request and transmitting a response. This function is for overcoming modem turnaround delays.</p>
<i>P 10.1.5 Maximum Response Delay</i>	<p>Specify a maximum delay time between transmitting a request and receiving a response.</p>

6.1.4 EMC Precautions

To achieve interference-free operation of the RS485 network, Danfoss recommends the following EMC precautions.

N O T I C E
<p>Observe relevant national and local regulations, for example regarding protective earth 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 RS485 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 RS485 cable must cross motor and brake resistor cables at an angle of 90°.</p>

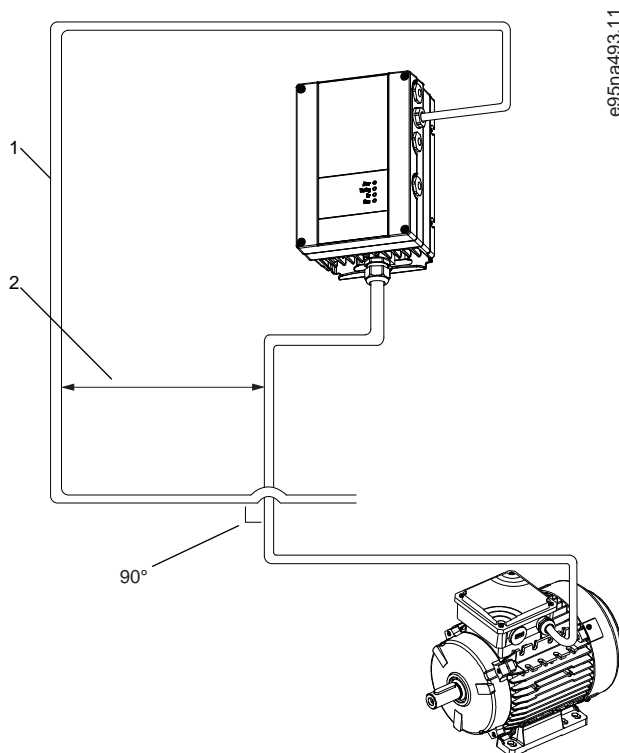


Illustration 52: Minimum Distance between Communication and Power Cables

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

6.1.5 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 (single-master system).

The physical layer is RS485, thus utilizing the RS485 port built into the drive. The FC protocol supports different telegram formats:

- A short format of 8 bytes for process 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:
 - Coast stop.
 - Quick stop.
 - DC brake stop.
 - Normal (ramp) stop.
- Reset after a fault trip.
- Run at various preset speeds.
- Run in reverse.

- Change of the active set-up.
- 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.

6.1.5.1 FC Protocol Message Framing Structure

6.1.5.1.1 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.



Illustration 53: Content of a Character

6.1.5.1.2 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.

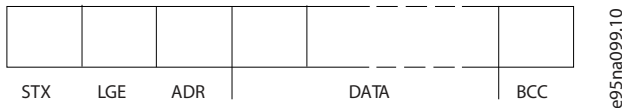


Illustration 54: Telegram Structure

6.1.5.1.3 Telegram Length (LGE)

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

Table 24: 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 ⁽¹⁾ +n bytes

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

6.1.5.1.4 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.

6.1.5.1.5 Data Control Byte (BCC)

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

6.1.5.1.6 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).

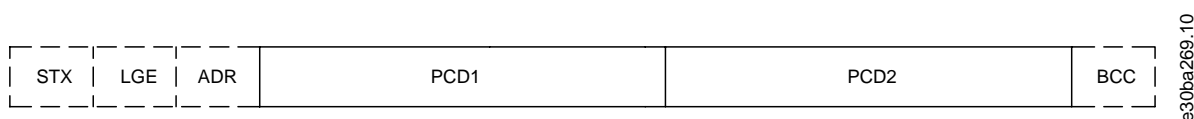


Illustration 55: Process Block

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.

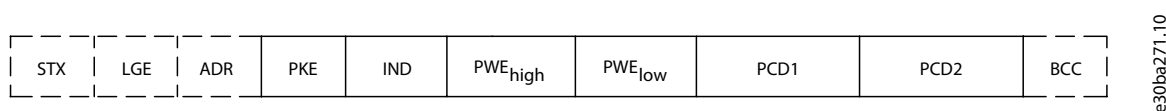


Illustration 56: Parameter Block

Text block

The text block is used to read or write texts via the data block.

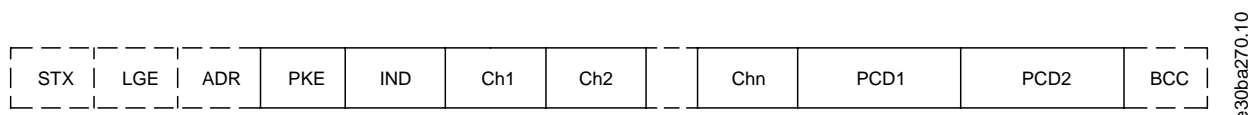


Illustration 57: Text Block

6.1.5.1.7 The PKE Field

The PKE field contains 2 subfields:

- Parameter command and response (AK)
- Parameter number (PNU)

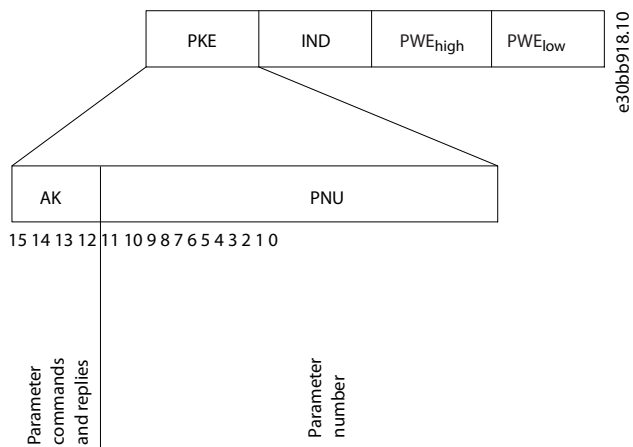


Illustration 58: PKE Field

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

Table 25: 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 26: 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 following table.

Table 27: 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.

6.1.5.1.8 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](#).

6.1.5.1.9 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.

6.1.5.1.10 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.

6.1.5.1.11 Data Types Supported by the Drive

Table 28: 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.

6.1.5.1.12 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 29: 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

6.1.5.1.13 Process Words (PCD)

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

Table 30: Process Words (PCD)

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

6.1.5.2 Examples

Parameter number: 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.

6.1.5.2.1 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 [6.1.5.1.12 Conversion](#).

The telegram looks like the following illustration.

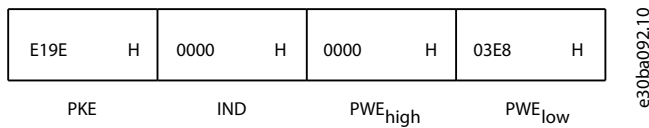


Illustration 59: Telegram

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 following illustration.

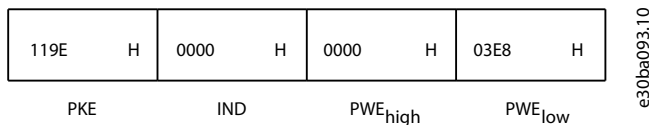


Illustration 60: Response from Master

6.1.5.2.2 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.

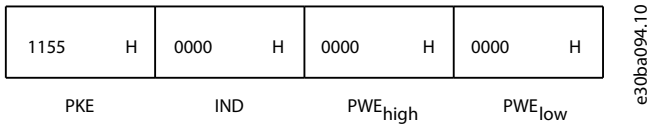


Illustration 61: Telegram

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 following illustration.

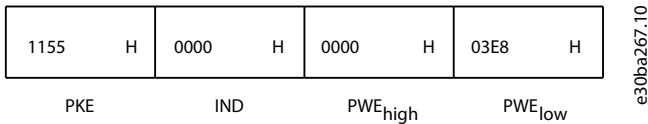


Illustration 62: Response

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.

6.1.6 Modbus RTU

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.

6.1.6.1 Drive with Modbus RTU

The drive communicates in Modbus RTU format over the built-in RS485 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 set-up.
- 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.

6.1.6.2 Network Configuration

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

Table 31: Parameters to Enable the Protocol

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

6.1.6.3 Modbus RTU Message Framing Structure

6.1.6.3.1 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 32: Format for Each Byte

Start bit	Data byte	Stop/ parity	Stop

Table 33: 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	<ul style="list-style-type: none"> • 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).

6.1.6.3.2 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 34: 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

6.1.6.3.3 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.

6.1.6.3.4 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.

6.1.6.3.5 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 (errorfree) 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](#).

6.1.6.3.6 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.

6.1.6.3.7 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.

6.1.6.3.8 Coil Register Addressing

6.1.6.3.8.1 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).

6.1.6.3.8.2 Coil Register

Table 35: 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
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.	–

6.1.6.3.8.3 Drive Control Word (FC Profile)

Table 36: 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

Coil	0	1
13	Reserved	
14	Set up LSB	
15	Reserved	
16	No reversing	Reversing

6.1.6.3.8.4 Drive Status Word (FC Profile)

Table 37: 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 alarm	Alarm
37	Not used	Not used
38	Not used	Not used
39	Not used	Not used
40	No warning	Warning
41	Not at reference	At reference
42	Hand mode	Auto 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

6.1.6.3.8.5 Address/Registers

Table 38: Address/Registers

Bus address	Bus register ⁽¹⁾	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	–	–

Bus address	Bus register ⁽¹⁾	PLC register	Content	Access	Description
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.

6.1.6.4 How to Access Parameters

6.1.6.4.1 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 $(10 * \text{parameter number} - 1)$ decimal.

Examples

Reading *P 5.5.3.13 Freeze Up/Down Step Delta* (16 bit): The parameter number is 312, and the register address is 3119 holding the parameter's 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 number 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.

6.1.6.4.2 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).

6.1.6.4.3 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.

6.1.6.4.4 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.

6.1.6.4.5 Conversion Factor

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

6.1.6.4.6 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).

6.1.6.5 Examples

6.1.6.5.1 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 39: 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 40: 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)	–

N O T I C E

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

6.1.6.5.2 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 41: 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 – (<i>P 5.5.3.3 Reference Maximum</i> 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 42: 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)	–

6.1.6.5.3 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 43: Query

Field name	Example (hex)
Follower address	01 (drive address)
Function	05 (write single coil)

Field name	Example (hex)
Coil address HI	00
Coil address LO	40 (64 decimal) Coil 65
Force data HI	FF
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 44: 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)	–

6.1.6.5.4 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 45: 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 46: 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)	–

6.1.6.5.5 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 47: 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 48: Response

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

Field name	Example (hex)
Starting address LO	19
Number of registers HI	00
Number of registers LO	02
Error check (CRC)	–

6.1.6.5.6 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.

