

Application Guide

# iC2-Micro Frequency Converters





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# 1 Introduction and Safety

## 1.1 Purpose of this Application Guide

This application guide is intended for qualified personnel such as:

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

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

## 1.2 Additional Resources

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

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

## 1.3 Version History

This 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 03 | Information in this version of the manual applies to software version 1.20. |

## 1.4 Safety Symbols

The following symbols are used in Danfoss documentation.

|                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------|
|  <b>DANGER</b>                       |
| Indicates a hazardous situation which, if not avoided, will result in death or serious injury.                          |
|  <b>WARNING</b>                      |
| Indicates a hazardous situation which, if not avoided, could result in death or serious injury.                         |
|  <b>CAUTION</b>                      |
| Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.                        |
| <b>NOTICE</b>                                                                                                           |
| Indicates information considered important, but not hazard-related (for example, messages relating to property damage). |

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

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

## 1.5 General Safety Considerations

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

### Safe operation guidelines

- The drive is not suitable as the only safety device in the system. Make sure that additional monitoring and protection devices on drives, motors, and accessories are installed according to the regional safety guidelines and accident prevention regulations.
- Before activating any automatic fault reset functions or change limit values, make sure that no dangerous situations can occur after restart. If the auto reset function is activated, the motor starts automatically after an automatic fault reset.
- Keep all doors and covers closed and terminal boxes screwed on during operation of the drive and when mains is connected.
- Drive components and accessories can still be live and connected to mains, even after the operation indicators are no longer illuminated.

### WARNING



#### LACK OF SAFETY AWARENESS

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

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

### WARNING



#### HAZARDOUS VOLTAGE

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

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

### WARNING



#### DISCHARGE TIME

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

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

Table 1: Discharge Time

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

### CAUTION



#### INTERNAL FAILURE HAZARD

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

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

### CAUTION



#### HOT SURFACES

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

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

## 1.6 Qualified Personnel

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

Persons with proven skills:

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

## 2 Application Software Overview

### 2.1 iC2-Micro Application Software Overview

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

- Basic Functions
- Controllers
- Protection Features
- Software Tools

### 2.2 Basic Functions

#### 2.2.1 Basic Functions Overview

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

#### 2.2.2 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%.

#### 2.2.3 Two Setups

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

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

#### 2.2.4 Ramps

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

#### 2.2.5 Quick Stop

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

#### 2.2.6 Limit Rotation Direction

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



### 2.2.7 Motor Phase Switch

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

### 2.2.8 Inching with Jogging Modes

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

### 2.2.9 Frequency Bypass

Specific motor frequencies can be bypassed during operation. The feature helps to minimize and avoid mechanical resonance of the machine, limiting vibration and noise of the system.

### 2.2.10 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.

### 2.2.11 Flying Start

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

### 2.2.12 Mains Dropout

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

### 2.2.13 Kinetic Backup

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

### 2.2.14 Resonance Damping

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

### 2.2.15 Mechanical Brake Control

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

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

### 2.2.16 Controllers

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

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

## Process controller

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

## Speed controller

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

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

## Torque controller

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

## 2.3 IO Control and Readouts

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

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

## 2.4 Motor Control Features

### 2.4.1 Motor Control Features Overview

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

### 2.4.2 Motor Types

The drive supports standard available motors like:

- Induction motors
- Permanent magnet motors

### 2.4.3 Load 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.

### 2.4.4 Motor Control Principle

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

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

### 2.4.5 Motor Nameplate and Catalog

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

## 2.4.6 Automatic Motor Adaptation (AMA)

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

## 2.4.7 Automation Energy Optimization (AEO)

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

# 2.5 Braking of Load

## 2.5.1 Braking of Load Overview

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

## 2.5.2 Resistor Braking

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

## 2.5.3 Overvoltage Control (OVC)

If braking time is not critical or the load is varying, the overvoltage control (OVC) feature is used to control 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.

## 2.5.4 DC Brake

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

## 2.5.5 AC Brake

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

## 2.5.6 DC Hold

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

## 2.5.7 Load Sharing

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

# 2.6 Protection Features

## 2.6.1 Grid Protections

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

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

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

## 2.6.2 Drive Protection Features

The drive is monitored and protected during operation.

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.

## 2.6.3 Motor Protection Features

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

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

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

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

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

## 2.6.4 Protection of Externally Connected Components

Externally connected options like brake resistors can be monitored.

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

## 2.6.5 Automatic Derating

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

## 2.7 Monitoring Features

### 2.7.1 Monitoring Features Overview

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

### 2.7.2 Speed Monitoring

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

### 2.7.3 Event Log and Operational Counters

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

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

## 2.8 Software Tools

### 2.8.1 Software Tools Overview

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

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

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

### 2.8.2 MyDrive® Select

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

MyDrive® Select is available as a web-based tool at [select.mydrive.danfoss.com](https://select.mydrive.danfoss.com) and as a mobile device app that can be downloaded from app stores.

### 2.8.3 MyDrive® Harmonics

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

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

### 2.8.4 MyDrive® ecoSmart™

MyDrive® ecoSmart™ determines the energy efficiency of the drive being used and the system efficiency class according to IEC 61800-9.

MyDrive® ecoSmart™ uses information about the selected motor, load points, and AC drive to calculate the efficiency class and part load efficiency for a Danfoss AC drive, either for a free-standing drive (CDM), or a drive with a motor (PDS).

MyDrive® ecoSmart™ is available as a web-based tool at [ecosmart.mydrive.danfoss.com](https://ecosmart.mydrive.danfoss.com) and as a mobile device app that can be downloaded from app stores.

### 2.8.5 MyDrive® Insight

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

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

## 3 User Interfaces and How to Configure

### 3.1 Overview of User Interfaces

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

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

### 3.2 Control Panel

#### 3.2.1 Overview of Control Panel

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

#### 3.2.2 Control Panel and Control Panel 2.0 OP2

The drive has 2 types of control panels as follows:

- **Control Panel:** It is inbuilt and by default delivered with the drive. The Control Panel buttons and indicators are described in [3.2.3 Control Panel Buttons and Indicators](#).
- **Control Panel 2.0 OP2:** An optional (accessory) control panel which provides better user experience. This type of control panel enables easy setup of the drive via parameters, monitoring of the drive status, and visualization of event notifications. The Control Panel 2.0 OP2 buttons and indicators are described in [3.2.5 Control Panel 2.0 OP2 Buttons and Indicators](#).

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.

3.2.3 Control Panel Buttons and Indicators

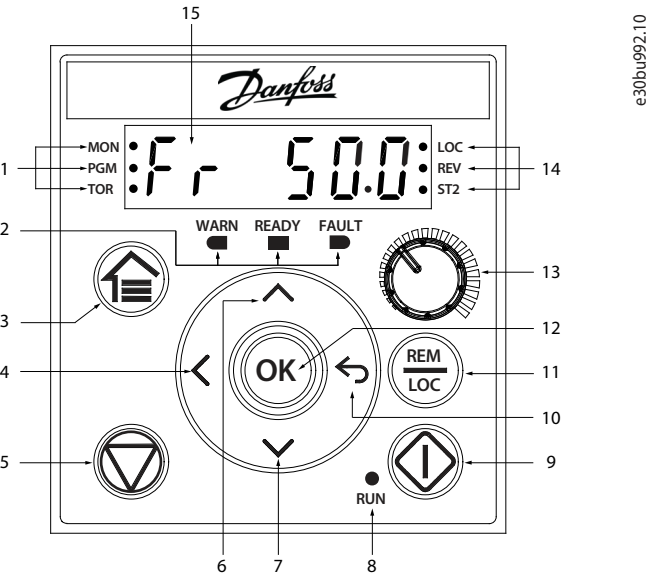


Figure 1: Control Panel

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

Table 2: Operation Buttons and Potentiometer

| Name         | Function                                                                                                                         |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|
| Home/Menu    | Toggles between status view and main menu.<br>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.                                                                                                  |

Table 2: Operation Buttons and Potentiometer (continued)

| Name          | Function                                                                           |
|---------------|------------------------------------------------------------------------------------|
| Stop/Reset    | Stops the drive in local mode.                                                     |
|               | Resets the drive to clear a fault.                                                 |
| Potentiometer | Changes the reference value when the reference value is selected as potentiometer. |

Table 3: Status Indicator Lights

| Name | Function                                          |
|------|---------------------------------------------------|
| MON  | On: The main display is showing the drive status. |
| PGM  | On: The drive is in programming status.           |
| TOR  | On: The drive is in torque mode.                  |
|      | Off: The drive is in speed mode.                  |
| LOC  | On: The drive is in local mode.                   |
|      | Off: The drive is in remote mode.                 |
| REV  | On: The drive is in reverse direction.            |
|      | Off: The drive is in forward direction.           |
| ST2  | Refer to <a href="#">Table 6</a> .                |

Table 4: Operating Indicator Lights

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

Table 5: Run Indicator Light

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

Table 6: Multiple Setups Indicator Light

| ST2                              | Off     | On      | Flash   | Flash quickly |
|----------------------------------|---------|---------|---------|---------------|
| Active setup <sup>(1)</sup>      | Setup 1 | Setup 2 | Setup 1 | Setup 2       |
| Programming setup <sup>(2)</sup> | Setup 1 | Setup 2 | Setup 2 | Setup 1       |

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

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



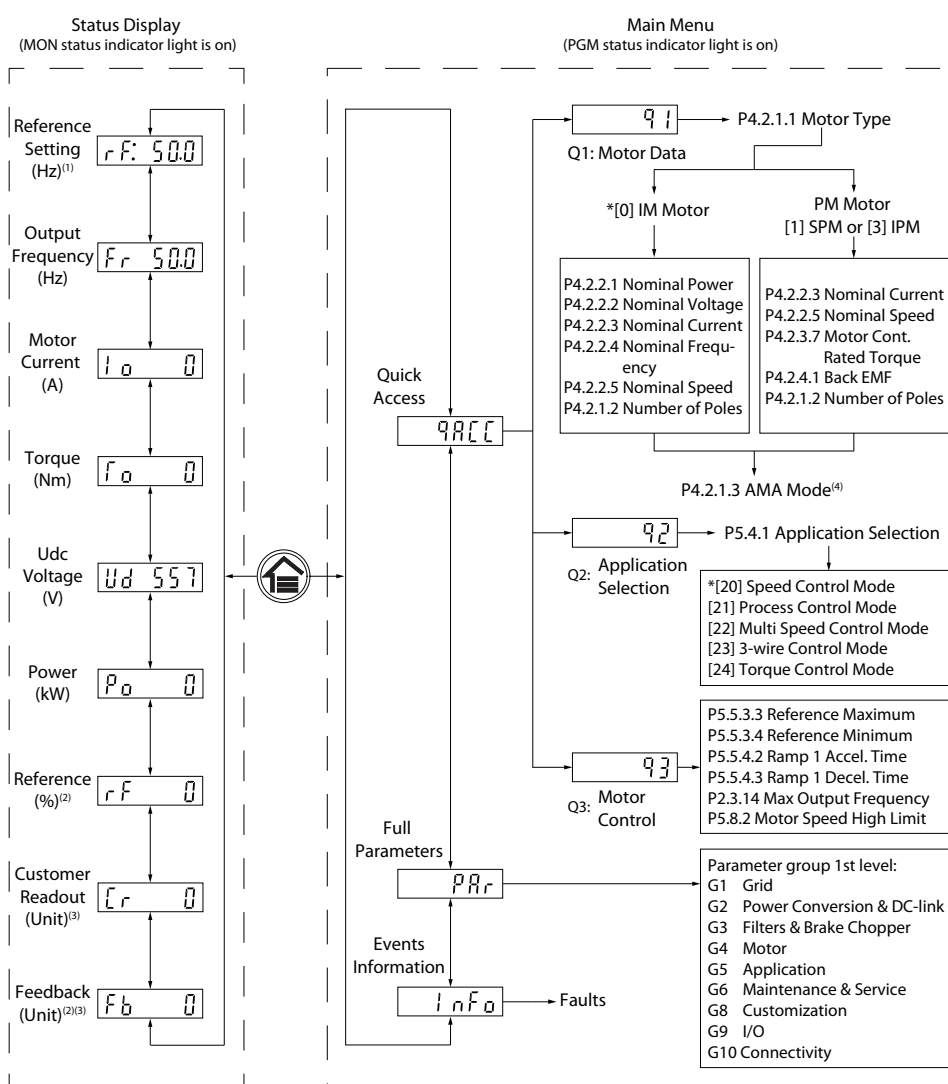
## 3.2.4 Control Panel Basic Configuration

### 3.2.4.1 Overview of Control Panel Basic Configuration

Basic configurations of the control panel include:

- Readout status of the motor and the drive which includes warnings and faults.
- Navigate to the menus to view or change parameter settings for the drive.

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



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.

Figure 2: Operation with Control Panel

### 3.2.4.2 Understanding Readout Screens

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



Figure 3: Home Screen

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

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

- Reference Setting (Hz)
- Output Frequency (Hz)
- Motor Current (A)
- Torque (Nm)
- Udc Voltage (V)
- Power (kW)
- Customer Readout (Unit)\*

**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.

### 3.2.4.3 Menu Group Screen and Navigation

#### 3.2.4.3.1 Overview of 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 Converters.
- **Events Information:** To view all active and history events such as faults, in the iC2-Micro Frequency Converters.

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



Figure 4: Menu Functions

### 3.2.4.3.2 Quick Access Navigation

Quick Access consists of the following 3 functions to set up the iC2-Micro Frequency Converters 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.

#### NOTICE

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

See AMA procedure in [5.4.5 Automatic Motor Adaptation \(AMA\)](#).

- **q2 - Application Selection:** Enables to select typical application configurations. The application selections are pre-configured parameter settings. 5 preset common applications are supported in iC2-Micro frequency converter, which are
  - Speed control mode
  - Process control mode
  - Multi-speed control mode
  - 3-wire control mode
  - Torque control mode

For more information, see [5.5.1 Application Selection Overview](#).

#### NOTICE

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

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

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

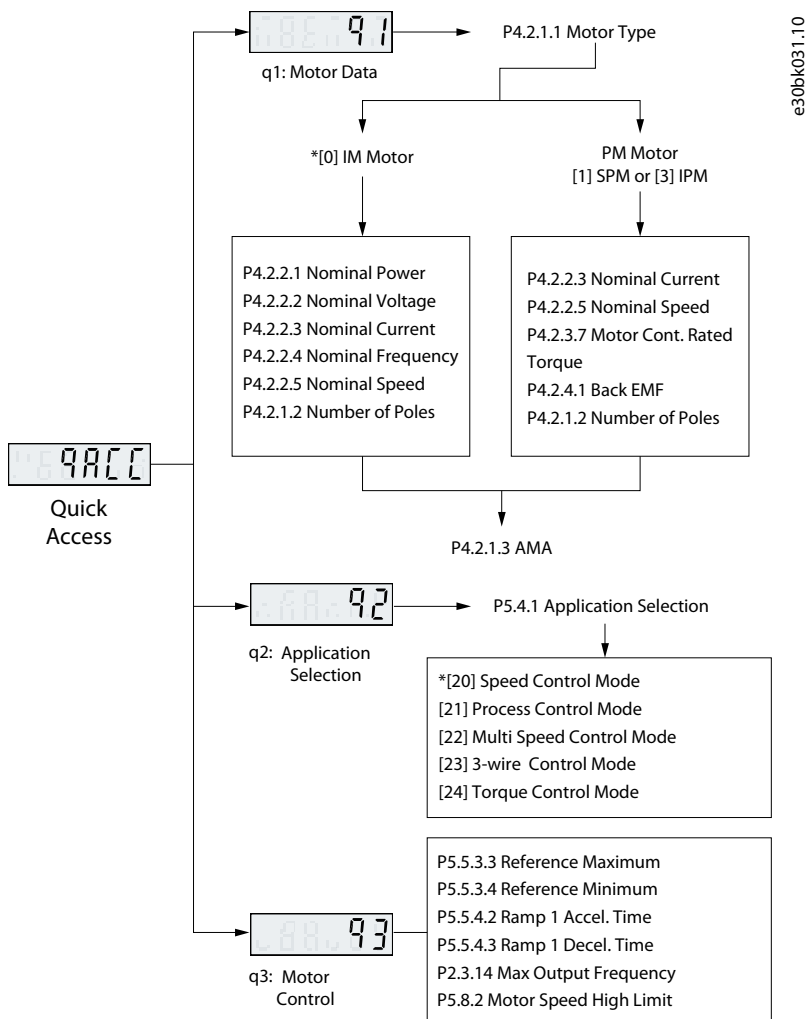


Figure 5: Quick Access Functions

### 3.2.4.3.3 Parameter Group Screen and Navigation

#### Overview

Press the *Up/Down* buttons to select the all parameters menu. See overview of full parameters in [3.2.4.3.1 Overview of Menu Group Screen and Navigation](#). Press *OK* to enter the sub-menus.

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

[Figure 6](#) shows how to navigate to a parameter and the example considered is **P 2.3.1 Overvoltage Controller Enable**.

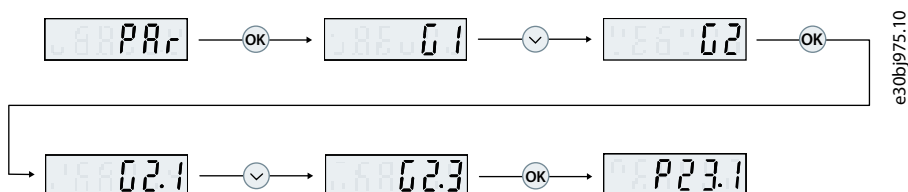


Figure 6: Parameter Navigation

## Changing Selections in a Parameter

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

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

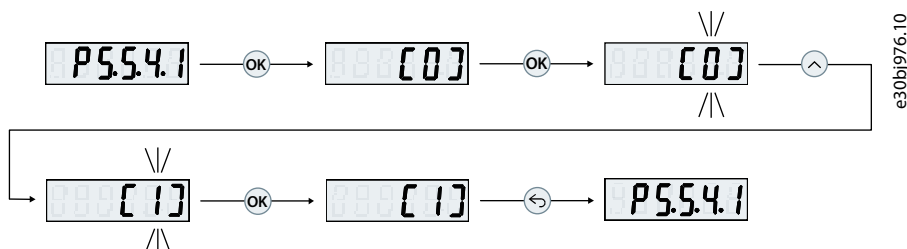


Figure 7: Changing Selections in a Parameter

1. Press the *Up/Down* buttons to go to the parameter.
2. Press *OK* to view the current selection setting.
3. Press *OK* to modify selection.

 The selection numbers begin to flash.

4. Use the *Up/Down* button to browse through the selection numbers.
5. Press *OK* at the required selection number.

 The flash stops.

## Changing Parameter Value

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

Figure 8 shows an overview of the relevant screens when changing the value of a parameter.

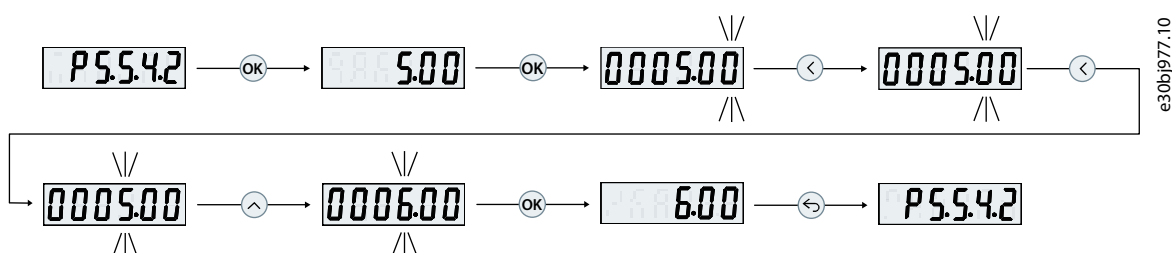


Figure 8: Changing Parameter Value

1. Press the *Up/Down* 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.

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.

### 3.2.4.4 Restoring Default Settings

#### 3.2.4.4.1 Overview

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

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

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

Manual initialization erases all data related to motor, programming, localization, monitoring, and restores factory default settings.

Manual initialization does not reset the following information:

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

#### 3.2.4.4.2 Recommended Initialization (via parameters)

1. Select **P 6.6.8 Operation Mode** and press **OK**.
2. Select **[2] Initialisation** and press **OK**.
3. Remove power to the unit and wait until the display turns off.
4. Apply power to the unit. Default parameter settings are restored during start-up. This may take slightly longer than normal.
5. **Fault 80, Drive initialised** to default value is shown.
6. Press **Stop/Reset** to return to operating mode.

#### 3.2.4.4.3 Manual Initialization

1. Remove power to the unit and wait until the display turns off.
2. Press and hold **Home/Menu**, and **OK** buttons at the same time, while applying power to the unit.

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

### 3.2.5 Control Panel 2.0 OP2 Buttons and Indicators

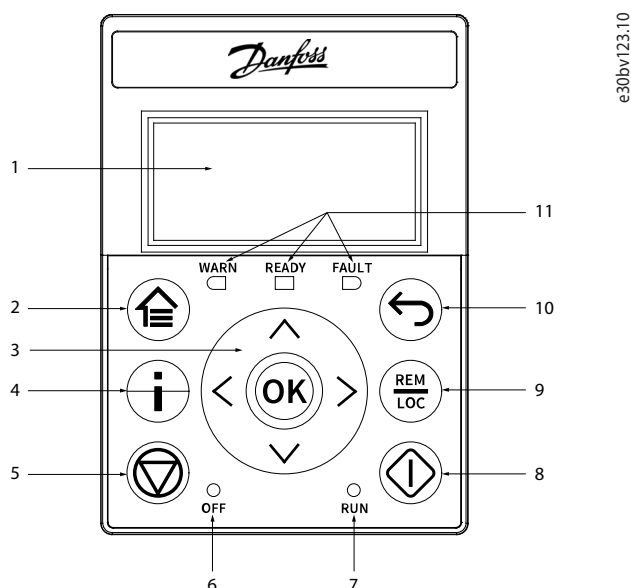


Figure 9: Control Panel 2.0 OP2 Overview

Table 7: Control Panel Elements Description

| Legend | Name of element | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Display         | Provides access to content and settings. The display provides detailed information about the status of the drive.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 2      | Home/Menu       | <ul style="list-style-type: none"> <li>Toggles between status view and main menu.</li> <li>Long press to access the shortcut menu for quickly reading and editing parameters.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                 |
| 3      | Arrows and [OK] | <ul style="list-style-type: none"> <li><b>Arrows:</b> Navigate within the different screens and menus, and tune the parameter values.</li> <li><b>[OK]:</b> Confirms selections and data in the control panel display.</li> </ul>                                                                                                                                                                                                                                                                                                                        |
| 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         | <p>The indicator has the following states:</p> <ul style="list-style-type: none"> <li><b>Steady on:</b> The indicator is in this state when: <ul style="list-style-type: none"> <li>The drive is not modulating and the drive is coasted.</li> <li>The stop or coast signal is applied. Ramp times, protections, and stopping functions might prolong this state.</li> </ul> </li> <li><b>Off:</b> The drive is in operation, a start signal is applied, and the output is active. This also includes ramping, running on reference, and AMA.</li> </ul> |

Table 7: Control Panel Elements Description (continued)

| Legend | Name of element         | Description                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7      | RUN LED                 | The indicator has the following states: <ul style="list-style-type: none"> <li>• <b>On:</b> The drive is in normal operation.</li> <li>• <b>Off:</b> The drive has stopped.</li> <li>• <b>Flash:</b> The indicator is in this state when: <ul style="list-style-type: none"> <li>- In the motor-stopping process (ramp down).</li> <li>- The drive received a <i>RUN</i> command, but no frequency output.</li> </ul> </li> </ul> |
| 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"> <li>• <b>[WARN]:</b> A steady yellow light indicates a warning.</li> <li>• <b>[READY]:</b> A steady green light indicates that the drive is ready.</li> <li>• <b>[FAULT]:</b> A flashing red light indicates a fault.</li> </ul>                                                                                                            |

## 3.2.6 Control Panel 2.0 OP2 Basic Configurations

### 3.2.6.1 Overview

Basic configurations of the control panel include:

- Readout status of the motor and the drive which includes warnings and faults.
- Navigate to the menus in order to view or change parameter settings for the drive.

### 3.2.6.2 Understanding Readout Screens

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

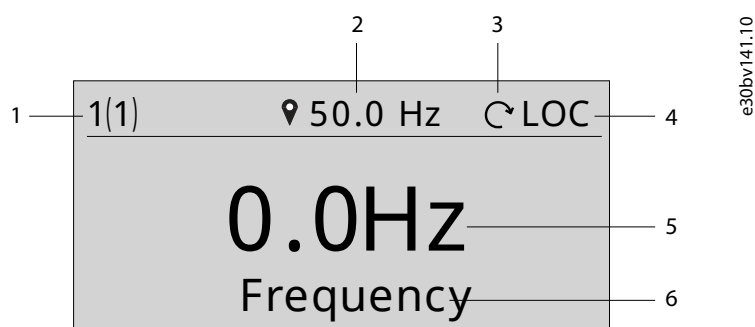


Figure 10: Home Screen

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



Table 8: Legend Table

| Legend | Description                                                                                                                                                                                                                                         |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | <ul style="list-style-type: none"> <li>The front number indicates active setup.<sup>(1)</sup></li> <li>The number in brackets indicates the programming setup.<sup>(2)</sup></li> </ul>                                                             |
| 2      | <ul style="list-style-type: none"> <li>On <i>Readout Screens</i>, the value with unit after the setpoint icon is the reference setting data.</li> <li>On <i>Menu Screens</i>, the value with unit (no setpoint icon) is the output data.</li> </ul> |
| 3      | <b>Direction icon:</b> indicates the direction of motor rotation.                                                                                                                                                                                   |
| 4      | <b>LOC/REM:</b> indicates local or remote control mode. <ul style="list-style-type: none"> <li>LOC: local control mode.</li> <li>REM: remote control mode.</li> </ul>                                                                               |
| 5      | <b>Middle value:</b> indicates the readouts value.                                                                                                                                                                                                  |
| 6      | <b>Readout type</b>                                                                                                                                                                                                                                 |

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 [3.2.4.2 Understanding Readout Screens](#).

## Reference setting in local mode

In local mode, press the *OK* button on *Readout Screen* to enter the reference setting. The reference value is valid immediately via pressing *up*, *down*, and *left* arrows for setting.

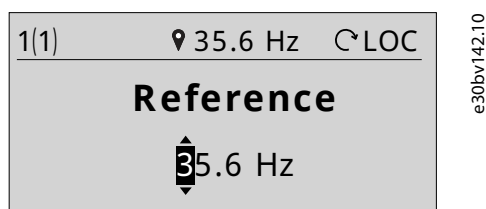


Figure 11: Setting the Reference Value

## 3.2.6.3 Menu Screen and Navigation

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

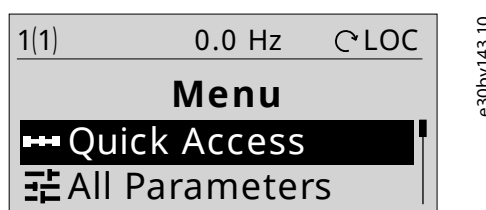


Figure 12: Menu Screen

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

Table 9: Menu Screen

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

### Basic navigation handling techniques

- To navigate through and within the different functionalities or parameter groups, use the navigation buttons of the Control Panel 2.0 OP2.
- Use the *Back* button to navigate to a higher level, and the *OK* button to navigate to a lower level.

### 3.2.6.4 Parameter Group Screens and Overall Navigation

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

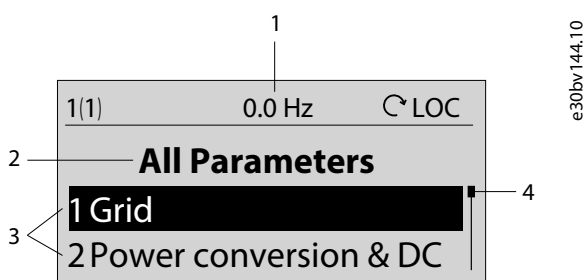


Figure 13: Parameter Group Screen

The following information is contained in the parameter group screen:

Table 10: Legend Table

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

### 3.2.6.5 Changing Selections in a Parameter

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

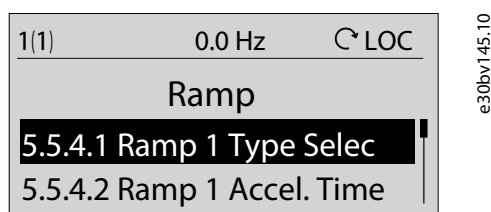


Figure 14: Changing Selections in a Parameter

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

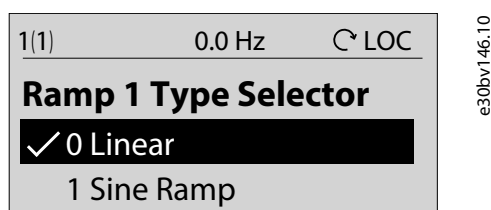


Figure 15: Selections in a Parameter (Example)

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

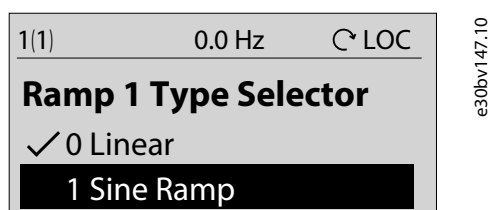


Figure 16: Browsing through the Selections (Example)

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

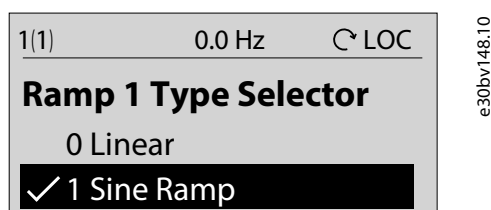


Figure 17: Confirming the Selections (Example)

### 3.2.6.6 Changing Parameter Value

In the example, the *parameter P 5.5.4.2 Ramp 1 Accel. Time* is considered and [Figure 18](#) 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.

[Figure 18](#) shows all the screens relevant to change the value of a parameter.

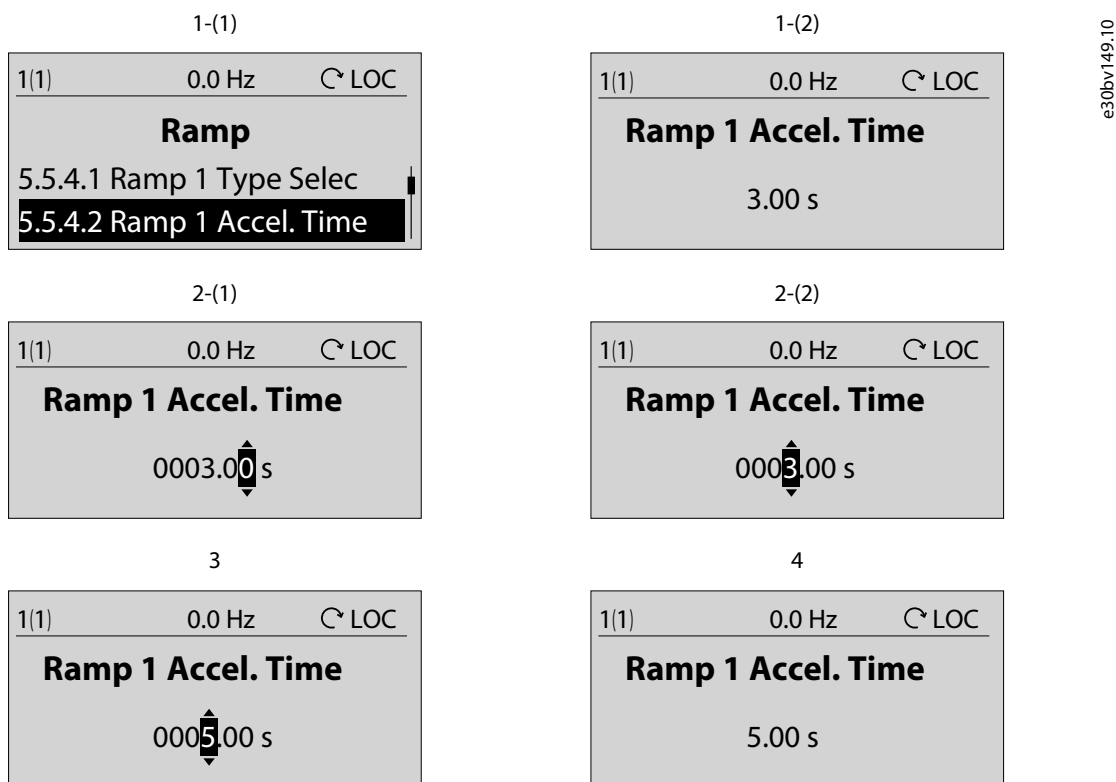


Figure 18: Changing Value in a Parameter

### 3.3 MyDrive® Insight

#### 3.3.1 Overview of MyDrive® Insight

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

- Fast and easy configuration and commissioning.
- Monitor the drives as part of daily operations.
- Collect data and information for troubleshooting, maintenance, and service.
- Discovery of and access to multiple drives in a network.
- Intuitive user interface.
- Notifications and visualizations on real-time information and events about the drive.
- PC control to perform operations such as starting or stopping the drive, set references, set direction, reset, and coast of the drive.
- Perform updates on single drives.
- Backup and restore of parameter settings.
- Data logging and analyzing for troubleshooting.

#### NOTICE

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

#### NOTICE

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

### 3.3.2 Getting Started with MyDrive® Insight

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

1. To establish a point-to-point connection between the drive and the device, use either of the following 2 methods:
  - Connect signal wires to RS485 terminals as described on the backside of the cover plate. A conventional adapter can be used for connecting to device USB port.
  - Use the RJ45 port on the drive by using an accessory adapter and cable to connect the drive with the device USB port.

#### NOTICE

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

#### NOTICE

Via the second connection method, only limited functionalities are available, for example, parameter configuration, parameter/project backup and restore, commissioning, monitoring, and diagnosing.

- For the second connection method, use the fixed baud rate 115200 and address 1.

2. After powering up the drive and when the drive is in *Ready* state, open MyDrive® Insight on the device.
3. Click *Direct Connect* icon, as shown.

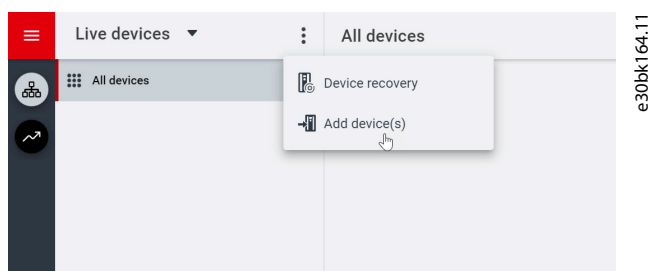
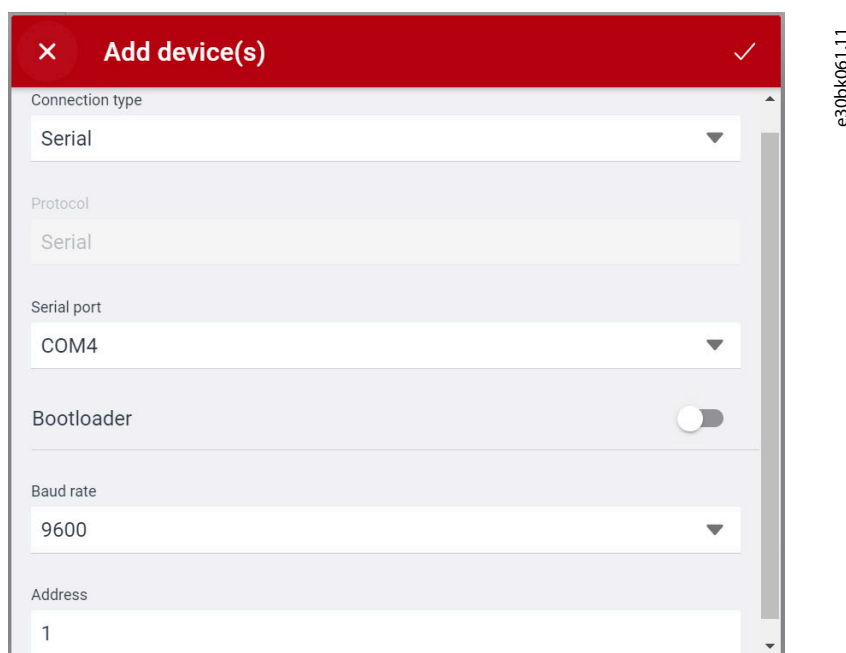


Figure 19: Establish Connection

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



The screenshot shows a dialog box titled "Add device(s)" with a red header bar containing a close button (X) and a checkmark button. The dialog contains the following fields and controls:

- Connection type:** A dropdown menu with "Serial" selected.
- Protocol:** A dropdown menu with "Serial" selected.
- Serial port:** A dropdown menu with "COM4" selected.
- Bootloader:** A toggle switch that is currently turned off.
- Baud rate:** A dropdown menu with "9600" selected.
- Address:** A text input field with the value "1".

On the right side of the dialog, there is a vertical scrollbar and a text label "e30bK061.11".

Figure 20: Serial Connection

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

### 3.3.3 Accessing Parameters and Understanding Parameter Screens in MyDrive® Insight

#### Accessing parameters

1. To access the parameters of the connected drive, click *Setup & Service*. This opens the menus related to *Setup & Service*.
2. Click *Parameters* → *Live*, as shown.

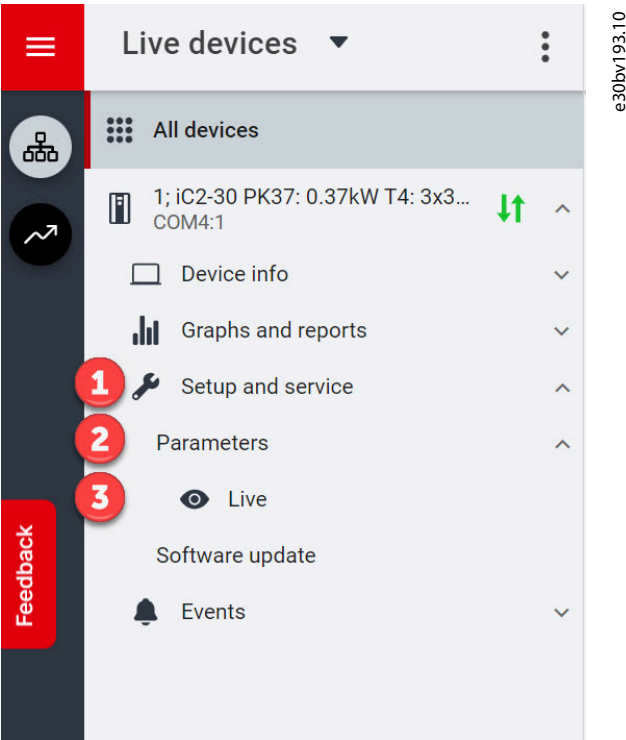


Figure 21: Setup & Service

### Parameter screen overview

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

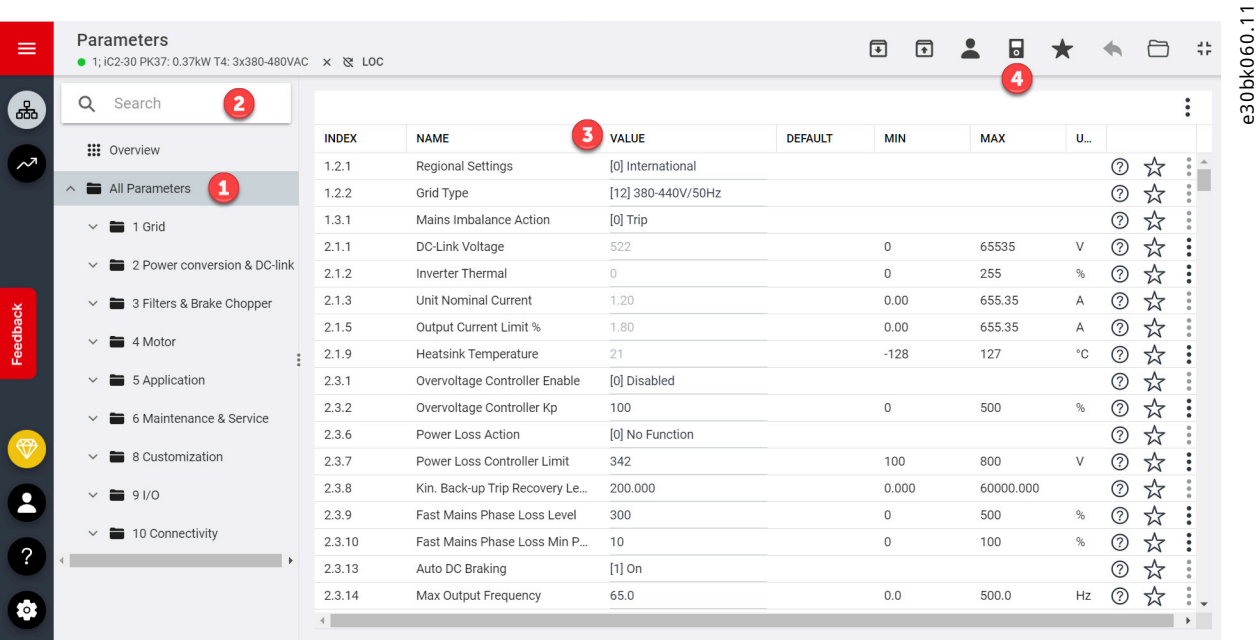


Figure 22: Parameter Screen

Table 11: Legend Table

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

## Navigate through different parameter groups

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

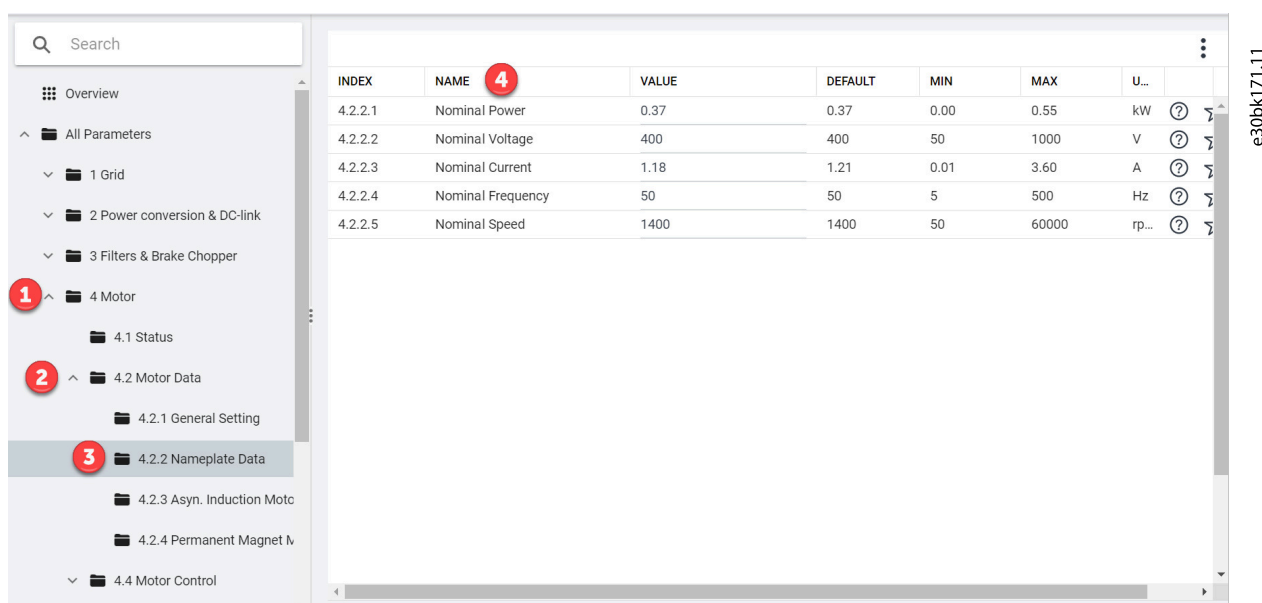


Figure 23: Navigating to a Parameter Group

1. Click the parameter group from *All Parameters* screen.
2. Click the parameter subgroup.
3. Repeat step 2, until the right level of parameter subgroup is reached to find the specific parameters (4).

## NOTICE

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

## Searching for a specific parameter

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

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



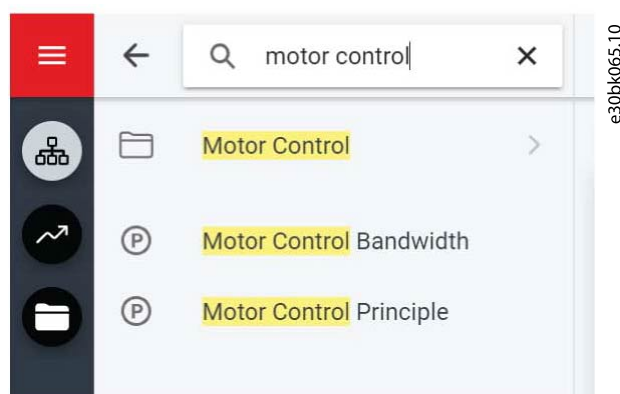


Figure 24: Search Button

### 3.3.4 Viewing and Changing Parameter Settings

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

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

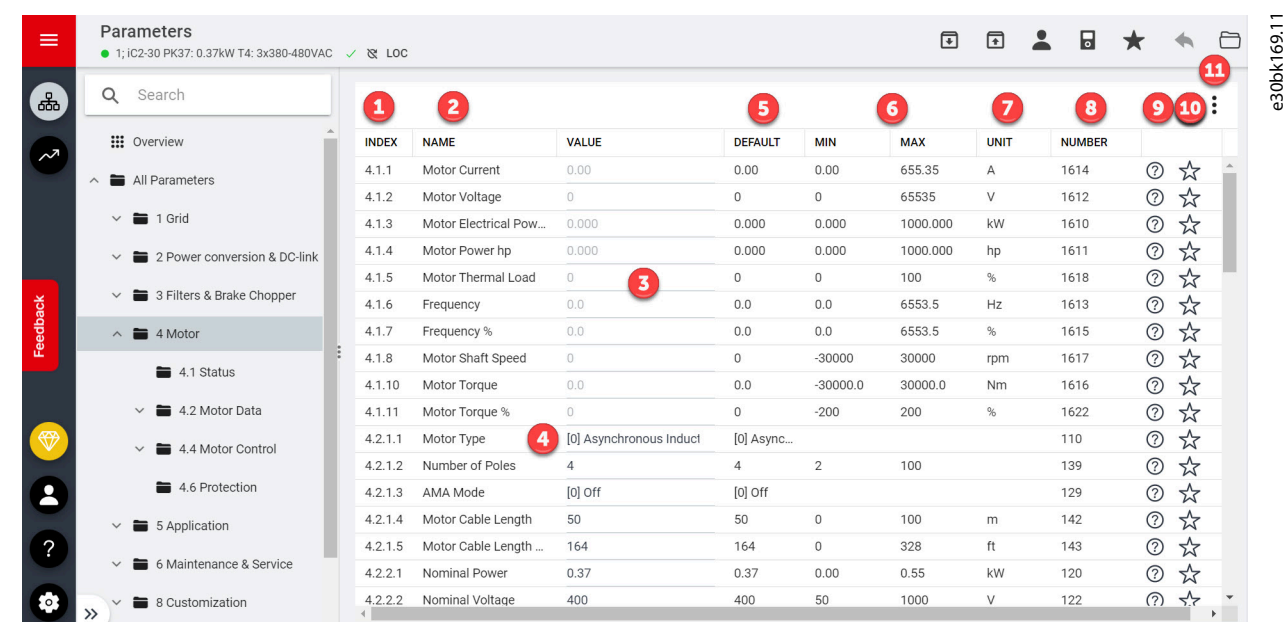


Figure 25: Parameter Overview

Table 12: Legend Table

| Number | Field Name                | Description                                                                                                                                           |
|--------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Index                     | Based on the parameter group structure, the index defines the location of the parameter. The index is not used as a unique identifier of a parameter. |
| 2      | Name                      | Name of the parameter.                                                                                                                                |
| 3      | Parameter status or value | Provides the current status or value of a parameter. The parameter which is shown in a light gray color cannot be changed.                            |

Table 12: Legend Table (continued)

| Number | Field Name             | Description                                                                                                                                      |
|--------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 4      | Selection parameters   | To see all selections available for the parameter, click the value in the <i>Value</i> field.                                                    |
| 5      | <i>Default</i>         | The factory setting (default value) of the parameter.                                                                                            |
| 6      | Range of parameters    | The parameter value can be modified based on the ranges defined (maximum and minimum values).                                                    |
| 7      | <i>Unit</i>            | When applicable, the user unit of the parameter is shown in the <i>Unit</i> field.                                                               |
| 8      | <i>Number</i>          | Parameter number (PUN) is the unique identifier of a parameter for modbus registers. See <a href="#">6.1.6.2.8 Parameter Number (PNU)</a> .      |
| 9      | Help                   | Click the ? button to see description about the parameter. For more detailed descriptions, see <a href="#">7.1 Reading the Parameter Table</a> . |
| 10     | Favorite               | To add parameters to Favorites, click the button.                                                                                                |
| 11     | Edit and reset columns | Use the 3 dots icon to select the required column types or reset all columns. The columns sequence could be changed with click, hold, and drag.  |

### 3.3.5 PC Control to Operate the Drive using MyDrive® Insight

To operate the drive using PC control, click control panel button in MyDrive® Insight. [Figure 26](#) shows the different screens to operate the drive via MyDrive® Insight.

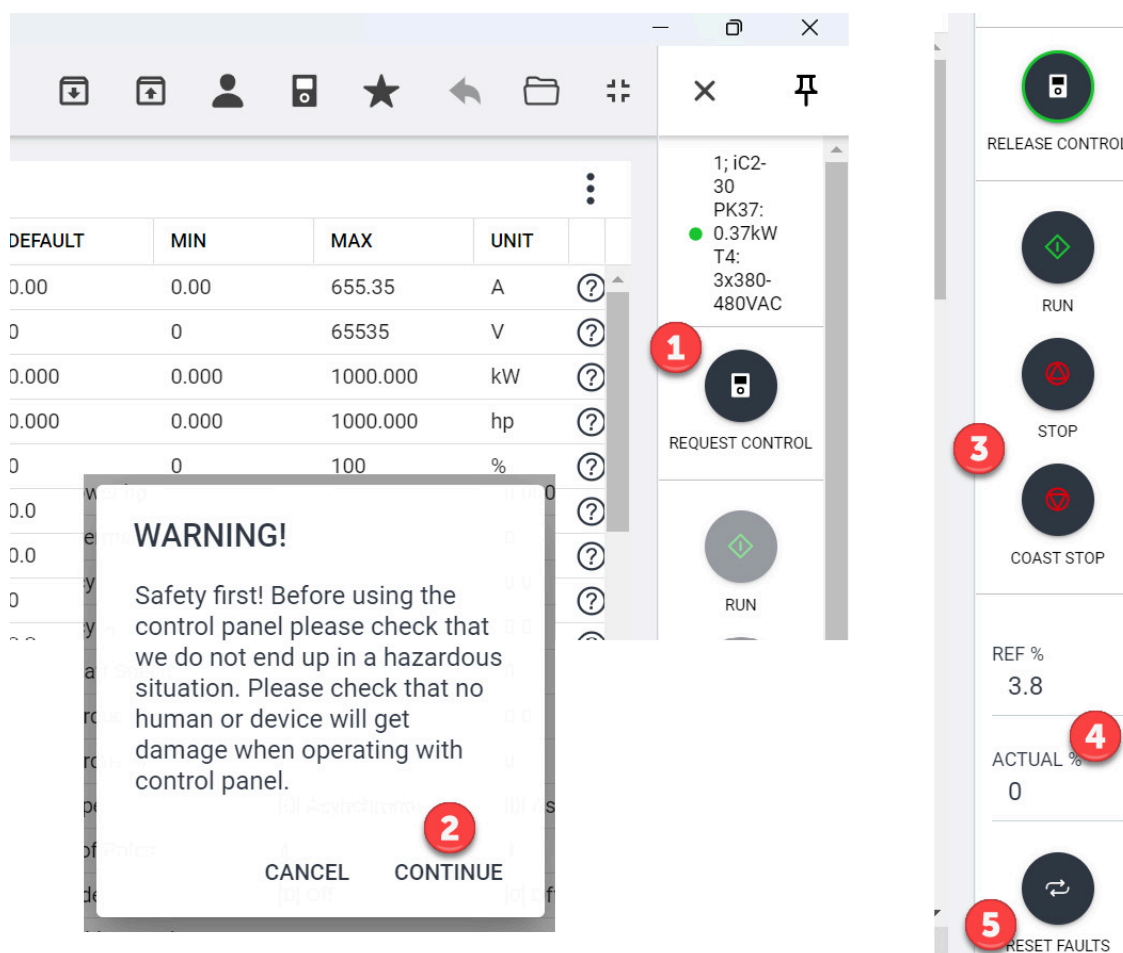


Figure 26: Operate Drive using MyDrive® Insight

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

1. Click the *REQUEST CONTROL* button.
2. Click *Continue*, to confirm secure operation conditions, while controlling the drive using MyDrive® Insight.
3. Use the *START*, *STOP*, *STOP COAST* buttons to perform a drive operation.
4. Increase or decrease the reference speed.
5. In case of a fault event, click *RESET FAULTS* to reset a drive.

### 3.3.6 Backing Up the Drive

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

 The *Parameters Live* screen appears.

