GE
Industrial Solutions

AF-600 FP™
Fan & Pump Drive

Programming Guide

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Contents

1 Introduction

1.1 Software Version

AF-600 FP
This guide can be used with all AF-600 FP frequency converters with software version 2.4 or later. The actual software version number can be read from *parameter ID-43 Software Version*.

Table 1.1 Software Version

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It has been assumed that all devices are sitting behind a firewall that does packet filtering and the environment has well-implemented restrictions on the software that can run inside the firewall. All nodes are assumed to be "trusted" nodes.

1.3 Approvals

1.4 Symbols

The following symbols are used in this manual.

⚠WARNING

Indicates a potentially hazardous situation which could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that may result in damage to equipment or property.

1.5 Definitions

1.5.1 Frequency Converter

$I_{DRIVE,MAX}$
Maximum output current.

$I_{DRIVE,\ N}$
Rated output current supplied by the frequency converter.

$U_{DRIVE,\ MAX}$
Maximum output voltage.

1.5.2 Input

Control command
Start and stop the connected motor with keypad and digital inputs.
Functions are divided into 2 groups.

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

Group 1	Reset, coast stop, reset, and coast stop, quick stop, DC brake, stop, the [OFF] key.
Group 2	Start, pulse start, reversing, start reversing, jog, freeze output.

Table 1.2 Function Groups

1.5.3 Motor

Motor running
Torque generated on output shaft and speed from 0 RPM to maximum speed on motor.

f_{JOG}
Motor frequency when the jog function is activated (via digital terminals).

f_M
Motor frequency.

f_{MAX}
Maximum motor frequency.

f_{MIN}
Minimum motor frequency.

$f_{M,N}$
Rated motor frequency (nameplate data).

I_M
Motor current (actual).

$I_{M,N}$
Rated motor current (nameplate data).

$n_{M,N}$
Nominal motor speed (nameplate data).

n_s
Synchronous motor speed

$$n_s = \frac{2 \times par.\ F-04 \times 60\ s}{par.\ P-01}$$

n_{slip}
Motor slip.

$P_{M,N}$
Rated motor power (nameplate data in kW or hp).

$T_{M,N}$
Rated torque (motor).

U_M
Instant motor voltage.

$U_{M,N}$
Rated motor voltage (nameplate data).

Break-away torque

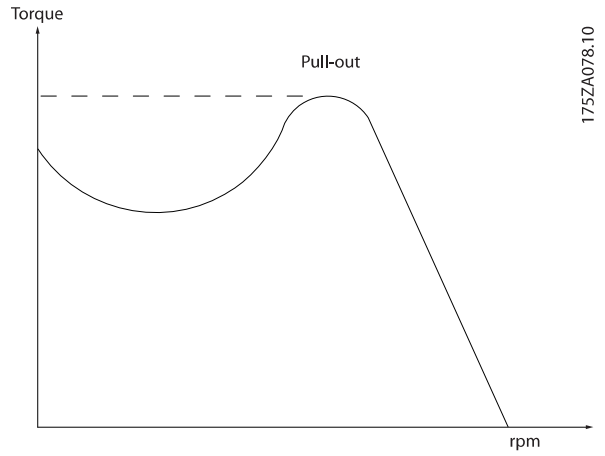

Illustration 1.1 Break-away Torque

η_{DRIVE}
The efficiency of the frequency converter is defined as the ratio between the power output and the power input.

Start-disable command
A stop command belonging to Group 1 control commands - see *Table 1.2*.

Stop command
A stop command belonging to Group 1 control commands - see *Table 1.2*.

1.5.4 References

Advanced Vector Control
If compared with standard voltage/frequency ratio control, advanced vector control improves the dynamics and the stability, both when the speed reference is changed and in relation to the load torque.

Analog reference
A signal transmitted to the analog inputs 53 or 54 (voltage or current).

Binary reference
A signal transmitted to the serial communication port.

Preset reference
A defined preset reference to be set from -100% to +100% of the reference range. Selection of 8 preset references via the digital terminals.

Pulse reference
A pulse frequency signal transmitted to the digital inputs (terminal 29 or 33).

Ref_{MAX}
Determines the relationship between the reference input at 100% full scale value (typically 10 V, 20 mA) and the resulting reference. The maximum reference value is set in *parameter F-53 Maximum Reference*.

Ref_{MIN}
Determines the relationship between the reference input at 0% value (typically 0 V, 0 mA, 4 mA) and the resulting reference. The minimum reference value is set in *parameter F-52 Minimum Reference*.

1.5.5 Miscellaneous

Analog Inputs
The analog inputs are used for controlling various functions of the frequency converter.
There are two types of analog inputs:
Current input, 0-20 mA and 4-20 mA
Voltage input, -10 to +10 V DC.

Analog Outputs
The analog outputs can supply a signal of 0-20 mA, 4-20 mA.

Auto tune
Auto tune algorithm determines the electrical parameters for the connected motor at standstill.

CT Characteristics
Constant torque characteristics used for all applications such as conveyor belts, displacement pumps and cranes.

Digital Inputs
The digital inputs can be used for controlling various functions of the frequency converter.

Digital Outputs
The frequency converter features two Solid State outputs that can supply a 24 V DC (max. 40 mA) signal.

DSP
Digital Signal Processor.

Electronic thermal overload
Electronic thermal overload is a thermal load calculation based on present load and time. Its purpose is to estimate the motor temperature.

Intermittent Duty Cycle
An intermittent duty rating refers to a sequence of duty cycles. Each cycle consists of an on-load and an off-load period. The operation can be either periodic duty or non-periodic duty.

Keypad
The keypad makes up a complete interface for control and programming of the frequency converter. The keypad is detachable and can be installed up to 3 m from the frequency converter, i.e. in a front panel with the installation kit option.

Logic Controller (LC)
The LC is a sequence of user defined actions executed when the associated user defined events are evaluated as true by the Logic Controller. (Parameter group *LC-##*).

lsb
Least significant bit.

msb
Most significant bit.

MCM
Short for Mille Circular Mil, an American measuring unit for cable cross-section. 1 MCM = 0.5067mm^2.

On-line/Off-line Parameters
Changes to on-line parameters are activated immediately after the data value is changed. Press [OK] to activate changes to off-line parameters.

Process PID
The PID control maintains the desired speed, pressure, temperature, etc. by adjusting the output frequency to match the varying load.

PCD
Process Control Data

Power Cycle
Switch off the mains until display is dark – then turn power on again.

Pulse Input/Incremental Encoder
An external, digital pulse transmitter used for feeding back information on motor speed. The encoder is used in applications where great accuracy in speed control is required.

RCD
Residual Current Device.

Set-up
Save parameter settings in four Set-ups. Change between the four parameter Set-ups and edit one Set-up, while another Set-up is active.

SFAVM
Switching pattern called **S**tator **F**lux oriented **A**synchronous **V**ector **M**odulation (*parameter F-37 Adv. Switching Pattern*).

Slip Compensation
The frequency converter compensates for the motor slip by giving the frequency a supplement that follows the measured motor load keeping the motor speed almost constant.

STW
Status Word

Drive Standard Bus
Includes RS-485 bus with drive protocol or MC protocol. See *parameter O-30 Protocol*.

Thermistor
A temperature-dependent resistor placed where the temperature is to be monitored (frequency converter or motor).

Trip
A state entered in fault situations, e.g. if the frequency converter is subject to an over-temperature or when the frequency converter is protecting the motor, process or mechanism. Restart is prevented until the cause of the fault has disappeared and the trip state is cancelled by

activating reset or, in some cases, by being programmed to reset automatically. Trip may not be used for personal safety.

Trip Locked
A state entered in fault situations when the frequency converter is protecting itself and requiring physical intervention, e.g. if the frequency converter is subject to a short circuit on the output. A locked trip can only be cancelled by cutting off mains, removing the cause of the fault, and reconnecting the frequency converter. Restart is prevented until the trip state is cancelled by activating reset or, in some cases, by being programmed to reset automatically. Trip may not be used for personal safety.

VT Characteristics
Variable torque characteristics used for pumps and fans.

60° AVM
Switching pattern called 60° **A**synchronous **V**ector **M**odulation (*parameter F-37 Adv. Switching Pattern*).

Power Factor
The power factor is the relation between I_1 and I_{RMS}.

$$Power\ factor = \frac{\sqrt{3} \times U \times I_1 \cos\phi}{\sqrt{3} \times U \times I_{RMS}}$$

The power factor for 3-phase control:

$$= \frac{I1 \times \cos\phi 1}{I_{RMS}} = \frac{I_1}{I_{RMS}} \text{ since } \cos\phi 1 = 1$$

The power factor indicates to which extent the frequency converter imposes a load on the mains supply.
The lower the power factor, the higher the I_{RMS} for the same kW performance.

$$I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2 + .. + I_n^2}$$

In addition, a high power factor indicates that the different harmonic currents are low.
The frequency converters' built-in DC coils produce a high power factor, which minimizes the imposed load on the mains supply.

1.6 Safety

Safety regulations

- Disconnect mains supply to the frequency converter whenever repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains supply plugs. For information about the discharge time, see .
- [Off] does not disconnect the mains supply and must not be used as a safety switch.
- Ground the equipment properly, protect the user against supply voltage, and protect the motor against overload in accordance with applicable national and local regulations.
- The ground leakage current exceeds 3.5 mA. Ensure correct grounding of the equipment by a certified electrical installer.
- Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains plugs.
- The frequency converter has more voltage sources than L1, L2, and L3, when load sharing (linking of DC intermediate circuit) or external 24 V DC is installed. Check that all voltage sources have been disconnected and that the necessary time has elapsed before commencing repair work. For information about the discharge time, see .

Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the drive is connected to mains. If personal safety considerations (e.g. risk of personal injury caused by contact with moving machine parts following an unintentional start) make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient. In such cases the mains supply must be disconnected.
2. The motor may start while setting the parameters. If this means that personal safety may be compromised (e.g. personal injury caused by contact with moving machine parts), motor starting must be prevented by disconnection of the motor connection.
3. A motor that has been stopped with the mains supply connected, may start if faults occur in the electronics of the drive, through temporary overload or if a fault in the power supply grid or motor connection is remedied. If unintended start must be prevented for personal safety reasons (e.g. risk of injury caused by contact with moving machine parts), the normal stop functions of the drive are not sufficient. In such cases the mains supply must be disconnected.
4. Control signals from, or internally within, the drive may in rare cases be activated in error, be delayed or fail to occur entirely. When used in situations where safety is critical, e.g. when controlling the electromagnetic brake function of a hoist application, these control signals must not be relied on exclusively.

⚠WARNING

High Voltage

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.
Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back up.
Systems where frequency converters are installed must, if necessary, be equipped with additional monitoring and protective devices according to the valid safety regulations, e.g law on mechanical tools, regulations for the prevention of accidents etc. Modifications on the frequency converters by means of the operating software are allowed.

NOTICE

Hazardous situations shall be identified by the machine builder/integrator who is responsible for considering necessary preventive measures. Additional monitoring and protective devices may be included, always according to valid national safety regulations, for example law on mechanical tools, regulations for the prevention of accidents.

Protection mode
Once a hardware limit on motor current or DC-link voltage is exceeded, the frequency converter enters Protection mode. Protection mode means a change of the PWM modulation strategy and a low switching frequency to minimise losses. This continues 10 s after the last fault and increases the reliability and the robustness of the frequency converter while re-establishing full control of the motor.

1.7 Electrical Wiring

1.7.1 Electrical Wiring - Control Cables

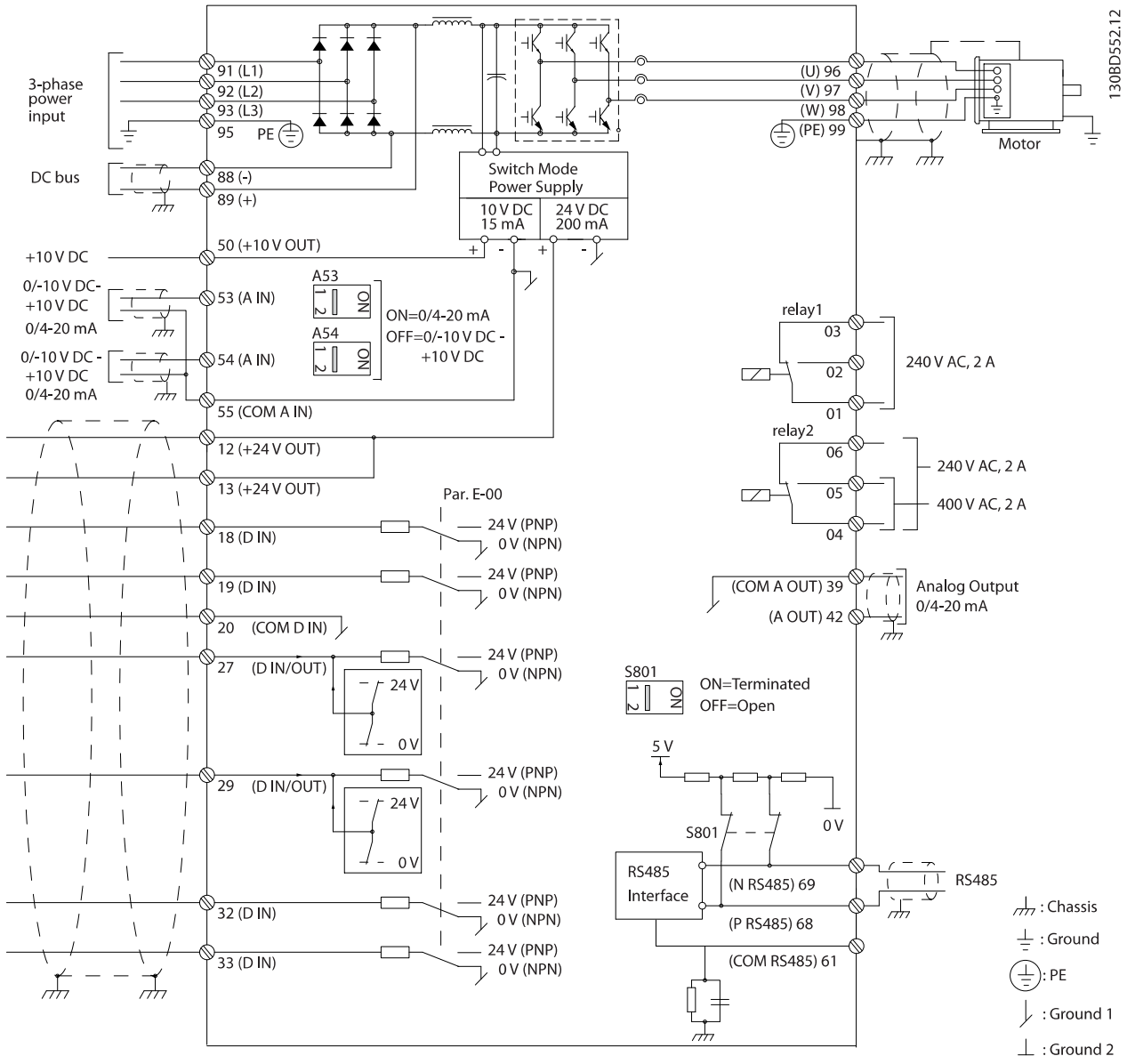

Illustration 1.2 Diagram Showing All Electrical Terminals without Options

Long control cables and analog signals may in rare cases and depending on installation result in 50/60 Hz ground loops due to noise from mains supply cables.

If this occurs, it may be necessary to break the shield or insert a 100 nF capacitor between shield and chassis.

The digital and analog inputs and outputs must be connected separately to the common inputs (terminal 20, 55, 39) of the frequency converter to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

1

Input polarity of control terminals

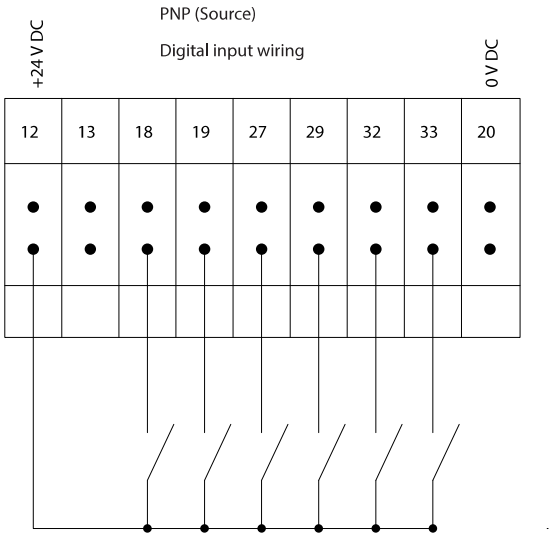

Illustration 1.3 PNP Source

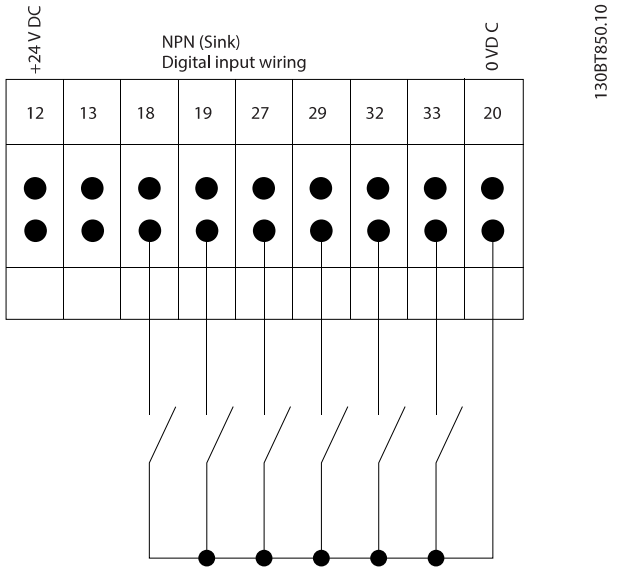

Illustration 1.4 NPN (Sink)

NOTICE

Control cables must be screened/armoured.

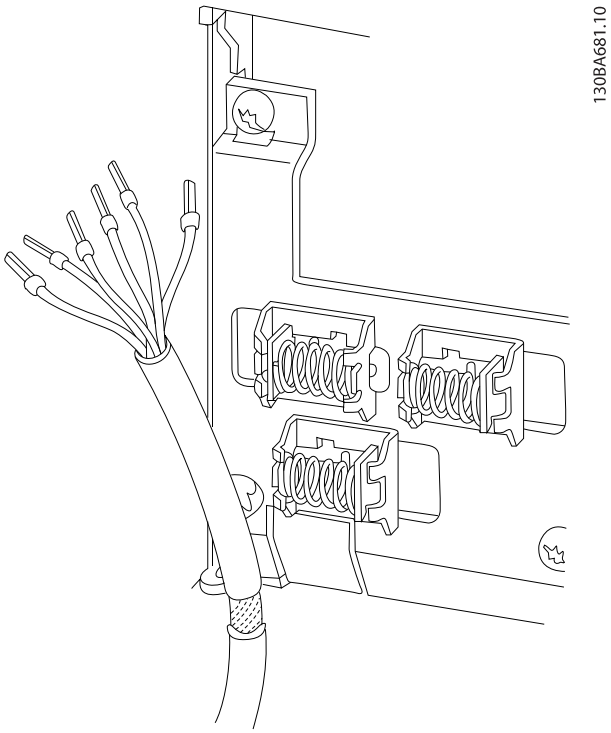

Illustration 1.5 Control Cables

2 How to Program

2.1 Keypad

2.1.1 How to Operate Graphical Keypad

The keypad is divided into 4 functional groups:

1. Graphical display with status lines.
2. Menu keys and indicator lights (LEDs) - selecting mode, changing parameters, and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

Graphical display
The LCD display is backlit with a total of 6 alpha-numeric lines. All data is displayed on the keypad, which can show up to 5 operating variables while in Status mode.

Display lines:

a. **Status line**
Status messages displaying icons and graphics.

b. **Line 1–2**
Operator data lines displaying data and variables defined or selected by the user. Press [Status] to add 1 extra line.

c. **Status line**
Status messages displaying text.

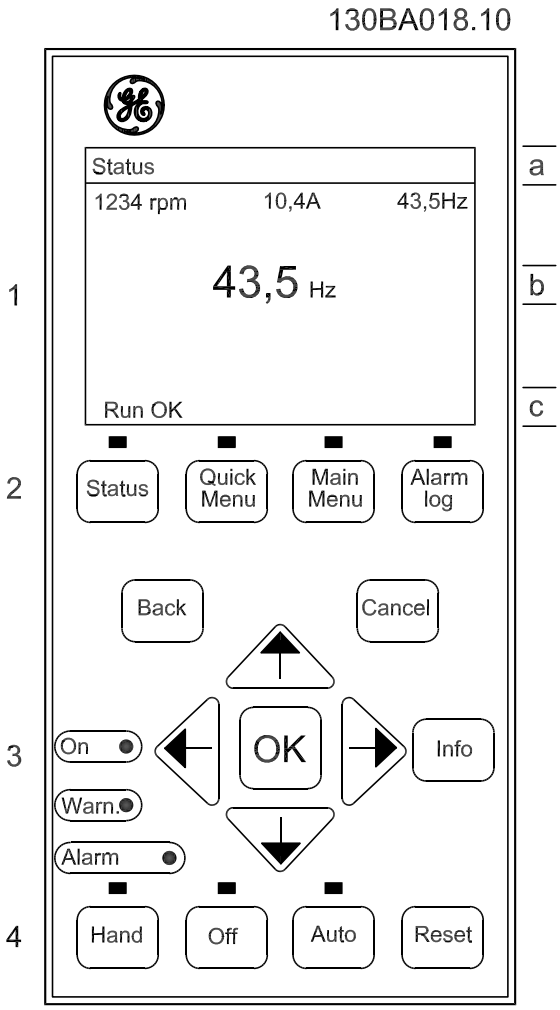

Illustration 2.1 LCP

The display is divided into 3 sections:
Top section
(a) shows the status when in Status mode, or up to 2 variables when not in Status mode, and in the case of alarm/warning.

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

Middle section
(b) shows up to 5 variables with related unit, regardless of status. In case of alarm/warning, the warning is shown instead of the variables.

2

Bottom section
(c) always shows the state of the frequency converter in status mode.

Press [Status] to toggle between 3 status readout displays. Operating variables with different formatting are shown in each status screen.

Each value/measurement readout parameter selected in *parameter K-20 Display Line 1.1 Small* to *parameter K-24 Display Line 3 Large* has its own scale and number of digits after a possible decimal point. Larger numeric values are displayed with few digits after the decimal point.
Ex.: Current readout
5.25 A; 15.2 A 105 A.

Status display I
This readout state is standard after start-up or restore. Press [INFO] to obtain information about the value/ measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).
See the operating variables shown in the display in *Illustration 2.2*. 1.1, 1.2, and 1.3 are shown in small size. 2 and 3 are shown in medium size.

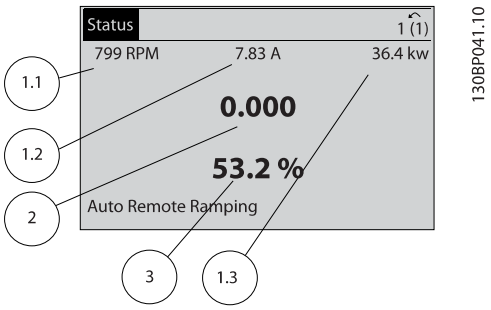

Illustration 2.2 Example of Status Display I

Status display II
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in *Illustration 2.3*.
In the example, speed, motor current, motor power, and frequency are selected as variables in the first and second lines.
1.1, 1.2, and 1.3 are shown in small size. 2 is shown in large size.

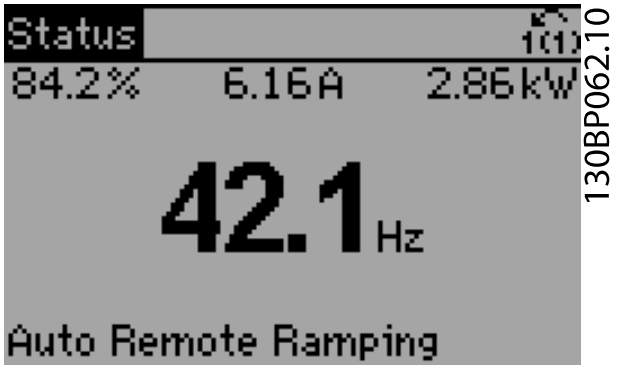

Illustration 2.3 Example of Status Display II

Status display III
This state displays the event and action of the Logic Controller.

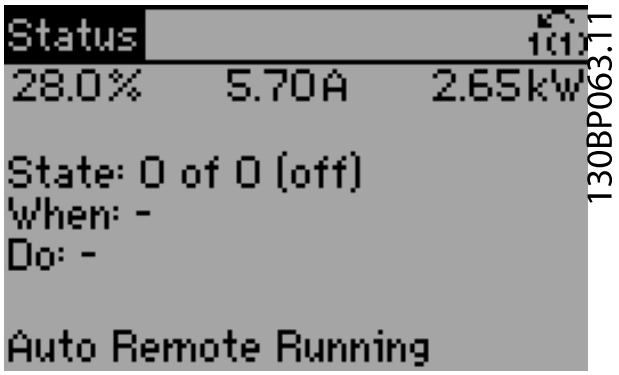

Illustration 2.4 Example of Status Display III

Display contrast adjustment
Press [Status] and [▲] for darker display.
Press [Status] and [▼] for brighter display.

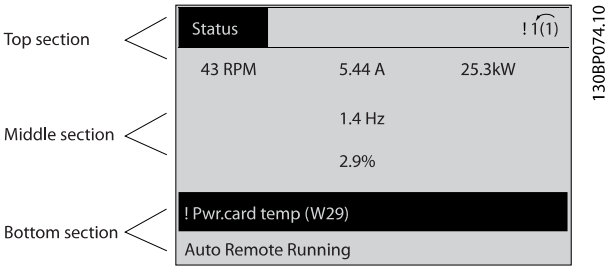

Illustration 2.5 Display Sections

Indicator lights (LEDs)

If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear in the display.

The On LED is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V external supply. At the same time, the backlight is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.

Illustration 2.6 Indicator Lights

Keys

Menu keys

The menu keys are divided into functions. The keys below the display and indicator lights are used for parameter set-up, including selection of display indication during normal operation.

Illustration 2.7 Menu Keys

[Status]

[Status] indicates the status of the frequency converter and/or the motor. 3 different readouts can be selected by pressing the [Status] key:

- 5-line readouts.
- 4-line readouts.
- Logic Controller.

Press [Status] to select the display mode or for changing back to *Display* mode from either *Quick Menu* mode, *Main Menu* mode, or *Alarm* mode. Also press [Status] to toggle between single or double readout mode.

[Quick Menu]

[Quick Menu] allows quick set-up of the frequency converter. The most common functions can be programmed here.

The Quick Menu consists of

- Quick Start
- Fan Macros
- Pump Macros
- Compressor Macros
- Closed Loop
- Parameter Data Check
- Trendings

The *Function Set-up* provides quick and easy access to all parameters required for most applications including:

- Most VAV and CAV supply and return fans.
- Cooling tower fans.
- Primary, secondary, and condenser water pumps.
- Other pump, fan, and compressor applications.

Among other features, it also includes parameters for selecting which variables to display in the keypad: digital preset speeds, scaling of analog references, closed loop single-zone and multi-zone applications, and specific functions related to fans, pumps, and compressors.

The Quick Menu parameters can be accessed immediately unless a password has been created via:

- *Parameter K-60 Main Menu Password*.
- *Parameter K-61 Access to Main Menu w/o Password*.
- *Parameter K-65 Quick Menu Password*.
- *Parameter K-66 Access to Quick Menu w/o Password*.

It is possible to switch directly between *Quick Menu* mode and *Main Menu* mode.

[Main Menu]

Press [Main Menu] to program all parameters. The main menu parameters can be accessed immediately unless a password has been created via:

- *Parameter K-60 Main Menu Password*.
- *Parameter K-61 Access to Main Menu w/o Password*.
- *Parameter K-65 Quick Menu Password*.
- *Parameter K-66 Access to Quick Menu w/o Password*.

For most applications, it is not necessary to access the main menu parameters. Instead, the *Quick Menu*, *Quick Set-up* and *Function Set-up* provide the simplest and quickest access to the most required parameters.

It is possible to switch directly between *Main Menu* mode and *Quick Menu* mode.

Parameter shortcut can be carried out by pressing [Main Menu] for 3 s. The parameter shortcut allows direct access to any parameter.

2

[Alarm Log]
[Alarm Log] displays an alarm list of the 10 most recent alarms (numbered A1-A10). To obtain more details about an alarm, press the navigation keys to manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

The [Alarm Log] key on the keypad allows access to both alarm log and maintenance log.

[Back]
[Back] reverts to the previous step or layer in the navigation structure.

Illustration 2.8 Back Key

[Cancel]
[Cancel] cancels the last change or command as long as the display has not been changed.

Illustration 2.9 Cancel Key

[Info]
[Info] displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.
Exit Info mode by pressing either [Info], [Back], or [Cancel].

Illustration 2.10 Info Key

Navigation Keys
The 4 navigation keys are used to navigate between the different options available in the Quick Menu, Main Menu, and Alarm Log. Press the keys to move the cursor.

[OK]
Press [OK] to select a parameter marked by the cursor and for enabling the change of a parameter.

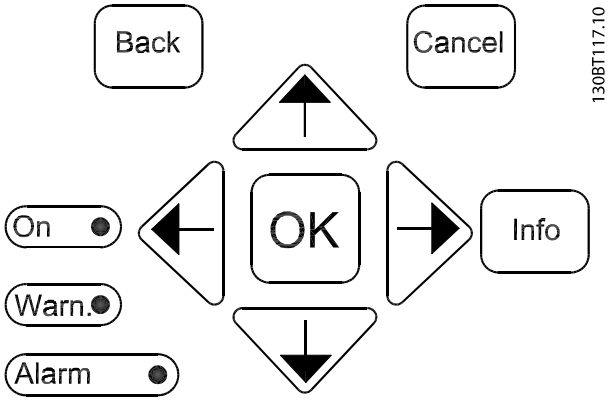

Illustration 2.11 Navigation Keys

Operation keys
Operation keys for local control are found at the bottom of the keypad.

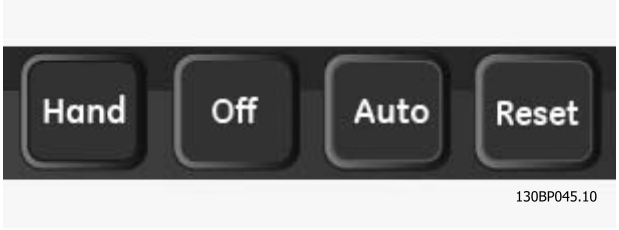

Illustration 2.12 Operation Keys

[Hand]
[Hand] enables control of the frequency converter via the keypad. [Hand] also starts the motor and allows entering the motor speed data with the navigation keys. The key can be selected as *[1] Enable* or *[0] Disable* via *parameter K-40 [Hand] Button on Keypad*.
The following control signals are still active when [Hand] is activated:

- [Hand] - [Off] - .[Auto]
- Reset.
- Coasting stop inverse.
- Reversing.
- Set-up select lsb - Set-up select msb.
- Stop command from serial communication.
- Quick stop.
- DC brake.

NOTICE

External stop signals activated with control signals or a fieldbus override a start command via the keypad.

[Off]
[Off] stops the connected motor. The key can be selected as *[1] Enabled* or *[0] Disabled* via *parameter K-41 [Off] Button on Keypad*. If no external stop function is selected and the [Off] key is inactive, the motor can only be stopped by disconnecting the mains supply.

[Auto]
[Auto] enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter starts. The key can be selected as *[1] Enabled* or *[0] Disabled* via *parameter K-42 [Auto] Button on Keypad*.

NOTICE

An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand] – [Auto].

[Reset]
Press [Reset] to reset the frequency converter after an alarm (trip). It can be selected as *[1] Enable* or *[0] Disable* via *parameter K-43 [Reset] Button on Keypad*.

The parameter shortcut can be carried out by pressing the [Main Menu] key for 3 s. The parameter shortcut allows direct access to any parameter.

2.1.2 Quick Transfer of Parameter Settings between Multiple Frequency Converters

Once the set-up of a frequency converter is complete, store the data in the keypad or on a PC via Drive Control Tool Software DCT 10.

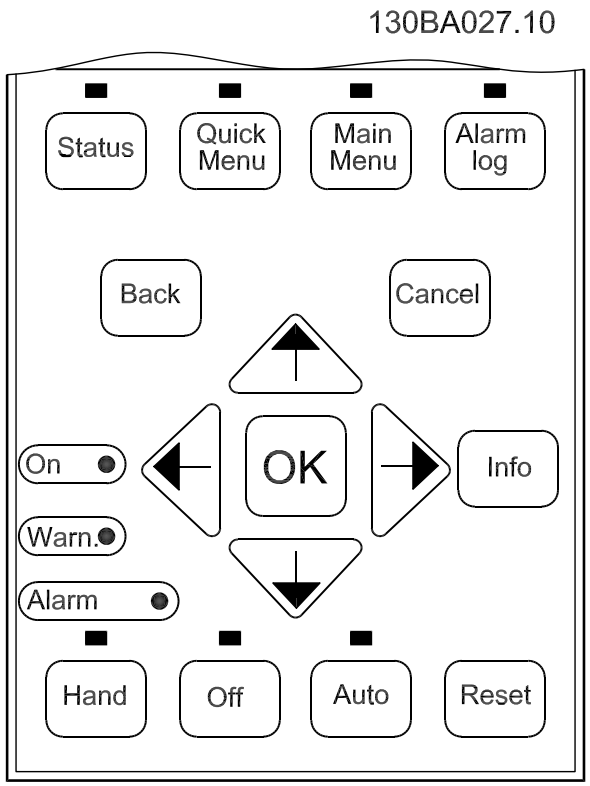

Illustration 2.13 Keypad

Data storage in keypad

NOTICE

Stop the motor before performing this operation.
To store the data in the LCP:

1. Go to *parameter K-50 Keypad Copy*.
2. Press the [OK] key.
3. Select *[1] All to keypad*.
4. Press the [OK] key.

All parameter settings are now stored in the keypad indicated by the progress bar. When 100% is reached, press [OK].

Connect the keypad to another frequency converter and copy the parameter settings to this frequency converter as well.

2

Data transfer from keypad to frequency converter

NOTICE

Stop the motor before performing this operation.

To transfer the data from the LCP to the frequency converter:

1. Go to *parameter K-50 Keypad Copy*.
2. Press the [OK] key.
3. Select *[2] All from keypad*.
4. Press the [OK] key.

The parameter settings stored in the keypad are now transferred to the frequency converter indicated by the progress bar. When 100% is reached, press [OK].

2.1.3 Parameter Set-Up

The frequency converter can be used for practically all assignments, thus offering a significant number of parameters. The series offers a choice between 2 programming modes - the *Quick Menu* mode and the *Main Menu* mode.
The *Main Menu* provides access to all parameters. The *Quick Menu* takes the user through a few parameters making it possible to program the majority of applications. Regardless of the programming mode, parameters can be changed in both *Quick Menu* mode and in *Main Menu* mode.

2.1.4 Quick Menu Mode

Parameter data

The keypad provides access to all parameters listed in the *Quick Menu*. To set parameters pressing [Quick Menu] - enter or change parameter data or settings in accordance with the following procedure:

1. Press Quick Menu key then press Quick Start.
2. Press [▲] or [▼] to find the parameter to change.
3. Press [OK].
4. Press [▲] or [▼] to select the correct parameter setting.
5. Press [OK].
6. To move to a different digit within a parameter setting, use the [◄] and [►].
7. Highlighted area indicates digit selected for change.
8. Press [Cancel] to disregard change, or press [OK] to accept change and enter the new setting.

Example of changing parameter data

Assume F-07 Accel Time 1 is set to 6 s and you want to change it to 10 s. Use the following procedure:

1. Press [Quick Menu].
2. Press [▼] to select Quick Start.
3. Press [OK].
4. With [▼]find par. F-07 Accel Time 1.
5. Press [OK].
6. Use the arrow keys to change the 6.00 to 10.00..
7. Press [OK].

The drive now accelerates to rated speed in 10 s instead of 6 s.

Do the set-up in the order that the parameters are listed!

Select [Parameter Data Check] to obtain information about:

- The last 10 changes. Press [▲] and [▼] to scroll between the last 10 changed parameters.
- The changes made since default setting.

Trendings

Loggings show information about the display line readouts. The information is shown as graphs.
Only display parameters selected in *parameter K-20 Display Line 1.1 Small* and *parameter K-24 Display Line 3 Large* can be viewed. Up to 120 samples can be stored in the memory for later reference.

Efficient parameter set-up for HVAC applications

The parameters can easily be set up for most HVAC applications only by using the *Quick Set-up*.
After pressing [Quick Menu], the different options in the *Quick Menu* are listed.

Example of using the Quick Set-up

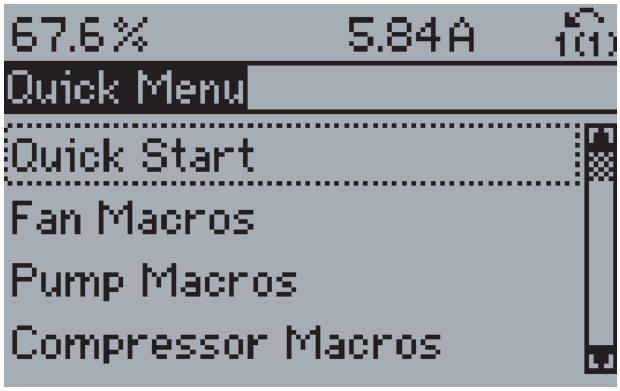

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Illustration 2.14 Quick Menu View

Access the most important set-up parameters of the frequency converter via *Quick Set-up*. After programming, the frequency converter is ready for operation. The *Quick Set-up* parameters are shown in *Table 2.1*.