N O T I C E

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

Table 49: 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 50: 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)

Field name	Example (hex)
Quantity of coils HI	00
Quantity of coils LO	10 (16 coils)
Error check (CRC)	-

6.1.7 Danfoss FC Control Profile

6.1.7.1 Control Word According to FC Profile

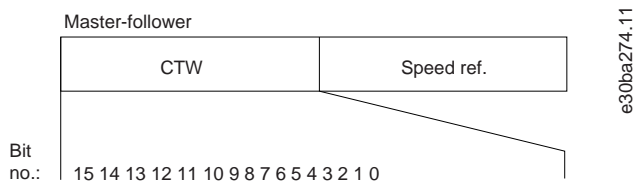


Illustration 63: Control Word According to FC Profile

Table 51: 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 set-up	Selection lsb
14	Reserved	Reserved
15	No function	Reverse

6.1.7.2 Explanation of control word bit

6.1.7.2.1 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 52: Control Bits

Programmed reference value	Parameter	Bit 01	Bit 00
1	<i>P 5.5.3.10 Preset Reference [0]</i>	0	0
2	<i>P 5.5.3.10 Preset Reference [1]</i>	0	1
3	<i>P 5.5.3.10 Preset Reference [2]</i>	1	0
4	<i>P 5.5.3.10 Preset Reference [3]</i>	1	1

N O T I C E

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

6.1.7.2.2 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.

6.1.7.2.3 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.

6.1.7.2.4 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*).

6.1.7.2.5 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*).

N O T I C E

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*).

6.1.7.2.6 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.

6.1.7.2.7 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.

6.1.7.2.8 Bit 08, Jog

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

6.1.7.2.9 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 (*P 5.5.4.2 Ramp 2 Ramp Up Time* to *P 5.5.4.3 Ramp 2 Ramp Down Time*) is active.

6.1.7.2.10 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.

6.1.7.2.11 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.

6.1.7.2.12 Bit 13, Set-up Selection

Use bit 13 to select from the 2 set-ups 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 53: Set-up 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.

6.1.7.2.13 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.

6.1.7.2.14 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.

6.1.7.3 Status Word According to FC Profile (STW)

Set P 10.1.1 Protocol to [0] FC.

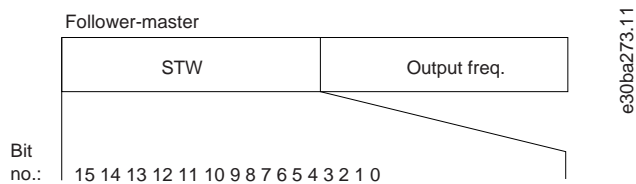


Illustration 64: Status Word

Table 54: 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)

Bit	Bit = 0	Bit = 1
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

6.1.7.4 Explanation of Status Word Bit

6.1.7.4.1 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).

6.1.7.4.2 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.

6.1.7.4.3 Bit 02, Coast Stop

Bit 02=0: The drive releases the motor.

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

6.1.7.4.4 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].

6.1.7.4.5 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.

6.1.7.4.6 Bit 05, Not Used

Bit 05 is not used in the status word.

6.1.7.4.7 Bit 06, No Error/Triplock

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

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

6.1.7.4.8 Bit 07, No Warning/Warning

Bit 07=0: There are no warnings.

Bit 07=1: A warning has occurred.

6.1.7.4.9 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.

6.1.7.4.10 Bit 09, Local Operation/Bus Control

Bit 09=0: [Off/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.

6.1.7.4.11 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.

6.1.7.4.12 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.

6.1.7.4.13 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.

6.1.7.4.14 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.

6.1.7.4.15 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.

6.1.7.4.16 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%.

6.1.7.5 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.

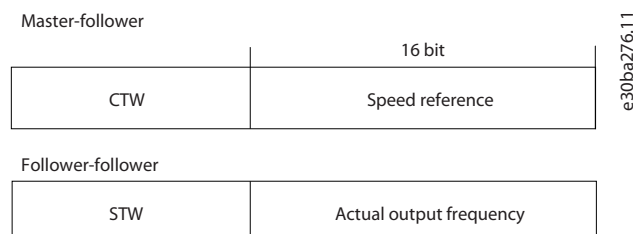


Illustration 65: Actual Output Frequency (MAV)

The reference and MAV are scaled as follows:

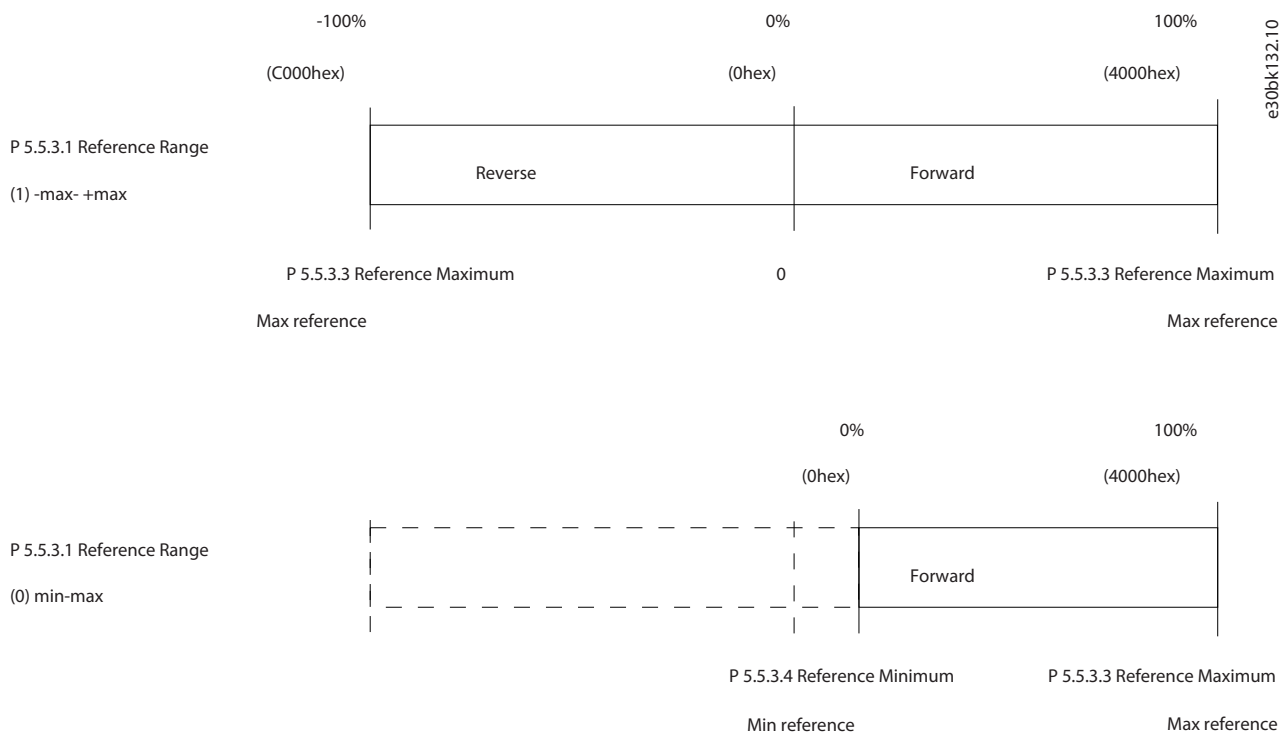


Illustration 66: Reference and MAV

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 55: 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 56: 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 [6.1.6.3.5 Function Field](#).

Table 57: 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.
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.

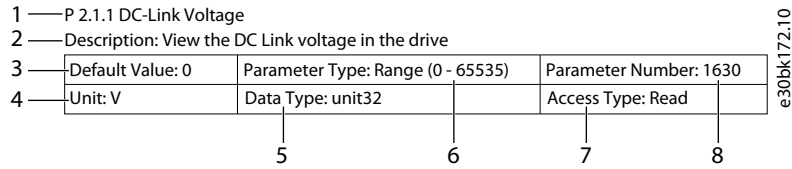


Illustration 67: Reading the Parameter Table

- 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 unit of the parameter.
- 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 access type of the parameter. See [7.1.3 Understanding Access Types](#).
- 8 indicates the unique parameter number which is relevant for modbus registers. See [6.1.5.1.8 Parameter Number \(PNU\)](#) and [6.1.6.4.1 Parameter Handling](#).

7.1.1 Understanding Parameter Types

Following are the different type of parameter information.

Table 58: 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, the user can set any value 0–255, for the parameter.

7.1.2 Understanding Data Types

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

Table 59: 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 type of parameters and descriptions.

Table 60: 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

Description: 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
0	International: Default value of P 4.2.2.4 <i>Nominal Frequency</i> is set to 50 Hz.
1	North America: Default value of P 4.2.2.4 <i>Nominal Frequency</i> is set to 60 Hz.

P 1.2.2 Grid Type

Description: 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 name	Selection description
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
22	440-480V/50Hz
100	200-240V/60Hz/IT-grid
101	200-240V/60Hz/Delta

Selection name	Selection description
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

Description: Select an action of frequency converter 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 and 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 <i>Fast Mains Phase Loss Level</i> and P 2.3.10 <i>Fast Mains Phase Loss Min Power</i> .
5	Fast Warning: Enable the fast detection to issue a warning. The option is related to P 2.3.9 <i>Fast Mains Phase Loss Level</i> and P 2.3.10 <i>Fast Mains Phase Loss Min Power</i> .

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

7.3.1 Status (Menu Index 2.1)

P 2.1.1 DC-Link Voltage

Description: 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

Description: 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

Description: 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 %

Description: 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

Description: 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

7.3.2 Protection (Menu Index 2.3)

P 2.3.1 Overvoltage Controller Enable

Description: 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 [Disable]	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 and description
0	Disabled: No OVC required.
1	Enabled (not at stop): Activate OVC except when using a stop signal to stop the frequency converter.
2	<p>Enable: Activate OVC.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>⚠ CAUTION ⚠</p> <p>PERSONAL INJURY AND EQUIPMENT DAMAGE</p> <p>Enabling OVC in hoisting applications may lead to personal injuries and equipment damage</p> <ul style="list-style-type: none"> - DO NOT enable OVC in hoisting applications. </div>

P 2.3.2 Overvoltage Controller Kp

Description: 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 (0–500)	Parameter Number: 219
Unit: %	Data Type: uint16	Access Type: Read/Write

P 2.3.6 Power Loss Action

Description: 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 and 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 <i>Power Loss Controller Limit</i> . The ramp follows the setting in P 5.7.7 <i>Quick Stop Ramp Time</i> . 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] <i>Ctrl. ramp-down</i> , except that in [2] <i>Ctrl. ramp-down</i> , 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.
4	<p>Kinetic Back-up: Kinetic back-up 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.</p> <p>The DC-level during [4] <i>Kinetic backup</i> is P 2.3.7 <i>Power Loss Controller Limit</i> 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 back-up, UDC increases above P 2.3.7 <i>Power Loss Controller Limit</i> x 1.35. This is detected in 1 of the following ways:</p> <ul style="list-style-type: none"> • If $U_{DC} > P\ 2.3.7\ \text{Power Loss Controller Limit} \times 1.35 \times 1.05$ • 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 <i>Power Loss Controller Limit</i> x 1.35 x 1.02. This does not fulfill the criterion above, and the frequency converter tries to reduce UDC to P 2.3.7 <i>Power Loss Controller Limit</i> 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 prevents 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 above situation occurs. Instead of waiting for that, the present criterion is introduced.