2. Click the icon as shown in the figure.

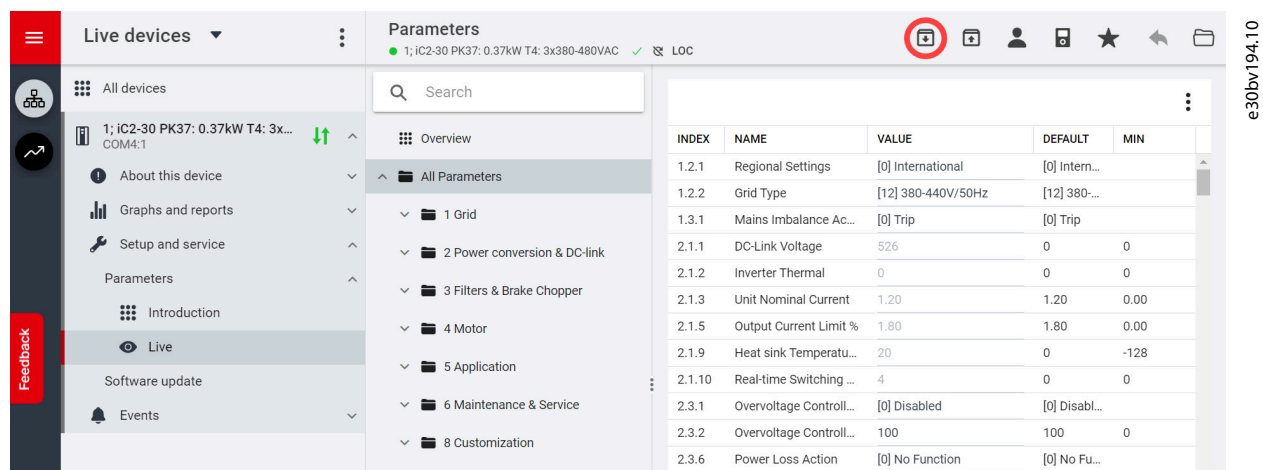


Figure 27: Backup Destination Icon

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

- **Project:** Backup an existing project or a new project.

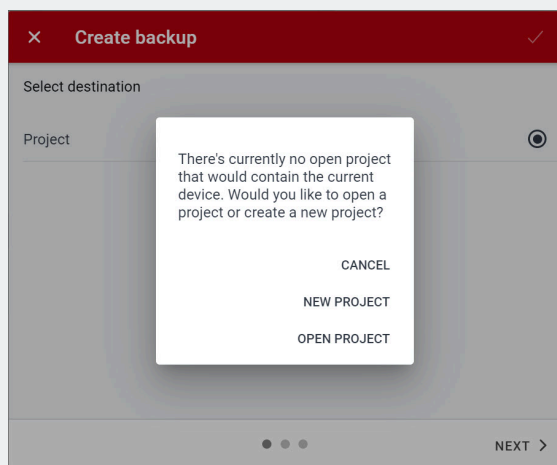


Figure 28: Backup Destination

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

➡ Once backup is completed, a screen appears with a notification. If a project backup is created, the backup is shown in the device menu under *Parameters*.

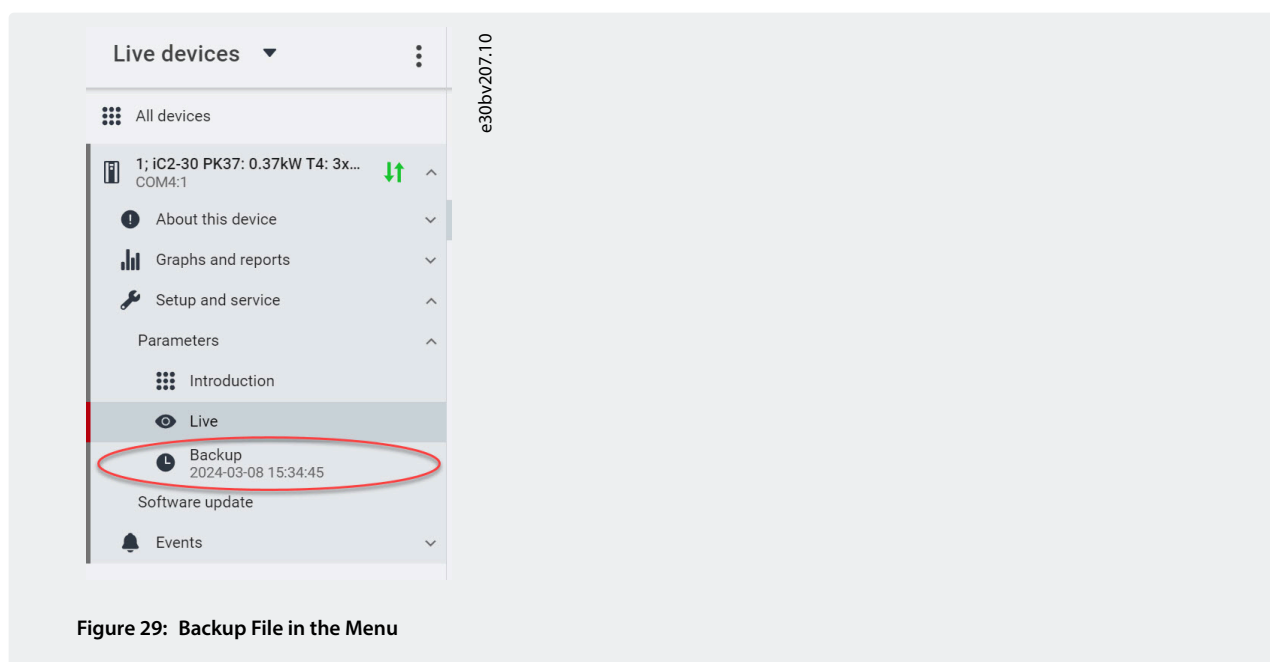


Figure 29: Backup File in the Menu

### 3.3.7 Restoring the Data to the Drive

1. To restore data to the drive, select a drive, go to *Setup & Service*→*Parameters*.
2. Click the icon as shown in the image below.

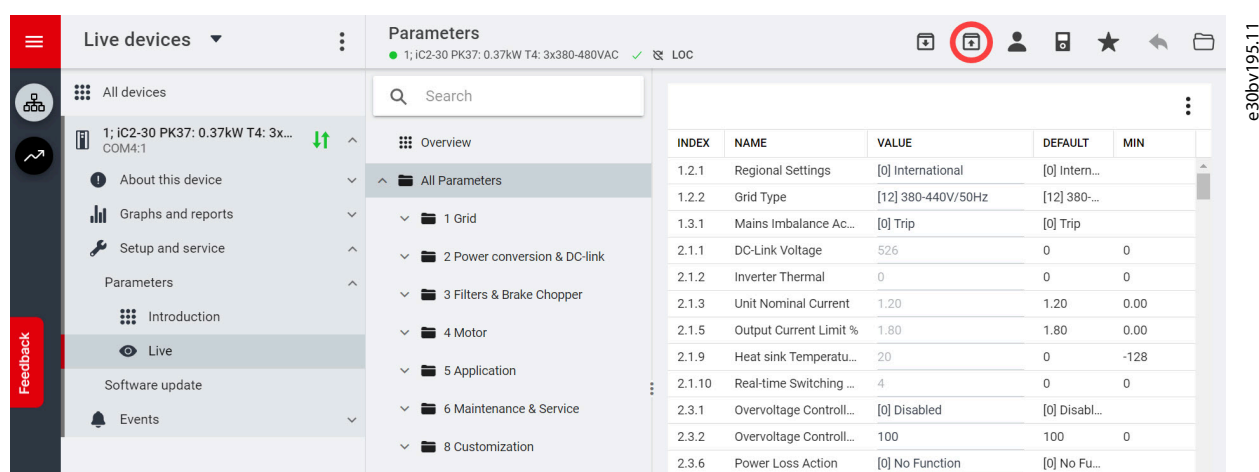
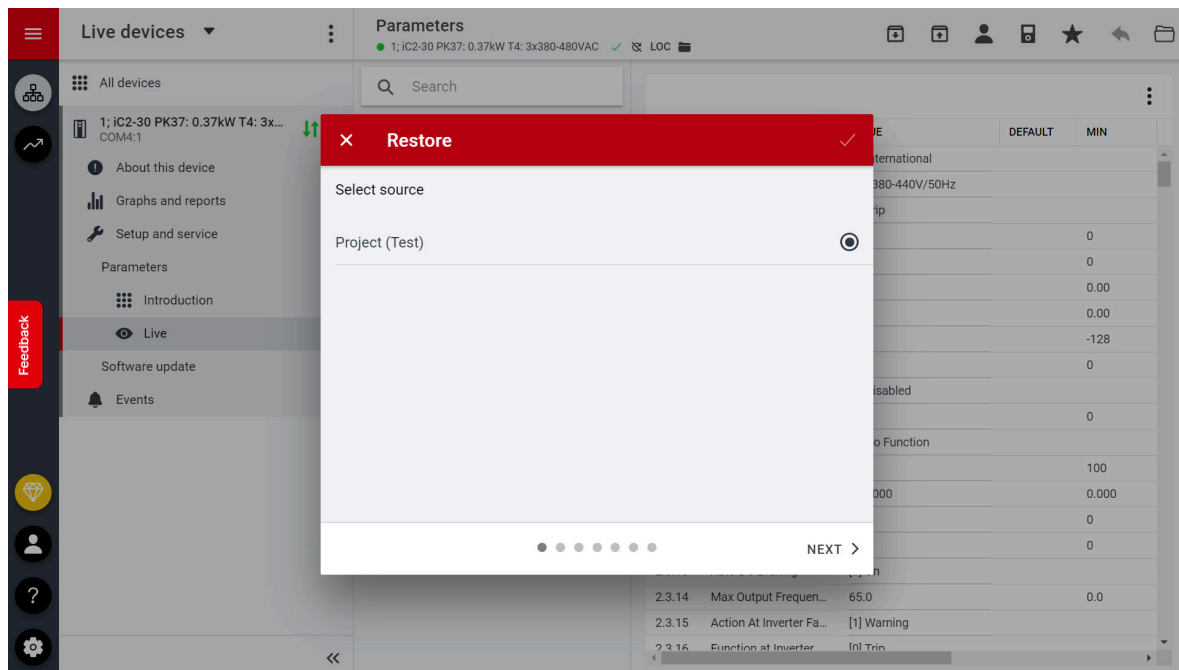


Figure 30: Restore Data Icon

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

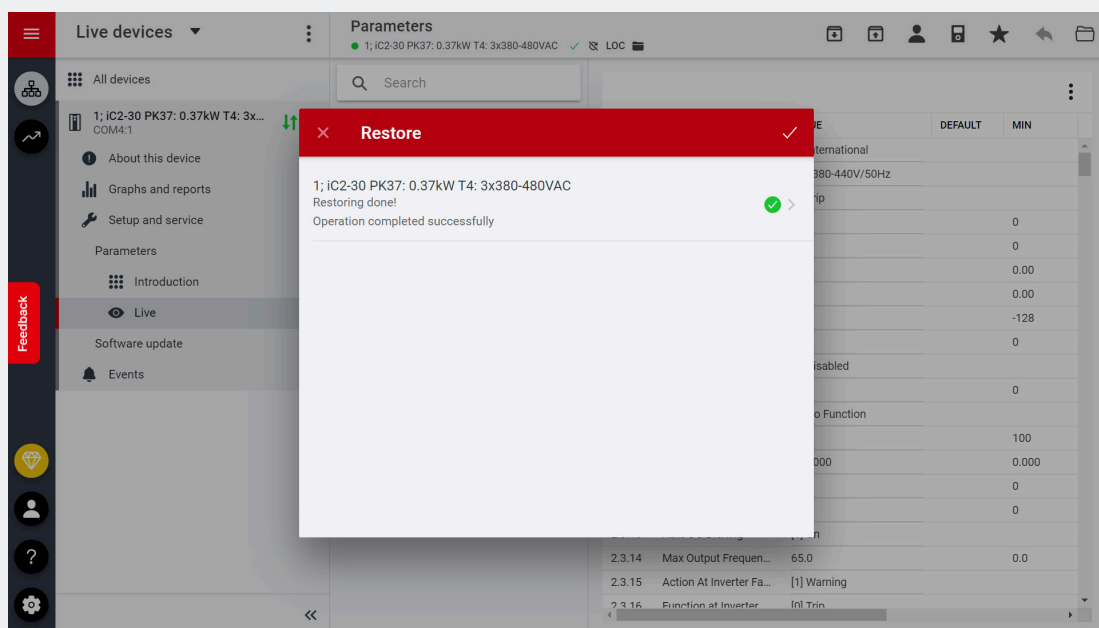


e30bk167.11

Figure 31: Source of Data for Restore

4. Click *Next*, and select a backup source drive.
5. Click *Next* and select a backup.
6. Select the content for restoring data into the drive, and click *Next*.

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



e30bv208.10

Figure 32: Restoring Done

## 4 Application Software Structure and Overview

### 4.1 Understanding Application Software Structure

The basic design principle of the application software structure and the related hierarchy refers to the setup of a typical iC2-Micro drive, as shown in the [Figure 33](#).

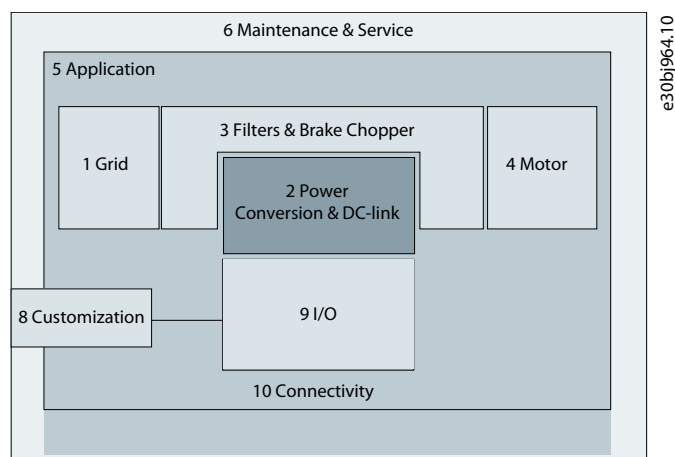


Figure 33: Application Menu Overview

### 4.2 Parameter Groups, Related Content, and Settings

- All generic settings such as Grid, Power Conversion and DC-link, Filters & Brake Chopper, and Motor are accessed via parameter groups (menu indexes) 1–4.
- Most of the application-specific parameters are accessed via parameter groups (menu index) 5 Application.
- Features and functions related to the application such as Maintenance & Service and Customization are in parameter groups (menu indexes) 6 and 8 respectively.
- The basic setup for external control signals and communication interfaces is done in parameter groups (menu indexes) 9 and 10 respectively.
- Features and related parameters are grouped in individual parameter groups. Each feature has a parameter group of its own.
- Status information for each parameter group is available separately for easy access.

The following table provides information about the parameter groups.

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

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



| Parameter group<br>1st level | Parameter group<br>2nd level                                                                      | Parameter group<br>1st level | Parameter group<br>2nd level                                        | Parameter group<br>1st level | Parameter group<br>2nd level                                                                                                                                                                                                                                   | Parameter group<br>1st level | Parameter group<br>2nd level                                                                                    | Parameter group<br>1st level | Parameter group<br>2nd level                     |
|------------------------------|---------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------|
| 1 Grid                       | 1.2 Grid Settings<br>1.3 Grid Protection                                                          | 4 Motor                      | 4.1 Status<br>4.2 Motor Data<br>4.4 Motor Control<br>4.6 Protection | 5 Application                | 5.1 Status<br>5.2 Protection<br>5.4 Operation Mode<br>5.5 Control<br>5.6 Start Settings<br>5.7 Stop Settings<br>5.8 Speed Control<br>5.9 Inching<br>5.10 Torque Control<br>5.11 Mechanical Brake Control<br>5.12 Process Control<br>5.27 Fieldbus Process Data | 6 Maintenance & Service      | 6.1 Status<br>6.2 Software Information<br>6.5 Cooling Fan<br>6.6 Parameter Handling<br>6.7 Drive Identification | 8 Customization              | 8.1 Custom Readout<br>8.4 Smart Logic Controller |
| 2 Power Conversion & DC-link | 2.1 Status<br>2.3 Protection<br>2.4 Modulation<br>2.5 DC-Link Control<br>2.7 Output Current Limit | 3 Filters & Brake Chopper    | 3.1 Status<br>3.2 Brake Chopper<br>3.3 Brake Resistor               | 9 I/O                        | 9.3 I/O Status<br>9.4 Digital Inputs/Outputs<br>9.5 Analog Inputs/Outputs                                                                                                                                                                                      | 10 Connectivity              | 10.1 FC Port Settings<br>10.2 FC Port Diagnostics                                                               |                              |                                                  |

Figure 34: Parameter Groups

## 5 Configuration Setup Examples

### 5.1 Introduction & Prerequisite

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

- For control panel related information, see [3.2.4.1 Overview of Control Panel Basic Configuration](#).
- For information on using MyDrive® Insight, see [3.3.1 Overview of MyDrive® Insight](#).
- Detailed information about the parameters is described in *Chapter Parameter Descriptions*.

A typical wiring schematic for iC2-Micro Frequency Converters is shown.

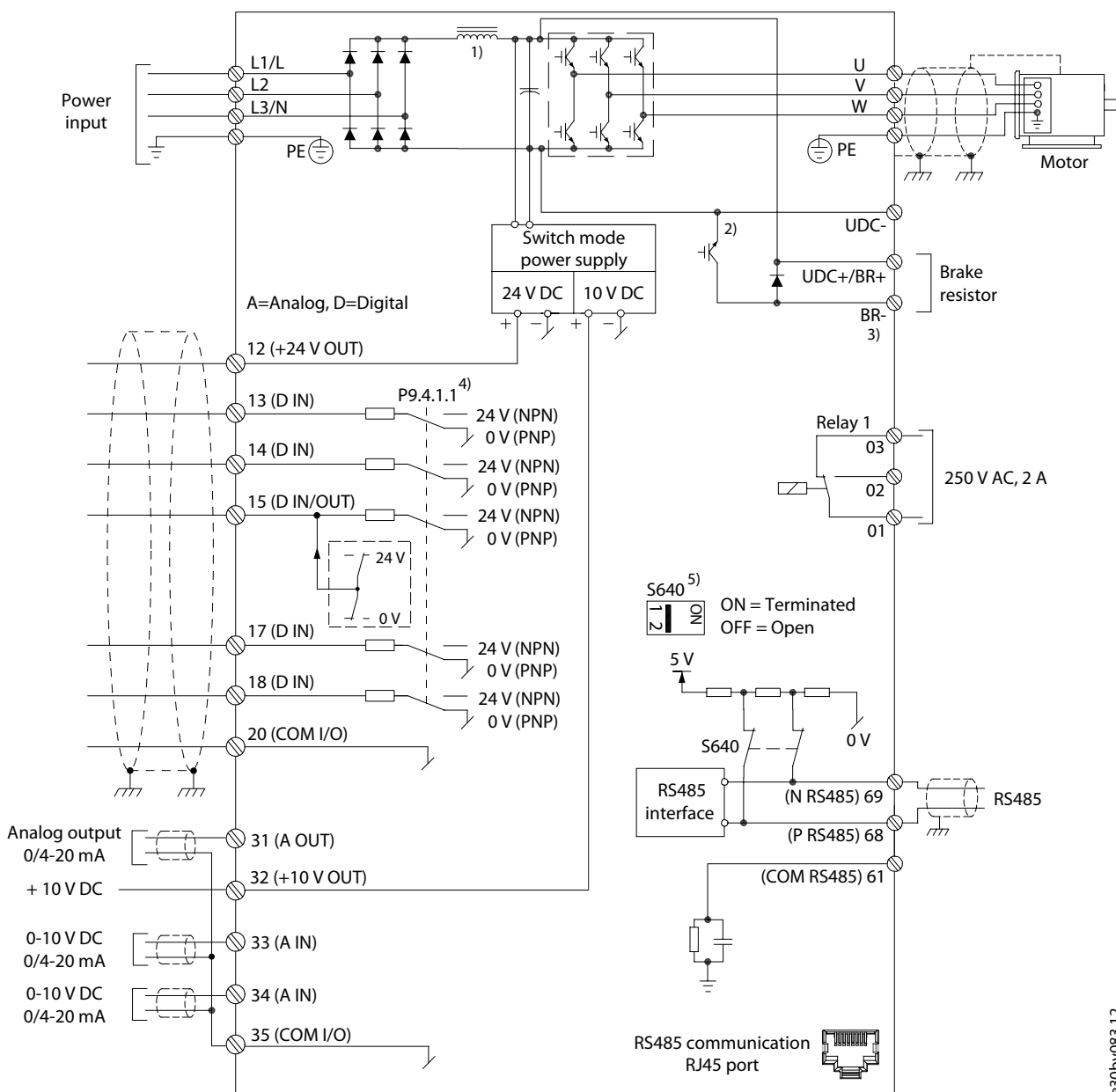


Figure 35: Wiring Diagram

e30bv083.12

- 1 Single DC choke in MA05a.
- 2 Built-in brake chopper is only applicable to drives in the power range of 3x380–480 V 2.2 kW (3.0 hp) and above, and 3x200–240 V 1.5 kW (2 hp) and above.
- 3 No BR terminals for 1x100–120 V, 1x200–240 V, 3x200–240 V 0.37–0.75 kW (0.5–1.0 hp), and 3x380–480 V 0.37–1.5 kW (0.5–2.0 hp) drives.
- 4 Select the PNP or NPN mode via **parameter P 9.4.1.1 Digital I/O mode** (PNP=Source, NPN=Sink).
- 5 Use switch S640 (bus terminal) to enable termination on the RS485 port (terminals 68 and 69).

## 5.2 Basic Setup of a Drive

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

### Prerequisite:

- Ensure that the drive is mounted safely as described in the iC2-Micro Frequency Converters Operating Guide.
- To use MyDrive® Insight for configuration, install [MyDrive® Insight](#) from MyDrive Suite app.

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

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

The steps described in detail are as follows:

1. Configure the grid settings using the following parameter.

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

2. Configure the operation mode using the following parameter.

| Parameter index | Parameter name        | Example setting            | Parameter number |
|-----------------|-----------------------|----------------------------|------------------|
| 5.4.2           | <b>Operation Mode</b> | <b>[0] Speed Open Loop</b> | 100              |

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

| Parameter index | Parameter name            | Example setting                   | Parameter number |
|-----------------|---------------------------|-----------------------------------|------------------|
| 5.5.1.1         | <b>Control Site</b>       | <b>[0] Digital and Ctrl. Word</b> | 801              |
| 5.5.1.2         | <b>Control Source</b>     | <b>[1] FC Port</b>                | 802              |
| 5.5.3.5         | <b>Reference Function</b> | <b>[0] Sum</b>                    | 304              |
| 5.5.3.6         | <b>Reference Site</b>     | <b>[0] Linked to Loc/Rem</b>      | 313              |
| 5.5.3.7         | <b>Reference 1 Source</b> | <b>[1] Analog Input 33</b>        | 315              |
| 5.5.3.8         | <b>Reference 2 Source</b> | <b>[2] Analog Input 34</b>        | 316              |

| Parameter index | Parameter name            | Example setting                 | Parameter number |
|-----------------|---------------------------|---------------------------------|------------------|
| 5.5.3.9         | <i>Reference 3 Source</i> | <i>[11] Local Bus Reference</i> | 317              |
| 5.5.2.1         | <i>Coasting Select</i>    | <i>[3] Logic OR</i>             | 850              |
| 5.5.2.2         | <i>Quick Stop Select</i>  | <i>[3] Logic OR</i>             | 851              |
| 5.5.2.4         | <i>Start Select</i>       | <i>[3] Logic OR</i>             | 853              |
| 5.5.2.5         | <i>Reversing Select</i>   | <i>[3] Logic OR</i>             | 854              |
| 9.4.1.2         | <i>T13 Digital Input</i>  | <i>[8] Start</i>                | 510              |
| 9.4.1.3         | <i>T14 Digital Input</i>  | <i>[10] Reversing</i>           | 511              |
| 9.4.1.4         | <i>T15 Digital Input</i>  | <i>[1] Reset</i>                | 512              |
| 9.4.1.5         | <i>T17 Digital Input</i>  | <i>[14] Jog</i>                 | 513              |

## 5.3 Setting up the Drive using Quick Access via Control Panel

The following steps shows the quick access setup.

1. Power up the drive.
2. Press *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 [5.4.5 Automatic Motor Adaptation \(AMA\)](#).
6. Select application type in **q2 Application Selection** and wiring I/O terminals accordingly. For more information, see [5.5.1 Application Selection Overview](#).
7. Enter **q3 Motor Control** to configure reference limitations, output limitations, and ramp time.
8. Press *REM/LOC*, to set the drive in remote operation.
9. To start the drive by I/O terminals.

## 5.4 Motor Configuration

### 5.4.1 Motor Configuration Overview

The setup examples in this chapter describe motor configuration.

#### NOTICE

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

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

### 5.4.2 Asynchronous Motor Setup

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

| Parameter index | Parameter name           | Recommended setting    | Parameter number |
|-----------------|--------------------------|------------------------|------------------|
| 4.2.2.1         | <b>Nominal Power</b>     | As shown on nameplate. | 120              |
| 4.2.2.2         | <b>Nominal Voltage</b>   | As shown on nameplate. | 122              |
| 4.2.2.4         | <b>Nominal Frequency</b> | As shown on nameplate. | 123              |
| 4.2.2.3         | <b>Nominal Current</b>   | As shown on nameplate. | 124              |
| 4.2.2.5         | <b>Nominal Speed</b>     | As shown on nameplate. | 125              |

- 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         | <b>Stator Resistance (Rs)</b>      | As shown on motor datasheet. | 130              |
| 4.2.3.2         | <b>Rotor Resistance (Rr)</b>       | As shown on motor datasheet. | 131              |
| 4.2.3.4         | <b>Stator Leakage Reactance X1</b> | As shown on motor datasheet. | 133              |
| 4.2.3.6         | <b>Main Reactance Xh</b>           | As shown on motor datasheet. | 135              |

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

### 5.4.3 PM Motor Setup in VVC+

#### Prerequisites

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

#### Procedure

- Set the following parameters using the motor name plate and motor datasheet.

| Parameter index | Parameter name                  | Recommended setting          | Parameter number |
|-----------------|---------------------------------|------------------------------|------------------|
| 4.2.2.3         | <b>Nominal Current</b>          | As shown on motor datasheet. | 124              |
| 4.2.3.7         | <b>Motor Cont. Rated Torque</b> | As shown on motor datasheet. | 126              |
| 4.2.2.5         | <b>Nominal Speed</b>            | As shown on motor datasheet. | 125              |
| 4.2.1.2         | <b>Number of Poles</b>          | As shown on motor datasheet. | 139              |

| Parameter index | Parameter name                       | Recommended setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Parameter number |
|-----------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 4.2.3.1         | <b><i>Stator Resistance (Rs)</i></b> | 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         | <b><i>d-axis Inductance (Ld)</i></b> | 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         | <b><i>Back EMF</i></b>               | 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:<br>Back EMF=(Voltage/RPM)x1000=(320/1800)x1000=178. | 140              |

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

2. To test motor operation, start the motor at low speed (100–200 RPM). If the motor does not turn, check installation, general parameter configurations, and motor data.
3. Perform parking operation by setting **P 5.6.14 Sync. Motor Parking Current %** and **P 5.6.13 Sync. Motor Parking Time**. The factory setting values of the parameters can be adjusted and increased for applications with high inertia. Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. The following table shows recommendations in different applications.

Table 13: Recommendations in Different Applications

| Application                                               | Settings                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low inertia applications $I_{Load}/I_{Motor} < 5$         | <ul style="list-style-type: none"> <li>• Increase the value for <b>P 4.4.4.10 Voltage filter time const.</b> by factor 5–10.</li> <li>• Reduce the value for <b>P 4.4.4.7 Damping Gain</b>.</li> <li>• Reduce the value (&lt;100%) for <b>P 4.4.4.14 Min. Current at Low Speed</b>.</li> </ul> |
| Medium inertia applications $50 > I_{Load}/I_{Motor} > 5$ | Keep calculated values.                                                                                                                                                                                                                                                                        |
| High inertia applications $I_{Load}/I_{Motor} > 50$       | Increase the values for <b>P 4.4.4.7 Damping Gain</b> , <b>P 4.4.4.9 Low Speed Filter Time Const.</b> , and <b>P 4.4.4.8 High Speed Filter Time Const.</b>                                                                                                                                     |
| High load at low speed <30% (rated speed)                 | Increase the value for <b>P 4.4.4.10 Voltage filter time const.</b><br>Increase the value for <b>P 4.4.4.14 Min. Current at Low Speed</b> (>100% for longer time can overheat the motor).                                                                                                      |

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

#### 5.4.4 Speed Control Configuration with I/O Using Default

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

| Parameter index | Parameter name                 | Recommended settings                                                                                                        | Parameter number |
|-----------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>5.4.3</b>    | <b>Motor Control Principle</b> | Use default: <b>[1] VVC+</b> . In most situations, selecting VVC+ provides optimum performance without further adjustments. | 101              |
| <b>5.4.2</b>    | <b>Operation Mode</b>          | Use default: <b>[0] Speed Open Loop</b>                                                                                     | 100              |
| <b>9.4.1.2</b>  | <b>T13 Digital Input</b>       | Use default: <b>[8] Start</b>                                                                                               | 510              |
| <b>9.4.1.3</b>  | <b>T14 Digital Input</b>       | Use default: <b>[10] Reversing</b>                                                                                          | 511              |
| <b>9.4.1.4</b>  | <b>T15 Digital Input</b>       | Use default: <b>[1] Reset</b>                                                                                               | 512              |
| <b>9.4.1.5</b>  | <b>T17 Digital Input</b>       | Use default: <b>[14] Jog</b>                                                                                                | 513              |
| <b>5.5.3.7</b>  | <b>Reference 1 Source</b>      | <b>[1] Analog Input 33</b>                                                                                                  | 315              |
| <b>9.5.1.2</b>  | <b>T31 Analog Output</b>       | Use default: <b>[100] Output Frequency</b>                                                                                  | 691              |
| <b>9.4.3.1</b>  | <b>Function Relay</b>          | Use default: <b>[9] Fault</b>                                                                                               | 540              |
| <b>5.5.3.3</b>  | <b>Reference Maximum</b>       | Use default: 50                                                                                                             | 303              |

| Parameter index | Parameter name             | Recommended settings                     | Parameter number |
|-----------------|----------------------------|------------------------------------------|------------------|
| 5.5.3.4         | <i>Reference Minimum</i>   | Use default: 0                           | 302              |
| 5.5.4.2         | <i>Ramp 1 Accel. Time</i>  | Set value according to real application. | 341              |
| 5.5.4.3         | <i>Ramp 1. Decel. Time</i> | Set value according to real application. | 342              |

### 5.4.5 Automatic Motor Adaptation (AMA)

- Via running AMA in VVC+ mode, the drive builds a mathematical model of the motor to optimize compatibility between drive and motor, and thus enhances the motor control performance.
- Some motors may be unable to run the complete version of the test. In that case, select **[2] Enable Reduced AMA** in *parameter P 4.2.1.3 AMA Mode*.
- The AMA completes within 5 minutes. For best results, run the following procedure on a cold motor.

#### Procedure

1. Set motor data according to the motor nameplate.
2. If needed, set motor cable length in *parameter P 4.2.1.4 Motor Cable Length*.
3. Set **[1] Enable Complete AMA** or **[2] Enable Reduced AMA** for *parameter P 4.2.1.3 AMA Mode*, and the main display shows *To start AMA*.
4. Press the *Start* 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.

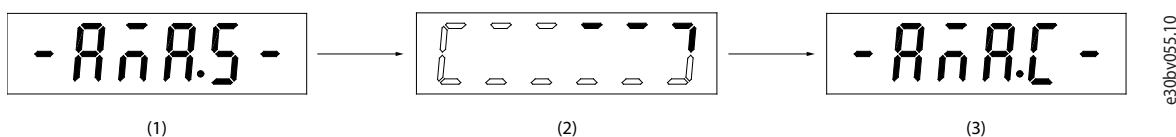


Figure 36: AMA Status Indications

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

## 5.5 Application Selection

### 5.5.1 Application Selection Overview

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

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

#### NOTICE

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

#### NOTICE

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



The iC2-Micro Frequency Converters have 5 standard modes which have pre-configured parameters and are set automatically. [Table 14](#) contains a summary of the different modes and suitable applications.

**Table 14: Standard Modes and Suitable Application**

| Application selection mode | Suitable application                                                                                                                                                                                                                                 |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Speed control mode         | The default mode in iC2-Micro Frequency Converters application selection function. The mode is used in typical speed control applications for running at stable speed, the frequency converter is controlled by an analog input as reference signal. |
| Process control mode       | The mode is suitable for applications which require monitoring and adjusting of, for example, temperature, pressure, speed, which must be kept at a desired level using sensor feedback.                                                             |
| Multi speed control mode   | The mode is suitable for applications with 4 different speeds by using 2 digital inputs. By using 1 more digital input, 8 speeds are possible.                                                                                                       |
| 3-wire control mode        | The mode is suitable for typical speed control applications where start or stop is controlled with 2 push buttons.                                                                                                                                   |
| Torque control mode        | Suitable for torque control applications which require motor control via torque.                                                                                                                                                                     |

## 5.5.2 Configuring Speed Control Mode

The section describes the basic configuration for speed control mode.

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

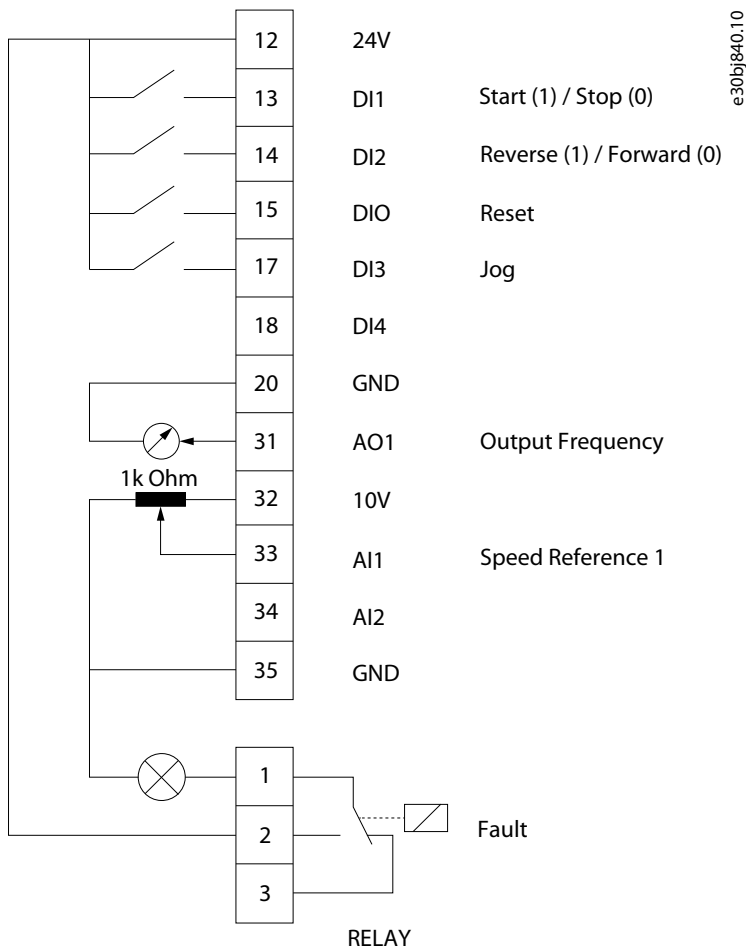


Figure 37: Default Connections

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

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

Table 15: Default Settings

| Category       | Parameter index | Parameter name           | Default setting            | Parameter number |
|----------------|-----------------|--------------------------|----------------------------|------------------|
| Operation Mode | 5.4.2           | <b>Operation Mode</b>    | <b>[0] Speed Open Loop</b> | 100              |
| DI 1 - T13     | 9.4.1.2         | <b>T13 Digital Input</b> | <b>[8] Start</b>           | 510              |
| DI 2 - T14     | 9.4.1.3         | <b>T14 Digital Input</b> | <b>[10] Reversing</b>      | 511              |
| DI/O - T15     | 9.4.1.4         | <b>T15 Digital Input</b> | <b>[1] Reset</b>           | 512              |
| DI 3 - T17     | 9.4.1.5         | <b>T17 Digital Input</b> | <b>[14] Jog</b>            | 513              |
| DI 4 - T18     | 9.4.1.6         | <b>T18 Digital Input</b> | <b>[0] No Operation</b>    | 515              |

Table 15: Default Settings (continued)

| Category           | Parameter index | Parameter name                    | Default setting                                                                                              | Parameter number |
|--------------------|-----------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------|------------------|
| AI1 - T33          | 9.5.2.1         | <i>T33 mode</i>                   | <i>[1] 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>                   | <i>[0] 0-20mA</i>                                                                                            | 690              |
|                    | 9.5.1.2         | <i>T31 Analog Output</i>          | <i>*[100] Output Frequency</i>                                                                               | 691              |
| Relay              | 9.4.3.1         | <i>Function Relay</i>             | <i>[9] Fault</i>                                                                                             | 540              |
| External reference | 5.5.3.5         | <i>Reference Function</i>         | <i>[0] Sum</i>                                                                                               | 304              |
|                    | 5.5.3.7         | <i>Reference 1 Source</i>         | <i>[1] Analog Input 33</i>                                                                                   | 315              |
|                    | 5.5.3.8         | <i>Reference 2 Source</i>         | <i>[2] Analog Input 34</i>                                                                                   | 316              |
|                    | 5.5.3.9         | <i>Reference 3 Source</i>         | <i>[11] Local Bus Reference</i>                                                                              | 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 <i>[1] 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              |

### 5.5.3 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. Set these parameters according to the application's requirements.

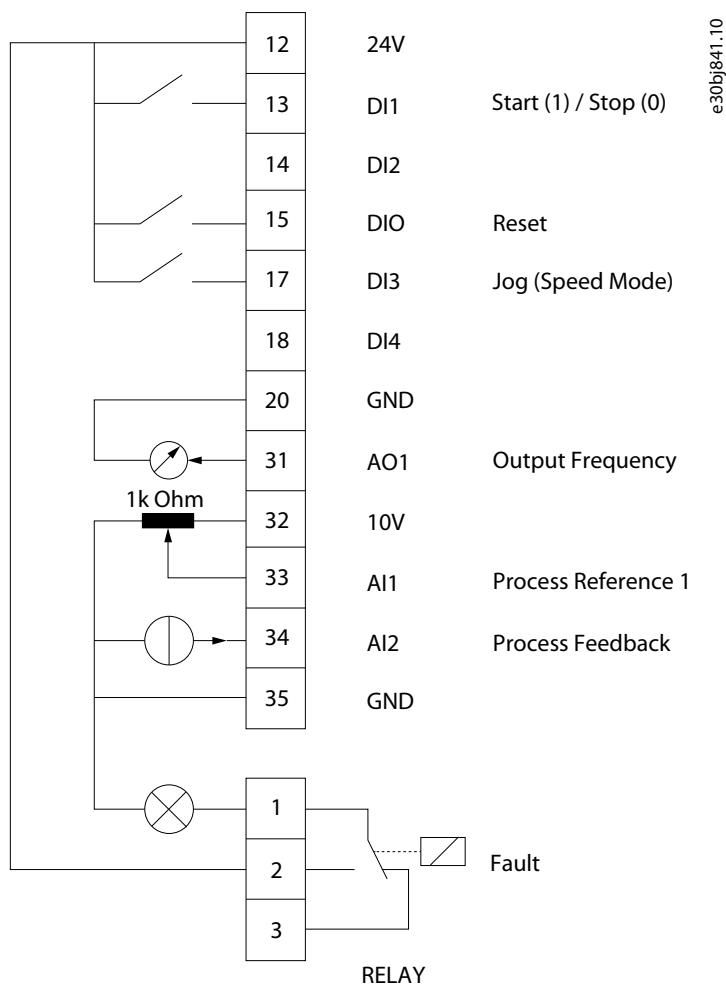


Figure 38: Default Connections for Process Control

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

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

Table 16: Process Control Mode Default Settings

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

Table 16: Process Control Mode Default Settings (continued)

| Category           | Parameter index | Parameter name                      | Default setting                                                                                             | Parameter number |
|--------------------|-----------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| AI1 - T33          | 9.5.2.1         | <i>T33 mode</i>                     | <i>[1] Voltage Mode</i>                                                                                     | 619              |
|                    | 9.5.2.2         | <i>T33 High Voltage</i>             | 10V                                                                                                         | 611              |
|                    | 9.5.2.3         | <i>T33 Low Voltage</i>              | 0.07 V                                                                                                      | 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              |
| AI2 - T34          | 9.5.3.1         | <i>T34 mode</i>                     | <i>[0] Current Mode</i>                                                                                     | 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 <i>[1] North America</i> is selected for <i>P 1.2.1 Regional Settings</i> , 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>                     | <i>[0] 0-20mA</i>                                                                                           | 690              |
|                    | 9.5.1.2         | <i>T31 Analog Output</i>            | <i>[100] Output Frequency</i>                                                                               | 691              |
| Relay              | 9.4.3.1         | <i>Function Relay</i>               | <i>[9] Fault</i>                                                                                            | 540              |
| PID                | 5.12.4.1        | <i>Feedback 1 Resource</i>          | <i>[2] Analog Input 34</i>                                                                                  | 720              |
|                    | 5.12.5.7        | <i>PID Normal / Inverse Control</i> | <i>[0] Normal</i>                                                                                           | 730              |
| Jog                | 5.9.2           | <i>Jog Reference</i>                | 5.0                                                                                                         | 311              |
|                    | 5.9.1           | <i>Jog Ramp Time</i>                | 3 s                                                                                                         | 380              |
| External reference | 5.5.3.5         | <i>Reference Function</i>           | <i>[0] Sum</i>                                                                                              | 304              |
|                    | 5.5.3.7         | <i>Reference 1 Source</i>           | <i>[1] Analog Input 33</i>                                                                                  | 315              |
|                    | 5.5.3.8         | <i>Reference 2 Source</i>           | <i>[0] Function</i>                                                                                         | 316              |
|                    | 5.5.3.9         | <i>Reference 3 Source</i>           | <i>[0] Function</i>                                                                                         | 317              |

## 5.5.4 Configuring Multi-Speed Control Mode

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

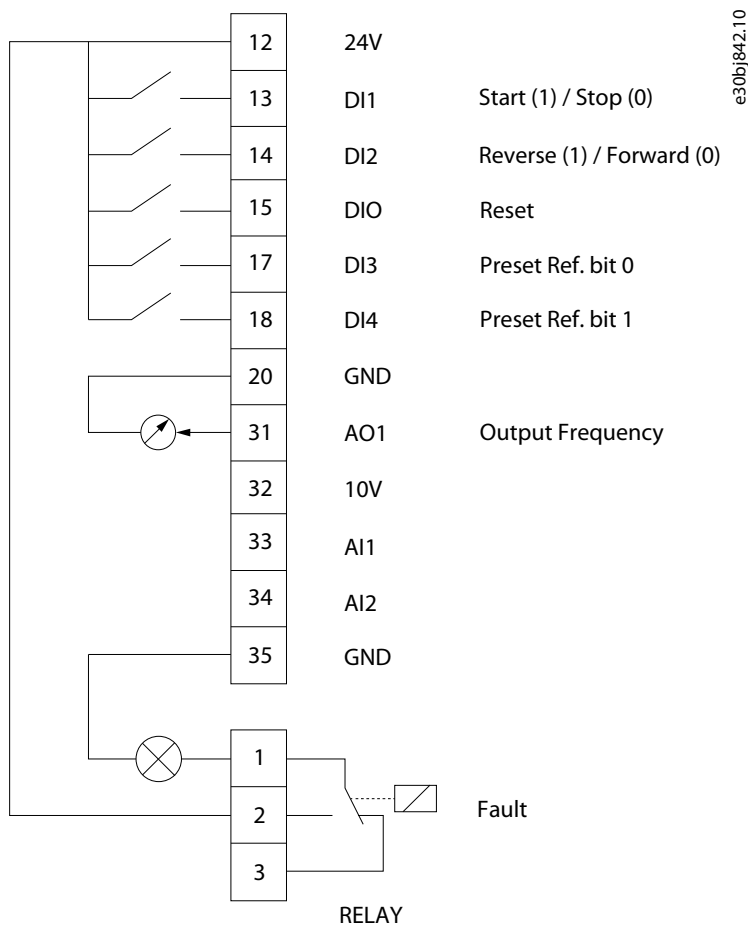


Figure 39: Default Connections

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

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

Table 17: Default Settings

| Category       | Parameter index | Parameter name           | Default setting               | Parameter number |
|----------------|-----------------|--------------------------|-------------------------------|------------------|
| Operation mode | 5.4.2           | <i>Operation Mode</i>    | <b>[0] Speed Open Loop</b>    | 100              |
| DI 1 - T13     | 9.4.1.2         | <i>T13 Digital Input</i> | <b>[8] Start</b>              | 510              |
| DI 2 - T14     | 9.4.1.3         | <i>T14 Digital Input</i> | <b>[10] Reversing</b>         | 511              |
| DI/O - T15     | 9.4.1.4         | <i>T15 Digital Input</i> | <b>[1] Reset</b>              | 512              |
| DI 3 - T17     | 9.4.1.5         | <i>T17 Digital Input</i> | <b>[16] Preset Ref. Bit 0</b> | 513              |
| DI 4 - T18     | 9.4.1.6         | <i>T18 Digital Input</i> | <b>[17] Preset Ref. Bit 1</b> | 515              |
| AO1 - T42      | 9.5.1.1         | <i>T31 Mode</i>          | <b>[0] 0–20 mA</b>            | 690              |
|                | 9.5.1.2         | <i>T31 Analog Output</i> | <b>[100] Output Frequency</b> | 691              |
| Relay          | 9.4.3.1         | <i>Function Relay</i>    | <b>[9] Fault</b>              | 540              |

Table 17: Default Settings (continued)

| Category           | Parameter index | Parameter name            | Default setting                                                                                             | Parameter number |
|--------------------|-----------------|---------------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| 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>   | <b>Note:</b> Set as array type <a href="#">Table 18</a> .                                                   | 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] <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              |

Table 18: Parameter P 5.5.3.10 Preset Reference Setting (Array Type)

| 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                       |

### 5.5.5 Configuring Wire Control Mode

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

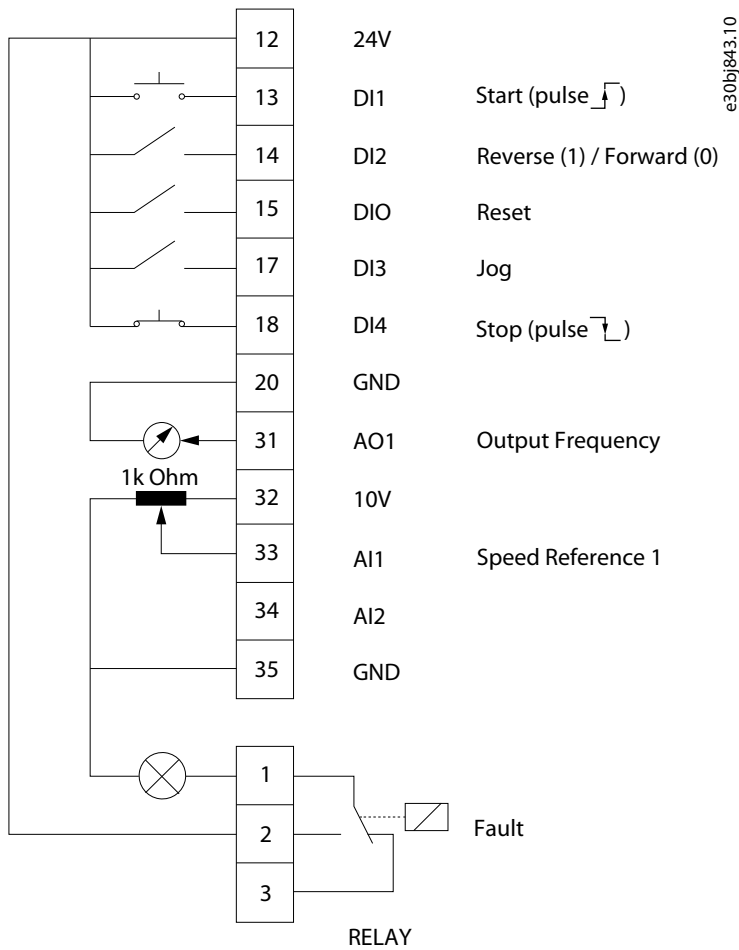


Figure 40: Default Connections

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

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

Table 19: Default Settings

| Category       | Parameter index | Parameter name           | Default setting            | Parameter number |
|----------------|-----------------|--------------------------|----------------------------|------------------|
| Operation mode | 5.4.2           | <i>Operation Mode</i>    | <i>[0] Speed Open Loop</i> | 100              |
| DI 1 - T13     | 9.4.1.2         | <i>T13 Digital Input</i> | <i>[9] Latched start</i>   | 510              |
| DI 2 - T14     | 9.4.1.3         | <i>T14 Digital Input</i> | <i>[10] Reversing</i>      | 511              |
| DI/O - T15     | 9.4.1.4         | <i>T15 Digital Input</i> | <i>[1] Reset</i>           | 512              |
| DI 3 - T17     | 9.4.1.5         | <i>T17 Digital Input</i> | <i>[14] Jog</i>            | 513              |
| DI 4 - T18     | 9.4.1.6         | <i>T18 Digital Input</i> | <i>[6] Stop inverse</i>    | 515              |



Table 19: Default Settings (continued)

| Category           | Parameter index | Parameter name                    | Default setting                                                                                             | Parameter number |
|--------------------|-----------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| AI1 - T33          | 9.5.2.1         | <i>T33 Mode</i>                   | <i>[1] Voltage Mode</i>                                                                                     | 619              |
|                    | 9.5.2.2         | <i>T33 High Voltage</i>           | 10 V                                                                                                        | 611              |
|                    | 9.5.2.3         | <i>T33 Low Voltage</i>            | 0.07 V                                                                                                      | 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>                   | <i>[0] 0-20mA</i>                                                                                           | 690              |
|                    | 9.5.1.2         | <i>T31 Analog Output</i>          | <i>[100] Output Frequency</i>                                                                               | 691              |
| Relay              | 9.4.3.1         | <i>Function Relay</i>             | <i>[9] Fault</i>                                                                                            | 540              |
| External reference | 5.5.3.5         | <i>Reference Function</i>         | <i>[0] Sum</i>                                                                                              | 304              |
|                    | 5.5.3.7         | <i>Reference 1 Source</i>         | <i>[1] Analog Input 33</i>                                                                                  | 315              |
|                    | 5.5.3.8         | <i>Reference 2 Source</i>         | <i>[0] No Function</i>                                                                                      | 316              |
|                    | 5.5.3.9         | <i>Reference 3 Source</i>         | <i>[0] No Function</i>                                                                                      | 317              |
| 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 <i>[1] 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              |

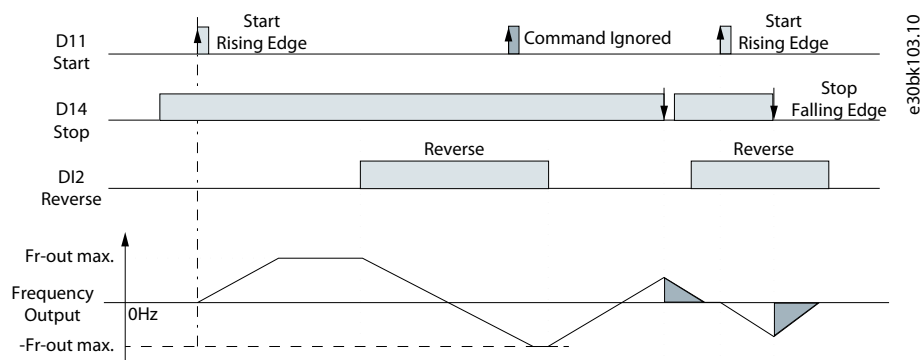


Figure 41: Example

## 5.5.6 Configuring Torque Control Mode

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

**Note the following:**

- Torque control mode is supported in VVC+ control only, and only for [0] *Asynchronous Induction Motor, IM* selected in **P 4.2.1.1 Motor Type** control.
- Torque reference value for **P 5.5.3.3 Reference Maximum** is calculated automatically based on the motor data entered according to motor nameplate.
- Make sure **P 9.5.2.6 T33 High Ref./Feedb. Value** is set according to the application requirement. Typically, the value in **P 9.5.2.6 T33 High Ref./Feedb. Value** is equal to the value in **P 5.5.3.3 Reference Maximum**.
- If the operation does not require speed limit under torque control, set **P 5.10.3 Speed Limit Mode Torque Ctrl.** to [0] *No Function*.