Parameter	[Units]
Parameter K-01 Language	
Parameter K-02 Motor Speed Unit	
Parameter P-02 Motor Power [HP][1)]	[Hp]
Parameter P-07 Motor Power [kW]	[kW]
Parameter F-05 Motor Rated Voltage	[V]
Parameter F-04 Base Frequency	[Hz]
Parameter P-03 Motor Current	[A]
Parameter P-06 Base Speed	[RPM]
Parameter F-01 Frequency Setting 1	
Parameter F-02 Operation Method	
Parameter F-07 Accel Time 1	[s]
Parameter F-08 Decel Time 1	[s]
Parameter F-10 Electronic Overload	
Parameter F-15 Motor Speed High Limit [Hz][1)]	[Hz]
Parameter F-16 Motor Speed Low Limit [Hz][1)]	[Hz]
Parameter F-17 Motor Speed High Limit [RPM]	[RPM]
Parameter F-18 Motor Speed Low Limit [RPM]	[RPM]
Parameter H-08 Reverse Lock	
Parameter P-04 Auto Tune	

Table 2.1 Quick Set-up Parameters

1) The information shown in the display depends on the selections made in parameter K-02 Motor Speed Unit and parameter K-03 Regional Settings. The default settings of parameter K-02 Motor Speed Unit and parameter K-03 Regional Settings depend on which region of the world the frequency converter is supplied to, but can be reprogrammed as required.

2.1.5 Macros

The Macros provide quick and easy access to all parameters required for most HVAC applications including:

- Most VAV and CAV supply and return fans.
- Cooling tower fans.
- Primary pumps.
- Secondary pumps.
- Condenser water pumps.
- Other pump, fan and compressor applications.

How to access Macros - example

1. Turn on the frequency converter (green LED lights).

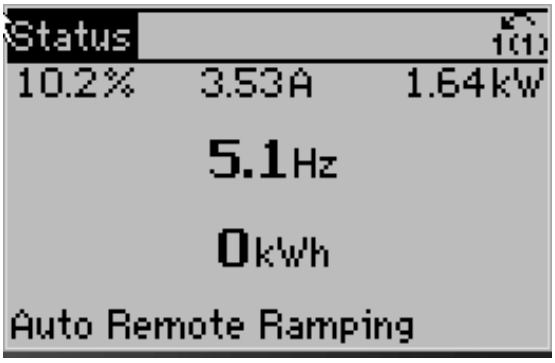


Illustration 2.15 Frequency Converter Turned On

2. Press [Quick Menus].

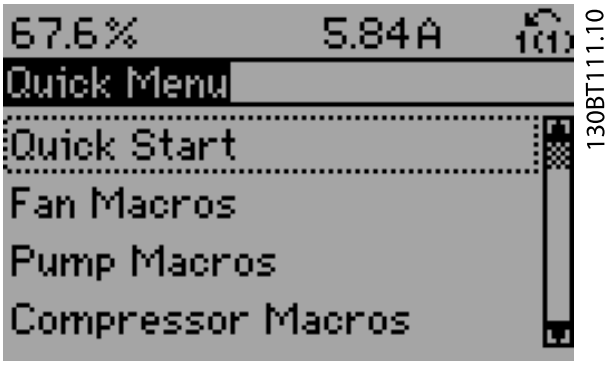


Illustration 2.16 Quick Menu Selected

3. Press [▲] and [▼] to scroll down to Fan Macros. Press [OK].

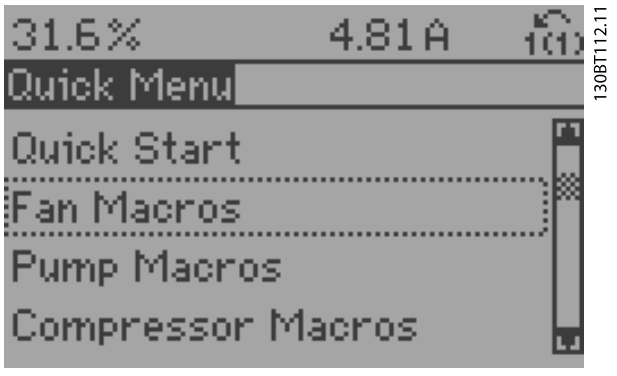


Illustration 2.17 Scrolling to Function Set-up

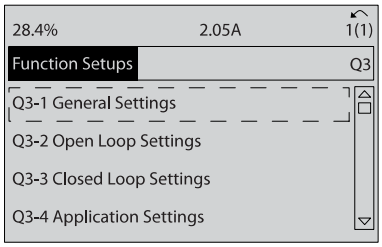


Illustration 2.18 Function Set-ups Options

4. Press [▲] and [▼] to scroll down to find AP-62 Broken Belt Delay.

Illustration 2.19 General Settings Options

5. Press [OK].

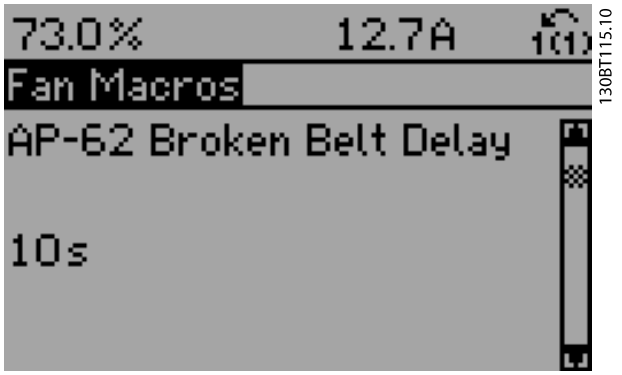


Illustration 2.20 ***Parameter AN-50 Terminal 42 Output*** **Selected**

6. Press [▲] and [▼] to change the delay time.

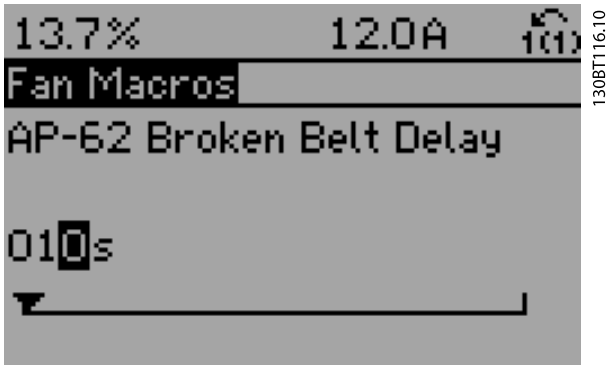


Illustration 2.21 Setting a Parameter

Function Set-ups parameters

The Quick Menu parameters are grouped in the following way:

Fan Macros	Pump Macros	Compressor Macros
Parameter AP-60 Broken Belt Function	*Parameter AP-20 Low Power Auto Set-up*	*Parameter H-43 Torque Characteristics*
Parameter AP-61 Broken Belt Torque	*Parameter AP-21 Low Power Detection*	*Parameter F-24 Holding Time*
Parameter AP-62 Broken Belt Delay	*Parameter AP-22 Low Speed Detection*	*Parameter AP-75 Short Cycle Protection*
Parameter C-40 Semi-Auto Jump Freq Set-up	*Parameter AP-23 No-Flow Function*	*Parameter AP-76 Interval between Starts*
Parameter H-43 Torque Characteristics	*Parameter AP-24 No-Flow Delay*	*Parameter AP-77 Minimum Run Time*
Parameter AP-22 Low Speed Detection	*Parameter AP-40 Minimum Run Time*	*Parameter E-51 Terminal 27 Mode*
Parameter AP-23 No-Flow Function	*Parameter AP-41 Minimum Sleep Time*	*Parameter E-52 Terminal 29 Mode*
Parameter AP-24 No-Flow Delay	*Parameter AP-42 Wake-up Speed [RPM]*	*Parameter E-03 Terminal 27 Digital Input*
Parameter AP-40 Minimum Run Time	*Parameter AP-43 Wake-up Speed [Hz]*	*Parameter E-04 Terminal 29 Digital Input*
Parameter AP-41 Minimum Sleep Time	*Parameter AP-44 Wake-up Ref./FB Difference*	*Parameter E-24 Function Relay*
Parameter AP-42 Wake-up Speed [RPM]	*Parameter AP-45 Setpoint Boost*	*Parameter H-09 Start Mode*
Parameter AP-43 Wake-up Speed [Hz]	*Parameter AP-46 Maximum Boost Time*	*Parameter H-36 Trip Speed Low [RPM]*
Parameter AP-44 Wake-up Ref./FB Difference	*Parameter AP-26 Dry Pump Function*	*Parameter H-37 Trip Speed Low [Hz]*
Parameter AP-45 Setpoint Boost	*Parameter AP-27 Dry Pump Delay*	–
Parameter AP-46 Maximum Boost Time	*Parameter AP-80 Flow Compensation*	–
Parameter B-10 Brake Function	*Parameter AP-81 Square-linear Curve Approximation*	–
Parameter B-16 AC brake Max. Current	*Parameter AP-82 Work Point Calculation*	–
Parameter B-17 Over-voltage Control	*Parameter AP-83 Speed at No-Flow [RPM]*	–
Parameter H-09 Start Mode	*Parameter AP-84 Speed at No-Flow [Hz]*	–
Parameter F-24 Holding Time	*Parameter AP-85 Speed at Design Point [RPM]*	–
Parameter H-80 Function at Stop	*Parameter AP-86 Speed at Design Point [Hz]*	–
Parameter B-00 DC Hold Current	*Parameter AP-87 Pressure at No-Flow Speed*	–
Parameter H-08 Reverse Lock	*Parameter AP-88 Pressure at Rated Speed*	–
–	*Parameter AP-89 Flow at Design Point*	–
–	*Parameter AP-90 Flow at Rated Speed*	–
–	*Parameter H-43 Torque Characteristics*	–
–	*Parameter H-09 Start Mode*	–

Table 2.2 Application Settings

Single Zone Int. Set Point	Single Zone Ext. Set Point	Multi Zone/Adv
Parameter H-40 Configuration Mode	*Parameter H-40 Configuration Mode*	*Parameter H-40 Configuration Mode*
Parameter CL-12 Reference/Feedback Unit	*Parameter CL-12 Reference/Feedback Unit*	*Parameter F-01 Frequency Setting 1*
Parameter CL-13 Minimum Reference/Feedb.	*Parameter CL-13 Minimum Reference/Feedb.*	*Parameter C-30 Frequency Command 2*
Parameter CL-14 Maximum Reference/Feedb.	*Parameter CL-14 Maximum Reference/Feedb.*	*Parameter CL-00 Feedback 1 Source*
Parameter AN-22 Terminal 54 Low Current	*Parameter AN-10 Terminal 53 Low Voltage*	*Parameter CL-01 Feedback 1 Conversion*
Parameter AN-24 Terminal 54 Low Ref./Feedb. Value	*Parameter AN-11 Terminal 53 High Voltage*	*Parameter CL-02 Feedback 1 Source Unit*
Parameter AN-25 Terminal 54 High Ref./Feedb. Value	*Parameter AN-12 Terminal 53 Low Current*	*Parameter CL-03 Feedback 2 Source*
Parameter AN-26 Terminal 54 Filter Time Constant	*Parameter AN-13 Terminal 53 High Current*	*Parameter CL-04 Feedback 2 Conversion*
Parameter AN-27 Terminal 54 Live Zero	*Parameter AN-14 Terminal 53 Low Ref./Feedb. Value*	*Parameter CL-05 Feedback 2 Source Unit*
Parameter AN-00 Live Zero Timeout Time	*Parameter AN-15 Terminal 53 High Ref./Feedb. Value*	*Parameter CL-06 Feedback 3 Source*
Parameter AN-01 Live Zero Timeout Function	*Parameter AN-22 Terminal 54 Low Current*	*Parameter CL-07 Feedback 3 Conversion*
Parameter CL-21 Setpoint 1	*Parameter AN-24 Terminal 54 Low Ref./Feedb. Value*	*Parameter CL-08 Feedback 3 Source Unit*

Single Zone Int. Set Point	Single Zone Ext. Set Point	Multi Zone/Adv
Parameter CL-81 PID Normal/ Inverse Control	*Parameter AN-25 Terminal 54 High Ref./Feedb. Value*	*Parameter CL-12 Reference/Feedback Unit*
Parameter CL-82 PID Start Speed [RPM]	*Parameter AN-26 Terminal 54 Filter Time Constant*	*Parameter CL-13 Minimum Reference/Feedb.*
Parameter CL-83 PID Start Speed [Hz]	*Parameter AN-27 Terminal 54 Live Zero*	*Parameter CL-14 Maximum Reference/Feedb.*
Parameter CL-93 PID Proportional Gain	*Parameter AN-00 Live Zero Timeout Time*	*Parameter AN-10 Terminal 53 Low Voltage*
Parameter CL-94 PID Integral Time	*Parameter AN-01 Live Zero Timeout Function*	*Parameter AN-11 Terminal 53 High Voltage*
–	*Parameter CL-81 PID Normal/ Inverse Control*	*Parameter AN-12 Terminal 53 Low Current*
–	*Parameter CL-82 PID Start Speed [RPM]*	*Parameter AN-13 Terminal 53 High Current*
–	*Parameter CL-83 PID Start Speed [Hz]*	*Parameter AN-14 Terminal 53 Low Ref./Feedb. Value*
–	*Parameter CL-93 PID Proportional Gain*	*Parameter AN-15 Terminal 53 High Ref./Feedb. Value*
–	*Parameter CL-94 PID Integral Time*	*Parameter AN-16 Terminal 53 Filter Time Constant*
–	–	*Parameter AN-17 Terminal 53 Live Zero*
–	–	*Parameter AN-20 Terminal 54 Low Voltage*
–	–	*Parameter AN-21 Terminal 54 High Voltage*
–	–	*Parameter AN-22 Terminal 54 Low Current*
–	–	*Parameter AN-23 Terminal 54 High Current*
–	–	*Parameter AN-24 Terminal 54 Low Ref./Feedb. Value*
–	–	*Parameter AN-25 Terminal 54 High Ref./Feedb. Value*
–	–	*Parameter AN-26 Terminal 54 Filter Time Constant*
–	–	*Parameter AN-27 Terminal 54 Live Zero*
–	–	*Parameter AN-00 Live Zero Timeout Time*
–	–	*Parameter AN-01 Live Zero Timeout Function*
–	–	*Parameter H-76 Warning Feedback Low*
–	–	*Parameter H-77 Warning Feedback High*
–	–	*Parameter CL-20 Feedback Function*
–	–	*Parameter CL-21 Setpoint 1*
–	–	*Parameter CL-22 Setpoint 2*
–	–	*Parameter CL-81 PID Normal/ Inverse Control*
–	–	*Parameter CL-82 PID Start Speed [RPM]*
–	–	*Parameter CL-83 PID Start Speed [Hz]*
–	–	*Parameter CL-93 PID Proportional Gain*
–	–	*Parameter CL-94 PID Integral Time*
–	–	*Parameter CL-70 Closed Loop Type*
–	–	*Parameter CL-71 PID Performance*
–	–	*Parameter CL-72 PID Output Change*
–	–	*Parameter CL-73 Minimum Feedback Level*
–	–	*Parameter CL-74 Maximum Feedback Level*
–	–	*Parameter CL-79 PID Autotuning*

Table 2.3 Closed Loop Settings

2.1.6 Main Menu Mode

Press [Main Menu] to select the *Main Menu* mode. The below readout appears on the display.
The middle and bottom sections on the display show a list of parameter groups which can be selected by toggling the [▲] and [▼] keys.

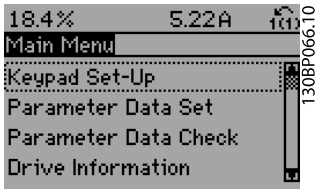


Illustration 2.22 Main Menu Mode

Each parameter has a name and number which remain the same regardless of the programming mode. In the *Main Menu* mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. However, depending on the configuration (*parameter H-40 Configuration Mode*), some parameters can be hidden.

2.1.7 Parameter Selection

In the *Main Menu* mode, the parameters are divided into groups. Press the navigation keys to select parameter group.
The following parameter groups are accessible:

Group number	Parameter group
K	Keypad Set-up
F	Fundamental Parameters
E	Digital In/Outs
C	Frequency Control Functions
P	Motor Data
H	High Perf Parameters
AN	Analog In/Out
SP	Special Functions
O	Options/comms
AO	Analog I/O Option
DN	DeviceNet
PB	PROFIBUS
LN	LonWorks
BN	BACnet
ID	Drive Information
DR	Data Readouts
LG	Logs & I/O Opt. Status
AP	HVAC Appl. Param.
FB	Fire/Bypass Operation
T	Timed Functions
CL	PID Closed Loop
XC	Extended PID Closed Loop
PC	Pump Controller
LC	Logic Controller
B	Braking Functions

Table 2.4 Parameter Selection

After selecting a parameter group, press the navigation keys to select a parameter.
The middle section on the display shows the parameter number and name, and the selected parameter value.

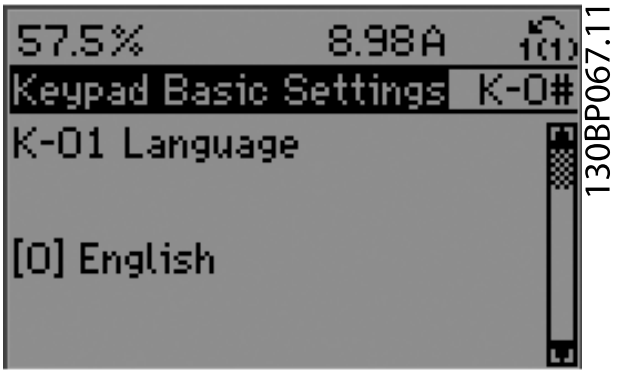


Illustration 2.23 Parameter Selection

2.1.8 Changing Data

Press [OK] to change the selected parameter. The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

2

2.1.9 Changing a Text Value

If the selected parameter is a text value, change the text value with the [▲] [▼] keys.
Place the cursor on the value that should be saved and press [OK].

Illustration 2.24 Changing a Text Value

2.1.10 Changing a Group of Numeric Data Values

If the selected parameter represents a numeric data value, change the data value pressing the [◄] [►] navigation keys, as well as the [▲] [▼] navigation keys. Press [◄] [►] keys to move the cursor horizontally.

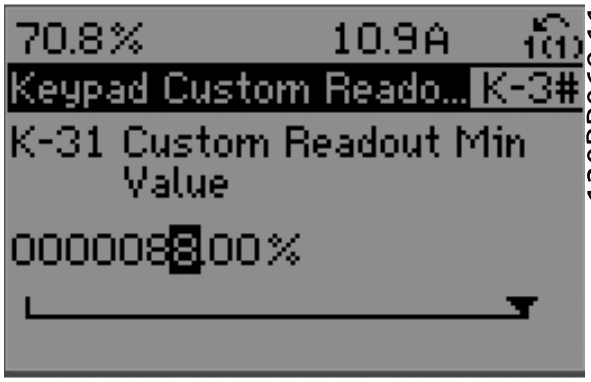


Illustration 2.25 Changing a Group of Numeric Data Values

Press the [▲] [▼] keys to change the data value. [▲] increases the data value, and [▼] decreases the data value. Place the cursor on the value to save and press [OK].

Illustration 2.26 Changing a Group of Numeric Data Values

2.1.11 Value, Step-by-step

Certain parameters can be changed step-by-step. This applies to:

- *Parameter P-07 Motor Power [kW]*.
- *Parameter F-05 Motor Rated Voltage*.
- *Parameter F-04 Base Frequency*.

The parameters are changed both as a group of numeric data values and as numeric data values that are infinitely varying.

2.1.12 Read out and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack. *Parameter ID-30 Alarm Log: Error Code* to *parameter ID-33 Alarm Log: Date and Time* contain a fault log which can be read out. Select a parameter, press [OK], and use the [▲]/[▼] navigation keys to scroll through the value log.

Use *parameter C-05 Multi-step Frequency 1 - 8* as another example:
Select the parameter, press [OK], and use the [▲]/[▼] navigation keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. To change the value, press the [▲]/[▼] keys. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.

2.1.13 Restore to Default Settings

Restore the frequency converter to default settings in 2 ways.

Recommended restore (via *parameter H-03 Restore Factory Settings*)

1. Select *parameter H-03 Restore Factory Settings*.
2. Press [OK].
3. Select *restore*.
4. Press [OK].
5. Cut off the mains supply and wait until the display turns off.
6. Reconnect the mains supply - the frequency converter is now reset.
7. Change *parameter H-03 Restore Factory Settings* back to *[0] Normal Operation*.

NOTICE

Resets parameters selected in Quick Start menu with default factory setting.

Parameter H-03 Restore Factory Settings restores all except:

Parameter SP-50 RFI Filter.

Parameter O-30 Protocol.

Parameter O-31 Address.

Parameter O-32 Drive Port Baud Rate.

Parameter O-35 Minimum Response Delay.

Parameter O-36 Maximum Response Delay.

Parameter O-37 Maximum Inter-Char Delay.

Parameter ID-00 Operating hours to *parameter ID-05 Over Volt's*.

Parameter ID-20 Historic Log: Event to *parameter ID-22 Historic Log: Time*.

Parameter ID-30 Alarm Log: Error Code to *parameter ID-32 Alarm Log: Time*.

Manual restore

1. Disconnect from mains and wait until the display turns off.
2. Press [Status] - [Main Menu] - [OK] at the same time while power up for keypad, Graphical Display
3. Release the keys after 5 seconds
4. The frequency converter is now programmed according to default settings.

This procedure initializes all except:

- *Parameter ID-00 Operating hours*.
- *Parameter ID-03 Power Up's*.
- *Parameter ID-04 Over Temp's*.
- *Parameter ID-05 Over Volt's*.

NOTICE

Manual restore:

- **Resets serial communication.**
- **Resets *parameter SP-50 RFI Filter* and fault log settings.**
-

NOTICE

After restore and power cycling, the display does not show any information until after a couple of minutes.

3 Parameter Description

3.1 K-## Keypad Set-up

3

Parameters related to the fundamental functions of the frequency converter, function of the keypad buttons and configuration of the keypad display.

3.1.1 K-0# Keypad Basic Settings

Parameter group for basic frequency converter settings.

K-01 Language

Option:		Function:
		Defines the language to be used in the display. The frequency converter is delivered with 9 different languages.
[0] *	English	
[1]	Deutsch	
[2]	Francais	
[4]	Spanish	
[5]	Italiano	
[10]	Chinese	
[12]	Bras.port	
[22]	English US	
[24]	Russian	

K-02 Motor Speed Unit

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** ***NOTICE*** **Changing the motor speed unit resets certain parameters to their initial value. Select the motor speed unit before modifying other parameters.**
[0]	RPM	Select to show motor speed variables and parameters using motor speed (RPM).
[1] *	Hz	Select to show motor speed variables and parameters using output frequency (Hz).

K-03 Regional Settings

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** The display output depends on the settings in *parameter K-02 Motor Speed Unit* and *parameter K-03 Regional Settings*. The default settings of *parameter K-02 Motor Speed Unit* and *parameter K-03 Regional Settings* depend on which region of the world the frequency converter is supplied to. Reprogram the settings as required. The settings not used are made invisible.
[0]	Interna-tional	Sets *parameter P-07 Motor Power [kW]* units to [kW] and the default value of *parameter F-04 Base Frequency* [50 Hz].
[1] *	US	Sets *parameter P-02 Motor Power [HP]* units to [hp] and the default value of *parameter F-04 Base Frequency* to 60 Hz.

K-04 Operating State at Power-up

Option:		Function:
		Select the operating mode after reconnection of the frequency converter to mains voltage after power-down when operating in hand-on (local) mode.
[0] *	Resume	Resumes operation of the frequency converter maintaining the same local reference and the same start/stop condition (applied by [Hand]/ [Off] on the keypad or local start via a digital input as before the frequency converter was powered down.
[1]	Forced stop, ref=old	Stops the frequency converter, but at the same time retains the local speed reference before power-down in the memory. After mains voltage is reconnected and after receiving a start command (pressing [Hand] or local start command via a digital input), the frequency converter restarts and operates at the retained speed reference.

K-05 Local Mode Unit

Option:		Function:
		Defines if the local reference unit is shown in terms of the motor shaft speed (in RPM/Hz) or as percent.
[0] *	As Motor Speed Unit	
[1]	%	

3.1.2 K-1# Keypad Set-up Operations

Define and control the individual parameter set-ups.
The frequency converter has 4 parameter set-ups that can be programmed independently of each other. This makes the frequency converter very flexible and able to meet the requirements of many different HVAC system control schemes, often saving the cost of external control equipment. For example, these can be used to program the frequency converter to operate according to 1 control scheme in 1 set-up (for example daytime operation) and another control scheme in another set-up (for example night set back). Alternatively, they can be used by an AHU or packaged unit OEM to identically program all their factory fitted frequency converters for different equipment models within a range to have the same parameters, and then during production/commissioning simply select a specific set-up depending on which model within that range the frequency converter is installed on.
The active set-up (that is the set-up in which the frequency converter is currently operating) can be selected in *parameter K-10 Active Set-up* and is displayed in the keypad. Using *[9] Multi set-up* it is possible to switch between set-ups with the frequency converter running or stopped, via digital input or serial communication commands (for example for night set back). If it is necessary to change setups while running, ensure that *parameter K-12 This Set-up Linked to* is programmed as required. For most HVAC applications it is not necessary to program *parameter K-12 This Set-up Linked to* even if change of set up while running is required, but for very complex applications, using the full flexibility of the multiple set-ups, it may be required. Using *parameter K-11 Edit Set-up* it is possible to edit parameters within any of the set-ups while continuing the frequency converter operation in its active set-up which can be a different set-up to the one being edited. Using *parameter K-51 Set-up Copy* it is possible to copy parameter settings between the set-ups to enable quicker commissioning if similar parameter settings are required in different set-ups.
If a set-up is changed via a fieldbus, it takes up to 5 s before the new values are reflected via the fieldbus.

K-10 Active Set-up		
Option:		**Function:**
		Select the set-up in which the frequency converter is to operate. Use *parameter K-51 Set-up Copy* to copy a set-up to 1 or all other set-ups. To avoid conflicting settings of the same parameter within 2 different set-ups, link the set-ups using *parameter K-12 This Set-up Linked to*. Stop the frequency converter before switching between set-ups where parameters marked *not changeable during operation* have different values.

K-10 Active Set-up		
Option:		**Function:**
		Parameters which are *not changeable during operation* are marked FALSE in *chapter 5 Parameter Lists*.
[0]	Factory setup	Cannot be changed. It contains the GE data set, and can be used as a data source when returning the other set-ups to a known state.
[1] *	Set-up 1	*[1] Set-up 1* to *[4] Set-up 4* are the 4 parameter set-ups within which all parameters can be programmed.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]	Multi Set-up	Is used for remote selection of set-ups using digital inputs and the serial communication port. This set-up uses the settings from *parameter K-12 This Set-up Linked to*.

K-11 Edit Set-up		
Option:		**Function:**
		Select the set-up to be edited (that is programmed) during operation; either the active set-up or 1 of the inactive set-ups. The set-up number being edited is shown in the keypad in brackets.
[0]	Factory setup	Cannot be edited, but it is useful as a data source to return the other set-ups to a known state.
[1]	Set-up 1	*[1] Set-up 1* to *[4] Set-up 4* can be edited freely during operation, independently of the active set-up.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9] *	Active Set-up	The set-up in which the frequency converter is operating can be edited during operation. Editing parameters in the selected set-up would normally be done from the keypad, but it is also possible from any of the serial communication ports.

K-12 This Set-up Linked to		
Option:		**Function:**
		Use this parameter only if a change of set-ups is required while the motor is running. This parameter ensures that parameters which are not changeable during operation have the same setting in all relevant set-ups. To enable conflict-free changes from 1 set-up to another while the frequency converter is running, link set-ups containing parameters which are not changeable during operation.

3

K-12 This Set-up Linked to		
Option:		**Function:**
		The link ensures synchronising of the *not changeable during operation* parameter values when moving from 1 set-up to another during operation. *Not changeable during operation* parameters can be identified by the label FALSE in the parameter lists in *chapter 5 Parameter Lists*. The *parameter K-12 This Set-up Linked to* feature is used when *[9] Multi set-up* in *parameter K-10 Active Set-up* is selected. Use *[9] Multi set-up* to move from 1 set-up to another during operation while the motor runs. For example: Use *[9] Multi set-up* to shift from set-up 1 to set-up 2 while the motor runs. Program parameters in set-up 1 first, then ensure that set-up 1 and set-up 2 are synchronised (or linked). Synchronisation can be performed in of the 2 ways: • Change the edit set-up to *[2] Set-up 2* in *parameter K-11 Edit Set-up* and set *parameter K-12 This Set-up Linked to* to *[1] Set-up 1*. This starts the linking (synchronising) process.

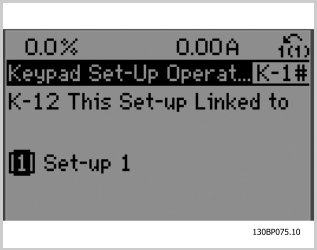


Illustration 3.1 Set-up Handling

		• While still in set-up 1, using *parameter K-50 Keypad Copy*, copy set-up 1 to set-up 2. Then set *parameter K-12 This Set-up Linked to* to *[2] Set-up 2*. This starts the linking process.

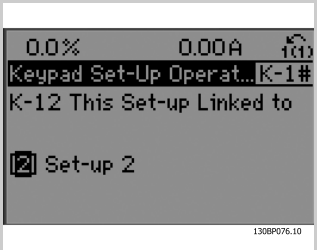


Illustration 3.2 Set-up Handling

		After the link is complete, *parameter K-13 Readout: Linked Set-ups* reads set-ups 1 and 2 to indicate that all *not changeable during operation* parameters are now the same in set-up 1 and set-up 2. If there are changes to a *not changeable during operation* parameter, for example *parameter P-30 Stator Resistance (Rs)*, in set-up 2, they are also changed automatically in set-up 1. A switch between set-up 1 and set-up 2 during operation is now possible.
[0] *	Not linked	
[1]	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	

K-13 Readout: Linked Set-ups		
Array [5]		
Range:		**Function:**
0*	[0 - 255]	View a list of all the set-ups linked by *parameter K-12 This Set-up Linked to*. The parameter has 1 index for each parameter set-up. The value for each index shows which set-ups are linked to that parameter set-up.

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

Table 3.1 Set-up Link Example

K-14 Readout: Edit Set-ups / Channel		
Range:		**Function:**
0*	[-2147483648 - 2147483647]	View the setting of *parameter K-11 Edit Set-up* for each of the 4 different communication channels. When the number is shown in hex, as it is in the keypad, each number shows 1 channel. Numbers 1–4 show a set-up number; F stands for the factory setting, and A stands for an active set-up. The channels are, from right to left: keypad, Drive-bus, USB, HPFB1.5. Example: The value AAAAAA21h means that the Drive-bus channel uses set-up 2 in *parameter K-11 Edit Set-up*, the keypad uses set-up 1, and all other channels use the active set-up.

K-15 Readout: Actual Set-up		
Range:		**Function:**
0*	[0 - 255]	

3.1.3 K-2# Keypad Display

Define the variables displayed in the keypad.

[0] *	None	No display value selected
[537]	Display Text 1	Enables an individual text string to be written, for display in the keypad or to be read via serial communication.
[538]	Display Text 2	Enables an individual text string to be written, for display in the keypad or to be read via serial communication.
[539]	Display Text 3	Enables an individual text string to be written, for display in the keypad or to be read via serial communication.
[589]	Date and Time Readout	Displays the current date and time.
[953]	Profibus Warning Word	Displays Profibus communication warnings.
[2205]	Readout Transmit Error Counter	View the number of CAN control transmission errors since the last power-up.
[2206]	Readout Receive Error Counter	View the number of CAN control receipt errors since the last power-up.
[2207]	Readout Bus Off Counter	View the number of Bus Off events since the last power-up.
[2213]	Warning Parameter	View a DeviceNet-specific warning word. One separate bit is assigned to every warning.
[1501]	Running Hours	View the number of running hours of the motor.
[1502]	kWh Counter	View the mains power consumption in kWh.
[1200]	Control Word	View the Control Word sent from the frequency converter via the serial communication port in hex code.
[1201]	Reference [Unit]	Total reference (sum of digital/analog/ preset/bus/freeze ref./catch up and slow-down) in selected unit.
[1202]	Reference [%]	Total reference (sum of digital/analog/ preset/bus/freeze ref./catch up and slow-down) in percent.
[1203]	Status Word	Present status word
[1205]	Main Actual Value [%]	View the two-byte word sent with the Status word to the bus Master reporting the Main Actual Value.
[1209]	Custom Readout	View the user-defined readouts as defined in *parameter K-30 Unit for Custom Readout*, *parameter K-31 Min Value of Custom Readout* and *parameter K-32 Max Value of Custom Readout*.
[1210]	Power [kW]	Actual power consumed by the motor in kW.
[1211]	Power [hp]	Actual power consumed by the motor in HP.
[1212]	Motor Rated Voltage	Voltage supplied to the motor.
[1213]	Frequency	Motor frequency, i.e. the output frequency from the frequency converter in Hz
[1214]	Motor Current	Phase current of the motor measured as effective value.
[1215]	Frequency [%]	Motor frequency, i.e. the output frequency from the frequency converter in percent.
[1216]	Torque [Nm]	Present motor load as a percentage of the rated motor torque.
[1217]	Speed [RPM]	Motor speed reference. Actual speed will depend on slip compensation being used (compensation set in *parameter P-09 Slip Compensation*). If not used, actual speed will be the value read in the display minus motor slip.
[1218]	Motor Thermal	Thermal load on the motor, calculated by the Electronic Thermal Overload function. See also parameter group H-9# Motor Temperature.
[1222]	Torque [%]	Shows the actual torque produced, in percentage.
[1230]	DC Link Voltage	Intermediate circuit voltage in the frequency converter.
[1232]	Brake Energy /s	Present brake power transferred to an external brake resistor. Stated as an instantaneous value.
[1233]	Brake Energy /2 min	Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 seconds.
[1234]	Heatsink Temp.	Present heat sink temperature of the frequency converter. The cut-out limit is 95 ± 5° C; cutting back in occurs at 70 ± 5° C.
[1235]	Drive Thermal	Percentage load of the inverters.
[1236]	Drive Nominal Current	Nominal current of the frequency converter.
[1237]	Drive Max. Current	Maximum current of the frequency converter.
[1238]	Logic Controller State	State of the event executed by the control.
[1239]	Control Card Temp.	Temperature of the control card.
[1250]	External Reference	Sum of the external reference as a percentage, i.e. the sum of analog/ pulse/bus.

[1252]	Feedback [Unit]	Reference value from programmed digital input(s).
[1253]	Digi Pot Reference	View the contribution of the digital potentiometer to the actual reference Feedback.
[1254]	Feedback 1 [Unit]	View the value of Feedback 1. See also par. CL-0#.
[1255]	Feedback 2 [Unit]	View the value of Feedback 2. See also par. CL-0#.
[1256]	Feedback 3 [Unit]	View the value of Feedback 3. See also par. CL-0#.
[1258]	PID Output [%]	Returns the Drive Closed Loop PID controller output value in percent.
[1260]	Digital Input	Displays the status of the digital inputs. Signal low = 0; Signal high = 1. Regarding order, see *parameter DR-60 Digital Input*. Bit 0 is at the extreme right.
[1261]	Terminal 53 Switch Setting	Setting of input terminal 53. Current = 0; Voltage = 1.
[1262]	Analog Input 53	Actual value at input 53 either as a reference or protection value.
[1263]	Terminal 54 Switch Setting	Setting of input terminal 54. Current = 0; Voltage = 1.
[1264]	Analog Input 54	Actual value at input 54 either as reference or protection value.
[1265]	Analog Output 42 [mA]	Actual value at output 42 in mA. Use *parameter AN-50 Terminal 42 Output* to select the variable to be represented by output 42.
[1266]	Digital Output [bin]	Binary value of all digital outputs.
[1267]	Freq. Input #29 [Hz]	Actual value of the frequency applied at terminal 29 as a pulse input.
[1268]	Freq. Input #33 [Hz]	Actual value of the frequency applied at terminal 33 as a pulse input.
[1269]	Pulse Output #27 [Hz]	Actual value of pulses applied to terminal 27 in digital output mode.
[1270]	Pulse Output #29 [Hz]	Actual value of pulses applied to terminal 29 in digital output mode.
[1271]	Relay Output [bin]	View the setting of all relays.
[1272]	Counter A	View the present value of Counter A.
[1273]	Counter B	View the present value of Counter B.
[1275]	Analog In X30/11	Actual value at input X30/11 either as reference or protection value.
[1276]	Analog In X30/12	Actual value at input X30/12 either as reference or protection value.
[1277]	Analog Out X30/8 [mA]	Actual value at output X30/8 in mA. Use par. AN-60 to select the value to be shown.
[1280]	Fieldbus CTW 1	Control word (CTW) received from the Bus Master.
[1282]	Fieldbus REF 1	Main reference value sent with control word via the serial communications network e.g. from the BMS, PLC or other master controller.
[1284]	Comm. Option STW	Extended fieldbus communication option status word.
[1285]	Drive Port CTW 1	Control word (CTW) received from the Bus Master.
[1286]	Drive Port REF 1	Status word (STW) sent to the Bus Master.
[1290]	Alarm Word	One or more alarms in a Hex code (used for serial communications)
[1291]	Alarm Word 2	One or more alarms in a Hex code (used for serial communications)
[1292]	Warning Word	One or more warnings in a Hex code (used for serial communications)
[1293]	Warning Word 2	One or more warnings in a Hex code (used for serial communications)
[1294]	Ext. Status Word	One or more status conditions in a Hex code (used for serial communications)
[1295]	Ext. Status Word 2	One or more status conditions in a Hex code (used for serial communications)
[1296]	Maintenance Word	The bits reflect the status for the programmed Preventive Maintenance Events in parameter group T-1#
[1830]	Analog Input X42/1	Shows the value of the signal applied to terminal X42/1 on the Analog I/O card.
[1831]	Analog Input X42/3	Shows the value of the signal applied to terminal X42/3 on the Analog I/O card.
[1832]	Analog Input X42/5	Shows the value of the signal applied to terminal X42/5 on the Analog I/O card.
[1833]	Analog Out X42/7 [V]	Shows the value of the signal applied to terminal X42/7 on the Analog I/O card.
[1834]	Analog Out X42/9 [V]	Shows the value of the signal applied to terminal X42/9 on the Analog I/O card.
[1835]	Analog Out X42/11 [V]	Shows the value of the signal applied to terminal X42/11 on the Analog I/O card.
[2117]	Ext. 1 Reference [Unit]	The value of the reference for extended Closed Loop Controller 1
[2118]	Ext. 1 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 1
[2119]	Ext. 1 Output [%]	The value of the output from extended Closed Loop Controller 1
[2137]	Ext. 2 Reference [Unit]	The value of the reference for extended Closed Loop Controller 2
[2138]	Ext. 2 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 2
[2139]	Ext. 2 Output [%]	The value of the output from extended Closed Loop Controller 2
[2157]	Ext. 3 Reference [Unit]	The value of the reference for extended Closed Loop Controller 3
[2158]	Ext. 3 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 3
[2159]	Ext. 3 Output [%]	The value of the output from extended Closed Loop Controller 3
[1230]	No-Flow Power	The calculated No Flow Power for the actual operating speed

[2316]	Maintenance Text	
[2580]	Pump Status	
[2581]	Pump Status	Status for the operation of each individual pump controlled by the Pump Controller.