Selection number	Selection name and description
5	Kinetic Back-up, Trip: The difference between kinetic back-up with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains 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
7	Kin. Back-up, Trip with Recovery: Kinetic back-up with recovery combines the features of kinetic back-up and kinetic back-up with trip. This feature makes it possible to select between kinetic back-up and kinetic back-up with trip based on a recovery speed, which is configurable in <i>P 2.3.8 Kin. Back-up Trip Recovery Level</i> to enable detection of mains returning. If the mains do not return, the frequency converter ramps down to 0 RPM and trips. If mains return while kinetic back-up is at a speed above the value set in <i>P 2.3.8 Kin. Back-up Trip Recovery Level</i> , normal operation is resumed. This is equal to [4] <i>Kinetic Back-up</i> . The DC level during [7] <i>Kinetic back-up</i> is <i>P 2.3.7 Power Loss Controller Limit</i> x 1.35. If mains return while kinetic back-up is at a speed below <i>P 2.3.8 Kin. Back-up Trip Recovery Level</i> , the frequency converter ramps down to 0 RPM using the ramp and then trips.

P 2.3.7 Power Loss Controller Limit

Description: 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. Back-up Trip Recovery Level

Description: Enter the kinetic back-up 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

Description: 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

Description: 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

Description: Protective function against overvoltage at coast in 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

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

P 2.3.14 Max Output Frequency

Description: 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

N O T I C E

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

Description: 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

Selection number	Selection name
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

Description: 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

Description: 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 heatsink 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

Description: 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

Description: 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

Description: 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.

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 and 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	<p>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 (typical when running oversynchronously). The output voltage is increased according to the degree of overmodulation.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>NOTICE</p> <p>Overmodulation leads to increased torque ripple as harmonics are increased.</p> </div>

7.3.4 DC-Link Control (Menu Index 2.5)

P 2.5.1 Damping Gain Factor

Description: 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

Description: 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 %

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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* .

N O T I C E

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. The parameter *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

Description: View the motor current measured as a mean value, Irms.

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

Description: 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

Description: Motor power consumption in kW. 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: 1610
Unit: kW	Data Type: uint32	Access Type: Read

P 4.1.4 Motor Power Hp

Description: Motor power consumption in kW. 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

Description: View the calculated motor temperature in percentage of allowed maximum. At 100% a trip will occur, 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

Description: 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 %

Description: 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

Description: 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

Description: 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 %

Description: 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

Description: Select the motor type. Select [0] 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
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 <i>P 4.4.4.7 Damping Gain</i> to <i>P 4.4.4.10 Voltage filter time const.</i> 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

Description: 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 n_s 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:

$$P 4.2.2.4 \text{ Nominal Frequency} * 120 / P 4.2.2.5 \text{ Nominal Speed}$$

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

Description: 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
0	Off: No Function.
1	<p>Enable Complete AMA: Depending on the option selected in <i>P 4.2.1.1 Motor Type</i>, the AMA is performed on different parameters.</p> <ul style="list-style-type: none"> If <i>[0] Asynchron</i> is selected, the AMA is performed on: <i>P 4.2.3.1 Stator Resistance (Rs)</i>, <i>P 4.2.3.2 Rotor Resistance (Rr)</i>. <i>P 4.2.3.4 Stator Leakage Reactance (X1)</i>. <i>P 4.2.3.6 Main Reactance (Xh)</i>. If <i>[1] PM, non-salient SPM</i> is selected, the AMA is performed on: <i>P 4.2.3.1 Stator Resistance (Rs)</i>. <i>P 4.2.4.3 daxis Inductance (Ld)</i>. If <i>[3] PM, salient IPM</i> is selected, the AMA is performed on: <i>P 4.2.3.1 Stator Resistance (Rs)</i>. <i>P 4.2.4.3 daxis Inductance (Ld)</i>, <i>P 4.2.4.7 qaxis Inductance (Lq)</i>, <i>P 4.2.4.4 daxis Inductance Sat. (LdSat)</i>, <i>P 4.2.4.8 qaxis Inductance Sat. (LqSat)</i>.
2	<p>Enable Reduced AMA: Perform a reduced AMA of the stator resistance R_s. <i>P 4.2.3.1 Stator Resistance (Rs)</i> in the system only. (This option is only for asynchronous motors.). Perform AMA on cold motor.</p>

NOTICE

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

P 4.2.1.4 Motor Cable Length

Description: 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

Description: 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

Description: Set the nominal motor power from the motor nameplate data. **Note:** 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

Description: Set the nominal motor voltage from the motor nameplate data. **Note:** Changing this parameter affects 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

Description: Enter the nominal motor current value from the motor nameplate data. **Note:** 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

Description: Select the motor frequency value from the motor nameplate data. **Note:** Changing this parameter affects 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

Description: Enter the nominal motor speed value from the motor nameplate data. **Note:** Changing this parameter affects 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

Description: 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

Description: 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 X1

Description: 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 Main Reactance Xh

Description: 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

Description: 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

Description: 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

NOTICE

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

P 4.2.4.3 d-axis Inductance Ld

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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: 66	Parameter Type: Range (40 - 75)	Parameter Number: 1441
Unit: %	Data Type: uint8	Access Type: Read/Write

P 4.4.1.3 Torque Characteristic

Description: 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

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

P 4.4.1.4 Clockwise Direction

Description: 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

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

P 4.4.1.5 Motor Control Bandwidth

Description: Select type of motor control bandwidth.

Default Value: 1 [Medium]	Parameter Type: Selection	Parameter Number: 108
Unit: -	Data Type: enum	Access Type: Read/Write

Selection number	Selection name
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] <i>Adaptive 1</i> .

7.5.3.2 AC-Brake (Menu Index 4.4.2)

P 4.4.2.1 Enable AC Brake

Description: 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

Description: Enter the maximum allowed current when using 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 asynchronous motors.

P 4.4.2.3 AC Brake Voltage Control Kp

Description: 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. It equals 1.0 means that 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 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

Description: 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

Description: 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 below.

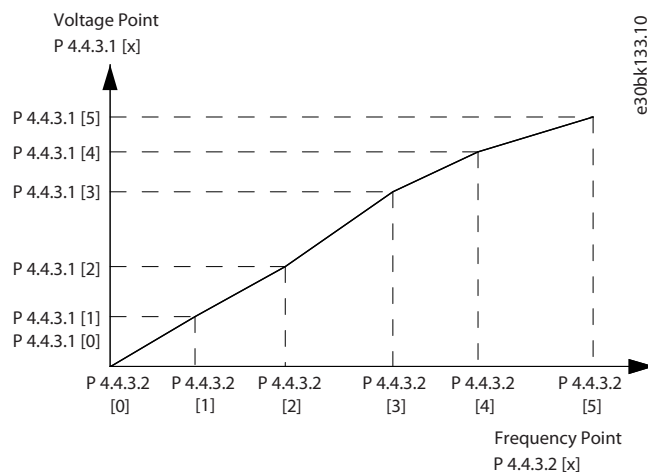


Illustration 68: Example of U/f Characteristic

7.5.3.4 Dependent Setting (Menu Index 4.4.4)

P 4.4.4.1 Slip Comp. Gain

Description: 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

Description: 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.

Description: 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.

Description: 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

Description: 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

Description: 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

Description: 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.

Description: 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.

Description: 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.

Description: 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

Description: 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

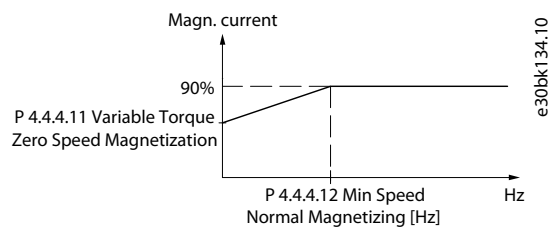


Illustration 69: Motor Magnetization

P 4.4.4.12 Min Speed Normal Magnetizing [Hz]

Description: 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

Description: 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

Description: 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

Description: Level of applied deadtime compensation in percentage. A high level (>90%) optimizes the dynamic motor response, a level from 50–90% good for both motor-torque-ripple minimization and the motor dynamics, a zero level turns off the deadtime 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

Description: Set a bias signal (in [%]) to add to the current-sense signal for deadtime 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

Description: 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

Selection number	Selection name
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

Description: Deadtime 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

Description: 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

Description: 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

Description: 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

Description: 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.

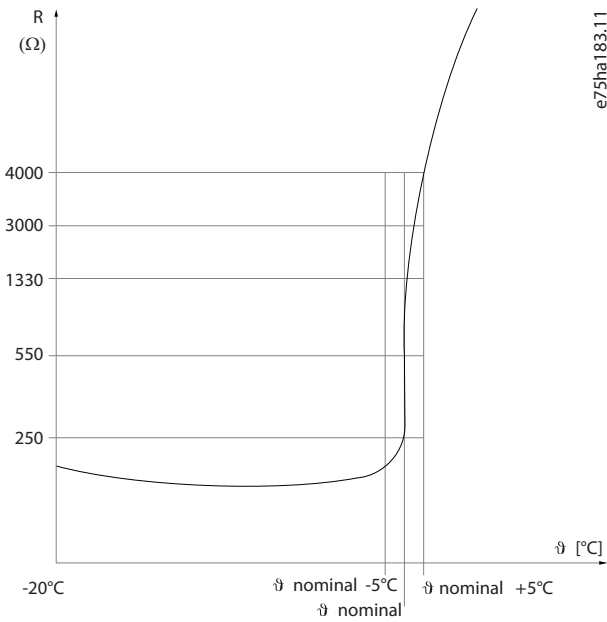
Default Value: 0.00	Parameter Type: Range (Size Related)	Parameter Number: 450
Unit: A	Data Type: uint32	Access Type: Read/Write

P 4.6.7 Motor Thermal Protection

Description: 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
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 $>3 \text{ k}\Omega$. Integrate a thermistor (PTC sensor) in the motor for winding protection.
3	ETR Warning 1: Calculates the load and activates a warning in the display when the motor is overloaded. Program a warning signal via 1 of the digital outputs.
4	ETR Trip 1: Calculates the load and stops (trips) the 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

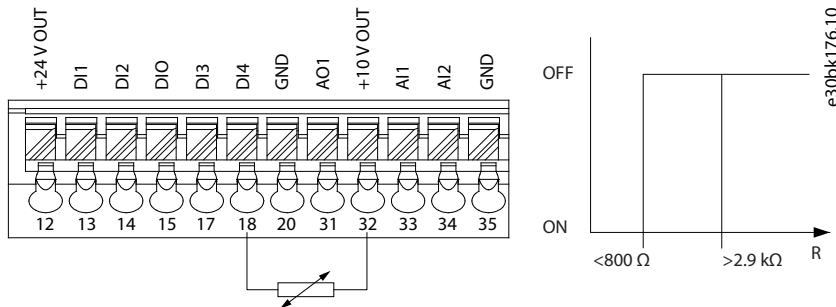


e75ha183.11

Illustration 70: 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.