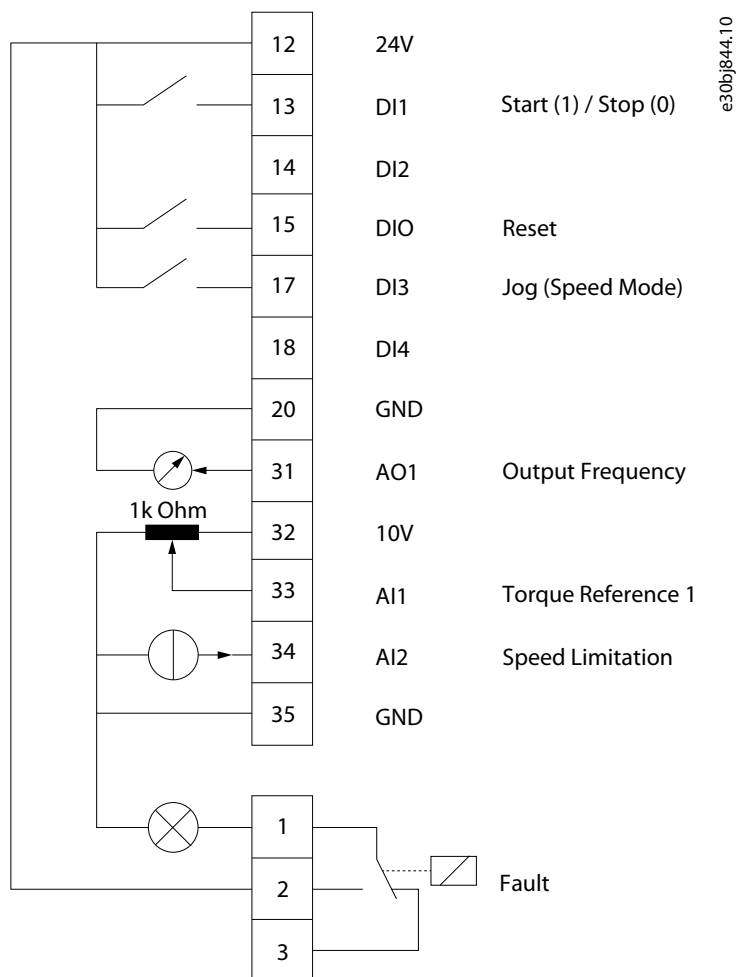


Figure 42: Default Connections

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

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

Table 20: Default Settings

| Category           | Parameter index | Parameter name                       | Default setting                                                                                             | Parameter number |
|--------------------|-----------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| Operation mode     | 5.4.2           | <i>Operation Mode</i>                | <i>[4] Torque Open Loop</i>                                                                                 | 100              |
| DI 1 - T13         | 9.4.1.2         | <i>T13 Digital Input</i>             | <i>[8] Start</i>                                                                                            | 510              |
| DI 2 - T14         | 9.4.1.3         | <i>T14 Digital Input</i>             | <i>[0] No operation</i>                                                                                     | 511              |
| DI/O - T15         | 9.4.1.4         | <i>T15 Digital Input</i>             | <i>[1] Reset</i>                                                                                            | 512              |
| DI 3 - T17         | 9.4.1.5         | <i>T17 Digital Input</i>             | <i>[14] Jog</i>                                                                                             | 513              |
| DI 4 - T18         | 9.4.1.6         | <i>T18 Digital Input</i>             | <i>[0] No Operation</i>                                                                                     | 515              |
| AI1 - T33          | 9.5.2.1         | <i>T33 Mode</i>                      | <i>[1] 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>    | 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>                      | <i>[0] Current Mode</i>                                                                                     | 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 <i>[1] North America</i> is selected for <i>P 1.2.1 Regional Settings</i> , 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>                      | <i>[0] 0-20 mA</i>                                                                                          | 690              |
|                    | 9.5.1.2         | <i>T31 Analog Output</i>             | <i>[100] Output Frequency</i>                                                                               | 691              |
| Relay              | 9.4.3.1         | <i>Function Relay</i>                | <i>[9] Fault</i>                                                                                            | 540              |
| External reference | 5.5.3.5         | <i>Reference Function</i>            | <i>[0] Sum</i>                                                                                              | 304              |
|                    | 5.5.3.7         | <i>Reference 1 Source</i>            | <i>[1] Analog Input 33</i>                                                                                  | 315              |
|                    | 5.5.3.8         | <i>Reference 2 Source</i>            | <i>[0] No Function</i>                                                                                      | 316              |
|                    | 5.5.3.9         | <i>Reference 3 Source</i>            | <i>[11] No Function</i>                                                                                     | 317              |
| Speed Limit        | 5.10.3          | <i>Speed Limit Mode Torque Ctrl.</i> | <i>[0] No Function</i>                                                                                      | 421              |

Table 20: Default Settings (*continued*)

| Category         | Parameter index | Parameter name           | Default setting                                            | Parameter number |
|------------------|-----------------|--------------------------|------------------------------------------------------------|------------------|
| 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 [Figure 43](#).

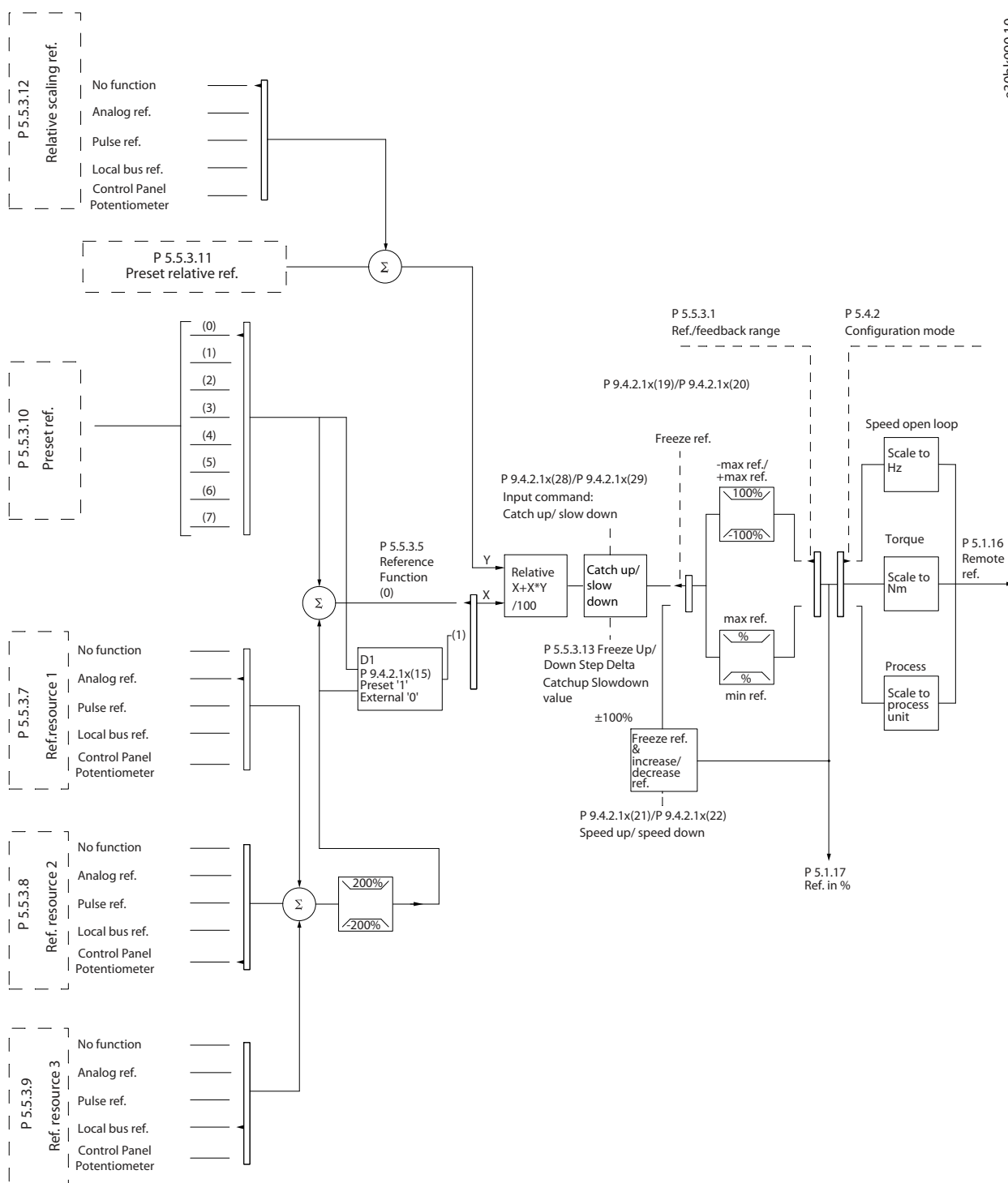


Figure 43: Remote Reference

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

- **X (the external reference):** A sum (see **P 5.5.3.5 T34 Low Current**) of up to 4 externally selected references, comprising any combination (determined by the setting of **P 5.5.3.7 Reference 1 Source**, **P 5.5.3.8 Reference 2 Source**, and **P 5.5.3.9 Reference 3 Source**) of a fixed preset reference (**P 5.5.3.10 Preset Reference**), variable analog references, variable digital pulse references, and various fieldbus references in any unit the drive is monitoring ([Hz], [RPM], [Nm], and so on).
- **Y (the relative reference):** A sum of 1 fixed preset reference (**P 5.5.3.11 Preset Relative Reference**) and 1 variable analog reference (**P 5.5.3.12 Relative Scaling Reference Resource**) in [%].

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

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

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

## 5.6.2 Reference Limits

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

Reference range = Minimum to maximum

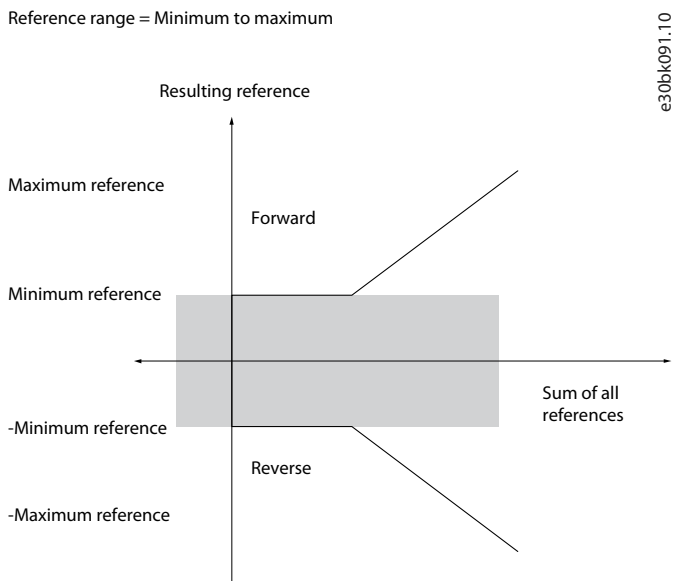


Figure 44: Reference Range is Set to 0

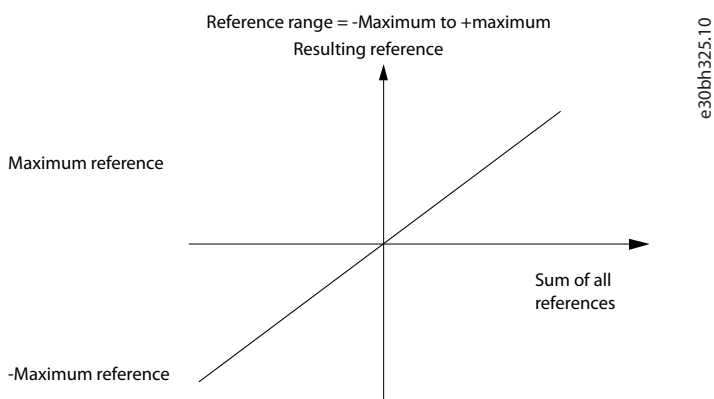


Figure 45: Reference Range is Set to 1

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

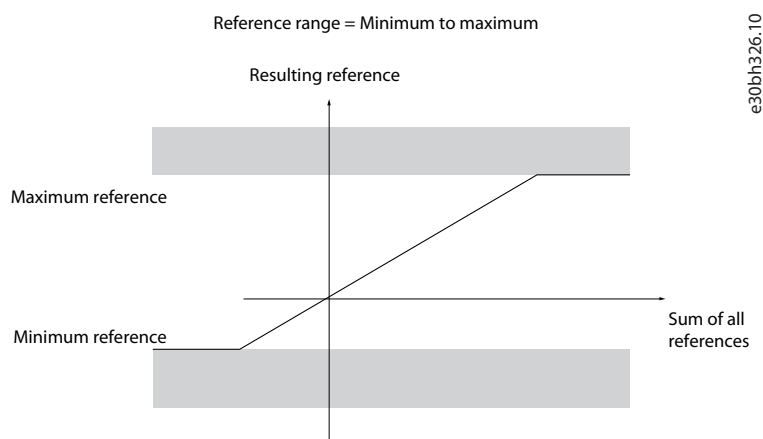


Figure 46: Sum of all References when Configuration Mode is set to Process

### 5.6.3 Scaling of Preset References and Bus References

Preset references are scaled according to the following rules:

- When **P 5.5.3.1 Reference Range** is set to **[0] Min–Max**, 0% reference equals 0 [unit] where unit can be any unit, for example RPM, m/s, and bar. 100% reference equals the maximum (absolute value of **P 5.5.3.3 Reference Maximum**, absolute value of **P 5.5.3.4 Reference Minimum**).
- When **P 5.5.3.3 Reference Range** is set to **[1] -Max–+Max**, 0% reference equals 0 [unit], and 100% reference equals maximum reference.

Bus references are scaled according to the following rules:

- When **P 5.5.3.1 Reference Range** is set to **[0] Min–Max**, 0% reference equals minimum reference and 100% reference equals maximum reference.
- When **P 5.5.3.1 Reference Range** is set to **[1] -Max–+Max**, -100% reference equals -maximum reference, and 100% reference equals maximum reference.

### 5.6.4 Scaling of Analog and Pulse References and Feedback

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

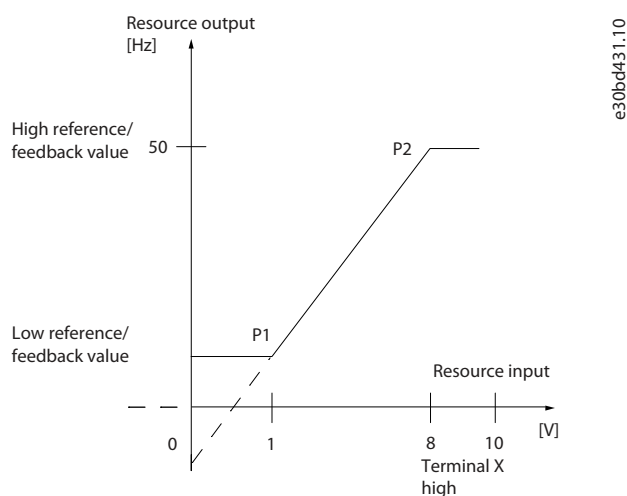


Figure 47: Minimum and Maximum Endpoints

The endpoints P1 and P2 are defined in the [Table 21](#) depending on the choice of input.

Table 21: 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                           | <i>P 9.5.2.7 T33 Low Ref./ Feedb. Value</i>  | <i>P 9.5.3.7 T34 Low Ref./ Feedb. Value</i>  | <i>P 9.5.3.7 T34 Low Ref./ Feedb. Value</i>  | <i>P 9.4.4.4 T18 Low Ref./ Feedb. Value</i>  |
| Minimum input value                               | <i>P 9.5.2.3 T33 Low Voltage</i>             | <i>P 9.5.3.3 T34 Low Voltage</i>             | <i>P 9.5.3.5 T34 Low Current</i>             | <i>P 9.4.4.2 T18 Low Frequency</i>           |
| P2=(Maximum input value, maximum reference value) |                                              |                                              |                                              |                                              |
| Maximum reference value                           | <i>P 9.5.2.6 T33 High Ref./ Feedb. Value</i> | <i>P 9.5.3.6 T34 High Ref./ Feedb. Value</i> | <i>P 9.5.3.6 T34 High Ref./ Feedb. Value</i> | <i>P 9.4.4.3 T18 High Ref./ Feedb. Value</i> |
| Maximum input value                               | <i>P 9.5.2.2 T33 High Voltage</i>            | <i>P 9.5.3.2 T34 High Voltage</i>            | <i>P 9.5.3.4 T34 High Current</i>            | <i>P 9.4.4.1 T18 High Frequency</i>          |

### 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 21](#) for relevant parameter) or maximum reference value at 0. In other words, either P1 or P2 must be on the X-axis in the [Figure 48](#).
- Ensure that both points defining the scaling graph are in the same quadrant.

P1 or P2 defines the size of the dead band as shown in the [Figure 48](#).

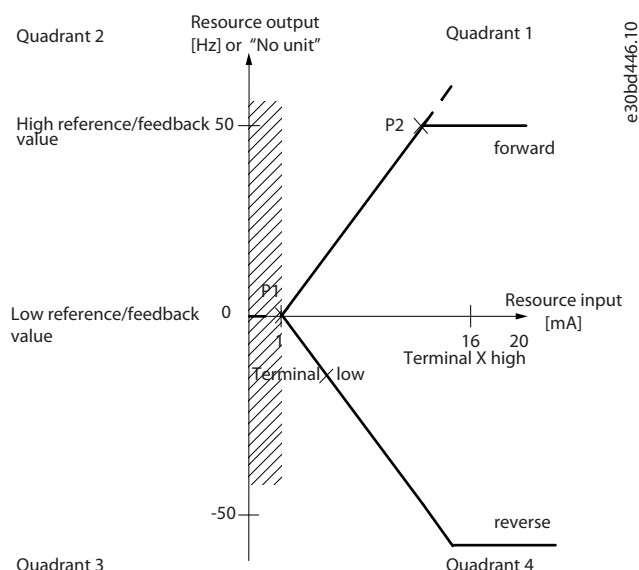


Figure 48: Size of Dead Band

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

[Figure 49](#) shows how reference input with limits inside minimum to maximum limits clamps.



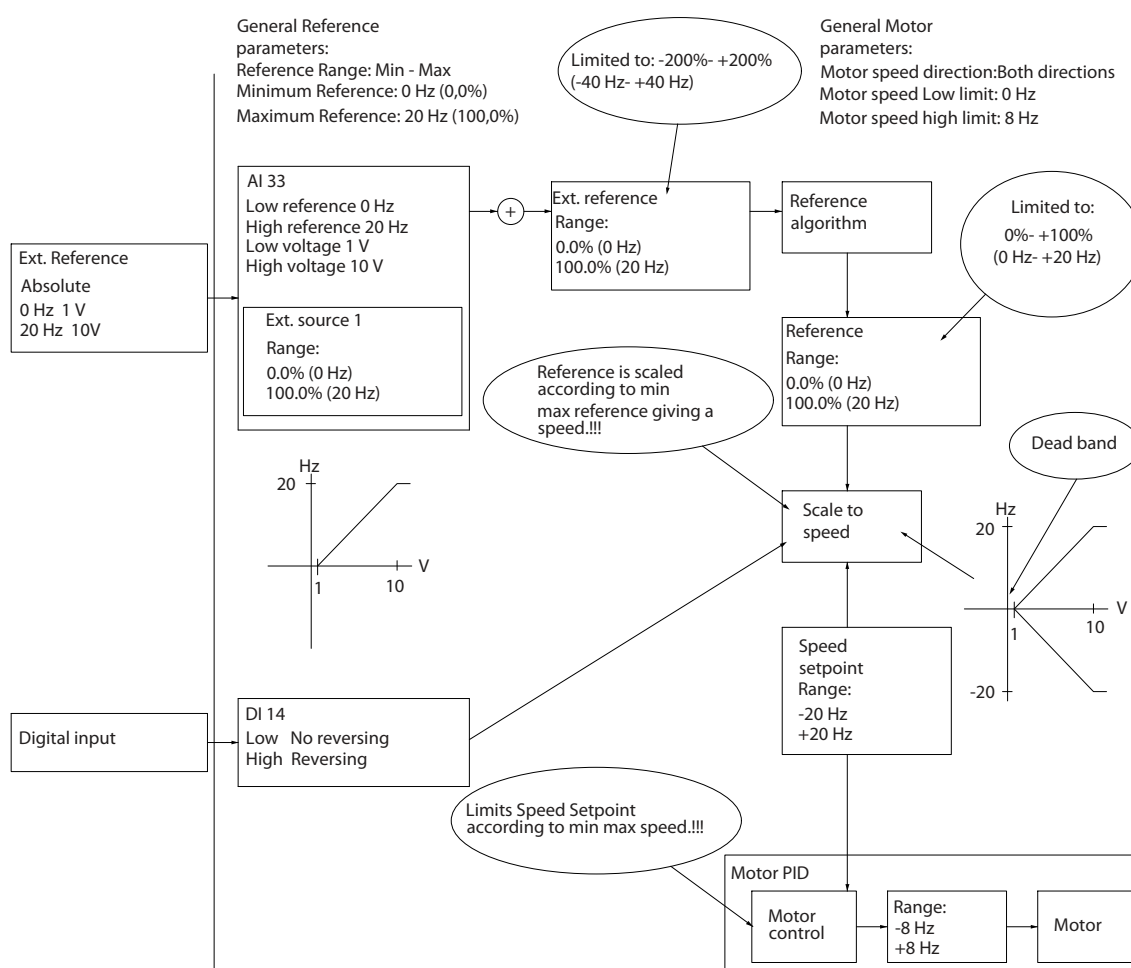
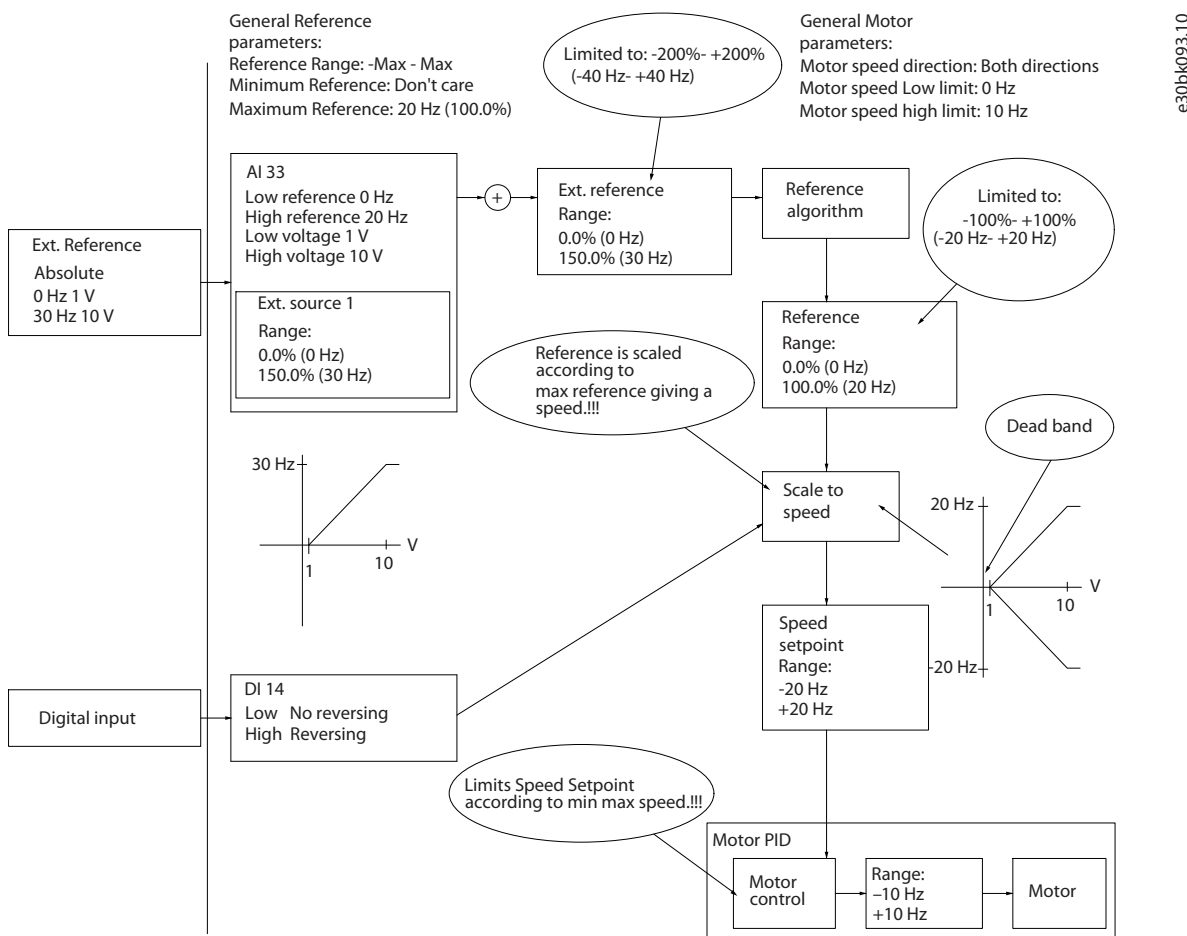


Figure 49: Clamping of Reference Input with Limits inside Minimum to Maximum

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

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



e30bk093.10

## 6 RS485 Configurations

### 6.1 RS485 Installation and Set up

#### 6.1.1 Introduction

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 [Figure 51](#).

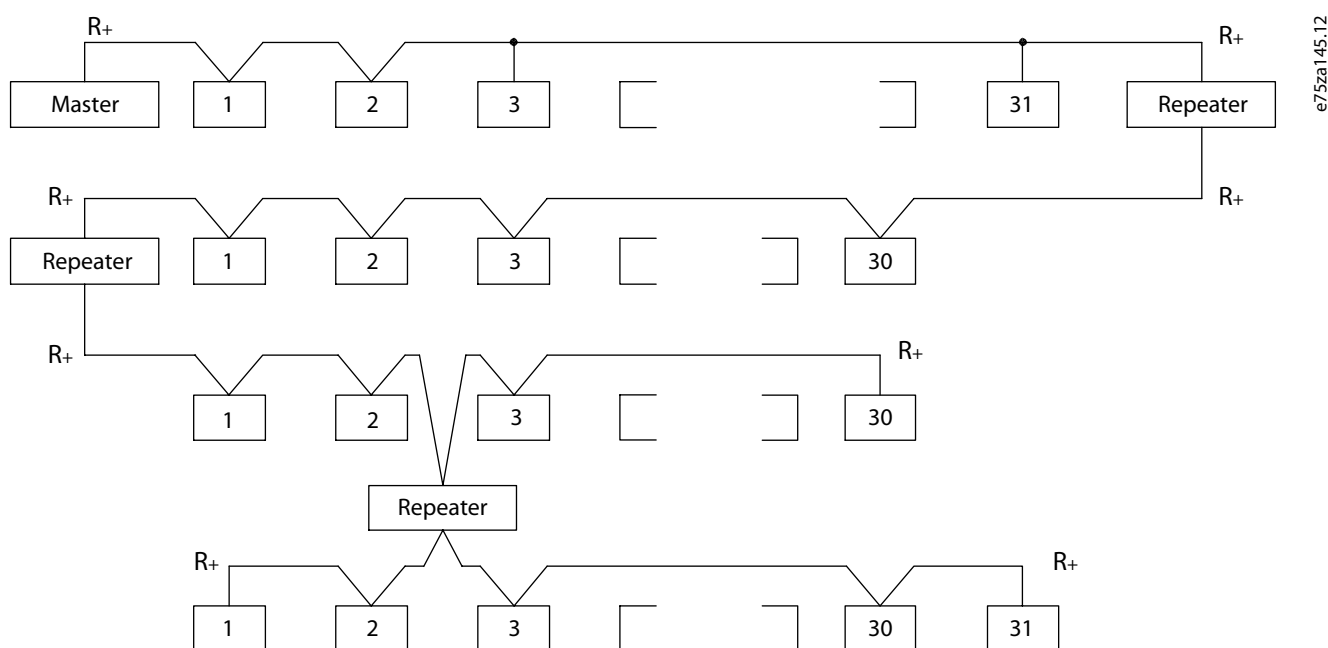


Figure 51: RS485 Bus Interface

#### 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 22: Cable Specifications

| Cable                  | Shielded twisted pair (STP)                                                           |
|------------------------|---------------------------------------------------------------------------------------|
| Impedance [ $\Omega$ ] | 120                                                                                   |
| Cable length [m (ft)]  | Maximum 1200 (3937) (including drop lines).<br>Maximum 500 (1640) station-to-station. |

6.1.2 Connecting the Drive to the RS485 Network

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

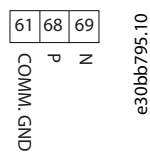


Figure 52: Network Connection

- 2. Connect the cable shield to the cable clamps.

NOTICE

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

6.1.3 Hardware Setup

To terminate the RS485 bus, use the terminator switch on the main control board of the drive. The factory setting for the switch is OFF.

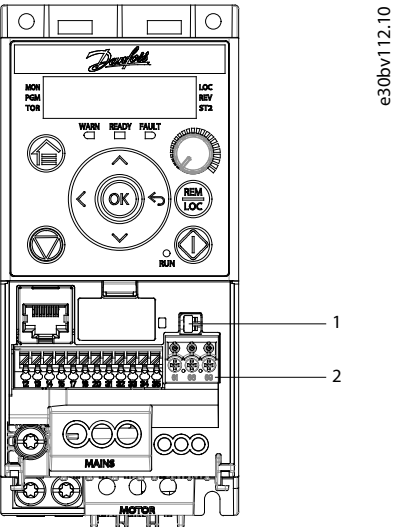


Figure 53: Terminator Switch Factory Setting

|   |                                                          |   |                 |
|---|----------------------------------------------------------|---|-----------------|
| 1 | RS485 termination switch (ON=RS485 terminated, OFF=Open) | 2 | RS485 terminals |
|---|----------------------------------------------------------|---|-----------------|

6.1.4 Parameter Settings for RS485 Communication

Two communication protocols are internal to the frequency converter.

- Danfoss FC

- Modbus RTU

Functions can be programmed remotely using the protocol software and RS485 connection, or in parameter group 10.

Table 23: RS485 Communication Parameter Settings

| Parameter                              | Function                                                                                                                                             |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>P 10.1.1 Protocol</i>               | Select the application protocol to run for the RS485 interface.                                                                                      |
| <i>P 10.1.2 Address</i>                | Set the node address.<br><br><b>NOTICE</b><br>The address range depends on the protocol selected in <i>P 10.1.1 Protocol</i> .                       |
| <i>P 10.1.3 Baud Rate</i>              | Set the baud rate.<br><br><b>NOTICE</b><br>The default baud rate depends on the protocol selected in <i>P 10.1.1 Protocol</i> .                      |
| <i>P 10.1.4 Parity/Stop Bits</i>       | Set the parity and number of stop bits.<br><br><b>NOTICE</b><br>The default selection depends on the protocol selected in <i>P 10.1.1 Protocol</i> . |
| <i>P 10.1.6 Minimum Response Delay</i> | Specify a minimum delay time between receiving a request and sending a response. This function is for overcoming modem turnaround delays.            |
| <i>P 10.1.5 Maximum Response Delay</i> | Specify a maximum delay time between sending a request and receiving a response.                                                                     |

### 6.1.5 EMC Precautions

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

| NOTICE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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°. |

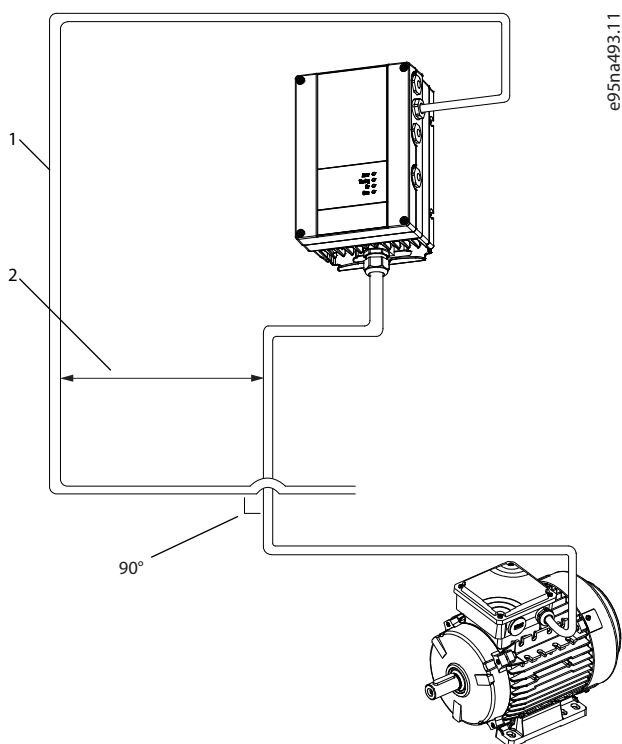


Figure 54: Minimum Distance between Communication and Power Cables

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

## 6.1.6 FC Protocol

### 6.1.6.1 FC Protocol Overview

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

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

The master function cannot be transferred to another node (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.

## 6.1.6.2 FC Protocol Message Framing Structure

### 6.1.6.2.1 Content of a Character (byte)

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

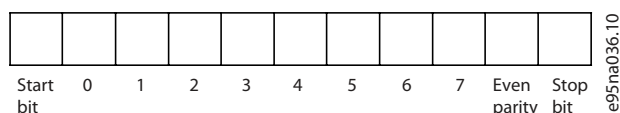


Figure 55: Content of a Character

### 6.1.6.2.2 Telegram Structure

Each telegram has the following structure:

- Start character (STX) = 02 hex.
- A byte denoting the telegram length (LGE).
- A byte denoting the drive address (ADR).

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

A data control byte (BCC) completes the telegram.



Figure 56: Telegram Structure

### 6.1.6.2.3 Telegram Length (LGE)

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

Table 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 <sup>(1)</sup> +n bytes |

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

#### 6.1.6.2.4 Drive Address (ADR)

Address format 1–126:

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

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

#### 6.1.6.2.5 Data Control Byte (BCC)

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

#### 6.1.6.2.6 The Data Field

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

The 3 types of telegram are:

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

##### Process block (PCD)

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

- Control word and reference value (from master to follower).
- Status word and present output frequency (from follower to master).

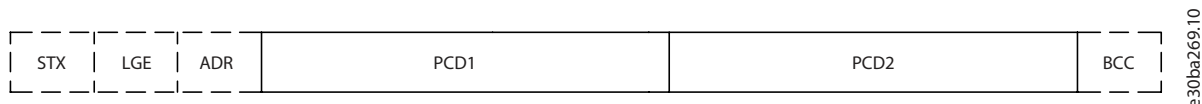


Figure 57: Process Block

##### Parameter block

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

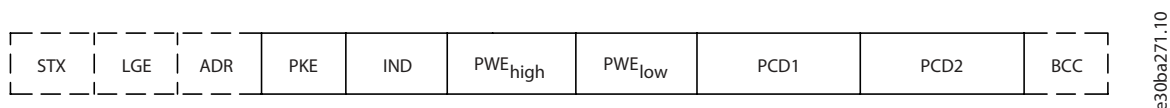


Figure 58: Parameter Block

##### Text block

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

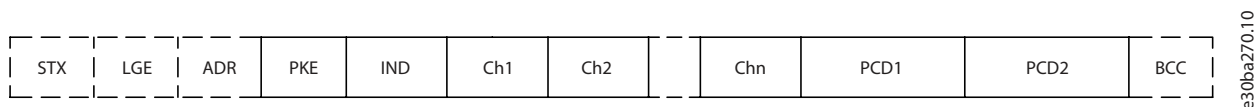


Figure 59: Text Block



### 6.1.6.2.7 The PKE Field

The PKE field contains 2 subfields:

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

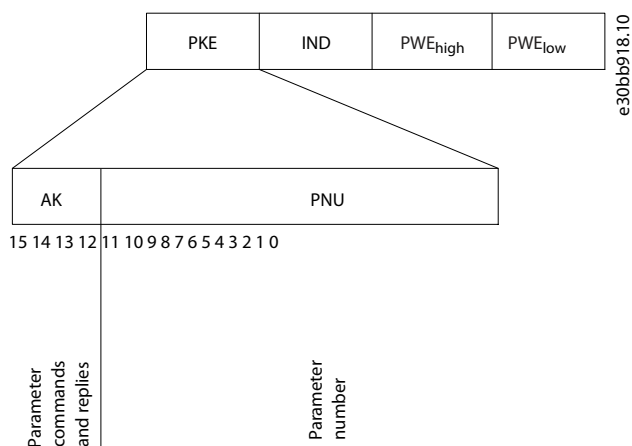


Figure 60: PKE Field

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

Table 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). |

Table 26: Response (*continued*)

|   |   |   |   |                              |
|---|---|---|---|------------------------------|
| 0 | 1 | 1 | 1 | Command cannot be performed. |
| 1 | 1 | 1 | 1 | Text transferred.            |

If the command cannot be performed, the follower sends *0111 Command cannot be performed* response and issues the following fault reports in the [Table 27](#).

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.                                |

#### 6.1.6.2.8 Parameter Number (PNU)

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

### 6.1.6.2.9 Index (IND)

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

### 6.1.6.2.10 Parameter Value (PWE)

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

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

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

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

### 6.1.6.2.11 Data Types Supported by the Drive

Table 28: Data Types

| Data types | Description                |
|------------|----------------------------|
| 3          | Integer 16                 |
| 4          | Integer 32                 |
| 5          | Unsigned 8 <sup>(1)</sup>  |
| 6          | Unsigned 16 <sup>(1)</sup> |
| 7          | Unsigned 32 <sup>(1)</sup> |
| 9          | Text string                |
| 10         | Byte string                |
| 13         | Time difference            |
| 33         | Reserved                   |
| 35         | Bit sequence               |

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

### 6.1.6.2.12 Conversion

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

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

Table 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           |

#### 6.1.6.2.13 Process Words (PCD)

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

Table 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 |

#### 6.1.6.3 Examples

##### 6.1.6.3.1 Overview of Examples

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

##### 6.1.6.3.2 Writing a Parameter Value

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

Write the data in EEPROM.

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

- IND = 0000 hex.
- PWE<sub>HIGH</sub> = 0000 hex.
- PWE<sub>LOW</sub> = 03E8 hex.

Data value 1000, corresponding to 100 Hz, see [6.1.6.2.12 Conversion](#).

The telegram looks like the following illustration.

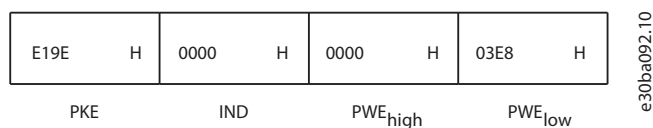


Figure 61: Telegram

## NOTICE

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

The response from the follower to the master is shown in the [Figure 62](#).

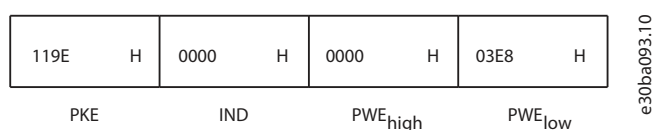


Figure 62: Response from Master

### 6.1.6.3.3 Reading a Parameter Value

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

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

- IND = 0000 hex.
- PWE<sub>HIGH</sub> = 0000 hex.
- PWE<sub>LOW</sub> = 0000 hex.

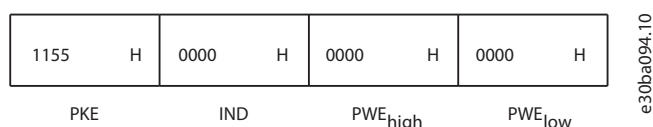


Figure 63: Telegram

If the value in **P 5.5.4.2 Ramp 1 Ramp Up Time** is 10 s, the response from the follower to the master is shown in the [Figure 64](#).

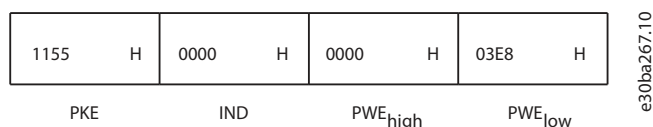


Figure 64: Response

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

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

## 6.1.7 Modbus RTU

### 6.1.7.1 Modbus RTU Introduction

#### Prerequisite knowledge

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

### Modbus RTU overview

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

During communications over a Modbus RTU network, the protocol:

- determines how each controller learns its device address.
- recognizes a telegram addressed to it.
- determines which actions to take.
- extracts any data or other information contained in the telegram.

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

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

- The device (or broadcast) address.
- A function code defining the requested action.
- Any data to be sent.
- An error-checking field.

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

#### 6.1.7.2 Drive with Modbus RTU

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

### 6.1.7.3 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) |

### 6.1.7.4 Modbus RTU Message Framing Structure

#### 6.1.7.4.1 Modbus RTU Message Byte Format

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

Table 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.<br>2 hexadecimal characters contained in each 8-bit field of the telegram.                                                                                                                               |
| Bits per byte     | <ul style="list-style-type: none"> <li>1 start bit.</li> <li>8 data bits, least significant bit sent first.</li> <li>1 bit for even/odd parity; no bit for no parity.</li> <li>1 stop bit if parity is used; 2 bits if no parity.</li> </ul> |
| Error check field | Cyclic redundancy check (CRC).                                                                                                                                                                                                               |

#### 6.1.7.4.2 Modbus RTU Telegram Structure

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

Table 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 |

#### 6.1.7.4.3 Start/Stop Field

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

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

#### 6.1.7.4.4 Address Field

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

#### 6.1.7.4.5 Function Field

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

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

#### 6.1.7.4.6 Data Field

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

The information can include items such as:

- Coil or register addresses.
- The quantity of items to be handled.
- The count of actual data bytes in the field.



#### 6.1.7.4.7 CRC Check Field

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

#### 6.1.7.4.8 Coil Register Addressing

##### Introduction

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

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

##### Coil Register

Table 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.<br>Closed-loop mode: Drive feedback signal. | Follower to master |
| 65          | Parameter write control (master to follower).                                       | Master to follower |
|             | 0 = Parameter changes are written to the RAM of the drive.                          |                    |
|             | 1 = Parameter changes are written to the RAM and EEPROM of the drive.               |                    |
| 66–65536    | Reserved.                                                                           | –                  |

##### Drive Control Word (FC Profile)

Table 36: Drive Control Word (FC Profile)

| Coil | 0                    | 1           |
|------|----------------------|-------------|
| 01   | Preset reference lsb |             |
| 02   | Preset reference msb |             |
| 03   | DC brake             | No DC brake |

Table 36: Drive Control Word (FC Profile) (continued)

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

## Drive Status Word (FC Profile)

Table 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   | Local mode             | Remote mode        |
| 43   | Out of frequency range | In frequency range |
| 44   | Stopped                | Running            |
| 45   | Not used               | Not used           |
| 46   | No voltage warning     | Voltage warning    |

Table 37: Drive Status Word (FC Profile) (continued)

| Coil | 0                    | 1               |
|------|----------------------|-----------------|
| 47   | Not in current limit | Current limit   |
| 48   | No thermal warning   | Thermal warning |

## Address/Registers

Table 38: Address/Registers

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

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

### 6.1.7.5 How to Access Parameters

#### 6.1.7.5.1 Parameter Handling

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

## Examples

Reading **P 5.5.3.13 Freeze Up/Down Step Delta** (16 bit): The parameter 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.

### 6.1.7.5.2 Storage of Data

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

### 6.1.7.5.3 IND (Index)

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

### 6.1.7.5.4 Text Blocks

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

### 6.1.7.5.5 Conversion Factor

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

### 6.1.7.5.6 Parameter Values

Standard data types

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

Non-standard data types

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

### 6.1.7.6 Examples

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

Description

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

Query

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

Table 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)  | –                    |

### NOTICE

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

### 6.1.7.6.2 Read Holding Registers (03 hex)

#### Description

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

#### Query

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

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

Table 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)       | –             |

### 6.1.7.6.3 Force/Write Single Coil (05 hex)

#### Description

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

#### Query

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

Table 43: Query

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

### 6.1.7.6.4 Preset Single Register (06 hex)

#### Description

This function presets a value into a single holding register.

#### Query

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

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

Table 45: Query

| Field name          | Example (hex)             |
|---------------------|---------------------------|
| Follower address    | 01                        |
| Function            | 06                        |
| Starting address HI | 03 (register address 999) |

Table 45: Query (continued)

| Field name          | Example (hex)             |
|---------------------|---------------------------|
| 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)   | –             |

## 6.1.7.6.5 Preset Multiple Registers (10 hex)

### Description

This function presets values into a sequence of holding registers.

### Query

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

Example of a request to preset 2 registers (set **P 4.2.2.3 Nominal Current** to 738 (7.38 A). The parameter number is 124.

Table 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            |



Table 47: Query (continued)

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

### 6.1.7.6.6 Force/Write Multiple Coils (0F hex)

#### Description

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

#### Query

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

### NOTICE

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

Table 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)      |

Table 49: Query (continued)

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

## 6.1.8 Danfoss FC Control Profile

### 6.1.8.1 Control Word According to FC Profile

Modbus Holding Register numbers for Input data – CTW and REF – and output data – STW and MAV – are defined in [Table 51](#):

Table 51: Modbus Holding Register Numbers for Input and Output Data

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

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

Table 52: Lower Register Numbers for Input and Output Data

|                  |                                                 |
|------------------|-------------------------------------------------|
| 02810 input data | Frequency converter control word register (CTW) |
| 02811 input data | Bus reference register (REF)                    |

Table 52: Lower Register Numbers for Input and Output Data (continued)

|                   |                                                |
|-------------------|------------------------------------------------|
| 02910 output data | Frequency converter status word register (STW) |
| 02911 output data | Frequency converter main value register (MAV)  |

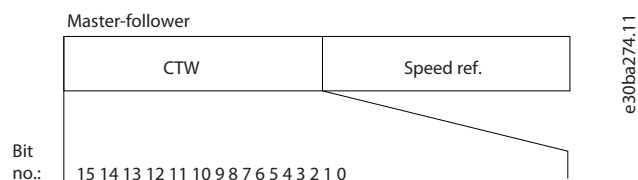


Figure 65: Control Word According to FC Profile

Table 53: Control Word According to FC Profile

| Bit | Bit value = 0         | Bit value = 1          |
|-----|-----------------------|------------------------|
| 00  | Reference value       | External selection lsb |
| 01  | Reference value       | External selection msb |
| 02  | DC brake              | Ramp                   |
| 03  | Coasting              | No coasting            |
| 04  | Quick stop            | Ramp                   |
| 05  | Hold output frequency | Use ramp               |
| 06  | Ramp stop             | Start                  |
| 07  | No function           | Reset                  |
| 08  | No function           | Jog                    |
| 09  | Ramp 1                | Ramp 2                 |
| 10  | Data invalid          | Data valid             |
| 11  | Relay 01 open         | Relay 01 active        |
| 12  | Reserved              | Reserved               |
| 13  | Parameter setup       | Selection lsb          |
| 14  | Reserved              | Reserved               |
| 15  | No function           | Reverse                |

### 6.1.8.2 Explanation of Control Word Bit

#### Bits 00/01

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

Table 54: Control Bits

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

### NOTICE

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

#### Bit 02, DC Brake

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

Bit 02=1: Leads to ramping.

#### Bit 03, Coasting

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

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

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

#### Bit 04, Quick Stop

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

#### Bit 05, Hold Output Frequency

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

### NOTICE

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

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

#### Bit 06, Ramp Stop/Start

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

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

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

#### Bit 07, Reset

Bit 07=0: No reset.

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

### Bit 08, Jog

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

### Bit 09, Selection of Ramp 1/2

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

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

### Bit 10, Data Not Valid/Data Valid

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

Bit 10=0: The control word is ignored.

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

### Bit 11, Relay 01

Bit 11=0: Relay 01 not activated.

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

### Bit 13, Setup Selection

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

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

Table 55: Setup selection

| Setup | Bit 13 |
|-------|--------|
| 1     | 0      |
| 2     | 1      |

### NOTICE

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

### Bit 14, Torque OK/Limit Exceeded

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

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

### Bit 15, Reverse

Bit 15=0: No reversing.

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

### 6.1.8.3 Status Word According to FC Profile (STW)

Set *P 10.1.1 Protocol* to *[0] FC*.

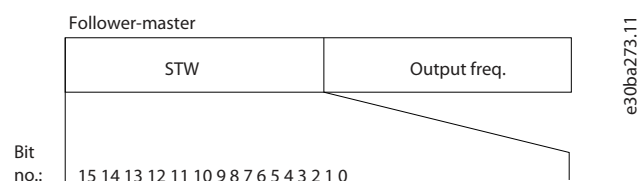


Figure 66: Status Word

Table 56: Status Word According to FC Profile

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

#### 6.1.8.4 Explanation of Status Word Bit

##### Bit 00, Control Not Ready/Ready

Bit 00=0: The drive trips.

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

##### Bit 01, Drive Ready

Bit 01=0: The drive is not ready.

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

##### Bit 02, Coast Stop

Bit 02=0: The drive releases the motor.

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

**Bit 03, No Error/Trip**

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

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

**Bit 04, No Error/Error (No Trip)**

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

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

**Bit 05, Not Used**

Bit 05 is not used in the status word.

**Bit 06, No Error/Trip lock**

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

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

**Bit 07, No Warning/Warning**

Bit 07=0: There are no warnings.

Bit 07=1: A warning has occurred.

**Bit 08, Speed  $\neq$  Reference/Speed=Reference**

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

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

**Bit 09, Local Operation/Bus Control**

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

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

**Bit 10, Out of Frequency Limit**

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

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

**Bit 11, No Operation/In Operation**

Bit 11=0: The motor is not running.

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

**Bit 12, Drive OK/Stopped, Auto Start**

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

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

**Bit 13, Voltage OK/Limit Exceeded**

Bit 13=0: There are no voltage warnings.

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

#### Bit 14, Torque OK/Limit Exceeded

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

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

#### Bit 15, Timer OK/Limit Exceeded

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

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

### 6.1.8.5 Bus Speed Reference Value

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

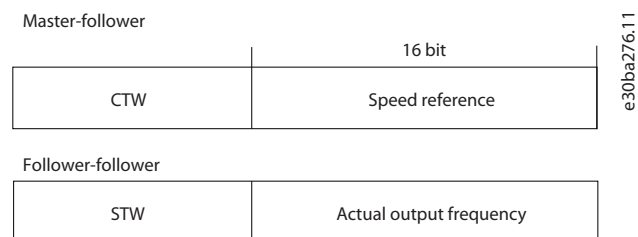


Figure 67: Actual Output Frequency (MAV)

The reference and MAV are scaled as follows:

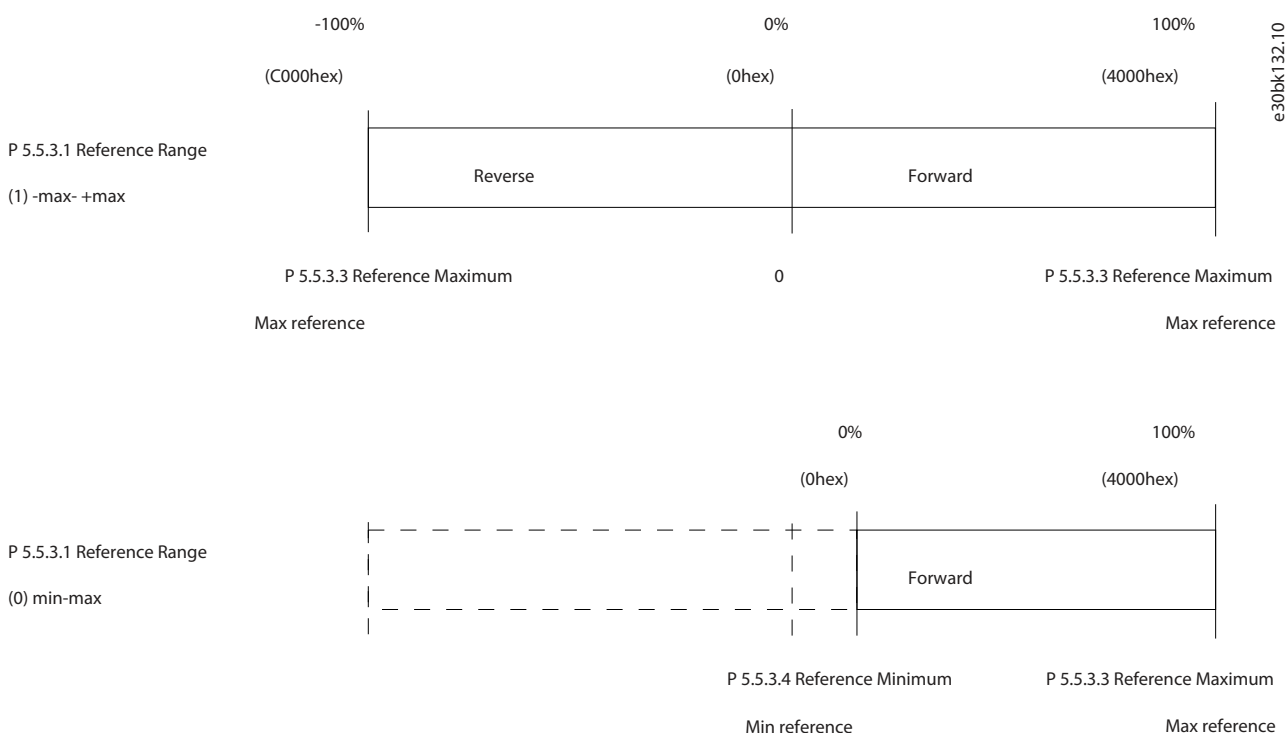


Figure 68: Reference and MAV



## 6.2 How to Control the Drive

### 6.2.1 Introduction

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

### 6.2.2 Function Codes Supported by Modbus RTU

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

Table 57: 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 58: Function Codes

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

### 6.2.3 Modbus Exception Codes

For a full explanation of the structure of an exception code response, refer to [6.1.7.4.5 Function Field](#).

Table 59: 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.

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

e30bk172.11

Figure 69: Reading the Parameter Table

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

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

3 indicates the default setting from the factory.

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

5 indicates the data type of the parameter. See [7.1.2 Understanding Data Types](#).

6 indicates the type of parameter. Parameters have either defined ranges or selections. See [7.1.1 Understanding Parameter Types](#).

7 indicates the unit of the parameter.

8 indicates the access type of the parameter. See [7.1.3 Understanding Access Types](#).

#### 7.1.1 Understanding Parameter Types

Following are the different type of parameter information.