K-20 Display Line 1.1 Small

Option: Function:

		Select a variable for display in line 1, left position.
		The options are the same as those listed under K-2#.

K-21 Display Line 1.2 Small

Option: Function:

		Select a variable for display in line 1, middle position.
		The options are the same as those listed under K-2#.

K-22 Display Line 1.3 Small

Option: Function:

		Select a variable for display in line 1, right position.
		The options are the same as those listed under K-2#.

K-23 Display Line 2 Large

Option: Function:

		Select a variable for display in line 2.
		The options are the same as those listed under K-2#.

K-24 Display Line 3 Large

Option: Function:

		Select a variable for display in line 3.
		The options are the same as those listed under K-2#.

K-25 Quick Start

Array [20]

Range: Function:

0*	[0 - 9999]	Define up to 50 parameters to appear in the Q1 Quick Start, accessible via the [Quick Menu] key on the keypad. The parameters are displayed in the Q1 Quick Start in the order they are programmed into this array parameter. Delete parameters by setting the value to 0000. For example, this can be used to provide quick, simple access to just 1 or up to 50 parameters which require changing on a regular basis (for example, for plant maintenance reasons) or by an OEM to enable simple commissioning of their equipment.

3.1.4 K-3# Keypad Custom Readout

It is possible to customize the display elements for various purposes:

- Custom readout. Value proportional to speed (linear, squared, or cubed depending on unit selected in *parameter K-30 Unit for Custom Readout*).
- Display text. Text string stored in a parameter.

Custom readout

The calculated value to be shown is based on the settings in:

- *Parameter K-30 Unit for Custom Readout*.
- *Parameter K-31 Min Value of Custom Readout* (linear only).
- *Parameter K-32 Max Value of Custom Readout*.
- *Parameter F-17 Motor Speed High Limit [RPM]*.
- *Parameter F-15 Motor Speed High Limit [Hz]*.
- Actual speed.

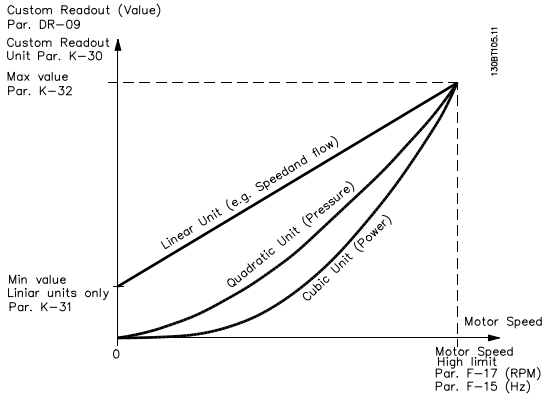


Illustration 3.3 Custom Readout

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

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

Table 3.2 Speed Relations for Different Unit Types

K-30 Unit for Custom Readout

Option: Function:

		Program a value to be shown in the LCP display-keypad. The value has a linear, squared, or cubed relation to speed. This relation depends on the unit selected (see *Table 3.2*). The actual calculated value can be read in *parameter DR-09 Custom Readout*, and/or shown in the display by selecting

K-30 Unit for Custom Readout

Option:		Function:
		[DR-09 Custom Readout] in *parameter K-20 Display Line 1.1 Small* to *parameter K-24 Display Line 3 Large*.
[0]		
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

K-31 Min Value of Custom Readout

Range:		Function:
0.00 CustomReadoutUnit*	[-999999.99 - 100.00 CustomReadoutUnit]	This parameter allows selection of the minimum value of the custom-defined readout (occurs at zero speed). It is only possible to select a value different from 0 when selecting a linear unit in *parameter K-30 Unit for Custom Readout*. For quadratic and cubic units the minimum value is 0.
0.00 CustomReadoutUnit*	[-999999.99 - 100.00 CustomReadoutUnit]	

K-32 Max Value of Custom Readout

Range:		Function:
100 CustomReadoutUnit*	[par. K-31 - 999999.99 CustomReadoutUnit]	This parameter sets the maximum value to be shown when the speed of the motor has reached the set value for *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]* (depends on setting in *parameter K-02 Motor Speed Unit*).

K-37 Display Text 1

Range:		Function:
0*	[0 - 25]	In this parameter, it is possible to write an individual text string to show in the keypad or to be read via serial communication. To show the text permanently, select *[37] Display Text 1* in 1 of the following parameters: • *Parameter K-20 Display Line 1.1 Small.* • *Parameter K-21 Display Line 1.2 Small.* • *Parameter K-22 Display Line 1.3 Small.* • *Parameter K-23 Display Line 2 Large.* • *Parameter K-24 Display Line 3 Large.* • *Parameter K-37 Display Text 1.* Changing *parameter EN-08 Host Name* changes *parameter K-37 Display Text 1* - but not vice versa.

K-38 Display Text 2		
Range:		**Function:**
0*	[0 - 25]	In this parameter, it is possible to write an individual text string to show in the keypad, or to be read via serial communication. To show the text permanently, select *[38] Display Text 2* in: • *Parameter K-20 Display Line 1.1 Small*. • *Parameter K-21 Display Line 1.2 Small*. • *Parameter K-22 Display Line 1.3 Small*. • *Parameter K-23 Display Line 2 Large*. • *Parameter K-24 Display Line 3 Large*. Press [▲] or [▼] to change a character. Press [◄] and [►] to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between 2 characters and pressing [▲] or [▼].

K-39 Display Text 3		
Range:		**Function:**
0*	[0 - 25]	In this parameter, it is possible to write an individual text string to show in the keypad or to be read via serial communication. To show the text permanently, select display text 3 in *parameter K-20 Display Line 1.1 Small*, *parameter K-21 Display Line 1.2 Small*, *parameter K-22 Display Line 1.3 Small*, *parameter K-23 Display Line 2 Large* or *parameter K-24 Display Line 3 Large*. Press [▲] or [▼] to change a character. Press [◄] and [►] to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between 2 characters and pressing [▲] or [▼].

3.1.5 K-4# Keypad

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

K-40 [Hand] Button on Keypad		
Option:		**Function:**
[0]	Disabled	Select to disable the key.
[1] *	Enabled	[Hand] key enabled.
[2]	Password Protection	Avoid unauthorized start in hand-on mode. If *parameter K-40 [Hand] Button on Keypad* is included in *Quick Start Menu*, define the password in *parameter K-65 Quick Menu Password*. Otherwise, define the password in *parameter K-60 Main Menu Password*.

K-41 [Off] Button on Keypad		
Option:		**Function:**
[0]	Disabled	Select to disable the key.
[1] *	Enabled	[Off] key is enabled.
[2]	Password Protection	Avoid unauthorized stop. If *parameter K-41 [Off] Button on Keypad* is included in *Quick Start Menu*, define the password in *parameter K-65 Quick Menu Password*. Otherwise, define the password in *parameter K-60 Main Menu Password*.

K-42 [Auto] Button on Keypad		
Option:		**Function:**
[0]	Disabled	Select to disable the key.
[1] *	Enabled	[Auto] key is enabled.
[2]	Password Protection	Avoid unauthorized start in auto-on mode. If *parameter K-42 [Auto] Button on Keypad* is included in *Quick Start Menu*, define the password in *parameter K-65 Quick Menu Password*. Otherwise, define the password in *parameter K-60 Main Menu Password*.

K-43 [Reset] Button on Keypad		
Option:		**Function:**
[0]	Disabled	Select to disable the key.
[1] *	Enabled	[Reset] key is enabled.
[2]	Password Protection	Avoid unauthorized resetting. If *parameter K-43 [Reset] Button on Keypad* is included in *parameter K-25 Quick Start*, define the password in *parameter K-65 Quick Menu Password*. Otherwise, define the password in *parameter K-60 Main Menu Password*.
[3]	Enabled without OFF	
[4]	Password without OFF	
[5]	Enabled with OFF	Pressing the key resets the frequency converter, but does not start it.
[6]	Password with OFF	Prevents unauthorized reset. After authorized reset, the frequency converter does not start. See option *[2] Password* for information on how to set the password.

3.1.6 K-5# Copy/Save

Copy parameters from and to the keypad. Use these parameters for saving and copying set-ups from 1 frequency converter to another.

3

K-50 Keypad Copy		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	No copy	
[1]	All to Keypad	Copies all parameters in all set-ups from the frequency converter memory to the keypad memory. For service purposes, copy all parameters to the keypad after commissioning.
[2]	All from Keypad	Copies all parameters in all set-ups from the keypad memory to the frequency converter memory.
[3]	Size indep. From Keypad	Copies only the parameters that are independent of the motor size. Use the latest selection to program several frequency converters with the same function without disturbing motor data which are already set.
[10]	Delete LCP copy data	

K-51 Set-up Copy		
Option:		**Function:**
[0] *	No copy	No function.
[1]	Copy to set-up 1	Copies all parameters in the present programming set-up (defined in *parameter K-11 Edit Set-up*) to set-up 1.
[2]	Copy to set-up 2	Copies all parameters in the present programming set-up (defined in *parameter K-11 Edit Set-up*) to set-up 2.
[3]	Copy to set-up 3	Copies all parameters in the present programming set-up (defined in *parameter K-11 Edit Set-up*) to set-up 3.
[4]	Copy to set-up 4	Copies all parameters in the present programming set-up (defined in *parameter K-11 Edit Set-up*) to set-up 4.
[9]	Copy to all	Copies the parameters in the present set-up to each of the set-ups 1 to 4.

3.1.7 K-6# Password Protection

K-60 Main Menu Password		
Range:		**Function:**
100*	[-9999 - 9999]	Define the password for access to the Main Menu via the [Main Menu] key. If *parameter K-61 Access to Main Menu w/o Password* is set to *[0] Full access*, this parameter is ignored.

K-61 Access to Main Menu w/o Password		
Option:		**Function:**
[0] *	Full access	Disables password defined in *parameter K-60 Main Menu Password*.
[1]	Keypad: Read only	Prevents unauthorized editing of *Main Menu* parameters.
[2]	Keypad: No access	Prevents unauthorized viewing and editing of *Main Menu* parameters.
[3]	Bus: Read only	
[4]	Bus: No access	
[5]	All: Read only	
[6]	All: No access	

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

K-65 Quick Menu Password		
Range:		**Function:**
200*	[-9999 - 9999]	Define the password for access to Quick Start Menu via the [Quick Menu] key. If *parameter K-66 Access to Quick Menu w/o Password* is set to *[0] Full access*, this parameter is ignored.

K-66 Access to Quick Menu w/o Password		
Option:		**Function:**
[0] *	Full access	Disables password defined in *parameter K-65 Quick Menu Password*.
[1]	Keypad: Read only	Prevents unauthorized editing of Quick Start Menu-parameters.
[2]	Keypad: No access	Prevents unauthorized viewing and editing of Quick Start Menu-parameters.
[3]	Bus: Read only	
[4]	Bus: No access	
[5]	All: Read only	
[6]	All: No access	

If *parameter K-61 Access to Main Menu w/o Password* is set to *[0] Full access*, this parameter is ignored.

K-67 Bus Password Access		
Range:		**Function:**
0*	[0 - 9999]	Use this parameter to unlock the frequency converter via network or DCT-10.

3.1.8 K-7# Clock Settings

Set the time and date of the internal clock. The internal clock can be used for timed actions, energy log, trend analysis, date/time stamps on alarms, logged data, preventive maintenance, and so on.

It is possible to program the clock for daylight saving time/summertime, weekly working days/non-working days including 20 exceptions (holidays, and so on). Although the clock settings can be set via the keypad, they can also be set along with timed actions and preventative maintenance functions using the DCT-10 tool.

NOTICE

The frequency converter has no back-up of the clock function and the set date/time resets to default (2000-01-01 00:00) after a power-down unless the OPCAIO Analog Option Module or OPC24VPS 24 V DC External Supply Option Module is installed. If no module with back-up is installed, only use the clock function if the frequency converter is integrated into the BMS using serial communications, with the BMS maintaining synchronization of control equipment clock times. In *parameter K-79 Clock Fault*, it is possible to program for a warning if the clock has not been set properly, for example after a power down.

NOTICE

If mounting OPCAIO Analog I/O w RTC, a battery back-up of the date and time is included.

K-70 Date and Time		
Range:	**Function:**	
0*	[0 - 0]	Sets the date and time of the internal clock. The format to be used is set in *parameter K-71 Date Format* and *parameter K-72 Time Format*.

K-71 Date Format		
Option:		**Function:**
		Sets the date format to be used in the keypad.
[0] *	YYYY-MM-DD	
[1]	DD-MM-YYYY	
[2]	MM/DD/YYYY	

K-72 Time Format		
Option:		**Function:**
		Sets the time format to be used in the keypad.
[0] *	24 h	
[1]	12 h	

K-74 DST/Summertime		
Option:		**Function:**
		Select how to handle daylight saving time/summertime. For manual setting of DST/summertime, enter the start date and end date in *parameter K-76 DST/Summertime Start* and *parameter K-77 DST/Summertime End*.
[0] *	Off	
[2]	Manual	

K-76 DST/Summertime Start		
Range:		**Function:**
0*	[0 - 0]	Sets the date and time when DST/summertime starts. The date is programmed in the format selected in *parameter K-71 Date Format*.

K-77 DST/Summertime End		
Range:		**Function:**
0*	[0 - 0]	Sets the date and time when DST/summertime ends. The date is programmed in the format selected in *parameter K-71 Date Format*.

K-79 Clock Fault		
Option:		**Function:**
		Enables or disables the clock warning when the clock has not been set, or has been reset due to a power-down and no back-up is installed. If Analog I/O Option is installed, *[1] Enabled* is default.
[0] *	Disabled	
[1]	Enabled	

3.1.9 K-8# Days and Date/Time Readout

K-81 Working Days		
Array [7] Array with 7 elements [0]–[6] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼].		
Option:		**Function:**
		Set for each weekday if it is a working day or a non-working day. First element of the array is Monday. The working days are used for timed actions.
[0] *	No	
[1]	Yes	

K-82 Additional Working Days		
Array [5] Array with 5 elements [0]–[4] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼].		
Range:		**Function:**
0*	[0 - 0]	Defines dates for additional working days that would normally be non-working days according to *parameter K-81 Working Days*.

3

K-83 Additional Non-Working Days		
Array [15] Array with 15 elements [0]–[14] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼].		
Range:		**Function:**
0*	[0 - 0]	Defines dates for additional working days that would normally be non-working days according to *parameter K-81 Working Days*.

K-89 Date and Time Readout		
Range:		**Function:**
0*	[0 - 25]	Shows the current date and time. The date and time is updated continuously. The clock does not begin counting until a setting different from default has been made in *parameter K-70 Date and Time*.

3.2 F-## Fundamental Parameters

3.2.1 F-0# Fundamental Parameters

F-01 Frequency Setting 1

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the 1st reference signal: • *Parameter F-01 Frequency Setting 1.* • *Parameter C-30 Frequency Command 2.* • *Parameter C-34 Frequency Command 3.* Define up to 3 different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1] *	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potentiometer	
[21]	Analog input X30/11	(OPCGPIO)
[22]	Analog input X30/12	(OPCGPIO)
[23]	Analog Input X42/1	(OPCAIO)
[24]	Analog Input X42/3	(OPCAIO)
[25]	Analog Input X42/5	(OPCAIO)
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

F-02 Operation Method

Option:		Function:
		Select which reference site to activate.
[0] *	Linked to Hand / Auto	Use local reference when in hand-on mode, or remote reference when in auto-on mode.

F-02 Operation Method

Option:		Function:
[1]	Remote	Use remote reference in both hand-on mode and auto-on mode.
[2]	Local	Use local reference in both hand-on mode and auto-on mode. ***NOTICE*** **When set to *[2] Local*, the frequency converter starts with this setting again after a power-down.**

F-03 Max Output Frequency 1

Range:		Function:
100.0 Hz*	[1 - 590 Hz]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the maximum output frequency value. *Parameter F-03 Max Output Frequency 1* 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 *parameter H-40 Configuration Mode*. When *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*, the maximum value is limited to 300 Hz.

F-04 Base Frequency

Range:		Function:
50 Hz*	[20 - 1000 Hz]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Select the motor frequency value from the motor nameplate data.

F-05 Motor Rated Voltage

Range:		Function:
400 V*	[10 - 1000 V]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the frequency converter.

3

F-07 Accel Time 1		
Range:		**Function:**
10.00 s*	[1.00 - 3600 s]	Enter the accel time, that is the acceleration time from 0 RPM–*parameter P-06 Base Speed*. Select a accel time such that the output current does not exceed the current limit in *parameter F-43 Current Limit* during ramping. See decel time in *parameter F-08 Decel Time 1*. $par.\ F-07 = \frac{t_{acc} \times n_{nom}\ [par.P-06]}{ref\ [RPM]}[s]$

F-08 Decel Time 1		
Range:		**Function:**
20.00 s*	[1.00 - 3600 s]	Enter the decel time, that is the deceleration time from *parameter P-06 Base Speed*–0 RPM. Select a decel time preventing overvoltage from arising in the inverter due to regenerative operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in *parameter F-43 Current Limit*. See accel time in *parameter F-07 Accel Time 1*. $par.\ F-08 = \frac{t_{dec} \times n_{nom}\ [par.P-06]}{ref\ [RPM]}[s]$

F-09 Torque Boost		
This parameter is not visible on the LCP.		
Range:		**Function:**
100 %*	[0 - 300 %]	***NOTICE*** ***Parameter F-09 Torque Boost* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Enter the % value to compensate voltage in relation to load when the motor is running at low speed, and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active.

Motor size [kW]	Change–over [Hz]
0.25–7.5	<10
11–45	<5
55–550	<3–4

Table 3.3 Low Speed Load Compensation

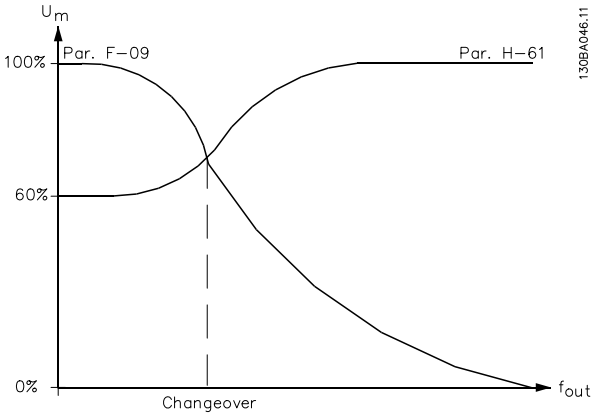


Illustration 3.4 Low Speed Load Compensation

3.2.2 F-1# Fundamental Parameters 1

NOTICE

When using multiple motors, the electronic thermal relay on the frequency converter cannot be used to provide individual motor protection. Supply a separate motor overload for each motor.

F-10 Electronic Overload		
Option:		**Function:**
		The frequency converter determines the motor temperature for motor overload protection in 2 different ways: • Via a thermistor sensor connected to 1 of the analog or digital inputs (*parameter F-12 Motor Thermistor Input*). See *chapter 3.2.3.1 PTC Thermistor Connection*. • Via calculation 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 $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor. See *chapter 3.2.3.2 Electronic Thermal Overload*. • Via a mechanical thermal switch (Klixon type). See *chapter 3.2.3.3 Klixon*. The ETR provides class 20 motor overload protection in accordance with NEC.

F-10 Electronic Overload		
Option:		**Function:**
[0]	No protection	If the motor is continuously overloaded, and no warning or trip of frequency converter is wanted.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts in the event of motor overtemperature.
[2]	Thermistor trip	Stops (trips) the frequency converter when the connected thermistor in the motor reacts in the event of motor overtemperature.
[3]	Elec. OL Warning 1	
[4] *	Elec. OL Trip 1	
[5]	Elec. OL Warning 2	
[6]	Elec. OL Trip 2	
[7]	Elec. OL Warning 3	
[8]	Elec. OL Trip 3	
[9]	Elec. OL Warning 4	
[10]	Elec. OL Trip 4	
[20]	ATEX ETR	
[21]	Advanced ETR	

Electronic Overload functions 1-4 calculate the load when the set-up where they were selected is active. For example Elec. OL Warning 3 or Trip 3 starts calculating when set-up 3 is selected. For the North American market: The Electronic Overload functions provide class 20 motor overload protection in accordance with NEC.

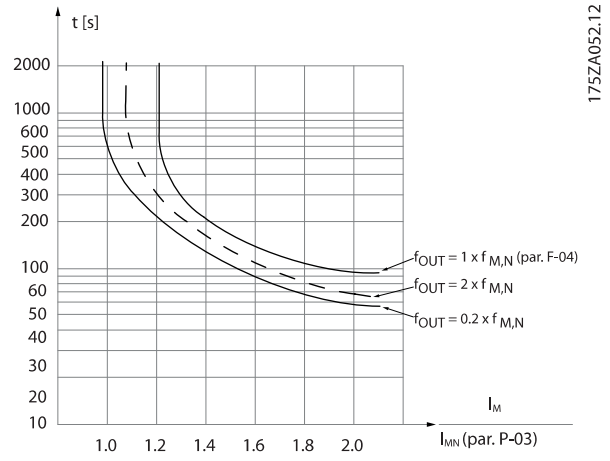


Illustration 3.5 Thermal Motor Protection

NOTICE

If the temperature of the motor is monitored through a thermistor or a KTY Sensor, the PELV is not complied with in case of short circuits between motor windings and the sensor. To comply with PELV, isolate the sensor appropriately.

NOTICE

The Electronic Overload timer function does not work when *parameter P-20 Motor Construction=[1] PM, non-salient SPM*.

NOTICE

For correct operation of the Electronic Overload function, the setting in *parameter H-43 Torque Characteristics* must fit the application (see description of *parameter H-43 Torque Characteristics*).

3.2.3.1 PTC Thermistor Connection

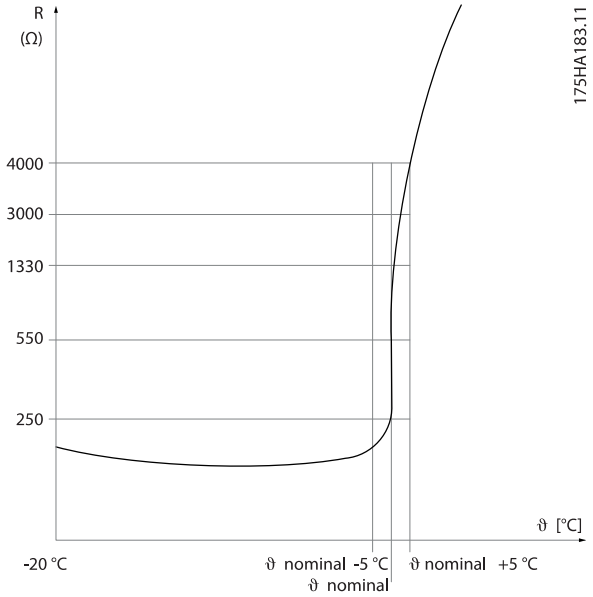


Illustration 3.6 PTC Profile

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

- Set *parameter F-10 Electronic Overload* to *[2] Thermistor Trip*.
- Set *parameter F-12 Motor Thermistor Input* to *[6] Digital Input*.

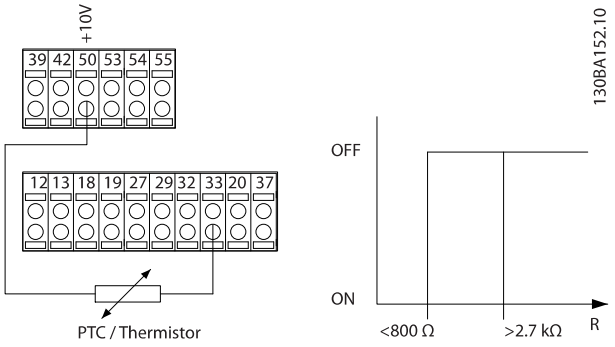


Illustration 3.7 PTC Thermistor Connection - Digital Input

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

- Set *parameter F-10 Electronic Overload* to *[2] Thermistor Trip*.
- Set *parameter F-12 Motor Thermistor Input* to *[2] Analog Input 54*.

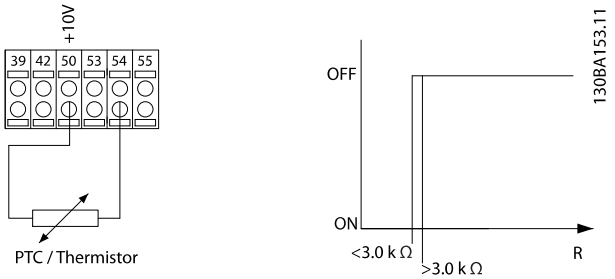


Illustration 3.8 PTC Thermistor Connection - Analog Input

Input digital/analog	Supply voltage	Threshold cut out values.
Digital	10 V	<800 Ω⇒2.7 kΩ
Analog	10 V	<3.0 kΩ⇒3.0 kΩ

Table 3.4 Threshold Cutout Values

NOTICE

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

3.2.3.2 Electronic Thermal Overload

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

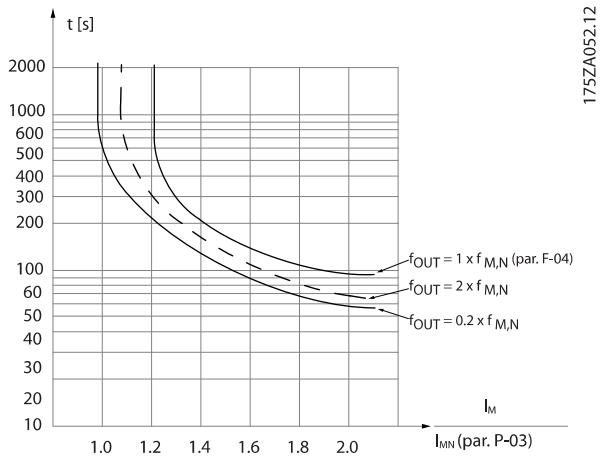


Illustration 3.9 Electronic Thermal Overload Profile

3.2.3.3 Klixon

The Klixon type thermal circuit breaker uses a KLIXON® metal dish. At a predetermined overload, the heat caused by the current through the disc causes a trip.

Using a digital input and 24 V as supply:
Example: The frequency converter trips when the motor temperature is too high.

Parameter set-up:

- Set *parameter F-10 Electronic Overload* to *[2] Thermistor Trip*.
- Set *parameter F-12 Motor Thermistor Input* to *[6] Digital Input*.

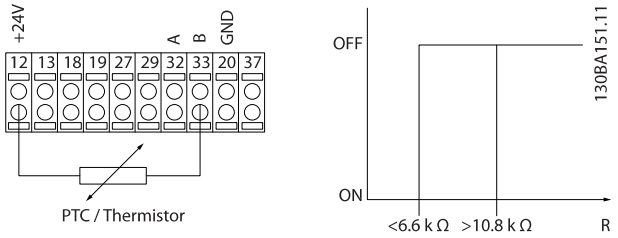


Illustration 3.10 Thermistor Connection

F-11 Motor External Fan		
Option:	**Function:**	
[0] *	No	No external fan on motor, that is the motor is derated at low speed.
[1]	Yes	Applies an external motor fan (external ventilation), so no derating of the motor is required at low speed. The upper curve in *Illustration 3.9* (f_{out} = 1 x $f_{M,N}$) is followed if the motor current is lower than nominal motor current (see *parameter P-03 Motor Current*). If the motor current exceeds nominal current, the operation time still decreases as if no fan was installed.

F-12 Motor Thermistor Input

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** ***NOTICE*** **Set digital input to *[0] PNP - Active at 24 V* in E-0#.** Select the input to which the thermistor (PTC sensor) should be connected. An analog input option *[1] Analog Input 53* or *[2] Analog Input 54* cannot be selected if the analog input is already in use as a reference source (selected in *parameter F-01 Frequency Setting 1*, *parameter C-30 Frequency Command 2* or *parameter C-34 Frequency Command 3*).
[0] *	None	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Digital input 18	
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	

F-15 Motor Speed High Limit [Hz]

Range:		Function:
50.0 Hz*	[par. F-16 - par. F-03 Hz]	

F-16 Motor Speed Low Limit [Hz]

Range:		Function:
0 Hz*	[0 - par. F-15 Hz]	Enter the minimum limit for motor speed in Hz. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The speed low limit must not exceed the setting in *parameter F-15 Motor Speed High Limit [Hz]*.

F-17 Motor Speed High Limit [RPM]

Range:		Function:
1500 RPM*	[par. F-18 - 60000 RPM]	***NOTICE*** **Any changes in *parameter F-17 Motor Speed High Limit [RPM]* reset the value in *parameter H-73 Warning Speed High* to the value set in *parameter F-17 Motor Speed High Limit [RPM]*.**

F-17 Motor Speed High Limit [RPM]

Range:		Function:
		NOTICE **Maximum output frequency cannot exceed 10% of the carrier frequency (*parameter F-26 Motor Noise (Carrier Freq)*).** Enter the maximum limit for motor speed in RPM. The motor speed high limit can be set to correspond to the manufacturer's maximum rated motor. The motor speed high limit must exceed the setting in *parameter F-18 Motor Speed Low Limit [RPM]*. The parameter name appears as either *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*, depending on: • The settings of other parameters in the *Main Menu*. • Default settings based on geographical location.

F-18 Motor Speed Low Limit [RPM]

Range:		Function:
0 RPM*	[0 - par. F-17 RPM]	Enter the minimum limit for motor speed in RPM. The motor speed low limit can be set to correspond to the minimum motor speed recommended by the manufacturer. The motor speed low limit must not exceed the setting in *parameter F-17 Motor Speed High Limit [RPM]*.

3.2.4 F-2# Fundamental Parameters 2

F-20 PM Start Mode

Option:		Function:
[0]	Rotor Detection	Suitable for all applications where the motor is known to be standing still when starting (for example conveyors, pumps, and non-wind milling fans).
[1] *	Parking	If the motor turns at a low speed (that is lower than 2–5% of the nominal speed), for example due to fans with windmilling, select *[1] Parking* and adjust *parameter B-06 Parking Current* and *parameter B-07 Parking Time* accordingly.

3

F-24 Holding Time		
Range:		**Function:**
00 s*	[0 - 120 s]	Enter the time delay between the start command and the time when the frequency converter supplies the power to the motor. This parameter is related to the start function selected in *parameter F-25 Start Function*.

F-26 Motor Noise (Carrier Freq)		
Option:		**Function:**
		Select the carrier frequency. Changing the carrier frequency can help reduce acoustic noise from the motor. ***NOTICE*** **Switching frequencies higher than 5.0 kHz lead to automatic derating of the maximum output of the frequency converter.**
[0]	1.0 kHz	
[1]	1.5 kHz	
[2]	2.0 kHz	
[3]	2.5 kHz	
[4]	3.0 kHz	
[5]	3.5 kHz	
[6]	4.0 kHz	
[7] *	5.0 kHz	
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	
[12]	12.0kHz	
[13]	14.0 kHz	
[14]	16.0kHz	

F-27 Motor Tone Random		
Option:		**Function:**
[0] *	Off	No change of the acoustic motor switching noise.
[1]	On	Select to reduce the acoustic noise from the motor.

3.2.5 F-3# Fundamental Parameters 3

F-37 Adv. Switching Pattern		
Option:		**Function:**
		Select the switching pattern: 60° AVM or SFAVM.
[0] *	60 AVM	
[1]	SFAVM	

F-38 Overmodulation		
Option:		**Function:**
[0] *	Off	Selects no overmodulation of the output voltage to avoid torque ripple on the motor shaft.
[1]	On	The overmodulation function generates an extra voltage of up to 8% of U_{max} output voltage without overmodulation. This extra voltage results in an extra torque of 10–12% in the middle of the oversyncronous range (from 0% at nominal speed, rising to approximately 12% at double nominal speed).

3.2.6 F-4# Fundamental Parameters

F-40 Torque Limiter (Driving)		
Range:		**Function:**
110.0 %*	[0 - 1000.0 %]	Enter the maximum torque limit for motor operation. The torque limit is active in the speed range up to and including the nominal motor speed set in *parameter P-06 Base Speed*. To protect the motor from reaching the stalling torque, the default setting is 1.1 x the rated motor torque (calculated value). See also *parameter SP-25 Trip Delay at Torque Limit* for further details.

F-41 Torque Limiter (Braking)		
Range:		**Function:**
100 % *	[0 - 1000.0 %]	Enter the maximum torque limit for generator-mode operation. The torque limit is active in the speed range up to and including the nominal motor speed (*parameter P-06 Base Speed*). Refer to *parameter SP-25 Trip Delay at Torque Limit* for further details.

F-43 Current Limit		
Range:		**Function:**
110.0 %*	[1.0 - 1000.0 %]	Enter the current limit for motor and generator operation. To protect the motor from reaching the stalling torque, the default setting is 1.1 x the rated motor current (set in *parameter P-03 Motor Current*).

3.2.7 F-5# Extended References

F-52 Minimum Reference		
Range:		**Function:**
0.000*	[-999999.999 - par. F-53]	
		Enter the Minimum Reference. The Minimum Reference is the lowest

F-52 Minimum Reference		
Range:		**Function:**
		obtainable by summing all references. This value defines the lower limit for both the local and remote reference depending on the choice in par. F-02 *Operation Method*. ***NOTICE*** **This parameter is used in open loop only.**

F-53 Maximum Reference		
Range:		**Function:**
60.000*	[par. F-52 - 999999.999]	Enter the Maximum Reference. The Maximum Reference is the highest obtainable by summing all references. This value defines the upper limit for both the local and remote reference depending on the choice in par. F-02 *Operation Method*.

F-54 Reference Function		
Option:		**Function:**
[0]	Sum	Sums 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 on a digital input.

3.2.8 F-6# References

F-64 Preset Relative Reference		
Range:		**Function:**
0 % *	[-100 - 100 %]	The actual reference, X, is increased or decreased with the percentage Y, set in *parameter F-64 Preset Relative Reference*. This results in the actual reference Z. Actual reference (X) is the sum of the inputs selected in: • *Parameter F-01 Frequency Setting 1*. • *Parameter C-30 Frequency Command 2*. • *Parameter C-34 Frequency Command 3*. • *Parameter O-02 Control Word Source*.

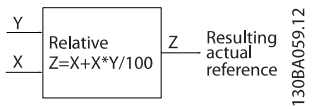


Illustration 3.11 Preset Relative Reference

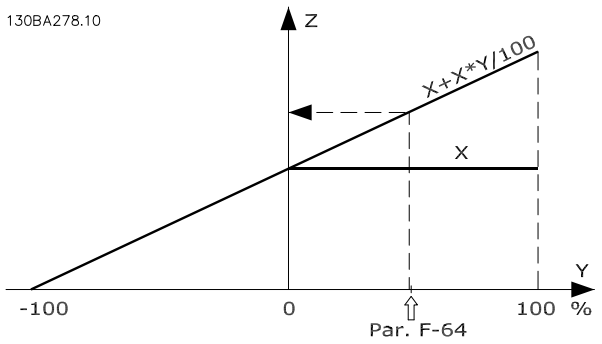


Illustration 3.12 Actual Reference

3.2.9 F-9# Digital Potentiometer

The digital potentiometer function allows the user to increase or decrease the actual reference by adjusting the set-up of the digital inputs using the functions INCREASE, DECREASE or CLEAR. To activate the function, at least one digital input must be set up to INCREASE or DECREASE.

F-90 Step Size		
Range:		**Function:**
0.10 % *	[0.01 - 200 %]	Enter the increment size required for increase/decrease as a percentage of the synchronous motor speed, n_s. If increase/ decrease is activated, the resulting reference is increased or decreased by the value set in this parameter.

F-91 Accel/Decel Time		
Range:		**Function:**
1 s	[0 - 3600 s]	Enter the ramp time, that is the time for adjustment of the reference 0–100% of the specified digital potentiometer function (increase, decrease, or clear). If increase/decrease is activated for longer than the ramp delay period specified in *parameter F-95 Accel/ Decel Ramp Delay*, the actual reference is acceled/ deceled according to this ramp time. The ramp time is defined as the time spent to adjust the reference by the step size specified in *parameter F-90 Step Size*.

F-92 Power Restore		
Option:		**Function:**
[0] *	Off	Resets the digital pot-meter reference to 0% after power-up.
[1]	On	Restores the most recent digital pot-meter reference at power-up.

3

F-93 Maximum Limit		
Range:		**Function:**
100 %*	[-200 - 200 %]	Set the maximum permissible value for the resulting reference. This is recommended if the digital pot-meter is used for fine-tuning of the resulting reference.

F-94 Minimum Limit		
Range:		**Function:**
0 %*	[-200 - 200 %]	Set the minimum permissible value for the resulting reference. This is advisable if the digital pot-meter is used for fine-tuning of the resulting reference.

F-95 Accel/Decel Ramp Delay		
Range:		**Function:**
0.000*	[0.000 - 0.000]	Enter the delay required from activation of the digital potentiometer function until the frequency converter starts to ramp the reference. With a delay of 0 ms, the reference starts to ramp as soon as increase/decrease is activated. See also *parameter F-91 Accel/Decel Time*.