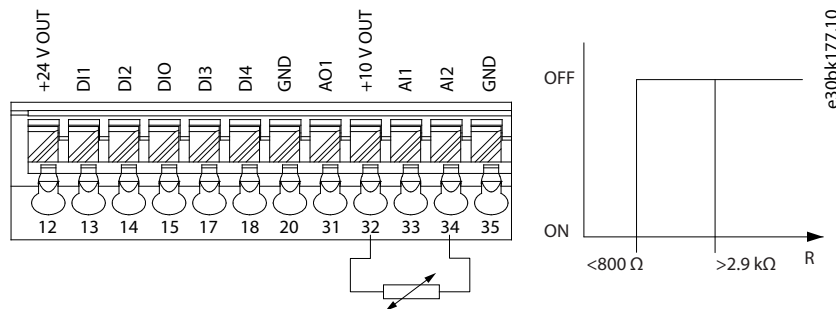


e30bk176.10

Illustration 71: 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.



e30bk177.10

Illustration 72: PTC Thermistor Connection - Analog Input

Table 61: Threshold Cut Out Values

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

N O T I C E

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

P 4.6.8 Thermistor Source

Description: 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

N O T I C E

Set the digital input to [0] PNP - Active at 24V in Digital Input Mode.

P 4.6.9 Motor External Fan

Description: 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
0	No: 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

Description: Select [1] Trip 10s, 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 10s 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
0	Off: No alarm is shown if a missing motor phase occurs.
1	Trip 10 s : An alarm is shown if a missing motor phase occurs.

P 4.6.13 Fault Level

Description: 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
3	Trip Lock: Alarm is set to trip lock.
4	Trip with Delayed Reset: Alarm is configured into trip alarm, 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 alarm. This option uses the 8th element to control the fault level of fault 13, Overcurrent.
5	Fly start: At start-up, the frequency converter tries to catch a spinning motor. If this option is selected, P 5.6.3 <i>Enable Flying Start</i> is forced to [1] <i>Enabled</i> . This option uses the 8th element to control the fault level of fault 13, Overcurrent.

Table 62: Selection of Action when Selected Alarm Appears

Index	Alarm	Trip lock	Trip with delay	Fly start
0	Reserved	-	-	-
1	Reserved	-	-	-
2	Reserved	-	-	-
3	Reserved	-	-	-
4	Reserved	-	-	-
5	Reserved	-	-	-
6	Reserved	-	-	-
7	Overcurrent	D	X	X

D indicates Default Setting and X indicates Possible Selection.

P 4.6.14 Sync. Locked Rotor Protection

Description: 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
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]

Description: 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

Description: 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

Description: 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

Description: Use this parameter to view fault word 3 in hex code.

Default Value: 0	Parameter Type: Range (0–4294967295)	Parameter Number: 1697
Unit: -	Data Type: uint32	Access Type: Read

P 5.1.4 Warning Word 1

Description: Use this parameter to view 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

Description: Use this parameter to view 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

Description: Use this parameter to view 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

Description: Use this parameter to view the control word sent from the frequency converter 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

Description: Use this parameter to view the status word sent from the frequency converter 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

Description: 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

Description: 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 5.1.16 Reference [Unit]

Description: Use this parameter to view the present value of reference applied in the frequency converter resulting from the choice of 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 [%]

Description: 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

Description: 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 [%]

Description: Use this parameter to view the Main Actual Value sent from the frequency converter via bus.

Default Value: 0.00	Parameter Type: Range (-200.00 - 200.00)	Parameter Number: 1605
Unit: %	Data Type: int16	Access Type: Read

P 5.1.26 FC Port CTW 1

Description: Use this parameter to view the two-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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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
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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Selection number	Selection name
22	Multi Speed Control Mode
23	Three Wire Control Mode
24	Torque Control Mode

P 5.4.2 Operation Mode

Description: 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
0	Speed Open Loop: Enable speed control (without feedback signal from 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

Description: Use this parameter to select U/f mode or VVC+ mode as 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
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.

N O T I C E

When P 4.2.1.1 Motor Type is set to PM enabled options, only VVC+ option is available.

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

Description: 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
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

Description: 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

Description: 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

Description: 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

Description: Select 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
0	Resume: Restart the frequency converter, maintaining the start or stop settings using <i>START</i> or <i>STOP</i> 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 <i>START</i> .
2	Forced Stop, Ref.=0: Reset the local reference to 0 upon restarting the frequency converter.

P 5.5.1.15 [REM/LOC] Button

Description: 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 [Off/Reset] Button

Description: Use this parameter to select the function of the Off/Reset button. To avoid accidental stop or reset of the drive from control panel, select *Disabled* [0]. 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

Description: Use this parameter to select whether the coasting function is controlled via the terminals (digital input) and/or via the bus.

N O T I C E

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 and descriptions
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

Description: Use this parameter to select whether the Quick Stop function is controlled via the terminals (digital input) and/or via the bus.

N O T I C E

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 and descriptions
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

Description: Use this parameter to select whether the DC brake is controlled via the terminals (digital input) and/or via the fieldbus.

N O T I C E

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 and descriptions
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

Description: 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 and descriptions
0	Digital input: A digital input triggers the start function.
1	Bus: A serial communication port or the fieldbus triggers the start function.
2	Logic AND: The fieldbus/serial communication port and a digital input trigger the start function.
3	Logic OR: The fieldbus/serial communication port or a digital input triggers the start function.

P 5.5.2.5 Reversing Select

Description: Use this parameter to select whether the drive reverse function is controlled via the terminals (digital input) and/or via the fieldbus.

N O T I C E

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 and descriptions
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

Description: Use this parameter to select whether the drive setup selection is controlled via the terminals (digital input) and/or via the fieldbus.

N O T I C E

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 and descriptions
0	Digital input: A digital input triggers the setup selection.
1	Bus: A serial communication port or the fieldbus triggers the setup selection.
2	Logic AND: The fieldbus/serial communication port and a digital input trigger the setup selection.
3	Logic OR: The fieldbus/serial communication port or a digital input triggers the setup selection.

P 5.5.2.7 Preset Reference Select

Description: Use this parameter to select whether the drive Preset Reference selection is controlled via the terminals (digital input) and/or via the fieldbus.

N O T I C E

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 and descriptions
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

Description: 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 and descriptions
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 <i>P 5.8.1 Rotation Direction</i> .

P 5.5.3.2 Reference/Feedback Unit

Description: 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	m ³ /s
24	m ³ /min
25	m ³ /h
30	kg/s
31	kg/min
32	kg/h
33	t/min

Selection number	Selection name
34	t/h
40	m/s
41	m/min
45	m
60	°C
70	mbar
71	bar
72	Pa
73	kPa
74	m WG
80	kW
120	GPM
121	gal/s
122	gal/min
123	gal/h
124	CFM
125	ft ³ /s
126	ft ³ /min
127	ft ³ /h
130	lb/s
131	lb/min
132	lb/h
140	ft/s
141	ft/min
145	ft
150	lb ft
160	°F
170	psi
171	lb/in ²
172	in WG
173	ft WG
180	HP

P 5.5.3.3 Reference Maximum

Description: 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

Description: 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

Description: 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 and descriptions
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

Description: Use this parameter to select which reference site to activate. To use the local reference in Hand mode, or the remote reference in Auto mode, select [0] Linked to Loc / Rem. To use the same reference in both Hand and Auto 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

Description: 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
21	Potentiometer

P 5.5.3.8 Reference 2 Source

Description: 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
21	Potentiometer

P 5.5.3.9 Reference 3 Source

Description: 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
21	Potentiometer

P 5.5.3.10 Preset Reference

Description: 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

Description: 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

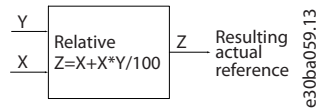


Illustration 73: Preset Relative Reference

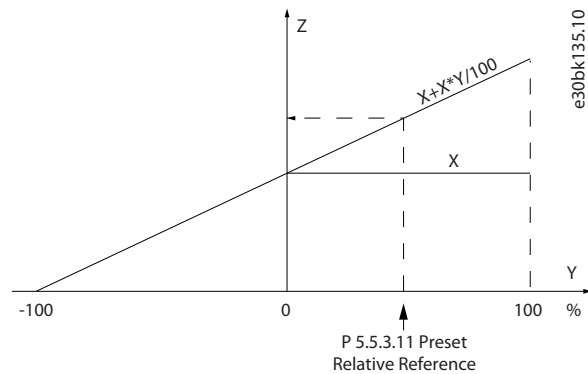


Illustration 74: Actual Reference

P 5.5.3.12 Relative Scaling Reference Resource

Description: 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

Description: 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 5.5.3.20 Enable Potentiometer

Description: 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

Description: 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 provides 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
0	Linear
1	Sine Ramp
2	Sine 2 Ramp: Only be used with speed control mode) S-ramp based on the values set in <i>P 5.5.4.2 Ramp 1 Accel. Time</i> and <i>P 5.5.4.3 Ramp 1 Decel. Time</i> .

P 5.5.4.2 Ramp 1 Accel. Time

Description: 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

Description: 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

Description: 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 provides 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
0	Linear
1	Sine Ramp
2	Sine 2 Ramp: Only be used with speed control mode) 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

P 5.5.4.9 Ramp 2 Accel. Time

Description: 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

Description: 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

Description: 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 (0.0–10.0)	Parameter Number: 171
Unit: s	Data Type: uint8	Access Type: Read/Write

P 5.6.2 Start Function

Description: Use this parameter to select the start function during start delay, in case 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 and descriptions
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 brake current (P 5.7.4 DC Brake Current %) during the start delay time.