Table 60: 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 61: Overview on data type

| Data type | Description | Type      | Range          |
|-----------|-------------|-----------|----------------|
| enum      | Enumeration |           | 0,1,2....      |
| int       | Integer     | 8, 16, 32 | -32768...32767 |

Table 61: Overview on data type (continued)

| Data type | Description      | Type      | Range         |
|-----------|------------------|-----------|---------------|
| 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 62: Access Types and Descriptions

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

## 7.2 Grid (Menu Index 1)

### 7.2.1 Grid Settings (Menu Index 1.2)

#### P 1.2.1 Regional Settings

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

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

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                |
|------------------|----------------|----------------------------------------------------------------------|
| 0                | International  | Default value of <b>P 4.2.2.4 Nominal Frequency</b> is set to 50 Hz. |
| 1                | North America  | Default value of <b>P 4.2.2.4 Nominal Frequency</b> is set to 60 Hz. |

#### P 1.2.2 Grid Type

Select the supply voltage, frequency, and type.

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

The following are the selections for the parameter.

| Selection number | Selection name        |
|------------------|-----------------------|
| 0                | 200-240V/50Hz/IT-grid |
| 1                | 200-240V/50Hz/Delta   |
| 2                | 200-240V/50Hz         |
| 5                | 100-110V/50Hz/IT-grid |
| 6                | 100-110V/50Hz/Delta   |
| 7                | 100-110V/50Hz         |
| 10               | 380-440V/50Hz/IT-grid |
| 11               | 380-440V/50Hz/Delta   |
| 12               | 380-440V/50Hz         |
| 20               | 440-480V/50Hz/IT-grid |
| 21               | 440-480V/50Hz/Delta   |
| 22               | 440-480V/50Hz         |
| 100              | 200-240V/60Hz/IT-grid |
| 101              | 200-240V/60Hz/Delta   |
| 102              | 200-240V/60Hz         |
| 105              | 100-110V/60Hz/IT-grid |
| 106              | 100-110V/60Hz/Delta   |
| 107              | 100-110V/60Hz         |
| 110              | 380-440V/60Hz/IT-grid |
| 111              | 380-440V/60Hz/Delta   |
| 112              | 380-440V/60Hz         |
| 120              | 440-480V/60Hz/IT-grid |
| 121              | 440-480V/60Hz/Delta   |
| 122              | 440-480V/60Hz         |

## 7.2.2 Grid Protection (Menu Index 1.3)

### P 1.3.1 Mains Imbalance Action

Select an action 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 | Selection description                                                                                                                                                                |
|------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Trip           | Trips the frequency converter.                                                                                                                                                       |
| 1                | Warning        | Issue a warning.                                                                                                                                                                     |
| 2                | Disabled       | No action is taken.                                                                                                                                                                  |
| 4                | Fast Trip      | Enable the fast detection to trip the frequency converter. The option is related to <i>P 2.3.9 Fast Mains Phase Loss Level</i> and <i>P 2.3.10 Fast Mains Phase Loss Min Power</i> . |
| 5                | Fast Warning   | Enable the fast detection to issue a warning. The option is related to <i>P 2.3.9 Fast Mains Phase Loss Level</i> and <i>P 2.3.10 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

View the DC-link voltage in the drive.

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

#### P 2.1.2 Inverter Thermal

View the percentage of thermal load on the frequency converter.

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

#### P 2.1.3 Unit Nominal Current

View the inverter nominal current, which should match the nameplate data on the connected motor. The data is used for calculation of torque and motor overload protection.

|                |              |                 |                     |
|----------------|--------------|-----------------|---------------------|
| Default value: | Size Related | Parameter type: | Range (0.00–655.35) |
|----------------|--------------|-----------------|---------------------|

|                   |        |              |      |
|-------------------|--------|--------------|------|
| Parameter number: | 1636   | Unit:        | A    |
| Data type:        | uint16 | Access type: | Read |

### P 2.1.5 Output Current Limit %

View the inverter maximum current, which should match the nameplate data on the connected motor. The data is used for calculation of torque and motor protection.

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

### P 2.1.9 Heatsink Temperature

View the frequency converter heat sink temperature.

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

### P 2.1.10 Real-time Switching Frequency

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

|                   |      |                 |              |
|-------------------|------|-----------------|--------------|
| Default value:    | 0    | Parameter type: | Range (0–32) |
| Parameter number: | 1866 | Unit:           | kHz          |
| Data type:        | int8 | Access type:    | Read         |

## 7.3.2 Protection (Menu Index 2.3)

### P 2.3.1 Overvoltage Controller Enable

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

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

The following are the selections for the parameter.

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


**CAUTION**
**PERSONAL INJURY AND EQUIPMENT DAMAGE**

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

- DO NOT enable OVC in hoisting applications.

### P 2.3.2 Overvoltage Controller Kp

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

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

### P 2.3.6 Power Loss Action

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

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

This parameter is typically used where short mains interruptions (voltage dips) are present. At 100% load and a short voltage interruption, the DC voltage on the main capacitors drops quickly. For larger frequency converters, it only takes a few milliseconds before the DC level is down to about 373 V DC and the IGBTs cut off and lose control of the motor. When mains is restored, and the IGBTs start again, the output frequency and voltage vector do not correspond to the speed/frequency of the motor, and the result is normally an overvoltage or overcurrent, mostly resulting in a trip lock. **P 2.3.6 Power Loss Action** can be programmed to avoid this situation. Select the function to which the frequency converter must act when the threshold in **P 2.3.6 Power Loss Action** at mains fault has been reached.

The following are the selections for the parameter.



| Selection number | Selection name        | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Function           | The frequency converter does not compensate for a mains interruption. The voltage on the DC link drops quickly, and the motor is lost within milliseconds to seconds. Trip lock is the result.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                | Ctrl. Ramp-down       | The frequency converter retains control of the motor and does a controlled ramp down from <b>P 2.3.7 Power Loss Controller Limit</b> . The ramp follows the setting in <b>P 5.7.7 Quick Stop Ramp Time</b> . 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 <b>[1] Ctrl. ramp-down</b> , except that in <b>[2] Ctrl. ramp-down, Trip</b> a reset is necessary for starting up after power-up.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3                | Coasting              | Centrifuges can run for an hour without supply. In those situations, it is possible to select a coast function at mains interruption, together with a flying start, which occurs when the mains is restored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Selection number | Selection name        | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                | Kinetic Back-up       | <p>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 <b>P 2.3.7 Power Loss Controller Limit</b> x 1.35. If the mains does not return, UDC is maintained as long as possible by ramping the speed down towards 0 RPM. Finally, the frequency converter coasts. If mains returns while in kinetic backup, UDC increases above <b>P 2.3.7 Power Loss Controller Limit</b> x 1.35. This is detected in 1 of the following ways:</p> <ul style="list-style-type: none"> <li>• If <math>UDC &gt; P\ 2.3.7\ Power\ Loss\ Controller\ Limit \times 1.35 \times 1.05</math></li> <li>• If the speed is above the reference. This is relevant if mains comes back at a lower level than before, for example, <b>P 2.3.7 Power Loss Controller Limit</b> x 1.35 x 1.02. This does not fulfill the criterion above, and the frequency converter tries to reduce UDC to <b>P 2.3.7 Power Loss Controller Limit</b> x 1.35 by increasing the speed. This does not succeed as mains cannot be lowered.</li> <li>• If running motoric. The same mechanism as in the previous point, but where the inertia avoids the speed from going above the reference speed. This leads to the motor running motoric until the speed is above the reference speed, and the above situation occurs. Instead of waiting for that, the present criterion is introduced.</li> </ul> |
| 5                | Kinetic Back-up, Trip | <p>The difference between kinetic backup with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains return or not. The function is made so that it does not even detect if mains return. This is the reason for the relatively high level on the DC link during ramp down.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| Selection number | Selection name                   | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6                | Fault                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7                | Kin. Back-up, Trip with Recovery | Kinetic backup with recovery combines the features of kinetic backup and kinetic backup with trip. This feature makes it possible to select between kinetic backup and kinetic backup with trip based on a recovery speed, which is configurable in <b>P 2.3.8 Kin. Back-up Trip Recovery Level</b> to enable detection of mains returning. If the mains does not return, the frequency converter ramps down to 0 RPM and trips. If mains return while kinetic backup is at a speed above the value set in <b>P 2.3.8 Kin. Backup Trip Recovery Level</b> , normal operation is resumed. This is equal to [4] <b>Kinetic Backup</b> . The DC level during [7] <b>Kinetic backup</b> is <b>P 2.3.7 Power Loss Controller Limit</b> x 1.35. If mains return while kinetic backup is at a speed below <b>P 2.3.8 Kin. Backup Trip Recovery Level</b> , the frequency converter ramps down to 0 RPM using the ramp and then trips. |

### P 2.3.7 Power Loss Controller Limit

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

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

### P 2.3.8 Kin. Back-up Trip Recovery Level

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

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

### P 2.3.9 Fast Mains Phase Loss Level

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

|                   |      |                 |               |
|-------------------|------|-----------------|---------------|
| Default value:    | 300  | Parameter type: | Range (0–500) |
| Parameter number: | 1417 | Unit:           | %             |

|            |        |              |            |
|------------|--------|--------------|------------|
| Data type: | uint16 | Access type: | Read/Write |
|------------|--------|--------------|------------|

### P 2.3.10 Fast Mains Phase Loss Min. Power

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

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

### P 2.3.13 Auto DC Braking

Protective function against overvoltage at coast in IT grid environment. This parameter is active only when **[1] On** is selected in this parameter, and IT grid options are selected in **P 1.2.2 Grid Type**.

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

The following are the selections for the parameter.

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

### P 2.3.14 Max Output Frequency

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

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

#### NOTICE

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

### P 2.3.15 Action at Inverter Fault

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

|                |             |                 |           |
|----------------|-------------|-----------------|-----------|
| Default value: | 1 [Warning] | Parameter type: | Selection |
|----------------|-------------|-----------------|-----------|

|                   |      |              |            |
|-------------------|------|--------------|------------|
| Parameter number: | 1427 | Unit:        | V          |
| Data type:        | enum | Access type: | Read/Write |

The following are the selections for the parameter.

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

### P 2.3.16 Function at Inverter Overload

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

|                   |          |                 |            |
|-------------------|----------|-----------------|------------|
| Default value:    | 0 [Trip] | Parameter type: | Selection  |
| Parameter number: | 1461     | Unit:           | –          |
| Data type:        | enum     | Access type:    | Read/Write |

| Selection number | Selection name |
|------------------|----------------|
| 0                | Trip           |
| 1                | Derate         |

### P 2.3.17 Adjustable Temperature Warning

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

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

## 7.3.3 Modulation (Menu Index 2.4)

### P 2.4.2 Min. Switching Frequency

Set the lowest switching frequency allowed by the application.

|                   |             |                 |           |
|-------------------|-------------|-----------------|-----------|
| Default value:    | 2 [2.0 KHz] | Parameter type: | Selection |
| Parameter number: | 1463        | Unit:           | –         |

|                         |                       |                     |            |
|-------------------------|-----------------------|---------------------|------------|
| <b>Data type:</b>       | enum                  | <b>Access type:</b> | Read/Write |
| <b>Selection number</b> | <b>Selection name</b> |                     |            |
| 2                       | 2.0 KHz               |                     |            |
| 3                       | 3.0 KHz               |                     |            |
| 4                       | 4.0 KHz               |                     |            |
| 5                       | 5.0 KHz               |                     |            |
| 6                       | 6.0 KHz               |                     |            |
| 7                       | 8.0 KHz               |                     |            |
| 8                       | 10.0 KHz              |                     |            |
| 9                       | 12.0 KHz              |                     |            |
| 10                      | 16.0 KHz              |                     |            |

### P 2.4.3 Switching Frequency

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

|                          |                                      |                        |            |
|--------------------------|--------------------------------------|------------------------|------------|
| <b>Default value:</b>    | 4 [4.0 KHz]                          | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 1401                                 | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum                                 | <b>Access type:</b>    | Read/Write |
| <b>Selection number</b>  | <b>Selection name (Size Related)</b> |                        |            |
| 2                        | 2.0 KHz                              |                        |            |
| 3                        | 3.0 KHz                              |                        |            |
| 4                        | 4.0 KHz                              |                        |            |
| 5                        | 5.0 KHz                              |                        |            |
| 6                        | 6.0 KHz                              |                        |            |
| 7                        | 8.0 KHz                              |                        |            |
| 8                        | 10.0 KHz                             |                        |            |
| 9                        | 12.0 KHz                             |                        |            |
| 10                       | 16.0 KHz                             |                        |            |

#### NOTICE

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

### P 2.4.5 Over Modulation

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

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

Following are the selections for the parameter:

| Selection number | Selection name | Selection description                                                                                                                                                                                                                                                                                |
|------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Off            | To avoid torque ripple on the motor shaft, select <b>[0] Off</b> for no overmodulation of the output voltage. This feature may be useful for applications such as grinding machines.                                                                                                                 |
| 1                | On             | Select <b>[1] On</b> 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. |

#### NOTICE

Overmodulation leads to increased torque ripple as harmonics are increased.

## 7.3.4 DC-Link Control (Menu Index 2.5)

### P 2.5.1 Damping Gain Factor

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

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

### P 2.5.2 DC-Link Voltage Compensation

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

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

| Selection number | Selection name |
|------------------|----------------|
| 0                | Off            |
| 1                | On             |

### 7.3.5 Output Current Limit (Menu Index 2.7)

#### P 2.7.1 Output Current Limit %

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

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

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

#### P 2.7.2 Current Limit $K_p$

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

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

#### P 2.7.3 Current Limit $T_i$

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

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

#### P 2.7.4 Current Lim Ctrl, Filter Time

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

|                   |      |                 |                   |
|-------------------|------|-----------------|-------------------|
| Default value:    | 5    | Parameter type: | Range (1.0–100.0) |
| Parameter number: | 1432 | Unit:           | ms                |



|            |        |              |            |
|------------|--------|--------------|------------|
| Data type: | uint16 | Access type: | Read/Write |
|------------|--------|--------------|------------|

### P 2.7.5 Trip Delay at Current Limit

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

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

## 7.4 Filters & Brake Chopper (Menu Index 3)

### 7.4.1 Status (Menu Index 3.1)

#### P 3.1.1 Brake Energy

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

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

### 7.4.2 Brake Chopper (Menu Index 3.2)

#### P 3.2.1 Enable Brake Chopper

Select method for dissipation of excess brake energy.

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

| Selection number | Selection name |
|------------------|----------------|
| 0                | Disable        |
| 1                | Enable         |

#### P 3.2.2 Brake Chopper Voltage Reduce

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

|                |              |                 |                      |
|----------------|--------------|-----------------|----------------------|
| Default value: | Size Related | Parameter type: | Range (Size Related) |
|----------------|--------------|-----------------|----------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 214    | Unit:        | V          |
| Data type:        | uint16 | Access type: | Read/Write |

### 7.4.3 Brake Resistor (Menu Index 3.3)

#### P 3.3.2 Brake Resistor Value

Set the brake resistor value in  $\Omega$ . 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:           | $\Omega$             |
| Data type:        | uint16       | Access type:    | Read/Write           |

#### P 3.3.3 Brake Resistor Power Limit

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

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

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

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

The following are the elements of the formula:

- $P_{br, avg}$  is the average power dissipated in the brake resistor.
- $R_{br}$  is the resistance of the brake resistor.
- $t_{br}$  is the active breaking time within the 120 s period  $T_{br}$ .
- $U_{br}$  is the DC voltage where the brake resistor is active.

For T4 units, the DC voltage is 770 V, which can be reduced by **P 3.2.2 Brake Chopper Voltage Reduce**.

#### NOTICE

If  $R_{br}$  is not known or if  $T_{br}$  is different from 120 s, the practical approach is to run the brake application, readout **P 3.1.1 Brake Energy**, and then enter this value + 20% in **P 3.3.3 Brake Resistor Power Limit**.

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

## 7.5 Motor (Menu Index 4)

### 7.5.1 Status (Menu Index 4.1)

#### P 4.1.1 Motor Current

View the motor current measured as a mean value, 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

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

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

#### P 4.1.3 Motor Electrical Power

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

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

#### P 4.1.4 Motor Power Hp

Motor power consumption in 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

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

View the actual motor frequency value.

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

### P 4.1.7 Frequency %

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

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

### P 4.1.8 Motor Shaft Speed

View the actual motor RPM. In open loop or closed-loop process control the motor RPM is estimated. In speed closed-loop modes the motor RPM is measured.

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

### P 4.1.10 Motor Torque

View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. As a result, the minimum value and the maximum value depend on the maximum motor current and the motor used.

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

### P 4.1.11 Motor Torque %

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

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

## 7.5.2 Motor Data (Menu Index 4.2)

### 7.5.2.1 General Settings (Menu Index 4.2.1)

#### P 4.2.1.1 Motor Type

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

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

The following are the selections for the parameter.

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

#### P 4.2.1.2 Number of Pole

Enter the number of motor poles.

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

The dependency of the motor's synchronous speed  $n_s$  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 Nominal Frequency\*120/P 4.2.2.5 Nominal Speed

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

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

### P 4.2.1.3 AMA Mode

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

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

The following are the selections for the parameter.

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

### NOTICE

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

### P 4.2.1.4 Motor Cable Length

Enter the length of the motor cable in unit meters.

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

### P 4.2.1.5 Motor Cable Length Feet

Motor cable length.

|                |     |                 |               |
|----------------|-----|-----------------|---------------|
| Default value: | 164 | Parameter type: | Range (0–328) |
|----------------|-----|-----------------|---------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 143    | Unit:        | Ft         |
| Data type:        | uint16 | Access type: | Read/Write |

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

### 7.5.2.2 Nameplate Data (Menu Index 4.2.2)

#### P 4.2.2.1 Nominal Power

Set the nominal motor power from the motor nameplate data. 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

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

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

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

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

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:           | $\Omega$             |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 4.2.3.2 Rotor Resistance Rr

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

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 131          | Unit:           | $\Omega$             |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 4.2.3.4 Stator Leakage Reactance X1

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:           | $\Omega$             |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 4.2.3.6 Main Reactance Xh

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:           | $\Omega$             |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 4.2.3.7 Motor Cont. Rated Torque



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

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

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

#### 7.5.2.4 Permanent Magnet Motor (Menu Index 4.2.4)

##### P 4.2.4.1 Back EMF

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.

|                          |              |                        |                      |
|--------------------------|--------------|------------------------|----------------------|
| <b>Default value:</b>    | Size Related | <b>Parameter type:</b> | Range (Size Related) |
| <b>Parameter number:</b> | 140          | <b>Unit:</b>           | V                    |
| <b>Data type:</b>        | uint16       | <b>Access type:</b>    | Read/Write           |

#### NOTICE

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

##### P 4.2.4.3 d-axis Inductance Ld

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

|                          |              |                        |                      |
|--------------------------|--------------|------------------------|----------------------|
| <b>Default value:</b>    | Size Related | <b>Parameter type:</b> | Range (Size Related) |
| <b>Parameter number:</b> | 137          | <b>Unit:</b>           | mH                   |
| <b>Data type:</b>        | int32        | <b>Access type:</b>    | Read/Write           |

##### P 4.2.4.4 d-axis Inductance LdSat

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

|                       |              |                        |                      |
|-----------------------|--------------|------------------------|----------------------|
| <b>Default value:</b> | Size Related | <b>Parameter type:</b> | Range (Size Related) |
|-----------------------|--------------|------------------------|----------------------|

|                   |       |              |            |
|-------------------|-------|--------------|------------|
| Parameter number: | 144   | Unit:        | mH         |
| Data type:        | int32 | Access type: | Read/Write |

#### P 4.2.4.6 Ld Current Point

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

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

#### P 4.2.4.7 q-axis Inductance Lq

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

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

#### P 4.2.4.8 q-axis Inductance LqSat

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

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

#### P 4.2.4.10 Lq Current Point

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

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

### 7.5.3 Motor Control (Menu Index 4.4)

#### 7.5.3.1 General Settings (Menu Index 4.4.1)

##### P 4.4.1.2 AEO Minimum Magnetization

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

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

##### P 4.4.1.3 Torque Characteristic

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

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

The following are the selections for the parameter.

| Selection number | Selection name        | Selection description                                                                                                                   |
|------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Constant Torque       | Motor shaft output provides constant torque under variable speed control.                                                               |
| 1                | Variable Torque       | Motor shaft output provides variable torque under variable speed control. Set the variable torque level in <b>P 4.4.4.13 VT Level</b> . |
| 2                | Auto Energy Optim. CT | Automatically optimizes energy consumption by minimizing magnetization and frequency via <b>P 4.4.1.2 AEO Minimum Magnetisation</b> .   |

##### P 4.4.1.4 Clockwise Direction

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

|                   |            |                 |            |
|-------------------|------------|-----------------|------------|
| Default value:    | 0 [Normal] | Parameter type: | Selection  |
| Parameter number: | 106        | Unit:           | –          |
| Data type:        | enum       | Access type:    | Read/Write |

The following are the selections for the parameter.

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

#### P 4.4.1.5 Motor Control Bandwidth

Select type of motor control bandwidth.

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

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                         |
|------------------|----------------|-----------------------------------------------------------------------------------------------|
| 0                | High           | For high dynamic response.                                                                    |
| 1                | Medium         | Optimized for smooth steady state operation.                                                  |
| 2                | Low            | Optimized for smooth steady state operation with lowest dynamic response.                     |
| 3                | Adaptive 1     | Optimized for smooth steady state operation, with extra active damping.                       |
| 4                | Adaptive 2     | Focuses on low-inductance PM motors. This option is an alternative to <b>[3] Adaptive 1</b> . |

#### 7.5.3.2 AC-Brake (Menu Index 4.4.2)

##### P 4.4.2.1 Enable AC Brake

Select the method for dissipation of excess brake energy.

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

| Selection number | Selection name |
|------------------|----------------|
| 0                | Disable        |
| 1                | Enable         |

##### P 4.4.2.2 AC Brake, Max current

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

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 100    | Parameter type: | Range (0–160) |
| Parameter number: | 216    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### NOTICE

The parameter is only available for induction motors.

#### P 4.4.2.3 AC Brake Voltage Control Kp

Use the parameter to set AC brake power capability (set ramp-down time when inertia is constant). If the DC-link voltage is not higher than the DC-link voltage warning value, the generator torque can be adjusted with this parameter. The higher the AC-brake gain is, the stronger the brake capability is. 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

Enter the voltage at each frequency point to manually form a U/f characteristic matching the motor. The frequency points are defined in **P 4.4.3.2 Frequency Point**.

|                   |              |                 |                |
|-------------------|--------------|-----------------|----------------|
| Default value:    | Size Related | Parameter type: | Range (0–1000) |
| Parameter number: | 155          | Unit:           | V              |
| Data type:        | uint16       | Access type:    | Read/Write     |

##### P 4.4.3.2 Frequency Point

Enter the frequency points to manually form a U/f characteristic matching the motor. The voltage at each point is defined in **P 4.4.3.1 Voltage Point**.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 156          | Unit:           | Hz                   |
| Data type:        | uint16       | Access type:    | Read/Write           |

Make a U/f characteristic based on 6 definable voltages and frequencies. See figure below.

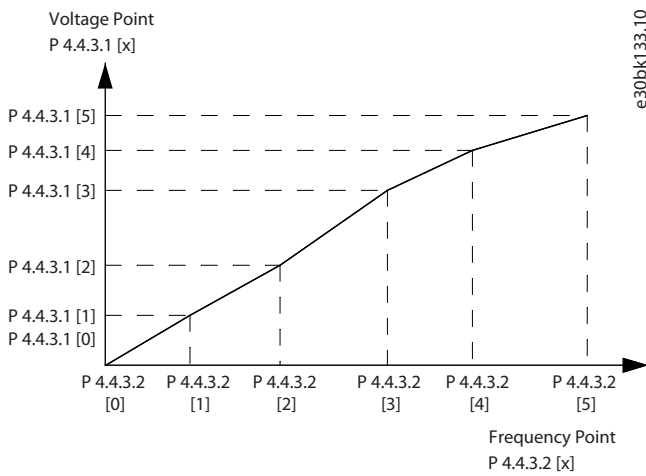


Figure 70: Example of U/f Characteristic

### 7.5.3.4 Dependent Setting (Menu Index 4.4.4)

#### P 4.4.4.1 Slip Comp. Gain

Enter the % value for slip compensation to compensate for tolerances in the value of  $n_{M,N}$ . Slip compensation is calculated automatically, that is, based on the rated motor speed  $n_{M,N}$ . This function is not active when **P 5.4.2 Configuration Mode** is set to [1] *Speed closed loop*, [2] *Torque closed loop*, or [4] *Torque open loop*, or when **P 5.4.3 Motor Control Principle** is set to [0] *U/f*, or when **P 4.2.1.1 Motor Type** is set to [1] *PM, Non-salient SPM* or [3] *PM, Salient IPM*.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 162          | Unit:           | %                    |
| Data type:        | int16        | Access type:    | Read/Write           |

#### P 4.4.4.2 Slip Comp. Time Constant

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

|                   |        |                 |                   |
|-------------------|--------|-----------------|-------------------|
| Default value:    | 0.10   | Parameter type: | Range (0.05–5.00) |
| Parameter number: | 163    | Unit:           | s                 |
| Data type:        | uint16 | Access type:    | Read/Write        |

#### P 4.4.4.3 High Speed Load Comp.

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

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 100   | Parameter type: | Range (0–300) |
| Parameter number: | 161   | Unit:           | %             |
| Data type:        | int16 | Access type:    | Read/Write    |

#### P 4.4.4.4 Low Speed Load Comp.

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

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 100   | Parameter type: | Range (0–300) |
| Parameter number: | 160   | Unit:           | %             |
| Data type:        | int16 | Access type:    | Read/Write    |

#### P 4.4.4.5 Res. Damp Gain

Enter the resonance damping value. Use the parameter and **P 4.4.4.6 Res. Damp High Pass Time Constant** to help eliminate high frequency resonance problems. To reduce resonance oscillation, increase the value of **P 4.4.4.5 Res. Damp Gain**.

|                   |              |                 |               |
|-------------------|--------------|-----------------|---------------|
| Default value:    | Size Related | Parameter type: | Range (0–500) |
| Parameter number: | 164          | Unit:           | %             |
| Data type:        | uint16       | Access type:    | Read/Write    |

#### P 4.4.4.6 Res. Damp High Pass Time Constant

Set the parameter and **P 4.4.4.5 Res. Damp Gain** to help eliminate high frequency resonance problems. Enter the time constant that provides the best dampening.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 165          | Unit:           | s                    |
| Data type:        | uint16       | Access type:    | Read/Write           |

#### P 4.4.4.7 Damping Gain

The damping gain stabilizes the PM machine to run the PM machine smooth and stable. The value of Damping gain controls the dynamic performance of the PM machine. High damping gain gives low dynamic performance and low damping gain give high dynamic performance. The dynamic performance is related to the machine data and load type. When the damping gain is too high or low the control becomes unstable.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 120   | Parameter type: | Range (Size Related) |
| Parameter number: | 114   | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read/Write           |

#### P 4.4.4.8 High Speed Filter Time Const.

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

|                |              |                 |                      |
|----------------|--------------|-----------------|----------------------|
| Default value: | Size Related | Parameter type: | Range (Size Related) |
|----------------|--------------|-----------------|----------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 116    | Unit:        | s          |
| Data type:        | uint16 | Access type: | Read/Write |

#### P 4.4.4.9 Low Speed Filter Time Const.

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

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 115          | Unit:           | s                    |
| Data type:        | uint16       | Access type:    | Read/Write           |

#### P 4.4.4.10 Voltage Filter Time Const.

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

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 117          | Unit:           | s                    |
| Data type:        | uint16       | Access type:    | Read/Write           |

#### P 4.4.4.11 Variable Torque Zero Speed Magnetization

Use this parameter along with *P 4.4.4.12 Min Speed Normal Magnetizing [Hz]* to obtain a different magnetizing current on the motor when running at low speed. Enter a percentage value of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 100    | Parameter type: | Range (0–300) |
| Parameter number: | 150    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

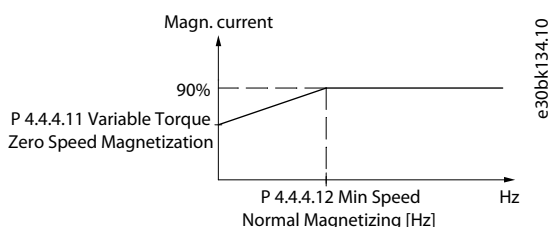


Figure 71: Motor Magnetization

#### P 4.4.4.12 Min Speed Normal Magnetizing [Hz]

Set the required frequency for normal magnetizing current. Use this parameter along with *P 4.4.4.11 Variable Torque Zero Speed Magnetization*.

|                |     |                 |                      |
|----------------|-----|-----------------|----------------------|
| Default value: | 1.0 | Parameter type: | Range (Size Related) |
|----------------|-----|-----------------|----------------------|



|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 152    | Unit:        | Hz         |
| Data type:        | uint16 | Access type: | Read/Write |

#### P 4.4.4.13 VT Level

Enter the level of motor magnetization at low speed. Selecting a low value reduces energy loss in the motor but also reduces load capability.

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 66    | Parameter type: | Range (40–90) |
| Parameter number: | 1440  | Unit:           | %             |
| Data type:        | uint8 | Access type:    | Read/Write    |

### NOTICE

This parameter is not active when **P 4.2.1.1 Motor Type** is set to options that enable PM motor mode.

#### P 4.4.4.14 Min. Current at Low Speed

Enter the minimum motor current at low speed. Increasing this current improves motor torque at low speed. The parameter is only enabled for PM motors.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 166          | Unit:           | %                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

### 7.5.3.5 Dead Time Compensation (Menu Index 4.4.4.5)

#### P 4.4.5.1 Dead Time Compensation Level

Level of applied dead time 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 dead time compensation.

|                   |              |                 |               |
|-------------------|--------------|-----------------|---------------|
| Default value:    | Size Related | Parameter type: | Range (0–100) |
| Parameter number: | 1407         | Unit:           | –             |
| Data type:        | uint8        | Access type:    | Read/Write    |

#### P 4.4.5.2 Dead Time Bias Current Level

Set a bias signal (in [%]) to add to the current-sense signal for dead time compensation.

|                   |              |                 |               |
|-------------------|--------------|-----------------|---------------|
| Default value:    | Size Related | Parameter type: | Range (0–100) |
| Parameter number: | 1409         | Unit:           | %             |
| Data type:        | uint8        | Access type:    | Read/Write    |

### P 4.4.5.3 Dead Time Compensation Zero Current Level

Setting this parameter to **[1] Enabled** at a long motor cable minimizes the motor-torque ripple.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | [0] Disabled | Parameter type: | Selection  |
| Parameter number: | 1464         | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                    |
|------------------|----------------|------------------------------------------------------------------------------------------|
| 0                | Disabled       | The function is not active.                                                              |
| 1                | Enabled        | When a long motor cable is used, select this option to minimize the motor torque ripple. |

### P 4.4.5.4 Speed Derate Dead Time Compensation

Dead time compensation level is reduced linearly versus output frequency from the maximum level set by **P 4.4.5.1 Dead Time Compensation Level** to a minimum level set in this parameter.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 1465         | Unit:           | Hz                   |
| Data type:        | uint16       | Access type:    | Read/Write           |

## 7.5.4 Protection (Menu Index 4.6)

### P 4.6.1 Warning Freq. High

Use this parameter to set a high limit for the frequency range. When the motor speed is above this limit, warning bit 9 is set in **P 5.1.9 Ext. Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this parameter set limit is reached.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 441          | Unit:           | Hz                   |
| Data type:        | uint16       | Access type:    | Read/Write           |

### P 4.6.2 Warning Freq. Low

When the motor speed falls below this limit, warning bit 10 is set in **P 5.1.9 Ext. Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this parameter set limit is reached.

|                |   |                 |                      |
|----------------|---|-----------------|----------------------|
| Default value: | 0 | Parameter type: | Range (Size Related) |
|----------------|---|-----------------|----------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 440    | Unit:        | Hz         |
| Data type:        | uint16 | Access type: | Read/Write |

#### P 4.6.3 Warning Current High

Enter the I-high value. When the motor current exceeds this limit, a bit in the drives status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 451          | Unit:           | A                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 4.6.4 Warning Current Low

Enter the I-low value. When the motor current falls below this limit, a bit in the drives status word is set. This value can also be programmed to produce a signal on the digital output or the relay output.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.00   | Parameter type: | Range (Size Related) |
| Parameter number: | 450    | Unit:           | A                    |
| Data type:        | uint32 | Access type:    | Read/Write           |

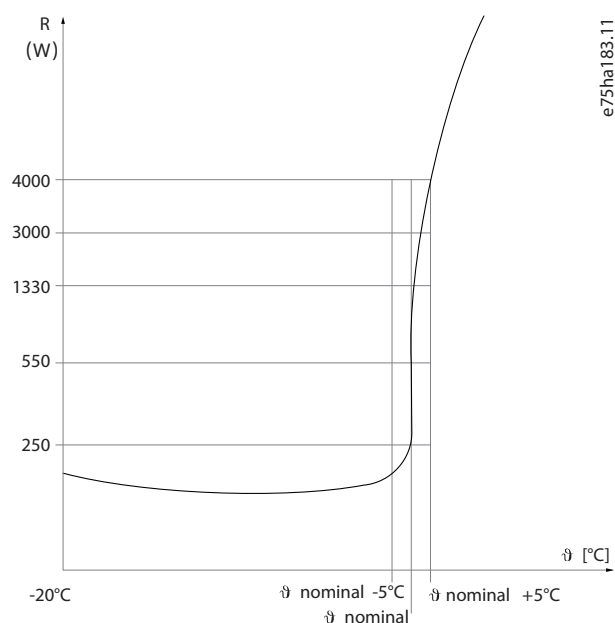
#### P 4.6.7 Motor Thermal Protection

Motor thermal protection can be implemented via a PTC sensor in the motor windings connected to 1 of the analog or digital inputs (**P 4.6.8 Thermistor Source**). Or via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current  $I_{M,N}$ , and the rated motor frequency  $f_{M,N}$ . It is possible to activate an overheat warning or fault.

|                   |                   |                 |            |
|-------------------|-------------------|-----------------|------------|
| Default value:    | 0 [No Protection] | Parameter type: | Selection  |
| Parameter number: | 190               | Unit:           | –          |
| Data type:        | enum              | Access type:    | Read/Write |

| Selection number | Selection name     | Selection description                                                                                                                                                                                                                    |
|------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Protection      | Continuously overloaded motor, when no warning or trip of the frequency converter is required.                                                                                                                                           |
| 1                | Thermistor Warning | Activates a warning when the connected thermistor in the motor reacts to a motor overtemperature.                                                                                                                                        |
| 2                | Thermistor Trip    | Stops (trips) the frequency converter when the connected thermistor in the motor reacts to a motor overtemperature. The thermistor cut out value must be >3 kΩ. Integrate a thermistor (PTC sensor) in the motor for winding protection. |

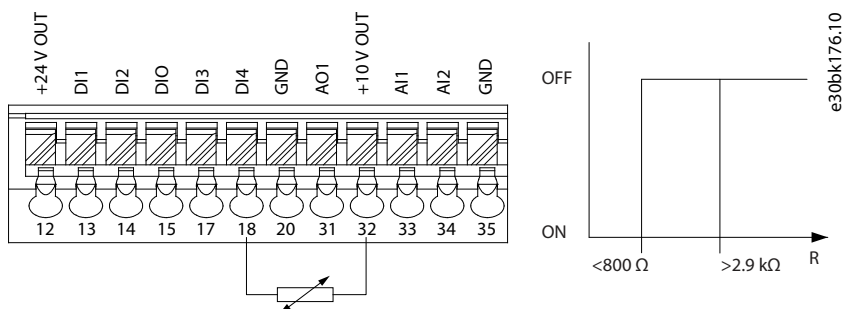
| Selection number | Selection name                | Selection description                                                                                                                                                                                                                                  |
|------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                | ETR Warning 1                 | Calculates the load and activates a warning in the display when the motor is overloaded. Program a warning signal via 1 of the digital outputs.                                                                                                        |
| 4                | ETR Trip 1                    | Calculates the load and stops (trips) the frequency converter when the motor is overloaded. Program a warning signal via 1 of the digital outputs. The signal appears in the event of a warning and if the frequency converter trips (thermal warning) |
| 22               | ETR Trip - Extended Detection |                                                                                                                                                                                                                                                        |



**Figure 72: PTC Profile**

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

- Set **P 4.6.7 Motor Thermal Protection** to **[2] Thermistor Trip**.
- Set **P 4.6.8 Thermistor Source** to **[6] Digital Input 18**.



**Figure 73: PTC Thermistor Connection - Digital Input**

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

- Set **P 4.6.7 Motor Thermal Protection** to **[2] Thermistor Trip**.
- Set **P 4.6.8 Thermistor Source** to **[2] Analog Input 34**.

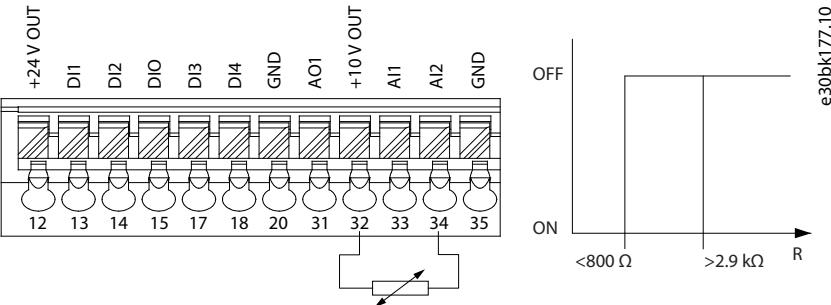


Figure 74: PTC Thermistor Connection - Analog Input

Table 63: Threshold Cut Out Values

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

### NOTICE

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

### P 4.6.8 Thermistor Source

Select the input at which the thermistor (PTC sensor) should be connected. When using an analog input, the same analog input cannot be used for any other purpose such as reference or feedback source.

|                   |          |                 |            |
|-------------------|----------|-----------------|------------|
| Default value:    | 0 [None] | Parameter type: | Selection  |
| Parameter number: | 193      | Unit:           | –          |
| Data type:        | enum     | Access type:    | Read/Write |

| Selection number | Selection name   |
|------------------|------------------|
| 0                | None             |
| 1                | Analog Input 33  |
| 2                | Analog Input 34  |
| 3                | Digital Input 13 |
| 4                | Digital Input 14 |
| 6                | Digital Input 18 |

## NOTICE

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

### P 4.6.9 Motor External Fan

Select whether an external fan to the motor is required.

|                   |        |                 |            |
|-------------------|--------|-----------------|------------|
| Default value:    | 0 [No] | Parameter type: | Selection  |
| Parameter number: | 191    | Unit:           | –          |
| Data type:        | enum   | Access type:    | Read/Write |

| Selection number | Selection name | Selection description                                                                                           |
|------------------|----------------|-----------------------------------------------------------------------------------------------------------------|
| 0                | No             | External fan is required and the motor is derated at low speed.                                                 |
| 1                | Yes            | Apply an external motor fan (external ventilation), so that derating of the motor is not required at low speed. |

### P 4.6.12 Missing Motor Phase Function

Select **[1] Trip 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 10 s** is recommended to avoid motor damage.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 1 [Yes] | Parameter type: | Selection  |
| Parameter number: | 458     | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

| Selection number | Selection name | Selection description                              |
|------------------|----------------|----------------------------------------------------|
| 0                | Off            | No 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

Use this parameter to customize fault levels.

|                   |               |                 |            |
|-------------------|---------------|-----------------|------------|
| Default value:    | 3 [Trip Lock] | Parameter type: | Selection  |
| Parameter number: | 1490          | Unit:           | –          |
| Data type:        | enum          | Access type:    | Read/Write |

| Selection number | Selection name          | Selection description                                                                                                                                                                                                                                                                           |
|------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                | Trip Lock               | 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 <b>Fault 13, Overcurrent</b> 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 <b>Fault 13, Overcurrent</b> . |
| 5                | Fly start               | At start-up, the frequency converter tries to catch a spinning motor. If this option is selected, <b>P 5.6.3 Enable Flying Start</b> is forced to <b>[1] Enabled</b> . This option uses the 8th element to control the fault level of <b>Fault 13, Overcurrent</b> .                            |

Table 64: 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

Locked rotor detection for PM motor.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Off] | Parameter type: | Selection  |
| Parameter number: | 3022    | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

| Selection number | Selection name | Selection description                      |
|------------------|----------------|--------------------------------------------|
| 0                | Off            | The function is not active.                |
| 1                | On             | The locked rotor protection for PM motors. |

#### P 4.6.15 Sync. Locked Rotor Detection Time [s]

Locked rotor detection time for PM motor.

|                   |       |                 |                  |
|-------------------|-------|-----------------|------------------|
| Default value:    | 0.10  | Parameter type: | Range (0.05–1.0) |
| Parameter number: | 3023  | Unit:           | s                |
| Data type:        | uint8 | Access type:    | Read/Write       |

## 7.6 Application (Menu Index 5)

### 7.6.1 Status (Menu Index 5.1)

#### P 5.1.1 Fault Word 1

Use this parameter to view fault word 1 in hex code.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 1690   | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

#### P 5.1.2 Fault Word 2

Use this parameter to view fault word 2 in hex code.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 1691   | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

#### P 5.1.3 Fault Word 3

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

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 1697   | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

#### P 5.1.4 Warning Word 1

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

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

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

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

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

Use this parameter to view the extended status word in hex code.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 1694   | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

#### P 5.1.10 Ext. Status Word 2

Use this parameter to view the extended status word 2 in hex code.

|                |   |                 |                      |
|----------------|---|-----------------|----------------------|
| Default value: | 0 | Parameter type: | Range (0–4294967295) |
|----------------|---|-----------------|----------------------|

|                   |        |              |      |
|-------------------|--------|--------------|------|
| Parameter number: | 1695   | Unit:        | –    |
| Data type:        | uint32 | Access type: | Read |

#### P 5.1.16 Reference [Unit]

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 [%]

Use this parameter to view the total reference.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.0   | Parameter type: | Range (-200.0–200.0) |
| Parameter number: | 1602  | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 5.1.18 External Reference

Use this parameter to view the sum of all external reference sources defined in *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source*.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.0   | Parameter type: | Range (-200.0–200.0) |
| Parameter number: | 1650  | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 5.1.19 Main Actual Value [%]

Use this parameter to view the Main Actual Value sent from the 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

Use this parameter to view the 2 byte control word (CTW) received from the bus master.

|                |      |                 |                 |
|----------------|------|-----------------|-----------------|
| Default value: | 1084 | Parameter type: | Range (0–65535) |
|----------------|------|-----------------|-----------------|

|                   |        |              |      |
|-------------------|--------|--------------|------|
| Parameter number: | 1685   | Unit:        | –    |
| Data type:        | uint16 | Access type: | Read |

### P 5.1.27 FC Port REF 1

Use this parameter to view the last received reference from the FC port.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0     | Parameter type: | Range (-32768–32767) |
| Parameter number: | 1686  | Unit:           | –                    |
| Data type:        | int16 | Access type:    | Read                 |

## 7.6.2 Protection (Menu Index 5.2)

### P 5.2.1 Warning Reference High

Use this parameter to set the high limit for the reference range. When the actual reference exceeds this limit, warning bit 19 is set in **P 5.1.9 Ext. Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

|                   |          |                 |                            |
|-------------------|----------|-----------------|----------------------------|
| Default value:    | 4999.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 455      | Unit:           | –                          |
| Data type:        | int32    | Access type:    | Read/Write                 |

### P 5.2.2 Warning Reference Low

Use this parameter to set the low limit for the reference range. When the actual reference exceeds this limit, warning bit 20 is set in **P 5.1.9 Ext. Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

|                   |           |                 |                            |
|-------------------|-----------|-----------------|----------------------------|
| Default value:    | -4999.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 454       | Unit:           | –                          |
| Data type:        | int32     | Access type:    | Read/Write                 |

### P 5.2.3 Warning Feedback High

Use this parameter to set the high limit for the feedback range. When the feedback exceeds this limit, warning bit 5 is set in **P 5.1.9 Ext. Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

|                   |          |                 |                            |
|-------------------|----------|-----------------|----------------------------|
| Default value:    | 4999.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 457      | Unit:           | ProcessCtrlUnit            |
| Data type:        | int32    | Access type:    | Read/Write                 |

### P 5.2.4 Warning Feedback Low

Use this parameter to set the low limit for the feedback range. When the feedback exceeds this limit, warning bit 6 is set in **P 5.1.9 Ext.Status Word**. The output relay or the digital output can be configured to indicate this warning. The warning indicator light of the control panel is not turned on when this limit is reached.

|                   |           |                 |                            |
|-------------------|-----------|-----------------|----------------------------|
| Default value:    | -4999.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 456       | Unit:           | ProcessCtrlUnit            |
| Data type:        | int32     | Access type:    | Read/Write                 |

### P 5.2.9 Lost Load Function

Select an action if lost load is detected.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Off] | Parameter type: | Selection  |
| Parameter number: | 2260    | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                                                            |
|------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Off            | The function is not active.                                                                                                                                                      |
| 1                | Warning        | The frequency converter continues to run, but activates a warning. A frequency converter digital output or a serial communication bus communicates a warning to other equipment. |
| 2                | Trip           | The frequency converter stop running and activates a fault. A frequency converter digital output or a serial communication bus communicates a fault to other equipment.          |

### P 5.2.10 Lost Load Detection Torque Level

Set the minimum allowed torque level in percent to motor nominal torque. The lost load detection can be activated below this level.

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 10    | Parameter type: | Range (5–100) |
| Parameter number: | 2261  | Unit:           | %             |
| Data type:        | uint8 | Access type:    | Read/Write    |

### P 5.2.11 Lost Load Detection Delay

Set the minimum duration that the torque has to be below detection limit before activating the lost load exception.

|                |    |                 |               |
|----------------|----|-----------------|---------------|
| Default value: | 10 | Parameter type: | Range (0–600) |
|----------------|----|-----------------|---------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 2262   | Unit:        | s          |
| Data type:        | uint16 | Access type: | Read/Write |

### P 5.2.16 Watchdog Response

Use this parameter to select the timeout function. The timeout function activates when the control word fails to be updated within the time period specified in *P 5.2.17 Watchdog Delay*.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Off] | Parameter type: | Selection  |
| Parameter number: | 804     | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Off            |
| 1                | Freeze Output  |
| 2                | Stop           |
| 3                | Jogging        |
| 4                | Max. Speed     |
| 5                | Stop and Trip  |
| 6                | Qstop and Trip |
| 7                | Select Setup 1 |
| 8                | Select Setup 2 |
| 26               | Trip           |

### P 5.2.17 Watchdog Delay

Use this parameter to enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped, and the function selected in *P 5.2.16 Watchdog Response* is then carried out.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 1.0    | Parameter type: | Range (0.5–6000.0) |
| Parameter number: | 803    | Unit:           | s                  |
| Data type:        | uint16 | Access type:    | Read/Write         |

## 7.6.3 Operation Mode (Menu Index 5.4)

### P 5.4.1 Application Selection

Use this parameter to select integrated application functions. When an application is selected, a set of its related parameters is set automatically.

|                   |                         |                 |            |
|-------------------|-------------------------|-----------------|------------|
| Default value:    | 20 [Speed Control Mode] | Parameter type: | Selection  |
| Parameter number: | 16                      | Unit:           | –          |
| Data type:        | enum                    | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name           |
|------------------|--------------------------|
| 20               | Speed Control Mode       |
| 21               | Process Control Mode     |
| 22               | Multi Speed Control Mode |
| 23               | Three Wire Control Mode  |
| 24               | Torque Control Mode      |

### P 5.4.2 Operation Mode

Use this parameter to select the application control principle to be used.

|                   |                     |                 |            |
|-------------------|---------------------|-----------------|------------|
| Default value:    | 0 [Speed Open Loop] | Parameter type: | Selection  |
| Parameter number: | 100                 | Unit:           | –          |
| Data type:        | enum                | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name      | Selection description                                                                                                                                                                |
|------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Speed Open Loop     | Enable speed control (without feedback signal from motor) with automatic slip compensation for almost constant speed at varying loads. Compensations are active and can be disabled. |
| 3                | Process Closed Loop | Enable the use of process control in the frequency converter.                                                                                                                        |
| 4                | Torque Open Loop    | Enable the use of torque open loop in the frequency converter                                                                                                                        |

### P 5.4.3 Motor Control Principle

Use this parameter to select U/f mode or VVC+ mode as motor control principle.

|                |          |                 |           |
|----------------|----------|-----------------|-----------|
| Default value: | 1 [VVC+] | Parameter type: | Selection |
|----------------|----------|-----------------|-----------|

|                   |      |              |            |
|-------------------|------|--------------|------------|
| Parameter number: | 101  | Unit:        | –          |
| Data type:        | enum | Access type: | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                                       |
|------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | U/f            | When running U/f, control slip and load compensations are not included. The control is used for parallel-connected motors and/or special motor applications |
| 1                | VVC+           | Normal running mode, including slip and load compensations.                                                                                                 |

#### NOTICE

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

### 7.6.4 Control (Menu Index 5.5)

#### 7.6.4.1 General Settings (Menu Index 5.5.1)

##### P 5.5.1.1 Control Place Selection

Use this parameter to select the control place of the unit.

|                   |                            |                 |            |
|-------------------|----------------------------|-----------------|------------|
| Default value:    | 0 [Digital and Ctrl. word] | Parameter type: | Selection  |
| Parameter number: | 801                        | Unit:           | –          |
| Data type:        | enum                       | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name         | Selection description                            |
|------------------|------------------------|--------------------------------------------------|
| 0                | Digital and Ctrl. word | Use both the digital input and the control word. |
| 1                | Digital only           | Use the digital input only.                      |
| 2                | Control word only      | Use the control word only.                       |

##### P 5.5.1.2 Control Source

Use this parameter to select the source of the control word.

|                   |             |                 |            |
|-------------------|-------------|-----------------|------------|
| Default value:    | 1 [FC Port] | Parameter type: | Selection  |
| Parameter number: | 802         | Unit:           | –          |
| Data type:        | enum        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | None           |
| 1                | FC Port        |

#### P 5.5.1.6 Configurable Status Word STW

Use this parameter to configure status word bits. Bits 5 and 12–15 of the STW are configurable for various Drive status signals.

|                          |                     |                        |            |
|--------------------------|---------------------|------------------------|------------|
| <b>Default value:</b>    | 1 [Profile Default] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 813                 | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum                | <b>Access type:</b>    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name         |
|------------------|------------------------|
| 0                | No function            |
| 1                | Profile default        |
| 10               | T13 DI status          |
| 11               | T14 DI status          |
| 12               | T15 DI status          |
| 13               | T17 DI status          |
| 15               | T18 DI status          |
| 21               | Thermal warning        |
| 30               | Brake fault (IGBT)     |
| 40               | Out of reference range |
| 54               | Running                |
| 59               | On reference           |

#### P 5.5.1.7 Configurable Control Word CTW

Use this parameter to configure control word bits. The control word has 16 bits (0–15). Bits 10 and 12–15 are configurable.

|                          |                     |                        |            |
|--------------------------|---------------------|------------------------|------------|
| <b>Default value:</b>    | 1 [Profile Default] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 814                 | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum                | <b>Access type:</b>    | Read/Write |

The following are the selections for the parameter.



| Selection number | Selection name        |
|------------------|-----------------------|
| 0                | None                  |
| 1                | Profile default       |
| 2                | CTW valid, active low |

#### P 5.5.1.10 Operating State at Power-up

Select operating mode for restart upon reconnection of the drive to mains voltage after power down. This function is active in Local mode only.

|                   |                            |                 |            |
|-------------------|----------------------------|-----------------|------------|
| Default value:    | 1 [Forced stop, ref = old] | Parameter type: | Selection  |
| Parameter number: | 4                          | Unit:           | –          |
| Data type:        | enum                       | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name        | Selection description                                                                                                                                                    |
|------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Resume                | Restart the frequency converter, maintaining the start or stop settings using <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

Use this parameter to select the function of the REM/LOC button. To avoid accidental LOC/REM change of the drive, select **[0] Disabled**. The setting can be locked by **P 6.6.20 Password**.

|                   |             |                 |            |
|-------------------|-------------|-----------------|------------|
| Default value:    | 1 [Enabled] | Parameter type: | Selection  |
| Parameter number: | 46          | Unit:           | –          |
| Data type:        | enum        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Disabled       |
| 1                | Enabled        |

#### P 5.5.1.16 [Stop/Reset] Button

Use this parameter to select the function of the *Stop/Reset* button. To avoid accidental stop or reset of the drive from control panel, select **[0] Disabled**. The setting can be locked by **P 6.6.20 Password**.

|                   |             |                 |            |
|-------------------|-------------|-----------------|------------|
| Default value:    | 1 [Enabled] | Parameter type: | Selection  |
| Parameter number: | 44          | Unit:           | –          |
| Data type:        | enum        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name     |
|------------------|--------------------|
| 0                | Disabled           |
| 1                | Enabled            |
| 7                | Reset Only Enabled |

#### 7.6.4.2 Digital/Bus (Menu Index 5.5.2)

##### P 5.5.2.1 Coasting Select

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

| NOTICE                                                                                                                      |  |
|-----------------------------------------------------------------------------------------------------------------------------|--|
| This parameter is active only when <b>P 5.5.1.1 Control Place Selection</b> is set to <b>[0] Digital and control word</b> . |  |

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 850          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                    |
|------------------|----------------|----------------------------------------------------------------------------------------------------------|
| 0                | Digital input  | Activate the coasting command via a digital input                                                        |
| 1                | Bus            | Activate the coasting command via the serial communication port or fieldbus option.                      |
| 2                | Logic AND      | Activate the coasting command via the fieldbus/serial communication port and 1 extra digital input.      |
| 3                | Logic OR       | Activate the coasting command via the fieldbus/serial communication port or via 1 of the digital inputs. |