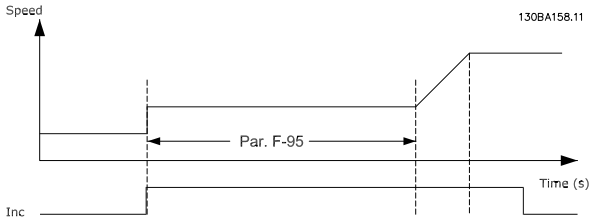


Illustration 3.13 Ramp Delay Case 1

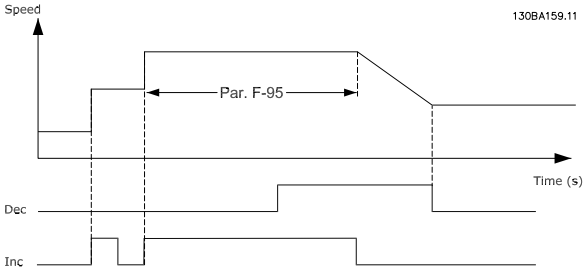


Illustration 3.14 Ramp Delay Case 2

3.3 E-## Digital In/Outs

Parameter group for configuring the digital input and output.

[0]	No operation	No reaction to signals transmitted to the terminal.
[1]	Reset	Resets 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 inv	Reset and coasting stop Inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic '0' ⇒ coasting stop and reset.
[5]	DC-brake inverse	Inverted input for DC braking (NC). Stops motor by energizing it with a DC current for a certain time period. See *parameter B-00 DC Hold Current* to *parameter B-03 DC Brake Cut In Speed [RPM]*. The function is only active when the value in par. B-02 is different from 0. Logic '0' ⇒ DC braking.
[6]	Stop inverse	Stop Inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (*parameter F-08 Decel Time 1*, *parameter E-11 Decel Time 2*u. ***NOTICE*** **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 Torque limit & stop [27] and connect this digital output to a digital input that is configured as coast.**
[7]	External interlock	Same function as Coasting stop, inverse, but External Interlock generates the alarm message 'external fault' on the display when the terminal which is programmed for Coast Inverse is logic '0'. The alarm message will also be active via digital outputs and relay outputs, if programmed for External Interlock. The alarm can be reset using a digital input or the [RESET] key if the cause for the External Interlock has been removed. A delay can be programmed in *parameter AP-00 External Interlock Delay*, External Interlock Time. After applying a signal to the input, the reaction described above will be delayed with the time set in *parameter AP-00 External Interlock Delay*.
[8] *	Start	(Default Digital input 18): Select start for a start/stop command. Logic '1' = start, logic '0' = stop.
[9]	Latched start	The motor starts, if a pulse is applied for min. 2 ms. The motor stops when Stop inverse is activated.
[10]	Reversing	(Default Digital input 19). Change the direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in *parameter H-08 Reverse Lock*. 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.
[14]	Jog	(Default Digital input 29): Use to activate jog speed. See par. C-20.
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that External/preset [1] has been selected in par. F-54. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Preset ref. bit 0,1, and 2 enables a choice between one of the eight preset references according to the table below.
[17]	Preset ref bit 1	Same as Preset ref bit 0 [16].
[18]	Preset ref bit 2	Same as Preset ref bit 0 [16].

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 3.5

[19]	Freeze reference	Freezes the actual reference, which is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/ down is used, the speed change always follows ramp 2 (par. E-10 and E-11) in the range 0 - par. F-53 Maximum Reference.
[20]	Freeze output	Freezes the actual motor frequency (Hz), which is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (par. E-10 and E-11) in the range 0 - *parameter F-04 Base Frequency*.

3

		NOTICE **When Freeze output is active, the frequency converter cannot be stopped via a low 'start [8]' signal. Stop the frequency converter via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse.**
[21]	Speed up	Select Speed up and Speed down if digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up/ down is activated for less than 400 msec. the resulting reference will be increased/ decreased by 0.1 %. If Speed up/ down is activated for more than 400 msec. the resulting reference will follow the setting in accelling/decelling parameters F-07, F-08, E-10 and E-11.

	Shut down	Catch up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Table 3.6

[22]	Speed down	Same as Speed up [21].
[23]	Set-up select bit 0	Select Set-up select bit 0 or Select Set-up select bit 1 to select one of the four set-ups. Set *parameter K-10 Active Set-up*.
[24]	Set-up select bit 1	Same as Set-up select bit 0 [23].
[32]	Pulse Input	Select Pulse input when using a pulse sequence as either reference or feedback.
[34]	Ramp bit 0	Enables a choice between one of the 4 ramps available, according to the table below.
[36]	Line failure inverse	Activates *parameter SP-10 Line failure*. Mains failure inverse is active in the Logic .0. situation.
[37]	Fire Mode	A signal applied will put the frequency converter into Fire Mode and all other commands will be disregarded. See FB-0# *Fire Mode*.
[52]	Run permissive	The input terminal, for which the Run permissive has been programmed must be logic "1" before a start command can be accepted. Run permissive has a logic 'AND' function related to the terminal which is programmed for *START* [8], *Jog* [14] or *Freeze Output* [20], which means that in order to start running the motor, both conditions must be fulfilled. If Run Permissive is programmed on multiple terminals, Run permissive needs only be logic '1' on one of the terminals for the function to be carried out. The digital output signal for Run Request (*Start* [8], *Jog* [14] or *Freeze output* [20]) will not be affected by Run Permissive. ***NOTICE*** **If no Run Permissive signal is applied but either Run, Jog or Freeze commands is activated, the status line in the display will show either Run Requested, Jog Requested or Freeze Requested.**
[53]	Hand start	A signal applied will put the frequency converter into Hand mode as if button *Hand* on the keypad has been pressed and a normal stop command will be overridden. If disconnecting the signal, the motor will stop. To make any other start commands valid, another digital input must be assign to *Auto Start* and a signal applied to this. The *Hand* and *Auto* buttons on the keypad has no impact. The *Off* button on the keypad will override *Hand Start* and *Auto Start*. Press either the *Hand* or *Auto* button to make *Hand Start* and *Auto Start* active again. If no signal on neither *Hand Start* nor *Auto Start*, the motor will stop regardless of any normal Start command applied. If signal applied to both *Hand Start* and *Auto Start*, the function will be *Auto Start*. If pressing the *Off* button on the keypad the motor will stop regardless of signals on *Hand Start* and *Auto Start*.
[54]	Auto start	A signal applied will put the frequency converter into Auto mode as if the keypad button *Auto* has been pressed. See also *Hand Start* [53]
[55]	DigiPot increase	INCREASE signal to the Digital Potentiometer function described in parameter group F-9#
[56]	DigiPot decrease	DECREASE signal to the Digital Potentiometer function described in parameter group F-9#
[57]	DigiPot clear	Clears the Digital Potentiometer reference described in parameter group F-9#
[62]	Reset Counter A	Input for reset of counter A.
[65]	Reset Counter B	Input for reset of counter B.
[66]	Sleep Mode	Forces frequency converter into Sleep Mode (see parameter group AP-4#). Reacts on the rising edge of signal applied.
[78]	Reset Maint. Word	Resets all data in *parameter DR-96 Maintenance Word* to 0.
[120]	Lead Pump Start	
[121]	Lead Pump Alternation	

[130]	Pump 1 Interlock	
[131]	Pump 2 Interlock	
[132]	Pump 3 Interlock	

E-00 Digital I/O Mode

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** Digital inputs and programmed digital outputs are pre-programmable for operation either in PNP or NPN systems.
[0] *	PNP - Active at 24V	Action on positive directional pulses (0). PNP systems are pulled down to GND.
[1]	NPN - Active at 0V	Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the frequency converter.

E-01 Terminal 18 Digital Input

Option:	Function:
	Same options and functions as E-0#, except for *Pulse input*.

E-02 Terminal 19 Digital Input

Option:	Function:
	Same options and functions as E-0#, except for *Pulse input*.

E-03 Terminal 27 Digital Input

Option:	Function:
	Same options and functions as parameter group E-0#, except for *Pulse input*.

E-04 Terminal 29 Digital Input

Option:	Function:
	Same options and functions as parameter group E-0#, except for *Pulse input*.

E-05 Terminal 32 Digital Input

Option:	Function:
	Same options and functions as parameter group E-0#.

E-06 Terminal 33 Digital Input

Option:	Function:
	Same options and functions as parameter group. E-0#.

3.3.1 E-1# Additional Accel Decel Ramps

Choosing ramp parameters.

E-10 Accel Time 2

Range:		Function:
10.00 s*	[1.00 - 3600 s]	Enter the accel time, that is the acceleration time from 0 RPM–*parameter P-06 Base Speed*. Select a accel time such that the output current does not exceed the current limit in *parameter F-43 Current Limit* during ramping. See decel time in *parameter E-11 Decel Time 2*. $par.E-10 = \frac{tacc \times nnom\ [par.P-06]}{ref\ [rpm]}\ [s]$

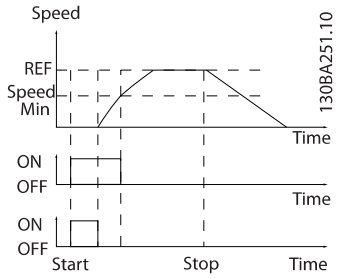
E-11 Decel Time 2

Range:		Function:
20.00 s*	[1.00 - 3600 s]	Enter the decel time, that is the deceleration time from *parameter P-06 Base Speed*–0 RPM. Select a decel time such that no overvoltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter F-43 Current Limit*. See accel time in *parameter E-10 Accel Time 2*. $par.E-11 = \frac{tdec \times nnom\ [par.P-06]}{ref\ [rpm]}\ [s]$

3.3.2 E-2# Digital Outputs

[0] *	No operation	Default for all digital outputs and relay outputs.
[1]	Control ready	The control board receives supply voltage.
[2]	Drive ready	The control board receives supply voltage.
[3]	Drive rdy/rem ctrl	The frequency converter is ready for operation and applies a supply signal on the control board.
[4]	Standby / no warning	Ready for operation. No start or stop command is been given (start/disable). There are no warnings.
[5]	Running	Motor is running.
[6]	Running / no warning	Output speed is higher than the speed set in *parameter H-81 Min Speed for Function at Stop [RPM]*. The motor is running and there are no warnings.
[8]	Run on ref/no warn	Motor runs at reference speed.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in *parameter F-40 Torque Limiter (Driving)* has been exceeded.
[12]	Out of current range	The motor current is outside the range set in *parameter F-43 Current Limit*.

[13]	Below current, low	Motor current is lower than set in *parameter H-70 Warning Current Low*.
[14]	Above current, high	Motor current is higher than set in *parameter H-71 Warning Current High*.
[15]	Out of speed range	Output frequency is outside the frequency range set in *parameter H-72 Warning Speed Low* and *parameter H-71 Warning Current High*.
[16]	Below speed, low	Output speed is lower than the setting in *parameter H-72 Warning Speed Low*.
[17]	Above speed, high	Output speed is higher than the setting in *parameter H-73 Warning Speed High*.
[18]	Out of feedb. range	Feedback is outside the range set in *parameter H-76 Warning Feedback Low* and *parameter H-77 Warning Feedback High*.
[19]	Below feedback, low	Feedback is below the limit set in *parameter H-76 Warning Feedback Low*.
[20]	Above feedback, high	Feedback is above the limit set in *parameter H-77 Warning Feedback High*.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
[25]	Reverse	*Reversing. Logic '1'* when CW rotation of the motor. Logic '0' when CCW rotation of the motor. If the motor is not rotating the output will follow the reference.
[26]	Bus OK	Active communication (no time-out) via the serial communication port.
[27]	Torque limit & stop	Use in performing a coasting 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 war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/ relay to cut out the main voltage from the frequency converter.
[35]	External Interlock	External Interlock function has been activated via one of the digital inputs.
[40]	Out of ref range	Reference is outside the range set in *parameter H-74 Warning Reference Low* and *parameter H-75 Warning Reference High*.
[41]	Below reference, low	Reference is below the limit set in *parameter H-74 Warning Reference Low*.
[42]	Above ref, high	Reference is above the limit set in *parameter H-75 Warning Reference High*.
[45]	Bus ctrl.	Controls output via bus. The state of the output is set in *parameter E-90 Digital & Relay Bus Control*. The output state is retained in the event of bus time-out.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in *parameter E-90 Digital & Relay Bus Control*. In the event of bus time-out the output state is set high (On).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in *parameter E-90 Digital & Relay Bus Control*. In the event of bus time-out the output state is set low (Off).
[55]	Pulse output	
[60]	Comparator 0	See parameter group LC-1#.If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See parameter group LC-1#. If Comparator 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[62]	Comparator 2	See parameter group LC-1#. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[63]	Comparator 3	See parameter group LC-1#. If Comparator 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[64]	Comparator 4	See parameter group LC-1#. If Comparator 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[65]	Comparator 5	See parameter group LC-1#. If Comparator 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[70]	Logic rule 0	See parameter group LC-4#. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic rule 1	See parameter group LC-4#. If Logic Rule 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[72]	Logic rule 2	See parameter group LC-4#. If Logic Rule 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[73]	Logic rule 3	See parameter group LC-4#. If Logic Rule 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[74]	Logic rule 4	See parameter group LC-4#. If Logic Rule 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[75]	Logic rule 5	See parameter group LC-4#. If Logic Rule 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[80]	Logic Controller digital output A	See *parameter LC-52 Logic Controller Action*. The output will go high whenever the Logic Action [38] *Set dig. out. A high* is executed. The output will go low whenever the Logic Action [32] Set dig. out. A low is executed.
[81]	Logic Controller digital output B	See *parameter LC-52 Logic Controller Action*. The input will go high whenever the Logic Action [39] *Set dig. out. A high* is executed.

		The input will go low whenever the Logic Action [33] *Set dig. out. A low* is executed.
[82]	Logic Controller digital output C	See *parameter LC-52 Logic Controller Action*. The input will go high whenever the Logic Action [40] *Set dig. out. A high* is executed. The input will go low whenever the Logic Action [34] *Set dig. out. A low* is executed.
[83]	Logic Controller digital output D	See *parameter LC-52 Logic Controller Action*. The input will go high whenever the Logic Action [41] *Set dig. out. A* high is executed. The input will go low whenever the Logic Action [35] *Set dig. out. A low* is executed.
[84]	Logic Controller digital output E	See *parameter LC-52 Logic Controller Action*. The input will go high whenever the Logic Action [42] *Set dig. out. A high* is executed. The input will go low whenever the Logic Action [36] *Set dig. out. A low* is executed.
[85]	Logic Controller digital output F	See *parameter LC-52 Logic Controller Action*. The input will go high whenever the Logic Action [43] *Set dig. out. A high* is executed. The input will go low whenever the Logic Action [37] *Set dig. out. A low* is executed.
[160]	No alarm	Output is high when no alarm is present.
[161]	Running reverse	Output is high when the frequency converter is running counter clockwise (the logical product of the status bits 'running' AND 'reverse').
[165]	Local ref active	Output is high when *parameter F-02 Operation Method* = [2] Local or when *parameter F-02 Operation Method* = [0] *Linked to hand auto* at the same time as the keypad is in Hand mode.
[166]	Remote ref active	Output is high when *parameter F-02 Operation Method = Remote* [1] or *Linked to hand/auto* [0] while the keypad is in [Auto] mode.
[167]	Start command act.	Output is high when there is an active Start command (i.e. via digital input bus connection or [Hand] or [Auto]), and no Stop or Start command is active.
[168]	Hand mode	Output is high when the frequency converter is in Hand mode (as indicated by the LED light above [Hand]).
[169]	Auto mode	Output is high when the frequency converter is in Auto mode (as indicated by the LED light above [on]).
[180]	Clock Fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. Maintenance	One or more of the Preventive Maintenance Events programmed in *parameter T-10 Maintenance Item* has passed the time for the specified action in *parameter T-11 Maintenance Action*.
[190]	No-Flow	A No-Flow situation or Minimum Speed situation has been detected if enabled in *parameter AP-21 Low Power Detection* and/or *parameter AP-22 Low Speed Detection*.
[191]	Dry Pump	A Dry Pump condition has been detected. This function must be enabled in *parameter AP-26 Dry Pump Function*.
[192]	End Of Curve	A pump running with max. speed for a period of time without reaching the set pressure has been detected. To enable this function please see *parameter AP-50 End of Curve Function*.
[193]	Sleep Mode	The frequency converter/system has turned into sleep mode. See parameter group AP-4#.
[194]	Broken Belt	A Broken Belt condition has been detected. This function must be enabled in *parameter AP-60 Broken Belt Function*.
[195]	Bypass Valve Control	The bypass valve control (Digital / Relay output in the frequency converter) is used for compressor systems to unload the compressor during start-up by using a bypass valve. After the start command is given the bypass valve will be open until the frequency converter reaches *parameter F-18 Motor Speed Low Limit [RPM]*) . After the limit has been reached the bypass valve will be closed, allowing the compressor to operate normally. This procedure will not be activated again before a new start is initiated and the frequency converter speed is zero during the receiving of start signal. *Parameter F-24 Holding Time* can be used in order to delay the motor start. The Bypass valve control principle:  **Illustration 3.15**
[196]	Fire Mode	The frequency converter is operating in Fire Mode. See parameter group FB-0# *Fire Mode*.
[197]	Fire Mode was Act.	The frequency converter has been operating in Fire Mode, but is now back in normal operation.
[198]	Drive Bypass	To be used as signal for activating an external electromechanical bypass switching the motor direct on line. See FB-1# *Drive Bypass*.
[200]	Full capacity	All pumps running and at full speed

		The below setting options are all related to the Cascade Controller. Wiring diagrams and settings for parameter, see parameter group PC-## for more details.
[201]	Pump 1 running	One or more of the pumps controlled by the Cascade Controller is/are running. The function will also depend on the setting in *parameter PC-06 Number of Pumps*. If set to *No* [0] Pump 1 refers to the pump controlled by relay RELAY1 etc. If set to *Yes* [1] Pump 1 refers to the pump controlled by the frequency converter only (without any of the build in relays involved) and Pump 2 to the pump controlled by the relay RELAY1. See table below
[202]	Pump 2 running	See [201]
[203]	Pump 3 running	See [201]

Setting in parameter group E-##	Setting in parameter PC-06 Number of Pumps	
	[0] No	[1] Yes
[200] Pump 1 Running	Controlled by RELAY1	Frequency Converter controlled
[201] Pump 2 Running	Controlled by RELAY2	Controlled by RELAY1
[203] Pump 3 Running	Controlled by RELAY3	Controlled by RELAY2

Table 3.7

E-20 Terminal 27 Digital Output

Option:		Function:
		Same options and functions as parameter group E-2#.

E-21 Terminal 29 Digital Output

Option:		Function:
		Same options and functions as parameter group E-2#.

E-24 Function Relay

Array [8]

(Relay 1 [0], Relay 2 [1]

Option OPCRLY: Relay 7 [6], Relay 8 [7] and Relay 9 [8])

Option:		Function:
		Same options and functions as parameter group E-2#.

E-26 On Delay, Relay

Array [20]

Range:		Function:
0.01 s*	[0.01 - 600 s]	Enter the delay of the relay cut in time. Select 1 of 2 internal mechanical relays in an array function. See *parameter E-24 Function Relay* for details.

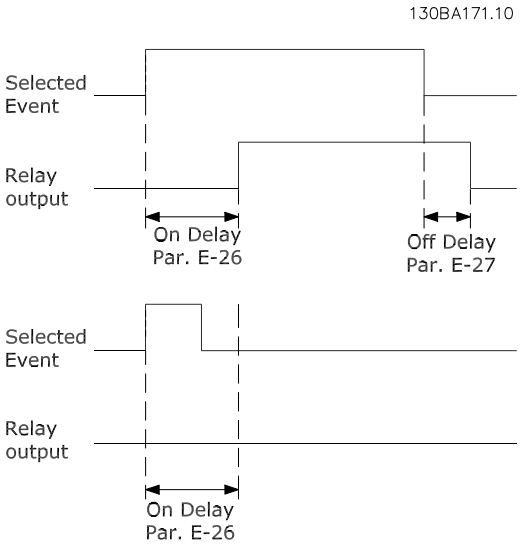


Illustration 3.16 On Delay, Relay

E-27 Off Delay, Relay

Array[20]

Range:		Function:
0.01 s*	[0.01 - 600 s]	Enter the delay of the relay cut out time. Select 1 of 2 internal mechanical relays in an array function. See *parameter E-24 Function Relay* for details. If the selected event condition changes before a delay timer expires, the relay output is unaffected.

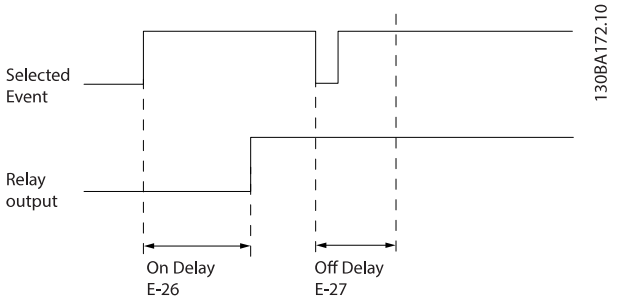


Illustration 3.17 Off Delay, Relay

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

3.3.3 E-5# I/O Mode / Add On I/O

E-51 Terminal 27 Mode

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

E-52 Terminal 29 Mode

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	Input	Defines terminal 29 as a digital input.
[1]	Output	Defines terminal 29 as a digital output.

E-53 Terminal X30/2 Digital Input

This parameter is active when the OPCGPIO General Purpose I/O Option Module is installed in the frequency converter.
It has the same options and functions as parameter group E-0# except for *Pulse input* [32].

E-54 Terminal X30/3 Digital Input

This parameter is active when the OPCRLY General Purpose I/O Option Module is installed in the frequency converter.
It has the same options and functions as parameter group E-0# except for *Pulse input* [32].

E-55 Terminal X30/4 Digital Input

This parameter is active when the General Purpose I/O Option Module is installed in the frequency converter.
It has the same options and functions as parameter group E-0# except for *Pulse input* [32].

E-56 Term X30/6 Digi Out (OPCGPIO)

This parameter is active when the General Purpose I/O Option Module is mounted in the frequency converter.

Option:		Function:
		Same options and functions as parameter group E-2#.

E-57 Term X30/7 Digi Out (OPCGPIO)

This parameter is active when the General Purpose I/O Option Module is mounted in the frequency converter.

Option:		Function:
		Same options and functions as parameter group E-2#.

3.3.4 E-6# Pulse Input

E-60 Term. 29 Low Frequency

Range:		Function:
100 Hz*	[0 - 110000 Hz]	Enter the low frequency limit corresponding to the low motor shaft speed (that is low reference value) in *parameter E-62 Term. 29 Low Ref./Feedb. Value*. Refer to in this section.

E-61 Term. 29 High Frequency

Range:		Function:
100 Hz*	[0 - 110000 Hz]	Enter the high frequency limit corresponding to the high motor shaft speed (that is high reference value) in *parameter E-63 Term. 29 High Ref./Feedb. Value*.

E-62 Term. 29 Low Ref./Feedb. Value

Range:		Function:
0*	[-999999.999 - 999999.999]	Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also *parameter E-67 Term. 33 Low Ref./Feedb. Value*.

E-63 Term. 29 High Ref./Feedb. Value

Range:		Function:
100*	[-999999.999 - 999999.999]	Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also *parameter E-68 Term. 33 High Ref./Feedb. Value*.

E-64 Pulse Filter Time Constant #29

Range:		Function:
100 ms*	[1 - 1000 ms]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the pulse filter time constant. The pulse filter dampens oscillations of the feedback signal, which is an advantage if there is a lot of noise in the system. A high time constant value results in better dampening, but also increases the time delay through the filter.

3

E-65 Term. 33 Low Frequency		
Range:		**Function:**
100 Hz*	[0 - 110000 Hz]	Enter the low frequency corresponding to the low motor shaft speed (that is low reference value) in *parameter E-67 Term. 33 Low Ref./Feedb. Value*.

E-66 Term. 33 High Frequency		
Range:		**Function:**
100 Hz*	[0 - 110000 Hz]	Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in *parameter E-68 Term. 33 High Ref./Feedb. Value*.

E-67 Term. 33 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the low reference value [RPM] for the motor shaft speed. This is also the low feedback value, see also *parameter E-62 Term. 29 Low Ref./Feedb. Value*.

E-68 Term. 33 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Enter the high reference value [RPM] for the motor shaft speed. See also *parameter E-63 Term. 29 High Ref./ Feedb. Value*.

E-69 Pulse Filter Time Constant #33		
Range:		**Function:**
100 ms*	[1 - 1000 ms]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the pulse filter time constant. The low-pass filter reduces the influence, and dampens oscillations on the feedback signal from the control. This is an advantage if there is a great amount of noise in the system.

3.3.5 E-7# Pulse Output

E-70 Terminal 27 Pulse Output Variable		
Option:		**Function:**
[0] *	No operation	
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[100]	Output frequency	
[101]	Reference	

E-70 Terminal 27 Pulse Output Variable		
Option:		**Function:**
[102]	Feedback	
[103]	Motor Current	
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[113]	Ext. Closed Loop 1	
[114]	Ext. Closed Loop 2	
[115]	Ext. Closed Loop 3	

E-71 Pulse Output Max Freq #27		
Range:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
5000 Hz*	[0 - 32000 Hz]	Set the maximum frequency for terminal 27 corresponding to the output variable selected in *parameter E-70 Terminal 27 Pulse Output Variable*.

E-72 Terminal 29 Pulse Output Variable		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the variable for viewing on terminal 29. Same options and functions as parameter group *E-75*.
[0] *	No operation	
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor Current	
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[113]	Ext. Closed Loop 1	
[114]	Ext. Closed Loop 2	
[115]	Ext. Closed Loop 3	

E-74 Pulse Output Max Freq #29		
Range:		**Function:**
5000 Hz*	[0 - 32000 Hz]	Set the maximum frequency for terminal 29 corresponding to the output variable set in *parameter E-72 Terminal 29 Pulse Output Variable*.

E-75 Terminal X30/6 Pulse Output Variable		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the maximum frequency on terminal X30/6 referring to the output variable in *parameter E-75 Terminal X30/6 Pulse Output Variable*. This parameter is active when General Purpose I/O OPCGPIO General Purpose I/O is installed in the frequency converter.
[0] *	No operation	
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor Current	
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[113]	Ext. Closed Loop 1	
[114]	Ext. Closed Loop 2	
[115]	Ext. Closed Loop 3	

E-76 Pulse Output Max Freq #X30/6		
Range:		**Function:**
5000 Hz*	[0 - 32000 Hz]	

3.3.6 E-9# Bus-Controlled

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

E-90 Digital & Relay Bus Control		
Range:		**Function:**
0*	[0 - 2147483647]	This parameter holds the state of the digital outputs and relays that is controlled by bus. A logical 1 indicates that the output is high or active. A logical 0 indicates that the output is low or inactive.

E-90 Digital & Relay Bus Control	
Range:	**Function:**
Bit 0	CC Digital Output Terminal 27
Bit 1	CC Digital Output Terminal 29
Bit 2	GPIO Digital Output Terminal X 30/6
Bit 3	GPIO Digital Output Terminal X 30/7
Bit 4	CC Relay 1 output terminal
Bit 5	CC Relay 2 output terminal
Bit 6	Option B Relay 1 output terminal
Bit 7	Option B Relay 2 output terminal
Bit 8	Option B Relay 3 output terminal
Bit 9-31	Reserved for future terminals

Table 3.8

E-93 Pulse Out #27 Bus Control		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal 27 when it is configured as bus-controlled.

E-94 Pulse Out #27 Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal 27 when it is configured as bus-controlled timeout, and timeout is detected.

E-95 Pulse Out #29 Bus Control		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal 29 when it is configured as bus-controlled.

E-96 Pulse Out #29 Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal 29 when it is configured as bus-controlled timeout, and timeout is detected.

E-97 Pulse Out #X30/6 Bus Control		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal X30/6 when it is configured as bus-controlled.

E-98 Pulse Out #X30/6 Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Contains the frequency to apply to the digital output terminal X30/6 when it is configured as bus-controlled timeout, and timeout is detected.

3.4 C-## Frequency Control Functions

3.4.1 C-0# Frequency Control Functions

C-01 Jump Frequency From [Hz]

Array [4]

Range:		Function:
0 Hz*	[0 - par. F-15 Hz]	Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

C-02 Jump Speed From [RPM]

Array [4]

Range:		Function:
0 RPM*	[0 - par. F-17 RPM]	Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

C-03 Jump Speed To [RPM]

Array [4]

Range:		Function:
0 RPM*	[0 - par. F-17 RPM]	Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

C-04 Jump Frequency To [Hz]

Array [4]

Range:		Function:
0 Hz*	[0 - par. F-15 Hz]	Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

C-05 Multi-step Frequency 1 - 8

Array [8]

Range:		Function:
0 %*	[-100 - 100 %]	Enter up to 8 different preset references (0-7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (*parameter F-53 Maximum Reference*, for closed loop, see *parameter CL-14 Maximum Reference/Feedb.*). When using preset references, select preset reference bit 0/1/2 [16], [17], or [18] for the corresponding digital inputs in parameter group *E-0# Digital Inputs*.

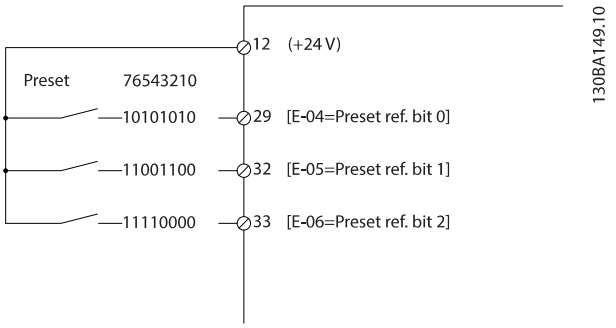


Illustration 3.18 Preset Reference Scheme

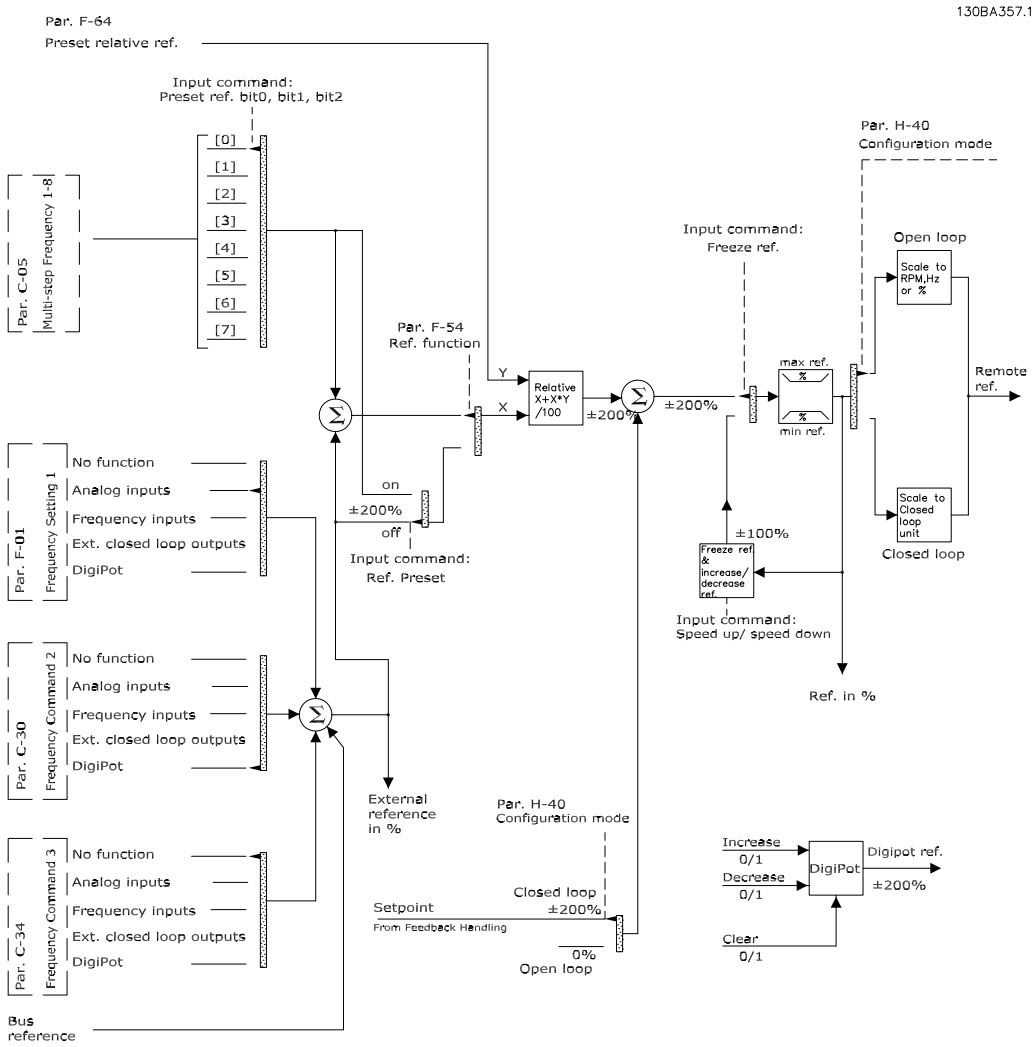


Illustration 3.19 Example of Open-loop Operation and Closed-loop Operation

3.4.2 C-2# Jog Setup

C-20 Jog Speed [Hz]		
Range:		**Function:**
10.0 Hz*	[0 - par. F-15 Hz]	The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated. See also *parameter C-21 Jog Speed [RPM]* and *parameter C-22 Jog Accel/Decel Time*.

C-21 Jog Speed [RPM]		
Range:		**Function:**
300 RPM*	[0 - par. F-17 RPM]	Enter a value for the jog speed n_{JOG}, which is a fixed output speed. The frequency converter runs at this speed when the jog function is activated. The maximum limit is defined in *parameter F-17 Motor Speed High Limit [RPM]*.

C-21 Jog Speed [RPM]		
Range:		**Function:**
		See also *parameter C-20 Jog Speed [Hz]* and *parameter C-22 Jog Accel/Decel Time*.

C-22 Jog Accel/Decel Time		
Range:		**Function:**
20.00 s*	[1 - 3600 s]	Enter the jog ramp time, that is the acceleration/deceleration time between 0 RPM and the nominal motor speed ($n_{M,N}$) (set in *parameter P-06 Base Speed*). Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in *parameter F-43 Current Limit*. The jog ramp time starts after activating a jog signal via the keypad, a selected digital input, or the serial communication port. $par.\ C-22 = \frac{tjog \times nnom\ [par.\ P-06]}{jog\ speed\ [par.\ C-21]}\ [s]$

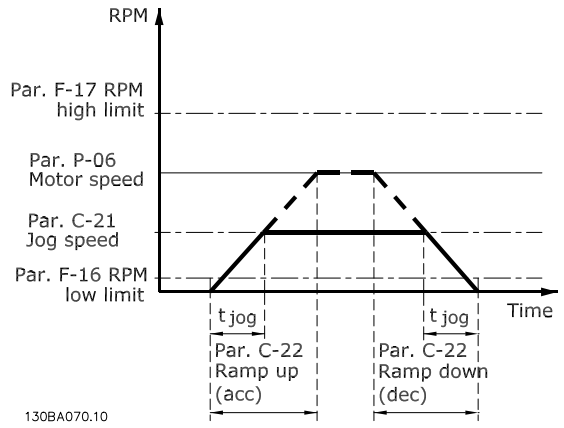


Illustration 3.20 Jog Ramp Time

C-23 Quick Stop Decel Time		
Enter the quick stop ramp time. This is the acceleration/ deceleration time between 0 RPM and the rated motor frequency in *parameter P-06 Base Speed*. During ramping, the output current must not exceed the current limit in *parameter F-43 Current Limit*.		
Range:		**Function:**
20.00 s*	[1 - 3600 s]	

3.4.3 C-3# Frequency Setting 2 and 3

C-30 Frequency Command 2		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the 2nd reference signal: • *Parameter F-01 Frequency Setting 1.* • *Parameter C-30 Frequency Command 2.* • *Parameter C-34 Frequency Command 3.* Define up to 3 different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20] *	Digital Potenti-ometer	

C-30 Frequency Command 2		
Option:		**Function:**
[21]	Analog input X30/11	(OPCGPIO)
[22]	Analog input X30/12	(OPCGPIO)
[23]	Analog Input X42/1	(OPCAIO)
[24]	Analog Input X42/3	(OPCAIO)
[25]	Analog Input X42/5	(OPCAIO)
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

C-34 Frequency Command 3		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the 3rd reference signal: • *Parameter F-01 Frequency Setting 1.* • *Parameter C-30 Frequency Command 2.* • *Parameter C-34 Frequency Command 3.* Define up to 3 different reference signals. The sum of these reference signals defines the actual reference.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potenti-ometer	
[21]	Analog input X30/11	(OPCGPIO)
[22]	Analog input X30/12	(OPCGPIO)
[23]	Analog Input X42/1	(OPCAIO)
[24]	Analog Input X42/3	(OPCAIO)

C-34 Frequency Command 3		
Option:		**Function:**
[25]	Analog Input X42/5	(OPCAIO)
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

3.4.4 C-4# Semi-Auto Jump Freq Set-up

C-40 Semi-Auto Jump Freq Set-up		
Option:		**Function:**
[0] *	Off	No function.
[1]	Enabled	Starts the semi-automatic bypass set-up and continues with the procedure described in .

3.5 P-## Motor Data

3.5.1 P-0# Motor Data

P-02 Motor Power [HP]		
Range:		**Function:**
4.00 hp*	[0.09 - 3000.00 hp]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor power in hp according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. Depending on the selections made in *parameter K-03 Regional Settings*, either *parameter P-07 Motor Power [kW]* or *parameter P-02 Motor Power [HP]* is made invisible.

P-03 Motor Current		
Range:		**Function:**
7.20 A*	[0.10 - 10000.00 A]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor current value from the motor nameplate data. The data is used for calculating motor torque, motor thermal protection, and so on.