Selection number	Selection name and descriptions
2	Coast/delay time: Motor 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 <i>P 5.6.4 Start Speed [Hz]</i> and the output current corresponds to the setting of the start current in <i>P 5.6.5 Start Current</i> . 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 <i>P 5.6.4 Start Speed [Hz]</i> and <i>P 5.6.5 Start Current</i> during the start delay time. The motor rotates in the reference direction. If the reference signal equals 0, <i>P 5.6.4 Start Speed [Hz]</i> is ignored and the output speed equals 0. The output current corresponds to the setting of the start current in <i>P 5.6.5 Start Current</i> .
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

Description: 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
0	Disabled: No function.
1	Enabled: Enable the frequency converter to catch and control a spinning motor. When <i>P 5.6.3 Enable Flying Start</i> is enabled, <i>P 5.6.1 Start Zero Speed Time</i> , and <i>P 5.6.2 Start Function</i> 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]

Description: 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

Description: 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

Description: 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]

Description: 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 possible 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

Description: 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 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 5.6.11 Sync. Motor Start Mode

Description: Use this parameter to select the motor start-up 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
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

Selection number	Selection name
	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 rotor at stop and starts the motor directly without rotor detection and angle calculation. When in the situation of 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 %

Description: 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

Description: 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 %

Description: 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]

Description: 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 [%]

Description: 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

Description: 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 and descriptions
0	Coast: Leaves the motor in free mode
1	DC Hold/Motor Preheat: Energizes the motor with a DC-hold current (see <i>P 5.7.6 DC Hold Current %</i>).
3	<p>Pre-magnetizing: Builds up a magnetic field while the motor is stopped. This allows the motor to produce torque quickly at commands (asynchronous 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:</p> <p>Solution 1:</p> <ul style="list-style-type: none"> 1. Start the frequency converter with a 0 RPM reference. 2. Wait 2–4 rotor time constants (see the formula below) before increasing the speed reference. <p>Solution 2:</p> <ul style="list-style-type: none"> 1. Set <i>P 5.6.1 Start Zero Speed Time</i> to the premagnetize time (2–4 rotor time constants). 2. Set <i>P 5.6.2 Start Function</i> to [0] DC hold. 3. Set the DC hold current magnitude (<i>P 5.7.6 DC Hold Current %</i>) to be equal to $I_{pre-mag} = \frac{U_{nom}}{1.73 \times X_h}$. <p>Sample rotor time constants = $(X_h + X_2) / (6.3 \times Freq_{nom} \times R_r)$ 1 kW = 0.2 s 10 kW = 0.5 s 100 kW = 1.7 s.</p>
10	Coast With Stop at Low Reference: When a stop command is given, or a start command is removed, and the reference is below <i>P 5.7.2 Min Speed for Function at Stop [Hz]</i> , 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 <i>P 5.7.2 Min Speed for Function at Stop [Hz]</i> , energizes the motor with a DC-hold current (see <i>P 5.7.6 DC Hold Current %</i>).

P 5.7.2 Min Speed for Function at Stop [Hz]

Description: 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

Description: 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 %

Description: 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

Description: 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 %

Description: 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 pre-heats 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

N O T I C E

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

P 5.7.7 Quick Stop Ramp Time

Description: 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

Description: 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
0	Clockwise: Only operation in 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]

Description: 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]

Description: 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 5.8.8 Torque Limit Mode Speed Ctrl

Description: 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

Description: Some systems call for avoiding certain output speeds due to resonance problems in the system. 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

Description: Some systems call for avoiding certain output speeds due to resonance problems in the system. 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

Description: 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

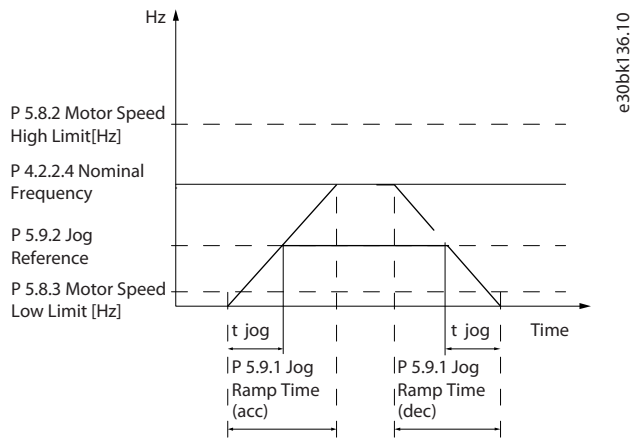


Illustration 75: Jog Ramp Time

P 5.9.2 Jog Reference

Description: 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

Description: 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

Description: 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.

Description: 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

Selection number	Selection name
4	Analog in 33 inverted
6	Analog in 34
8	Analog in 34 inverted

P 5.10.4 Torque PID Proportional Gain

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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 Inv. Max. Current*.

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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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 5.12.5.1 PID Proportional Gain

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

7.6.12 Fieldbus Process Data (Menu Index 5.27)

P 5.27.1 PCD Write Selection

Description: Use this parameter to select the parameters to be assigned to the PCD's telegrams. The number of available PCDs depends on the telegram type. The values in the PCDs are then written to the selected parameters as data values.

Enter up to 16 different preset mapping 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
2	Maximum Reference
3	Ramp 1 Ramp Up Time

Selection number	Selection name
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 Define1
82	User Define2
83	User Define3
84	User Define4
85	User Define5
86	User Define6
87	User Define7
88	User Define8

P 5.27.2 PCD Read Selection

Description: 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 mapping 0–15 in this parameter, using array programming. If this parameter is active, addresses 2910–2925 represent values of the 16 parameters. If this parameter is not active, addresses 2910 and 2911 are used as status word register and main actual value. Addresses 2912–2925 are reserved.

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
4	Control Word

Selection number	Selection name
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

Selection number	Selection name
54	External Status Word 2
55	Fault Word 3
56	Warning Word 3
81	User Define1
82	User Define2
83	User Define3
84	User Define4
85	User Define5
86	User Define6
87	User Define7
88	User Define8
100	Main Actual Value [N2]

7.7 Maintenance and Service (Menu Index 6)

7.7.1 Status (Menu Index 6.1)

P 6.1.1 Latest Fault Number

Description: 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

Description: 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

Description: 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

Description: 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's

Description: 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's

Description: 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's

Description: 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

Description: 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:

Table 63: Selections

Selection Number	Selection Name
0	Do Not Reset
1	Reset Counter

P 6.1.9 Reset Running Hours Counter

Description: 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:

Table 64: Selections

Selection Number	Selection Name
0	Do Not Reset
1	Reset Counter

P 6.1.10 Internal Fault Reason

Description: 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

Description: Use this parameter to view the time when the logged event occurred. Time is measured in seconds from drive start-up.

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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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	Description
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

Description: 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

Description: 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 RS485 when accessed by RS485.

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

Description: 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

Description: 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

Description: 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

N O T I C E

In automatic reset mode, the motor can start without a warning.

The following are the selections for the parameter:

Selection number	Selection name
0	Manual reset: Perform a reset via <i>Stop/Reset</i> 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

N O T I C E

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

Description: 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

N O T I C E

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

Description: 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

Description: 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

Description: 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
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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

P 8.1.1 Custom Readout

Description: 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

Description: 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:

Table 65: Selections

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
23	m ³ /s
24	m ³ /min
25	m ³ /h
30	kg/s
31	kg/min
32	kg/h
33	t/min
34	t/h
40	m/s
41	m/min
45	m
60	°C

Selection Number	Selection Name
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	ft ³ /h
140	ft/s
141	ft/min
160	°F
170	psi
171	lb/in ²
172	in WG
173	ft WG
180	HP

P 8.1.3 Custom Readout Min Value

Description: 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

Description: 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

7.9 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

Description: 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

Description: 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]

Description: 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

Description: 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 available selections.

Selection number	Selection name
0	Current mode
1	Voltage mode

P 9.3.5 T33 Analog Input

Description: 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

Description: 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 available selections.

Selection number	Selection name
0	Current mode
1	Voltage mode

P 9.3.7 T34 Analog Input

Description: 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]

Description: 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]

Description: 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

Description: 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

Description: For digital I/O: Select [0] PNP for action on positive directional pulses. PNP are pulled down to GND. Select [1] NPN systems for action on negative directional pulses. NPN are 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 available selections.

Selection number	Selection name
0	PNP: Action on positive directional pulses (0). PNP systems are pulled down to ground (GND).
1	NPN: Action on negative directional pulses (1). NPN systems are pulled up to +24 V internally in the frequency converter.

P 9.4.1.2 T13 Digital Input

Description: 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 available selections.

Selection number	Selection name	Description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/ alarm. Not all alarms 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 <i>Quick Stop Ramp Time</i> . 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 <i>DC Brake Current %</i> to P 5.7.5 <i>DC Brake Frequency</i> . The function is only active when the value in P 5.7.3 <i>DC Brake Time</i> 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 <i>Ramp 1 Decel. Time</i> , P 5.5.4.10 <i>Ramp 2 Decel. Time</i>). 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] <i>Torque limit</i> 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 <i>Rotation Direction</i> . 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 <i>Jog Reference 1</i> .
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that [1] <i>External/preset</i> has been selected in P 5.5.3.5 <i>Reference Function</i> . 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 66 .

Selection number	Selection name	Description
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
19	Freeze Reference	Freeze the actual reference, which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (P 5.5.4.9 <i>Ramp 2 Accel. Time</i> and P 5.5.4.10 <i>Ramp 2 Decel. Time</i>) in the range P 5.5.3.3 <i>Reference Maximum</i> .
20	Freeze Output	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (P 5.5.4.9 <i>Ramp 2 Accel. Time</i> and P 5.5.4.10 <i>Ramp 2 Decel. Time</i>) in the range 0–P 4.2.2.4 <i>Nominal Frequency</i> . Note: When [20] <i>Freeze output</i> is active, the frequency converter cannot be stopped by setting the signal on [8] <i>Start to low</i> . Stop the frequency converter via a terminal programmed for [2] <i>Coasting inverse</i> or [3] <i>Coast and reset, inverse</i> .
21	Speed Up	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . 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 <i>Ramp 2 Accel. Time</i> / P 5.5.4.10 <i>Ramp 2 Decel. Time</i>).
22	Speed Down	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . 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 <i>Ramp 2 Accel. Time</i> / P 5.5.4.10 <i>Ramp 2 Decel. Time</i>).
23	Set-up Select Bit 0	Select [23] <i>Set-up select bit 0</i> to select 1 of the 2 set-ups. Set P 6.6.1 <i>Active Set-up</i> to [9] <i>Multi Set-up</i> .
25	Start and Coast	Select [25] <i>Start and Coast</i> 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 <i>Freeze Up/Down Step Delta</i> . See Table 67 .
29	Slow Down	Reduce reference value by percentage (relative) set in P 5.5.3.13 <i>Freeze Up/Down Step Delta</i> . See Table 67 .
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 alarm.

Table 66: Preset Ref Bit

Preset ref. bit	2	1	0
Preset ref.0	0	0	0
Preset ref. 1	0	0	1

Preset ref. bit	2	1	0
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 67: 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

Description: 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 available selections.

Selection number	Selection name	Description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/ alarm. Not all alarms 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.
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.

Selection number	Selection name	Description
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 <i>P 5.8.1 Rotation Direction</i> . 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 <i>P 5.9.2 Jog Reference 1</i> .
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that [1] <i>External/preset</i> has been selected in <i>P 5.5.3.5 Reference Function</i> . 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 66 .
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
19	Freeze Reference	Freeze the actual reference, which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 5.5.3.3 Reference Maximum</i> .
20	Freeze Output	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 4.2.2.4 Nominal Frequency</i> . Note: When [20] <i>Freeze output</i> is active, the frequency converter cannot be stopped by setting the signal on [8] <i>Start to low</i> . Stop the frequency converter via a terminal programmed for [2] <i>Coasting inverse</i> or [3] <i>Coast and reset, inverse</i> .
21	Speed Up	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . 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 <i>P 5.5.4.9 Ramp 2 Accel. Time / P 5.5.4.10 Ramp 2 Decel. Time</i> . See Table 67 .
22	Speed Down	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . 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 <i>P 5.5.4.9 Ramp 2 Accel. Time / P 5.5.4.10 Ramp 2 Decel. Time</i> . See Table 67 .