##### P 5.5.2.2 Quick Stop Select

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

### NOTICE

This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to [0] *Digital and control word*.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 851          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                            |
|------------------|----------------|------------------------------------------------------------------------------------------------------------------|
| 0                | Digital input  | Activate the quick stop command via a digital input.                                                             |
| 1                | Bus            | Activate the quick stop command via the serial communication port or fieldbus option.                            |
| 2                | Logic AND      | Activate the quick stop command via the fieldbus/serial communication port and also via 1 of the digital inputs. |
| 3                | Logic OR       | Activate the quick stop command via the fieldbus/serial communication port or via 1 of the digital inputs.       |

### P 5.5.2.3 DC Brake Select

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

### NOTICE

This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to [0] *Digital and control word*.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 852          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                  |
|------------------|----------------|------------------------------------------------------------------------------------------------------------------------|
| 0                | Digital input  | Activate the DC brake command via a digital input.                                                                     |
| 1                | Bus            | Activate the DC brake command via the serial communication port or fieldbus option.                                    |
| 2                | Logic AND      | Activate the DC brake command via the fieldbus/serial communication port and additionally via 1 of the digital inputs. |
| 3                | Logic OR       | Activate the DC brake command via the fieldbus/serial communication port or via 1 of the digital inputs.               |

### P 5.5.2.4 Start Select

Use this parameter to select whether the drive start function is controlled via the terminals (digital input) and/or via the fieldbus. This parameter is active only when **P 5.5.1.1 Control Place Selection** is set to **[0] Digital and control word**.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 853          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                  |
|------------------|----------------|----------------------------------------------------------------------------------------|
| 0                | Digital input  | A digital input triggers the start function.                                           |
| 1                | Bus            | A serial communication port or the fieldbus triggers the start function.               |
| 2                | Logic AND      | The fieldbus/serial communication port and a digital input trigger the start function. |
| 3                | Logic OR       | The fieldbus/serial communication port or a digital input triggers the start function. |

#### P 5.5.2.5 Reversing Select

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

| NOTICE                                                                                                                      |  |
|-----------------------------------------------------------------------------------------------------------------------------|--|
| This parameter is active only when <b>P 5.5.1.1 Control Place Selection</b> is set to <b>[0] Digital and control word</b> . |  |

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 854          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                      |
|------------------|----------------|--------------------------------------------------------------------------------------------|
| 0                | Digital input  | A digital input triggers the reversing function.                                           |
| 1                | Bus            | A serial communication port or the fieldbus triggers the reversing function.               |
| 2                | Logic AND      | The fieldbus/serial communication port and a digital input trigger the reversing function. |
| 3                | Logic OR       | The fieldbus/serial communication port or a digital input triggers the reversing function. |

#### P 5.5.2.6 Set-up Select

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

### NOTICE

This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to [0] *Digital and control word*.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 855          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                   |
|------------------|----------------|-----------------------------------------------------------------------------------------|
| 0                | Digital input  | A digital input triggers the setup selection.                                           |
| 1                | Bus            | A serial communication port or the fieldbus triggers the setup selection.               |
| 2                | Logic AND      | The fieldbus/serial communication port and a digital input trigger the setup selection. |
| 3                | Logic OR       | The fieldbus/serial communication port or a digital input triggers the setup selection. |

### P 5.5.2.7 Preset Reference Select

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

### NOTICE

This parameter is active only when *P 5.5.1.1 Control Place Selection* is set to [0] *Digital and control word*.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 3 [Logic OR] | Parameter type: | Selection  |
| Parameter number: | 856          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                |
|------------------|----------------|--------------------------------------------------------------------------------------|
| 0                | Digital input  | A digital input triggers the preset reference selection.                             |
| 1                | Bus            | A serial communication port or the fieldbus triggers the preset reference selection. |

| Selection number | Selection name | Selection description                                                                              |
|------------------|----------------|----------------------------------------------------------------------------------------------------|
| 2                | Logic AND      | The fieldbus/serial communication port and a digital input trigger the preset reference selection. |
| 3                | Logic OR       | The fieldbus/serial communication port or a digital input triggers the preset reference selection. |

### 7.6.4.3 Reference (Menu Index 5.5.3)

#### P 5.5.3.1 Reference Range

Use this parameter to select the range of the reference signal and the feedback signal.

|                   |             |                 |            |
|-------------------|-------------|-----------------|------------|
| Default value:    | 0 [Min–Max] | Parameter type: | Selection  |
| Parameter number: | 300         | Unit:           | –          |
| Data type:        | enum        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                           |
|------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------|
| 0                | Min–Max        | Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. |
| 1                | –Max–Max       | For both positive and negative values (both directions), relative to <b>P 5.8.1 Rotation Direction</b> .                        |

#### P 5.5.3.2 Reference/Feedback Unit

Use this parameter to select the unit to be used in Process PID Control references and feedback.

|                   |        |                 |            |
|-------------------|--------|-----------------|------------|
| Default value:    | 3 [Hz] | Parameter type: | Selection  |
| Parameter number: | 301    | Unit:           | –          |
| Data type:        | enum   | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | None           |
| 1                | %              |
| 2                | RPM            |
| 3                | Hz             |
| 4                | Nm             |
| 5                | PPM            |

| Selection number | Selection name       |
|------------------|----------------------|
| 10               | l/min                |
| 12               | Pulse/s              |
| 20               | l/s                  |
| 21               | l/min                |
| 22               | l/h                  |
| 23               | m <sup>3</sup> /s    |
| 24               | m <sup>3</sup> /min  |
| 25               | m <sup>3</sup> /h    |
| 30               | kg/s                 |
| 31               | kg/min               |
| 32               | kg/h                 |
| 33               | t/min                |
| 34               | t/h                  |
| 40               | m/s                  |
| 41               | m/min                |
| 45               | m                    |
| 60               | °C                   |
| 70               | mbar                 |
| 71               | bar                  |
| 72               | Pa                   |
| 73               | kPa                  |
| 74               | m WG                 |
| 80               | kW                   |
| 120              | GPM                  |
| 121              | gal/s                |
| 122              | gal/min              |
| 123              | gal/h                |
| 124              | CFM                  |
| 125              | ft <sup>3</sup> /s   |
| 126              | ft <sup>3</sup> /min |
| 127              | ft <sup>3</sup> /h   |
| 130              | lb/s                 |
| 131              | lb/min               |

| Selection number | Selection name     |
|------------------|--------------------|
| 132              | lb/h               |
| 140              | ft/s               |
| 141              | ft/min             |
| 145              | ft                 |
| 150              | lb ft              |
| 160              | °F                 |
| 170              | psi                |
| 171              | lb/in <sup>2</sup> |
| 172              | in WG              |
| 173              | ft WG              |
| 180              | HP                 |

#### P 5.5.3.3 Reference Maximum

Use this parameter to set the maximum reference. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the configuration in **P 5.4.2 Configuration Mode**.

|                   |              |                 |                            |
|-------------------|--------------|-----------------|----------------------------|
| Default value:    | Size Related | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 303          | Unit:           | Reference Feedback Unit    |
| Data type:        | int32        | Access type:    | Read/Write                 |

#### P 5.5.3.4 Reference Minimum

Use this parameter to set the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when **P 5.5.3.1 Reference Range** is set to **[0] Min.- Max.** The minimum reference unit matches the choice of configuration in **P 5.4.2 Configuration Mode**.

|                   |       |                 |                            |
|-------------------|-------|-----------------|----------------------------|
| Default value:    | 0.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 302   | Unit:           | Reference Feedback Unit    |
| Data type:        | int32 | Access type:    | Read/Write                 |

#### P 5.5.3.5 Reference Function

Use this parameter to select which reference source to use. To sum both external and preset reference sources, select **[0] Sum**. To use either the preset or the external reference source, select **[1] External/Preset**.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Sum] | Parameter type: | Selection  |
| Parameter number: | 304     | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |



The following are the selections for the parameter.

| Selection number | Selection name  | Selection description                                                                                                       |
|------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------|
| 0                | Sum             | Sum both external and preset reference sources.                                                                             |
| 1                | External/Preset | Use either the preset or the external reference source. Shift between external and preset via a command or a digital input. |

#### P 5.5.3.6 Reference Site

Use this parameter to select which reference site to activate. To use the local reference in Local mode, or the remote reference in Remote mode, select **[0] Linked to Loc / Rem**. To use the same reference in both Remote and Local modes, select **[1] Remote** or **[2] Local** respectively.

|                          |                       |                        |            |
|--------------------------|-----------------------|------------------------|------------|
| <b>Default value:</b>    | 0 [Linked to Loc/Rem] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 313                   | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum                  | <b>Access type:</b>    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name    |
|------------------|-------------------|
| 0                | Linked to Loc/Rem |
| 1                | Remote            |
| 2                | Local             |

#### P 5.5.3.7 Reference 1 Source

Use this parameter to select the input for the 1st reference signal. The parameters **P 5.5.3.7 Reference 1 Source**, **P 5.5.3.8 Reference 2 Source**, and **P 5.5.3.9 Reference 3 Source** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

|                          |                     |                        |            |
|--------------------------|---------------------|------------------------|------------|
| <b>Default value:</b>    | 1 [Analog Input 33] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 315                 | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum                | <b>Access type:</b>    | 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 |

| Selection number | Selection name      |
|------------------|---------------------|
| 11               | Local bus reference |
| 21               | Potentiometer       |

### P 5.5.3.8 Reference 2 Source

Use this parameter to select the input for the 2nd reference signal. The parameters *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

|                   |                     |                 |            |
|-------------------|---------------------|-----------------|------------|
| Default value:    | 2 [Analog Input 34] | Parameter type: | Selection  |
| Parameter number: | 316                 | Unit:           | –          |
| Data type:        | enum                | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name      |
|------------------|---------------------|
| 0                | No function         |
| 1                | Analog Input 33     |
| 2                | Analog Input 34     |
| 8                | Frequency Input 18  |
| 11               | Local Bus reference |
| 21               | Potentiometer       |

### P 5.5.3.9 Reference 3 Source

Use this parameter to select the input for the 3rd reference signal. *P 5.5.3.7 Reference 1 Source*, *P 5.5.3.8 Reference 2 Source*, and *P 5.5.3.9 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

|                   |                          |                 |            |
|-------------------|--------------------------|-----------------|------------|
| Default value:    | 11 [Local bus reference] | Parameter type: | Selection  |
| Parameter number: | 317                      | Unit:           | –          |
| Data type:        | enum                     | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name     |
|------------------|--------------------|
| 0                | No function        |
| 1                | Analog Input 33    |
| 2                | Analog Input 34    |
| 8                | Frequency Input 18 |

| Selection number | Selection name      |
|------------------|---------------------|
| 11               | Local bus reference |
| 21               | Potentiometer       |

### P 5.5.3.10 Preset Reference

Use this parameter, an array [8], to define preset references. Enter up to 8 different preset references. To activate a preset reference, use digital input and select from [16] *Preset reference bit 0*, [17] *Preset reference bit 1*, or [18] *Preset reference bit 2*, in the corresponding parameter in *parameter group P 9.4.1 Digital Input*.

|                   |       |                 |                        |
|-------------------|-------|-----------------|------------------------|
| Default value:    | 0.00  | Parameter type: | Range (-100.00–100.00) |
| Parameter number: | 310   | Unit:           | %                      |
| Data type:        | int16 | Access type:    | Read/Write             |

### P 5.5.3.11 Preset Relative Reference

Use this parameter, an array [8], to define a fixed value to be added to the variable value defined in *P 5.5.3.12 Relative Scaling Reference Resource*. Their sum is multiplied by the actual reference. This product is then added to the actual reference to give the resulting actual reference.

|                   |       |                 |                        |
|-------------------|-------|-----------------|------------------------|
| Default value:    | 0.00  | Parameter type: | Range (-100.00–100.00) |
| Parameter number: | 314   | Unit:           | %                      |
| Data type:        | int16 | Access type:    | Read/Write             |

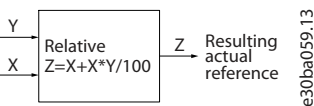


Figure 75: Preset Relative Reference

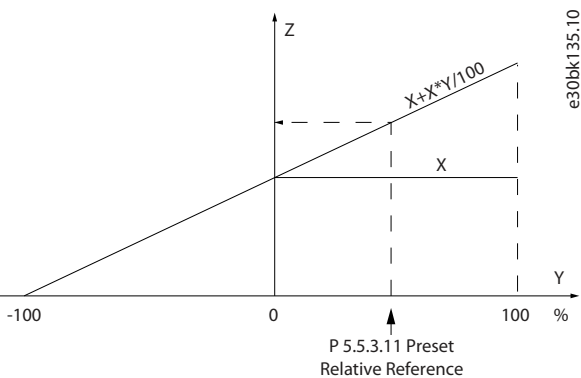


Figure 76: Actual Reference

### P 5.5.3.12 Relative Scaling Reference Resource

Use this parameter to define a variable value to be added to the fixed value defined in *P 5.5.3.11 Preset Relative Reference*. Their sum is multiplied by the actual reference. This product is then added to the actual reference to give the resulting actual reference.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 318  | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name      |
|------------------|---------------------|
| 0                | No function         |
| 1                | Analog Input 33     |
| 2                | Analog Input 34     |
| 8                | Frequency Input 18  |
| 11               | Local bus reference |
| 21               | Potentiometer       |

#### P 5.5.3.13 Freeze Up/Down Step Delta

Use this parameter to enter a percentage value (relative) to be either added to or deducted from the actual reference for catch up or slow down respectively.

|                   |       |                 |                     |
|-------------------|-------|-----------------|---------------------|
| Default value:    | 0.00  | Parameter type: | Range (0.00–100.00) |
| Parameter number: | 312   | Unit:           | %                   |
| Data type:        | int16 | Access type:    | Read/Write          |

#### P 5.5.3.20 Enable Potentiometer

Use this parameter to enable or disable the potentiometer. The setting can be locked with **P 6.6.20 Password**.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 0 [Disabled] | Parameter type: | Selection  |
| Parameter number: | 45           | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Disabled       |
| 1                | Enabled        |

#### 7.6.4.4 Ramp (Menu Index 5.5.4)

##### P 5.5.4.1 Ramp 1 Type Selector

Use this parameter to select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp provides constant acceleration during ramping. Sine Ramp and Sine 2 Ramp provide non-linear acceleration.

|                   |            |                 |            |
|-------------------|------------|-----------------|------------|
| Default value:    | 0 [Linear] | Parameter type: | Selection  |
| Parameter number: | 340        | Unit:           | –          |
| Data type:        | enum       | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                                 |
|------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Linear         |                                                                                                                                                       |
| 1                | Sine Ramp      |                                                                                                                                                       |
| 2                | Sine 2 Ramp    | 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

Use this parameter to enter acceleration time. The values range from 0 Hz to the motor frequency defined in *P 4.2.2.4 Nominal Frequency*. Select a ramp up time such that the output current does not exceed the current limit in *P 2.7.1 Output Current Limit %* during ramping.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 341          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 5.5.4.3 Ramp 1 Decel. Time

Use this parameter to enter the deceleration time. The values range from the motor frequency defined in *P 4.2.2.4 Nominal Frequency* to 0 Hz. Select a ramp down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *P 2.7.1 Output Current Limit %*.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 342          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 5.5.4.8 Ramp 2 Type Selector

Use this parameter to select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp provides constant acceleration during ramping. Sine Ramp and Sine 2 Ramp provide non-linear acceleration.

|                |            |                 |           |
|----------------|------------|-----------------|-----------|
| Default value: | 0 [Linear] | Parameter type: | Selection |
|----------------|------------|-----------------|-----------|

|                   |      |              |            |
|-------------------|------|--------------|------------|
| Parameter number: | 350  | Unit:        | –          |
| Data type:        | enum | Access type: | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                                      |
|------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Linear         |                                                                                                                                                            |
| 1                | Sine Ramp      |                                                                                                                                                            |
| 2                | Sine 2 Ramp    | (Only to be used with speed control mode) S-ramp based on the values set in <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> . |

#### P 5.5.4.9 Ramp 2 Accel. Time

Use this parameter to enter acceleration time. The values range from 0 Hz to the motor frequency defined in **P 4.2.2.4 Nominal Frequency**. Select a ramp-up time such that the output current does not exceed the current limit in **P 2.7.1 Output Current Limit %** during ramping.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 351          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 5.5.4.10 Ramp 2 Decel. Time

Use this parameter to enter the deceleration time. The values range from the motor frequency defined in **P 4.2.2.4 Nominal Frequency** to 0 Hz. Select a ramp-down time such that no overvoltage occurs in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in **P 2.7.1 Output Current Limit %**.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 352          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

### 7.6.5 Start Settings (Menu Index 5.6)

#### P 5.6.1 Start Zero Speed Time

Use this parameter to define a delay of the starting time. The frequency converter begins with the start function selected in **P 5.6.2 Start Function**. Set the start delay time until acceleration is to begin.

|                   |       |                 |                  |
|-------------------|-------|-----------------|------------------|
| Default value:    | 0.0   | Parameter type: | Range (0.0–25.5) |
| Parameter number: | 171   | Unit:           | s                |
| Data type:        | uint8 | Access type:    | Read/Write       |

## P 5.6.2 Start Function

Use this parameter to select the start function during start delay, 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        | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | DC Hold/delay time    | Energize motor with a DC hold current ( <i>P 5.7.6 DC Hold Current</i> %) during the start delay time.                                                                                                                                                                                                                                                                                                                                                                                                |
| 1                | DC-Brake/delay time   | Energize motor with a DC break current ( <i>P 5.7.4 DC Brake Current</i> %) during the start delay time.                                                                                                                                                                                                                                                                                                                                                                                              |
| 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

Use this parameter to control the flying start function. This function makes it possible to catch a motor which is spinning freely due to a mains dropout.

|                   |              |                 |            |
|-------------------|--------------|-----------------|------------|
| Default value:    | 0 [Disabled] | Parameter type: | Selection  |
| Parameter number: | 173          | Unit:           | –          |
| Data type:        | enum         | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name                     | Selection description                                                                                                                                                                                                |
|------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Disabled                           | No function.                                                                                                                                                                                                         |
| 1                | Enabled                            | Enable the frequency converter to catch and control a spinning motor. When <b>P 5.6.3 Enable Flying Start</b> is enabled, <b>P 5.6.1 Start Zero Speed Time</b> , and <b>P 5.6.2 Start Function</b> have no function. |
| 2                | Enabled Always                     | Enable flying start at every start command.                                                                                                                                                                          |
| 3                | Enabled Reference Direction        | Enable the frequency converter to catch and control a spinning motor. The search is performed only in the reference direction.                                                                                       |
| 4                | Enabled Always Reference Direction | Enable flying start at every start command. The search is performed only in the reference direction.                                                                                                                 |

#### P 5.6.4 Start Speed [Hz]

Use this parameter to set the motor start speed. After the start signal the output speed leaps to the set value. This parameter can be used for vertical movement applications (such as cone rotor). Set the start function in **P 5.6.2 Start Function** to **[3] Start Speed Clockwise**, **[4] Horizontal Operation**, or **[5] VVC+ Clockwise**, and set a start delay time in **P 5.6.1 Start Zero Speed Time**.

|                   |              |                 |                   |
|-------------------|--------------|-----------------|-------------------|
| Default value:    | Size Related | Parameter type: | Range (0.0–500.0) |
| Parameter number: | 175          | Unit:           | Hz                |
| Data type:        | uint16       | Access type:    | Read/Write        |

#### P 5.6.5 Start Current

Use this parameter to set the boost current for the motor. Some motors, for example cone-rotor motors, need extra current or starting speed to disengage the rotor. To obtain this boost, set the required current in **P 5.6.5 Start Current**. Set the start speed with **P 5.6.4 Start Speed [Hz]**. Set parameter **P 5.6.2 Start Function** to **[3] Start Speed Clockwise** or **[4] Horizontal Operation**, and set a start delay time in **P 5.6.1 Start Zero Speed Time**.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.00–1000.00) |
| Parameter number: | 176          | Unit:           | A                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

#### P 5.6.6 Breakaway Current Boost

Use this parameter to set the breakaway current boost. The frequency converter provides higher current than normal current levels to enhance breakaway-torque capacity.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Off] | Parameter type: | Selection  |
| Parameter number: | 422     | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

The following are the selections for the parameter.



| Selection number | Selection name |
|------------------|----------------|
| 0                | Off            |
| 1                | On             |

### P 5.6.7 Start Max Speed [Hz]

Use this parameter to enable high starting torque. The time from the moment the start signal is given, until the speed exceeds the speed set in this parameter, becomes a start zone. In the start zone, the current limit and motor torque limit are set to the maximum 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

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

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      | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Rotor Detection     | Estimates the electrical angle of the rotor and uses that as a starting point. This is the standard selection for automation drive applications. If flying start detects that the motor is running at low speed or is stopped, the drive can detect the rotor position (the angle), and start the motor from there.                                                                                                                                                                                            |
| 1                | Parking             | The Parking function applies DC current across the stator winding and rotates the rotor to electrical zero position. This selection is typically selected for pump and fan applications. If flying start detects that the motor is running at low speed or is stopped, the drive sends out a DC current to make the motor park at an angle and then start the motor from.                                                                                                                                      |
| 3                | Rotor Last Position | This option takes the advantage of the last position of rotor at stop and gives a quick start. It is only used in the situation of controlled stop, the drive records the last position of 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 %

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

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 100    | Parameter type: | Range (Size Related) |
| Parameter number: | 146    | Unit:           | %                    |
| Data type:        | uint16 | Access type:    | Read/Write           |

#### P 5.6.13 Sync. Motor Parking Time

Use this parameter to set the duration of the Parking Current set in **P 5.6.14 Sync. Motor Parking Current %**, once activated.

|                   |        |                 |                  |
|-------------------|--------|-----------------|------------------|
| Default value:    | 3.0    | Parameter type: | Range (0.1–60.0) |
| Parameter number: | 207    | Unit:           | s                |
| Data type:        | uint16 | Access type:    | Read/Write       |

#### P 5.6.14 Sync. Motor Parking Current %

Use this parameter to set current as percentage of the rated motor current, set with **P 4.2.2.3 Nominal Current**. Is used when **[1] Parking** is selected in **P 5.6.11 Sync. Motor Start Mode**.

|                   |     |                 |               |
|-------------------|-----|-----------------|---------------|
| Default value:    | 100 | Parameter type: | Range (0–150) |
| Parameter number: | 206 | Unit:           | %             |

|            |        |              |            |
|------------|--------|--------------|------------|
| Data type: | uint16 | Access type: | Read/Write |
|------------|--------|--------------|------------|

### P 5.6.15 Sync. High Starting Torque Time [s]

Use this parameter to set the high starting torque time for a PM motor in VVC+ mode.

|                   |              |                 |                    |
|-------------------|--------------|-----------------|--------------------|
| Default value:    | Size Related | Parameter type: | Range (0.00–60.00) |
| Parameter number: | 3020         | Unit:           | s                  |
| Data type:        | uint16       | Access type:    | Read/Write         |

### P 5.6.16 Sync. High Starting Torque Current [%]

Use this parameter to set the high starting torque current for a PM Motor in VVC+ mode.

|                   |              |                 |                   |
|-------------------|--------------|-----------------|-------------------|
| Default value:    | Size Related | Parameter type: | Range (0.0–200.0) |
| Parameter number: | 3021         | Unit:           | %                 |
| Data type:        | uint 32      | Access type:    | Read/Write        |

## 7.6.6 Stop Settings (Menu Index 5.7)

### P 5.7.1 Function at Stop

Use this parameter to select the drive function after a stop command or after the speed is ramped down to the level set in **P 5.7.2 Min Speed for Function at Stop [Hz]**.

|                   |           |                 |            |
|-------------------|-----------|-----------------|------------|
| Default value:    | 0 [Coast] | Parameter type: | Selection  |
| Parameter number: | 180       | Unit:           | –          |
| Data type:        | enum      | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name        | Selection description                                                               |
|------------------|-----------------------|-------------------------------------------------------------------------------------|
| 0                | Coast                 | Leaves the motor in free mode                                                       |
| 1                | DC Hold/Motor Preheat | Energizes the motor with a DC-hold current (see <b>P 5.7.6 DC Hold Current %</b> ). |

| Selection number | Selection name                     | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                | Pre-magnetizing                    | <p>Builds up a magnetic field while the motor is stopped. This allows the motor to produce torque quickly at commands (induction motors only). This premagnetizing function does not help the 1st start command.</p> <p>Two different solutions are available to pre-magnetize the machine for the 1st start command:</p> <p><b>Solution 1:</b></p> <ul style="list-style-type: none"> <li>1. Start the frequency converter with a 0 RPM reference.</li> <li>2. Wait 2–4 rotor time constants (see the formula below) before increasing the speed reference.</li> </ul> <p><b>Solution 2:</b></p> <ul style="list-style-type: none"> <li>1. Set <b>P 5.6.1 Start Zero Speed Time</b> to the premagnetize time (2–4 rotor time constants).</li> <li>2. Set <b>P 5.6.2 Start Function</b> to <b>[0] DC hold</b>.</li> <li>3. Set the DC hold current magnitude (<b>P 5.7.6 DC Hold Current %</b>) to be equal to <math>I_{pre-mag} = U_{nom}/(1.73 \times X_h)</math>.</li> </ul> <p>Sample rotor time constants = <math>(X_h + X_2)/(6.3 \times Freq_{nom} \times R_r)</math> 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 <b>P 5.7.2 Min Speed for Function at Stop [Hz]</b> , 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 <b>P 5.7.2 Min Speed for Function at Stop [Hz]</b> , energizes the motor with a DC-hold current (see <b>P 5.7.6 DC Hold Current %</b> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

### P 5.7.2 Min Speed for Function at Stop [Hz]

Use this parameter to set the output frequency at which to activate **P 5.7.1 Function at Stop**.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.0    | Parameter type: | Range (Size Related) |
| Parameter number: | 182    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.7.3 DC Brake Time

Set the duration of the DC brake current set in **P 5.7.4 DC Brake Current %**, once activated.

|                   |        |                 |                  |
|-------------------|--------|-----------------|------------------|
| Default value:    | 10.0   | Parameter type: | Range (0.0–60.0) |
| Parameter number: | 202    | Unit:           | s                |
| Data type:        | uint16 | Access type:    | Read/Write       |

### P 5.7.4 DC Brake Current %

Use this parameter to enter a value for current as a percentage of the rated motor current. See **P 4.2.2.3 Nominal Current**. When the speed is lower than the limit set in **P 5.7.5 DC Brake Frequency**, or when the DC-brake Inverse function is active, (in **parameter group 9.4.1. Digital Inputs** set to **[5] DC-brake Inverse**; or via the serial port), a DC-brake current is applied on a stop command. See **P 5.7.3 DC Brake Time** for duration.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 50     | Parameter type: | Range (0–150) |
| Parameter number: | 201    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### NOTICE

##### MOTOR OVERHEATING

The maximum value depends on the rated motor current. To avoid motor damage caused by overheating, do not run at 100% for too long.

### P 5.7.5 DC Brake Frequency

Use this parameter to set the DC-brake cut in speed for activation of the DC-brake current set in **P 5.7.4 DC Brake Current**, together with a stop command.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.0    | Parameter type: | Range (Size Related) |
| Parameter number: | 204    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.7.6 DC Hold Current %

Use this parameter to set the holding current as a percentage of the rated motor current, see **P 4.2.2.3 Nominal Current**). The parameter holds the motor function (holding torque) or preheats the motor. This parameter is active if DC hold is selected in **P 5.6.2 Start Function** as **[0] DC Hold/Delay Time** or **P 5.7.1 Function at Stop** as **[1] DC Hold / Motor Preheat**.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 50     | Parameter type: | Range (0–160) |
| Parameter number: | 200    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### NOTICE

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

Use this parameter to enter the quick-stop ramp-down time, which is the deceleration time from the nominal motor speed to 0 Hz. Ensure that no resulting overvoltage occurs in the inverter due to regenerative operation of the motor required to achieve the given ramp-down time. Ensure also that the generated current required to achieve the given ramp-down time does not exceed the current limit (set in **P 2.7.1 Current Limit**). Activate quick stop with a signal on a selected digital input, or via the serial communication port.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 381          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

## 7.6.7 Speed Control (Menu Index 5.8)

### P 5.8.1 Rotation Direction

Use this parameter to select the motor speed directions required. Use this parameter to prevent unwanted reversing.

|                   |                     |                 |            |
|-------------------|---------------------|-----------------|------------|
| Default value:    | 2 [Both directions] | Parameter type: | Selection  |
| Parameter number: | 410                 | Unit:           | –          |
| Data type:        | enum                | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name  | Selection description                                                    |
|------------------|-----------------|--------------------------------------------------------------------------|
| 0                | Clockwise       | Only operation in clockwise direction is allowed.                        |
| 2                | Both directions | Operation in both clockwise and counterclockwise directions are allowed. |

### P 5.8.2 Motor Speed High Limit [Hz]

Use this parameter to enter the maximum limit for motor speed. The parameter can be set to match the maximum motor speed recommended by the manufacturer. The Motor Speed High Limit must exceed the value in **P 5.8.3 Motor Speed Low Limit [Hz]**. The output frequency must not exceed 1/10 of the switching frequency.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 65.0   | Parameter type: | Range (Size Related) |
| Parameter number: | 414    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.8.3 Motor Speed Low Limit [Hz]

Use this parameter to enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The motor speed low limit must not exceed **P 5.8.2 Motor Speed High Limit**.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.0    | Parameter type: | Range (Size Related) |
| Parameter number: | 412    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.8.8 Torque Limit Mode Speed Ctrl

Use this parameter to select an analog input for scaling the settings in *P 5.10.1 Torque Limit Motor Mode* and *P 5.10.2 Torque Limit Generator Mode* 0–100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling. This parameter is only active when *P 5.4.2 Configuration Mode* is in speed mode.

|                   |                 |                 |            |
|-------------------|-----------------|-----------------|------------|
| Default value:    | 0 [No Function] | Parameter type: | Selection  |
| Parameter number: | 420             | Unit:           | –          |
| Data type:        | enum            | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name        |
|------------------|-----------------------|
| 0                | No function           |
| 2                | Analog in 33          |
| 4                | Analog in 33 inverted |
| 6                | Analog in 34          |
| 8                | Analog in 34 inverted |

### P 5.8.11 Band, High Limit

Some systems call for avoiding certain output speeds due to resonance problems in the system. Use this parameter, an array [4], to enter the upper limits of the speeds to be avoided.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.0    | Parameter type: | Range (Size Related) |
| Parameter number: | 463    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.8.12 Band, Low Limit

Some systems call for avoiding certain output speeds due to resonance problems in the system. Use this parameter, an array [4], to enter the lower limits of the speeds to be avoided.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0.0    | Parameter type: | Range (Size Related) |
| Parameter number: | 461    | Unit:           | Hz                   |
| Data type:        | uint16 | Access type:    | Read/Write           |

## 7.6.8 Inching (Menu Index 5.9)

### P 5.9.1 Jog Ramp Time

Use this parameter to enter the jog ramp time, which is the acceleration/deceleration time between 0 Hz and the rated motor frequency **P 4.2.2.4 Nominal Frequency**. Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in **P 2.7.1 Current Limit**.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (0.01–3600.00) |
| Parameter number: | 380          | Unit:           | s                    |
| Data type:        | uint32       | Access type:    | Read/Write           |

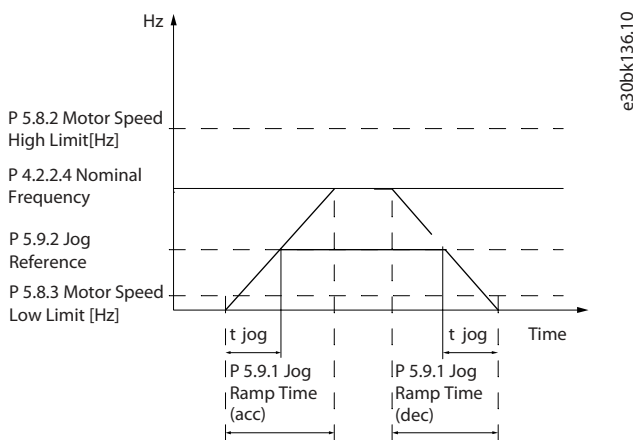


Figure 77: Jog Ramp Time

### P 5.9.2 Jog Reference

Use this parameter to set the jog speed. The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated.

|                   |        |                 |                   |
|-------------------|--------|-----------------|-------------------|
| Default value:    | 5.0    | Parameter type: | Range (0.0–500.0) |
| Parameter number: | 311    | Unit:           | Hz                |
| Data type:        | uint16 | Access type:    | Read/Write        |

## 7.6.9 Torque Control (Menu Index 5.10)

### P 5.10.1 Motor Torque Limit

Use this parameter to enter the maximum torque limit for motor operation. This function limits the torque on the shaft to protect the mechanical installation.

|                   |              |                 |                      |
|-------------------|--------------|-----------------|----------------------|
| Default value:    | Size Related | Parameter type: | Range (Size Related) |
| Parameter number: | 416          | Unit:           | %                    |
| Data type:        | uint16       | Access type:    | Read/Write           |



### P 5.10.2 Regenerative Torque Limit

Use this parameter to enter the maximum torque limit for generator mode operation. This function limits the torque on the shaft to protect the mechanical installation.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 100    | Parameter type: | Range (Size Related) |
| Parameter number: | 417    | Unit:           | %                    |
| Data type:        | uint16 | Access type:    | Read/Write           |

### P 5.10.3 Speed Limit Mode Torque Ctrl.

Use this parameter to select an analog input for scaling the settings in **P 2.3.14 Max Output Frequency** 0–100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling. This parameter is only active when **P 5.4.2 Operation Mode** is in torque mode.

|                   |                 |                 |            |
|-------------------|-----------------|-----------------|------------|
| Default value:    | 0 [No function] | Parameter type: | Selection  |
| Parameter number: | 421             | Unit:           | –          |
| Data type:        | enum            | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name        |
|------------------|-----------------------|
| 0                | No function           |
| 2                | Analog in 33          |
| 4                | Analog in 33 inverted |
| 6                | Analog in 34          |
| 8                | Analog in 34 inverted |

### P 5.10.4 Torque PID Proportional Gain

Use this parameter to enter the proportional gain value for the torque controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 100    | Parameter type: | Range (0–500) |
| Parameter number: | 712    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

### P 5.10.5 Torque PID Integration Time

Use this parameter to enter the integration time for the torque controller. Selection of a low value makes the controller react faster. Too low a setting leads to control instability.

|                |       |                 |                     |
|----------------|-------|-----------------|---------------------|
| Default value: | 0.020 | Parameter type: | Range (0.002–2.000) |
|----------------|-------|-----------------|---------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 713    | Unit:        | s          |
| Data type:        | uint16 | Access type: | Read/Write |

### P 5.10.6 Trip Delay at Torque Limit

Use this parameter to define the delay for tripping the torque warning. When the output torque reaches the torque limit, a warning is triggered. If the torque limit warning is continuously present for the period specified in this parameter, the frequency converter trips. To disable the feature, enter the value of 60 s.

|                   |       |                 |              |
|-------------------|-------|-----------------|--------------|
| Default value:    | 60    | Parameter type: | Range (0–60) |
| Parameter number: | 1425  | Unit:           | s            |
| Data type:        | uint8 | Access type:    | Read/Write   |

## 7.6.10 Mechanical Brake Control (Menu Index 5.11)

### P 5.11.1 Brake Closing Speed

Use this parameter to set the motor frequency when the mechanical brake activates, when a stop condition is present.

|                   |        |                 |                   |
|-------------------|--------|-----------------|-------------------|
| Default value:    | 0.0    | Parameter type: | Range (0.0–400.0) |
| Parameter number: | 222    | Unit:           | Hz                |
| Data type:        | uint16 | Access type:    | Read/Write        |

### P 5.11.2 Brake Close Time

Use this parameter to enter the brake delay time for the coast after ramp-down time. The shaft is held at zero speed with full holding torque. Ensure that the mechanical brake has locked the load before the motor enters coast mode.

|                   |       |                 |                 |
|-------------------|-------|-----------------|-----------------|
| Default value:    | 0.0   | Parameter type: | Range (0.0–5.0) |
| Parameter number: | 223   | Unit:           | s               |
| Data type:        | uint8 | Access type:    | Read/Write      |

### P 5.11.3 Release Brake Current

Use this parameter to set the motor current for release of the mechanical brake, when a start condition is present. The upper limit is specified with *P 2.1.5 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

Use this parameter to select whether to use the mechanical brake in direction changes. Select **[1] On** if the mechanical brake must engage when the shaft changes direction. The speed at which the mechanical brake engages is selected in **P 5.11.1 Brake Closing Speed**.

|                   |         |                 |            |
|-------------------|---------|-----------------|------------|
| Default value:    | 0 [Off] | Parameter type: | Selection  |
| Parameter number: | 239     | Unit:           | –          |
| Data type:        | enum    | Access type:    | Read/Write |

The following are the selections of the parameter:

| Selection number | Selection name      |
|------------------|---------------------|
| 0                | Off                 |
| 1                | On                  |
| 2                | On with start delay |

## 7.6.11 Process Control (Menu Index 5.12)

### 7.6.11.1 Status (Menu Index 5.12.1)

#### P 5.12.1.1 Process PID Error

This parameter shows the error value in the process PID controller.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.0   | Parameter type: | Range (-200.0–200.0) |
| Parameter number: | 1890  | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 5.12.1.2 Process PID Output

This parameter shows the raw output value from the process PID controller.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.0   | Parameter type: | Range (-200.0–200.0) |
| Parameter number: | 1891  | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 5.12.1.3 Process PID Clamped Output

This parameter shows the output value from the process PID controller after reaching a clamp limit.

|                |     |                 |                      |
|----------------|-----|-----------------|----------------------|
| Default value: | 0.0 | Parameter type: | Range (-200.0–200.0) |
|----------------|-----|-----------------|----------------------|

|                   |       |              |      |
|-------------------|-------|--------------|------|
| Parameter number: | 1892  | Unit:        | %    |
| Data type:        | int16 | Access type: | Read |

#### P 5.12.1.4 Process PID Gain Scaled Output

This parameter shows the output value from the process PID controller after reaching a clamp limit and scaling the resulting value with consideration to the gain.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.0   | Parameter type: | Range (-200.0–200.0) |
| Parameter number: | 1893  | Unit:           | %                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 5.12.1.5 Feedback Value

Use this parameter to view the feedback resulting from the selection of scaling in *P 5.5.3.1 Reference Range*, *P 5.5.3.3 Reference Maximum*, and *P 5.5.3.4 Reference Minimum*.

|                   |       |                 |                            |
|-------------------|-------|-----------------|----------------------------|
| Default value:    | 0.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 1652  | Unit:           | Process Ctrl Unit          |
| Data type:        | int32 | Access type:    | Read                       |

### 7.6.11.2 Feedback (Menu Index 5.12.4)

#### P 5.12.4.1 Feedback 1 Resource

Use this parameter to select which drive input is treated as the feedback source.

|                   |                 |                 |            |
|-------------------|-----------------|-----------------|------------|
| Default value:    | 0 [No function] | Parameter type: | Selection  |
| Parameter number: | 720             | Unit:           | –          |
| Data type:        | enum            | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name     |
|------------------|--------------------|
| 0                | No function        |
| 1                | Analog Input 33    |
| 2                | Analog Input 34    |
| 4                | Frequency Input 18 |

#### P 5.12.4.2 Feedback 2 Resource

Use this parameter to select which drive input is treated as the source of the feedback.

|                   |                 |                 |            |
|-------------------|-----------------|-----------------|------------|
| Default value:    | 0 [No function] | Parameter type: | Selection  |
| Parameter number: | 722             | Unit:           | –          |
| Data type:        | enum            | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name     |
|------------------|--------------------|
| 0                | No function        |
| 1                | Analog Input 33    |
| 2                | Analog Input 34    |
| 4                | Frequency Input 18 |

#### P 5.12.4.3 Feedback 1 Conversion

Use this parameter to select a conversion for the Feedback 1 signal. To leave the feedback signal unchanged, select **[0] Linear**.

|                   |            |                 |            |
|-------------------|------------|-----------------|------------|
| Default value:    | 0 [Linear] | Parameter type: | Selection  |
| Parameter number: | 760        | Unit:           | –          |
| Data type:        | enum       | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name |
|------------------|----------------|
| 0                | Linear         |
| 1                | Square root    |

#### P 5.12.4.4 Feedback 2 Conversion

Use this parameter to select a conversion for the Feedback 2 signal. To leave the feedback signal unchanged, select **[0] Linear**.

|                   |            |                 |            |
|-------------------|------------|-----------------|------------|
| Default value:    | 0 [Linear] | Parameter type: | Selection  |
| Parameter number: | 762        | Unit:           | –          |
| Data type:        | enum       | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name |
|------------------|----------------|
| 0                | Linear         |
| 1                | Square root    |

### 7.6.11.3 PID Controller (Menu Index 5.12.5)

#### P 5.12.5.1 PID Proportional Gain

Use this parameter to enter the process controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable.

|                   |        |                 |                   |
|-------------------|--------|-----------------|-------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.0–10.00) |
| Parameter number: | 733    | Unit:           | –                 |
| Data type:        | uint16 | Access type:    | Read/Write        |

#### P 5.12.5.1 PID Proportional Gain

Use this parameter to enter the process controller integral time. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action.

|                   |         |                 |                      |
|-------------------|---------|-----------------|----------------------|
| Default value:    | 9999.00 | Parameter type: | Range (0.10–9999.00) |
| Parameter number: | 734     | Unit:           | s                    |
| Data type:        | uint32  | Access type:    | Read/Write           |

#### P 5.12.5.4 Antiwindup Enabled

Use this parameter to control error regulation. To continue regulation of an error even when the output frequency cannot be increased or decreased, select **[0] Off**. To cease regulation of an error when the output frequency can no longer be adjusted, select **[1] On**.

|                   |        |                 |            |
|-------------------|--------|-----------------|------------|
| Default value:    | 1 [On] | Parameter type: | Selection  |
| Parameter number: | 731    | Unit:           | –          |
| Data type:        | enum   | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name |
|------------------|----------------|
| 0                | Off            |
| 1                | On             |

#### P 5.12.5.5 PID Differentiation Time

Use this parameter to enter the process controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the process feedback. Setting this parameter to zero disables the differentiator.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 0.00   | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 735    | Unit:           | s                  |
| Data type:        | uint16 | Access type:    | Read/Write         |

### P 5.12.5.6 PID Diff. Gain Limit

Use this parameter to enter a limit for the differentiator gain. If there is no limit, the differentiator gain increases when there are fast changes. To obtain a pure differentiator gain at slow changes and a constant differentiator gain where fast changes occur, limit the differentiator gain.

|                   |        |                 |                  |
|-------------------|--------|-----------------|------------------|
| Default value:    | 5.0    | Parameter type: | Range (1.0–50.0) |
| Parameter number: | 736    | Unit:           | –                |
| Data type:        | uint16 | Access type:    | Read/Write       |

### P 5.12.5.7 PID Normal/Inverse Control

Use this parameter to select output speed change during errors. To set the process control to increase the output speed when the process error is positive, select **[0] Normal**. To reduce the output speed when the process error is positive, select **[1] Inverse**.

|                   |            |                 |            |
|-------------------|------------|-----------------|------------|
| Default value:    | 0 [Normal] | Parameter type: | Selection  |
| Parameter number: | 730        | Unit:           | –          |
| Data type:        | enum       | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name |
|------------------|----------------|
| 0                | Normal         |
| 1                | Inverse        |

### P 5.12.5.8 PID Start Speed

Use this parameter to enter the motor speed to be attained as a start signal for starting PID control. Upon power-up, the drive operates using speed open loop control. When the Process PID start speed is reached, the drive changes to PID control.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–6000) |
| Parameter number: | 732    | Unit:           | RPM            |
| Data type:        | uint16 | Access type:    | Read/Write     |

### P 5.12.5.9 On Reference Bandwidth

Use this parameter to enter the On Reference bandwidth. When the PI Control Error (the difference between the reference and the feedback) is greater than the value of this parameter, then the On Reference status bit is set to 0.

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 5     | Parameter type: | Range (0–200) |
| Parameter number: | 739   | Unit:           | %             |
| Data type:        | uint8 | Access type:    | Read/Write    |

#### 7.6.11.4 Feed Forward (Menu Index 5.12.6)

##### P 5.12.6.1 PID Feed Forward Factor

Use this parameter to enter the PID feed forward factor. The feed forward factor sends a constant fraction of the reference signal to bypass PID control, so the PID only has an effect on the remaining fraction of the control signal. This function increases dynamic performance.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 0      | Parameter type: | Range (0–200) |
| Parameter number: | 738    | Unit:           | %             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### 7.6.11.5 Sleep Mode (Menu Index 5.12.7)

The sequence when running sleep mode in open loop ([1] *Speed* is selected in P 5.12.7.1 *Sleep Mode in Process Closed-loop Mode*)

1. The motor speed is less than P 5.12.7.8 *Sleep Speed [Hz]* and the motor has been running longer than P 5.12.7.2 *Minimum Run Time*.
2. The drive ramps the motor speed down to P 5.7.2 *Min Speed for Function at Stop [Hz]*.
3. The drive activates P 5.7.1 *Function at Stop*. The drive is now in sleep mode.
4. The drive compares the speed setpoint with P 5.12.7.4 *Wake-Up Speed [Hz]* to detect wake-up situation.
5. The speed setpoint is greater than P 5.12.7.4 *Wake-Up Speed [Hz]* and the sleep condition has lasted for more than P 5.12.7.3 *Minimum Sleep Time*. The drive is now out of sleep mode.
6. Go back to speed open loop control (ramp motor speed up to the speed setpoint).

The sequence when running sleep mode in closed loop ([0] *Feed. and Speed* is selected in P 5.12.7.1 *Sleep Mode in Process Closed-loop Mode*)

1. When the error between reference and feedback is greater than P 5.12.7.5 *Wake-Up Reference/Feedback Difference*, and the output speed is less than the sleep mode speed, the drive enters boost status. If P 5.12.7.6 *Setpoint Boost* is not set, the drive enters sleep mode.
2. After P 5.12.7.7 *Maximum Boost Time*, the drive ramps the motor speed down to P 5.7.2 *Min Speed for Function at Stop [Hz]*.
3. The drive activates P 5.7.1 *Function at Stop*. The drive is now in sleep mode.
4. When the error between reference and feedback is greater than P 5.12.7.5 *Wake-Up Reference/Feedback Difference*, and the condition lasts more than P 5.12.7.3 *Minimum Sleep Time*, the drive is out of sleep mode.
5. The drive reverts to closed loop control.

The sequence when running sleep mode in closed loop ([2] *Feedback* is selected in P 5.12.7.1 *Sleep Mode in Process Closed-loop Mode*)

1. When the error between reference and feedback is greater than P 5.12.7.5 *Wake-Up Reference/Feedback Difference*, the drive enters boost status. If P 5.12.7.6 *Setpoint Boost* is not set, the drive enters sleep mode.
2. After P 5.12.7.7 *Maximum Boost Time*, the drive ramps the motor speed down to P 5.7.2 *Min Speed for Function at Stop [Hz]*.
3. The drive activates P 5.7.1 *Function at Stop*. The drive is now in sleep mode.
4. When the error between reference and feedback is greater than P 5.12.7.5 *Wake-Up Reference/Feedback Difference*, and the condition lasts more than P 5.12.7.3 *Minimum Sleep Time*, the drive is out of sleep mode.
5. The drive reverts to closed loop control.



## NOTICE

Sleep mode is not active when local reference is active (set speed manually with navigation buttons on the control panel). Does not work in Local mode. Remote setup in open loop must be carried out before setting input/output in closed loop.

### P 5.12.7.1 Sleep Mode in Process Closed-loop Mode

This parameter is for sleep mode running in process closed loop. Use this parameter to set whether the feedback is detected for entering sleep mode.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 2202 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

| Selection number | Selection name  | Selection description                                            |
|------------------|-----------------|------------------------------------------------------------------|
| 0                | Feed. and Speed | Feedback is detected together with the speed.                    |
| 1                | Speed           | Feedback is not detected, only sleep speed and time are checked. |
| 2                | Feedback        | Feedback is detected only.                                       |

### P 5.12.7.2 Minimum Run Time

Set the minimum running time for the motor after a start command (digital input or bus) before entering the sleep mode.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 10     | Parameter type: | Range (0–600) |
| Parameter number: | 2240   | Unit:           | s             |
| Data type:        | uint16 | Access type:    | Read/Write    |

### P 5.12.7.3 Minimum Sleep Time

Set the minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 10     | Parameter type: | Range (0–600) |
| Parameter number: | 2241   | Unit:           | s             |
| Data type:        | uint16 | Access type:    | Read/Write    |

### P 5.12.7.4 Wake-Up Speed [Hz]

This parameter is used when **P 5.4.2 Operation Mode** is set for open loop, and the speed reference is from an external controller. Set the reference speed when the Sleep Mode is deactivated.

|                   |      |                 |                |
|-------------------|------|-----------------|----------------|
| Default value:    | 100  | Parameter type: | Range (0–4000) |
| Parameter number: | 2243 | Unit:           | Hz             |

|            |        |              |            |
|------------|--------|--------------|------------|
| Data type: | uint16 | Access type: | Read/Write |
|------------|--------|--------------|------------|

#### P 5.12.7.5 Wake-Up Reference/Feedback Difference

This parameter is used when **P 5.4.2 Operation Mode** is set for process closed loop. Set the allowed pressure drop in percentage of setpoint for the pressure ( $P_{set}$ ) before canceling the sleep mode.

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 10    | Parameter type: | Range (0–100) |
| Parameter number: | 2244  | Unit:           | %             |
| Data type:        | uint8 | Access type:    | Read/Write    |

#### P 5.12.7.6 Setpoint Boost

This parameter is used when **P 5.4.2 Operation Mode** is set for process closed loop. In systems with, for example, constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This extends the time when the motor is stopped and help to avoid frequent start/stop. Set the overpressure/temperature in percentage of setpoint for the pressure ( $P_{set}$ )/temperature before entering the Sleep Mode. If setting for 5%, the boost pressure is  $P_{set} \cdot 1.05$ . The negative values can be used for, for example, cooling tower control where a negative change is needed.

|                   |      |                 |                  |
|-------------------|------|-----------------|------------------|
| Default value:    | 0    | Parameter type: | Range (-100–100) |
| Parameter number: | 2245 | Unit:           | %                |
| Data type:        | int8 | Access type:    | Read/Write       |

#### P 5.12.7.7 Maximum Boost Time

This parameter is used when **P 5.4.2 Operation Mode** is set for process closed loop. Set the maximum time of the boost mode. If the set time exceeds, the drive does not wait for the set boost pressure to be reached, and enters the sleep mode.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 60     | Parameter type: | Range (0–600) |
| Parameter number: | 2246   | Unit:           | s             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### P 5.12.7.8 Sleep Speed [Hz]

Set the sleep speed. When the drive speed is below the sleep speed, the drive enters the sleep mode.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–4000) |
| Parameter number: | 2247   | Unit:           | Hz             |
| Data type:        | uint16 | Access type:    | Read/Write     |

#### P 5.12.7.9 Sleep Delay Time

Set the delay time for the motor to wait before entering the sleep mode when the condition of entering sleep mode is met.

|                |   |                 |                |
|----------------|---|-----------------|----------------|
| Default value: | 0 | Parameter type: | Range (0–3600) |
|----------------|---|-----------------|----------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 2248   | Unit:        | s          |
| Data type:        | uint16 | Access type: | Read/Write |

#### P 5.12.7.10 Wake-Up Delay Time

Set the delay time for the motor to wait before waking up from sleep mode when the condition of waking up is met.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–3600) |
| Parameter number: | 2249   | Unit:           | s              |
| Data type:        | uint16 | Access type:    | Read/Write     |

### 7.6.12 Fieldbus Process Data (Menu Index 5.27)

#### P 5.27.1 PCD Write Selection

Use this parameter to select the parameters to be assigned to the 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         |
| 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] |

| Selection number | Selection name                 |
|------------------|--------------------------------|
| 11               | Digital & Relay Bus Control    |
| 13               | Terminal 31 Output Bus Control |
| 15               | FC Port CTW                    |
| 16               | FC Port REF                    |
| 81               | User Define 0                  |
| 82               | User Define 1                  |
| 83               | User Define 2                  |
| 84               | User Define 3                  |
| 85               | User Define 4                  |
| 86               | User Define 5                  |
| 87               | User Define 6                  |
| 88               | User Define 7                  |

### P 5.27.2 PCD Read Selection

Use this parameter to select the parameters to be assigned to the PCDs of the telegrams. The number of available PCDs depends on the telegram type. PCDs contain the actual data values of the selected parameters.