P-04 Auto Tune		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** The Auto Tune function optimises dynamic motor performance by automatically optimising the advanced motor parameters (*parameter P-30 Stator Resistance (Rs)* to *parameter P-35 Main Reactance (Xh)*) at motor standstill.
[0] *	Off	No function.
[1]	Full Auto Tune	Performs Auto Tune of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h.
[2]	Reduced Auto Tune	Performs a reduced Auto Tune of the stator resistance R_s in the system only. Select this option if an LC filter is used between the frequency converter and the motor.

Activate the Auto Tune function by pressing [Hand] after selecting *[1] Enable complete AMA* or *[2] Enable reduced AMA*. After a normal sequence, the display reads: *Press [OK] to finish Auto Tune*. After pressing [OK], the frequency converter is ready for operation.

NOTICE

- **For the best results of the frequency converter, run Auto Tune on a cold motor.**
- **Auto Tune cannot be performed while the motor is running.**

NOTICE

Avoid generating external torque during Auto Tune.

NOTICE

If 1 of the settings in parameter group *P-## Motor Data* is changed, *parameter P-30 Stator Resistance (Rs)* to *parameter P-39 Motor Poles* return to default settings.

NOTICE

Only run complete Auto Tune without filter, and only run reduced Auto Tune with filter.

P-06 Base Speed		
Range:		**Function:**
1420 RPM*	[100 - 60000 RPM]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor speed value from the motor nameplate data. The data is used for calculating automatic motor compensations.

P-07 Motor Power [kW]		
Range:		**Function:**
4.00 kW*	[0.09 - 3000.00 kW]	Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. Depending on the selections made in *parameter K-03 Regional Settings*, either *parameter P-07 Motor Power [kW]* or *parameter P-02 Motor Power [HP]* is made invisible.

3

P-08 Motor Rotation Check

Option:		Function:
		⚠WARNING **HIGH VOLTAGE** **Frequency converters contain high voltage when connected to AC mains input, DC supply, or load sharing.** • **Remove mains power before disconnecting motor phase cables.** ***NOTICE*** **Once the motor rotation check is enabled, the display shows: *Note! Motor may run in wrong direction*.** **Pressing [OK], [Back], or [Cancel] dismisses the message and shows a new message: *Press [Hand] to start the motor. Press [Cancel] to abort*. Pressing [Hand] starts the motor at 5 Hz in forward direction and the display shows: *Motor is running*. Check if motor rotation direction is correct. Press [Off] to stop the motor. Pressing [Off] stops the motor and resets *parameter P-08 Motor Rotation Check*. If motor rotation direction is incorrect, interchange 2 motor phase cables.** Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except external interlock.
[0] *	Off	Motor rotation check is not active.
[1]	Enabled	Motor rotation check is enabled.

P-09 Slip Compensation

Range:		Function:
0 %*	[-500 - 500 %]	***NOTICE*** ***Parameter P-09 Slip Compensation* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, that is on the basis of the rated motor speed $n_{M,N}$.

P-10 Slip Compensation Time Constant

Range:		Function:
0.10 s*	[0.05 - 5 s]	***NOTICE*** ***Parameter P-10 Slip Compensation Time Constant* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Enter the slip compensation reaction speed. A high value results in slow reaction, and a low value results in quick reaction. If low-frequency resonance problems arise, use a longer time setting.

P-20 Motor Construction

Select the motor construction type.

Option:		Function:
[0] *	Asynchron	For asynchronous motors.
[1]	PM, non salient SPM	Use for non-salient PM motors.

P-24 Damping Gain

Range:		Function:
120 %*	[0 - 250 %]	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 gives high dynamic performance. The dynamic performance is related to the machine data and load type. If the damping gain is too high or low, the control becomes unstable.

P-25 Low Speed Filter Time Const.

Range:		Function:
0.01 s*	[0.01 - 20 s]	High-pass filter damping time constant determines the response time to load steps. Obtain quick control through a short damping time constant. However, if this value is too low, the control becomes unstable. This time constant is used below 10% rated speed.

P-26 High Speed Filter Time Const.

Range:		Function:
0.01 s*	[0.01 - 20 s]	High-pass filter damping time constant determines the response time to load steps. Obtain quick control through a short damping time constant. However, if this value is too low, the control becomes unstable. This time constant is used above 10% rated speed.

P-27 Voltage filter time const.		
Range:		**Function:**
0.001 s*	[0.001 - 1 s]	Supply voltage filter time constant is used for reducing the influence of high frequency ripples and system resonances in the calculation of machine supply voltage. Without this filter, the ripples in the currents can distort the calculated voltage and affect the stability of the system.

3.5.2 P-3# Adv. Motor Data

P-30 Stator Resistance (Rs)		
Range:		**Function:**
1.4000 Ohm*	[0.0140 - 140.0000 Ohm]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** For PM motors, see the description under *parameter P-37 d-axis Inductance (Ld)*. Set the stator resistance value. Enter the value from a motor datasheet or perform an Auto Tune on a cold motor.

P-31 Rotor Resistance (Rr)		
Range:		**Function:**
1.0000 Ohm*	[0.0100 - 100.0000 Ohm]	Fine-tuning R_r will improve shaft performance. Set the rotor resistance value using one of these methods: 1. Run an Auto Tune on a cold motor. The frequency converter will measure the value from the motor. All compensations are reset to 100%. 2. Enter the R_r value manually. Obtain the value from the motor supplier. 3. Use the R_r default setting. The frequency converter establishes the setting on the basis of the motor nameplate data.

P-35 Main Reactance (Xh)		
Range:		**Function:**
100.0000 Ohm*	[1.0000 - 10000.0000 Ohm]	***NOTICE*** ***Parameter P-35 Main Reactance (Xh)* does not have effect when *parameter P-20 Motor Construction*=[1] PM, non salient SPM.** Set the main reactance of the motor using 1 of these methods: • Run an Auto Tune on a cold motor. The frequency converter measures the value from the motor. • Enter the X_h value manually. Obtain the value from the motor supplier. • Use the X_h default setting. The frequency converter establishes the setting on the basis of the motor nameplate data.

P-36 Iron Loss Resistance (Rfe)		
Range:		**Function:**
10000.000 Ohm*	[0 - 10000.000 Ohm]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the equivalent ironloss resistance (R_{Fe}) value to compensate for iron losses in the motor. The R_{Fe} value cannot be found by performing an Auto Tune. The R_{Fe} value is especially important in torque control applications. If R_{Fe} is unknown, leave *parameter P-36 Iron Loss Resistance (Rfe)* on default setting.

P-37 d-axis Inductance (Ld)		
Range:		**Function:**
0.000 mH*	[0.000 - 1000.000 mH]	***NOTICE*** **This parameter is only active when *parameter P-20 Motor Construction* is set to *[1] PM, non-salient SPM*.** Enter the value of the d-axis inductance. Obtain the value from the PM motor datasheet.

3

For asynchronous motor, stator resistance and d-axis inductance values are normally described in technical specifications as between line and common (startpoint). For PM motors, they are typically described in technical specifications as between line-line. PM motors are typically built for star connection.

Parameter P-30 Stator Resistance (Rs) (line to common).	This parameter gives stator winding resistance (R_s) similar to asynchronous motor stator resistance. The stator resistance is defined for line-to-common measurement. For line-line data, where stator resistance is measured between any 2 lines, divide by 2.
Parameter P-37 d-axis Inductance (Ld) (line to common).	This parameter gives direct axis inductance of the PM motor. The d-axis inductance is defined for phase-to-common measurement. For line-line data, where stator resistance is measured between any 2 lines, divide by 2.

Table 3.9 Parameters Related to PM Motors

NOTICE

Motor manufacturers provide values for stator resistance (*parameter P-30 Stator Resistance (Rs)*) and d-axis inductance (*parameter P-37 d-axis Inductance (Ld)*) in technical specifications as between line and common (startpoint) or line between line. There is no general standard. The different set-ups of stator winding resistance and induction are shown in *Illustration 3.21*. GE frequency converters always require the line-to-common value. The back EMF of a PM motor is defined as induced EMF developed across any of 2 phases of stator winding of a free-running motor. GE frequency converters always require the line-to-line RMS value measured at 1000 RPM, mechanical speed of rotation. This is shown in *Illustration 3.22*).

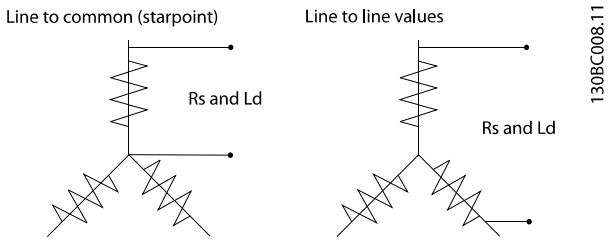


Illustration 3.21 Stator Winding Set-ups

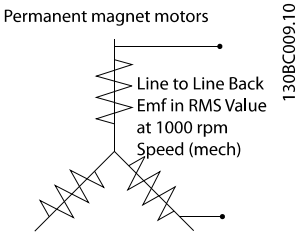


Illustration 3.22 Machine Parameter Definitions of Back EMF of PM Motors

P-38 q-axis Inductance (Lq)		
Range:		**Function:**
0.000 mH*	[0.000 - 1000 mH]	**NOTICE** **This parameter cannot be adjusted while the motor is running.** Set the value of the q-axis inductance. See the motor datasheet.

P-39 Motor Poles		
Range:		**Function:**
4*	[2 - 100]	**NOTICE** **This parameter cannot be adjusted while the motor is running.** Enter the number of motor poles.

Poles	~n_n@ 50 Hz	~n_n@ 60 Hz
2	2700–2880	3250–3460
4	1350–1450	1625–1730
6	700–960	840–1153

Table 3.10 Pole Counts and Related Frequencies

Table 3.10 shows the pole numbers for normal speed ranges of various motor types. Define motors designed for other frequencies separately. The motor pole value is always an even number, because it refers to the total pole numbers, not pairs of poles. The frequency converter creates the initial setting of *parameter P-39 Motor Poles* based on *parameter F-04 Base Frequency* and *parameter P-06 Base Speed*.

P-44 d-axis Inductance Sat. (LdSat)		
Range:		**Function:**
0.0 mH*	[0 - 1000 mH]	Enter the inductance saturation of Ld. Ideally, this parameter has the same value as *parameter P-37 d-axis Inductance (Ld)*. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

P-45 q-axis Inductance Sat. (LqSat)		
Range:		**Function:**
0.0 mH*	[0 - 1000 mH]	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *parameter P-38 q-axis Inductance (Lq)*. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

P-46 Position Detection Gain		
Range:		**Function:**
100 %*	[20 - 200 %]	Adjusts the amplitude of the test pulse during position detection at start. Adjust this parameter to improve the position measurement.

P-47 Torque Calibration		
Option:		**Function:**
[0] *	Off	
[1]	1st start after pwr-up	
[2]	Every start	
[3]	1st start with store	
[4]	Every start with store	

P-48 Inductance Sat. Point		
Range:		**Function:**
35 %*	[1 - 500 %]	Enter the induction saturation point.

P-62 Locked Rotor Protection		
Option:		**Function:**
[0] *	Off	
[1]	On	

P-63 Locked Rotor Detection Time [s]		
Range:		**Function:**
0.10 s*	[0.05 - 1 s]	

3.6 H-## High Perf Parameters

3.6.1 H-0# High Perf Operations

H-01 Option Detection		
Option:		**Function:**
[0] *	Protect Option Config.	Freezes the current settings and prevents unwanted changes when missing or defective options are detected.
[1]	Enable Option Change	Changes frequency converter settings and is used when modifying the system configuration. This parameter setting returns to *[0] Protect Option Config.* after an option change.

H-03 Restore Factory Settings		
Option:		**Function:**
		Use this parameter to specify normal operation, to perform tests, or to restore all parameters except: • *Parameter ID-03 Power Up's.* • *Parameter ID-04 Over Temp's.* • *Parameter ID-05 Over Volt's.* This function is active only when the power is cycled (power off/power on) to the frequency converter.
[0] *	Normal operation	Normal operation of the frequency converter with the motor in the selected application.
[2]	Restore Factory Settings	*[2] Restore Factory Settings* Resets all parameter values to default settings, except for: • *Parameter ID-03 Power Up's.* • *Parameter ID-04 Over Temp's.* • *Parameter ID-05 Over Volt's.* The frequency converter resets during the next power-up. *Parameter H-03 Restore Factory Settings* also reverts to the default setting *[0] Normal operation*.

H-04 Auto-Reset (Times)		
Option:		**Function:**
		Select the reset function after tripping. Once reset, the frequency converter can be restarted.
[0]	Manual reset	Select *[0] Manual reset*, to perform a reset via [RESET] or via the digital inputs.
[1]	Automatic reset x 1	Select *Automatic reset x 1…x20* [1]-[12] to perform between one and twenty automatic resets after tripping.
[2]	Automatic reset x 2	
[3]	Automatic reset x 3	
[4]	Automatic reset x 4	
[5]	Automatic reset x 5	
[6]	Automatic reset x 6	
[7]	Automatic reset x 7	
[8]	Automatic reset x 8	
[9]	Automatic reset x 9	
[10]	Automatic reset x 10	
[11]	Automatic reset x 15	
[12]	Automatic reset x 20	
[13] *	Infinite auto reset	Select *[13] Infinite Automatic Reset* for continuous resetting after tripping.

NOTICE

The motor may start without warning. If the specified number of AUTOMATIC RESETs is reached within 10 minutes, the frequency converter enters Manual reset [0] mode. After the Manual reset is performed, the setting of *parameter H-04 Auto-Reset (Times)* 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 zero.

H-05 Auto-Reset (Reset Interval)		
Range:		**Function:**
10 s*	[0 - 600 s]	Enter the time interval from trip to start of the automatic reset function. This parameter is active when *parameter H-04 Auto-Reset (Times)* is set to *[1]–[13] Automatic reset*.

H-06 Fan Operation		
Option:		**Function:**
		Select the minimum speed of the main fan.
[0] *	Auto	Select *[0] Auto* to run the fan only when the internal temperature of the frequency converter is in the range 35 °C (95 °F) to approximately 55 °C (131 °F). The fan runs at low speed at 35 °C (95 °F) and at full speed at approximately 55 °C (131 °F).
[1]	On 50%	
[2]	On 75%	
[3]	On 100%	
[4]	Auto (Low temp env.)	

H-08 Reverse Lock		
Option:		**Function:**
		NOTICE **The setting in *parameter H-08 Reverse Lock* has impact on the flying start in *parameter H-09 Start Mode*.** Selects the motor speed direction required. Use this parameter to prevent unwanted reversing.
[0]	Clockwise	Only operation in clockwise direction is allowed.
[2] *	Both directions	Operation in both clockwise and counter-clockwise direction is allowed.

H-09 Start Mode		
Option:		**Function:**
		This function enables catching a motor which is spinning freely due to a mains drop-out. When *parameter H-09 Start Mode* is enabled, *parameter F-24 Holding Time* has no function. Search direction for flying start is linked to the setting in *parameter H-08 Reverse Lock*. *[0] Clockwise*: Flying start searches in clockwise direction. If not successful, a DC brake is activated. *[2] Both Directions*: The flying start first makes a search in the direction determined by the last reference (direction). If the speed is not found, it makes a search in the other direction. If not successful, a DC brake is activated in the time set in *parameter B-02 DC Braking Time*. Start then takes place from 0 Hz.
[0] *	Disabled	Select *[0] Disable* if this function is not required.
[1]	Enabled	Select *[1] Enable* to enable the frequency converter to catch and control a spinning motor. The parameter is always set to *[1] Enable* when *parameter P-20 Motor Construction*=[1] PM non-salient. Important related parameters: • *Parameter H-58 Flying Start Test Pulses Current* • *Parameter H-59 Flying Start Test Pulses Frequency* • *Parameter F-20 PM Start Mode* • *Parameter B-06 Parking Current* • *Parameter B-07 Parking Time* • *Parameter B-03 DC Brake Cut In Speed [RPM]* • *Parameter B-04 DC Brake Cut In Speed [Hz]* • *Parameter B-06 Parking Current*

H-09 Start Mode		
Option:		**Function:**
		• *Parameter B-07 Parking Time*

The flying-start function used for PM motors is based on an initial speed estimation. The speed is always estimated as the first thing after an active start signal is given. Based on the setting of *parameter F-20 PM Start Mode* the following happens:
Parameter F-20 PM Start Mode=[0] Rotor Detection:
If the speed estimate appears as greater than 0 Hz, the frequency converter catches the motor at that speed and resumes normal operation. Otherwise, the frequency converter estimates the rotor position and start normal operation from there.

Parameter F-20 PM Start Mode=[1] Parking:
A speed estimate lower than the setting in *parameter H-59 Flying Start Test Pulses Frequency* engages the parking function (see *parameter B-06 Parking Current* and *parameter B-07 Parking Time*). Otherwise, the frequency converter catches the motor at that speed and resumes normal operation. Refer to the description of *parameter F-20 PM Start Mode* for recommended settings.

Current limitations of the flying-start principle used for PM motors:

- The speed range is up to 100% nominal speed or the field weakening speed (whichever is lowest).
- PMSM with high back EMF (>300 VLL(rms)) and high winding inductance (>10 mH) needs more time for reducing short-circuit current to 0 and may be susceptible to error in estimation.
- Current testing limited to a speed range up to 300 Hz. For certain units, the limit is 250 Hz; all 200–240 V units up to and including 2.2 kW (3 hp) and all 380–480 V units up to and including 4 kW (5.36 hp).

3

3.6.2 H-3## Stop Speed

H-36 Trip Speed Low [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. F-17 RPM]	***NOTICE*** **This parameter is only available if *parameter K-02 Motor Speed Unit* is set to *[11] RPM*.** Enter the low limit for the motor speed at which the frequency converter trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the frequency converter trips with *alarm 49, Speed Limit*.

H-37 Trip Speed Low [Hz]		
Range:		**Function:**
0 Hz*	[0 - par. F-15 Hz]	***NOTICE*** **This parameter is only available if *parameter K-02 Motor Speed Unit* is set to *[1] Hz*.** Enter the low limit for the motor speed at which the frequency converter trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the frequency converter trips with *alarm 49, Speed Limit*.

3.6.3 H-4# Advanced Settings

H-40 Configuration Mode		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** ***NOTICE*** **When set to *[3] Closed Loop*, the commands reversing and start reversing do not reverse the motor direction.**
[0] *	Open Loop	Motor speed is determined by applying a speed reference or by setting the speed when in hand-on mode. Open loop is also used if the frequency converter is part of a closed-loop control system based on an external PID controller providing a speed reference signal as output.

H-40 Configuration Mode		
Option:		**Function:**
[3]	Closed Loop	Motor speed is determined by a reference from the built-in PID controller varying the motor speed as in a closed-loop control process (for example constant pressure or flow). Configure the PID controller in parameter group *CL-##* or via the *Function Set-ups* accessed by pressing [Quick Menu].

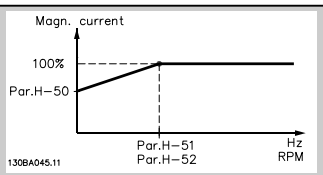
H-43 Torque Characteristics		
Option:		**Function:**
[0]	Compressor torque	For speed control of screw and scroll compressors. Provides a voltage which is optimised for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1] *	Variable torque	For speed control of centrifugal pumps and fans. Also to be used when controlling more than 1 motor from the same frequency converter (for example, multiple condenser fans or cooling tower fans). Provides a voltage which is optimised for a squared torque load characteristic of the motor.
[2]	Energy Savings CT	For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage which is optimised for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the Energy Saving feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in *parameter SP-43 Motor Cosphi*. The parameter has a default value which is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an auto tune function can be carried out using *parameter P-04 Auto Tune*. It is rarely necessary to adjust the motor power factor parameter manually.
[3]	Auto Energy Optim. VT	For optimum energy-efficient speed control of centrifugal pumps and fans. Provides a voltage optimised for a squared torque load characteristic of the motor. In addition, the Energy Saving feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in *parameter SP-43 Motor Cosphi*. The parameter

H-43 Torque Characteristics		
Option:		**Function:**
		has a default value and is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an auto tune function can be carried out using *parameter P-04 Auto Tune*. It is rarely necessary to adjust the motor power factor parameter manually.

H-48 Clockwise Direction		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** This parameter defines the term *clockwise* corresponding to the keypad direction arrow. Used for easy change of direction of shaft rotation without swapping motor wires.
[0] *	Normal	The motor shaft turns in clockwise direction when the frequency converter is connected U⇒U, V⇒V, and W⇒W to the motor.
[1]	Inverse	Motor shaft turns in counterclockwise direction when the frequency converter is connected U⇒U, V⇒V, and W⇒W to the motor.

3.6.4 H-5#

H-50 Motor Magnetisation at Zero Speed		
This parameter is not visible on the LCP.		
Range:		**Function:**
100 % *	[0 - 300 %]	***NOTICE*** ***Parameter H-50 Motor Magnetisation at Zero Speed* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Use this parameter along with *parameter H-51 Min Speed Normal Magnetising [RPM]* to obtain a different thermal load on the motor when running at low speed. Enter a value which is a percentage of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

H-50 Motor Magnetisation at Zero Speed		
This parameter is not visible on the LCP.		
Range:		**Function:**
		 **Illustration 3.24 Motor Magnetisation**

H-51 Min Speed Normal Magnetising [RPM]		
This parameter is not visible on the LCP.		
Range:		**Function:**
15 RPM*	[10 - 300 RPM]	***NOTICE*** ***Parameter H-51 Min Speed Normal Magnetising [RPM]* has no effect when *parameter P-20 Motor Construction=[1] PM, non-salient SPM*.** Set the required speed for normal magnetizing current. If the speed is set lower than the motor slip speed, *parameter H-50 Motor Magnetisation at Zero Speed* and *parameter H-51 Min Speed Normal Magnetising [RPM]* are of no significance. Use this parameter along with *parameter H-50 Motor Magnetisation at Zero Speed*. See *Table 3.10*.

H-52 Min Speed Normal Magnetising [Hz]		
This parameter is not visible on the LCP.		
Range:		**Function:**
0.5 Hz*	[0.3 - 10.0 Hz]	***NOTICE*** ***Parameter H-52 Min Speed Normal Magnetising [Hz]* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Set the required frequency for normal magnetising current. If the frequency is set lower than the motor slip frequency, *parameter H-50 Motor Magnetisation at Zero Speed* and *parameter H-51 Min Speed Normal Magnetising [RPM]* are inactive. Use this parameter along with *parameter H-50 Motor Magnetisation at Zero Speed*. See *Table 3.10*.

3

H-58 Flying Start Test Pulses Current

Range:		Function:
30 % *	[0 - 200 %]	Set the magnitude of the magnetising current for the pulses used to detect the motor direction. Higher values result in more accurate results when the frequency converter is oversized compared to the motor. The value range and function depend on *parameter P-20 Motor Construction*: *[0] Asynchron*: [0-200%] Reducing this value reduces the generated torque. 100% means full nominal motor current. In this case, the default value is 30%. *[1] PM non salient*: [0-40%] A general setting of 20% is recommended on PM motors. Higher values can give increased performance. However, on motors with back EMF higher than 300 VLL (rms) at nominal speed and high winding inductance (more than 10 mH) a lower value is recommended to avoid wrong speed estimation. The parameter is active when *parameter H-09 Start Mode* is enabled.

H-59 Flying Start Test Pulses Frequency

Range:		Function:
200 % *	[0 - 500 %]	***NOTICE*** **See description of *parameter F-20 PM Start Mode* for an overview of the relation between the PM Flying Start parameters.** The parameter is active when *parameter H-09 Start Mode* is enabled. The value range and function depend on *parameter P-20 Motor Construction*: *[0] Asynchron*: [0-500%] Control the percentage of the frequency for the pulses used to detect the motor direction. Increasing this value reduces the generated torque. In this mode, 100% means 2 times the slip frequency. *[1] PM non salient*: [0-10%] This parameter defines the motor speed (in % of nominal motor speed) below which the parking function (see *parameter B-06 Parking Current* and *parameter B-07 Parking Time* becomes active). This parameter is only active when *parameter F-20 PM Start Mode* is set to *[1] Parking* and only after starting the motor.

3.6.5 H-6# Load Depend. Setting

H-61 High Speed Load Compensation

This parameter is not visible on the LCP.

Range:		Function:
100 %*	[0 - 300 %]	***NOTICE*** ***Parameter H-61 High Speed Load Compensation* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Enter the % value to compensate voltage in relation to load when the motor is running at high speed, and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active. **Motor size** | **Change-over** 1.1–7.5 kW | > 10 Hz

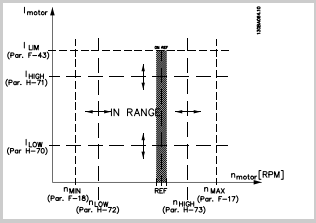
H-64 Resonance Dampening

Range:		Function:
100 %*	[0 - 500 %]	***NOTICE*** ***Parameter H-64 Resonance Dampening* has no effect when *parameter P-20 Motor Construction=[1] PM*, non-salient SPM.** Enter the resonance damping value. Set *parameter H-64 Resonance Dampening* and *parameter H-65 Resonance Dampening Time Constant* to help eliminate high frequency resonance problems. To reduce resonance oscillation, increase the value of *parameter H-64 Resonance Dampening*.

H-65 Resonance Dampening Time Constant

Range:		Function:
5 ms*	[5 - 50 ms]	***NOTICE*** ***Parameter H-65 Resonance Dampening Time Constant* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** Set *parameter H-64 Resonance Dampening* and *parameter H-65 Resonance Dampening Time Constant* to help eliminate high frequency resonance problems. Enter the time constant that provides the best dampening.

3.6.6 H-7# Adjustable Warnings

H-70 Warning Current Low		
Range:	**Function:**	
0 A*	[0 - par. H-71 A]	Warnings are shown on the display, programmed output, or fieldbus.  **Illustration 3.25 Low Current Limit** Enter the I_{LOW} value. When the motor current drops below this limit (I_{LOW}), the display reads *Current low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. Refer to *Illustration 3.25*.

H-71 Warning Current High		
Range:		**Function:**
par. DR-37 A*	[par. H-70 - par. DR-37 A]	Enter the I_{HIGH} value. When the motor current exceeds this limit (I_{HIGH}), the display reads *Current high*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. Refer to *Illustration 3.25*.

H-72 Warning Speed Low		
Range:		**Function:**
0 RPM*	[0 - par. H-73 RPM]	Enter the n_{LOW} value. When the motor speed drops below this limit (n_{LOW}), the display reads *Speed Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. Program the lower signal limit of the motor speed, n_{LOW}, within the normal working range of the frequency converter. Refer to the *Illustration 3.25*.

H-73 Warning Speed High		
Range:		**Function:**
3600 RPM*	[par. H-72 - 60000 RPM]	***NOTICE*** **Any changes in *parameter F-17 Motor Speed High Limit [RPM]* reset the value in *parameter H-73 Warning Speed High* to the same value as set in *parameter F-17 Motor Speed High Limit [RPM]*.** **If a different value is needed in *parameter H-73 Warning Speed High*, it must be set after programming of *parameter F-17 Motor Speed High Limit [RPM]*.** Enter the n_{HIGH} value. When the motor speed exceeds this limit (n_{HIGH}), the display reads *Speed high*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02. Program the upper signal limit of the motor speed, n_{HIGH}, within the normal working range of the frequency converter. Refer to *Illustration 3.25*.

H-74 Warning Reference Low		
Range:		**Function:**
-999999.999*	[-999999.999 - par. H-75]	Enter the lower reference limit. When the actual reference drops below this limit, the display indicates Ref_{Low}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02.

H-75 Warning Reference High		
Range:		**Function:**
999999.999*	[par. H-74 - 999999.999]	Enter the upper reference limit. When the actual reference exceeds this limit, the display reads Ref_{High}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02.

3

H-76 Warning Feedback Low		
Range:		**Function:**
-999999.999 ProcessCtrlUnit*	[-999999.999 - par. H-77 ProcessCtrlUnit]	Enter the lower feedback limit. When the feedback drops below this limit, the display reads $Feedb_{Low}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29, and on relay output 01 or 02.

H-77 Warning Feedback High		
Range:		**Function:**
999999.999 ProcessCtrlUnit*	[par. H-76 - 999999.999 ProcessCtrlUnit]	Enter the upper feedback limit. When the feedback exceeds this limit, the display reads $Feedb_{High}$.

H-78 Missing Motor Phase Function		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Shows an alarm if motor phase is missing.
[0]	Disabled	No alarm is shown if a missing motor phase occurs.
[1]	Trip 100 ms	An alarm is shown if a missing motor phase occurs.
[2] *	Trip 1000 ms	
[3]	Trip 100 ms lim 3 phase detec.	
[5]	Motor Check	

3.6.7 H-8# Stop Adjustments

H-80 Function at Stop		
Option:		**Function:**
		Select the frequency converter function after a stop command or after the speed is decelerated to the settings in *parameter H-81 Min Speed for Function at Stop [RPM]*. Available selections depend on *parameter P-20 Motor Construction*: *[0] Asynchronous*: *[0] Coast* *[1] DC hold*

H-80 Function at Stop		
Option:		**Function:**
		[2] Motor check, warning *[6] Motor check, alarm* *[1] PM non-salient*: *[0] Coast*
[0] *	Coast	Leaves motor in free mode.
[1]	DC Hold/ Motor Preheat	Energizes motor with a DC hold current (see *parameter B-00 DC Hold Current*).
[2]	Motor check	The frequency converter issues a warning if 1 or more phases are missing.
[6]	Motor check, alarm	The frequency converter issues an alarm if 1 or more phases are missing.

H-81 Min Speed for Function at Stop [RPM]		
Range:		**Function:**
3 RPM*	[0 - 600 RPM]	Set the speed at which to activate *parameter H-80 Function at Stop*.

H-82 Min Speed for Function at Stop [Hz]		
Range:		**Function:**
0.1 Hz*	[0 - 20.0 Hz]	Set the output frequency at which to activate *parameter H-80 Function at Stop*.

3.6.8 H-9#

H-94 ATEX ETR cur.lim. speed reduction		
Range:		**Function:**
0 %*	[0 - 100 %]	

H-98 ATEX ETR interpol. points freq.		
Range:		**Function:**
0.0 Hz*	[0 - 1000.0 Hz]	

H-99 ATEX ETR interpol points current		
Range:		**Function:**
0 %*	[0 - 100 %]	

3.7 AN-## Analog In/Out

3.7.1 AN-## Analog In/Out

Parameter group for configuration of the analog input and output.

3.7.2 AN-0# Analog I/O Mode

Parameter group for setting up the analog I/O configuration.
The frequency converter is equipped with 2 analog inputs:

- Terminals 53
- Terminals 54

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

NOTICE

Thermistors may be connected to either an analog or a digital input.

AN-00 Live Zero Timeout Time		
Range:		**Function:**
10 s*	[1 - 99 s]	Enter the live zero timeout in s. Live zero timeout time is active for analog inputs, that is, terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input drops below 50% of the value set in: • *Parameter AN-10 Terminal 53 Low Voltage.* • *Parameter AN-12 Terminal 53 Low Current.* • *Parameter AN-20 Terminal 54 Low Voltage.* • *Parameter AN-22 Terminal 54 Low Current.* For a time period longer than the time set in *parameter AN-00 Live Zero Timeout Time*, the function selected in *parameter AN-01 Live Zero Timeout Function* is activated.

AN-01 Live Zero Timeout Function		
Option:		**Function:**
		Select the timeout function. The function set in *parameter AN-01 Live Zero Timeout Function* is activated if the input signal on terminal 53 or 54 is below 50% of the value in: • *Parameter AN-10 Terminal 53 Low Voltage.* • *Parameter AN-12 Terminal 53 Low Current.* • *Parameter AN-20 Terminal 54 Low Voltage.* • *Parameter AN-22 Terminal 54 Low Current.* The function can also be activated for a time period defined in *parameter AN-00 Live Zero Timeout Time*. If several timeouts occur simultaneously, the frequency converter prioritizes the timeout functions as follows: 1. *Parameter AN-01 Live Zero Timeout Function.* 2. *Parameter O-04 Control Word Timeout Function.*
[0] *	Off	
[1]	Freeze output	Frozen at the present value. Live zero timeout time does not apply to freeze output.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to maximum speed.
[5]	Stop and trip	Overruled to stop with subsequent trip.

AN-02 Fire Mode Live Zero Timeout Function		
Option:		**Function:**
		Select the time-out function when Fire mode is active. The function set in this parameter is activated if the input signal on analog inputs is lower than 50% of the low value for a time period defined in *parameter AN-00 Live Zero Timeout Time*.
[0] *	Off	
[1]	Freeze output	Frozen at the present value.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to max. speed.

3.7.3 AN-1# Analog Input 1

Parameters for configuring the scaling and limits for analog input 1 (terminal 53).

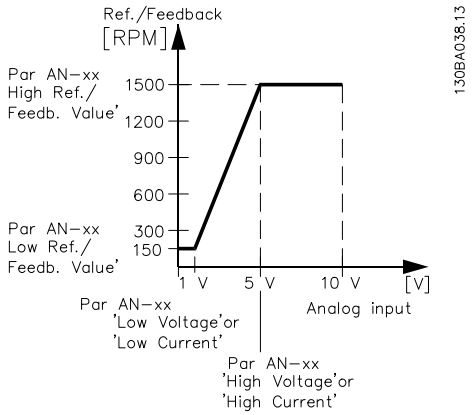


Illustration 3.26

AN-10 Terminal 53 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-11 V]	***NOTICE*** **For the live zero alarms to work, *parameter AN-10 Terminal 53 Low Voltage* must have a value of 1 V or greater.** Enter the low voltage value. This analog input scaling value should correspond to the low reference feedback value set in *parameter AN-14 Terminal 53 Low Ref./Feedb. Value*.

AN-11 Terminal 53 High Voltage		
Range:		**Function:**
10 V*	[par. AN-10 - 10 V]	Enter the high-voltage value. This analog input scaling value should correspond to the high reference feedback value set in *parameter AN-15 Terminal 53 High Ref./Feedb. Value*.

AN-12 Terminal 53 Low Current		
Range:		**Function:**
4 mA*	[0 - par. AN-13 mA]	Enter the low current value. This reference signal should correspond to the low reference feedback value, set in *parameter AN-14 Terminal 53 Low Ref./Feedb. Value*. Set the value at >2 mA to activate the live zero timeout function in *parameter AN-01 Live Zero Timeout Function*.

AN-13 Terminal 53 High Current		
Range:		**Function:**
20 mA*	[par. AN-12 - 20 mA]	Enter the high current value corresponding to the high reference/ feedback set in *parameter AN-15 Terminal 53 High Ref./Feedb. Value*.

AN-14 Terminal 53 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current set in *parameter AN-10 Terminal 53 Low Voltage* and *parameter AN-12 Terminal 53 Low Current*.

AN-15 Terminal 53 High Ref./Feedb. Value		
Range:		**Function:**
100.000*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/ high current value set in *parameter AN-11 Terminal 53 High Voltage* and *parameter AN-13 Terminal 53 High Current*.

AN-16 Terminal 53 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the filter time constant. This constant is a first-order digital low-pass filter time for suppressing electrical noise in terminal 53. A high value improves dampening, but also increases the delay through the filter.

AN-17 Terminal 53 Live Zero		
Option:		**Function:**
		Disables the live zero monitoring, for example if the analog outputs are used as part of a decentral I/O system (that is if these are used to feed a building management system with data, and not as part of any control functions related to the frequency converter).
[0]	Disabled	
[1] *	Enabled	

3.7.4 AN-2# Analog Input 2

Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

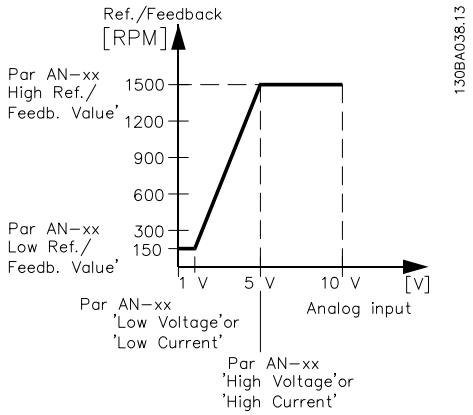


Illustration 3.27

AN-20 Terminal 54 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-21 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference feedback value set in *parameter AN-24 Terminal 54 Low Ref./Feedb. Value*.

AN-21 Terminal 54 High Voltage		
Range:		**Function:**
10 V*	[par. AN-20 - 10 V]	Enter the high-voltage value. This analog input scaling value should correspond to the high reference feedback value set in *parameter AN-25 Terminal 54 High Ref./Feedb. Value*.

AN-22 Terminal 54 Low Current		
Range:		**Function:**
4 mA*	[0 - par. AN-23 mA]	Enter the low current value. This reference signal should correspond to the low reference feedback value, set in *parameter AN-24 Terminal 54 Low Ref./Feedb. Value*. Set the value at >2 mA to activate the live zero time-out function in *parameter AN-01 Live Zero Timeout Function*.

AN-23 Terminal 54 High Current		
Range:		**Function:**
20 mA*	[par. AN-22 - 20 mA]	Enter the high current value corresponding to the high reference feedback value set in *parameter AN-25 Terminal 54 High Ref./ Feedb. Value*.

AN-24 Terminal 54 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current value set in *parameter AN-20 Terminal 54 Low Voltage* and *parameter AN-22 Terminal 54 Low Current*.

AN-25 Terminal 54 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in *parameter AN-21 Terminal 54 High Voltage* and *parameter AN-23 Terminal 54 High Current*.

AN-26 Terminal 54 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. Increasing the value improves dampening but also increases the time delay through the filter.

AN-27 Terminal 54 Live Zero		
Option:		**Function:**
		Disables the live zero-monitoring, for example if the analog outputs are used as part of a decentral I/O system (that is if these are used to feed a building management system with data, and not as part of any control functions related to the frequency converter).
[0]	Disabled	
[1] *	Enabled	

3.7.5 AN-3# Analog Input 3 OPCGPIO General Purpose I/O

Parameter group for configuring the scale and limits for analog input 3 (X30/11) in OPCGPIO General Purpose I/O.