Selection number	Selection name	Description
23	Set-up Select Bit 0	Select [23] <i>Set-up select bit 0</i> to select 1 of the 2 set-ups. Set <i>P 6.6.1 Active Set-up</i> to [9] <i>Multi Set-up</i> .
25	Start and Coast	Select [25] <i>Start and Coast</i> 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 <i>P 5.5.3.13 Freeze Up/Down Step Delta</i> . See Table 67 .
29	Slow Down	Reduce reference value by percentage (relative) set in <i>P 5.5.3.13 Freeze Up/Down Step Delta</i> . See Table 67 .
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 alarm.

P 9.4.1.4 T15 Digital Input

Description: 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 available selections.

Selection number	Selection name	Description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/ alarm. Not all alarms 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 <i>P 5.7.7 Quick Stop Ramp Time</i> . 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] <i>Torque limit</i> 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 <i>P 5.7.4 DC Brake Current %</i> to <i>P 5.7.5 DC Brake Frequency</i> . The function is only active when the value in <i>P 5.7.3 DC Brake Time</i> 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 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> , <i>P 5.5.4.10 Ramp 2 Decel. Time</i>).

Selection number	Selection name	Description
		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] <i>Torque limit</i> 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 <i>Rotation Direction</i> . 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 <i>Jog Reference 1</i> .
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that [1] <i>External/preset</i> has been selected in P 5.5.3.5 <i>Reference Function</i> . 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 66 .
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
19	Freeze Reference	Freeze the actual reference, which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (P 5.5.4.9 <i>Ramp 2 Accel. Time</i> and P 5.5.4.10 <i>Ramp 2 Decel. Time</i>) in the range 0– P 5.5.3.3 <i>Maximum Reference</i> .
20	Freeze Output	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (P 5.5.4.9 <i>Ramp 2 Accel. Time</i> and P 5.5.4.10 <i>Ramp 2 Decel. Time</i>) in the range 0–P 4.2.2.4 <i>Nominal Frequency</i> . Note: When [20] <i>Freeze output</i> is active, the frequency converter cannot be stopped by setting the signal on [8] <i>Start to low</i> . Stop the frequency converter via a terminal programmed for [2] <i>Coasting inverse</i> or [3] <i>Coast and reset, inverse</i> .
21	Speed Up	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . 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 <i>Ramp 2 Accel. Time</i> / P 5.5.4.10 <i>Ramp 2 Decel. Time</i> . See Table 67 .
22	Speed Down	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . When

Selection number	Selection name	Description
		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 <i>P 5.5.4.9 Ramp 2 Accel. Time / P 5.5.4.10 Ramp 2 Decel. Time</i> . See Table 67 .
23	Set-up Select Bit 0	Select <i>[23] Set-up select bit 0</i> to select 1 of the 2 set-ups. Set <i>P 6.6.1 Active Set-up</i> to <i>[9] Multi Set-up</i> .
25	Start and Coast	Select <i>[25] Start and Coast</i> 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 <i>P 5.5.3.13 Freeze Up/Down Step Delta</i> . See Table 67 .
29	Slow Down	Reduce reference value by percentage (relative) set in <i>P 5.5.3.13 Freeze Up/Down Step Delta</i> . See Table 67 .
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 alarm.

P 9.4.1.5 T17 Digital Input

Description: 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 available selections.

Selection number	Selection name	Description
0	No Operation	No reaction to signals transmitted to the terminal.
1	Reset	Resets the frequency converter after a trip/ alarm. Not all alarms 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 <i>P 5.7.7 Quick Stop Ramp Time</i> . 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 <i>[27] Torque limit</i> 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 <i>P 5.7.4 DC Brake Current %</i> to <i>P 5.7.5 DC Brake Frequency</i> . The function is only active when the value in <i>P 5.7.3 DC Brake Time</i> is different from 0. Logic 0⇒DC braking.

Selection number	Selection name	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 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>). 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] <i>Torque limit</i> 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 <i>P 5.8.1 Rotation Direction</i> . 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] <i>External/preset</i> has been selected in <i>P 5.5.3.5 Reference Function</i> . 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 66 .
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
19	Freeze Reference	Freeze the actual reference, which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 5.5.3.3 Reference Maximum</i> .
20	Freeze Output	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 4.2.2.4 Nominal Frequency</i> . Note: When [20] <i>Freeze output</i> is active, the frequency converter cannot be stopped by setting the signal on [8] <i>Start</i> to low. Stop the frequency converter via a terminal programmed for [2] <i>Coasting inverse</i> or [3] <i>Coast and reset, inverse</i> .
21	Speed Up	Select [21] <i>Speed up</i> and [22] <i>Speed down</i> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] <i>Freeze reference</i> or [20] <i>Freeze output</i> . When speed up/down is activated for less than 400 ms, the resulting reference is increased/decreased by

Selection number	Selection name	Description
		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 67 .
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 67 .
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 67 .
29	Slow Down	Reduce reference value by percentage (relative) set in P 5.5.3.13 Freeze Up/Down Step Delta. See Table 67 .
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 alarm.

P 9.4.1.6 T18 Digital Input

Description: 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 available.

Selection number	Selection name	Description
0	No Operation	Action on positive directional pulses (0). PNP systems are pulled down to ground (GND).
1	Reset	Resets the frequency converter after a trip/ alarm. Not all alarms 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.

Selection number	Selection name	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 <i>P 5.7.4 DC Brake Current %</i> to <i>P 5.7.5 DC Brake Frequency</i> . The function is only active when the value in <i>P 5.7.3 DC Brake Time</i> 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 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>). 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] <i>Torque limit</i> 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 <i>P 5.8.1 Rotation Direction</i> . 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 <i>P 5.9.2 Jog Reference 1</i> .
15	Preset Reference On	Shift between external reference and preset reference. It is assumed that [1] <i>External/preset</i> has been selected in <i>P 5.5.3.5 Reference Function</i> . 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 66 .
17	Preset Ref. Bit 1	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
18	Preset Ref. Bit 2	Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See Table 66 .
19	Freeze Reference	Freeze the actual reference, which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 5.5.3.3 Reference Maximum</i> .
20	Freeze Output	Freeze the actual motor frequency (Hz), which is now the point of enable/condition for [21] <i>Speed up</i> and [22] <i>Speed down</i> to be used. If [21] <i>Speed up</i> or [22] <i>Speed down</i> is used, the speed change always follows ramp 2 (<i>P 5.5.4.9 Ramp 2 Accel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>) in the range 0– <i>P 4.2.2.4 Nominal Frequency</i> . Note: When [20] <i>Freeze output</i> is active, the frequency converter cannot be stopped by setting the signal on [8] <i>Start</i> to low. Stop the frequency converter via a terminal programmed for [2] <i>Coasting inverse</i> or [3] <i>Coast and reset, inverse</i> .

Selection number	Selection name	Description
21	Speed Up	Select [21] Speed up and [22] Speed down if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either [19] Freeze reference or [20] Freeze output. When speed up/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 67 .
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 67 .
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 67 .
29	Slow Down	Reduce reference value by percentage (relative) set in P 5.5.3.13 Freeze Up/Down Step Delta. See Table 67 .
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 alarm.
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.

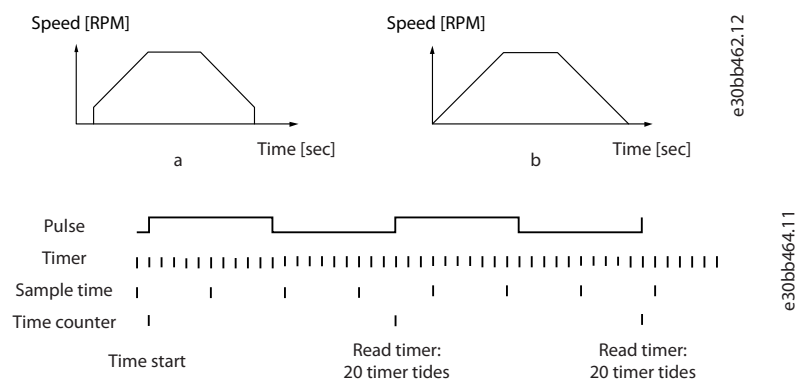


Illustration 76: Duration between Pulse Flanks

7.9.2.2 T15 as Digital Output (Menu Index 9.4.2)

P 9.4.2.1 T15 Mode

Description: 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 available selections.

Selection number	Selection name	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

Description: 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 available selections.

Table 68: Selections

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 auto-on mode.
4	Stand-by / No Warning	Ready for operation. No start or stop command is given (start/disable). No warnings are active.
5	Running	The motor is running and shaft torque is present.
6	Running / No Warning	The motor is running and there are no warnings.
7	Run in Range / No Warning	The motor is running within the programmed current and speed ranges set in <i>P 4.6.4 Warning Current Low</i> to <i>P 4.6.3 Warning Current High</i> . 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 <i>P 5.10.1 Motor Torque Limit</i> or <i>P 5.10.2 Regenerative Torque Limit</i> has been exceeded.
12	Out of Current Range	The motor current is outside the range set in <i>P 2.7.1 Output Current Limit %</i> .
13	Below Current, Low	The motor current is lower than set in <i>P 4.6.4 Warning Current Low</i> .
14	Above Current, High	The motor current is higher than set in <i>P 4.6.3 Warning Current High</i> .
15	Out of Frequency Range	Output frequency is outside the frequency range.
16	Below Frequency, Low	The output speed is lower than the setting in <i>P 4.6.2 Warning Freq. Low</i> .

Selection number	Selection name	Selection description
17	Above Frequency, High	The output speed is higher than the setting in <i>P 4.6.1 Warning Freq. High</i> .
18	Out of Feedback Range	The feedback is outside the range set in <i>P 5.2.4 Warning Feedback Low</i> and <i>P 5.2.3 Warning Feedback High</i> .
19	Below Feedback, Low	The feedback is below the limit set in <i>P 5.2.4 Warning Feedback Low</i> .
20	Above Feedback, High	The feedback is above the limit set in <i>P 5.2.3 Warning Feedback High</i> .
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 auto-on 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	
37	Control Word Bit 12	
40	Out of Ref. Range	This option is active when the actual speed is outside the settings in <i>P 5.2.2 Warning Reference Low</i> to <i>P 5.2.1 Warning Reference High</i> .
41	Below Reference, Low	This option is active when the actual speed is below the speed reference setting.
42	Above Reference, 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 <i>P 9.4.6.1 Digital & Relay Bus Control</i> . 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 <i>P 9.4.6.1 Digital & Relay Bus Control</i> . When bus timeout occurs, the output state is set high (On).
47	Bus Control, Timeout: Off	
55	Pulse Output	
56	Heat Sink Cleaning Warning, High	

Selection number	Selection name	Selection description
160	No Fault	The output is high when no alarm 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	
166	Remote Ref. Active	
167	Start Command Active	
168	Drive in Local Mode	
169	Drive in Remote Mode	
194	Lost Load Function	A lost-load condition is detected.