Enter up to 16 different preset 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.

|                          |          |                        |            |
|--------------------------|----------|------------------------|------------|
| <b>Default value:</b>    | 0 [None] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 843      | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum     | <b>Access type:</b>    | 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     |
| 5                | Reference [Unit] |
| 6                | Reference %      |
| 7                | Status Word      |

| Selection number | Selection name                   |
|------------------|----------------------------------|
| 8                | Main Actual Value [%]            |
| 9                | Custom Readout                   |
| 10               | Power [kW]                       |
| 11               | Power [hp]                       |
| 12               | Motor Voltage                    |
| 13               | Frequency                        |
| 14               | Motor Current                    |
| 15               | Frequency [%]                    |
| 16               | Torque [Nm]                      |
| 17               | Motor Thermal                    |
| 18               | DC Link Voltage                  |
| 19               | Heat Sink Temperature            |
| 20               | Inverter Thermal                 |
| 22               | External Reference               |
| 23               | Feedback [Unit]                  |
| 24               | Digital Input 13, 14, 15, 17, 18 |
| 25               | Terminal 33 Switch Setting       |
| 26               | Analog Input 33                  |
| 27               | Terminal 34 Switch Setting       |
| 28               | Analog Input 34                  |
| 29               | Analog Output 31 [mA]            |
| 30               | Relay Output                     |
| 33               | Fault Word                       |
| 34               | Warning Word                     |
| 35               | External Status Word             |
| 39               | Fault Word 2                     |
| 40               | Warning Word 2                   |
| 43               | Speed [RPM]                      |
| 44               | Digital Output                   |
| 54               | External Status Word 2           |
| 55               | Fault Word 3                     |
| 56               | Warning Word 3                   |
| 81               | User Define 8                    |

| Selection number | Selection name         |
|------------------|------------------------|
| 82               | User Define 9          |
| 83               | User Define 10         |
| 84               | User Define 11         |
| 85               | User Define 12         |
| 86               | User Define 13         |
| 87               | User Define 14         |
| 88               | User Define 15         |
| 100              | Main Actual Value [N2] |

### P 5.27.3 PCD User Define

Customize the User define X of Parameter PCD Write Configuration or PCD Read Configuration, [0-7] for PCD Write, [8-15] for PCD Read.

|                   |        |                 |                 |
|-------------------|--------|-----------------|-----------------|
| Default value:    | 0      | Parameter type: | Range (0–65535) |
| Parameter number: | 844    | Unit:           | –               |
| Data type:        | uint16 | Access type:    | Read/Write      |

## 7.7 Maintenance and Service (Menu Index 6)

### 7.7.1 Status (Menu Index 6.1)

#### P 6.1.1 Latest Fault Number

Use this parameter to view the fault logs. 10 fault logs can be viewed. 0 contains the most recent logged fault, and 9 has the oldest logged fault.

|                   |       |                 |               |
|-------------------|-------|-----------------|---------------|
| Default value:    | 0     | Parameter type: | Range (0–255) |
| Parameter number: | 1530  | Unit:           | –             |
| Data type:        | uint8 | Access type:    | Read          |

#### P 6.1.2 Operating Hours

Use this parameter to view how many hours the frequency converter has run. The value is saved when the drive is turned off.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–2147483647) |
| Parameter number: | 1500   | Unit:           | h                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 6.1.3 Running Hours

Use this parameter to view how many hours the motor has run. Reset the counter with **P 6.1.9 Reset Running Hours Counter**. The value is saved when the drive is turned off.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–2147483647) |
| Parameter number: | 1501   | Unit:           | h                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 6.1.4 kWh Counter

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in **P 6.1.8 Reset kWh Counter**.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–2147483647) |
| Parameter number: | 1502   | Unit:           | kWh                  |
| Data type:        | uint32 | Access type:    | Read                 |

### P 6.1.5 Power Up's

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

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

Use this parameter to view the number of frequency converter overvoltages that have occurred since production.

|                   |        |                 |                 |
|-------------------|--------|-----------------|-----------------|
| Default value:    | 0      | Parameter type: | Range (0–65535) |
| Parameter number: | 1505   | Unit:           | –               |
| Data type:        | uint16 | Access type:    | Read            |

### P 6.1.8 Reset kWh Counter

Use this parameter to reset the kWh counter to zero (see **P 6.1.4 kWh Counter**).

|                   |                  |                 |            |
|-------------------|------------------|-----------------|------------|
| Default value:    | 0 [Do not reset] | Parameter type: | Selection  |
| Parameter number: | 1506             | Unit:           | –          |
| Data type:        | enum             | Access type:    | Read/Write |

The following are the available selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Do Not Reset   |
| 1                | Reset Counter  |

### P 6.1.9 Reset Running Hours Counter

Use this parameter to reset the Running Hours counter to zero (see **P 6.1.3 Running Hours**).

|                   |                  |                 |            |
|-------------------|------------------|-----------------|------------|
| Default value:    | 0 [Do not reset] | Parameter type: | Selection  |
| Parameter number: | 1507             | Unit:           | –          |
| Data type:        | enum             | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Do Not Reset   |
| 1                | Reset Counter  |

### P 6.1.10 Internal Fault Reason

Use this parameter to view a description of the error. This parameter is used in combination with **fault 38 Internal Fault**.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0     | Parameter type: | Range (–32767–32767) |
| Parameter number: | 1531  | Unit:           | –                    |
| Data type:        | int16 | Access type:    | Read                 |

### P 6.1.11 Fault Log: Time

Use this parameter to view the time when the logged event occurred. Time is measured in seconds from drive 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

Use this parameter to view the combined software version consisting of power software and control software.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1543          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.2.2 SW ID Control Card

Use this parameter to view the control board software version number.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1549          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.2.3 SW ID Power Card

Use this parameter to view the power card software version number.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1550          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.2.7 ECP SW Version

View the ECP ID number.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1548          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

## 7.7.3 Cooling Fan (Menu Index 6.5)

### P 6.5.1 Fan Control Mode

Use this parameter to select the fan control mode.

|                   |                                           |                 |            |
|-------------------|-------------------------------------------|-----------------|------------|
| Default value:    | 7 [On when Inverter is on, otherwise off] | Parameter type: | Selection  |
| Parameter number: | 1452                                      | Unit:           | –          |
| Data type:        | enum                                      | Access type:    | Read/Write |

The following are the selections for the parameter:

| Selection number | Selection name                       |
|------------------|--------------------------------------|
| 5                | Constant-on Mode                     |
| 6                | Constant-off Mode                    |
| 7                | On-when-inverter-is-on-else-off Mode |

## 7.7.4 Parameter Handling (Menu Index 6.6)

### P 6.6.1 Active Set-up

Use this parameter to select the setup to control the drive functions. Use Multi setup for remote selection.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 1    | Parameter type: | Selection  |
| Parameter number: | 10   | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 1                | Set-up 1       |
| 2                | Set-up 2       |
| 9                | Multi Set-up   |

### P 6.6.2 Programming Set-up

Use this parameter to select the setup to be edited. The setup is configured by control panel when it is accessed by control panel, and by 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

Use this parameter to link or unlink setups. The link ensures synchronizing of the parameters that cannot be changed while the motor is running. When setups are linked, it is possible to shift from 1 setup to another during operation. When selecting linked, the parameter values of **Edit Set-up** are overwritten with the values of the other setup.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 20   | Parameter type: | Selection  |
| Parameter number: | 12   | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Not linked     |
| 20               | Linked         |

### P 6.6.4 Set-up Copy

Use this parameter to copy parameters between set-ups.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 51   | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name           |
|------------------|--------------------------|
| 0                | No copy                  |
| 1                | Copy from Set-up 1       |
| 2                | Copy from Set-up 2       |
| 9                | Copy from Factory Set-up |

### P 6.6.6 Reset Mode

Use this parameter to define whether the frequency converter waits for a manual reset, or resets itself automatically after tripping. In manual reset mode, press the *Stop/Reset* button or use digital inputs to reset the frequency converter.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1420 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

## NOTICE

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

The following are the selections for the parameter.

| Selection number | Selection name       | Selection description                                                   |
|------------------|----------------------|-------------------------------------------------------------------------|
| 0                | Manual reset         | Perform a reset via <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    |                                                                         |

## NOTICE

If the specified number of automatic resets is reached within 10 minutes, the frequency converter enters **[0] Manual Reset Mode**. After the manual reset is performed, the setting of **P 6.6.6 Reset Mode** reverts to the original selection. If the number of automatic resets is not reached within 10 minutes, or when a manual reset is performed, the internal automatic reset counter returns to 0.

### P 6.6.7 Automatic Restart Time

Use this parameter to enter the time interval from the trip event to the automatic reset. This parameter is active when **P 6.6.6 Reset Mode** is set to a selection between [1]–[13].

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 10     | Parameter type: | Range (0–600) |
| Parameter number: | 1421   | Unit:           | s             |
| Data type:        | uint16 | Access type:    | Read/Write    |

## NOTICE

A value of 0s cannot be set when **P 6.6.6 Reset Mode** is set to **[13] Infinite auto reset**.

## P 6.6.8 Operation Mode

Use this parameter to select the drive operation mode. To reset drive parameter values to default, select **[2] Initialization**. The communication related parameters remain unchanged. The frequency converter resets during the next power-up.

|                   |                      |                 |            |
|-------------------|----------------------|-----------------|------------|
| Default value:    | 0 [Normal operation] | Parameter type: | Selection  |
| Parameter number: | 1422                 | Unit:           | –          |
| Data type:        | enum                 | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name   |
|------------------|------------------|
| 0                | Normal operation |
| 2                | Initialization   |

## P 6.6.9 Service Code

This parameter is intended for use by service technicians only.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 1429   | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read/Write           |

## P 6.6.12 ECP Copy

Use this parameter to select the ECP copy functions.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 50   | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name       | Selection description                                                                            |
|------------------|----------------------|--------------------------------------------------------------------------------------------------|
| 0                | No copy              | Do not copy any parameter.                                                                       |
| 1                | All to ECP           | Copy all parameters in all setups from drive to ECP.                                             |
| 2                | All from ECP         | Copy all parameters in all setups from ECP to drive.                                             |
| 3                | Size indep. from ECP | Copy only parameters which are independent of motor size, w/o disturbing motor data already set. |

### P 6.6.20 Password

Use this parameter to define the password for access to the *Main Menu* via the *Home* button. Setting the value to 0 disables the password function.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 0      | Parameter type: | Range (0–999) |
| Parameter number: | 60     | Unit:           | –             |
| Data type:        | uint16 | Access type:    | Read/Write    |

### P 6.6.26 Language

Use this parameter to define the language to be used in the display.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1    | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | English        |
| 10               | 中文             |

## 7.7.5 Drive Identification (Menu Index 6.7)

### P 6.7.1 Drive Type

Use this parameter to view the product type of the drive. The readout is identical to the frequency converter series power field of the model code definition, characters 1–6.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1540          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.2 Power Section

Use this parameter to view the current rating of the drive. The readout is identical to the frequency converter series power field of the model code definition, characters 7–10.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1541          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.3 Voltage

Use this parameter to view the mains voltage of the drive. The readout is identical to the frequency converter series power field of the model code definition.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1542          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.4 Ordered Model Code

Use this parameter to view the model code string used for reordering the frequency converter in its original configuration.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1544          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.6 Drive Ordering No

Use this parameter to view the code number used for reordering the drive in its original configuration.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1546          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.7 Drive Serial Number

Use this parameter to view the serial number of the frequency converter.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1551          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

### P 6.7.9 Power Card Serial Number

Use this parameter to view the serial number of the power card.

|                   |               |                 |      |
|-------------------|---------------|-----------------|------|
| Default value:    | –             | Parameter type: | –    |
| Parameter number: | 1553          | Unit:           | –    |
| Data type:        | VisibleString | Access type:    | Read |

## 7.8 Customization (Menu Index 8)

### 7.8.1 Custom Readout (Menu Index 8.1)

#### P 8.1.1 Custom Readout

View the user-defined readouts as defined in parameters *P 8.1.2 Custom Readout Unit*, *P 8.1.3 Custom Readout Min Value*, and *P 8.1.4 Custom Readout Max Value*.

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0.00  | Parameter type: | Range (0.00–9999.00) |
| Parameter number: | 1609  | Unit:           | CustomReadoutUnit    |
| Data type:        | int32 | Access type:    | Read                 |

#### P 8.1.1 Custom Readout Unit

Set the user-defined readouts unit.

|                   |       |                 |            |
|-------------------|-------|-----------------|------------|
| Default value:    | 1 [%] | Parameter type: | Selection  |
| Parameter number: | 30    | Unit:           | –          |
| Data type:        | enum  | Access type:    | Read/Write |

The following are the available selections for the parameter.

| Selection number | Selection name      |
|------------------|---------------------|
| 0                | None                |
| 1                | %                   |
| 5                | PPM                 |
| 10               | l/min               |
| 11               | RPM                 |
| 12               | Pulse/s             |
| 20               | l/s                 |
| 21               | l/min               |
| 22               | l/h                 |
| 23               | m <sup>3</sup> /s   |
| 24               | m <sup>3</sup> /min |
| 25               | m <sup>3</sup> /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                |
| 127              | ft <sup>3</sup> /h |
| 140              | ft/s               |
| 141              | ft/min             |
| 160              | °F                 |
| 170              | psi                |
| 171              | lb/in <sup>2</sup> |
| 172              | in WG              |
| 173              | ft WG              |
| 180              | HP                 |

### P 8.1.3 Custom Readout Min Value

Set the custom readout value that corresponds to zero speed.

|                   |       |                 |                        |
|-------------------|-------|-----------------|------------------------|
| Default value:    | 0.00  | Parameter type: | Range (0.00–999999.99) |
| Parameter number: | 31    | Unit:           | CustomReadoutUnit      |
| Data type:        | int32 | Access type:    | Read/Write             |

### P 8.1.4 Custom Readout Max Value

Set the custom readout value that corresponds to motor high speed limit.

|                   |        |                 |                        |
|-------------------|--------|-----------------|------------------------|
| Default value:    | 100.00 | Parameter type: | Range (0.00–999999.99) |
| Parameter number: | 32     | Unit:           | CustomReadoutUnit      |
| Data type:        | int32  | Access type:    | Read/Write             |

## 7.8.2 Smart Logic Controller (Menu Index 8.4)

### 7.8.2.1 Overview of Smart Logic Controller

The Smart Logic Controller, also called SLC, is a logic controller which can be used together with logical operations of the drive.

The Smart Logic Controller manages sequences via an event/action handling. Events and actions are each numbered and linked in pairs (states), which means if an event is evaluated as true, the linked action in each state is executed. After this, the next event is evaluated and its belonging action is executed, and so on. Only 1 event is evaluated at a time. No matter in which state the sequence stops last time, the sequence always starts at state 0. If an event is evaluated as false, the SLC takes no action during the scan interval and no other events are evaluated. It is possible to program up to 20 states in the controller. When the last event/action is executed, the sequence starts again from event/action 0. See [Figure 78](#).

- Set **P 8.4.2.1 Enable Controller** to **[1] On** to enable the sequence controller of the SLC.
- Set **P 8.4.2.2 Start Controller** to start the sequence controller function.
- Set **P 8.4.2.3 Stop Controller** or disable the SLC in **P 8.4.2.1 Enable Controller** to stop the sequence.
- To reset all SLC parameters, select **[1] Reset SLC** in **P 8.4.2.4 Reset Controller** and start programming from scratch.

The controller is common for all setups. If setups are changed during the execution of the sequence, the sequence continues from the last state.

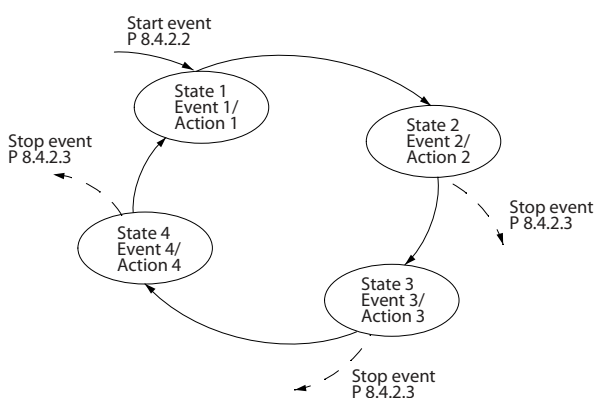


Figure 78: Example with Events/Actions

### NOTICE

SLC is only active in Remote mode, not in Local mode.

### 7.8.2.2 Status (Menu Index 8.4.1)

#### P 8.4.1.1 Controller State

View the actual state of the Smart Logic Controller (SLC).

|                   |       |                 |              |
|-------------------|-------|-----------------|--------------|
| Default value:    | 0     | Parameter type: | Range (0–20) |
| Parameter number: | 1638  | Unit:           | –            |
| Data type:        | uint8 | Access type:    | Read         |

#### P 8.4.1.2 Counter A

View the present value of Counter A. Counters are useful as comparator operands, see **P 8.4.3.1 Comparator Operand**. The value can be reset or changed either via digital inputs (*parameter group P 9.4 Digital Inputs/Outputs*) or by using an SLC action (**P 8.4.6.2 Action**).

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0     | Parameter type: | Range (-32768–32767) |
| Parameter number: | 1672  | Unit:           | –                    |
| Data type:        | int16 | Access type:    | Read                 |

#### P 8.4.1.3 Counter B

View the present value of Counter B. Counters are useful as comparator operands, see **P 8.4.3.1 Comparator Operand**. The value can be reset or changed either via digital inputs (*parameter group P 9.4 Digital Inputs/Outputs*) or by using an SLC action (**P 8.4.6.2 Action**).

|                   |       |                 |                      |
|-------------------|-------|-----------------|----------------------|
| Default value:    | 0     | Parameter type: | Range (-32768–32767) |
| Parameter number: | 1673  | Unit:           | –                    |
| Data type:        | int16 | Access type:    | Read                 |

### 7.8.2.3 SLC Settings (Menu Index 8.4.2)

Use SLC settings to activate, deactivate, and reset the Smart Logic Control.

#### P 8.4.2.1 Enable Controller

Enable or disable the Smart Logic Control.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1300 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                      |
|------------------|----------------|------------------------------------------------------------------------------------------------------------|
| 0                | Off            | Enable the start of Smart Logic Control when a start command is present, for example, via a digital input. |
| 1                | On             | Disable the Smart Logic Control.                                                                           |

#### P 8.4.2.2 Start Controller

Select the condition (TRUE or FALSE) to activate the Smart Logic Controller.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 39   | Parameter type: | Selection  |
| Parameter number: | 1301 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name       | Selection description                                     |
|------------------|----------------------|-----------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                               |
| 1                | TRUE                 | Enters True in logic rule.                                |
| 2                | Running              | See <i>P 9.4.3.1 Function Relay [5]</i> for description.  |
| 3                | In range             | See <i>P 9.4.3.1 Function Relay [7]</i> for description.  |
| 4                | On reference         | See <i>P 9.4.3.1 Function Relay [8]</i> for description.  |
| 7                | Out of current range | See <i>P 9.4.3.1 Function Relay [12]</i> for description. |
| 8                | Below I low          | See <i>P 9.4.3.1 Function Relay [13]</i> for description. |
| 9                | Above I high         | See <i>P 9.4.3.1 Function Relay [14]</i> for description. |
| 16               | Thermal warning      | See <i>P 9.4.3.1 Function Relay [21]</i> for description. |
| 17               | Mains out of range   | Mains voltage is outside the specified voltage range.     |
| 18               | Reversing            | See <i>P 9.4.3.1 Function Relay [25]</i> for description. |
| 19               | Warning              | A warning is active.                                      |
| 20               | Alarm (trip)         | A trip alarm is active.                                   |
| 21               | Alarm (trip lock)    | A trip lock alarm is active.                              |
| 22               | Comparator 0         | Use result of comparator 0 in logic rule.                 |
| 23               | Comparator 1         | Use result of comparator 1 in logic rule.                 |
| 24               | Comparator 2         | Use result of comparator 2 in logic rule.                 |
| 25               | Comparator 3         | Use result of comparator 3 in logic rule.                 |
| 26               | Logic rule 0         | Use result of logic rule 0 in logic rule.                 |
| 27               | Logic rule 1         | Use result of logic rule 1 in logic rule.                 |
| 28               | Logic rule 2         | Use result of logic rule 2 in logic rule.                 |
| 29               | Logic rule 3         | Use result of logic rule 3 in logic rule.                 |
| 33               | Digital input T13    | Use value of DI1 in logic rule.                           |
| 34               | Digital input T14    | Use value of DI2 in logic rule.                           |
| 35               | Digital input T15    | Use value of DIO in logic rule.                           |
| 36               | Digital input T17    | Use value of DI3 in logic rule.                           |

| Selection number | Selection name  | Selection description                                                                                   |
|------------------|-----------------|---------------------------------------------------------------------------------------------------------|
| 39               | Start command   | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped   | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |
| 42               | Auto Reset Trip | An auto reset is performed.                                                                             |
| 50               | Comparator 4    | Use result of comparator 4 in logic rule.                                                               |
| 51               | Comparator 5    | Use result of comparator 5 in logic rule.                                                               |
| 60               | Logic rule 4    | Use result of logic rule 4 in logic rule.                                                               |
| 61               | Logic rule 5    | Use result of logic rule 5 in logic rule.                                                               |
| 83               | Lost Load       | Lost load is performed.                                                                                 |

### P 8.4.2.3 Stop Controller

Select the condition (TRUE or FALSE) to deactivate the Smart Logic Controller.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 40   | Parameter type: | Selection  |
| Parameter number: | 1302 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name       | Selection description                                     |
|------------------|----------------------|-----------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                               |
| 1                | TRUE                 | Enters True in logic rule.                                |
| 2                | Running              | See <b>P 9.4.3.1 Function Relay [5]</b> for description.  |
| 3                | In range             | See <b>P 9.4.3.1 Function Relay [7]</b> for description.  |
| 4                | On reference         | See <b>P 9.4.3.1 Function Relay [8]</b> for description.  |
| 7                | Out of current range | See <b>P 9.4.3.1 Function Relay [12]</b> for description. |
| 8                | Below I low          | See <b>P 9.4.3.1 Function Relay [13]</b> for description. |
| 9                | Above I high         | See <b>P 9.4.3.1 Function Relay [14]</b> for description. |
| 16               | Thermal warning      | See <b>P 9.4.3.1 Function Relay [21]</b> for description. |
| 17               | Mains out of range   | Mains voltage is outside the specified voltage range.     |
| 18               | Reversing            | See <b>P 9.4.3.1 Function Relay [25]</b> for description. |
| 19               | Warning              | A warning is active.                                      |
| 20               | Alarm (trip)         | A trip alarm is active.                                   |
| 21               | Alarm (trip lock)    | A trip lock alarm is active.                              |

| Selection number | Selection name    | Selection description                                                                                   |
|------------------|-------------------|---------------------------------------------------------------------------------------------------------|
| 22               | Comparator 0      | Use result of comparator 0 in logic rule.                                                               |
| 23               | Comparator 1      | Use result of comparator 1 in logic rule.                                                               |
| 24               | Comparator 2      | Use result of comparator 2 in logic rule.                                                               |
| 25               | Comparator 3      | Use result of comparator 3 in logic rule.                                                               |
| 26               | Logic rule 0      | Use result of logic rule 0 in logic rule.                                                               |
| 27               | Logic rule 1      | Use result of logic rule 1 in logic rule.                                                               |
| 28               | Logic rule 2      | Use result of logic rule 2 in logic rule.                                                               |
| 29               | Logic rule 3      | Use result of logic rule 3 in logic rule.                                                               |
| 30               | SL Time-out 0     | Use result of timer 0 in logic rule.                                                                    |
| 31               | SL Time-out 1     | Use result of timer 1 in logic rule.                                                                    |
| 32               | SL Time-out 2     | Use result of timer 2 in logic rule.                                                                    |
| 33               | Digital input T13 | Use value of DI1 in logic rule.                                                                         |
| 34               | Digital input T14 | Use value of DI2 in logic rule.                                                                         |
| 35               | Digital input T15 | Use value of DIO in logic rule.                                                                         |
| 36               | Digital input T17 | Use value of DI3 in logic rule.                                                                         |
| 39               | Start command     | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped     | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |
| 42               | Auto Reset Trip   | An auto reset is performed.                                                                             |
| 50               | Comparator 4      | Use result of comparator 4 in logic rule.                                                               |
| 51               | Comparator 5      | Use result of comparator 5 in logic rule.                                                               |
| 60               | Logic rule 4      | Use result of logic rule 4 in logic rule.                                                               |
| 61               | Logic rule 5      | Use result of logic rule 5 in logic rule.                                                               |
| 70               | SL Time-out 3     | Use result of timer 3 in logic rule.                                                                    |
| 71               | SL Time-out 4     | Use result of timer 4 in logic rule.                                                                    |
| 72               | SL Time-out 5     | Use result of timer 5 in logic rule.                                                                    |
| 73               | SL Time-out 6     | Use result of timer 6 in logic rule.                                                                    |
| 74               | SL Time-out 7     | Use result of timer 7 in logic rule.                                                                    |
| 83               | Lost Load         | Lost load is performed.                                                                                 |

#### P 8.4.2.4 Reset Controller

Select to reset parameters to default settings.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1303 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name   | Selection description                         |
|------------------|------------------|-----------------------------------------------|
| 0                | Do not reset SLC | Do not reset SLC.                             |
| 1                | Reset SLC        | Reset all SLC parameters to default settings. |

### 7.8.2.4 Comparators (Menu Index 8.4.3)

Comparators are used for comparing continuous variables (output frequency, output current, analog input, and so on) to fixed preset values.

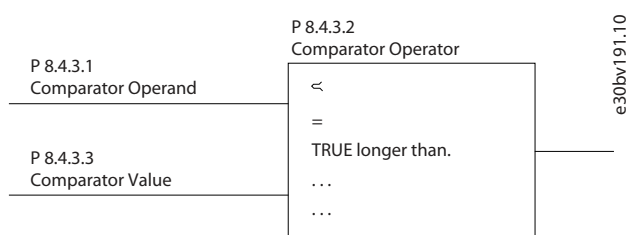


Figure 79: Comparator Parameters

In addition, there are digital values which are compared to fixed time values. See explanation in **P 8.4.3.1 Comparator Operand**. Comparators are evaluated once in each scan interval. Use the result (TRUE or FALSE) directly. All parameters in this parameter group are array parameters with index 0–5. Select index 0 to program Comparator 0, select index 1 to program Comparator 1, and so on.

#### P 8.4.3.1 Comparator Operand

Select the variable to be monitored by the comparator. This is an array parameter containing comparators 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 1    | Parameter type: | Selection  |
| Parameter number: | 1310 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                   |
|------------------|----------------|---------------------------------------------------------|
| 0                | Disabled       | Comparator is disabled.                                 |
| 1                | Reference      | Resulting remote reference (not local) as a percentage. |
| 2                | Feedback       | Feedback in [Hz].                                       |
| 3                | Motor speed    | Motor speed in [Hz].                                    |

| Selection number | Selection name    | Selection description               |
|------------------|-------------------|-------------------------------------|
| 4                | Motor Current     | Motor current in [A].               |
| 6                | Motor power       | Motor power in either [kW] or [hp]. |
| 7                | Motor voltage     | Motor voltage in [V].               |
| 12               | Analog input AI33 | Expressed as actual value.          |
| 13               | Analog input AI34 | Expressed as actual value.          |
| 19               | Pulse input FI18  | Expressed as actual value.          |
| 20               | Alarm number      | Shows number of the alarm.          |
| 30               | Counter A         | Number of counts.                   |
| 31               | Counter B         | Number of counts.                   |

### P 8.4.3.2 Comparator Operator

Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1311 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name    | Selection description                                                                                                                                                                                                                                                                                      |
|------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Less Than (<)     | Result of evaluation is True if variable selected in <b>P 8.4.3.1 Comparator Operand</b> is smaller than fixed value in <b>P 8.4.3.3 Comparator Value</b> . Result is False if variable selected in <b>P 8.4.3.1 Comparator Operand</b> is greater than fixed value in <b>P 8.4.3.3 Comparator Value</b> . |
| 1                | Approx. Equal (~) | Result of evaluation is True if variable selected in <b>P 8.4.3.1 Comparator Operand</b> is approximately equal to fixed value in <b>P 8.4.3.3 Comparator Value</b> .                                                                                                                                      |
| 2                | Greater Than (>)  | Inverse logic of selection 0.                                                                                                                                                                                                                                                                              |

### P 8.4.3.3 Comparator Value

Enter the "trigger level" for the variable which is monitored by this comparator. This is an array parameter containing comparator values 0–5.

|                   |       |                 |                          |
|-------------------|-------|-----------------|--------------------------|
| Default value:    | 0     | Parameter type: | Range (-9999000–9999000) |
| Parameter number: | 1312  | Unit:           | –                        |
| Data type:        | int32 | Access type:    | Read/Write               |



### 7.8.2.5 Timers (Menu Index 8.4.4)

Use the timer results to define an event (*P 8.4.6.1 Event*) or as boolean input in a logic rule (*P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.3 Logic Rule Boolean 2*, or *P 8.4.5.5 Logic Rule Boolean 3*).

When timer value has elapsed timer changes state from False to True.

#### P 8.4.4.1 Timer

Enter the value to define the duration of the FALSE output from the programmed timer. A timer is only FALSE if it is started by an action (see *P 8.4.6.2 Action* [29–31] and *P 8.4.6.2 Action* [70–74] Start timer X) and until the timer value has elapsed. This is an array parameter containing timers 0–7.

|                   |        |                 |                  |
|-------------------|--------|-----------------|------------------|
| Default value:    | 0      | Parameter type: | Range (0–360000) |
| Parameter number: | 1320   | Unit:           | s                |
| Data type:        | uint32 | Access type:    | Read/Write       |

### 7.8.2.6 Logic Rules (Menu Index 8.4.5)

Combine up to 3 boolean inputs (TRUE/FALSE inputs) from timers, comparators, digital inputs, status bits, and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in *P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.3 Logic Rule Boolean 2*, and *P 8.4.5.5 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *P 8.4.5.2 Logic Rule Operator 1* and *P 8.4.5.4 Logic Rule Operator 2*.

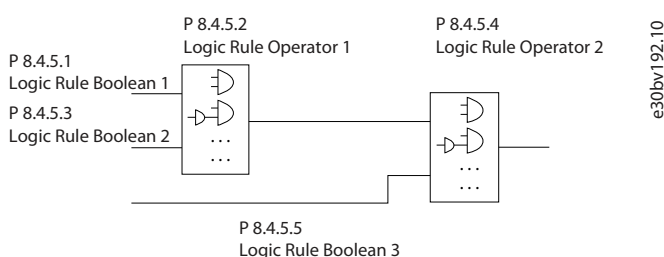


Figure 80: Parameters for Logic Rules

#### Priority of calculation

The results of *P 8.4.5.1 Logic Rule Boolean 1*, *P 8.4.5.2 Logic Rule Operator 1*, and *P 8.4.5.3 Logic Rule Boolean 2* are calculated first. The outcome (TRUE/FALSE) of this calculation is combined with the settings of *P 8.4.5.4 Logic Rule Operator 2* and *P 8.4.5.5 Logic Rule Boolean 3*, yielding the final result (TRUE/FALSE) of the logic rule.

#### P 8.4.5.1 Logic Rule Boolean 1

Select the 1st boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1340 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name       | Selection description                                                                                   |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                                                                             |
| 1                | TRUE                 | Enters True in logic rule.                                                                              |
| 2                | Running              | See <b>P 9.4.3.1 Function Relay [5]</b> for description.                                                |
| 3                | In range             | See <b>P 9.4.3.1 Function Relay [7]</b> for description.                                                |
| 4                | On reference         | See <b>P 9.4.3.1 Function Relay [8]</b> for description.                                                |
| 7                | Out of current range | See <b>P 9.4.3.1 Function Relay [12]</b> for description.                                               |
| 8                | Below I low          | See <b>P 9.4.3.1 Function Relay [13]</b> for description.                                               |
| 9                | Above I high         | See <b>P 9.4.3.1 Function Relay [14]</b> for description.                                               |
| 16               | Thermal warning      | See <b>P 9.4.3.1 Function Relay [21]</b> for description.                                               |
| 17               | Mains out of range   | Mains voltage is outside the specified voltage range.                                                   |
| 18               | Reversing            | See <b>P 9.4.3.1 Function Relay [25]</b> for description.                                               |
| 19               | Warning              | A warning is active.                                                                                    |
| 20               | Alarm (trip)         | A trip alarm is active.                                                                                 |
| 21               | Alarm (trip lock)    | A trip lock alarm is active.                                                                            |
| 22               | Comparator 0         | Use result of comparator 0 in logic rule.                                                               |
| 23               | Comparator 1         | Use result of comparator 1 in logic rule.                                                               |
| 24               | Comparator 2         | Use result of comparator 2 in logic rule.                                                               |
| 25               | Comparator 3         | Use result of comparator 3 in logic rule.                                                               |
| 26               | Logic rule 0         | Use result of logic rule 0 in logic rule.                                                               |
| 27               | Logic rule 1         | Use result of logic rule 1 in logic rule.                                                               |
| 28               | Logic rule 2         | Use result of logic rule 2 in logic rule.                                                               |
| 29               | Logic rule 3         | Use result of logic rule 3 in logic rule.                                                               |
| 30               | SL Time-out 0        | Use result of timer 0 in logic rule.                                                                    |
| 31               | SL Time-out 1        | Use result of timer 1 in logic rule.                                                                    |
| 32               | SL Time-out 2        | Use result of timer 2 in logic rule.                                                                    |
| 33               | Digital input T13    | Use value of DI1 in logic rule.                                                                         |
| 34               | Digital input T14    | Use value of DI2 in logic rule.                                                                         |
| 35               | Digital input T15    | Use value of DIO in logic rule.                                                                         |
| 36               | Digital input T17    | Use value of DI3 in logic rule.                                                                         |
| 39               | Start command        | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped        | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |

| Selection number | Selection name  | Selection description                     |
|------------------|-----------------|-------------------------------------------|
| 42               | Auto Reset Trip | An auto reset is performed.               |
| 50               | Comparator 4    | Use result of comparator 4 in logic rule. |
| 51               | Comparator 5    | Use result of comparator 5 in logic rule. |
| 60               | Logic rule 4    | Use result of logic rule 4 in logic rule. |
| 61               | Logic rule 5    | Use result of logic rule 5 in logic rule. |
| 70               | SL Time-out 3   | Use result of timer 3 in logic rule.      |
| 71               | SL Time-out 4   | Use result of timer 4 in logic rule.      |
| 72               | SL Time-out 5   | Use result of timer 5 in logic rule.      |
| 73               | SL Time-out 6   | Use result of timer 6 in logic rule.      |
| 74               | SL Time-out 7   | Use result of timer 7 in logic rule.      |
| 83               | Lost Load       | Lost load is performed.                   |

#### P 8.4.5.2 Logic Rule Operator 1

Select the 1st logical operator to use on the Boolean inputs from *P 8.4.5.1 Logic Rule Boolean 1* and *P 8.4.5.3 Logic Rule Boolean 2*. This is an array parameter containing logical operators 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1341 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                |
|------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Disabled       | Ignores <i>P 8.4.5.3 Logic Rule Boolean 2</i> , <i>P 8.4.5.4 Logic Rule Operator 2</i> , and <i>P 8.4.5.5 Logic Rule Boolean 3</i> . |
| 1                | AND            | Evaluates expression <i>P 8.4.5.1 Logic Rule Boolean 1</i> AND <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                               |
| 2                | OR             | Evaluates expression <i>P 8.4.5.1 Logic Rule Boolean 1</i> OR <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                                |
| 3                | AND NOT        | Evaluates expression <i>P 8.4.5.1 Logic Rule Boolean 1</i> AND NOT <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                           |
| 4                | OR NOT         | Evaluates expression <i>P 8.4.5.1 Logic Rule Boolean 1</i> OR NOT <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                            |
| 5                | NOT AND        | Evaluates expression NOT <i>P 8.4.5.1 Logic Rule Boolean 1</i> AND <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                           |
| 6                | NOT OR         | Evaluates expression NOT <i>P 8.4.5.1 Logic Rule Boolean 1</i> OR <i>P 8.4.5.3 Logic Rule Boolean 2</i> .                            |

| Selection number | Selection name | Selection description                                                                                          |
|------------------|----------------|----------------------------------------------------------------------------------------------------------------|
| 7                | NOT AND NOT    | Evaluates expression NOT <i>P 8.4.5.1 Logic Rule Boolean 1</i> AND NOT <i>P 8.4.5.3 Logic Rule Boolean 2</i> . |
| 8                | NOT OR NOT     | Evaluates expression NOT <i>P 8.4.5.1 Logic Rule Boolean 1</i> OR NOT <i>P 8.4.5.3 Logic Rule Boolean 2</i> .  |

### P 8.4.5.3 Logic Rule Boolean 2

Select the 2nd boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1342 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

| Selection number | Selection name       | Selection description                                     |
|------------------|----------------------|-----------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                               |
| 1                | TRUE                 | Enters True in logic rule.                                |
| 2                | Running              | See <i>P 9.4.3.1 Function Relay [5]</i> for description.  |
| 3                | In range             | See <i>P 9.4.3.1 Function Relay [7]</i> for description.  |
| 4                | On reference         | See <i>P 9.4.3.1 Function Relay [8]</i> for description.  |
| 7                | Out of current range | See <i>P 9.4.3.1 Function Relay [12]</i> for description. |
| 8                | Below I low          | See <i>P 9.4.3.1 Function Relay [13]</i> for description. |
| 9                | Above I high         | See <i>P 9.4.3.1 Function Relay [14]</i> for description. |
| 16               | Thermal warning      | See <i>P 9.4.3.1 Function Relay [21]</i> for description. |
| 17               | Mains out of range   | Mains voltage is outside the specified voltage range.     |
| 18               | Reversing            | See <i>P 9.4.3.1 Function Relay [25]</i> for description. |
| 19               | Warning              | A warning is active.                                      |
| 20               | Alarm (trip)         | A trip alarm is active.                                   |
| 21               | Alarm (trip lock)    | A trip lock alarm is active.                              |
| 22               | Comparator 0         | Use result of comparator 0 in logic rule.                 |
| 23               | Comparator 1         | Use result of comparator 1 in logic rule.                 |
| 24               | Comparator 2         | Use result of comparator 2 in logic rule.                 |
| 25               | Comparator 3         | Use result of comparator 3 in logic rule.                 |
| 26               | Logic rule 0         | Use result of logic rule 0 in logic rule.                 |
| 27               | Logic rule 1         | Use result of logic rule 1 in logic rule.                 |
| 28               | Logic rule 2         | Use result of logic rule 2 in logic rule.                 |

| Selection number | Selection name    | Selection description                                                                                   |
|------------------|-------------------|---------------------------------------------------------------------------------------------------------|
| 29               | Logic rule 3      | Use result of logic rule 3 in logic rule.                                                               |
| 30               | SL Time-out 0     | Use result of timer 0 in logic rule.                                                                    |
| 31               | SL Time-out 1     | Use result of timer 1 in logic rule.                                                                    |
| 32               | SL Time-out 2     | Use result of timer 2 in logic rule.                                                                    |
| 33               | Digital input T13 | Use value of DI1 in logic rule.                                                                         |
| 34               | Digital input T14 | Use value of DI2 in logic rule.                                                                         |
| 35               | Digital input T15 | Use value of DIO in logic rule.                                                                         |
| 36               | Digital input T17 | Use value of DI3 in logic rule.                                                                         |
| 39               | Start command     | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped     | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |
| 42               | Auto Reset Trip   | An auto reset is performed.                                                                             |
| 50               | Comparator 4      | Use result of comparator 4 in logic rule.                                                               |
| 51               | Comparator 5      | Use result of comparator 5 in logic rule.                                                               |
| 60               | Logic rule 4      | Use result of logic rule 4 in logic rule.                                                               |
| 61               | Logic rule 5      | Use result of logic rule 5 in logic rule.                                                               |
| 70               | SL Time-out 3     | Use result of timer 3 in logic rule.                                                                    |
| 71               | SL Time-out 4     | Use result of timer 4 in logic rule.                                                                    |
| 72               | SL Time-out 5     | Use result of timer 5 in logic rule.                                                                    |
| 73               | SL Time-out 6     | Use result of timer 6 in logic rule.                                                                    |
| 74               | SL Time-out 7     | Use result of timer 7 in logic rule.                                                                    |
| 83               | Lost Load         | Lost load is performed.                                                                                 |

#### P 8.4.5.4 Logic Rule Operator 2

Select the 2nd logical operator to be used on the Boolean input calculated in **P 8.4.5.1 Logic Rule Boolean 1**, **P 8.4.5.2 Logic Rule Operator 1**, and **P 8.4.5.3 Logic Rule Boolean 2**, and the boolean input coming from **P 8.4.5.5 Logic Rule Boolean 3**. This is an array parameter containing logical operators 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1343 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                                                                                                                                      |
|------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | Disabled       | Ignores <b>P 8.4.5.5 Logic Rule Boolean 3</b> .                                                                                                            |
| 1                | AND            | Evaluates expression [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] AND <b>P 8.4.5.5 Logic Rule Boolean 3</b> .         |
| 2                | OR             | Evaluates expression [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] OR <b>P 8.4.5.5 Logic Rule Boolean 3</b> .          |
| 3                | AND NOT        | Evaluates expression [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] AND NOT <b>P 8.4.5.5 Logic Rule Boolean 3</b> .     |
| 4                | OR NOT         | Evaluates expression [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] OR NOT <b>P 8.4.5.5 Logic Rule Boolean 3</b> .      |
| 5                | NOT AND        | Evaluates expression NOT [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] AND <b>P 8.4.5.5 Logic Rule Boolean 3</b> .     |
| 6                | NOT OR         | Evaluates expression NOT [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] OR <b>P 8.4.5.5 Logic Rule Boolean 3</b> .      |
| 7                | NOT AND NOT    | Evaluates expression NOT [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] AND NOT <b>P 8.4.5.5 Logic Rule Boolean 3</b> . |
| 8                | NOT OR NOT     | Evaluates expression NOT [ <b>P 8.4.5.1 Logic Rule Boolean 1</b> / <b>P 8.4.5.3 Logic Rule Boolean 2</b> ] OR NOT <b>P 8.4.5.5 Logic Rule Boolean 3</b> .  |

### P 8.4.5.5 Logic Rule Boolean 3

Select the 3rd boolean (TRUE or FALSE) input for the selected logic rule. This is an array parameter containing logical rules 0–5.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1344 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

| Selection number | Selection name       | Selection description                                     |
|------------------|----------------------|-----------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                               |
| 1                | TRUE                 | Enters True in logic rule.                                |
| 2                | Running              | See <b>P 9.4.3.1 Function Relay [5]</b> for description.  |
| 3                | In range             | See <b>P 9.4.3.1 Function Relay [7]</b> for description.  |
| 4                | On reference         | See <b>P 9.4.3.1 Function Relay [8]</b> for description.  |
| 7                | Out of current range | See <b>P 9.4.3.1 Function Relay [12]</b> for description. |
| 8                | Below I low          | See <b>P 9.4.3.1 Function Relay [13]</b> for description. |
| 9                | Above I high         | See <b>P 9.4.3.1 Function Relay [14]</b> for description. |
| 16               | Thermal warning      | See <b>P 9.4.3.1 Function Relay [21]</b> for description. |

| Selection number | Selection name     | Selection description                                                                                   |
|------------------|--------------------|---------------------------------------------------------------------------------------------------------|
| 17               | Mains out of range | Mains voltage is outside the specified voltage range.                                                   |
| 18               | Reversing          | See <b>P 9.4.3.1 Function Relay [25]</b> for description.                                               |
| 19               | Warning            | A warning is active.                                                                                    |
| 20               | Alarm (trip)       | A trip alarm is active.                                                                                 |
| 21               | Alarm (trip lock)  | A trip lock alarm is active.                                                                            |
| 22               | Comparator 0       | Use result of comparator 0 in logic rule.                                                               |
| 23               | Comparator 1       | Use result of comparator 1 in logic rule.                                                               |
| 24               | Comparator 2       | Use result of comparator 2 in logic rule.                                                               |
| 25               | Comparator 3       | Use result of comparator 3 in logic rule.                                                               |
| 26               | Logic rule 0       | Use result of logic rule 0 in logic rule.                                                               |
| 27               | Logic rule 1       | Use result of logic rule 1 in logic rule.                                                               |
| 28               | Logic rule 2       | Use result of logic rule 2 in logic rule.                                                               |
| 29               | Logic rule 3       | Use result of logic rule 3 in logic rule.                                                               |
| 30               | SL Time-out 0      | Use result of timer 0 in logic rule.                                                                    |
| 31               | SL Time-out 1      | Use result of timer 1 in logic rule.                                                                    |
| 32               | SL Time-out 2      | Use result of timer 2 in logic rule.                                                                    |
| 33               | Digital input T13  | Use value of DI1 in logic rule.                                                                         |
| 34               | Digital input T14  | Use value of DI2 in logic rule.                                                                         |
| 35               | Digital input T15  | Use value of DIO in logic rule.                                                                         |
| 36               | Digital input T17  | Use value of DI3 in logic rule.                                                                         |
| 39               | Start command      | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped      | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |
| 42               | Auto Reset Trip    | An auto reset is performed.                                                                             |
| 50               | Comparator 4       | Use result of comparator 4 in logic rule.                                                               |
| 51               | Comparator 5       | Use result of comparator 5 in logic rule.                                                               |
| 60               | Logic rule 4       | Use result of logic rule 4 in logic rule.                                                               |
| 61               | Logic rule 5       | Use result of logic rule 5 in logic rule.                                                               |
| 70               | SL Time-out 3      | Use result of timer 3 in logic rule.                                                                    |
| 71               | SL Time-out 4      | Use result of timer 4 in logic rule.                                                                    |
| 72               | SL Time-out 5      | Use result of timer 5 in logic rule.                                                                    |
| 73               | SL Time-out 6      | Use result of timer 6 in logic rule.                                                                    |

| Selection number | Selection name | Selection description                |
|------------------|----------------|--------------------------------------|
| 74               | SL Time-out 7  | Use result of timer 7 in logic rule. |
| 83               | Lost Load      | Lost load is performed.              |

### 7.8.2.7 States (Menu Index 8.4.6)

#### P 8.4.6.1 Event

Select the boolean input (TRUE or FALSE) to define the Smart Logic Controller event. This is an array parameter containing SLC events 0–19.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1351 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

| Selection number | Selection name       | Selection description                                     |
|------------------|----------------------|-----------------------------------------------------------|
| 0                | FALSE                | Enters False in logic rule.                               |
| 1                | TRUE                 | Enters True in logic rule.                                |
| 2                | Running              | See <i>P 9.4.3.1 Function Relay [5]</i> for description.  |
| 3                | In range             | See <i>P 9.4.3.1 Function Relay [7]</i> for description.  |
| 4                | On reference         | See <i>P 9.4.3.1 Function Relay [8]</i> for description.  |
| 7                | Out of current range | See <i>P 9.4.3.1 Function Relay [12]</i> for description. |
| 8                | Below I low          | See <i>P 9.4.3.1 Function Relay [13]</i> for description. |
| 9                | Above I high         | See <i>P 9.4.3.1 Function Relay [14]</i> for description. |
| 16               | Thermal warning      | See <i>P 9.4.3.1 Function Relay [21]</i> for description. |
| 17               | Mains out of range   | Mains voltage is outside the specified voltage range.     |
| 18               | Reversing            | See <i>P 9.4.3.1 Function Relay [25]</i> for description. |
| 19               | Warning              | A warning is active.                                      |
| 20               | Alarm (trip)         | A trip alarm is active.                                   |
| 21               | Alarm (trip lock)    | A trip lock alarm is active.                              |
| 22               | Comparator 0         | Use result of comparator 0 in logic rule.                 |
| 23               | Comparator 1         | Use result of comparator 1 in logic rule.                 |
| 24               | Comparator 2         | Use result of comparator 2 in logic rule.                 |
| 25               | Comparator 3         | Use result of comparator 3 in logic rule.                 |
| 26               | Logic rule 0         | Use result of logic rule 0 in logic rule.                 |
| 27               | Logic rule 1         | Use result of logic rule 1 in logic rule.                 |
| 28               | Logic rule 2         | Use result of logic rule 2 in logic rule.                 |



| Selection number | Selection name    | Selection description                                                                                   |
|------------------|-------------------|---------------------------------------------------------------------------------------------------------|
| 29               | Logic rule 3      | Use result of logic rule 3 in logic rule.                                                               |
| 30               | SL Time-out 0     | Use result of timer 0 in logic rule.                                                                    |
| 31               | SL Time-out 1     | Use result of timer 1 in logic rule.                                                                    |
| 32               | SL Time-out 2     | Use result of timer 2 in logic rule.                                                                    |
| 33               | Digital input T13 | Use value of DI1 in logic rule.                                                                         |
| 34               | Digital input T14 | Use value of DI2 in logic rule.                                                                         |
| 35               | Digital input T15 | Use value of DIO in logic rule.                                                                         |
| 36               | Digital input T17 | Use value of DI3 in logic rule.                                                                         |
| 39               | Start command     | This event is True, if frequency converter is started by any means (digital input or other).            |
| 40               | Drive stopped     | This event is True, if frequency converter is stopped or coasted by any means (digital input or other). |
| 42               | Auto Reset Trip   | An auto reset is performed.                                                                             |
| 50               | Comparator 4      | Use result of comparator 4 in logic rule.                                                               |
| 51               | Comparator 5      | Use result of comparator 5 in logic rule.                                                               |
| 60               | Logic rule 4      | Use result of logic rule 4 in logic rule.                                                               |
| 61               | Logic rule 5      | Use result of logic rule 5 in logic rule.                                                               |
| 70               | SL Time-out 3     | Use result of timer 3 in logic rule.                                                                    |
| 71               | SL Time-out 4     | Use result of timer 4 in logic rule.                                                                    |
| 72               | SL Time-out 5     | Use result of timer 5 in logic rule.                                                                    |
| 73               | SL Time-out 6     | Use result of timer 6 in logic rule.                                                                    |
| 74               | SL Time-out 7     | Use result of timer 7 in logic rule.                                                                    |
| 83               | Lost Load         | Lost load is performed.                                                                                 |

#### P 8.4.6.2 Action

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in **P 8.4.6.1 Event**) is evaluated as TRUE. This is an array parameter containing SLC actions 0–19.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 1352 | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name         | Selection description                                                                 |
|------------------|------------------------|---------------------------------------------------------------------------------------|
| 0                | Disabled               | Function is disabled.                                                                 |
| 1                | No action              | No action is taken.                                                                   |
| 2                | Select set-up 1        | Changes active setup to setup 1.                                                      |
| 3                | Select set-up 2        | Changes active setup to setup 2.                                                      |
| 10               | Select preset ref 0    | Selects preset reference 0.                                                           |
| 11               | Select preset ref 1    | Selects preset reference 1.                                                           |
| 12               | Select preset ref 2    | Selects preset reference 2.                                                           |
| 13               | Select preset ref 3    | Selects preset reference 3.                                                           |
| 14               | Select preset ref 4    | Selects preset reference 4.                                                           |
| 15               | Select preset ref 5    | Selects preset reference 5.                                                           |
| 16               | Select preset ref 6    | Selects preset reference 6.                                                           |
| 17               | Select preset ref 7    | Selects preset reference 7.                                                           |
| 18               | Select ramp 1          | Selects ramp 1.                                                                       |
| 19               | Select ramp 2          | Selects ramp 2.                                                                       |
| 22               | Run                    | Issues start command to drive.                                                        |
| 23               | Run reverse            | Issues start reverse command to drive.                                                |
| 24               | Stop                   | Issues stop command to drive.                                                         |
| 25               | Qstop                  | Issues quick stop command to drive.                                                   |
| 26               | DC Brake               | Issues DC brake command to drive.                                                     |
| 27               | Coast                  | The drive coasts immediately. All stop commands including coast command stop the SLC. |
| 28               | Freeze output          | Freezes output frequency.                                                             |
| 29               | Start timer 0          | Starts timer 0.                                                                       |
| 30               | Start timer 1          | Starts timer 1.                                                                       |
| 31               | Start timer 2          | Starts timer 2.                                                                       |
| 32               | Set digital out A low  | Set Digital output A low.                                                             |
| 33               | Set digital out B low  | Set Digital output B low.                                                             |
| 38               | Set digital out A high | Set Digital output A high.                                                            |
| 39               | Set digital out B high | Set Digital output B high.                                                            |
| 60               | Reset Counter A        | Resets counter A to 0.                                                                |
| 61               | Reset Counter B        | Resets counter B to 0.                                                                |
| 70               | Start Timer 3          | Starts timer 3.                                                                       |
| 71               | Start Timer 4          | Starts timer 4.                                                                       |

| Selection number | Selection name | Selection description |
|------------------|----------------|-----------------------|
| 72               | Start Timer 5  | Starts timer 5.       |
| 73               | Start Timer 6  | Starts timer 6.       |
| 74               | Start Timer 7  | Starts timer 7.       |
| 100              | ResetAlarm     | Reset the alarm.      |

## 7.9 I/O (Menu Index 9)

### 7.9.1 I/O (Menu Index 9.3)

#### 7.9.1.1 I/O Status (Menu Index 9.3)

##### P 9.3.1 Digital Input Status

View actual state of the digital inputs. The value should be analyzed using binary type. 0=no signal, 1=connected signal. From the right side to the left, bit 0, 2, 3, 4, 5 represent DI 18, 17, 15, 14, 13, respectively.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–4095) |
| Parameter number: | 1660   | Unit:           | –              |
| Data type:        | uint16 | Access type:    | Read           |

The following are the bit descriptions.

| Bit number | Bit description           |
|------------|---------------------------|
| Bit 0      | Digital input terminal 18 |
| Bit 2      | Digital input terminal 17 |
| Bit 3      | Digital input terminal 15 |
| Bit 4      | Digital input terminal 14 |
| Bit 5      | Digital input terminal 13 |

##### P 9.3.2 Digital Output Status

View the binary value of all digital outputs. (0=low output, 1=high output, '-'=Not digital output configuration). From the right side to the left, bit 3 represent DO 15.

|                   |        |                 |              |
|-------------------|--------|-----------------|--------------|
| Default value:    | 0      | Parameter type: | Range (0–63) |
| Parameter number: | 1666   | Unit:           | –            |
| Data type:        | uint16 | Access type:    | Read         |

The following are the bit descriptions.

| Bit number | Bit description            |
|------------|----------------------------|
| Bit 3      | Digital output terminal 15 |

### P 9.3.3 T31 Analog Output [mA]

View the actual value at output 31 in mA. The value shown reflects the selection in *P 9.5.1.1 T31 Mode* and *P 9.5.1.2 T31 Analog Output*.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 0.00   | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 1665   | Unit:           | mA                 |
| Data type:        | uint16 | Access type:    | Read               |

### P 9.3.4 T33 Setting

View the setting of input terminal 33 (current or voltage).

|                   |                  |                 |           |
|-------------------|------------------|-----------------|-----------|
| Default value:    | 1 [Voltage mode] | Parameter type: | Selection |
| Parameter number: | 1661             | Unit:           | –         |
| Data type:        | enum             | Access type:    | Read      |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Current mode   |
| 1                | Voltage mode   |

### P 9.3.5 T33 Analog Input

View actual input on analog input 33.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 1.00   | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 1662   | Unit:           | –                  |
| Data type:        | uint16 | Access type:    | Read               |

### P 9.3.6 T34 Setting

View the setting of input terminal 34 (current or voltage).

|                   |                  |                 |           |
|-------------------|------------------|-----------------|-----------|
| Default value:    | 1 [Voltage mode] | Parameter type: | Selection |
| Parameter number: | 1663             | Unit:           | –         |
| Data type:        | enum             | Access type:    | Read      |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Current mode   |
| 1                | Voltage mode   |

### P 9.3.7 T34 Analog Input

View actual input on analog input 34 (current or voltage).