AN-30 Terminal X30/11 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-31 V]	Sets the analog input scaling value to correspond to the low reference feedback value (set in *parameter AN-34 Term. X30/11 Low Ref./Feedb. Value*).

3

AN-31 Terminal X30/11 High Voltage		
Range:		**Function:**
10 V*	[par. AN-30 - 10 V]	Sets the analog input scaling value to correspond to the high reference feedback value (set in *parameter AN-35 Term. X30/11 High Ref./Feedb. Value*).

AN-34 Term. X30/11 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Sets the analog input scaling value to correspond to the low voltage value (set in *parameter AN-30 Terminal X30/11 Low Voltage*).

AN-35 Term. X30/11 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Sets the analog input scaling value to correspond to the high-voltage value (set in *parameter AN-31 Terminal X30/11 High Voltage*).

AN-36 Term. X30/11 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the filter time constant. This constant is a first-order digital low-pass filter time for suppressing electrical noise in terminal X30/11. A high value improves dampening, but also increases the delay through the filter.

AN-37 Term. X30/11 Live Zero		
Option:		**Function:**
		This parameter makes it possible to disable the live zero-monitoring. For example, to be used if the analog outputs are used in a decentral I/O system (when an analog output does not fulfil any control function, but feeds a data storage device).
[0]	Disabled	
[1] *	Enabled	

3.7.6 AN-4# Analog Input 4 OPCGPIO General Purpose I/O

Parameter group for configuring the scale and limits for analog input 4 (X30/12) placed on General Purpose I/O OPCGPIO General Purpose I/O.

AN-40 Terminal X30/12 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-41 V]	Sets the analog input scaling value to correspond to the low reference feedback value set in *parameter AN-44 Term. X30/12 Low Ref./Feedb. Value*.

AN-41 Terminal X30/12 High Voltage		
Range:		**Function:**
10 V*	[par. AN-40 - 10 V]	Sets the analog input scaling value to correspond to the high reference feedback value set in *parameter AN-45 Term. X30/12 High Ref./Feedb. Value*.

AN-44 Term. X30/12 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Sets the analog output scaling value to correspond to the low voltage value set in *parameter AN-40 Terminal X30/12 Low Voltage*.

AN-45 Term. X30/12 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Sets the analog input scaling value to correspond to the high-voltage value set in *parameter AN-41 Terminal X30/12 High Voltage*.

AN-46 Term. X30/12 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the filter time constant. This constant is a first-order digital low-pass filter time for suppressing electrical noise in terminal X30/12. A high value improves dampening, but also increases the delay through the filter.

AN-47 Term. X30/12 Live Zero		
Option:		**Function:**
		This parameter makes it possible to disable the live zero-monitoring. For example, to be used if the analog outputs are used in a decentral I/O system (when an analog output does not fulfil any control function, but feeds a data storage device).
[0]	Disabled	
[1] *	Enabled	

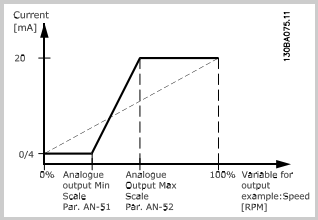
3.7.7 AN-5# Analog Output 1

Parameters for configuring the scaling and limits for analog output 1, that is terminal 42. Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal 39) is the same terminal and has the same electrical potential for analog common and digital common connection.
Resolution on analog output is 12 bit.

AN-50 Terminal 42 Output		
Option:		**Function:**
		NOTICE **Values for setting the minimum reference are found in open loop *parameter F-52 Minimum Reference* and for closed loop *parameter CL-13 Minimum Reference/Feedb.*. Values for maximum reference for open loop are found in *parameter F-53 Maximum Reference* and for closed loop *parameter CL-14 Maximum Reference/Feedb.*** This parameter enables the function of terminal 42 as an analog current output. Depending on the option selected, the output is either 0–20 mA or 4–20 mA. The current value can be read out in the LCP in *parameter DR-65 Analog Output 42 [mA]*.
[0]	No operation	
[100]	Output frequency	0–100 Hz, (0–20 mA).
[101]	Reference	Minimum reference–Maximum reference, (0–20 mA).
[102]	Feedback	-200% to +200% of *parameter CL-14 Maximum Reference/ Feedb.*, (0–20 mA).
[103]	Motor Current	0–Inverter maximum current (*parameter DR-37 Drive Max. Current*), (0-20 mA).
[104]	Torque rel to limit	0–Torque limit (*parameter F-40 Torque Limiter (Driving)*), (0–20 mA).
[105]	Torq relate to rated	0–Motor rated torque, (0–20 mA).
[106]	Power	0–Motor rated power, (0–20 mA).
[107]	Speed	0–Speed high limit (*parameter F-17 Motor Speed High Limit [RPM]* and *parameter F-15 Motor Speed High Limit [Hz]*), (0–20 mA).
[113]	Ext. Closed Loop 1	0–100%, (0–20 mA).
[114]	Ext. Closed Loop 2	0–100%, (0–20 mA).
[115]	Ext. Closed Loop 3	0–100%, (0–20 mA).
[117]	Shaft Power	
[118]	Shaft Power 4-20mA	
[130]	Output freq. 4-20mA	0–100 Hz.
[131]	Reference 4-20mA	Minimum reference–Maximum reference.
[132]	Feedback 4-20mA	-200% to +200% of *parameter CL-14 Maximum Reference/ Feedb.*
[133]	Motor cur. 4-20mA	0–Inverter maximum current (*parameter DR-37 Drive Max. Current*).
[134]	Torq.% lim 4-20 mA	0–Torque limit (*parameter F-40 Torque Limiter (Driving)*).
[135]	Torq.% nom 4-20mA	0–Motor rated torque.
[136]	Power 4-20mA	0–Motor rated power.
[137] *	Speed 4-20mA	0–Speed high limit (F-18 and F-15).
[139]	Bus ctrl.	0–100%, (0–20 mA).
[140]	Bus ctrl. 4-20 mA	0–100%.
[141]	Bus ctrl t.o.	0–100%, (0–20 mA).
[142]	Bus ctrl t.o. 4-20mA	0–100%.
[143]	Ext. CL 1 4-20mA	0–100%.
[144]	Ext. CL 2 4-20mA	0–100%.
[145]	Ext. CL 3 4-20mA	0–100%.
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	

AN-51 Terminal 42 Output Min Scale		
Range:		**Function:**
0 %*	[0 - 200 %]	Scale for the minimum output (0 mA or 4 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in *parameter AN-50 Terminal 42 Output*.

3

AN-52 Terminal 42 Output Max Scale		
Range:		**Function:**
100 %*	[0 - 200 %]	Scale for the maximum output (20 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in *parameter AN-50 Terminal 42 Output*.  **Illustration 3.28 Output Current vs Reference Variable** It is possible to obtain a value lower than 20 mA at full scale by programming values >100% by using a formula as follows: $20\ mA / desired\ maximum\ current\ \times\ 100\,\%$ $i.e.\ 10mA: \frac{20\ mA}{10\ mA} \times 100\,\% = 200\,\%$

Example 1:
Variable value = output frequency, range = 0–100 Hz.
Range needed for output = 0–50 Hz.
Output signal 0 mA or 4 mA is needed at 0 Hz (0% of range). Set *parameter AN-51 Terminal 42 Output Min Scale* to 0%.
Output signal 20 mA is needed at 50 Hz (50% of range). Set *parameter AN-52 Terminal 42 Output Max Scale* to 50%.

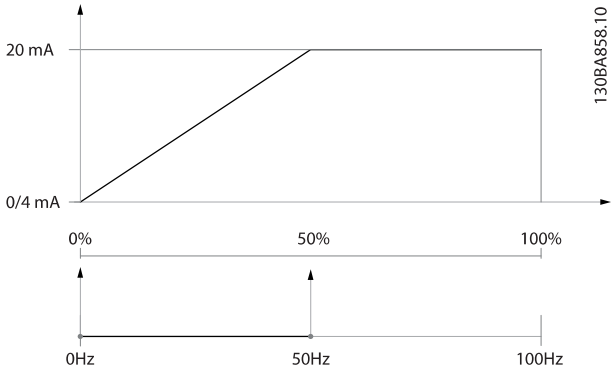


Illustration 3.29 Example 1

Example 2:
Variable = feedback, range = -200% to +200%.
Range needed for output = 0–100%.
Output signal 0 mA or 4 mA is needed at 0% (50% of range). Set *parameter AN-51 Terminal 42 Output Min Scale* to 50%.
Output signal 20 mA is needed at 100% (75% of range). Set *parameter AN-52 Terminal 42 Output Max Scale* to 75%.

Example 3:
Variable value = reference, range = minimum reference–maximum reference
Range needed for output = minimum reference (0%)–maximum reference (100%), 0–10 mA.
Output signal 0 mA or 4 mA is needed at minimum reference. Set *parameter AN-51 Terminal 42 Output Min Scale* to 0%.
Output signal 10 mA is needed at maximum reference (100% of range). Set *parameter AN-52 Terminal 42 Output Max Scale* to 200%.
(20 mA/10 mA x 100%=200%).

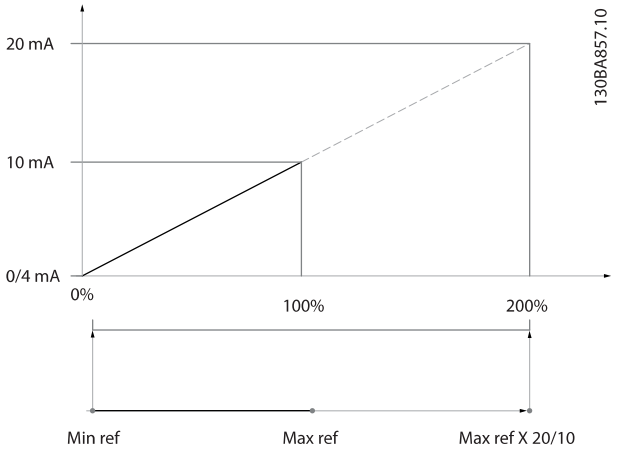


Illustration 3.30 Example 3

AN-53 Terminal 42 Output Bus Control		
Range:		**Function:**
0 %*	[0 - 100 %]	Holds the level of output 42 if controlled by bus.

AN-54 Terminal 42 Output Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Holds the preset level of output 42. If a timeout function is selected in *parameter AN-50 Terminal 42 Output*, the output is preset to this level if a fieldbus timeout occurs.

AN-55 Terminal 42 Output Filter

Option:		Function:
		The following readout parameters from selection in *parameter AN-50 Terminal 42 Output* have a filter selected when *parameter AN-55 Terminal 42 Output Filter* is on:

Selection	0–20 mA	4–20 mA
Motor current (0–I_{max})	[103]	[133]
Torque limit (0–T_{lim})	[104]	[134]
Rated torque (0–T_{nom})	[105]	[135]
Power (0–P_{nom})	[106]	[136]
Speed (0–$Speed_{max}$)	[107]	[137]

Table 3.11 Readout Parameters

[0] *	Off	Filter off.
[1]	On	Filter on.

3.7.8 AN-6# Analog Output 2 OPCGPIO General Purpose I/O

Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal X30/8) is the same terminal and electrical potential for analog common connection. Resolution on analog output is 12 bit.

AN-60 Terminal X30/8 Output

Same options and functions as *parameter AN-50 Terminal 42 Output*.

AN-61 Terminal X30/8 Min. Scale

Range:		Function:
0 %*	[0 - 200 %]	Scales the minimum output of the selected analog signal on terminal X30/8. Scale the minimum value as a percentage of the maximum signal value, that is 0 mA (or 0 Hz) is required at 25% of the maximum output value and 25% is programmed. The value can never exceed the corresponding setting in *parameter AN-62 Terminal X30/8 Max. Scale* if the value is below 100%. This parameter is active when General Purpose I/O OPCGPIO General Purpose I/O is mounted in the frequency converter.

AN-62 Terminal X30/8 Max. Scale

Range:		Function:
100 %*	[0 - 200 %]	Scales the maximum output of the selected analog signal on terminal X30/8. Scale the value to the required maximum value of the current signal output. Scale the output to give a lower current than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter,

AN-62 Terminal X30/8 Max. Scale

Range:		Function:
		that is 50%=20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows: $20\ mA/desired\ maximum\ current\ \times\ 100\,\%$ $i.e.\ 10\ mA: \frac{20\ mA}{10\ mA}\ \times\ 100\,\% = 200\,\%$

AN-63 Terminal X30/8 Output Bus Control

Range:		Function:
0 %*	[0 - 100 %]	Contains the value to apply to the output terminal when it is configured as bus-controlled.

AN-64 Terminal X30/8 Output Timeout Preset

Range:		Function:
0 %*	[0 - 100 %]	Contains the value to apply to the output terminal, when it is configured as bus-controlled timeout and timeout is detected.

3

3.8 SP-## Special Functions

Parameter group for configuring special frequency converter functions.

SP-00 Fault Level		
Use this parameter to customise fault levels.		
Option:		**Function:**
[0]	Off	Use *[0] Off* with caution as it ignores all warnings and alarms for the selected source.
[1]	Warning	
[2]	Trip	Changing a fault level from default option *[3] Trip Lock* to *[2] Trip* leads to the automatic reset of the alarm. For alarms involving overcurrent, the frequency converter has a hardware protection that issues a 3-minute recovery after 2 consecutive overcurrent incidents, this hardware protection cannot be overruled.
[3] *	Trip Lock	
[4]	Trip w. delayed reset	

Failure	Alarm	Off	Warning	Trip	Trip Lock
Inverter overloaded	9		X	X	
Overcurrent	13			X	D
Current limit	59		X		

Table 3.12 Selection of Choice of Action when Selected Alarm Appears

3.8.1 SP-1# Line On/Off

Parameters for configuring mains failure monitoring and handling.

SP-10 Line failure		
Option:		**Function:**
		Select the function by which the frequency converter must act when the threshold set in *parameter SP-11 Line Voltage at Input Fault* has been reached or a *Mains Failure Inverse* command is activated via 1 of the digital inputs (parameter group *E-0#*). Only selections *[0] No function*, *[3] Coasting,* or *[6] Alarm* are available when *parameter P-20 Motor Construction* is set to *[1] PM, non-salient SPM*.
[0] *	No function	The energy left in the capacitor bank is used to run the motor, but is discharged.
[1]	Ctrl. Decel	The frequency converter performs a controlled decel. *Parameter B-10 Brake Function* must be set to *[0] Off*.

SP-10 Line failure		
Option:		**Function:**
[3]	Coasting	The frequency converter turns off and the capacitor bank backs up the control card, thus ensuring a faster restart when mains reconnect (at short power zags).
[4]	Kinetic back-up	The frequency converter rides through by controlling speed for generative operation of the motor utilising the inertia moment of the system as long as sufficient energy is present.
[6]	Alarm	

NOTICE

For best performance of controlled decel and kinetic back-up, set *parameter H-43 Torque Characteristics* to *[0] Compressor* or *[1] Variable Torque* (no Energy Saving should be active).

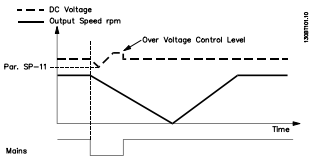


Illustration 3.31 Controlled Decel - Short Mains Failure. Decelling to stop followed by accelling to reference.

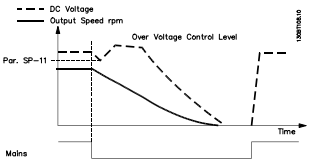


Illustration 3.32 Controlled Decel, Longer Mains Failure. Decelling as long as the energy in the system allows for it, then the motor coasts.

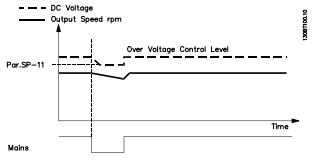


Illustration 3.33 Kinetic Back-up, Short Mains Failure. Ride through as long as the energy in the system allows it.

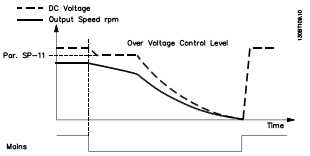


Illustration 3.34 Kinetic Back-up, Longer Mains Failure.
The motor coasts as soon as the energy in the system is too low.

SP-11 Line Voltage at Input Fault		
Range:		**Function:**
198 V*	[180 - 600 V]	This parameter defines the threshold voltage at which the function in *parameter SP-10 Line failure* is activated. Select the detection level depending on the supply quality. For a supply of 380 V, set *parameter SP-11 Line Voltage at Input Fault* to 342 V. This results in a DC detection level of 462 V (*parameter SP-11 Line Voltage at Input Fault*x1.35).

SP-12 Function at Line Imbalance		
Option:		**Function:**
		Operation under severe mains imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (for example a pump or fan running near full speed). When a severe mains imbalance is detected, select 1 of the available functions.
[0] *	Trip	Trips the frequency converter.
[1]	Warning	Issues a warning.
[2]	Disabled	No action.
[3]	Derate	Derates the frequency converter.

SP-16 Kin. Backup Gain		
Range:		**Function:**
100 %*	[0 - 500 %]	Enter the kinetic back-up gain value in percent.

3.8.2 SP-2# Reset Functions

Parameters for configuring auto reset handling, special trip handling, and control card self-test or restore.

SP-23 Typecode Setting		
Option:		**Function:**
		Use this parameter to set the typecode matching the specific frequency converter.

SP-25 Trip Delay at Torque Limit		
Range:		**Function:**
60 s*	[0 - 60 s]	Enter the torque limit trip delay in s. When the output torque reaches the torque limits (*parameter F-40 Torque Limiter (Driving)* and *parameter F-41 Torque Limiter (Braking)*), a warning is triggered. When the torque limit warning has been continuously present for the period specified in this parameter, the frequency converter trips. Disable the trip delay by setting the parameter to 60 s=OFF. Thermal frequency converter monitoring remains active.

SP-26 Trip Delay at Drive Fault		
Range:		**Function:**
1 s*	[0 - 35 s]	When the frequency converter detects an overvoltage in the set time, trip is effected after the set time.

SP-28 Production Settings		
Option:		**Function:**
[0] *	No action	
[1]	Service reset	
[2]	Set Production Mode	

SP-29 Service Code		
Range:		**Function:**
0*	[-2147483647 - 2147483647]	Enter code 5000 to restore the 8 digit ordering number in *parameter ID-46 GE Product No.* after a power card exchange. The number should match the ordering number on the nameplate of the frequency converter.

3.8.3 SP-3# Current Limit Control

The frequency converter features an integral current limit controller which is activated when the motor current, and thus the torque, is higher than the torque limits set in *parameter F-40 Torque Limiter (Driving)*.
When the current limit is reached during motor operation or regenerative operation, the frequency converter tries to reduce torque below the preset torque limits as quickly as possible without losing control of the motor.
While the current control is active, the frequency converter can only be stopped by setting a digital input to *[2] Coast inverse* or *[3] Coast and reset inv.* Any signal on terminals 18–33 are not active until the frequency converter is no longer near the current limit.
By using a digital input set to *[2] Coast inverse* or *[3] Coast and reset inv.*, the motor does not use the decel time, since the frequency converter is coasted.

3

SP-30 Current Lim Ctrl, Proportional Gain		
Range:		**Function:**
100 %*	[0 - 500 %]	Enter the proportional gain value for the current limit controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability.

SP-31 Current Lim Ctrl, Integration Time		
Range:		**Function:**
0.020 s*	[0.002 - 2 s]	Controls the current limit control integration time. Setting it to a lower value makes it react faster. A setting too low leads to control instability.

SP-32 Current Lim Ctrl, Filter Time		
Range:		**Function:**
26.0 ms*	[1 - 100 ms]	Sets a time constant for the current limit controller low-pass filter.

3.8.4 SP-4# Energy Savings

Parameters for adjusting the energy optimization level in both variable torque (VT) and Energy Saving mode.

Energy Saving is only active if *parameter H-43 Torque Characteristics*, is set for either *[2] Energy Savings CT* or *[3] Auto Energy Optim. VT*.

SP-40 VT Level		
Range:		**Function:**
66 %*	[40 - 90 %]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** ***NOTICE*** **This parameter is not active when *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*.** Enter the level of motor magnetization at low speed. Selection of a low value reduces energy loss in the motor, but also reduces load capability.

SP-41 Energy Savings Min. Magnetization		
Range:		**Function:**
40 %*	[40 - 200 %]	***NOTICE*** **This parameter is not active when *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*.**

SP-41 Energy Savings Min. Magnetization		
Range:		**Function:**
		Enter the minimum allowable magnetization for Automatic Energy Savings. Selection of a low value reduces energy loss in the motor, but can also reduce resistance to sudden load changes.

SP-42 Energy Savings Min. Frequency		
Range:		**Function:**
10 Hz*	[5 - 40 Hz]	***NOTICE*** **This parameter is not active when *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*.** Enter the minimum frequency at which the automatic energy Savings is to be active.

SP-43 Motor Cosphi		
Range:		**Function:**
0.66*	[0.40 - 0.95]	The Cos(phi) setpoint is automatically set for optimum Energy Saving performance during Auto Tune. This parameter should normally not be altered. However, in some situations it may be necessary to enter a new value to fine-tune.

3.8.5 SP-5# Environment

NOTICE

Perform a power cycle after changing any of the parameters in group *14-5* Environment*.

These parameters help the frequency converter to operate under special environmental conditions.

SP-50 RFI Filter		
Option:		**Function:**
[0]	Off	Select *[0] Off* if the frequency converter is fed by an isolated mains source (IT mains). If a filter is used, select *[0] Off* during charging to prevent a high leakage current making the RCD switch. In this mode, the internal RFI filter capacitors between enclosure and the mains RFI filter circuit are cut out to reduce the ground capacity currents.
[1] *	On	Select *[1] On* to ensure that the frequency converter complies with EMC standards.

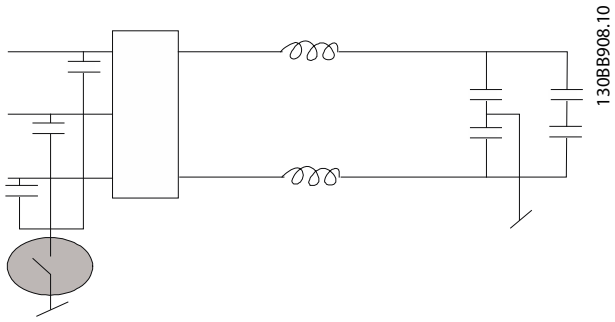


Illustration 3.35 RFI Filter

SP-51 DC Link Compensation		
Option:	**Function:**	
		The rectified AC-DC voltage in the frequency converter's DC-link is associated with voltage ripples. These ripples can increase in magnitude with increased load. These ripples are undesirable because they can generate current and torque ripples. A compensation method is used to reduce these voltage ripples in the DC link. In general, DC-link compensation is recommended for most applications, but pay attention when operating in field weakening as it can generate speed oscillations at the motor shaft. In field weakening, it is recommended to turn DC-link compensation off.
[0] *	Off	Disables DC-link compensation. This disables compensation for ripple in the DC bus and may be set when harmonic filters are used with the drive.
[1]	On	Enables DC-link compensation. This function compensates for lower or higher DC bus voltages to recreate a more perfect sine-wave. May overcompensate when harmonic filters are used.

SP-53 Fan Monitor		
Option:		**Function:**
		Select the frequency converter action if a fan fault is detected.
[0]	Disabled	
[1] *	Warning	
[2]	Trip	

SP-54 AHF Cap Reconnect Delay		
Range:		**Function:**
25 s*	[1 - 120 s]	Delay time between 2 consecutive AHF capacitor connections. The timer starts once the AHF capacitor disconnects, and connects back once delay expires and frequency converters power above 20% and below 30% of nominal power.

AHF capacitor connect output function for digital and relay outputs

Functional description:

1. Connect capacitors at 20% nominal power.
2. Hysteresis ±50% of the 20% nominal power (=minimum 10% and maximum 30% nominal power).
3. Off delay timer=10 s. The nominal power must be below 10% for 10 s to disconnect the capacitors. If the nominal power exceeds 10% during the 10 s delay, the timer (10 s) restarts.
4. The capacitor reconnect delay (default=25 s with a range from 1 s to 120 s, see *parameter SP-54 AHF Cap Reconnect Delay*) is used for the minimum off-time for the AHF capacitor output function.
5. In case of power loss, the frequency converter guarantees that the minimum off-time is satisfied when power is restored.

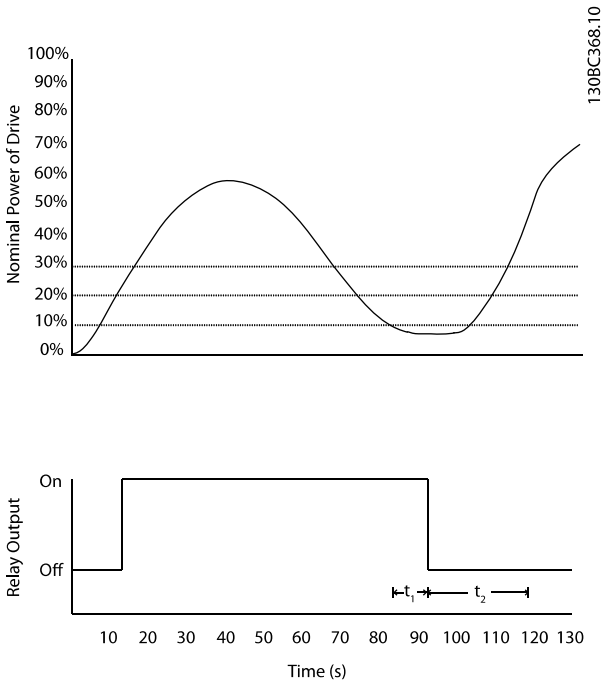


Illustration 3.36 Example of the Output Function

t_1 shows the off delay timer (10 s).
t_2 shows the capacitor reconnect delay (*parameter SP-54 AHF Cap Reconnect Delay*).

When the nominal power of the frequency converter exceeds 20%, the output function turns on. When the power goes below 10%, an off delay timer needs to expire before the output goes low. This is represented by t_1. After the output goes low, the capacitor reconnect delay timer needs to expire before the output is allowed to be on

again, showed by t_2. When t_2 expires, the nominal power is above 30% and the relay does not turn on.

SP-55 Output Filter		
Option:		**Function:**
[0] *	No Filter	
[2]	Sine Wave Filter Fixed	

SP-59 Actual Number of Inverter Units		
This parameter is only relevant for high-power frequency converters.		
Range:		**Function:**
1*	[1 - 1]	Sets the actual number of operating inverter units.

3.8.6 SP-6# Automatic Derate

This group contains parameters for derating the frequency converter in case of high temperature.

SP-60 Function at Over Temperature		
Option:		**Function:**
		If either heat sink or control card temperature exceeds a factory-programmed temperature limit, a warning is activated. If the temperature increases further, select whether the frequency converter should trip (trip lock) or derate the output current.
[0] *	Trip	The frequency converter trips (trip lock) and generate an alarm. Cycle power to reset the alarm. The motor restarts when the heat sink temperature has dropped below the alarm limit.
[1]	Derate	If the critical temperature is exceeded, the output current is reduced until the allowable temperature has been reached.

SP-61 Function at Drive Overload		
Option:		**Function:**
		Is used in case of steady overload beyond the thermal limits (110% for 60 s).
[0] *	Trip	Select *[0] Trip* to make the frequency converter trip and issue an alarm.
[1]	Derate	*[1] Derate* to reduce pump speed to decrease the load on the power section and allowing this to cool down.

SP-62 Drive Overload Derate Current		
Range:		**Function:**
95 %*	[50 - 100 %]	Defines the desired current level (in % of rated output current for the frequency converter) when running with reduced pump speed after load on the frequency converter has exceeded the allowable limit (110% for 60 s).

3.9 O-## Options/Comms

3.9.1 O-0# General Settings

O-01 Control Site

Option:		Function:
		The setting in this parameter overrides the settings in *parameter O-50 Coasting Select* to *parameter O-56 Preset Reference Select*.
[0] *	Digital and ctrl.word	Use both digital input and control word.
[1]	Digital only	Use digital inputs only.
[2]	Controlword only	Use control word only.

O-02 Control Word Source

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the source of the control word: 1 of 2 serial interfaces, or 4 installed options. During initial power-up, the drive automatically sets this parameter to *[3] Option A* if it detects a valid network option installed in slot A. If the option is removed, the drive detects a change in the configuration, sets *parameter O-02 Control Word Source* back to default setting *[1] Drive Port*, and the drive then trips. If an option is installed after initial power-up, the setting of *parameter O-02 Control Word Source* does not change but the drive trips and displays: *alarm 67, Option Changed*. The drive port is the RS485 port running the protocol as set in O-30 ([0] Drive, [1] Drive MC, [2] Modbus RTU, [3] Metasys N2, or [4] FLN.
[0]	None	
[1] *	Drive Port	The drive port is the RS485 port running the protocol as set in parameter O-30; Drive, Drive MC, Modbus RTU, Metasys N2, or FLN.
[2]	USB Port	
[3]	Option A	
[4]	Option B	
[30]	External Can	

O-03 Control Word Timeout Time

Range:		Function:
60.0 s*	[0.5 - 18000 s]	Enter the maximum time expected to pass between the reception of 2 consecutive messages. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *parameter O-04 Control Word Timeout Function* is then carried out. The object list holds information on the objects that triggers the control timeout: • Analog outputs • Binary outputs • AV0 • AV1 • AV2 • AV4 • BV1 • BV2 • BV3 • BV4 • BV5 • Multistate outputs

O-04 Control Word Timeout Function

Option:		Function:
		Select the timeout function. The timeout function is activated when the control word fails to be updated within the time period specified in *parameter O-03 Control Word Timeout Time*. *[20] N2 Override Release* only appears after setting the Metasys N2 protocol.
[0] *	Off	
[1]	Freeze output	
[2]	Stop	
[3]	Jogging	
[4]	Max. speed	
[5]	Stop and trip	
[7]	Select setup 1	
[8]	Select setup 2	
[9]	Select setup 3	
[10]	Select setup 4	
[20]	N2 Override Release	

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O-05 End-of-Timeout Function		
Option:		**Function:**
		Select the action after receiving a valid control word following a timeout. This parameter is active only when *parameter O-04 Control Word Timeout Function* is set to: • *[7] Set-up 1.* • *[8] Set-up 2.* • *[9] Set-up 3.* • *[10] Set-up 4.*
[0]	Hold set-up	Retains the set-up selected in *parameter O-04 Control Word Timeout Function* and shows a warning until *parameter O-06 Reset Control Word Timeout* toggles. Then the frequency converter resumes its original set-up.
[1] *	Resume set-up	Resumes the set-up that was active before the timeout.

O-06 Reset Control Word Timeout		
Option:		**Function:**
		This parameter is active only when option *[0] Hold set-up* has been selected in *parameter O-05 End-of-Timeout Function*.
[0] *	Do not reset	Retains the set-up specified in *parameter O-04 Control Word Timeout Function*: • *[7] Set-up 1.* • *[8] Set-up 2.* • *[9] Set-up 3.* • *[10] Set-up 4.*
[1]	Do reset	Returns the drive to the original set-up following a control word timeout. When the value is set to *[1] Do reset*, the drive performs the reset and immediately reverts to the *[0] Do not reset* setting.

O-07 Diagnosis Trigger		
Option:		**Function:**
		To send no extended diagnosis data (EDD), select *[0] Disable*. To send EDD upon alarms,. select *[1] Trigger on alarms*. To send EDD upon alarms or warnings, select *[2] Trigger alarm/warn.* Not all fieldbusses support the diagnosis functions.
[0] *	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm/warn.	

O-08 Readout Filtering		
If the speed feedback value readouts on fieldbus are fluctuating, this function is used. Select filtered, if the function is required. A power cycle is required for changes to take effect.		
Option:		**Function:**
[0] *	Motor Data Std-Filt.	Normal fieldbus readouts.
[1]	Motor Data LP-Filter	Filtered fieldbus readouts of the following parameters: • *Parameter DR-10 Power [kW].* • *Parameter DR-11 Power [hp].* • *Parameter DR-12 Motor Voltage.* • *Parameter DR-14 Motor current.* • *Parameter DR-16 Torque [Nm].* • *Parameter DR-17 Speed [RPM].* • *Parameter DR-22 Torque [%].* • *Parameter DR-25 Torque [Nm] High.*

O-09 Communication Charset		
Option:		**Function:**
[0]	ISO 8859-1	
[1] *	ANSI X3.4	
[2]	UTF - 8	

3.9.2 O-1# Control Settings

O-10 Control Word Profile		
Option:		**Function:**
		Select the interpretation of the control and status words corresponding to the installed network. Only the selections valid for the network installed in slot A are visible in the LPC display.
[0] *	Drive Profile	
[1]	PROFIdrive profile	
[5]	ODVA	Available only with DeviceNet MCA 104 and EtherNet IP .

O-13 Configurable Status Word STW		
Array [16]		
Option:		**Function:**
		This parameter enables configuration of bits 12–15 in the status word.
[0]	No function	
[1] *	Profile Default	The function corresponds to the profile default selected in *parameter O-10 Control Word Profile.*
[2]	Alarm 68 Only	Only set if *alarm 68, Safe stop* occurs.

O-13 Configurable Status Word STW		
Array [16]		
Option:		**Function:**
[3]	Trip excl Alarm 68	Set if a trip occurs, except if *alarm 68, Safe stop* executes the trip.
[10]	T18 DI status	
[11]	T19 DI status	The bit indicates the status of terminal 19. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[12]	T27 DI status	The bit indicates the status of terminal 27. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[13]	T29 DI status	The bit indicates the status of terminal 29. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[14]	T32 DI status	The bit indicates the status of terminal 32. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[15]	T33 DI status	The bit indicates the status of terminal 33. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
[30]	Brake fault (IGBT)	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 main voltage from the frequency converter.
[40]	Out of ref range	
[49]	Derate active	
[60]	Comparator 0	See *parameter group LC-1# Comparators*. If comparator 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See *parameter group LC-1# Comparators*. If comparator 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See *parameter group LC-1# Comparators*. If comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See *parameter group LC-1# Comparators*. If comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See *parameter group LC-1# Comparators*. If comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.

O-13 Configurable Status Word STW		
Array [16]		
Option:		**Function:**
[65]	Comparator 5	See *parameter group LC-1# Comparators*. If comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[70]	Logic Rule 0	See *parameter group LC-4# Logic Rules*. If logic rule 0 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[71]	Logic Rule 1	See *parameter group LC-4# Logic Rules*. If logic rule 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[72]	Logic Rule 2	See *parameter group LC-4# Logic Rules*. If logic rule 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[73]	Logic Rule 3	See *parameter group LC-4# Logic Rules*. If logic rule 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[74]	Logic Rule 4	See *parameter group LC-4# Logic Rules*. If logic rule 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[75]	Logic Rule 5	See *parameter group LC-4# Logic Rules*. If logic rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[80]	SL digital out A	See *parameter LC-52 Logic Controller Action*. The output goes high whenever the smart logic action *[38] Set digital out A high* is executed. The output goes low whenever the smart logic action *[32] Set digital out A low* is executed.
[81]	SL digital out B	See *parameter LC-52 Logic Controller Action*. The input goes high whenever the smart logic action *[39] Set digital out B high* is executed. The input goes low whenever the smart logic action *[33] Set digital out B low* is executed.
[82]	SL digital out C	See *parameter LC-52 Logic Controller Action*. The input goes high whenever the smart logic action *[40] Set digital out C high* is executed. The input goes low whenever the smart logic action *[34] Set digital out C low* is executed.
[83]	SL digital out D	See *parameter LC-52 Logic Controller Action*. The input goes high whenever the smart logic action *[41] Set digital out D high* is executed. The input goes low whenever the smart logic action *[35] Set digital out D low* is executed.
[84]	SL digital out E	See *parameter LC-52 Logic Controller Action*. The input goes high whenever the smart logic action *[42] Set digital out E high* is executed. The input goes low whenever the

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O-13 Configurable Status Word STW		
Array [16]		
Option:		**Function:**
		smart logic action *[36] Set digital out E low* is executed.
[85]	SL digital out F	See *parameter LC-52 Logic Controller Action*. The input goes high whenever the smart logic action *[43] Set digital out F high* is executed. The input goes low whenever the smart logic action *[37] Set digital out F low* is executed.
[86]	ATEX ETR cur. alarm	
[87]	ATEX ETR freq. alarm	
[88]	ATEX ETR cur. warning	
[89]	ATEX ETR freq. warning	

Activate or deactivate the storing of data in non-volatile memory.

O-16 Store Data Values		
Option:		**Function:**
[0] *	Off	
[1]	Store edit setup	
[2]	Store all setups	

O-19 Product Code		
Range:		**Function:**
0*	[0 - 2147483647]	Select 0 to read out the actual fieldbus product code according to the mounted fieldbus option. Select 1 to read out the actual vendor ID.

3.9.3 O-3# Drive Port Settings

O-30 Protocol		
Option:		**Function:**
		Protocol selection for the integrated Drive (standard) Port (RS485) on the control card. Parameter group BN-7# is only visible when *[9] Drive Option* is selected.
[0] *	Drive	Communication according to the Drive Protocol as described in the *AF-600 FP AF-600 FP Design Guide, RS485 Installation and Set-up*.
[1]	Drive MC	Same as [0] Drive but to be used when downloading SW to the drive or uploading dll file (covering information regarding parameters available in the drive and their inter-dependencies) to DCT-10.

O-30 Protocol		
Option:		**Function:**
[2]	Modbus RTU	Communication according to the Modbus RTU protocol as described in the *AF-600 FP AF-600 FP Design Guide, RS485 Installation and Set-up*.
[3]	Metasys N2	Communication according to the Metasys N2 protocal.
[4]	FLN	Communication according to the Apogee FLN P1 protocol.
[9]	Drive Option	To be used when a gateway is connected to the integrated RS485 port, for example the BACnet gateway. Following changes take place: • Address for the Drive port is set to 1, and *parameter O-31 Address*, is now used to set the address for the gateway on the network, for example BACnet. • Baud rate for the Drive port is set to a fixed value (115.200 Baud), and *parameter O-32 Drive Port Baud Rate*, is now used to set the baud rate for the network port (for example BACnet) on the gateway.
[20]	LEN	

O-31 Address		
Range:		**Function:**
1*	[1 - 255]	Enter the address for the Drive (standard) port. Valid range: 1–126.