P 9.4.2.3 T15 DO ON-Delay

Description: 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

Description: 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 9.4.3.1)

P 9.4.3.1 Function Relay

Description: 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 available selections.

Table 69: Selections

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 auto-on mode.
4	Stand-by / No Warning	Ready for operation. No start or stop command is given (start/disable). No warnings are active.
5	Running	The motor is running and shaft torque is present.

Selection number	Selection name	Selection description
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 <i>P 4.6.4 Warning Current Low</i> to <i>P 4.6.3 Warning Current High</i> . 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 <i>P 5.10.1 Motor Torque Limit</i> or <i>P 5.10.2 Regenerative Torque Limit</i> has been exceeded.
12	Out of Current Range	The motor current is outside the range set in <i>P 2.7.1 Output Current Limit %</i> .
13	Below Current, Low	The motor current is lower than set in <i>P 4.6.4 Warning Current Low</i> .
14	Above Current, High	The motor current is higher than set in <i>P 4.6.3 Warning Current High</i> .
15	Out of Frequency Range	Output frequency is outside the frequency range.
16	Below Frequency, Low	The output speed is lower than the setting in <i>P 4.6.2 Warning Freq. Low</i> .
17	Above Frequency, High	The output speed is higher than the setting in <i>P 4.6.1 Warning Freq. High</i> .
18	Out of Feedback Range	The feedback is outside the range set in <i>P 5.2.4 Warning Feedback Low</i> and <i>P 5.2.3 Warning Feedback High</i> .
19	Below Feedback, Low	The feedback is below the limit set in <i>P 5.2.4 Warning Feedback Low</i> .
20	Above Feedback, High	The feedback is above the limit set in <i>P 5.2.3 Warning Feedback High</i> .
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 auto-on 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.

Selection number	Selection name	Selection description
36	Control Word Bit 11	
37	Control Word Bit 12	
40	Out of Ref. Range	This option is active when the actual speed is outside the settings in <i>P 5.2.2 Warning Reference Low</i> to <i>P 5.2.1 Warning Reference High</i> .
41	Below Reference, Low	This option is active when the actual speed is below the speed reference setting.
42	Above Reference, 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 <i>P 9.4.6.1 Digital & Relay Bus Control</i> . 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 <i>P 9.4.6.1 Digital & Relay Bus Control</i> . When bus timeout occurs, the output state is set high (On).
47	Bus Control, Timeout: Off	
55	Pulse Output	
56	Heat Sink Cleaning Warning, High	
160	No Fault	The output is high when no alarm 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	
166	Remote Ref. Active	
167	Start Command Active	
168	Drive in Local Mode	
169	Drive in Remote Mode	
194	Lost Load Function	A lost-load condition is detected.

P 9.4.3.2 Relay ON-Delay

Description: 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

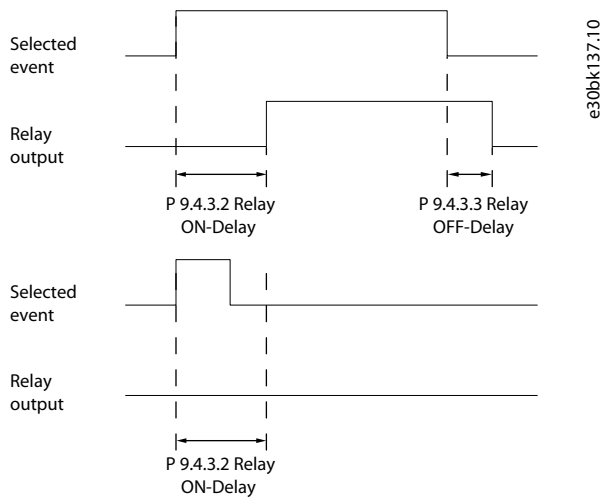


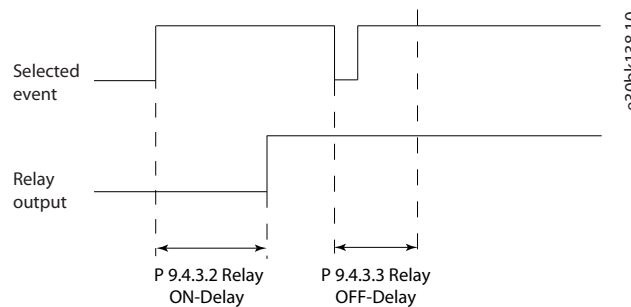
Illustration 77: On Delay, Relay

P 9.4.3.3 Relay OFF-Delay

Description: 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

Illustration 78: 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.

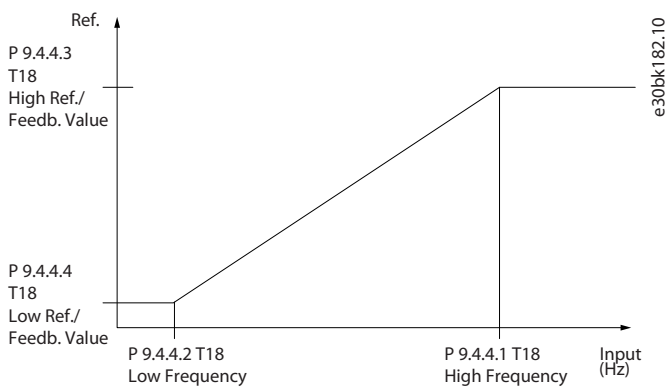


Illustration 79: Pulse Input

P 9.4.4.1 T18 High Frequency

Description: 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

Description: 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

Description: 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

Description: 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

7.9.2.5 T15 as Pulse Output (Menu Index 9.4.5)

P 9.4.5.1 T15 Pulse Output Variable

Description: 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 available selections.

Table 70: Selections

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

Selection number	Selection name
107	Speed
109	Max Out Frequency
113	PID Clamped Output

P 9.4.5.2 T15 Pulse Output Max. Freq

Description: 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

Description: 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 71: Bit Description

Bit	Bit Name
Bit 0	Digital Output Terminal 15
Bit 1-3	Reserved
Bit 4	Relay 1 Output Terminal
Bit 6-23	Reserved
Bit 24	Reserved
Bit 26-31	Reserved

P 9.4.6.2 T15 Pulse Out Bus Control

Description: 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

Description: 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

Description: 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 available selections.

Table 72: Selections

Selection Number	Selection Name
0	0-20 mA
1	4-20 mA

P 9.5.1.2 T31 Analog Output

Description: 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 available selections.

Table 73: Selections and Description

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
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

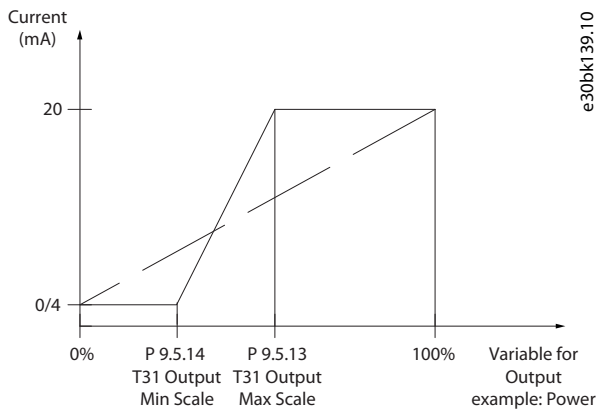


Illustration 80: Output Scale versus Current

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

Description: 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

Description: 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 available selections.

Table 74: Selections

Selection Number	Selection Name
0	Current Mode
1	Voltage Mode

P 9.5.2.2 T33 High Voltage

Description: 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

Description: 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 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: 610
Unit: V	Data Type: uint16	Access Type: Read/Write

P 9.5.2.4 T33 High Current

Description: 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

Description: 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 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: 612
Unit: mA	Data Type: uint16	Access Type: Read/Write

P 9.5.2.6 T33 High Ref./Feedb. Value

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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 *Voltage/Current Dead Zone Scale*.
- Dead-zone band central point is the mid-value of 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.
- The following illustration is an example of using T33 analog input (voltage mode, from 2 V to 10 V) for dead-zone function to control motor running between the speed from -50 Hz to 50 Hz.

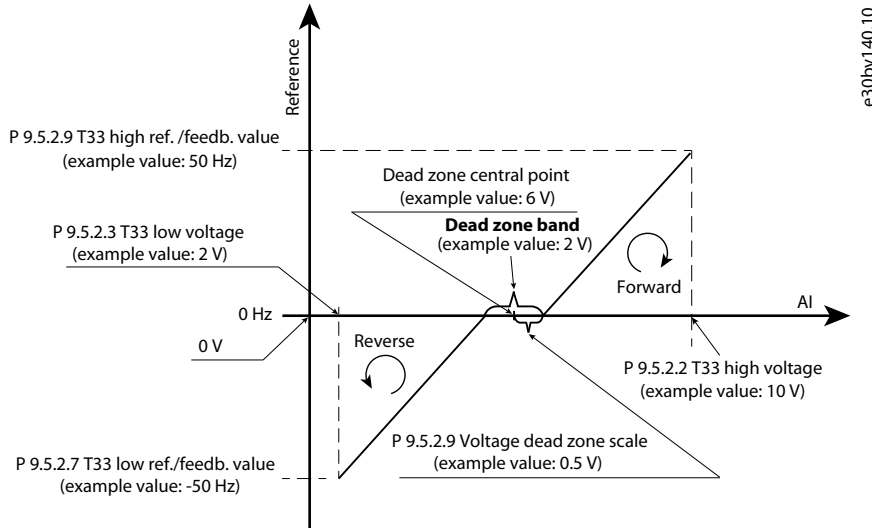


Illustration 81: Dead-zone Function Example

The typical parameter settings for the examples are shown in the following tables.

Table 75: Data for Dead-zone Function Key Parameters

Parameter		Data	Parameter number
9.5.2.1	T33 Mode	[1] Voltage Mode	619
9.5.2.2	T33 High Voltage	10.00 V	611
9.5.2.3	T33 Low Voltage	2.00 V	610
9.5.2.6	T33 High Ref./Feedb. Value	50.000	615
9.5.2.7	T33 Low Ref./Feedb. Value	-50.000	614
9.5.2.9	T33 Voltage Dead Zone Scale	0.5 V	617

Table 76: Data for Relevant Parameters

Parameter		Data	Parameter number
5.5.3.1	Reference Range	[1] -Max~+Max	300
5.5.3.3	Reference Maximum	50.00	303
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
5.8.1	Rotation Direction	[2] Both Directions	410

7.9.3.3 Input Terminal 34 (Menu Index 9.5.3)

P 9.5.3.1 T34 Mode

Description: 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 available selections.

Table 77: Selections

Selection Number	Selection Name
0	Current Mode
1	Voltage Mode

P 9.5.3.2 T34 High Voltage

Description: 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

Description: 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

Description: 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

Description: 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

Description: Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.3.2 T34 High Voltage / 9.5.3.4 T34 High Current*.