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 1.00   | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 1664   | Unit:           | –                  |
| Data type:        | uint16 | Access type:    | Read               |

### P 9.3.8 T18 Pulse Input [Hz]

View the actual value of the frequency applied at terminal 18 as an impulse input.

|                   |       |                 |                  |
|-------------------|-------|-----------------|------------------|
| Default value:    | 0     | Parameter type: | Range (0–130000) |
| Parameter number: | 1668  | Unit:           | –                |
| Data type:        | int32 | Access type:    | Read             |

### P 9.3.9 T15 Pulse Output [Hz]

View the actual value of impulses applied to terminal 15 in digital output mode.

|                   |       |                 |                 |
|-------------------|-------|-----------------|-----------------|
| Default value:    | 0     | Parameter type: | Range (0–40000) |
| Parameter number: | 1669  | Unit:           | –               |
| Data type:        | int32 | Access type:    | Read            |

### P 9.3.10 Relay Output

View the state of the relay outputs. The value should be analyzed using binary type. (0=off, 1=on). From the far right to left, corresponding to bit 4 is Relay Output 1.

|                   |        |                 |              |
|-------------------|--------|-----------------|--------------|
| Default value:    | 0      | Parameter type: | Range (0–31) |
| Parameter number: | 1671   | Unit:           | –            |
| Data type:        | uint16 | Access type:    | Read         |

## 7.9.2 Digital Inputs/Outputs (Menu Index 9.4)

### 7.9.2.1 Digital Input Setting (Menu Index 9.4.1)

#### P 9.4.1.1 Digital I/O mode

For digital I/O: Select **[0] PNP** for action on positive directional pulses. PNP 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 selections for the parameter.

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

#### P 9.4.1.2 T13 Digital Input

Select the function from the available digital input range.

|                   |           |                 |            |
|-------------------|-----------|-----------------|------------|
| Default value:    | 8 [Start] | Parameter type: | Selection  |
| Parameter number: | 510       | Unit:           | –          |
| Data type:        | enum      | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          | Selection description                                                                                                                                                                                                                                                                                              |
|------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation            | No reaction to signals transmitted to the terminal.                                                                                                                                                                                                                                                                |
| 1                | Reset                   | Resets the frequency converter after a trip/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 <b>P 5.7.7 Quick Stop Ramp Time</b> . 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 <b>P 5.7.4 DC Brake Current %</b> to <b>P 5.7.5 DC Brake Frequency</b> . The function is only active when the value in <b>P 5.7.3 DC Brake Time</b> is different from 0. Logic 0⇒DC braking. |

| Selection number | Selection name       | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6                | Stop Inverse         | <p>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 5.5.4.3 Ramp 1 Decel. Time</i> and <i>P 5.5.4.10 Ramp 2 Decel. Time</i>).</p> <p><b>Note:</b> 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.</p> |
| 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 <i>[1] 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 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 <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 17               | Preset Ref. Bit 1    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 18               | Preset Ref. Bit 2    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 19               | Freeze Reference     | <p>Freeze the actual reference, which is now the point of enable/condition for <i>[21] Speed up</i> and <i>[22] Speed down</i> to be used. If <i>[21] Speed up</i> or <i>[22] 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 <i>P 5.5.3.3 Reference Maximum</i>.</p>                                                                                                                                                                                                              |

| Selection number | Selection name        | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20               | Freeze Output         | <p>Freeze the actual motor frequency (Hz), which is now the point of enable/condition for <b>[21] Speed up</b> and <b>[22] Speed down</b> to be used. If <b>[21] Speed up</b> or <b>[22] Speed down</b> is used, the speed change always follows ramp 2 (<b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b>) in the range 0–<b>P 4.2.2.4 Nominal Frequency</b>.</p> <p><b>Note:</b> When <b>[20] Freeze output</b> is active, the frequency converter cannot be stopped by setting the signal on <b>[8] Start to low</b>. Stop the frequency converter via a terminal programmed for <b>[2] Coasting inverse</b> or <b>[3] Coast and reset, inverse</b>.</p> |
| 21               | Speed Up              | <p>Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b>. 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b>.</p>                                                                                                                                       |
| 22               | Speed Down            | <p>Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b>. 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b>.</p>                                                                                                                                       |
| 23               | Set-up Select Bit 0   | <p>Select <b>[23] Set-up select bit 0</b> to select 1 of the 2 set-ups. Set <b>P 6.6.1 Active Set-up</b> to <b>[9] Multi Set-up</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 25               | Start and Coast       | <p>Select <b>[25] Start and Coast</b> for a start command or coast stop. Logic 1=start, logic 0=coast stop.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 28               | Catch Up              | <p>Increase reference value by percentage (relative) set in <b>P 5.5.3.13 Freeze Up/Down Step Delta</b>. See <a href="#">Table 66</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 29               | Slow Down             | <p>Reduce reference value by percentage (relative) set in <b>P 5.5.3.13 Freeze Up/Down Step Delta</b>. See <a href="#">Table 66</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 34               | Ramp Bit 0            | <p>Enable a selection from the 2 ramps available.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 45               | Latched Start Reverse | <p>The motor starts to run reverse when a pulse is applied for minimum 4 ms. The motor stops when stop commands are given.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 51               | External Interlock    | <p>This function makes it possible to give an external fault to the frequency converter. This fault is treated as an internally generated alarm.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 60               | Counter A (up)        | <p>Input for increment counting in the SLC counter A.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 61               | Counter A (down)      | <p>Input for decrement counting in the SLC counter A.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 62               | Reset Counter A       | <p>Input for reset of counter A.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



| Selection number | Selection name   | Selection description                                          |
|------------------|------------------|----------------------------------------------------------------|
| 63               | Counter B (up)   | Input for increment counting in the SLC counter B.             |
| 64               | Counter B (down) | Input for decrement counting in the SLC counter B.             |
| 65               | Reset Counter B  | Input for reset of counter B.                                  |
| 101              | Sleep            | A signal applied puts the frequency converter into sleep mode. |

Table 65: Preset Ref Bit

| Preset ref. bit | 2 | 1 | 0 |
|-----------------|---|---|---|
| Preset ref.0    | 0 | 0 | 0 |
| Preset ref. 1   | 0 | 0 | 1 |
| Preset ref. 2   | 0 | 1 | 0 |
| Preset ref. 3   | 0 | 1 | 1 |
| Preset ref. 4   | 1 | 0 | 0 |
| Preset ref. 5   | 1 | 0 | 1 |
| Preset ref. 6   | 1 | 1 | 0 |
| Preset ref. 7   | 1 | 1 | 1 |

Table 66: Shut Down/Catch up

|                      | Shut down | Catch up |
|----------------------|-----------|----------|
| Unchanged speed      | 0         | 0        |
| Reduced by % value   | 1         | 0        |
| Increased by % value | 0         | 1        |
| Reduced by % value   | 1         | 1        |

### P 9.4.1.3 T14 Digital Input

Select the function from the available digital input range.

|                          |                |                        |            |
|--------------------------|----------------|------------------------|------------|
| <b>Default value:</b>    | 10 [Reversing] | <b>Parameter type:</b> | Selection  |
| <b>Parameter number:</b> | 511            | <b>Unit:</b>           | –          |
| <b>Data type:</b>        | enum           | <b>Access type:</b>    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation            | No reaction to signals transmitted to the terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1                | Reset                   | Resets the frequency converter after a trip/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 <b>P 5.7.7 Quick Stop Ramp Time</b> . 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 <b>P 5.7.4 DC Brake Current</b> to <b>P 5.7.5 DC Brake Frequency</b> . The function is only active when the value in <b>P 5.7.3 DC Brake Time</b> is different from 0. Logic 0⇒DC braking.                                                                                                                                                                                                                                                                              |
| 6                | Stop Inverse            | <p>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 (<b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b>).</p> <p><b>Note:</b> 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 <b>[27] Torque limit</b> and stop and connect this digital output to a digital input that is configured as coast.</p> |
| 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 <b>P 5.8.1 Rotation Direction</b> . 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 <b>P 5.9.2 Jog Reference 1</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Selection number | Selection name      | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15               | Preset Reference On | Shift between external reference and preset reference. It is assumed that <b>[1] External/preset</b> has been selected in <b>P 5.5.3.5 Reference Function</b> . 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 <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 17               | Preset Ref. Bit 1   | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 18               | Preset Ref. Bit 2   | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 19               | Freeze Reference    | Freeze the actual reference, which is now the point of enable/condition for <b>[21] Speed up</b> and <b>[22] Speed down</b> to be used. If <b>[21] Speed up</b> or <b>[22] Speed down</b> is used, the speed change always follows ramp 2 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ) in the range 0– <b>P 5.5.3.3 Reference Maximum</b> .                                                                                                                                                                                                                                                                                                   |
| 20               | Freeze Output       | Freeze the actual motor frequency (Hz), which is now the point of enable/condition for <b>[21] Speed up</b> and <b>[22] Speed down</b> to be used. If <b>[21] Speed up</b> or <b>[22] Speed down</b> is used, the speed change always follows ramp 2 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ) in the range 0– <b>P 4.2.2.4 Nominal Frequency</b> .<br><b>Note:</b> When <b>[20] Freeze output</b> is active, the frequency converter cannot be stopped by setting the signal on <b>[8] Start to low</b> . Stop the frequency converter via a terminal programmed for <b>[2] Coasting inverse</b> or <b>[3] Coast and reset, inverse</b> . |
| 21               | Speed Up            | Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b> . 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b> . See <a href="#">Table 66</a> .                                                                                                        |
| 22               | Speed Down          | Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b> . 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b> . See <a href="#">Table 66</a> .                                                                                                        |
| 23               | Set-up Select Bit 0 | Select <b>[23] Set-up select bit 0</b> to select 1 of the 2 set-ups. Set <b>P 6.6.1 Active Set-up</b> to <b>[9] Multi Set-up</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25               | Start and Coast     | Select <b>[25] Start and Coast</b> for a start command or coast stop. Logic 1=start, logic 0=coast stop.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Selection number | Selection name        | Selection description                                                                                                                         |
|------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 28               | Catch Up              | Increase reference value by percentage (relative) set in <b>P 5.5.3.13 Freeze Up/Down Step Delta</b> . See <a href="#">Table 66</a> .         |
| 29               | Slow Down             | Reduce reference value by percentage (relative) set in <b>P 5.5.3.13 Freeze Up/Down Step Delta</b> . See <a href="#">Table 66</a> .           |
| 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. |
| 60               | Counter A (up)        | Input for increment counting in the SLC counter A.                                                                                            |
| 61               | Counter A (down)      | Input for decrement counting in the SLC counter A.                                                                                            |
| 62               | Reset Counter A       | Input for reset of counter A.                                                                                                                 |
| 63               | Counter B (up)        | Input for increment counting in the SLC counter B.                                                                                            |
| 64               | Counter B (down)      | Input for decrement counting in the SLC counter B.                                                                                            |
| 65               | Reset Counter B       | Input for reset of counter B.                                                                                                                 |
| 101              | Sleep                 | A signal applied puts the frequency converter into sleep mode.                                                                                |

#### P 9.4.1.4 T15 Digital Input

Select the function from the available digital input range.

|                   |           |                 |            |
|-------------------|-----------|-----------------|------------|
| Default value:    | 1 [Reset] | Parameter type: | Selection  |
| Parameter number: | 512       | Unit:           | –          |
| Data type:        | enum      | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          | Selection description                                                                                                                                   |
|------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation            | No reaction to signals transmitted to the terminal.                                                                                                     |
| 1                | Reset                   | Resets the frequency converter after a trip/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. |

| Selection number | Selection name       | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                | Quick Stop Inverse   | Inverted input (NC). Generates a stop in accordance with the quick stop ramp time set in <b>P 5.7.7 Quick Stop Ramp Time</b> . When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop.<br><b>Note:</b> 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 <b>[27] Torque limit</b> 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 <b>P 5.7.4 DC Brake Current %</b> to <b>P 5.7.5 DC Brake Frequency</b> . The function is only active when the value in <b>P 5.7.3 DC Brake Time</b> 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 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ).<br><b>Note:</b> 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 <b>[27] Torque limit</b> 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 <b>P 5.8.1 Rotation Direction</b> . 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 <b>P 5.9.2 Jog Reference 1</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15               | Preset Reference On  | Shift between external reference and preset reference. It is assumed that <b>[1] External/preset</b> has been selected in <b>P 5.5.3.5 Reference Function</b> . 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 <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Selection number | Selection name      | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17               | Preset Ref. Bit 1   | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 18               | Preset Ref. Bit 2   | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 65</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 19               | Freeze Reference    | Freeze the actual reference, which is now the point of enable/condition for <b>[21] Speed up</b> and <b>[22] Speed down</b> to be used. If <b>[21] Speed up</b> or <b>[22] Speed down</b> is used, the speed change always follows ramp 2 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ) in the range 0– <b>P 5.5.3.3 Maximum Reference</b> .                                                                                                                                                                                                                                                                                                   |
| 20               | Freeze Output       | Freeze the actual motor frequency (Hz), which is now the point of enable/condition for <b>[21] Speed up</b> and <b>[22] Speed down</b> to be used. If <b>[21] Speed up</b> or <b>[22] Speed down</b> is used, the speed change always follows ramp 2 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ) in the range 0– <b>P 4.2.2.4 Nominal Frequency</b> .<br><b>Note:</b> When <b>[20] Freeze output</b> is active, the frequency converter cannot be stopped by setting the signal on <b>[8] Start to low</b> . Stop the frequency converter via a terminal programmed for <b>[2] Coasting inverse</b> or <b>[3] Coast and reset, inverse</b> . |
| 21               | Speed Up            | Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b> . 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b> . See <a href="#">Table 66</a> .                                                                                                        |
| 22               | Speed Down          | Select <b>[21] Speed up</b> and <b>[22] Speed down</b> if digital control of the up/down speed is needed (motor potentiometer). Activate this function by selecting either <b>[19] Freeze reference</b> or <b>[20] Freeze output</b> . 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 <b>P 5.5.4.9 Ramp 2 Accel. Time/P 5.5.4.10 Ramp 2 Decel. Time</b> . See <a href="#">Table 66</a> .                                                                                                        |
| 23               | Set-up Select Bit 0 | Select <b>[23] Set-up select bit 0</b> to select 1 of the 2 set-ups. Set <b>P 6.6.1 Active Set-up</b> to <b>[9] Multi Set-up</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25               | Start and Coast     | Select <b>[25] Start and Coast</b> 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 <b>P 5.5.3.13 Freeze Up/Down Step Delta</b> . See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 29               | Slow Down           | Reduce reference value by percentage (relative) set in <b>P 5.5.3.13 Freeze Up/Down Step Delta</b> . See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 34               | Ramp Bit 0          | Enable a selection from the 2 ramps available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| Selection number | Selection name        | Selection description                                                                                                                         |
|------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 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. |
| 60               | Counter A (up)        | Input for increment counting in the SLC counter A.                                                                                            |
| 61               | Counter A (down)      | Input for decrement counting in the SLC counter A.                                                                                            |
| 62               | Reset Counter A       | Input for reset of counter A.                                                                                                                 |
| 63               | Counter B (up)        | Input for increment counting in the SLC counter B.                                                                                            |
| 64               | Counter B (down)      | Input for decrement counting in the SLC counter B.                                                                                            |
| 65               | Reset Counter B       | Input for reset of counter B.                                                                                                                 |
| 101              | Sleep                 | A signal applied puts the frequency converter into sleep mode.                                                                                |

#### P 9.4.1.5 T17 Digital Input

Select the function from the available digital input range.

|                   |          |                 |            |
|-------------------|----------|-----------------|------------|
| Default value:    | 14 [Jog] | Parameter type: | Selection  |
| Parameter number: | 513      | Unit:           | –          |
| Data type:        | enum     | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation            | No reaction to signals transmitted to the terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                | Reset                   | Resets the frequency converter after a trip/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 <b>P 5.7.7 Quick Stop Ramp Time</b> . When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop.<br><b>Note:</b> 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 <b>[27] Torque limit</b> and stop and connect this digital output to a digital input that is configured as coast. |

| Selection number | Selection name       | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5                | DC-brake Inverse     | Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See <b>P 5.7.4 DC Brake Current %</b> to <b>P 5.7.5 DC Brake Frequency</b> . The function is only active when the value in <b>P 5.7.3 DC Brake Time</b> 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 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ).<br><b>Note:</b> 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 <b>[27] Torque limit</b> 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 <b>P 5.8.1 Rotation Direction</b> . 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 <b>[1] External/preset</b> has been selected in <b>P 5.5.3.5 Reference Function</b> . 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 <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 17               | Preset Ref. Bit 1    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 18               | Preset Ref. Bit 2    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



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

| Selection number | Selection name     | Selection description                                                                                                                         |
|------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 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. |
| 60               | Counter A (up)     | Input for increment counting in the SLC counter A.                                                                                            |
| 61               | Counter A (down)   | Input for decrement counting in the SLC counter A.                                                                                            |
| 62               | Reset Counter A    | Input for reset of counter A.                                                                                                                 |
| 63               | Counter B (up)     | Input for increment counting in the SLC counter B.                                                                                            |
| 64               | Counter B (down)   | Input for decrement counting in the SLC counter B.                                                                                            |
| 65               | Reset Counter B    | Input for reset of counter B.                                                                                                                 |
| 101              | Sleep              | A signal applied puts the frequency converter into sleep mode.                                                                                |

#### P 9.4.1.6 T18 Digital Input

Select the function from the available digital input range.

|                   |                  |                 |            |
|-------------------|------------------|-----------------|------------|
| Default value:    | 0 [No Operation] | Parameter type: | Selection  |
| Parameter number: | 515              | Unit:           | –          |
| Data type:        | enum             | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation            | Action on positive directional pulses (0). PNP systems are pulled down to 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 <b>P 5.7.7 Quick Stop Ramp Time</b> . When the motor stops, the shaft is in free mode. Logic 0⇒Quick-stop.<br><b>Note:</b> 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 <b>[27] Torque limit</b> and stop and connect this digital output to a digital input that is configured as coast. |

| Selection number | Selection name       | Selection description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5                | DC-brake Inverse     | Inverted input for DC braking (NC). Stops the motor by energizing it with a DC current for a certain time period. See <b>P 5.7.4 DC Brake Current %</b> to <b>P 5.7.5 DC Brake Frequency</b> . The function is only active when the value in <b>P 5.7.3 DC Brake Time</b> 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 ( <b>P 5.5.4.9 Ramp 2 Accel. Time</b> and <b>P 5.5.4.10 Ramp 2 Decel. Time</b> ).<br><b>Note:</b> 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 <b>[27] Torque limit</b> 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 <b>P 5.8.1 Rotation Direction</b> . 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 <b>P 5.9.2 Jog Reference 1</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 15               | Preset Reference On  | Shift between external reference and preset reference. It is assumed that <b>[1] External/preset</b> has been selected in <b>P 5.5.3.5 Reference Function</b> . 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 <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 17               | Preset Ref. Bit 1    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 18               | Preset Ref. Bit 2    | Preset reference bits 0, 1, and 2 enable the selection of 1 of the 8 preset references. See <a href="#">Table 66</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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

| Selection number | Selection name        | Selection description                                                                                                                         |
|------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 45               | Latched Start Reverse | The motor starts to run reverse when a pulse is applied for minimum 4 ms. The motor stops when stop commands are given.                       |
| 46               | Pulse PWM Input       | To enable variable duty cycle pulse signal as the reference.                                                                                  |
| 51               | External Interlock    | This function makes it possible to give an external fault to the frequency converter. This fault is treated as an internally generated fault. |
| 60               | Counter A (up)        | Input for increment counting in the SLC counter A.                                                                                            |
| 61               | Counter A (down)      | Input for decrement counting in the SLC counter A.                                                                                            |
| 62               | Reset Counter A       | Input for reset of counter A.                                                                                                                 |
| 63               | Counter B (up)        | Input for increment counting in the SLC counter B.                                                                                            |
| 64               | Counter B (down)      | Input for decrement counting in the SLC counter B.                                                                                            |
| 65               | Reset Counter B       | Input for reset of counter B.                                                                                                                 |
| 101              | Sleep                 | A signal applied puts the frequency converter into sleep mode.                                                                                |

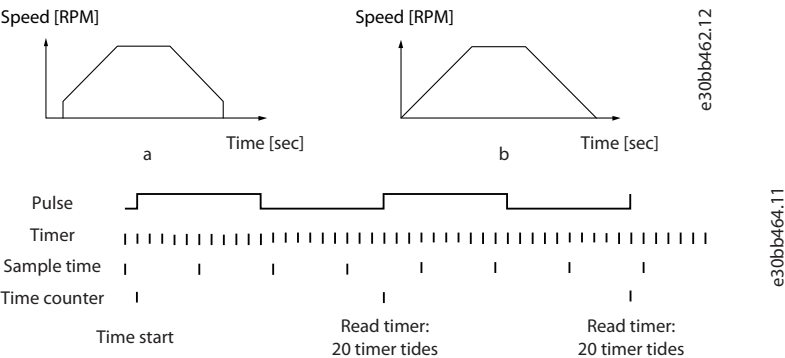


Figure 81: Duration between Pulse Flanks

### 7.9.2.2 T15 as Digital Output (Menu Index 9.4.2)

#### P 9.4.2.1 T15 Mode

Select **[0] Input** to define terminal 15 as a digital input. Select **[1] Output** to define terminal 15 as a digital output.

|                   |           |                 |            |
|-------------------|-----------|-----------------|------------|
| Default value:    | 0 [Input] | Parameter type: | Selection  |
| Parameter number: | 501       | Unit:           | –          |
| Data type:        | enum      | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                    |
|------------------|----------------|------------------------------------------|
| 0                | Input          | Defines terminal 15 as a digital input.  |
| 1                | Output         | Defines terminal 15 as a digital output. |

### P 9.4.2.2 T15 Digital Output

Select the function to control the digital output.

|                   |                  |                 |            |
|-------------------|------------------|-----------------|------------|
| Default value:    | 0 [No Operation] | Parameter type: | Selection  |
| Parameter number: | 530              | Unit:           | –          |
| Data type:        | enum             | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name            | Selection description                                                                                                                                                         |
|------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation              | Default for all digital outputs.                                                                                                                                              |
| 1                | Control Ready             | The control card is ready.                                                                                                                                                    |
| 2                | Drive Ready               | The frequency converter is ready for operation and applies a supply signal on the control board.                                                                              |
| 3                | Drive Ready / Remote Mode | The frequency converter is ready for operation and is in Remote mode.                                                                                                         |
| 4                | Stand-by / No Warning     | Ready for operation. No start or stop command is given (start/disable). No warnings are active.                                                                               |
| 5                | Running                   | The motor is running and shaft torque is present.                                                                                                                             |
| 6                | Running / No Warning      | The motor is running and there are no warnings.                                                                                                                               |
| 7                | Run in Range / No Warning | The motor is running within the programmed current and speed ranges set in <b>P 4.6.4 Warning Current Low</b> to <b>P 4.6.3 Warning Current High</b> . 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 <b>P 5.10.1 Motor Torque Limit</b> or <b>P 5.10.2 Regenerative Torque Limit</b> has been exceeded.                                                    |
| 12               | Out of Current Range      | The motor current is outside the range set in <b>P 2.7.1 Output Current Limit %</b> .                                                                                         |
| 13               | Below Current, Low        | The motor current is lower than set in <b>P 4.6.4 Warning Current Low</b> .                                                                                                   |
| 14               | Above Current, High       | The motor current is higher than set in <b>P 4.6.3 Warning Current High</b> .                                                                                                 |

| Selection number | Selection name               | Selection description                                                                                                                                                                                                                        |
|------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 <b>P 4.6.2 Warning Freq. Low</b> .                                                                                                                                                             |
| 17               | Above Frequency, High        | The output speed is higher than the setting in <b>P 4.6.1 Warning Freq. High</b> .                                                                                                                                                           |
| 18               | Out of Feedback Range        | The feedback is outside the range set in <b>P 5.2.4 Warning Feedback Low</b> and <b>P 5.2.3 Warning Feedback High</b> .                                                                                                                      |
| 19               | Below Feedback, Low          | The feedback is below the limit set in <b>P 5.2.4 Warning Feedback Low</b> .                                                                                                                                                                 |
| 20               | Above Feedback, High         | The feedback is above the limit set in <b>P 5.2.3 Warning Feedback High</b> .                                                                                                                                                                |
| 21               | Thermal Warning              | The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.                                                                                            |
| 22               | Ready, No Thermal Warning    | The frequency converter is ready for operation, and there is no overtemperature warning.                                                                                                                                                     |
| 23               | Remote, Ready, No TW         | The frequency converter is ready for operation and is in Remote mode. There is no overtemperature warning.                                                                                                                                   |
| 24               | Ready, No Over/under-voltage | The frequency converter is ready for operation and the mains voltage is within the specified voltage range.                                                                                                                                  |
| 25               | Reverse                      | The motor runs (or is ready to run) clockwise when logic=0 and counterclockwise when logic=1. The output changes when the reversing signal is applied.                                                                                       |
| 26               | Bus OK                       | Active communication (no timeout) via the serial communication port.                                                                                                                                                                         |
| 27               | Torque Limit & Stop          | Use in performing a coast stop and in torque limit condition. If the frequency converter has received a stop signal and is at the torque limit, the signal is logic 0.                                                                       |
| 28               | Brake, No Brake Warning      | The brake is active and there are no warnings.                                                                                                                                                                                               |
| 29               | Brake Ready, No Fault        | The brake is ready for operation and there are no faults.                                                                                                                                                                                    |
| 30               | Brake Fault (IGBT)           | The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the frequency converter. |
| 32               | Mech. Brake Control          | Enable control of an external mechanical brake.                                                                                                                                                                                              |
| 36               | Control Word Bit 11          | Bit 11 in control word controls the relay.                                                                                                                                                                                                   |
| 37               | Control Word Bit 12          | Bit 12 in control word controls the relay.                                                                                                                                                                                                   |
| 40               | Out of Ref. Range            | This option is active when the actual speed is outside the settings in <b>P 5.2.2 Warning Reference Low</b> to <b>P 5.2.1 Warning Reference High</b> .                                                                                       |

| Selection number | Selection name                   | Selection description                                                                                                                                                                                                                         |
|------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . 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 <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . When bus timeout occurs, the output state is set high (On).                                                                 |
| 47               | Bus Control, Timeout: Off        | Control output via fieldbus. The state of the output is set in <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . When bus timeout occurs, the output state is set low (Off).                                                                 |
| 55               | Pulse Output                     | Use terminal 15 as pulse output.                                                                                                                                                                                                              |
| 56               | Heat Sink Cleaning Warning, High | Activated when the heat sink temperature is not lower than the calculated value. The calculated value is equal to the maximum value of <b>P 2.1.9 Heat Sink Temperature</b> minus the current value of <b>P 2.1.9 Heat Sink Temperature</b> . |
| 60               | Comparator 0                     | Use result of comparator 0 in logic rule.                                                                                                                                                                                                     |
| 61               | Comparator 1                     | Use result of comparator 1 in logic rule.                                                                                                                                                                                                     |
| 62               | Comparator 2                     | Use result of comparator 2 in logic rule.                                                                                                                                                                                                     |
| 63               | Comparator 3                     | Use result of comparator 3 in logic rule.                                                                                                                                                                                                     |
| 64               | Comparator 4                     | Use result of comparator 4 in logic rule.                                                                                                                                                                                                     |
| 65               | Comparator 5                     | Use result of comparator 5 in logic rule.                                                                                                                                                                                                     |
| 70               | Logic rule 0                     | Use result of logic rule 0 in logic rule.                                                                                                                                                                                                     |
| 71               | Logic rule 1                     | Use result of logic rule 1 in logic rule.                                                                                                                                                                                                     |
| 72               | Logic rule 2                     | Use result of logic rule 2 in logic rule.                                                                                                                                                                                                     |
| 73               | Logic rule 3                     | Use result of logic rule 3 in logic rule.                                                                                                                                                                                                     |
| 74               | Logic rule 4                     | Use result of logic rule 4 in logic rule.                                                                                                                                                                                                     |
| 75               | Logic rule 5                     | Use result of logic rule 5 in logic rule.                                                                                                                                                                                                     |
| 80               | SL digital output A              | See <b>P 8.4.6.2 Action</b> . The output goes high whenever the smart logic action <b>[38] Set digital out A high</b> is executed. The output goes low whenever the smart logic action <b>[32] Set digital out A low</b> is executed.         |
| 81               | SL digital output B              | See <b>P 8.4.6.2 Action</b> . The output goes high whenever the smart logic action <b>[39] Set digital out B high</b> is executed. The output goes low whenever the smart logic action <b>[33] Set digital out B low</b> is executed.         |
| 160              | No Fault                         | The output is high when no alarm is present.                                                                                                                                                                                                  |



| Selection number | Selection name       | Selection description                                                                                                                     |
|------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 161              | Running Reverse      | The output is high when the frequency converter is running counterclockwise (the logical product of the status bits Running AND Reverse). |
| 165              | Local Ref. Active    | The output is high when local reference is activated.                                                                                     |
| 166              | Remote Ref. Active   | The output is high when remote reference is activated.                                                                                    |
| 167              | Start Command Active | The output is high when there is an active start command, and no stop command is active.                                                  |
| 168              | Drive in Local Mode  | The output is high when the frequency converter is in Local mode.                                                                         |
| 169              | Drive in Remote Mode | The output is high when the frequency converter is in Remote mode.                                                                        |
| 193              | Sleep Mode           | The frequency converter/system has entered sleep mode.                                                                                    |
| 194              | Lost Load Function   | A lost-load condition is detected.                                                                                                        |

#### P 9.4.2.3 T15 DO ON-Delay

Enter the digital output on delay time.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.00–600.00) |
| Parameter number: | 534    | Unit:           | s                   |
| Data type:        | uint16 | Access type:    | Read/Write          |

#### P 9.4.2.4 T15 DO OFF-Delay

Enter the digital output Off delay time.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.00–600.00) |
| Parameter number: | 535    | Unit:           | s                   |
| Data type:        | uint16 | Access type:    | Read/Write          |

### 7.9.2.3 Relay (Menu Index 9.4.3)

#### P 9.4.3.1 Function Relay

Select the function to control the output relays.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 9    | Parameter type: | Selection  |
| Parameter number: | 540  | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name            | Selection description                                                                                                                                                         |
|------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                | No Operation              | Default for all digital outputs.                                                                                                                                              |
| 1                | Control Ready             | The control card is ready.                                                                                                                                                    |
| 2                | Drive Ready               | The frequency converter is ready for operation and applies a supply signal on the control board.                                                                              |
| 3                | Drive Ready / Remote Mode | The frequency converter is ready for operation and is in Remote mode.                                                                                                         |
| 4                | Stand-by / No Warning     | Ready for operation. No start or stop command is given (start/disable). No warnings are active.                                                                               |
| 5                | Running                   | The motor is running and shaft torque is present.                                                                                                                             |
| 6                | Running / No Warning      | The motor is running and there are no warnings.                                                                                                                               |
| 7                | Run in Range / No Warning | The motor is running within the programmed current and speed ranges set in <b>P 4.6.4 Warning Current Low</b> to <b>P 4.6.3 Warning Current High</b> . 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 <b>P 5.10.1 Motor Torque Limit</b> or <b>P 5.10.2 Regenerative Torque Limit</b> has been exceeded.                                                    |
| 12               | Out of Current Range      | The motor current is outside the range set in <b>P 2.7.1 Output Current Limit %</b> .                                                                                         |
| 13               | Below Current, Low        | The motor current is lower than set in <b>P 4.6.4 Warning Current Low</b> .                                                                                                   |
| 14               | Above Current, High       | The motor current is higher than set in <b>P 4.6.3 Warning Current High</b> .                                                                                                 |
| 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 <b>P 4.6.2 Warning Freq. Low</b> .                                                                                              |
| 17               | Above Frequency, High     | The output speed is higher than the setting in <b>P 4.6.1 Warning Freq. High</b> .                                                                                            |
| 18               | Out of Feedback Range     | The feedback is outside the range set in <b>P 5.2.4 Warning Feedback Low</b> and <b>P 5.2.3 Warning Feedback High</b> .                                                       |
| 19               | Below Feedback, Low       | The feedback is below the limit set in <b>P 5.2.4 Warning Feedback Low</b> .                                                                                                  |
| 20               | Above Feedback, High      | The feedback is above the limit set in <b>P 5.2.3 Warning Feedback High</b> .                                                                                                 |
| 21               | Thermal Warning           | The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.                             |

| Selection number | Selection name               | Selection description                                                                                                                                                                                                                        |
|------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22               | Ready, No Thermal Warning    | The frequency converter is ready for operation, and there is no overtemperature warning.                                                                                                                                                     |
| 23               | Remote, Ready, No TW         | The frequency converter is ready for operation and is in Remote mode. There is no overtemperature warning.                                                                                                                                   |
| 24               | Ready, No Over/under-voltage | The frequency converter is ready for operation and the mains voltage is within the specified voltage range.                                                                                                                                  |
| 25               | Reverse                      | The motor runs (or is ready to run) clockwise when logic=0 and counterclockwise when logic=1. The output changes when the reversing signal is applied.                                                                                       |
| 26               | Bus OK                       | Active communication (no timeout) via the serial communication port.                                                                                                                                                                         |
| 27               | Torque Limit & Stop          | Use in performing a coast stop and in torque limit condition. If the frequency converter has received a stop signal and is at the torque limit, the signal is logic 0.                                                                       |
| 28               | Brake, No Brake Warning      | The brake is active and there are no warnings.                                                                                                                                                                                               |
| 29               | Brake Ready, No Fault        | The brake is ready for operation and there are no faults.                                                                                                                                                                                    |
| 30               | Brake Fault (IGBT)           | The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the frequency converter. |
| 32               | Mech. Brake Control          | Enable control of an external mechanical brake.                                                                                                                                                                                              |
| 36               | Control Word Bit 11          | Bit 11 in control word controls the relay.                                                                                                                                                                                                   |
| 37               | Control Word Bit 12          | Bit 12 in control word controls the relay.                                                                                                                                                                                                   |
| 40               | Out of Ref. Range            | This option is active when the actual speed is outside the settings in <b>P 5.2.2 Warning Reference Low</b> to <b>P 5.2.1 Warning Reference High</b> .                                                                                       |
| 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 <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . 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 <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . When bus timeout occurs, the output state is set high (On).                                                                |
| 47               | Bus Control, Timeout: Off    | Control output via fieldbus. The state of the output is set in <b>P 9.4.6.1 Digital &amp; Relay Bus Control</b> . When bus timeout occurs, the output state is set low (Off).                                                                |
| 55               | Pulse Output                 | Use terminal 15 as pulse output.                                                                                                                                                                                                             |

| Selection number | Selection name                   | Selection description                                                                                                                                                                                                                         |
|------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 56               | Heat Sink Cleaning Warning, High | Activated when the heat sink temperature is not lower than the calculated value. The calculated Value is equal to the maximum value of <b>P 2.1.9 Heat Sink Temperature</b> minus the current value of <b>P 2.1.9 Heat Sink Temperature</b> . |
| 60               | Comparator 0                     | Use result of comparator 0 in logic rule.                                                                                                                                                                                                     |
| 61               | Comparator 1                     | Use result of comparator 1 in logic rule.                                                                                                                                                                                                     |
| 62               | Comparator 2                     | Use result of comparator 2 in logic rule.                                                                                                                                                                                                     |
| 63               | Comparator 3                     | Use result of comparator 3 in logic rule.                                                                                                                                                                                                     |
| 64               | Comparator 4                     | Use result of comparator 4 in logic rule.                                                                                                                                                                                                     |
| 65               | Comparator 5                     | Use result of comparator 5 in logic rule.                                                                                                                                                                                                     |
| 70               | Logic rule 0                     | Use result of logic rule 0 in logic rule.                                                                                                                                                                                                     |
| 71               | Logic rule 1                     | Use result of logic rule 1 in logic rule.                                                                                                                                                                                                     |
| 72               | Logic rule 2                     | Use result of logic rule 2 in logic rule.                                                                                                                                                                                                     |
| 73               | Logic rule 3                     | Use result of logic rule 3 in logic rule.                                                                                                                                                                                                     |
| 74               | Logic rule 4                     | Use result of logic rule 4 in logic rule.                                                                                                                                                                                                     |
| 75               | Logic rule 5                     | Use result of logic rule 5 in logic rule.                                                                                                                                                                                                     |
| 80               | SL digital output A              | See <b>P 8.4.6.2 Action</b> . The output goes high whenever the smart logic action <b>[38] Set digital out A high</b> is executed. The output goes low whenever the smart logic action <b>[32] Set digital out A low</b> is executed.         |
| 81               | SL digital output B              | See <b>P 8.4.6.2 Action</b> . The output goes high whenever the smart logic action <b>[39] Set digital out B high</b> is executed. The output goes low whenever the smart logic action <b>[33] Set digital out B low</b> is executed.         |
| 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                | The output is high when local reference is activated.                                                                                                                                                                                         |
| 166              | Remote Ref. Active               | The output is high when remote reference is activated.                                                                                                                                                                                        |
| 167              | Start Command Active             | The output is high when there is an active start command, and no stop command is active.                                                                                                                                                      |
| 168              | Drive in Local Mode              | The output is high when the frequency converter is in Local mode.                                                                                                                                                                             |
| 169              | Drive in Remote Mode             | The output is high when the frequency converter is in Remote mode.                                                                                                                                                                            |
| 193              | Sleep Mode                       | The frequency converter/system has entered sleep mode.                                                                                                                                                                                        |
| 194              | Lost Load Function               | A lost-load condition is detected.                                                                                                                                                                                                            |

### P 9.4.3.2 Relay ON-Delay

Enter the delay of the relay cut-in time.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.00–600.00) |
| Parameter number: | 541    | Unit:           | s                   |
| Data type:        | uint16 | Access type:    | Read/Write          |

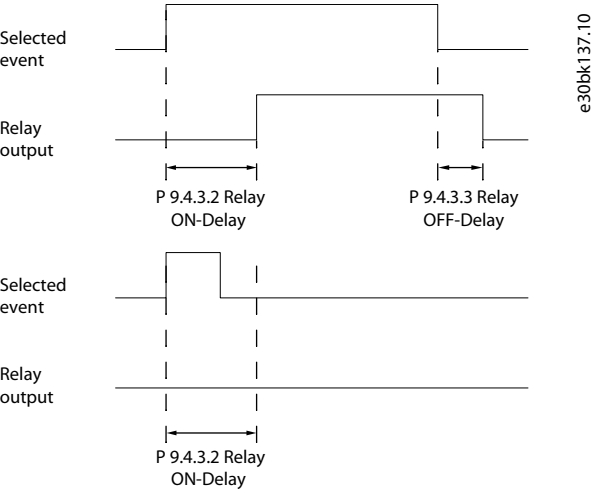


Figure 82: On Delay, Relay

### P 9.4.3.3 Relay OFF-Delay

Enter the delay of the relay cut-out time. See **P 9.4.3.1 Function Relay**. If the selected-event condition changes before a delay timer expires, the relay output is unaffected.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.00–600.00) |
| Parameter number: | 542    | Unit:           | s                   |
| Data type:        | uint16 | Access type:    | Read/Write          |

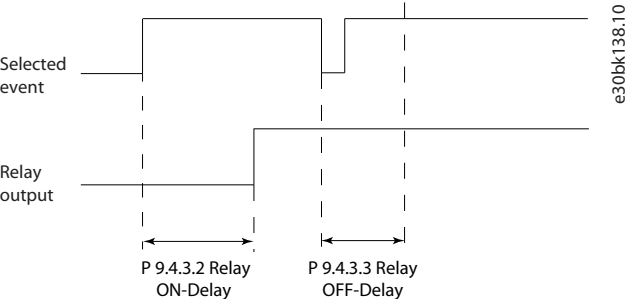


Figure 83: Off Delay, Relay

#### 7.9.2.4 T18 as Pulse Input (Menu Index 9.4.4)

The pulse input parameters are used to define an appropriate window for the impulse reference area by configuring the scaling and filter settings for the pulse inputs. Input terminals 18 act as frequency reference inputs. Set terminal 18 (**P 9.4.1.6 T18 Digital Input**) to [32] **Pulse input**.

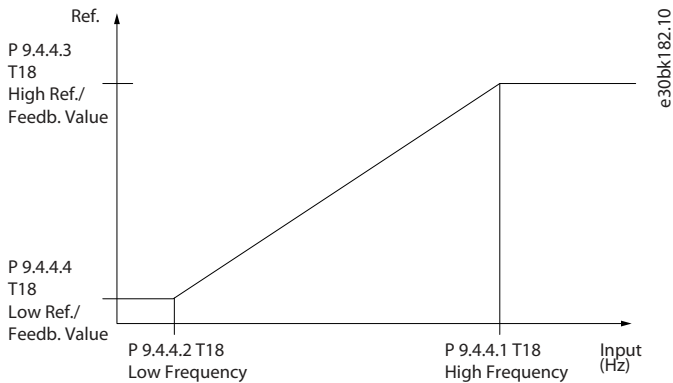


Figure 84: Pulse Input

##### P 9.4.4.1 T18 High Frequency

Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in **P 9.4.4.3 Term. 18 High Ref./Feedb. Value**.

|                   |         |                 |                 |
|-------------------|---------|-----------------|-----------------|
| Default value:    | 32000   | Parameter type: | Range (1–32000) |
| Parameter number: | 556     | Unit:           | Hz              |
| Data type:        | uint 32 | Access type:    | Read/Write      |

##### P 9.4.4.2 T18 Low Frequency

Enter the low frequency corresponding to the low motor shaft speed (that is low reference value) in **P 9.4.4.4 Term. 18 Low Ref./Feedb. Value**.

|                   |        |                 |                 |
|-------------------|--------|-----------------|-----------------|
| Default value:    | 4      | Parameter type: | Range (0–31999) |
| Parameter number: | 555    | Unit:           | Hz              |
| Data type:        | uint32 | Access type:    | Read/Write      |

##### P 9.4.4.3 T18 High Ref./Feedb. Value

Enter the high reference value for the motor shaft speed and the high feedback value.

|                   |              |                 |                            |
|-------------------|--------------|-----------------|----------------------------|
| Default value:    | Size Related | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 558          | Unit:           | Hz                         |
| Data type:        | int32        | Access type:    | Read/Write                 |

##### P 9.4.4.4 T18 Low Ref./Feedb. Value

Enter the low reference value for the motor shaft speed and the low feedback value.

|                   |       |                 |                            |
|-------------------|-------|-----------------|----------------------------|
| Default value:    | 0.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter number: | 557   | Unit:           | Hz                         |
| Data type:        | int32 | Access type:    | Read/Write                 |

#### P 9.4.4.5 T18 Pulse Filter Time Constant

Enter the pulse filter time constant. The low-pass filter reduces the influence on and dampens oscillations on the feedback signal from the control. This is an advantage, for example, if there is a great amount on noise in the system.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 100    | Parameter type: | Range (1–1000) |
| Parameter number: | 559    | Unit:           | ms             |
| Data type:        | uint16 | Access type:    | Read/Write     |

#### Variable duty cycle pulse signal as input

The normal pulse input has fixed 50% duty cycle. To enable variable duty cycle pulse signal as the reference, the terminal 18 must be set for variable duty cycle pulse signal as input. **P 9.4.1.6 T18 Digital Input** should be set as **[46] Pulse PWM Input**. The related parameters for reference source **P 5.5.3.x** should be selected as **[8] Frequency Input 18**. The frequency range of pulse input is from 1 Hz to 1 kHz.

**Parameter P 9.4.4.6 T18 PWM Polarity** is for selecting the polarity of pulse input signal. Select **[0] Positive** for positive direction pulses. Select **[1] Negative** for negative direction pulses. **P 9.4.4.7 T18 High Duty** is the duty cycle of pulse corresponding to the high reference value in **P 9.4.4.3 Term. 18 High Ref./Feedb. Value**. **P 9.4.4.8 T18 Low Duty** is the duty cycle of pulse corresponding to the low reference value in **P 9.4.4.4 Term. 18 Low Ref./Feedb. Value**.

#### P 9.4.4.6 T18 PWM Polarity

When setting the variable duty cycle pulse signal as the reference, use this parameter to select the activated PWM polarity. Select **[0] Positive**, for positive direction pulses. Select **[1] Negative**, for negative direction pulses.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 505  | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

| Selection number | Selection name |
|------------------|----------------|
| 0                | Positive       |
| 1                | Negative       |

#### P 9.4.4.7 T18 High Duty

When setting variable duty cycle pulse signal as the reference, use this parameter to enter the pulse PWM input high duty (%) that corresponds to the high reference value in **P 9.4.4.3 Term. 18 High Ref./Feedb. Value**.

|                |      |                 |                   |
|----------------|------|-----------------|-------------------|
| Default value: | 5000 | Parameter type: | Range (100–10000) |
|----------------|------|-----------------|-------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 507    | Unit:        | %          |
| Data type:        | uint16 | Access type: | Read/Write |

#### P 9.4.4.8 T18 Low Duty

When setting variable duty cycle pulse signal as the reference, use this parameter to enter the pulse PWM input low duty (%) that corresponds to the low reference value in **P 9.4.4.4 Term. 18 Low Ref./Feedb. Value**.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–9900) |
| Parameter number: | 506    | Unit:           | %              |
| Data type:        | uint16 | Access type:    | Read/Write     |

### 7.9.2.5 T15 as Pulse Output (Menu Index 9.4.5)

#### P 9.4.5.1 T15 Pulse Output Variable

Select the desired output on terminal 15.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 560  | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name         |
|------------------|------------------------|
| 0                | No Operation           |
| 45               | Bus Control            |
| 48               | Bus Control, Timeout   |
| 100              | Output Frequency       |
| 101              | Reference              |
| 102              | Process Feedback       |
| 103              | Motor Current          |
| 104              | Torque Relate to Limit |
| 105              | Torque Relate to Rated |
| 106              | Power                  |
| 107              | Speed                  |
| 109              | Max Out Frequency      |
| 113              | PID Clamped Output     |



### P 9.4.5.2 T15 Pulse Output Max. Freq

Set the maximum frequency for terminal 15, corresponding to the output variable selected in **parameter 9.4.5.1 T15 Pulse Output Variable**.

|                   |        |                 |                 |
|-------------------|--------|-----------------|-----------------|
| Default value:    | 5000   | Parameter type: | Range (4–32000) |
| Parameter number: | 562    | Unit:           | Hz              |
| Data type:        | uint32 | Access type:    | Read/Write      |

## 7.9.2.6 Bus Control (Menu Index 9.4.6)

### P 9.4.6.1 Digital & Relay Bus Control

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

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 590    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

Table 67: 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

Set the output frequency transferred to the output terminal 15 when the terminal is configured as **[45] Bus Control** in **P 9.4.5.1 T15 Pulse Output Variable**.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0      | Parameter type: | Range (0.00–100.00) |
| Parameter number: | 593    | Unit:           | %                   |
| Data type:        | uint16 | Access type:    | Read                |

### P 9.4.6.3 T15 Pulse Out Timeout Preset

Set the output frequency transferred to the output terminal 15 when the terminal is configured as **[48] Bus Control, Timeout** in **P 9.4.5.1 T15 Pulse Output Variable** and a timeout is detected.

|                   |        |                 |                     |
|-------------------|--------|-----------------|---------------------|
| Default value:    | 0      | Parameter type: | Range (0.00–100.00) |
| Parameter number: | 594    | Unit:           | %                   |
| Data type:        | uint16 | Access type:    | Read/Write          |

## 7.9.3 Analog Inputs/Outputs (Menu Index 9.5)

### 7.9.3.1 Output Terminal 31 (Menu Index 9.5.1)

#### P 9.5.1.1 T31 Mode

Set terminal 31 analog output range.

|                  |             |                 |            |
|------------------|-------------|-----------------|------------|
| Default value:   | 0 [0–20 mA] | Parameter type: | Selection  |
| Parameter Number | 690         | Unit:           | –          |
| Data type:       | enum        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | 0–20 mA        |
| 1                | 4–20 mA        |

#### P 9.5.1.2 T31 Analog Output

Select the function of Terminal 31.

|                  |                        |                 |            |
|------------------|------------------------|-----------------|------------|
| Default value:   | 100 [Output Frequency] | Parameter type: | Selection  |
| Parameter Number | 691                    | Unit:           | –          |
| Data type:       | enum                   | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name         |
|------------------|------------------------|
| 0                | No Operation           |
| 100              | Output Frequency       |
| 101              | Reference              |
| 102              | Process Feedback       |
| 103              | Motor Current          |
| 104              | Torque Relate to Limit |
| 105              | Torque Relate to Rated |

| Selection number | Selection name     |
|------------------|--------------------|
| 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**.

|                         |        |                        |                     |
|-------------------------|--------|------------------------|---------------------|
| <b>Default value:</b>   | 100.00 | <b>Parameter type:</b> | Range (0.00–200.00) |
| <b>Parameter Number</b> | 694    | <b>Unit:</b>           | %                   |
| <b>Data type:</b>       | uint16 | <b>Access type:</b>    | Read/Write          |

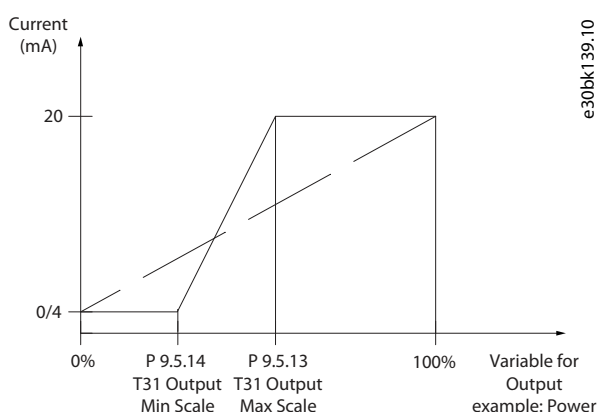


Figure 85: Output Scale versus Current

### 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**.

|                         |        |                        |                     |
|-------------------------|--------|------------------------|---------------------|
| <b>Default value:</b>   | 0      | <b>Parameter type:</b> | Range (0.00–200.00) |
| <b>Parameter Number</b> | 693    | <b>Unit:</b>           | %                   |
| <b>Data type:</b>       | uint16 | <b>Access type:</b>    | Read/Write          |

### P 9.5.1.5 T31 Output Bus Control

Holds the analog level of Output 31 if controlled by bus.

|                       |   |                        |                 |
|-----------------------|---|------------------------|-----------------|
| <b>Default value:</b> | 0 | <b>Parameter type:</b> | Range (0–16384) |
|-----------------------|---|------------------------|-----------------|

|                  |        |              |            |
|------------------|--------|--------------|------------|
| Parameter Number | 696    | Unit:        | –          |
| Data type:       | uint16 | Access type: | Read/Write |

### 7.9.3.2 Input Terminal 33 (Menu Index 9.5.2)

#### P 9.5.2.1 T33 Mode

Select the working mode of terminal 33.

|                  |                  |                 |            |
|------------------|------------------|-----------------|------------|
| Default value:   | 1 [Voltage Mode] | Parameter type: | Selection  |
| Parameter Number | 619              | Unit:           | –          |
| Data type:       | enum             | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Current Mode   |
| 1                | Voltage Mode   |

#### P 9.5.2.2 T33 High Voltage

Enter the voltage (V) that corresponds to the high reference value, as set in *P 9.5.2.6 T33 High Ref./Feedb. Value*.

|                  |        |                 |                    |
|------------------|--------|-----------------|--------------------|
| Default value:   | 10.00  | Parameter type: | Range (0.00–10.00) |
| Parameter Number | 611    | Unit:           | V                  |
| Data type:       | uint16 | Access type:    | Read/Write         |

#### P 9.5.2.3 T33 Low Voltage

Enter the voltage (V) that corresponds to the low reference value (set in *P 9.5.2.7 T33 Low Ref./Feedb. Value*). The value must be set at >1 V 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

Enter the current (mA) that corresponds to the high reference value (set in *P 9.5.2.6 T33 High Ref./Feedb. Value*).

|                  |       |                 |                    |
|------------------|-------|-----------------|--------------------|
| Default value:   | 20.00 | Parameter type: | Range (0.00–20.00) |
| Parameter Number | 613   | Unit:           | mA                 |

|            |        |              |            |
|------------|--------|--------------|------------|
| Data type: | uint16 | Access type: | Read/Write |
|------------|--------|--------------|------------|

#### P 9.5.2.5 T33 Low Current

Enter the current (mA) that corresponds to the low reference value (set in *P 9.5.2.7 T33 Low Ref./Feedb.Value*). The value must be set at >2 mA 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

Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.2.2 T33 High Voltage / P 9.5.2.4 T33 High Current*.

|                  |              |                 |                            |
|------------------|--------------|-----------------|----------------------------|
| Default value:   | Size Related | Parameter type: | Range (-4999.000–4999.000) |
| Parameter Number | 615          | Unit:           | –                          |
| Data type:       | int 32       | Access type:    | Read/Write                 |

#### P 9.5.2.7 T33 Low Ref./Feedb. Value

Enter the reference or feedback value that corresponds to the voltage or current set in *P 9.5.2.3 T33 Low Voltage / P 9.5.2.5 T33 Low Current*.

|                  |        |                 |                            |
|------------------|--------|-----------------|----------------------------|
| Default value:   | 0.000  | Parameter type: | Range (-4999.000–4999.000) |
| Parameter Number | 614    | Unit:           | –                          |
| Data type:       | int 32 | Access type:    | Read/Write                 |

#### P 9.5.2.8 T33 Filter Time Constant

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 33. A high time constant value improves dampening but also increases the time delay through the filter.

|                  |        |                 |                    |
|------------------|--------|-----------------|--------------------|
| Default value:   | 0.01   | Parameter type: | Range (0.01–10.00) |
| Parameter Number | 616    | Unit:           | s                  |
| Data type:       | uint16 | Access type:    | Read/Write         |

#### P 9.5.2.9 T33 Voltage Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of *P 9.5.2.9 T33 Voltage Dead Zone Scale*.

|                |   |                 |               |
|----------------|---|-----------------|---------------|
| Default value: | 0 | Parameter type: | Range (0–500) |
|----------------|---|-----------------|---------------|

|                  |        |              |            |
|------------------|--------|--------------|------------|
| Parameter Number | 617    | Unit:        | V          |
| Data type:       | uint16 | Access type: | Read/Write |

#### P 9.5.2.10 T33 Current Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of **P 9.5.2.10 T33 Current Dead Zone Scale**.

|                  |        |                 |                |
|------------------|--------|-----------------|----------------|
| Default value:   | 0      | Parameter type: | Range (0–1000) |
| Parameter Number | 618    | Unit:           | mA             |
| Data type:       | uint16 | Access type:    | Read/Write     |

#### Dead-zone function

- A non-zero value for the parameter **Voltage/Current Dead Zone Scale** enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal.
- The bandwidth of dead zone is the double value of **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.