O-32 Drive Port Baud Rate		
Option:		**Function:**
		Baud rates 9600, 19200, 38400, and 76800 baud are valid for BACnet only. The default value depends on the Drive protocol.
[0]	2400 Baud	
[1]	4800 Baud	
[2] *	9600 Baud	
[3]	19200 Baud	
[4]	38400 Baud	
[5]	57600 Baud	
[6]	76800 Baud	
[7]	115200 Baud	

O-33 Drive Port Parity		
Option:		**Function:**
		Parity and stop bits for the protocol *parameter O-30 Protocol* using the Drive port. For some of the protocols, not all options are visible. Default depends on the protocol selected.

O-33 Drive Port Parity		
Option:		**Function:**
[0] *	Even Parity, 1 Stop Bit	
[1]	Odd Parity, 1 Stop Bit	
[2]	No Parity, 1 Stop Bit	
[3]	No Parity, 2 Stop Bits	

O-34 Estimated cycle time		
Range:		**Function:**
0 ms*	[0 - 1000000 ms]	In noisy environments, the interface may be blocked due to overload or bad frames. This parameter specifies the time between 2 consecutive frames on the network. If the interface does not detect valid frames in that time, it flushes the receive buffer.

O-35 Minimum Response Delay		
Range:		**Function:**
10 ms*	[5 - 10000 ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

O-36 Maximum Response Delay		
Range:		**Function:**
10001 ms*	[11 - 10001 ms]	Specify the maximum permissible delay time between transmitting a request and receiving a response. Exceeding this delay time causes control word timeout.

O-37 Maximum Inter-Char Delay		
Range:		**Function:**
25.00 ms*	[0.00 - 35.00 ms]	Specify the maximum permissible time interval between receipt of 2 bytes. This parameter activates timeout if transmission is interrupted.

3.9.4 O-4# Drive MC protocol set

O-40 Telegram Selection		
Option:		**Function:**
		Enables use of freely configurable messages or standard messages for the Drive port.
[1] *	Standard telegram 1	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	

O-40 Telegram Selection		
Option:		**Function:**
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	
[200]	Custom telegram 1	

O-42 PCD Write Configuration		
Option:		**Function:**
[0] *	None	Select the parameters to be assigned to PCD's messages. The number of available PCDs depends on the message type. The values in PCD's will then be written to the selected parameters as data values.
[7]	Accel Time 1	
[8]	Decel Time 1	
[15]	Motor Speed High Limit [Hz]	
[16]	Motor Speed Low Limit [Hz]	
[17]	Motor Speed High Limit [RPM]	
[18]	Motor Speed Low Limit [RPM]	
[40]	Torque Limiter (Driving)	
[41]	Torque Limiter (Braking)	
[52]	Minimum Reference	
[53]	Maximum Reference	
[110]	Accel Time 2	
[111]	Decel Time 2	
[163]	Term. 29 High Ref./Feedb. Value	
[168]	Term. 33 High Ref./Feedb. Value	
[190]	Digital & Relay Bus Control	
[193]	Pulse Out #27 Bus Control	
[195]	Pulse Out #29 Bus Control	
[197]	Pulse Out #X30/6 Bus Control	
[222]	Jog Accel/Decel Time	
[223]	Quick Stop Decel Time	
[615]	Terminal 53 High Ref./Feedb. Value	
[625]	Terminal 54 High Ref./Feedb. Value	
[653]	Terminal 42 Output Bus Control	
[663]	Terminal X30/8 Output Bus Control	
[890]	Bus Jog 1 Speed	
[891]	Bus Jog 2 Speed	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1280]	Fieldbus CTW 1	
[1282]	Fieldbus REF 1	
[1285]	Drive Port CTW 1	
[1286]	Drive Port REF 1	

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O-42 PCD Write Configuration		
Option:		**Function:**
[1413]	Minimum Reference/Feedb.	
[1414]	Maximum Reference/Feedb.	
[1421]	Setpoint 1	
[1422]	Setpoint 2	
[1423]	Setpoint 3	
[2043]	Terminal X42/7 Bus Control	
[2053]	Terminal X42/9 Bus Control	
[2063]	Terminal X42/11 Bus Control	

O-43 PCD Read Configuration		
Option:		**Function:**
[0] *	None	Select the parameters to be assigned to PCD's of the messages. The number of available PCDs depends on the message type. PCDs contain the actual data values of the selected parameters.
[515]	Readout: Actual Set-up	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1200]	Control Word	
[1201]	Reference [Unit]	
[1202]	Reference [%]	
[1203]	Status Word	
[1205]	Main Actual Value [%]	
[1209]	Custom Readout	
[1210]	Power [kW]	
[1211]	Power [hp]	
[1212]	Torque [Nm]	
[1213]	Frequency	
[1214]	Motor current	
[1215]	Frequency [%]	
[1217]	Speed [RPM]	
[1218]	Motor Thermal	
[1222]	Torque [%]	
[1224]	Calibrated Stator Resistance	
[1230]	DC Link Voltage	
[1232]	Brake Energy /s	
[1233]	Brake Energy Average	
[1234]	Heatsink Temp.	
[1235]	Drive Thermal	
[1238]	Logic Controller State	
[1239]	Control Card Temp.	
[1250]	External Reference	
[1252]	Feedback[Unit]	
[1253]	Digi Pot Reference	
[1254]	Feedback 1 [Unit]	
[1255]	Feedback 2 [Unit]	
[1256]	Feedback 3 [Unit]	
[1260]	Digital Input	

O-43 PCD Read Configuration		
Option:		**Function:**
[1261]	Terminal 53 Switch Setting	
[1262]	Analog Input 53	
[1263]	Terminal 54 Switch Setting	
[1264]	Analog Input 54	
[1265]	Analog Output 42 [mA]	
[1266]	Digital Output [bin]	
[1267]	Freq. Input #29 [Hz]	
[1268]	Freq. Input #33 [Hz]	
[1269]	Pulse Output #27 [Hz]	
[1270]	Pulse Output #29 [Hz]	
[1271]	Relay Output [bin]	
[1272]	Counter A	
[1273]	Counter B	
[1275]	Analog In X30/11	
[1276]	Analog In X30/12	
[1277]	Analog Out X30/8 [mA]	
[1284]	Comm. Option STW	
[1285]	Drive Port CTW 1	
[1290]	Alarm Word	
[1291]	Alarm Word 2	
[1292]	Warning Word	
[1293]	Warning Word 2	
[1294]	Ext. Status Word	
[1295]	Ext. Status Word 2	
[1296]	Maintenance Word	
[1330]	Analog Input X42/1	
[1331]	Analog Input X42/3	
[1332]	Analog Input X42/5	
[1333]	Analog Out X42/7 [V]	
[1334]	Analog Out X42/9 [V]	
[1335]	Analog Out X42/11 [V]	
[1500]	Operating hours	
[1501]	Running Hours	
[1502]	kWh Counter	
[2497]	Alert Alarm Word	
[2498]	Alert Warning Word	
[2499]	Alert Status Word	

3.9.5 O-5# Digital/Bus

Parameters for configuring the control word merging.

NOTICE

These parameters are active only when *parameter O-01 Control Site* is set to *[0] Digital and control word*.

O-50 Coasting Select

Option:		Function:
		Select the trigger for the coasting function.
[0]	Digital input	A digital input triggers the coasting function.
[1]	Bus	A serial communication port or the network option module triggers the coasting function.
[2]	Logic AND	The network/serial communication port and a digital input trigger the coasting function.
[3] *	Logic OR	The network/serial communication port or a digital input trigger the coasting function.

O-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus. ***NOTICE*** **When *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*, only selection *[0] Digital input* is available.**
[0]	Digital input	Activates a DC Brake command via a digital input.
[1]	Bus	Activates a DC Brake command via the serial communication port or network option module.
[2]	Logic AND	Activates a DC Brake command via the network/ serial communication port, and also via 1 of the digital inputs.
[3] *	Logic OR	Activates a DC Brake command via the network/ serial communication port, or via 1 of the digital inputs.

O-53 Start Select

Option:		Function:
		Select the trigger for the start function.
[0]	Digital input	A digital input triggers the start function.
[1]	Bus	A serial communication port or the network option module triggers the start function.
[2]	Logic AND	The network/serial communication port and a digital input trigger the start function.
[3] *	Logic OR	The network/serial communication port or a digital input trigger the start function.

O-54 Reversing Select

Option:		Function:
		NOTICE **This parameter is active only when *parameter O-01 Control Site* is set to *[0] Digital and control word*.**

O-54 Reversing Select

Option:		Function:
		Select control of the drive reverse function via the terminals (digital input) and/or via the fieldbus.
[0] *	Digital input	Activates reverse command via a digital input.
[1]	Bus	Activates reverse command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates reverse command via the fieldbus/serial communication port, AND via 1 of the digital inputs.
[3]	Logic OR	Activates reverse command via the fieldbus/serial communication port OR via 1 of the digital inputs.

O-55 Set-up Select

Option:		Function:
		Select the trigger for the set-up selection.
[0]	Digital input	A digital input triggers the set-up selection.
[1]	Bus	A serial communication port or the network option module triggers the set-up selection.
[2]	Logic AND	The network/serial communication port and a digital input trigger the set-up selection.
[3] *	Logic OR	The network/serial communication port or a digital input trigger the set-up selection.

O-56 Preset Reference Select

Option:		Function:
		Select the trigger for the preset reference selection.
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the network option module triggers the preset reference selection.
[2]	Logic AND	The network/serial communication port and a digital input trigger the preset reference selection.
[3] *	Logic OR	The network/serial communication port or a digital input trigger the preset reference selection.

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3.9.6 O-8# Drive Port Diagnostics

These parameters are used for monitoring the bus communication via the Drive port.

O-80 Bus Message Count

Range:		Function:
0*	[0 - 0]	This parameter shows the number of valid messages detected on the network.

O-81 Bus Error Count

Array [6]

Range:		Function:
0*	[0 - 0]	This parameter shows the number of messages with faults (for example CRC fault) detected on the network.

O-82 Slave Messages Rcvd

Range:		Function:
0*	[0 - 0]	This parameter shows the number of valid messages addressed to the slave sent by the frequency converter.

O-83 Slave Error Count

Range:		Function:
0*	[0 - 0]	This parameter shows the number of error messages, which could not be executed by the frequency converter.

O-89 Diagnostics Count

Range:		Function:
0*	[-2147483648 - 2147483647]	

3.9.7 O-9# Bus Jog / Feedback

O-90 Bus Jog 1 Speed

Range:		Function:
100 RPM*	[0 - par. F-17 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or network option.

O-91 Bus Jog 2 Speed

Range:		Function:
200 RPM*	[0 - par. F-17 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or network option.

O-94 Bus Feedback 1

Range:		Function:
0*	[-200 - 200]	Write feedback to this parameter via the serial communication port or network option. This parameter must be selected in *parameter CL-00 Feedback 1 Source*, *parameter CL-03 Feedback 2 Source* or

O-94 Bus Feedback 1

Range:		Function:
		parameter CL-06 Feedback 3 Source as a feedback source.

O-95 Bus Feedback 2

Range:		Function:
0*	[-200 - 200]	See *parameter O-94 Bus Feedback 1* for further details.

O-96 Bus Feedback 3

Range:		Function:
0*	[-200 - 200]	See *parameter O-94 Bus Feedback 1* for further details.

3.10 AO-## Analog I/O Options

Parameter group AO-## is only available when an Analog I/O Option Module (opcaio) is added to the frequency converter.

3.10.1 AO-0# Analog I/O Mode

AO-00 Terminal X42/1 Mode		
Option:		**Function:**
		Terminal X42/1 can be programmed as an analog input accepting a voltage or input from either Pt1000 (1000 Ω at 0 °C) or Ni 1000 (1000 Ω at 0 °C) temperature sensors. Select the mode. *[2] Pt 1000 [℃]* and *[4] Ni 1000 [℃]* if operating in Celsius, or *[3] Pt 1000 [℉]* and *[5] Ni 1000 [℉]* if operating in Fahrenheit. ***NOTICE*** **If the input is not in use, set it for voltage.** If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit. • *Parameter CL-12 Reference/Feedback Unit.* • *Parameter XC-10 Ext. 1 Ref./Feedback Unit.* • *Parameter XC-30 Ext. 2 Ref./Feedback Unit.* • *Parameter XC-50 Ext. 3 Ref./Feedback Unit.*
[1] *	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

AO-01 Terminal X42/3 Mode		
Option:		**Function:**
		Terminal X42/3 can be programmed as an analog input accepting a voltage, or input from either Pt 1000 or Ni 1000 temperature sensors. Select the mode. *[2] Pt 1000 [℃]* and *[4] Ni 1000 [℃]* if operating in Celsius, or *[3] Pt 1000 [℉]* and *[5] Ni 1000 [℉]* if operating in Fahrenheit. ***NOTICE*** **If the input is not in use, set it for voltage.** If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit

AO-01 Terminal X42/3 Mode		
Option:		**Function:**
		• *Parameter CL-12 Reference/Feedback Unit.* • *Parameter XC-10 Ext. 1 Ref./Feedback Unit.* • *Parameter XC-30 Ext. 2 Ref./Feedback Unit.* • *Parameter XC-50 Ext. 3 Ref./Feedback Unit.*
[1] *	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

AO-02 Terminal X42/5 Mode		
Option:		**Function:**
		Terminal X42/5 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C) or Ni 1000 (1000 Ω at 0 °C) temperature sensors. Select the mode. *[2] Pt 1000 [℃]* and *[4] Ni 1000 [℃]* if operating in Celsius, or *[3] Pt 1000 [℉]* and *[5] Ni 1000 [℉]* if operating in Fahrenheit. ***NOTICE*** **If the input is not in use, set it for voltage.** If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit: • *Parameter CL-12 Reference/Feedback Unit.* • *Parameter XC-10 Ext. 1 Ref./Feedback Unit.* • *Parameter XC-30 Ext. 2 Ref./Feedback Unit.* • *Parameter XC-50 Ext. 3 Ref./Feedback Unit.*
[1] *	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

3

3.10.2 AO-1# Analog Input X42/1

AO-10 Terminal X42/1 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-31 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value set in *parameter AO-14 Term. X42/1 Low Ref./ Feedb. Value*.

AO-11 Terminal X42/1 High Voltage		
Range:		**Function:**
10 V*	[par. AN-30 - 10 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *parameter AO-15 Term. X42/1 High Ref./ Feedb. Value*.

AO-14 Term. X42/1 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage value set in *parameter AO-10 Terminal X42/1 Low Voltage*.

AO-15 Term. X42/1 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage value set in *parameter AO-11 Terminal X42/1 High Voltage*.

AO-16 Term. X42/1 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor runs.** This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/1. A high time constant value improves dampening, but also increases the time delay through the filter.

AO-17 Term. X42/1 Live Zero		
Option:		**Function:**
		This parameter makes it possible to enable the live zero monitoring, example, where the analog input is the frequency converter control, rather than being used as a decentral I/O system, such as a building management system.
[0]	Disabled	
[1] *	Enabled	

3.10.3 AO-2# Analog Input X42/3

AO-20 Terminal X42/3 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-31 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value set in *parameter AO-24 Term. X42/3 Low Ref./ Feedb. Value*.

AO-21 Terminal X42/3 High Voltage		
Range:		**Function:**
10 V*	[par. AN-30 - 10 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *parameter AO-25 Term. X42/3 High Ref./ Feedb. Value*.

AO-24 Term. X42/3 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage value set in *parameter AO-20 Terminal X42/3 Low Voltage*.

AO-25 Term. X42/3 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage value set in *parameter AO-21 Terminal X42/3 High Voltage*.

AO-26 Term. X42/3 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor runs.** Enter the time constant. This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/3. A high time constant value improves dampening, but also increases the time delay through the filter.

AO-27 Term. X42/3 Live Zero		
Option:		**Function:**
		This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the frequency converter control, rather than being used as a decentral I/O system, such as a building management system.
[0]	Disabled	
[1] *	Enabled	

3.10.4 AO-3# Analog Input X42/5

AO-30 Terminal X42/5 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - par. AN-31 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value set in *parameter AO-34 Term. X42/5 Low Ref./ Feedb. Value*.

AO-31 Terminal X42/5 High Voltage		
Range:		**Function:**
10 V*	[par. AN-30 - 10 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *parameter AO-35 Term. X42/5 High Ref./ Feedb. Value*.

AO-34 Term. X42/5 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage value set in *parameter AO-30 Terminal X42/5 Low Voltage*.

AO-35 Term. X42/5 High Ref./Feedb. Value		
Range:		**Function:**
100*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage value set in *parameter AO-21 Terminal X42/3 High Voltage*.

AO-36 Term. X42/5 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor runs.** This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/5. A high time constant value improves dampening, but also increases the time delay through the filter.

AO-37 Term. X42/5 Live Zero		
Option:		**Function:**
		Enable or disable the live zero monitoring.
[0]	Disabled	
[1] *	Enabled	

3.10.5 AO-4# Analog Out X42/7

AO-40 Terminal X42/7 Output		
Option:		**Function:**
		Set the function of terminal X42/7 as an analog current output.
[0] *	No operation	
[100]	Output frequency	0–100 Hz, (0–10 V).
[101]	Reference	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback	-200% to +200% of *parameter F-53 Maximum Reference*, (0–10 V).
[103]	Motor Current	0–inverter maximum current (*parameter DR-37 Drive Max. Current*), (0–10 V).
[104]	Torque rel to limit	0–torque limit (*parameter F-40 Torque Limiter (Driving)*), (0–10 V).
[105]	Torq relate to rated	0–motor rated torque, (0–10 V).
[106]	Power	0–motor rated power, (0–10 V).
[107]	Speed	0–speed high limit (*parameter F-17 Motor Speed High Limit [RPM]* and *parameter F-15 Motor Speed High Limit [Hz]*), (0–10 V).
[113]	Ext. Closed Loop 1	0–100%, (0–10 V).
[114]	Ext. Closed Loop 2	0–100%, (0–10 V).
[115]	Ext. Closed Loop 3	0–100%, (0–10 V).
[139]	Bus ctrl.	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).

AO-41 Terminal X42/7 Min. Scale		
Range:		**Function:**
0 %*	[0 - 200 %]	Scale the minimum output of the selected analog signal at terminal X42/7, as a percentage of the maximum signal level, example, if 0 V (or 0 Hz) is desired at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in *parameter AO-42 Terminal X42/7 Max. Scale*. See principle graph for *parameter AN-51 Terminal 42 Output Min Scale*.

3

AO-42 Terminal X42/7 Max. Scale		
Range:	**Function:**	
100 %*	[0 - 200 %]	Scale the maximum output of the selected analog signal at terminal X42/7. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage between 0 and 10 V is required at maximum output, calculate the percentage as follows: $\left(\frac{10V}{desired\ maximum\ voltage}\right) x\ 100\,\%$ that is $5V: \frac{10V}{5V} \times 100\,\% = 200\,\%$ See *Illustration 3.28*.

AO-43 Terminal X42/7 Bus Control		
Range:	**Function:**	
0 %*	[0 - 100 %]	Holds the level of terminal X42/7 if controlled by bus.

AO-44 Terminal X42/7 Timeout Preset		
Range:	**Function:**	
0 %*	[0 - 100 %]	Holds the preset level of terminal X42/7. If a fieldbus and a time-out function are selected in *parameter AO-50 Terminal X42/9 Output*, the output presets to this level.

3.10.6 AO-5# Analog Out X42/9

AO-50 Terminal X42/9 Output		
Option:		**Function:**
		Set the function of terminal X42/9.
[0] *	No operation	
[100]	Output frequency	0–100 Hz, (0–10 V).
[101]	Reference	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback	-200% to +200% of *parameter F-53 Maximum Reference*, (0–10 V).
[103]	Motor Current	0–inverter maximum current (*parameter DR-37 Drive Max. Current*), (0–10 V).
[104]	Torque rel to limit	0–torque limit (*parameter F-40 Torque Limiter (Driving)*), (0–10 V).
[105]	Torq relate to rated	0–motor rated torque, (0–10 V).

AO-50 Terminal X42/9 Output		
Option:		**Function:**
[106]	Power	0–motor rated power, (0–10 V).
[107]	Speed	0 –speed high limit (*parameter F-17 Motor Speed High Limit [RPM]* and *parameter F-15 Motor Speed High Limit [Hz]*), (0–10 V).
[113]	Ext. Closed Loop 1	0–100%, (0–10 V).
[114]	Ext. Closed Loop 2	0–100%, (0–10 V).
[115]	Ext. Closed Loop 3	0–100%, (0–10 V).
[139]	Bus ctrl.	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).

AO-51 Terminal X42/9 Min. Scale		
For more information, see *parameter AN-51 Terminal 42 Output Min Scale*.		
Range:	**Function:**	
0 %*	[0 - 200 %]	Scale the minimum output of the selected analog signal at terminal X42/9, as a percentage of the maximum signal level, example, if 0 V is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in *parameter AO-52 Terminal X42/9 Max. Scale*.

AO-52 Terminal X42/9 Max. Scale		
See *Illustration 3.28*.		
Range:	**Function:**	
100 %*	[0 - 200 %]	Scale the maximum output of the selected analog signal at terminal X42/9. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0-100% of the full-scale output, program the percentage value in the parameter, that is, 50%=10 V. If a voltage between 0 and 10 V is required at maximum output, calculate the percentage as follows: that is $5V: \frac{10V}{5V} \times 100\,\% = 200\,\%$

AO-53 Terminal X42/9 Bus Control		
Range:	**Function:**	
0 %*	[0 - 100 %]	Holds the level of terminal X42/9 if controlled by bus.

AO-54 Terminal X42/9 Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Holds the preset level of terminal X42/9. If a fieldbus and a time-out function are selected in *parameter AO-60 Terminal X42/11 Output*, the output presets to this level.

3.10.7 AO-6# Analog Out X42/11

AO-60 Terminal X42/11 Output		
Option:		**Function:**
		Set the function of terminal X42/11.
[0] *	No operation	
[100]	Output frequency	0–100 Hz, (0–10 V).
[101]	Reference	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback	-200% to +200% of *parameter F-53 Maximum Reference*, (0–10 V).
[103]	Motor Current	0–inverter maximum current (*parameter DR-37 Drive Max. Current*), (0–10 V).
[104]	Torque rel to limit	0–torque limit (*parameter F-40 Torque Limiter (Driving)*), (0–10 V).
[105]	Torq relate to rated	0–motor rated torque, (0–0 V).
[106]	Power	0–motor rated power, (0–10 V).
[107]	Speed	0–speed high limit (*parameter F-17 Motor Speed High Limit [RPM]* and *parameter F-15 Motor Speed High Limit [Hz]*), (0–10 V).
[113]	Ext. Closed Loop 1	0–100%, (0–10 V).
[114]	Ext. Closed Loop 2	0–100%, (0–10 V).
[115]	Ext. Closed Loop 3	0–100%, (0–10 V).
[139]	Bus ctrl.	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).

AO-61 Terminal X42/11 Min. Scale		
For more information, see *parameter AN-51 Terminal 42 Output Min Scale*.		
Range:		**Function:**
0 %*	[0 - 200 %]	Scale the minimum output of the selected analog signal at terminal X42/11, as a percentage of the maximum signal level. For example, if 0 V is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than

AO-61 Terminal X42/11 Min. Scale		
For more information, see *parameter AN-51 Terminal 42 Output Min Scale*.		
Range:		**Function:**
		the corresponding setting in *parameter AO-62 Terminal X42/11 Max. Scale*.

AO-62 Terminal X42/11 Max. Scale		
See *Illustration 3.28*.		
Range:		**Function:**
100 %*	[0 - 200 %]	Scale the maximum output of the selected analog signal at terminal X42/9. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. For example, If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is, 50%=10 V. If a voltage between 0 and 10 V is required at maximum output, calculate the percentage as follows: $\left(\frac{10V}{desired\ maximum\ voltage}\right)x100\,\%$ that is $5V:\frac{10V}{5V}x100\,\% = 200\,\%$

AO-63 Terminal X42/11 Bus Control		
Range:		**Function:**
0 %*	[0 - 100 %]	Holds the level of terminal X42/11 if controlled by bus.

AO-64 Terminal X42/11 Timeout Preset		
Range:		**Function:**
0 %*	[0 - 100 %]	Holds the preset level of terminal X42/11. If a fieldbus and a time-out function are selected, the output presets to this level.

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3.11 DN-## DeviceNet

3.11.1 DN-0# Common Settings

DN-00 DeviceNet Protocol		
Option:		**Function:**
[1] *	DeviceNet	***NOTICE*** **The parameter options depend on installed option.** View the active CAN protocol.

DN-01 Baud Rate Select		
Option:		**Function:**
		Select the network transmission speed. The selection must correspond to the transmission speed of the master and the other network nodes.
[16]	10 Kbps	
[17]	20 Kbps	
[18]	50 Kbps	
[19]	100 Kbps	
[20] *	125 Kbps	
[21]	250 Kbps	
[22]	500 Kbps	
[23]	800 Kbps	
[24]	1000 Kbps	

DN-02 MAC ID		
Range:		**Function:**
63*	[0 - 63]	Selection of station address. Every station connected to the same DeviceNet network must have an unambiguous address.

DN-05 Readout Transmit Error Counter		
Range:		**Function:**
0*	[0 - 255]	Shows the number of CAN control transmission errors since the last power-up.

DN-06 Readout Receive Error Counter		
Range:		**Function:**
0*	[0 - 255]	Shows the number of CAN control receipt errors since the last power-up.

DN-07 Readout Bus Off Counter		
Range:		**Function:**
0*	[0 - 255]	View the number of network off events since the last power-up.

3.11.2 DN-1# DeviceNet

DN-10 Process Data Type Selection		
Option:		**Function:**
		Select the instance (message) for data transmission. The instances available depend on the setting of *parameter O-10 Control Word Profile*. When *parameter O-10 Control Word Profile* is set to *[0] Drive protocol*, *parameter DN-10 Process Data Type Selection* options *[0] INSTANCE 100/150* and *[1] INSTANCE 101/151* are available. When *parameter O-10 Control Word Profile* is set to *[5] ODVA*, *parameter DN-10 Process Data Type Selection* options *[2] INSTANCE 20/70* and *[3] INSTANCE 21/71* are available. Instances 100/150 and 101/151 are GE-specific. Instances 20/70 and 21/71 are ODVA-specific AC motor profiles. For guidelines in message selection, refer to the *DeviceNet MCA 104 Installation Guide*. ***NOTICE*** **A change to this parameter is executed immediately.**
[0] *	INSTANCE 100/150	
[1]	INSTANCE 101/151	
[2]	INSTANCE 20/70	
[3]	INSTANCE 21/71	

DN-11 Process Data Config Write		
Option:		**Function:**
		Select the process write data for I/O assembly instances 101/151. Elements 2 and 3 of this array can be selected. Elements 0 and 1 of the array are fixed.
[0] *	None	
[7]	Accel Time 1	
[8]	Decel Time 1	
[15]	Motor Speed High Limit [Hz]	
[16]	Motor Speed Low Limit [Hz]	
[17]	Motor Speed High Limit [RPM]	
[18]	Motor Speed Low Limit [RPM]	
[40]	Torque Limiter (Driving)	
[41]	Torque Limiter (Braking)	
[52]	Minimum Reference	

DN-11 Process Data Config Write		
Option:		**Function:**
[53]	Maximum Reference	
[110]	Accel Time 2	
[111]	Decel Time 2	
[163]	Term. 29 High Ref./Feedb. Value	
[168]	Term. 33 High Ref./Feedb. Value	
[190]	Digital & Relay Bus Control	
[193]	Pulse Out #27 Bus Control	
[195]	Pulse Out #29 Bus Control	
[197]	Pulse Out #X30/6 Bus Control	
[222]	Jog Accel/Decel Time	
[223]	Quick Stop Decel Time	
[615]	Terminal 53 High Ref./Feedb. Value	
[625]	Terminal 54 High Ref./Feedb. Value	
[653]	Terminal 42 Output Bus Control	
[663]	Terminal X30/8 Output Bus Control	
[890]	Bus Jog 1 Speed	
[891]	Bus Jog 2 Speed	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1282]	Fieldbus REF 1	
[1285]	Drive Port CTW 1	
[1286]	Drive Port REF 1	
[1680]	Fieldbus CTW 1	

DN-12 Process Data Config Read		
Option:		**Function:**
[0] *	None	
[515]	Readout: Actual Set-up	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1200]	Control Word	
[1201]	Reference [Unit]	
[1202]	Reference [%]	
[1203]	Status Word	
[1205]	Main Actual Value [%]	
[1209]	Custom Readout	
[1210]	Power [kW]	
[1211]	Power [hp]	
[1212]	Torque [Nm]	
[1213]	Frequency	
[1214]	Motor current	
[1215]	Frequency [%]	
[1217]	Speed [RPM]	
[1218]	Motor Thermal	
[1222]	Torque [%]	
[1224]	Calibrated Stator Resistance	
[1230]	DC Link Voltage	
[1232]	Brake Energy /s	
[1233]	Brake Energy Average	
[1234]	Heatsink Temp.	

DN-12 Process Data Config Read		
Option:		**Function:**
[1235]	Drive Thermal	
[1238]	Logic Controller State	
[1239]	Control Card Temp.	
[1250]	External Reference	
[1252]	Feedback[Unit]	
[1253]	Digi Pot Reference	
[1254]	Feedback 1 [Unit]	
[1255]	Feedback 2 [Unit]	
[1256]	Feedback 3 [Unit]	
[1260]	Digital Input	
[1261]	Terminal 53 Switch Setting	
[1262]	Analog Input 53	
[1263]	Terminal 54 Switch Setting	
[1264]	Analog Input 54	
[1265]	Analog Output 42 [mA]	
[1266]	Digital Output [bin]	
[1267]	Freq. Input #29 [Hz]	
[1268]	Freq. Input #33 [Hz]	
[1269]	Pulse Output #27 [Hz]	
[1270]	Pulse Output #29 [Hz]	
[1271]	Relay Output [bin]	
[1272]	Counter A	
[1273]	Counter B	
[1275]	Analog In X30/11	
[1276]	Analog In X30/12	
[1277]	Analog Out X30/8 [mA]	
[1284]	Comm. Option STW	
[1285]	Drive Port CTW 1	
[1290]	Alarm Word	
[1291]	Alarm Word 2	
[1292]	Warning Word	
[1293]	Warning Word 2	
[1294]	Ext. Status Word	
[1295]	Ext. Status Word 2	
[1296]	Maintenance Word	
[1330]	Analog Input X42/1	
[1331]	Analog Input X42/3	
[1332]	Analog Input X42/5	
[1333]	Analog Out X42/7 [V]	
[1334]	Analog Out X42/9 [V]	
[1335]	Analog Out X42/11 [V]	
[1500]	Operating hours	
[1501]	Running Hours	
[1502]	kWh Counter	
[2497]	Alert Alarm Word	
[2498]	Alert Warning Word	
[2499]	Alert Status Word	

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DN-13 Warning Parameter		
Range:		**Function:**
0*	[0 - 65535]	View a DeviceNet-specific warning word. One bit is assigned to every warning.

Bit	Description
0	Bus not active.
1	Explicit connection timeout.
2	I/O connection.
3	Retry limit reached.
4	Actual is not updated.
5	CAN Network off.
6	I/O send error.
7	Restore error.
8	No bus supply.
9	Bus off.
10	Error passive.
11	Error warning.
12	Duplicate MAC ID error.
13	RX queue overrun.
14	TX queue overrun.
15	CAN overrun.

Table 3.13 Warning Bits

DN-14 Net Reference		
Read only from keypad.		
Option:		**Function:**
		Select the reference source in instances 21/71 and 20/70.
[0] *	Off	Enables reference via analog/digital inputs.
[1]	On	Enables reference via the network.

DN-15 Net Control		
Read only from keypad.		
Option:		**Function:**
		Select the control source in instances 21/71 and 20/70.
[0] *	Off	Enables control via analog/digital inputs.
[1]	On	Enable control via the network.

DN-18 internal_process_data_config_write		
Range:		**Function:**
0*	[0 - 9999]	

DN-19 internal_process_data_config_read		
Range:		**Function:**
0*	[0 - 9999]	

3.11.3 DN-2# COS Filters

DN-20 COS Filter 1		
Range:		**Function:**
0*	[0 - 65535]	Enter the value for COS filter 1 to set up the filter mask for the status word. When operating in COS (change-of-state), this function filters out bits in the status word that should not be sent if they change.

DN-21 COS Filter 2		
Range:		**Function:**
0*	[0 - 65535]	Enter the value for COS filter 2 to set up the filter mask for the Main Actual Value. When operating in COS, this function filters out bits in the main actual value that should not be sent if they change.

DN-22 COS Filter 3		
Range:		**Function:**
0*	[0 - 65535]	Enter the value for COS filter 3 to set up the filter mask for PCD 3. When operating in COS, this function filters out bits in PCD 3 that should not be sent if they change.

DN-23 COS Filter 4		
Range:		**Function:**
0*	[0 - 65535]	Enter the value for COS filter 4 to set up the filter mask for PCD 4. When operating in COS, this function filters out bits in PCD 4 that should not be sent if they change.

3.11.4 DN-3# Parameter Access

Parameter group providing access to indexed parameters and defining programming set-up.

DN-30 Array Index		
Range:		**Function:**
0*	[0 - 255]	View array parameters. This parameter is valid only when a DeviceNet MCA 104 is installed.

DN-31 Store Data Values		
Option:		**Function:**
		Parameter values changed via DeviceNet are not automatically stored in non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down.
[0] *	Off	Deactivates the non-volatile storage function.
[1]	Store edit setup	Stores all parameter values from the active set-up in the non-volatile memory. The selection returns to *[0] Off* when all values have been stored.
[2]	Store all setups	Stores all parameter values for all set-ups in the non-volatile memory. The selection returns to *[0] Off* when all parameter values have been stored.

DN-32 Devicenet Revision		
Range:		**Function:**
0*	[0 - 65535]	View the DeviceNet revision number. This parameter is used for EDS file creation.

DN-33 Store Always		
Option:		**Function:**
[0] *	Off	Deactivates non-volatile storage of data.
[1]	On	Stores parameter data received via DeviceNet MCA 104 in EEPROM non-volatile memory as default.

DN-34 DeviceNet Product Code		
Range:		**Function:**
120*	[0 - 65535]	

DN-39 Devicenet F Parameters		
Array [1000]. No keypad access.		
Range:		**Function:**
0*	[0 - 0]	This parameter is used to configure the frequency converter via DeviceNet MCA 104 and build the EDS file.

3.12 PB-## PROFIdrive

The parameters in this group are common for Profibus and PROFInet RT.

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PB-00 Setpoint		
Range:		**Function:**
0*	[0 - 65535]	

PB-07 Actual Value		
Range:		**Function:**
0*	[0 - 65535]	

PB-15 PCD Write Configuration		
Option:		**Function:**
[0] *	None	
[7]	Accel Time 1	
[8]	Decel Time 1	
[15]	Motor Speed High Limit [Hz]	
[16]	Motor Speed Low Limit [Hz]	
[17]	Motor Speed High Limit [RPM]	
[18]	Motor Speed Low Limit [RPM]	
[40]	Torque Limiter (Driving)	
[41]	Torque Limiter (Braking)	
[52]	Minimum Reference	
[53]	Maximum Reference	
[110]	Accel Time 2	
[111]	Decel Time 2	
[163]	Term. 29 High Ref./Feedb. Value	
[168]	Term. 33 High Ref./Feedb. Value	
[190]	Digital & Relay Bus Control	
[193]	Pulse Out #27 Bus Control	
[195]	Pulse Out #29 Bus Control	
[197]	Pulse Out #X30/6 Bus Control	
[222]	Jog Accel/Decel Time	
[223]	Quick Stop Decel Time	
[615]	Terminal 53 High Ref./Feedb. Value	
[625]	Terminal 54 High Ref./Feedb. Value	
[653]	Terminal 42 Output Bus Control	
[663]	Terminal X30/8 Output Bus Control	
[890]	Bus Jog 1 Speed	
[891]	Bus Jog 2 Speed	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1280]	Fieldbus CTW 1	
[1282]	Fieldbus REF 1	
[1285]	Drive Port CTW 1	
[1286]	Drive Port REF 1	

PB-16 PCD Read Configuration		
Option:		**Function:**
		Select the parameters to be assigned to PCD 3 to 10 of the messages. The number of available PCDs depends on the telegram type. PCDs 3 to 10 contain the actual data values of the selected parameters. For standard Profibus message, see *parameter PB-22 Telegram Selection*.
[0] *	None	
[515]	Readout: Actual Set-up	
[894]	Bus Feedback 1	
[895]	Bus Feedback 2	
[896]	Bus Feedback 3	
[1200]	Control Word	
[1201]	Reference [Unit]	
[1202]	Reference [%]	
[1203]	Status Word	
[1205]	Main Actual Value [%]	
[1209]	Custom Readout	
[1210]	Power [kW]	
[1211]	Power [hp]	
[1212]	Torque [Nm]	
[1213]	Frequency	
[1214]	Motor current	
[1215]	Frequency [%]	
[1217]	Speed [RPM]	
[1218]	Motor Thermal	
[1222]	Torque [%]	
[1224]	Calibrated Stator Resistance	
[1230]	DC Link Voltage	
[1232]	Brake Energy /s	
[1233]	Brake Energy Average	
[1234]	Heatsink Temp.	
[1235]	Drive Thermal	
[1238]	Logic Controller State	
[1239]	Control Card Temp.	
[1250]	External Reference	
[1252]	Feedback[Unit]	
[1253]	Digi Pot Reference	
[1254]	Feedback 1 [Unit]	
[1255]	Feedback 2 [Unit]	
[1256]	Feedback 3 [Unit]	
[1260]	Digital Input	
[1261]	Terminal 53 Switch Setting	
[1262]	Analog Input 53	
[1263]	Terminal 54 Switch Setting	
[1264]	Analog Input 54	
[1265]	Analog Output 42 [mA]	
[1266]	Digital Output [bin]	

PB-16 PCD Read Configuration

Option:		Function:
[1267]	Freq. Input #29 [Hz]	
[1268]	Freq. Input #33 [Hz]	
[1269]	Pulse Output #27 [Hz]	
[1270]	Pulse Output #29 [Hz]	
[1271]	Relay Output [bin]	
[1272]	Counter A	
[1273]	Counter B	
[1275]	Analog In X30/11	
[1276]	Analog In X30/12	
[1277]	Analog Out X30/8 [mA]	
[1284]	Comm. Option STW	
[1285]	Drive Port CTW 1	
[1290]	Alarm Word	
[1291]	Alarm Word 2	
[1292]	Warning Word	
[1293]	Warning Word 2	
[1294]	Ext. Status Word	
[1295]	Ext. Status Word 2	
[1296]	Maintenance Word	
[1330]	Analog Input X42/1	
[1331]	Analog Input X42/3	
[1332]	Analog Input X42/5	
[1333]	Analog Out X42/7 [V]	
[1334]	Analog Out X42/9 [V]	
[1335]	Analog Out X42/11 [V]	
[1500]	Operating hours	
[1501]	Running Hours	
[1502]	kWh Counter	
[2497]	Alert Alarm Word	
[2498]	Alert Warning Word	
[2499]	Alert Status Word	

PB-18 Node Address

Range:		Function:
126*	[0 - 126]	Enter the station address in this parameter or, alternatively, in the hardware switch. To adjust the station address in *parameter PB-18 Node Address*, set the hardware switch to 126 or 127 (all switches set to ON). Otherwise, this parameter shows the actual setting of the switch.