Default value: Size Related	Parameter type: 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

Description: Enter the reference or feedback value that corresponds to the voltage or current set in parameter *P 9.5.3.3 T34 High Voltage / P 9.5.3.5 T34 High Current*.

Default value: 0	Parameter type: 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

Description: 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

Description: 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

Description: 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

7.9.3.4 Potentiometer Reference (Menu Index 9.5.4)

P 9.5.4.1 Potentiometer High Ref.

Description: 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.

Description: 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

Description: Enter the timeout time. The function set in *P 9.5.6.2 Live Zero Timeout Function* is activated when the input signal on 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

Description: Select the timeout function. The function set in the parameter is activated when the input signal on 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 selections are available:

Table 78: Selections and Descriptions

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

Description: Select the protocol for the integrated RS485 port.

Default Value: 0 [FC]	Parameter Type: Selection	Parameter Number: 830
Unit: -	Data Type: enum	Access Type: Read/Write

The following are the available selections.

Selection number	Selection name	Description
0	FC	Communication according to the FC protocol.
2	Modbus RTU	Communication according to the Modbus RTU protocol.

P 10.1.2 Address

Description: Enter the address for the RS485 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

Description: Select the baud rate for the RS485 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

Selection number	Selection name
5	57600 Baud
6	76800 Baud
7	115200 Baud

P 10.1.4 Parity/Stop Bits

Description: 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

Description: Specify the maximum allowed delay time between receiving a request and transmitting the response. If this time is exceeded, no response will be 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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

Description: 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 drives 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 *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, an fault condition is activated and the drive stops 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 an fault.

Table 79: 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.

An fault triggers a trip. The trip removes power to the motor. It can be reset after the condition has been cleared by pressing *Stop/Reset* button, or through a digital input (See *P 9.4.1 Digital Input Setting*). The event that caused an 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 *Stop/Reset* button.
- A digital reset input.
- Serial communication/optional fieldbus reset signal.

N O T I C E

After a manual reset pressing *Stop/Reset* button, press *Start* button to restart the motor.

A warning precedes a fault.

A trip lock is an action when an 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 80: 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 <i>P 9.5.2.3 T33 Low Voltage</i> , <i>P 9.5.2.5 T33 Low Current</i> , <i>P 9.5.3.3 T34 Low Voltage</i> , and <i>P 9.5.3.5 T34 Low Current</i> .
3	No motor	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 overvoltage ⁽¹⁾	X	X	–	DC-link voltage exceeds the limit.
8	DC undervoltage ⁽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 <i>P 5.10.1 Motor Torque Limit</i> or <i>P 5.10.2 Regenerative Torque Limit</i> .
13	Overcurrent	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	Ground fault	–	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-circuited	–	X	X	Brake resistor is short-circuited, thus the brake function is disconnected.
26	Brake overload	X	X	–	The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.
27	Brake IGBT/Brake chopper short-circuited	–	X	X	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake check	–	X	–	Brake resistor is not connected/working.
30	U phase loss	–	X	X	Motor phase U is missing. Check the phase.

Number	Description	Warning	Fault	Trip lock	Cause
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 <i>Power Loss Controller Limit</i> , and P 2.3.6 <i>Power Loss Action</i> is NOT set to [0] <i>No Function</i> .
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.

Number	Description	Warning	Fault	Trip lock	Cause
80	Drive initialized to default value	–	X	–	All parameter settings are initialized to default settings.
87	Auto DC brake	X	–	–	Occurs in IT mains when the drive coasts, and the DC voltage is higher than 830 V 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	X	X	–	–
99	Locked rotor	–	X	–	Rotor is blocked.
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 Danfoss 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 81: 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	Ramping	Off
1	00000002	2	Pwr. card temp	Gate drive voltage fault	Reserved	Pwr. card temp	Reserved	AMA tuning	Hand/ Auto
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

Bit	Hex	Dec	Fault word	Fault word 2	Fault word 3	Warning word	Warning word 2	Extended status word	Extended status word 2
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 under-volt.	Start failed	Reserved	DC under-volt.	Reserved	Output freq. low	DC brake
11	00000800	2048	DC overvolt.	Reserved	Reserved	DC over-volt.	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
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

Bit	Hex	Dec	Fault word	Fault word 2	Fault word 3	Warning word	Warning word 2	Extended status word	Extended status word 2
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

8.7.1 WARNING/ALARM 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.

8.7.2 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.

8.7.3 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.

8.7.4 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.

8.7.5 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 an 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.

8.7.6 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 an alarm 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.

8.7.7 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*.

8.7.8 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 an fault.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down time, extend the ramp-down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

8.7.9 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.

8.7.10 FAULT 14, Earth (Ground) Fault

Cause

There is a discharge from the output phases to 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.

8.7.11 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 must perform installation, start-up, and maintenance.

- Disconnect power before proceeding.
- Remove the power to the drive and repair the short circuit.

8.7.12 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.

8.7.13 FAULT 18, Start Failed

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.

8.7.14 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.

8.7.15 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.

8.7.16 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.

Remedy

- Remove the power to the drive and remove the brake resistor.

8.7.17 FAULT 28, Brake Check

Cause

The brake resistor is not connected or not working.

Remedy

- Check if brake resistor is connected or it is too large for the drive.

8.7.18 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.

8.7.19 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.

8.7.20 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.

8.7.21 WARNING/FAULT 36, Mains Failure

Cause

This warning/alarm 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.

8.7.22 FAULT 38, Internal Fault

Cause

When an internal fault occurs, a code number is shown.

Troubleshooting

- See the following table for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

Table 82: Internal Fault List

Fault number	Cause	Solution
140-142	Power board EEPROM data error.	Upgrade the software in the drive to the latest version.
176	The firmware in the drive does not match the drive.	Upgrade the software in the drive to the latest version.
256	Flash ROM 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.
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.

8.7.23 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*.

8.7.24 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.

8.7.25 WARNING/FAULT 47, 24 V Supply Low

Cause

The 24 V DC is measured on the control card. This alarm appears when the detected voltage of terminal 12 is lower than 18 V.

Troubleshooting

- Check for a defective control card.

8.7.26 FAULT 50, AMA Calibration Failed

Troubleshooting

- Contact the Danfoss supplier or service department.

8.7.27 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*.

8.7.28 FAULT 52, AMA Low Inom

Cause

The motor current is too low.

Troubleshooting

- Check the settings in *parameter 1-24 Motor Current*.

8.7.29 FAULT 53, AMA Big Motor

Cause

The motor is too big for the AMA to operate.

8.7.30 FAULT 54, AMA Small Motor

Cause

The motor is too small for the AMA to operate.

8.7.31 FAULT 55, AMA Parameter Range

Cause

The AMA cannot run because the parameter values of the motor are out of the acceptable range.

8.7.32 FAULT 56, AMA Interrupt

Cause

The AMA is manually interrupted.

8.7.33 FAULT 57, AMA Timeout

Cause

Try to restart the AMA. Repeated restarts can overheat the motor.

8.7.34 FAULT 58, AMA Internal

Troubleshooting

Contact the Danfoss supplier.

8.7.35 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.

8.7.36 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.

8.7.37 FAULT 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

8.7.38 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.

8.7.39 FAULT 80, Drive Initialized to Default Value

Cause

Parameter settings are initialized to default settings after a manual reset. To clear the fault, reset the unit.

8.7.40 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*.

8.7.41 WARNING/FAULT 95, Lost Load Detected

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 alarm.

Troubleshooting

- Troubleshoot the system.
- Reset the drive after the fault is cleared.

8.7.42 FAULT 99, Locked Rotor

Cause

The rotor is blocked. It is only enabled for PM motor control.

Remedy

- 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]*.

8.7.43 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.

8.7.44 WARNING 127, Back EMF Too High

Cause

This warning applies to PM motors only. When the back EMF exceeds $90\% \times U_{invmax}$ (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.

Index

A	
Access types.....	86
ADR.....	62
AK.....	63, 65
Analog feedback.....	54
Analog reference.....	54
Application Selection.....	41
Automatic motor adaptation	
Faults.....	191
B	
Backup data using MyDrive® Insight.....	31
BCC.....	62
Bus references.....	54
C	
Catch up/slow down.....	53
Coast.....	80
Configuring multi-speed control mode.....	46
Configuring wire control mode.....	48
Control panel.....	12
Control panel 2.0 OP2.....	12, 21
Control word.....	79
Conversion.....	66
Conversion factor.....	66
Conversion index.....	66
D	
Data control byte.....	62
Data field.....	63
Data types.....	66, 86
DC brake.....	80
Dead band around 0.....	55
Default setting.....	19
Drive address.....	62
E	
EMC precautions.....	60
F	
Fault.....	181
Fault events.....	182
FC protocol.....	61
FC Protocol Examples.....	67
Fieldbus.....	181
Force/write multiple coil (0F hex).....	78
Force/write single coil (05 hex).....	75
Freeze reference.....	53
Function codes.....	84
Fuse.....	190
H	
Hardware setup.....	59
Hold output frequency.....	80
I	
IND.....	65
Index.....	65
Indicator lights.....	14
Initialization.....	19
J	
Jog.....	80
L	
LED.....	181
LGE.....	62
Local reference.....	52
M	
Mains imbalance.....	186
Mains phase loss.....	186
Modbus communication.....	59
Modbus exception codes.....	85
Modbus RTU.....	68, 84
Modbus RTU protocol.....	68
Motor thermal protection.....	83
MyDrive® Insight.....	11, 25
N	
Network connection.....	59
P	
Parameter block.....	63
Parameter number.....	65
Parameter types.....	86
Parameter value.....	65
PC control with MyDrive® Insight.....	30
PCD.....	63, 67
Phase loss.....	186
PKE field.....	63
PNU.....	63, 65, 73
Potentiometer.....	13
Preset multiple register (10 hex).....	77
Preset references.....	54
Preset single register (06 hex).....	76
Process block.....	63
Process control mode.....	44
Process words.....	67
Pulse feedback.....	54
Pulse reference.....	54
PWE.....	65
R	
Read coil status (01 hex).....	74
Read holding registers (03 hex).....	74
Reading parameter tables.....	86
Reference	
Limits.....	53
Remote reference.....	52
Restore data using MyDrive® Insight.....	31
Restoring default settings.....	19
RS485.....	58, 61
S	
Short circuit.....	188

Speed control mode.....	42	Trip (reset).....	181
Start failed.....	188	Trip condition.....	181
Status word.....	81	Trip lock.....	181, 181
Supply voltage.....	190		
T		V	
Telegram length.....	62	Voltage imbalance.....	186
Telegram structure.....	62	W	
Text block.....	63	Warning.....	181
Torque control mode.....	50	Warning events.....	182
Torque limit.....	187		
Trip (auto restart).....	181		

Danfoss A/S
Ulsnaes 1
DK-6300 Graasten
drives.danfoss.com

Danfoss can accept no responsibility for possible errors in catalogs, brochures, and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed. All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.