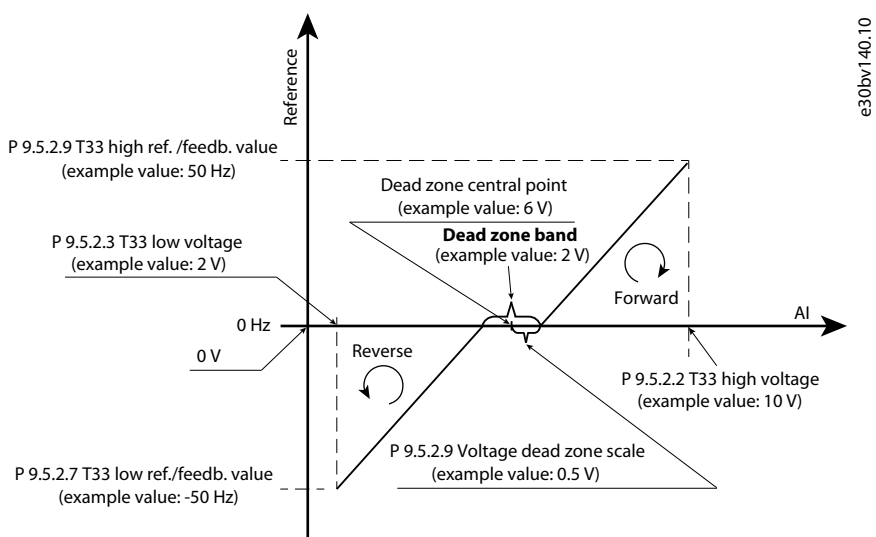


Figure 86: Dead-zone Function Example

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

Table 68: Data for Dead-zone Function Key Parameters

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

Table 69: Data for Relevant Parameters

| Parameter                           | Data                       | Parameter number |
|-------------------------------------|----------------------------|------------------|
| <i>P 5.5.3.1 Reference Range</i>    | <i>[1] -Max~+Max</i>       | 300              |
| <i>P 5.5.3.3 Reference Maximum</i>  | 50.00                      | 303              |
| <i>P 5.5.3.7 Reference 1 Source</i> | <i>[1] Analog Input 33</i> | 315              |
| <i>P 5.5.3.8 Reference 2 Source</i> | <i>[0] No function</i>     | 316              |
| <i>P 5.5.3.9 Reference 3 Source</i> | <i>[0] No function</i>     | 317              |
| <i>P 5.8.1 Rotation Direction</i>   | <i>[2] Both Directions</i> | 410              |

### 7.9.3.3 Input Terminal 34 (Menu Index 9.5.3)

#### P 9.5.3.1 T34 Mode

Select if terminal 34 is used for current or voltage input.

|                   |                  |                 |            |
|-------------------|------------------|-----------------|------------|
| Default value:    | 1 [Voltage Mode] | Parameter type: | Selection  |
| Parameter number: | 629              | Unit:           | –          |
| Data type:        | enum             | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Current Mode   |
| 1                | Voltage Mode   |

#### P 9.5.3.2 T34 High Voltage

Enter the voltage (V) that corresponds to the high reference value, as set in *P 9.5.3.6 T34 High Ref./Feedb. Value*.

|                |       |                 |                    |
|----------------|-------|-----------------|--------------------|
| Default value: | 10.00 | Parameter type: | Range (0.00–10.00) |
|----------------|-------|-----------------|--------------------|

|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 621    | Unit:        | V          |
| Data type:        | uint16 | Access type: | Read/Write |

### P 9.5.3.3 T34 Low Voltage

Enter the voltage (V) that corresponds to the low reference value (set in *P 9.5.3.7 T34 Low Ref./Feedb. Value*). The value must be set at >1 V in order to activate the live zero timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 0.07   | Parameter type: | Range (0.00–10.00) |
| Parameter number: | 620    | Unit:           | V                  |
| Data type:        | uint16 | Access type:    | Read/Write         |

### P 9.5.3.4 T34 High Current

Enter the current (mA) that corresponds to the high reference value (set in *P 9.5.3.6 T34 High Ref./Feedb. Value*).

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 20.00  | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 623    | Unit:           | mA                 |
| Data type:        | uint16 | Access type:    | Read/Write         |

### P 9.5.3.5 T34 Low Current

Enter the current (mA) that corresponds to the low reference value, set in *P 9.5.3.7 T34 Low Ref./Feedb. Value*. The value must be set at >2 mA in order to activate the Live Zero Timeout function in *P 9.5.6.2 Live Zero Timeout Function*.

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 4.00   | Parameter type: | Range (0.00–20.00) |
| Parameter number: | 622    | Unit:           | mA                 |
| Data type:        | uint16 | Access type:    | Read/Write         |

### P 9.5.3.6 T34 High Ref./Feedb. Value

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

|                   |              |                   |                            |
|-------------------|--------------|-------------------|----------------------------|
| Default value:    | Size Related | Parameter number: | Range (–4999.000–4999.000) |
| Parameter number: | 625          | Unit:             | –                          |
| Data type:        | int 32       | Access type:      | Read/Write                 |

### P 9.5.3.7 T34 Low Ref./Feedb. Value

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

|                |   |                   |                            |
|----------------|---|-------------------|----------------------------|
| Default value: | 0 | Parameter number: | Range (–4999.000–4999.000) |
|----------------|---|-------------------|----------------------------|



|                   |        |              |            |
|-------------------|--------|--------------|------------|
| Parameter number: | 624    | Unit:        | –          |
| Data type:        | int 32 | Access type: | Read/Write |

#### P 9.5.3.8 T34 Filter Time Constant

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

|                   |        |                 |                    |
|-------------------|--------|-----------------|--------------------|
| Default value:    | 0.01   | Parameter type: | Range (0.01–10.00) |
| Parameter number: | 626    | Unit:           | s                  |
| Data type:        | uint16 | Access type:    | Read/Write         |

#### P 9.5.3.9 T34 Voltage Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of **P 9.5.3.9 T34 Voltage Dead Zone Scale**.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 0      | Parameter type: | Range (0–500) |
| Parameter number: | 627    | Unit:           | V             |
| Data type:        | uint16 | Access type:    | Read/Write    |

#### P 9.5.3.10 T34 Current Dead Zone Scale

A non-zero value for the parameter enables the dead-zone function. The dead-zone band defines an area which could freeze the pointed speed reference by scaled analog input signal, or ignore unexpected vibration at desired speed caused by disturbance of reference signal. The bandwidth of dead zone is the double value of **P 9.5.3.10 T34 Current Dead Zone Scale**.

|                   |        |                 |                |
|-------------------|--------|-----------------|----------------|
| Default value:    | 0      | Parameter type: | Range (0–1000) |
| Parameter number: | 628    | Unit:           | mA             |
| Data type:        | uint16 | Access type:    | Read/Write     |

### 7.9.3.4 Potentiometer Reference (Menu Index 9.5.4)

#### P 9.5.4.1 Potentiometer High Ref.

Set the reference value to correspond to the maximum position of the control panel potentiometer.

|                  |        |                 |                            |
|------------------|--------|-----------------|----------------------------|
| Default value:   | 50.000 | Parameter type: | Range (–4999.000–4999.000) |
| Parameter Number | 682    | Unit:           | –                          |
| Data type:       | int32  | Access type:    | Read/Write                 |

#### P 9.5.4.2 Potentiometer Low Ref.

Set the reference value to correspond to the minimum position of the control panel potentiometer.

|                  |       |                 |                            |
|------------------|-------|-----------------|----------------------------|
| Default value:   | 0.000 | Parameter type: | Range (-4999.000–4999.000) |
| Parameter Number | 681   | Unit:           | –                          |
| Data type:       | int32 | Access type:    | Read/Write                 |

### 7.9.3.5 Live Zero (Menu Index 9.5.6)

#### P 9.5.6.1 Live Zero Response

Enter the timeout time. The function set in **P 9.5.6.2 Live Zero Timeout Function** is activated when the input signal on terminal is below 50% of the minimal value (for example, the minimal value for Terminal 33 voltage mode is **P 9.5.2.3 T33 Low Voltage**) for a time period defined in the parameter.

|                  |       |                 |              |
|------------------|-------|-----------------|--------------|
| Default value:   | 10    | Parameter type: | Range (1–99) |
| Parameter Number | 600   | Unit:           | s            |
| Data type:       | uint8 | Access type:    | Read/Write   |

#### P 9.5.6.2 Live Zero Timeout Function

Select the timeout function. The function set in the parameter is activated when the input signal on terminal is below 50% of the minimal value (for example, the minimal value for Terminal 33 voltage mode is **P 9.5.2.3 T33 Low Voltage**) for a time period defined in **P 9.5.6.1 Live Zero Response**.

|                  |         |                |            |
|------------------|---------|----------------|------------|
| Default value:   | 0 [Off] | Parameter type | Selection  |
| Parameter Number | 601     | Unit:          | –          |
| Data type:       | enum    | Access type:   | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Off            |
| 1                | Freeze Output  |
| 2                | Stop           |
| 3                | Jogging        |
| 4                | Max Speed      |
| 5                | Stop and Trip  |

## 7.10 Connectivity (Menu Index 10)

### 7.10.1 FC Port Settings (Menu Index 10.1)

#### P 10.1.1 Protocol

Select the protocol for the integrated RS485 port.

|                   |        |                 |            |
|-------------------|--------|-----------------|------------|
| Default value:    | 0 [FC] | Parameter type: | Selection  |
| Parameter number: | 830    | Unit:           | –          |
| Data type:        | enum   | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name | Selection description                               |
|------------------|----------------|-----------------------------------------------------|
| 0                | FC             | Communication according to the FC protocol.         |
| 2                | Modbus RTU     | Communication according to the Modbus RTU protocol. |

#### P 10.1.2 Address

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

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

Parity and stop bits for the protocol using the FC port. For some of the protocols, not all options are available.

|                   |                             |                 |            |
|-------------------|-----------------------------|-----------------|------------|
| Default value:    | 0 [Even Parity, 1 Stop Bit] | Parameter type: | Selection  |
| Parameter number: | 833                         | Unit:           | –          |
| Data type:        | enum                        | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name          |
|------------------|-------------------------|
| 0                | Even Parity, 1 Stop Bit |
| 1                | Odd Parity, 1 Stop Bit  |
| 2                | No Parity, 1 Stop Bit   |
| 3                | No Parity, 2 Stop Bits  |

#### P 10.1.5 Maximum Response Delay

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

Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

|                   |        |                 |               |
|-------------------|--------|-----------------|---------------|
| Default value:    | 0.010  | Parameter type: | Range (1–500) |
| Parameter number: | 835    | Unit:           | s             |
| Data type:        | uint16 | Access type:    | Read/Write    |

## 7.10.2 FC Port Diagnostics (Menu Index 10.2)

### P 10.2.1 Bus Message Count

This parameter shows the number of valid telegrams detected on the bus.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 880    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 10.2.1 Bus Error Count

This parameter shows the number of telegrams with faults (for example, CRC fault), detected on the bus.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 881    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 10.2.3 Slave Messaged Rcvd

This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 882    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 10.2.4 Slave Error Count

This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 883    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

### P 10.2.5 Slave Messages Sent

This parameter shows the number of messages sent from the slave.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 884    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

## P 10.2.6 Slave Timeout Errors

This parameter shows the number of slave timeout errors.

|                   |        |                 |                      |
|-------------------|--------|-----------------|----------------------|
| Default value:    | 0      | Parameter type: | Range (0–4294967295) |
| Parameter number: | 885    | Unit:           | –                    |
| Data type:        | uint32 | Access type:    | Read                 |

## P 10.2.7 Reset FC Port Diagnostics

Reset all FC port diagnostic counters.

|                   |      |                 |            |
|-------------------|------|-----------------|------------|
| Default value:    | 0    | Parameter type: | Selection  |
| Parameter number: | 888  | Unit:           | –          |
| Data type:        | enum | Access type:    | Read/Write |

The following are the selections for the parameter.

| Selection number | Selection name |
|------------------|----------------|
| 0                | Do not reset   |
| 1                | Reset counter  |

## 8 Troubleshooting

### 8.1 Introduction

When the drive fault circuitry detects a fault condition or a pending fault, an event that occurs in the drive is signaled by LED indicators on the control panel. The event types in iC2-Micro Frequency Converters include warning or fault.

### 8.2 Faults

A fault causes the drive to trip (suspend operation). The drive has 3 trip conditions, which are shown in line 1.

#### Trip (auto restart)

The drive is configured to restart automatically after the fault is removed. The number of automatic reset attempts can be continuous or limited to a programmed number of attempts. If the selected number of automatic reset attempts is exceeded, the trip condition changes to trip (reset).

#### Trip (reset)

Requires resetting of the drive before operation after a fault is cleared. To reset the drive manually, press *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 70: 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.

### NOTICE

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 71: 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       | X     | –         | No motor has been connected to the output of the drive.                                                                                                                                                          |
| 4      | Mains Phase Loss <sup>(1)</sup>  | X       | X     | X         | Missing phase on the supply side, or the voltage imbalance is too high. Check the supply voltage.                                                                                                                |
| 7      | DC Over Voltage <sup>(1)</sup>   | X       | X     | –         | DC-link voltage exceeds the limit.                                                                                                                                                                               |
| 8      | DC Under Voltage <sup>(1)</sup>  | 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     | Over Current                     | X       | X     | X         | Inverter peak current limit is exceeded. If this fault occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.                                                           |
| 14     | Earth Fault                      | X       | X     | X         | Discharge from output phases to ground.                                                                                                                                                                          |
| 16     | Short Circuit                    | –       | X     | X         | Short circuit in motor or on motor terminals.                                                                                                                                                                    |
| 17     | Control Word Timeout             | X       | X     | –         | No communication to the drive.                                                                                                                                                                                   |
| 18     | Start Failed                     | –       | X     | –         | May be caused by a blocked motor.                                                                                                                                                                                |
| 25     | Brake Resistor Short             | –       | X     | X         | Brake resistor is short-circuited, thus the brake function is disconnected.                                                                                                                                      |



Table 71: Warning and Fault Events Summary (continued)

| Number | Description                              | Warning | Fault | Trip lock | Cause                                                                                                                                                                                                                       |
|--------|------------------------------------------|---------|-------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26     | Brake Overload                           | X       | X     | –         | The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.                                                         |
| 27     | Brake IGBT/Brake chopper Short Circuited | –       | X     | X         | Brake transistor is short-circuited, thus brake function is disconnected.                                                                                                                                                   |
| 28     | Brake Check                              | –       | X     | X         | Brake resistor is not connected/working.                                                                                                                                                                                    |
| 30     | U phase loss                             | –       | X     | X         | Motor phase U is missing. Check the phase.                                                                                                                                                                                  |
| 31     | V phase loss                             | –       | X     | X         | Motor phase V is missing. Check the phase.                                                                                                                                                                                  |
| 32     | W phase loss                             | –       | X     | X         | Motor phase W is missing. Check the phase.                                                                                                                                                                                  |
| 36     | Mains Failure                            | X       | X     | –         | This warning/fault is only active if the supply voltage to the drive is less than the value set in <b>P 2.3.7 Power Loss Controller Limit</b> , and <b>P 2.3.6 Power Loss Action</b> is NOT set to <b>[0] No Function</b> . |
| 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     | –         | –                                                                                                                                                                                                                           |

Table 71: Warning and Fault Events Summary (continued)

| Number  | Description                  | Warning | Fault | Trip lock | Cause                                                                                                                                                                                                                                             |
|---------|------------------------------|---------|-------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 63      | Mechanical Brake Low         | –       | X     | –         | Actual motor current has not exceeded release brake current within start delay time window.                                                                                                                                                       |
| 69      | Power Card Temp              | X       | X     | X         | The cutout temperature of the power card has exceeded the upper limit.                                                                                                                                                                            |
| 80      | Drive Initialized            | –       | X     | –         | All parameter settings are initialized to default settings.                                                                                                                                                                                       |
| 87      | Auto DC brake                | X       | –     | –         | Occurs in IT mains when the drive coasts, and the DC voltage is higher than 830 V for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in <b>P 2.3.13 Auto DC Braking</b> . |
| 95      | Lost load detected           | 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 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 72: Description of Fault Word, Warning Word, and Extended Status Word

| Bit | Hex      | Dec | Fault word     | Fault word 2             | Fault word 3 | Warning word   | Warning word 2 | Extended status word | Extended status word 2 |
|-----|----------|-----|----------------|--------------------------|--------------|----------------|----------------|----------------------|------------------------|
| 0   | 00000001 | 1   | Brake check    | Reserved                 | Reserved     | Reserved       | Reserved       | Ramping              | Off                    |
| 1   | 00000002 | 2   | Pwr. card temp | Gate drive voltage fault | Reserved     | Pwr. card temp | Reserved       | AMA tuning           | Local/Remote           |
| 2   | 00000004 | 4   | Earth fault    | Reserved                 | Reserved     | Earth Fault    | Reserved       | Start CW/CCW         | Reserved               |
| 3   | 00000008 | 8   | Reserved       | Reserved                 | Reserved     | Reserved       | Reserved       | Slowdown             | Reserved               |
| 4   | 00000010 | 16  | Ctrl. word TO  | Reserved                 | Reserved     | Ctrl. word TO  | Reserved       | Catchup              | Reserved               |

Table 72: Description of Fault Word, Warning Word, and Extended Status Word (continued)

| Bit | Hex      | Dec     | Fault word       | Fault word 2       | Fault word 3 | Warning word               | Warning word 2  | Extended status word | Extended status word 2 |
|-----|----------|---------|------------------|--------------------|--------------|----------------------------|-----------------|----------------------|------------------------|
| 5   | 00000020 | 32      | Overcurrent      | Reserved           | Reserved     | Overcurrent                | Reserved        | Feedback high        | Reserved               |
| 6   | 00000040 | 64      | Torque limit     | Reserved           | Reserved     | Torque limit               | Reserved        | Feedback low         | Reserved               |
| 7   | 00000080 | 128     | Motor Th. over   | Reserved           | Reserved     | Motor Th. over             | Reserved        | Output current high  | Control ready          |
| 8   | 00000100 | 256     | Motor ETR over   | Lost Load          | No Motor     | Motor ETR over             | Lost Load       | Output current low   | Drive ready            |
| 9   | 00000200 | 512     | Inverter overld. | Reserved           | Reserved     | Inverter overld.           | Reserved        | Output freq. high    | Quick stop             |
| 10  | 00000400 | 1024    | DC under-volt.   | Start failed       | Reserved     | DC under-volt.             | Reserved        | Output freq. low     | DC brake               |
| 11  | 00000800 | 2048    | DC over-volt.    | 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               |

Table 72: Description of Fault Word, Warning Word, and Extended Status Word (*continued*)

| Bit | Hex      | Dec        | Fault word                     | Fault word 2   | Fault word 3 | Warning word    | Warning word 2    | Extended status word | Extended status word 2  |
|-----|----------|------------|--------------------------------|----------------|--------------|-----------------|-------------------|----------------------|-------------------------|
| 22  | 00400000 | 4194304    | Reserved                       | Locked rotor   | Reserved     | Reserved        | Reserved          | Reserved             | Reserved                |
| 23  | 00800000 | 8388608    | 24 V supply low                | Reserved       | Reserved     | 24 V supply low | Reserved          | Reserved             | Running                 |
| 24  | 01000000 | 16777216   | Mains failure                  | Reserved       | Reserved     | Mains failure   | Reserved          | Reserved             | Reserved                |
| 25  | 02000000 | 33554432   | Reserved                       | Current limit  | Reserved     | Current limit   | Reserved          | Reserved             | Reserved                |
| 26  | 04000000 | 67108864   | Brake resistor                 | Reserved       | Reserved     | Reserved        | Reserved          | Reserved             | Reserved                |
| 27  | 08000000 | 134217728  | Brake IGBT/Brake Chopper Start | Reserved       | Reserved     | Reserved        | Reserved          | Reserved             | Reserved                |
| 28  | 10000000 | 268435456  | Reserved                       | Feedback error | Reserved     | Feedback Error  | Reserved          | Reserved             | FlyStart active         |
| 29  | 20000000 | 536870912  | Drive initialized              | Reserved       | Reserved     | Reserved        | Back EMF too high | Reserved             | Heat sink clean warning |
| 30  | 40000000 | 1073741824 | Reserved                       | Reserved       | Reserved     | Reserved        | Reserved          | Reserved             | Reserved                |
| 31  | 80000000 | 2147483648 | Mech. brake low                | Reserved       | Reserved     | Reserved        | Reserved          | Database busy        | Reserved                |

## 8.7 List of Faults and Warnings

### WARNING/FAULT 2, Live Zero Error

#### Cause

This warning or fault only appears if programmed in **P 9.5.6.2 Live Zero Timeout Function**. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

#### Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 33 and 34 for signals, terminal 35 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

## WARNING/FAULT 4, Mains Phase Loss

### Cause

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in *P 1.3.1 Mains Imbalance Function*.

### Troubleshooting

- Check the supply voltage and supply currents to the drive.

## WARNING/FAULT 7, DC Overvoltage

### Cause

If the DC-link voltage exceeds the limit, the drive trips after a time.

### Troubleshooting

- Extend the ramp time.
- Change the ramp type.

## WARNING/FAULT 8, DC Under Voltage

### Cause

If the DC-link voltage (DC) drops below the undervoltage limit, the drive trips after a fixed time delay. The time delay varies with unit size.

### Troubleshooting

- Check that the supply voltage matches the drive voltage.
- Perform the input voltage test.
- Perform the soft charge circuit test.

## WARNING/FAULT 9, Inverter Overload

### Cause

The drive is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 90% and trips at 100%, while giving a FAULT. The drive cannot be reset until the counter is below 0%.

The fault occurs when the drive has run with more than 100% overload for too long.

### Troubleshooting

- Compare the output current shown on the control panel with the drive rated current.
- Compare the output current shown on the control panel with measured motor current.
- Show the thermal drive load on the control panel and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

## WARNING/FAULT 10, Motor Overload Temperature

### Cause

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the drive issues a warning or 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.

## WARNING/FAULT 11, Motor Thermistor Overtemp

### Cause

Check whether the thermistor is disconnected. Select whether the drive issues a warning or an fault in **P 4.6.7 Motor Thermal Protection**.

### Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 33 or 34, check that the thermistor is connected correctly between either terminal 33 or 34 (analog voltage input) and terminal 32 (+10 V supply). Also check that the terminal switch for 33 or 34 is set for voltage. Check that **P 4.6.8 Thermistor Resource** selects terminal 33 or 34.
- When using terminal 13, 14, or 18 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 32. Select the terminal to use in **P 4.6.8 Thermistor Resource**.

## WARNING/FAULT 12, Torque Limit

### Cause

The torque has exceeded the value in **P 5.10.1 Motor Torque Limit** or the value in **P 5.10.2 Regenerative Torque Limit**. **P 5.10.6 Trip Delay at Torque Limit** can change this warning from a warning-only condition to a warning followed by 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.

## WARNING/FAULT 13, Overcurrent

### Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 5 s, then the drive trips and issues an fault. Shock loading or fast acceleration with high-inertia loads can cause this fault.

### Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check **P 4.2.2.1 Nominal Power** to **P 4.2.2.5 Nominal Speed** for correct motor data.

## FAULT 14, Earth (Ground) Fault

### Cause

There is a discharge from the output phases to ground, either in the cable between the drive and the motor or in the motor itself.

### Troubleshooting

- Turn off the drive and remove the ground fault.
- Measure the resistance to ground the motor cables and the motor with a megohmmeter to check for ground faults in the motor.

## FAULT 16, Short Circuit

### Cause

There is short-circuiting in the motor or motor wiring.

### Troubleshooting

- |  <b>WARNING</b> |                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <p><b>HIGH VOLTAGE</b></p> <p>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.</p> <ul style="list-style-type: none"> <li>Only qualified personnel are allowed to perform installation, start-up, and maintenance.</li> </ul> |

Disconnect power before proceeding.

- Remove the power to the drive and repair the short circuit.

## WARNING/FAULT 17, Control Word Timeout

### Cause

There is no communication to the drive. The warning is only active when **P 5.2.16 Watchdog Response** is NOT set to [0] Off. If **P 5.2.16 Watchdog Response** is set to [5] Stop and trip, a warning appears, and the drive ramps down to a stop and shows an fault.

### Troubleshooting

- Check the connections on the serial communication cable.
- Increase **P 5.2.17 Watchdog Delay**.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

## FAULT 18, Start 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.

## FAULT 25, Brake Resistor Short Circuit

### Cause

The brake resistor is monitored during start-up. If a short circuit occurs, the brake function is disabled and the fault appears. The drive is tripped.

### Troubleshooting

- Remove the power to the drive and check the connection of the brake resistor.

## WARNING/FAULT 26, Brake Resistor Power Limit

### Cause

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in *P 3.3.2 Brake Resistor Value*. The warning is active when the dissipated braking power is higher than the value set in *P 3.3.3 Brake Resistor Power Limit*. The drive trips if the warning persists for 1200 s.

### Troubleshooting

- Decrease brake energy via lower speed or longer ramp time.

## FAULT 27, Brake IGBT/Brake Chopper Short Circuited

### Cause

The brake transistor is monitored during start-up. If a short circuit occurs, the brake function is disabled, and an fault is issued. The drive is tripped.

### Troubleshooting

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

## FAULT 28, Brake Check

### Cause

The brake resistor is not connected or not working.

### Troubleshooting

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

## FAULT 30, Motor Phase U Missing

### Cause

Motor phase U between the drive and the motor is missing.

### Troubleshooting

- Turn off the drive and check motor phase U.

## FAULT 31, Motor Phase V Missing

### Cause

Motor phase V between the drive and the motor is missing.

### Troubleshooting

- Turn off the drive and check motor phase V.

## FAULT 32, Motor Phase W Missing

### Cause

Motor phase W between the drive and the motor is missing.

### Troubleshooting

- Turn off the drive and check motor phase W.



## WARNING/FAULT 36, Mains Failure

### Cause

This warning/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.

## FAULT 38, Internal Fault

### Cause

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

### Troubleshooting

- See [Table 73](#) for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

Table 73: 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.<br>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.<br>If the fault occurs again, contact a Danfoss supplier.                                       |
| Other        | Other internal faults.                                           | Power cycle the drive. If the fault occurs again, contact a Danfoss supplier.                                                                            |

## WARNING 40, Overload of Digital Output Terminal 15

### Troubleshooting

- Check the load connected to terminal 15 or remove the short-circuit connection.
- Check **P 9.4.1.1 Digital I/O Mode** and **P 9.4.2.1 T 15 Mode**.

## FAULT 46, Gate Drive Voltage

### Cause

The supply for the gate drive on the power card is out of range. It is generated by the switch mode supply (SMPS) on the power card.

**Troubleshooting**

- Check for a defective power card.

**WARNING/FAULT 47, 24 V Supply Low****Cause**

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

**Troubleshooting**

- Check for a defective control card.

**FAULT 50, AMA Calibration Failed****Troubleshooting**

- Contact the Danfoss supplier or service department.

**FAULT 51, AMA Check Unom and Inom****Cause**

The settings for motor voltage, motor current, and motor power are wrong.

**Troubleshooting**

- Check settings in *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed*.

**FAULT 52, AMA Low Inom****Cause**

The motor current is too low.

**Troubleshooting**

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

**FAULT 53, AMA Big Motor****Cause**

The motor is too big for the AMA to operate.

**FAULT 54, AMA Small Motor****Cause**

The motor is too small for the AMA to operate.

**FAULT 55, AMA Parameter Range****Cause**

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

**FAULT 56, AMA Interrupt****Cause**

The AMA is manually interrupted.

## FAULT 57, AMA Timeout

### Troubleshooting

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

## FAULT 58, AMA Internal

### Troubleshooting

- Contact the Danfoss supplier.

## WARNING/FAULT 59, Current Limit

### Cause

The current is higher than the value in *P 2.7.1 Output Current Limit %*.

### Troubleshooting

- Ensure that the motor data in *P 4.2.2.1 Nominal Power* to *P 4.2.2.5 Nominal Speed* is set correctly.
- Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

## FAULT 60, External Interlock

### Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

### Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

## FAULT 63, Mechanical Brake Low

### Cause

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

## WARNING/FAULT 69, Power Card Temperature

### Cause

The cutout temperature of the power card has exceeded the upper limit.

### Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check the fan operation.
- Check the power card.

## FAULT 80, Drive Initialized to Default Value

### Cause

Parameter settings are initialized to default settings after a manual reset.

### Troubleshooting

- To clear the fault, reset the unit.

## WARNING 87, Auto DC-Braking

### Cause

Occurs in IT mains when the drive coasts, and the DC voltage is higher than 830 V for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in *P 2.3.13 Auto DC Braking*.

## WARNING/FAULT 95, Lost Load Detected

### Cause

Torque is below the torque level set for no load, indicating a lost load detection. *P 5.2.9 Lost Load Function* is set for alarm.

### Troubleshooting

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

## FAULT 99, Locked Rotor

### Cause

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

### Troubleshooting

- Check if the motor shaft is locked.
- Check if the start current triggers the current limit set in *P 2.1.5 Output Current Limit %*.
- Check if it increases the value in *P 4.6.15 Sync. Locked Rotor Detection Time [s]*.

## FAULT 126, Motor Rotating

### Cause

During AMA start-up, the motor is rotating. It is only valid for PM motor.

### Troubleshooting

- Check if the motor is rotating before starting the AMA.

## WARNING 127, Back EMF Too High

### Cause

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

## 9 Appendix

### 9.1 Parameter Lists

| Group index | Group name                 | Parameter index | Parameter name                   | Parameter number | Type   |
|-------------|----------------------------|-----------------|----------------------------------|------------------|--------|
| 1           | Grid                       |                 |                                  |                  |        |
| 1.2         | Grid Settings              |                 |                                  |                  |        |
|             |                            | 1.2.1           | Regional Settings                | 3                | enum   |
|             |                            | 1.2.2           | Grid Type                        | 6                | enum   |
| 1.3         | Grid Protection            |                 |                                  |                  |        |
|             |                            | 1.3.1           | Mains Imbalance Action           | 1412             | enum   |
| 2           | Power conversion & DC-link |                 |                                  |                  |        |
| 2.1         | Status                     |                 |                                  |                  |        |
|             |                            | 2.1.1           | DC-Link Voltage                  | 1630             | uint32 |
|             |                            | 2.1.2           | Inverter Thermal                 | 1635             | uint8  |
|             |                            | 2.1.3           | Unit Nominal Current             | 1636             | uint16 |
|             |                            | 2.1.5           | Output Current Limit %           | 1637             | uint16 |
|             |                            | 2.1.9           | Heat sink Temperature            | 1634             | int8   |
|             |                            | 2.1.10          | Real-time Switching Frequency    | 1866             | int8   |
| 2.3         | Protection                 |                 |                                  |                  |        |
|             |                            | 2.3.1           | Overvoltage Controller Enable    | 217              | enum   |
|             |                            | 2.3.2           | Overvoltage Controller Kp        | 219              | uint16 |
|             |                            | 2.3.6           | Power Loss Action                | 1410             | enum   |
|             |                            | 2.3.7           | Power Loss Controller Limit      | 1411             | uint16 |
|             |                            | 2.3.8           | Kin. Back-up Trip Recovery Level | 1415             | uint32 |
|             |                            | 2.3.9           | Fast Mains Phase Loss Level      | 1417             | uint16 |
|             |                            | 2.3.10          | Fast Mains Phase Loss Min Power  | 1418             | uint16 |
|             |                            | 2.3.13          | Auto DC Braking                  | 7                | enum   |
|             |                            | 2.3.14          | Max Output Frequency             | 419              | uint16 |
|             |                            | 2.3.15          | Action At Inverter Fault         | 1427             | enum   |
|             |                            | 2.3.16          | Function at Inverter Overload    | 1461             | enum   |
|             |                            | 2.3.17          | Adjustable Temperature Warning   | 442              | uint8  |
| 2.4         | Modulation                 |                 |                                  |                  |        |
|             |                            | 2.4.2           | Min. Switching Frequency         | 1463             | enum   |
|             |                            | 2.4.3           | Switching Frequency              | 1401             | enum   |

| Group index | Group name              | Parameter index | Parameter name                | Parameter number | Type   |
|-------------|-------------------------|-----------------|-------------------------------|------------------|--------|
|             |                         | 2.4.5           | Over Modulation               | 1403             | enum   |
| 2.5         | DC-Link Control         |                 |                               |                  |        |
|             |                         | 2.5.1           | Damping Gain Factor           | 1408             | uint8  |
|             |                         | 2.5.2           | DC-Link Voltage Compensation  | 1451             | enum   |
| 2.7         | Output Current Limit    |                 |                               |                  |        |
|             |                         | 2.7.1           | Output Current Limit %        | 418              | uint16 |
|             |                         | 2.7.2           | Current Limit Kp              | 1430             | uint16 |
|             |                         | 2.7.3           | Current Limit Ti              | 1431             | uint16 |
|             |                         | 2.7.4           | Current Lim Ctrl, Filter Time | 1432             | uint16 |
|             |                         | 2.7.5           | Trip Delay at Current Limit   | 1424             | uint8  |
| 3           | Filters & Brake Chopper |                 |                               |                  |        |
| 3.1         | Status                  |                 |                               |                  |        |
|             |                         | 3.1.1           | Brake Energy                  | 1633             | uint32 |
| 3.2         | Brake Chopper           |                 |                               |                  |        |
|             |                         | 3.2.1           | Enable Brake Chopper          | 215              | enum   |
|             |                         | 3.2.2           | Brake Chopper Voltage Reduce  | 214              | uint16 |
| 3.3         | Brake Resistor          |                 |                               |                  |        |
|             |                         | 3.3.2           | Brake Resistor Value          | 211              | uint16 |
|             |                         | 3.3.3           | Brake Resistor Power Limit    | 212              | uint32 |
| 4           | Motor                   |                 |                               |                  |        |
| 4.1         | Status                  |                 |                               |                  |        |
|             |                         | 4.1.1           | Motor Current                 | 1614             | uint16 |
|             |                         | 4.1.2           | Motor Voltage                 | 1612             | uint32 |
|             |                         | 4.1.3           | Motor Electrical Power        | 1610             | uint32 |
|             |                         | 4.1.4           | Motor Power hp                | 1611             | uint32 |
|             |                         | 4.1.5           | Motor Thermal Load            | 1618             | uint8  |
|             |                         | 4.1.6           | Frequency                     | 1613             | uint32 |
|             |                         | 4.1.7           | Frequency %                   | 1615             | uint16 |
|             |                         | 4.1.8           | Motor Shaft Speed             | 1617             | int32  |
|             |                         | 4.1.10          | Motor Torque                  | 1616             | int32  |
|             |                         | 4.1.11          | Motor Torque %                | 1622             | int16  |
| 4.2         | Motor Data              |                 |                               |                  |        |
| 4.2.1       | General Setting         |                 |                               |                  |        |

| Group index | Group name             | Parameter index | Parameter name                | Parameter number | Type   |
|-------------|------------------------|-----------------|-------------------------------|------------------|--------|
|             |                        | 4.2.1.1         | Motor Type                    | 110              | enum   |
|             |                        | 4.2.1.2         | Number of Poles               | 139              | uint8  |
|             |                        | 4.2.1.3         | AMA Mode                      | 129              | enum   |
|             |                        | 4.2.1.4         | Motor Cable Length            | 142              | uint8  |
|             |                        | 4.2.1.5         | Motor Cable Length Feet       | 143              | uint16 |
| 4.2.2       | Nameplate Data         |                 |                               |                  |        |
|             |                        | 4.2.2.1         | Nominal Power                 | 120              | uint16 |
|             |                        | 4.2.2.2         | Nominal Voltage               | 122              | uint16 |
|             |                        | 4.2.2.3         | Nominal Current               | 124              | uint32 |
|             |                        | 4.2.2.4         | Nominal Frequency             | 123              | uint16 |
|             |                        | 4.2.2.5         | Nominal Speed                 | 125              | uint16 |
| 4.2.3       | Asyn. Induction Motor  |                 |                               |                  |        |
|             |                        | 4.2.3.1         | Stator Resistance Rs          | 130              | uint32 |
|             |                        | 4.2.3.2         | Rotor Resistance Rr           | 131              | uint32 |
|             |                        | 4.2.3.4         | Stator Leakage Inductance Lls | 133              | uint32 |
|             |                        | 4.2.3.6         | Magnetizing Inductance Lm     | 135              | uint32 |
|             |                        | 4.2.3.7         | Motor Cont. Rated Torque      | 126              | uint32 |
| 4.2.4       | Permanent Magnet Motor |                 |                               |                  |        |
|             |                        | 4.2.4.1         | Back EMF                      | 140              | uint16 |
|             |                        | 4.2.4.3         | d-axis Inductance Ld          | 137              | int32  |
|             |                        | 4.2.4.4         | d-axis Inductance LdSat       | 144              | int32  |
|             |                        | 4.2.4.6         | Ld Current Point              | 148              | int16  |
|             |                        | 4.2.4.7         | q-axis Inductance Lq          | 138              | int32  |
|             |                        | 4.2.4.8         | q-axis Inductance LqSat       | 145              | int32  |
|             |                        | 4.2.4.10        | Lq Current Point              | 149              | uint16 |
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| 4.4.1       | General Settings       |                 |                               |                  |        |
|             |                        | 4.4.1.2         | AEO Minimum Magnetization     | 1441             | uint8  |
|             |                        | 4.4.1.3         | Torque Characteristic         | 103              | enum   |
|             |                        | 4.4.1.4         | Clockwise Direction           | 106              | enum   |
|             |                        | 4.4.1.5         | Motor Control Bandwidth       | 108              | enum   |
| 4.4.2       | AC-Brake               |                 |                               |                  |        |
|             |                        | 4.4.2.1         | Enable AC-Brake               | 210              | enum   |

| Group index | Group name             | Parameter index | Parameter name                            | Parameter number | Type   |
|-------------|------------------------|-----------------|-------------------------------------------|------------------|--------|
|             |                        | 4.4.2.2         | AC Brake, Max current                     | 216              | uint16 |
|             |                        | 4.4.2.3         | AC-Brake Voltage Control Kp               | 188              | uint16 |
| 4.4.3       | U/F Curve              |                 |                                           |                  |        |
|             |                        | 4.4.3.1         | Voltage Point                             | 155              | uint16 |
|             |                        | 4.4.3.2         | Frequency Point                           | 156              | uint16 |
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|             |                        | 4.4.4.1         | Slip Comp. Gain                           | 162              | int16  |
|             |                        | 4.4.4.2         | Slip Comp. Time Constant                  | 163              | uint16 |
|             |                        | 4.4.4.3         | High Speed Load Comp.                     | 161              | int16  |
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|             |                        | 4.4.4.5         | Res. Damp Gain                            | 164              | uint16 |
|             |                        | 4.4.4.6         | Res. Damp High Pass Time Constant         | 165              | uint16 |
|             |                        | 4.4.4.7         | Damping Gain                              | 114              | int16  |
|             |                        | 4.4.4.8         | High Speed Filter Time Const.             | 116              | uint16 |
|             |                        | 4.4.4.9         | Low Speed Filter Time Const.              | 115              | uint16 |
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|             |                        | 4.4.4.12        | Min Speed Normal Magnetizing [Hz]         | 152              | uint16 |
|             |                        | 4.4.4.13        | VT Level                                  | 1440             | uint8  |
|             |                        | 4.4.4.14        | Min. Current at Low Speed                 | 166              | uint32 |
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|             |                        | 4.4.5.1         | Dead Time Compensation Level              | 1407             | uint8  |
|             |                        | 4.4.5.2         | Dead Time Bias Current Level              | 1409             | uint8  |
|             |                        | 4.4.5.3         | Dead Time Compensation Zero Current Level | 1464             | enum   |
|             |                        | 4.4.5.4         | Speed Derate Dead Time Compensation       | 1465             | uint16 |
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|             |                        | 4.6.2           | Warning Freq. Low                         | 440              | uint16 |
|             |                        | 4.6.3           | Warning Current High                      | 451              | uint32 |
|             |                        | 4.6.4           | Warning Current Low                       | 450              | uint32 |



| Group index | Group name  | Parameter index | Parameter name                        | Parameter number | Type   |
|-------------|-------------|-----------------|---------------------------------------|------------------|--------|
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|             |             | 4.6.8           | Thermistor Source                     | 193              | enum   |
|             |             | 4.6.9           | Motor External Fan                    | 191              | enum   |
|             |             | 4.6.12          | Missing Motor Phase Function          | 458              | enum   |
|             |             | 4.6.13          | Fault Level                           | 1490             | enum   |
|             |             | 4.6.14          | Sync. Locked Rotor Protection         | 3022             | enum   |
|             |             | 4.6.15          | Sync. Locked Rotor Detection Time [s] | 3023             | uint8  |
| 5           | Application |                 |                                       |                  |        |
| 5.1         | Status      |                 |                                       |                  |        |
|             |             | 5.1.1           | Fault Word 1                          | 1690             | uint32 |
|             |             | 5.1.2           | Fault Word 2                          | 1691             | uint32 |
|             |             | 5.1.3           | Fault Word 3                          | 1697             | uint32 |
|             |             | 5.1.4           | Warning Word 1                        | 1692             | uint32 |
|             |             | 5.1.5           | Warning Word 2                        | 1693             | uint32 |
|             |             | 5.1.6           | Warning Word 3                        | 1698             | uint32 |
|             |             | 5.1.7           | Active Control Word                   | 1600             | uint16 |
|             |             | 5.1.8           | Drive Status Word                     | 1603             | uint16 |
|             |             | 5.1.9           | Ext. Status Word                      | 1694             | uint32 |
|             |             | 5.1.10          | Ext. Status Word 2                    | 1695             | uint32 |
|             |             | 5.1.16          | Reference [Unit]                      | 1601             | int32  |
|             |             | 5.1.17          | Reference [%]                         | 1602             | int16  |
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|             |             | 5.1.27          | FC Port REF 1                         | 1686             | int16  |
| 5.2         | Protection  |                 |                                       |                  |        |
|             |             | 5.2.1           | Warning Reference High                | 455              | int32  |
|             |             | 5.2.2           | Warning Reference Low                 | 454              | int32  |
|             |             | 5.2.3           | Warning Feedback High                 | 457              | int32  |
|             |             | 5.2.4           | Warning Feedback Low                  | 456              | int32  |
|             |             | 5.2.9           | Lost Load Function                    | 2260             | enum   |
|             |             | 5.2.10          | Lost Load Detection Torque Level      | 2261             | uint8  |

| Group index | Group name      | Parameter index | Parameter name                | Parameter number | Type   |
|-------------|-----------------|-----------------|-------------------------------|------------------|--------|
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|             |                 | 5.2.16          | Watchdog Response             | 804              | enum   |
|             |                 | 5.2.17          | Watchdog Delay                | 803              | uint16 |
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|             |                 | 5.4.1           | Application Selection         | 16               | enum   |
|             |                 | 5.4.2           | Operation Mode                | 100              | enum   |
|             |                 | 5.4.3           | Motor Control Principle       | 101              | enum   |
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|             |                 | 5.5.1.1         | Control Place Selection       | 801              | enum   |
|             |                 | 5.5.1.2         | Control Source                | 802              | enum   |
|             |                 | 5.5.1.6         | Configurable Status Word STW  | 813              | enum   |
|             |                 | 5.5.1.7         | Configurable Control Word CTW | 814              | enum   |
|             |                 | 5.5.1.10        | Operating State at Power-up   | 4                | enum   |
|             |                 | 5.5.1.15        | [REM/LOC] Button              | 46               | enum   |
|             |                 | 5.5.1.16        | [Off/Reset] Button            | 44               | enum   |
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|             |                 | 5.5.2.1         | Coasting Select               | 850              | enum   |
|             |                 | 5.5.2.2         | Quick Stop Select             | 851              | enum   |
|             |                 | 5.5.2.3         | DC Brake Select               | 852              | enum   |
|             |                 | 5.5.2.4         | Start Select                  | 853              | enum   |
|             |                 | 5.5.2.5         | Reversing Select              | 854              | enum   |
|             |                 | 5.5.2.6         | Set-up Select                 | 855              | enum   |
|             |                 | 5.5.2.7         | Preset Reference Select       | 856              | enum   |
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|             |                 | 5.5.3.1         | Reference Range               | 300              | enum   |
|             |                 | 5.5.3.2         | Reference/Feedback Unit       | 301              | enum   |
|             |                 | 5.5.3.3         | Reference Maximum             | 303              | int32  |
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|             |                 | 5.5.3.6         | Reference Site                | 313              | enum   |
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| Group index | Group name     | Parameter index | Parameter name                         | Parameter number | Type   |
|-------------|----------------|-----------------|----------------------------------------|------------------|--------|
|             |                | 5.5.3.9         | Reference 3 Source                     | 317              | enum   |
|             |                | 5.5.3.10        | Preset Reference                       | 310              | int16  |
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|             |                | 5.5.4.2         | Ramp 1 Accel. Time                     | 341              | uint32 |
|             |                | 5.5.4.3         | Ramp 1 Decel. Time                     | 342              | uint32 |
|             |                | 5.5.4.8         | Ramp 2 Type Selector                   | 350              | enum   |
|             |                | 5.5.4.9         | Ramp 2 Accel. Time                     | 351              | uint32 |
|             |                | 5.5.4.10        | Ramp 2 Decel. Time                     | 352              | uint32 |
| 5.6         | Start Settings |                 |                                        |                  |        |
|             |                | 5.6.1           | Start Zero Speed Time                  | 171              | uint8  |
|             |                | 5.6.2           | Start Function                         | 172              | enum   |
|             |                | 5.6.3           | Enable Flying Start                    | 173              | enum   |
|             |                | 5.6.4           | Start Speed [Hz]                       | 175              | uint16 |
|             |                | 5.6.5           | Start Current                          | 176              | uint32 |
|             |                | 5.6.6           | Breakaway Current Boost                | 422              | enum   |
|             |                | 5.6.7           | Start Max Speed [Hz]                   | 178              | uint16 |
|             |                | 5.6.8           | Start Max Time to Trip                 | 179              | uint8  |
|             |                | 5.6.11          | Sync. Motor Start Mode                 | 170              | enum   |
|             |                | 5.6.12          | Sync. Motor Detection Current %        | 146              | uint16 |
|             |                | 5.6.13          | Sync. Motor Parking Time               | 207              | uint16 |
|             |                | 5.6.14          | Sync. Motor Parking Current %          | 206              | uint16 |
|             |                | 5.6.15          | Sync. High Starting Torque Time [s]    | 3020             | uint16 |
|             |                | 5.6.16          | Sync. High Starting Torque Current [%] | 3021             | uint32 |
| 5.7         | Stop Settings  |                 |                                        |                  |        |
|             |                | 5.7.1           | Function at Stop                       | 180              | enum   |
|             |                | 5.7.2           | Min Speed for Function at Stop [Hz]    | 182              | uint16 |
|             |                | 5.7.3           | DC Brake Time                          | 202              | uint16 |

| Group index | Group name               | Parameter index | Parameter name                 | Parameter number | Type   |
|-------------|--------------------------|-----------------|--------------------------------|------------------|--------|
|             |                          | 5.7.4           | DC Brake Current %             | 201              | uint16 |
|             |                          | 5.7.5           | DC Brake Frequency             | 204              | uint16 |
|             |                          | 5.7.6           | DC Hold Current %              | 200              | uint16 |
|             |                          | 5.7.7           | Quick Stop Ramp Time           | 381              | uint32 |
| 5.8         | Speed Control            |                 |                                |                  |        |
|             |                          | 5.8.1           | Rotation Direction             | 410              | enum   |
|             |                          | 5.8.2           | Motor Speed High Limit [Hz]    | 414              | uint16 |
|             |                          | 5.8.3           | Motor Speed Low Limit [Hz]     | 412              | uint16 |
|             |                          | 5.8.8           | Torque Limit Mode Speed Ctrl   | 420              | enum   |
|             |                          | 5.8.11          | Band 1, High Limit             | 463              | uint16 |
|             |                          | 5.8.12          | Band 1, Low Limit              | 461              | uint16 |
| 5.9         | Inching                  |                 |                                |                  |        |
|             |                          | 5.9.1           | Jog Ramp Time                  | 380              | uint32 |
|             |                          | 5.9.2           | Jog Reference 1                | 311              | uint16 |
| 5.1         | Torque Control           |                 |                                |                  |        |
|             |                          | 5.10.1          | Motor Torque Limit             | 416              | uint16 |
|             |                          | 5.10.2          | Regenerative Torque Limit      | 417              | uint16 |
|             |                          | 5.10.3          | Speed Limit Mode Torque Ctrl.  | 421              | enum   |
|             |                          | 5.10.4          | Torque PID Proportional Gain   | 712              | uint16 |
|             |                          | 5.10.5          | Torque PID Integration Time    | 713              | uint16 |
|             |                          | 5.10.6          | Trip Delay at Torque Limit     | 1425             | uint8  |
| 5.11        | Mechanical Brake Control |                 |                                |                  |        |
|             |                          | 5.11.1          | Brake Closing Speed            | 222              | uint16 |
|             |                          | 5.11.2          | Brake Close Time               | 223              | uint8  |
|             |                          | 5.11.3          | Release Brake Current          | 220              | uint32 |
|             |                          | 5.11.4          | Mech. Brake w/ dir. Change     | 239              | enum   |
| 5.12        | Process Control          |                 |                                |                  |        |
| 5.12.1      | Status                   |                 |                                |                  |        |
|             |                          | 5.12.1.1        | Process PID Error              | 1890             | int16  |
|             |                          | 5.12.1.2        | Process PID Output             | 1891             | int16  |
|             |                          | 5.12.1.3        | Process PID Clamped Output     | 1892             | int16  |
|             |                          | 5.12.1.4        | Process PID Gain Scaled Output | 1893             | int16  |
|             |                          | 5.12.1.5        | Feedback Value                 | 1652             | int32  |

| Group index | Group name            | Parameter index | Parameter name                         | Parameter number | Type   |
|-------------|-----------------------|-----------------|----------------------------------------|------------------|--------|
| 5.12.4      | Feedback              |                 |                                        |                  |        |
|             |                       | 5.12.4.1        | Feedback 1 Resource                    | 720              | enum   |
|             |                       | 5.12.4.2        | Feedback 2 Resource                    | 722              | enum   |
|             |                       | 5.12.4.3        | Feedback 1 Conversion                  | 760              | enum   |
|             |                       | 5.12.4.4        | Feedback 2 Conversion                  | 762              | enum   |
| 5.12.5      | PID Controller        |                 |                                        |                  |        |
|             |                       | 5.12.5.1        | PID Proportional Gain                  | 733              | uint16 |
|             |                       | 5.12.5.2        | PID Integral Time                      | 734              | uint32 |
|             |                       | 5.12.5.4        | Antiwindup Enabled                     | 731              | enum   |
|             |                       | 5.12.5.5        | PID Differentiation Time               | 735              | uint16 |
|             |                       | 5.12.5.6        | PID Diff. Gain Limit                   | 736              | uint16 |
|             |                       | 5.12.5.7        | PID Normal/ Inverse Control            | 730              | enum   |
|             |                       | 5.12.5.8        | PID Start Speed                        | 732              | uint16 |
|             |                       | 5.12.5.9        | On Reference Bandwidth                 | 739              | uint8  |
| 5.12.6      | Feed Forward          |                 |                                        |                  |        |
|             |                       | 5.12.6.1        | PID Feed Forward Factor                | 738              | uint16 |
| 5.12.7      | SleepMode             |                 |                                        |                  |        |
|             |                       | 5.12.7.1        | Sleep Mode in Process Closed-loop Mode | 2202             | enum   |
|             |                       | 5.12.7.2        | Minimum Run Time                       | 2240             | uint16 |
|             |                       | 5.12.7.3        | Minimum Sleep Time                     | 2241             | uint16 |
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