PB-22 Telegram Selection

Option:		Function:
		Select a standard PROFIBUS telegram configuration for the frequency converter as an alternative to using the freely configurable messages in *parameter PB-15 PCD Write Configuration* and *parameter PB-16 PCD Read Configuration*.
[1]	Standard telegram 1	

PB-22 Telegram Selection

Option:		Function:
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108] *	PPO 8	

PB-23 Parameters for Signals

Array [1000]

Option:		Function:
		This parameter contains a list of signals available for selection in *parameter PB-15 PCD Write Configuration* and *parameter PB-16 PCD Read Configuration*.

PB-27 Parameter Edit

Option:		Function:
		Edit parameters via: • PROFIBUS. • The standard RS485 interface. • The keypad.
[0]	Disabled	Disables editing via PROFIBUS.
[1] *	Enabled	Enables editing via PROFIBUS.

PB-28 Process Control

Option:		Function:
		Process control (setting of control word, speed reference, and process data) is possible via either PROFIBUS or standard Network, but not both simultaneously. Local control is always possible via the keypad. Control via process control is possible via either terminals or Network depending on the settings in *parameter O-50 Coasting Select* to *parameter O-56 Preset Reference Select*.
[0]	Disable	Disables process control via PROFIBUS master class 1 and enables process control via standard Network or PROFIBUS master class 2.
[1] *	Enable cyclic master	Enables process control via PROFIBUS master class 1 and disables process control via standard Network or PROFIBUS master class 2.

PB-44 Fault Message Counter

Range:		Function:
0*	[0 - 65535]	Indicates the number of fault events presently stored in *parameter PB-45 Fault Code*. The buffer capacity is maximum 8 error events. The buffer and counter are set to 0 by reset or power-up.

3

PB-45 Fault Code		
Range:	**Function:**	
0*	[0 - 0]	This buffer contains the alarm word for all alarms and warnings that have occurred since last reset or power-up. The buffer capacity is maximum 8 error events.

PB-47 Fault Number		
Range:	**Function:**	
0*	[0 - 0]	This buffer contains the alarm word for all alarms and warnings that have occurred since last reset or power-up. The buffer capacity is maximum 8 error events.

PB-52 Fault Situation Counter		
Range:		**Function:**
0*	[0 - 1000]	

PB-53 Profibus Warning Word		
Read only		
Range:	**Function:**	
0*	[0 - 65535]	This parameter shows PROFIBUS communication warnings. Refer to the *AF-650 GP & AF-600 FP PROFIBUS DP Operating Instructions, DET-624* for further information.

Bit	Description
0	Connection with DP-master is not OK.
1	Not used.
2	NDL (Network data link layer) is not OK.
3	Clear data command received.
4	Actual value is not updated.
5	Baud rate search.
6	PROFIBUS ASIC is not transmitting.
7	Restore of PROFIBUS is not OK.
8	Frequency converter is tripped.
9	Internal CAN error.
10	Wrong configuration data from PLC.
11	Wrong ID sent by PLC.
12	Internal fault occurred.
13	Not configured.
14	Timeout active.
15	*Warning 34, Fieldbus fault* active.

Table 3.14 PROFIBUS Warning Word

PB-63 Actual Baud Rate		
Option:		**Function:**
		This parameter shows the actual PROFIBUS baud rate. The PROFIBUS master automatically sets the baud rate.
[0]	9,6 kbit/s	
[1]	19,2 kbit/s	

PB-63 Actual Baud Rate		
Option:		**Function:**
[2]	93,75 kbit/s	
[3]	187,5 kbit/s	
[4]	500 kbit/s	
[6]	1500 kbit/s	
[7]	3000 kbit/s	
[8]	6000 kbit/s	
[9]	12000 kbit/s	
[10]	31,25 kbit/s	
[11]	45,45 kbit/s	
[255] *	No baudrate found	

PB-64 Device Identification		
Range:		**Function:**
0*	[0 - 0]	

PB-65 Profile Number		
Range:	**Function:**	
0*	[0 - 0]	This parameter contains the profile identification. Byte 1 contains the profile number and byte 2 the version number of the profile.

PB-67 Control Word 1		
Range:		**Function:**
0*	[0 - 65535]	

PB-68 Status Word 1		
Range:		**Function:**
0*	[0 - 65535]	

PB-70 Edit Set-up		
This parameter is unique for keypad and fieldbus. See *parameter K-11 Edit Set-up*.		
Option:		**Function:**
		Select the set-up to edit.
[0]	Factory setup	Uses default data. This option can be used as a data source to return the other set-ups to a known state.
[1]	Set-up 1	Edits set-up 1.
[2]	Set-up 2	Edits set-up 2.
[3]	Set-up 3	Edits set-up 3.
[4]	Set-up 4	Edits set-up 4.
[9] *	Active Set-up	Follows the active set-up selected in *parameter K-10 Active Set-up*.

PB-71 Profibus Save Data Values

Option:		Function:
		Parameter values changed via PROFIBUS are not automatically stored in non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down.
[0] *	Off	Deactivates the non-volatile storage function.
[1]	Store edit setup	Stores all parameter values for all set-ups in the non-volatile memory. When all parameter values have been stored, the selection returns to *[0] Off*.
[2]	Store all setups	Stores all parameter values for all set-ups in the non-volatile memory. When all parameter values have been stored, the selection returns to *[0] Off*.

PB-72 ProfibusDriveReset

Option:		Function:
[0] *	No action	
[1]	Power-on reset	Resets the frequency converter after power-up, as for power-cycle.
[2]	Power-on reset prep	
[3]	Comm option reset	Resets the PROFIBUS DP option only. This is useful after changing certain settings in parameter group PB-##, for example, *parameter PB-18 Node Address*. When reset, the frequency converter disappears from the Network, which may cause a communication error from the master.

PB-75 DO Identification

Range:		Function:
0*	[0 - 65535]	Provides information about the DO (Drive Object).

PB-80 Defined Parameters (1)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS.

PB-81 Defined Parameters (2)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS.

PB-82 Defined Parameters (3)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS.

PB-83 Defined Parameters (4)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS.

PB-84 Defined Parameters (5)

Array [115]
No LCP access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter displays a list of all the defined frequency converter parameters available for PROFINET.

PB-85 Defined Parameters (6)

Range:		Function:
0*	[0 - 9999]	

PB-90 Changed Parameters (1)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the frequency converter parameters deviating from default setting.

PB-91 Changed Parameters (2)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the frequency converter parameters deviating from default setting.

PB-92 Changed Parameters (3)

Array [116]
No keypad access
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the frequency converter parameters deviating from default setting.

PB-93 Changed Parameters (4)

Range:		Function:
0*	[0 - 9999]	

PB-94 Changed Parameters (5)

Array [116]
No keypad Address
Read only

Range:		Function:
0*	[0 - 9999]	This parameter shows a list of all the frequency converter parameters deviating from default setting.

PB-99 Profibus Revision Counter

Range:		Function:
0*	[0 - 65535]	

3.13 EN-## Ethernet

The parameters in this group are common for Ethernet IP, Modbus TCP, and PROFInet RT.

EN-00 IP Address Assignment

Option:		Function:
		Selects the IP Address assignment method.
[0] *	Manual	Set the IP-address in *parameter EN-01 IP Address* IP Address.
[1]	DHCP	IP-address is assigned via DHCP server.
[2]	BOOTP	IP-address is assigned via BOOTP server.

EN-01 IP Address

Range:		Function:
0*	[0 - 4294967295]	Configure the IP address of the option. Read-only if *parameter EN-00 IP Address Assignment* is set to DHCP or BOOTP.

EN-02 Subnet Mask

Range:		Function:
0*	[0 - 4244635647]	Configure the IP subnet mask of the option. Read-only if *parameter EN-00 IP Address Assignment* is set to DHCP or BOOTP.

EN-03 Default Gateway

Range:		Function:
0*	[0 - 2147483647]	Configure the IP subnet mask of the option. Read-only if *parameter EN-00 IP Address Assignment* is set to DHCP or BOOTP.

EN-04 DHCP Server

Range:		Function:
0*	[0 - 2147483647]	***NOTICE*** **A power-cycle is necessary after setting the IP parameters manually.** Read only. Displays the IP address of the found DHCP or BOOTP server.

EN-05 Lease Expires

Range:		Function:
0*	[0 - 0]	Read only. Shows the lease-time left for the current DHCP-assigned IP address.
Size related*	[0 - 0]	

EN-06 Name Servers

Range:		Function:
0*	[0 - 2147483647]	IP addresses of domain name servers. Can be automatically assigned when using DHCP.

EN-07 Domain Name

Range:		Function:
0	[0 - 48]	Domain name of the attached network. Can be automatically assigned when using DHCP network.

EN-08 Host Name

Range:		Function:
Blank	[0-19 characters]	Logical (given) name of option.

EN-09 Physical Address

Range:		Function:
0*	[0 - 17]	Read-only. Shows the physical (MAC) address of the option.

3.13.1 EN-1# Ethernet Link Parameters

Applies for the whole parameter group.

Index [0] is used for port 1, and index [1] is used for port 2.

EN-10 Link Status

Option:		Function:
		Read-only. Shows the link status of the Ethernet ports.
[0] *	No Link	
[1]	Link	

EN-11 Link Duration

Range:		Function:
0*	[0 - 0]	Read-only. Shows the duration of the present link on each port in dd:hh:mm:ss.

EN-12 Auto Negotiation

Option:		Function:
		Configures Auto Negotiation of Ethernet link parameters, for each port: ON or OFF.
[0]	Off	*Link Speed* and *Link Duplex* can be configured in *parameter EN-13 Link Speed* and *parameter EN-14 Link Duplex*.
[1]	On	

EN-13 Link Speed

Option:		Function:
		Forces the link speed for each port in 10 or 100 Mbps. If *parameter EN-12 Auto Negotiation* is set to *[1] ON*, this parameter is *read-only* and displays the actual link speed. *None* is displayed if no link is present.
[0] *	None	
[1]	10 Mbps	
[2]	100 Mbps	

3

EN-14 Link Duplex

Option:		Function:
		Forces the duplex for each port to full or half duplex. If *parameter EN-12 Auto Negotiation* is set to: [ON], this parameter is read-only.
[0]	Half Duplex	
[1] *	Full Duplex	

EN-20 Control Instance

Range:	Function:
[None, 20, 21, 23, 100, 101, 103]	Read-only. Displays the connection to the master. In Ethernet/IP: If no CIP connection is present, *None* is displayed.

EN-21 Process Data Config Write

Range:	Function:
[[0 - 9] PCD read 0 - 9]	Configuration of readable process data.

EN-22 Process Data Config Read

Range:	Function:
[[0 - 9] PCD read 0 - 9]	Configuration of readable process data.

EN-27 Primary Master

Range:		Function:
0*	[0 - 4294967295]	Controls the Master's access to the process data. The value zero (0.0.0.0) means that other masters can take control of the drive immediately if the connection is lost or closed. Setting an IP number means that only a master with this value can establish a connection for controlling the drive. In systems with backup masters, this parameter should be left to the value zero (0.0.0.0).

EN-28 Store Data Values

Option:		Function:
		This parameter activates a function that stores all parameter values in the non-volatile memory (EEPROM) thus retaining parameter values at power-down. The parameter returns to [0] Off.
[0] *	Off	The store function is inactive.
[1]	Store All set-ups	All parameter values are stored in the non-volatile memory, in all 5 set-ups.

EN-29 Store Always

Option:		Function:
		Activates function that always stores received parameter data in non-volatile memory (EEPROM).
[0] *	Off	
[1]	On	

EN-30 Warning parameter

Range:	Function:
[0000–FFFF hex]	Read-only. Displays the Ethernet/IP specific 16-bit status-word.

Bit	Description
0	Owned
1	Not used
2	Configured
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used
8	Minor recoverable fault
9	Minor unrecoverable fault
10	Major recoverable fault
11	Major unrecoverable fault
12	Not used
13	Not used
14	Not used
15	Not used

Table 3.15 Bit Description

EN-31 Net Reference

Option:		Function:
		Read-only. Displays the reference source in Instance 21/71.
[0] *	Off	Reference from the network is not active.
[1]	On	Reference from the network is active.

EN-32 Net Control

Option:		Function:
		Read-only. Displays the control source in Instance 21/71.
[0] *	Off	Control via the network is not active.
[1]	On	Control via the network is active

EN-33 CIP Revision

Option:		Function:
		Read-only. Displays the CIP-version of the option software.
[0]	Major version (00 - 99)	
[1]	Minor version (00-99)	

EN-34 CIP Product Code

Range:		Function:
201*	[0 - 65535]	Read-only. Shows the CIP product code.

EN-35 EDS Parameter

Range:		Function:
0*	[0 - 0]	

EN-37 COS Inhibit Timer

Range:	Function:
[0–65.535 ms]	Read-only change-of-state inhibit timer. If the option is configured for COS operation, this inhibit timer can be configured in the forward open telegram to prevent that continuously changing PCD data generates extensive network traffic. The inhibit time is in ms, 0=disabled.

EN-38 COS Filters

Range:	Function:
[[0-9] Filter 0–9 (0000-FFFFhex)]	Change-of-state PCD filters. Sets up a filter mask for each word of process data when operating in COS-mode. Single bits in the PCDs can be filtered in/out.

EN-40 Status Parameter

Range:		Function:
0*	[0 - 0]	***NOTICE*** **This parameter is for Modbus TCP only**

EN-41 Slave Message Count

Range:		Function:
0*	[0 - 0]	***NOTICE*** **This parameter is for Modbus TCP only**

EN-42 Slave Exception Message Count

Range:		Function:
0*	[0 - 0]	***NOTICE*** **This parameter is for Modbus TCP only**

EN-80 FTP Server

Option:		Function:
[0] *	Disabled	Disables the built-in FTP server.
[1]	Enabled	Enables the built-in FTP server.

EN-81 HTTP Server

Option:		Function:
[0] *	Disabled	
[1]	Enabled	Enables the built-in HTTP (web) server.

EN-82 SMTP Service

Option:		Function:
[0] *	Disabled	
[1]	Enabled	Enables the SMTP (e-mail) service on the option.

EN-89 Transparent Socket Channel Port

Range:		Function:
0*	[0–9999]	Configures the TCP port-number for the transparent socket channel. This enables Drive-messages to be sent transparently on Ethernet via TCP. Default value is 4000, 0 means disabled.

EN-90 Cable Diagnostic

Option:		Function:
		NOTICE **The cable diagnostics function is only issued on ports where there is no link (see *parameter EN-10 Link Status*, *Link Status*)** Enables/disables advanced cable diagnosis function. If enabled, the distance to cable errors can be read out in *parameter EN-93 Cable Error Length*. The parameter resumes to the default setting of disable after the diagnostics have finished.
[0] *	Disabled	
[1]	Enabled	

EN-91 Auto Cross-Over

Option:		Function:
[0]	Disable	Disables the auto cross-over function.
[1] *	Enable	Enables the auto cross-over function. ***NOTICE*** **Disabling of the auto cross-over function requires crossed Ethernet cables for daisy-chaining the options.**

EN-92 IGMP Snooping

Option:		Function:
		This prevents flooding of the Ethernet protocol stack by only forwarding multicast packets to ports that are a member of the multicast group.
[0]	Disable	Disables the IGMP snooping function.
[1] *	Enable	Enables the IGMP snooping function.

EN-93 Cable Error Length

Range:		Function:
0*	[0 - 65535]	If cable diagnostics is enabled in *parameter EN-90 Cable Diagnostic*, the built-in switch is possible via time domain reflectometry (TDR). This measurement technique detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is shown in meters with an accuracy of ±2 m. The value 0 means that no errors are detected.

EN-94 Broadcast Storm Protection

Range:		Function:
-1 %*	[-1 - 20 %]	The built-in switch is capable of protecting the switch system from receiving too many broadcast packages, which can use up network resources. The value indicates a percentage of the total bandwidth that is allowed for broadcast messages. Example: OFF means that the filter is disabled - all broadcast messages passes through. The value 0% means that no broadcast messages passes through. A value of 10% means that 10% of the total bandwidth is allowed for broadcast messages. If the amount of broadcast messages increases above the 10% threshold, they are blocked.
-1 %*	[-1 - 20 %]	

EN-95 Broadcast Storm Filter

Option:		Function:
		Applies to *parameter EN-94 Broadcast Storm Protection*, if the broadcast storm protection should also include multicast messages.
[0] *	Broadcast only	
[1]	Broadcast & Multicast	

EN-96 Port Mirroring

Enables/disables port-mirroring function. For troubleshooting with a network analyzer tool.

Option:		Function:
[0] *	Disable	No port-mirroring
[1]	Port 1 to Port 2	All network traffic on port 1 is mirrored to port 2.
[2]	Port 2 to Port 1	All network traffic on port 2 is mirrored to port 1.
[10]	Port 1 disabled	
[11]	Port 2 disabled	
[254]	Int. Port to Port 1	
[255]	Int. Port to Port 2	

EN-98 Interface Counters

Range:		Function:
4000*	[0 - 4294967295]	Read-only. Advanced interface counters from built-in switch, can be used for low-level troubleshooting. The parameter shows a sum of port 1+port 2.

EN-99 Media Counters

Range:		Function:
0*	[0 - 4294967295]	Read-only. Advanced interface counters from built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1+port 2.

3.14 BN-## BACnet

3.14.1 BN-7# BACnet

NOTICE

Parameters in this group are active only when *parameter O-30 Protocol* is set to *[5] BACnet*.

BN-70 BACnet Device Instance		
Range:		**Function:**
1*	[0 - 4194302]	***NOTICE*** **This parameter is active only when *parameter O-30 Protocol* is set to *[9] Drive Option*.** Enter a unique ID number for the BACnet device.

BN-72 MS/TP Max Masters		
Range:		**Function:**
127*	[1 - 127]	Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

BN-73 MS/TP Max Info Frames		
Range:		**Function:**
1*	[1 - 65534]	Define how many info/data frames the device is allowed to send while holding the token.

BN-74 "I-Am" Service		
Option:		**Function:**
[0] *	Send at power-up	
[1]	Continuously	Select whether the device should send the "I-Am" service message only at power-up, or continuously with an interval of approximately 1 minute.

BN-75 Initialization Password		
Range:		**Function:**
1*	[1 - 20]	Enter the password needed for execution of Drive Re-initialisation from BACnet.

3.15 LN-## - LonWorks

Parameter group for all LonWorks specific parameters. Parameters related to LonWorks ID.

LN-00 Neuron ID

Range:		Function:
0*	[0 - 0]	View the Neuron chip's unique Neuron ID number.

LN-10 Drive Profile

Option:		Function:
		This parameter allows selecting between LONMARK functional profiles.
[0] *	VSD profile	The GE Profile and the Node Object are common for all profiles.

LN-15 LON Warning Word

Range:		Function:
0*	[0 - 65535]	This parameter contains the LON specific warnings.

Bit	Status
0	Internal fault
1	Internal fault
2	Internal fault
3	Internal fault
4	Internal fault
5	Reserved
6	Reserved
7	Reserved
8	Reserved
9	Changeable types
10	Initialisation error
11	Internal communication error
12	Software revision mismatch
13	Bus not active
14	Option not present
15	LON input (nvi/nci) exceeds limits

Table 3.16 LON Warning Word

LN-17 XIF Revision

Range:		Function:
0*	[0 - 5]	This parameter contains the version of the external interface file on the Neuron C chip on the LON option.

LN-18 LonWorks Revision

Range:		Function:
0*	[0 - 5]	This parameter contains the software version of the application program on the Neuron C chip on the LON option.

LN-21 Store Data Values

Option:		Function:
		This parameter is used to activate storing of data in the non-volatile memory.
[0] *	Off	Store function is inactive.
[2]	Store all setups	Stores all parameter values in the E^2PROM. The value returns to *Off* when all parameter values have been stored.

3.16 ID-## Drive Information

Parameter group containing frequency converter information such as operating data, hardware configuration, and software versions.

3.16.1 ID-0# Operating Data

ID-00 Operating hours		
Range:		**Function:**
0 h*	[0 - 2147483647 h]	View how many hours the frequency converter has run. The value is saved when the frequency converter is turned off.

ID-01 Running Hours		
Range:		**Function:**
0 h*	[0 - 2147483647 h]	View how many hours the motor has run. Reset the counter in *parameter ID-07 Reset Running Hours Counter*. The value is saved when the frequency converter is turned off.

ID-02 kWh Counter		
Range:		**Function:**
0 kWh*	[0 - 2147483647 kWh]	Registers the power consumption of the motor as an average value over 1 hour. Reset the counter in *parameter ID-06 Reset kWh Counter*.

ID-03 Power Up's		
Range:		**Function:**
0*	[0 - 2147483647]	View the number of times the frequency converter has been powered up.

ID-04 Over Temp's		
Range:		**Function:**
0*	[0 - 65535]	View the number of frequency converter temperature faults.

ID-05 Over Volt's		
Range:		**Function:**
0*	[0 - 65535]	View the number of frequency converter overvoltages.

ID-06 Reset kWh Counter		
Option:		**Function:**
[0] *	Do not reset	No reset of the kWh counter is required.
[1]	Reset counter	Press [OK] to reset the kWh counter to 0 (see *parameter ID-02 kWh Counter*).

ID-07 Reset Running Hours Counter		
Option:		**Function:**
[0] *	Do not reset	No reset of the running hours counter is required.
[1]	Reset counter	Select *[1] Reset counter* and press [OK] to reset the running hours counter (*parameter ID-01 Running Hours*) and *parameter ID-08 Number of Starts* to 0 (see also *parameter ID-01 Running Hours*).

ID-08 Number of Starts		
Range:		**Function:**
0*	[0 - 2147483647]	***NOTICE*** **This parameter is reset when resetting *parameter ID-07 Reset Running Hours Counter*.** This is a readout parameter only. The counter shows the number of starts and stops caused by a normal start/stop command and/or when entering/leaving sleep mode.

3.16.2 ID-1# Data Trending Settings

The data log enables continuous logging of up to 4 data sources (*parameter ID-10 Trending Source*) at individual rates (*parameter ID-11 Trending Interval*). A trigger event (*parameter ID-12 Trigger Event*) and window (*parameter ID-14 Samples Before Trigger*) are used to start and stop the logging conditionally.

ID-10 Trending Source		
Array [4]		
Option:		**Function:**
		Select which variables are to be logged.
[0] *	None	
[515]	Readout: Actual Set-up	
[1200]	Control Word	
[1201]	Reference [Unit]	
[1202]	Reference [%]	
[1203]	Status Word	
[1210]	Power [kW]	
[1211]	Power [hp]	
[1212]	Torque [Nm]	
[1213]	Frequency	
[1214]	Motor current	
[1217]	Speed [RPM]	
[1218]	Motor Thermal	
[1222]	Torque [%]	
[1224]	Calibrated Stator Resistance	
[1230]	DC Link Voltage	
[1232]	Brake Energy /s	

3

ID-10 Trending Source

Array [4]

Option:		Function:
[1233]	Brake Energy Average	
[1234]	Heatsink Temp.	
[1235]	Drive Thermal	
[1250]	External Reference	
[1252]	Feedback[Unit]	
[1254]	Feedback 1 [Unit]	
[1255]	Feedback 2 [Unit]	
[1256]	Feedback 3 [Unit]	
[1259]	Adjusted Setpoint	
[1260]	Digital Input	
[1262]	Analog Input 53	
[1264]	Analog Input 54	
[1265]	Analog Output 42 [mA]	
[1266]	Digital Output [bin]	
[1275]	Analog In X30/11	
[1276]	Analog In X30/12	
[1277]	Analog Out X30/8 [mA]	
[1290]	Alarm Word	
[1291]	Alarm Word 2	
[1292]	Warning Word	
[1293]	Warning Word 2	
[1294]	Ext. Status Word	
[1295]	Ext. Status Word 2	
[1330]	Analog Input X42/1	
[1331]	Analog Input X42/3	
[1332]	Analog Input X42/5	
[1333]	Analog Out X42/7 [V]	
[1334]	Analog Out X42/9 [V]	
[1335]	Analog Out X42/11 [V]	
[2110]	Bypass Status Word	
[2497]	Alert Alarm Word	
[2498]	Alert Warning Word	
[2499]	Alert Status Word	

ID-11 Trending Interval

Array [4]

Range:		Function:
0.000*	[0.000 - 0.000]	Enter the interval in ms between each sampling of the variables to be logged.

ID-12 Trigger Event

Option:		Function:
		Selects the trigger event. When the trigger event occurs, a window is applied to freeze the log. The log then retains a specified percentage of samples before the occurrence of the trigger event (*parameter ID-14 Samples Before Trigger*).

ID-12 Trigger Event

Option:		Function:
[0] *	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current Limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Line voltage out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	

ID-13 Trending Mode

Option:		Function:
[0] *	Trend always	Select *[0] Log always* for continuous logging.
[1]	Trend once on trigger	Select *[1] Log once on trigger* to conditionally start and stop logging using *parameter ID-12 Trigger Event* and *parameter ID-14 Samples Before Trigger*.

ID-14 Samples Before Trigger		
Range:		**Function:**
50*	[0 - 100]	Enter the percentage of all samples to be retained in the log before a trigger event occurs. See also *parameter ID-12 Trigger Event* and *parameter ID-13 Trending Mode*.

3.16.3 ID-2# Historic Log

View up to 50 logged data items via the array parameters in this parameter group. Data is logged every time an event occurs (not to be confused with LC events). Events in this context are defined as a change in 1 of the following areas:

- Digital inputs.
- Digital outputs.
- Warning word.
- Alarm word.
- Status word.
- Control word.
- Extended status word.

Events are logged with value and time stamp in ms. The time interval between 2 events depends on how often events occur (maximum once every scan time). Data logging is continuous, but if an alarm occurs, the log is saved and the values can be viewed on the display. This feature is useful, for example when carrying out service following a trip. View the historic log contained in this parameter via the serial communication port or via the display.

ID-20 Historic Log: Event		
Array [50]		
Range:		**Function:**
0*	[0 - 255]	View the event type of the logged events.

ID-21 Historic Log: Value		
Array [50]		
Range:		**Function:**
0*	[0 - 2147483647]	View the value of the logged event. Interpret the event values according to *Table 3.17*:

Digital input	Decimal value. See *parameter DR-60 Digital Input* for description after converting to binary value.
Digital output	Decimal value. See *parameter DR-66 Digital Output [bin]* for a description after converting to binary value.
Warning word	Decimal value. See *parameter DR-92 Warning Word* for a description.
Alarm word	Decimal value. See *parameter DR-90 Alarm Word* for a description.
Status word	Decimal value. See *parameter DR-03 Status Word* for a description after converting to binary value.
Control word	Decimal value. See *parameter DR-00 Control Word* for a description.
Extended status word	Decimal value. See *parameter DR-94 Ext. Status Word* for a description.

Table 3.17 Logged Events

ID-21 Historic Log: Value		
Array [50]		
Range:		**Function:**

ID-22 Historic Log: Time		
Array [50]		
Range:		**Function:**
0 ms*	[0 - 2147483647 ms]	View the time at which the logged event occurred. Time is measured in ms since frequency converter start. The maximum value corresponds to approximately 24 days, which means that the count restarts at 0 after this time period.

ID-23 Historic log: Date and Time		
Array [50]		
Range:		**Function:**
0*	[0 - 0]	Array parameter; Date & Time 0–49: This parameter shows at which time the logged event occurred.

3.16.4 ID-3# Alarm Log

Parameters in this group are array parameters, where up to 10 fault logs can be viewed. 0 is the most recent logged data, and 9 is the oldest. Fault codes, values, and time stamp can be viewed for all logged data.

3

ID-30 Alarm Log: Error Code		
Array [10]		
Range:	**Function:**	
0*	[0 - 255]	View the fault code and look up its meaning in *chapter 4 Troubleshooting*.

ID-31 Alarm Log: Value		
Array [10]		
Range:	**Function:**	
0*	[-32767 - 32767]	View an extra description of the error. This parameter is mostly used in combination with *alarm 38, internal fault*.

ID-32 Alarm Log: Time		
Array [10]		
Range:	**Function:**	
0 s*	[0 - 2147483647 s]	View the time when the logged event occurred. Time is measured in s from frequency converter start-up.

ID-33 Alarm Log: Date and Time		
Array [10]		
Range:	**Function:**	
0*	[0 - 0]	Array parameter; Date & Time 0–9: This parameter shows at which time the logged event occurred.

3.16.5 ID-4# Drive Identification

Parameters containing read-only information about the hardware and software configuration of the frequency converter.

ID-40 Drive Type		
Range:	**Function:**	
0*	[0 - 6]	View the Drive type.

ID-41 Power Section		
Range:	**Function:**	
0*	[0 - 20]	View the Drive type.

ID-42 Voltage		
Range:	**Function:**	
0*	[0 - 20]	View the Drive type.

ID-43 Software Version		
Range:	**Function:**	
0*	[0 - 5]	View the SW version

ID-44 GE Model Number		
Range:	**Function:**	
0*	[0 - 40]	View the model number string used for reordering the frequency converter in its original configuration.

ID-45 Actual Typecode String		
Range:	**Function:**	
0*	[0 - 40]	View the actual type code string.

ID-46 GE Product No.		
Range:	**Function:**	
0*	[0 - 8]	View the 8-digit number. To restore the ordering number after the power card exchange, see *parameter SP-29 Service Code*.

ID-47 GE Power Card Model No		
Range:	**Function:**	
0*	[0 - 8]	View the power card model number.

ID-48 Keypad ID Number		
Range:	**Function:**	
0*	[0 - 20]	View the keypad ID number.

ID-49 SW ID Control Card		
Range:	**Function:**	
0*	[0 - 20]	View the control card software version number.

ID-50 SW ID Power Card		
Range:	**Function:**	
0*	[0 - 20]	View the power card software version number.

ID-51 Drive Serial Number		
Range:	**Function:**	
0*	[0 - 10]	View the frequency converter serial number.

ID-53 Power Card Serial Number		
Range:	**Function:**	
0*	[0 - 19]	View the power card serial number.

ID-59 Filename		
Range:	**Function:**	
0*	[0 - 16]	CSIV Filename readout.

3.16.6 ID-6# Option Ident.

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A and B.

ID-60 Option Mounted

Array [8]

Range:		Function:
0*	[0 - 30]	Shows the type of the installed option.

ID-61 Option SW Version

Array [8]

Range:		Function:
0*	[0 - 20]	View the installed option software version.

ID-62 Option Ordering No

Array [8]

Range:		Function:
0*	[0 - 8]	Shows the ordering number for the installed options.

ID-63 Option Serial No

Array [8]

Range:		Function:
0*	[0 - 18]	View the installed option serial number.

ID-70 Option in Slot A

Range:		Function:
0*	[0 - 30]	View the type code string for the option installed in slot A, and a translation of the type code string. For example, for type code string AX, the translation is No option.

ID-71 Slot A Option SW Version

Range:		Function:
0*	[0 - 20]	View the software version for the option installed in slot A.

ID-72 Option in Slot B

Range:		Function:
0*	[0 - 30]	View the type code string for the option installed in slot B, and a translation of the type code string. For example, for type code string BX, the translation is No option.

ID-73 Slot B Option SW Version

Range:		Function:
0*	[0 - 20]	View the software version for the option installed in slot B.

ID-74 Option in Slot C1

Range:		Function:
0*	[0 - 30]	View the type code string for the option installed in slot C, and a translation of the type code string. For example, for type code string CXXXX, the translation is No option.

ID-75 Slot C0 Option SW Version

Range:		Function:
0*	[0 - 20]	View the software version for the option installed in slot C.

ID-76 Option in Slot C2

Range:		Function:
0*	[0 - 30]	Shows the typecode string for the options (CXXXX if no option) and the translation is, for example, *No option*.

ID-77 Slot C1 Option SW Version

Range:		Function:
0*	[0 - 20]	Software version for the installed option in option slot C.

3.16.7 ID-8#

ID-80 Fan Running Hours

Range:		Function:
0 h*	[0 - 2147483647 h]	View how many hours the heat sink fan has run (increments for each hour). The value is saved when the frequency converter is turned off.

ID-81 Preset Fan Running Hours

Range:		Function:
0 h*	[0 - 99999 h]	Enter the preset fan running hours counter, see *parameter ID-80 Fan Running Hours*. This parameter cannot be selected via the serial port, RS485.

3.16.8 ID-9# Parameter Info

ID-92 Defined Parameters

Range:		Function:
0*	[0 - 9999]	View a list of all defined parameters in the frequency converter. The list ends with 0.

ID-93 Modified Parameters

Range:		Function:
0*	[0 - 9999]	View a list of the parameters that have been changed from their default setting. The list ends with 0. Changes may not be visible until up to 30 s after implementation.

ID-98 Drive Identification		
Range:		**Function:**
0*	[0 - 40]	

ID-99 Parameter Metadata		
Array [30]		
Range:		**Function:**
0*	[0 - 9999]	This parameter contains data used by the DCT-10 tool.

3.17 DR-## Data Readouts

3.17.1 DR-0# General Status

DR-00 Control Word		
Range:		**Function:**
0*	[0 - 65535]	View the control word sent from the frequency converter via the serial communication port in hex code.

DR-01 Reference [Unit]		
Range:		**Function:**
0 ReferenceFeedbackUnit*	[-999999 - 999999 ReferenceFeedbackUnit]	View the present reference value applied on impulse or analog basis in the unit resulting from the configuration selected in *parameter H-40 Configuration Mode* (Hz, Nm, or RPM).

DR-02 Reference [%]		
Range:		**Function:**
0 %*	[-200 - 200 %]	View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references, plus catch up and slow down.

DR-03 Status Word		
Range:		**Function:**
0*	[0 - 65535]	View the status word sent from the frequency converter via the serial communication port in hex code.

DR-05 Main Actual Value [%]		
Range:		**Function:**
0 %*	[-100 - 100 %]	View the 2-byte word sent with the status word to the fieldbus master reporting the main actual value.

DR-09 Custom Readout		
Range:		**Function:**
0 CustomReadoutUnit*	[-999999.99 - 999999.99 CustomReadoutUnit]	View the user-defined readouts as defined in *parameter K-30 Unit for Custom Readout*, *parameter K-31 Min Value of Custom Readout*, and *parameter K-32 Max Value of Custom Readout*.

3.17.2 DR-1# Motor Status

DR-10 Power [kW]		
Range:		**Function:**
0 kW*	[0 - 10000 kW]	Shows motor power in kW. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 s may pass from when an input value changes to when the data readout values change. The resolution of readout value on fieldbus is in 10 W steps.

DR-11 Power [hp]		
Range:		**Function:**
0 hp*	[0 - 10000 hp]	View the motor power in hp. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 ms may pass from when an input value changes to when the data readout values change.

DR-12 Motor Voltage		
Range:		**Function:**
0 V*	[0 - 6000 V]	View the motor voltage, a calculated value used for controlling the motor.

DR-13 Frequency		
Range:		**Function:**
0 Hz*	[0 - 6500 Hz]	View the motor frequency, without resonance damping.

DR-14 Motor current		
Range:		**Function:**
0 A*	[0 - 10000 A]	View the motor current measured as an average value, I_{RMS}. The value is filtered, and thus approximately 1.3 s may pass from when an input value changes to when the data readout values change.

DR-15 Frequency [%]		
Range:		**Function:**
0 %*	[-100 - 100 %]	View a 2-byte word reporting the actual motor frequency (without resonance damping) as a percentage (scale 0000–4000 hex) of *parameter F-03 Max Output Frequency 1*. Set *parameter PB-16 PCD Read Configuration* index 1 to send it with the status word instead of the MAV.

3

DR-16 Torque [Nm]		
Range:		**Function:**
0 Nm*	[-30000 - 30000 Nm]	View the torque value with sign, applied to the motor shaft. Linearity is not exact between 110% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Therefore, the minimum and the maximum values depend on the maximum motor current as well as the motor used. The value is filtered, and thus approximately 1.3 s may pass from when an input changes value to when the data readout values change.

DR-17 Speed [RPM]		
Range:		**Function:**
0 RPM*	[-30000 - 30000 RPM]	View the actual motor RPM.

DR-18 Motor Thermal		
Range:		**Function:**
0 %*	[0 - 100 %]	View the calculated thermal load on the motor. The cut-out limit is 100%. The basis for calculation is the Electronic Thermal Overload function selected in *parameter F-10 Electronic Overload*.

DR-22 Torque [%]		
Range:		**Function:**
0 %*	[-200 - 200 %]	This is a readout parameter only. Shows the actual torque yielded in percentage of the rated torque, based on the setting of the motor size and rated speed in *parameter P-07 Motor Power [kW]* or *parameter P-02 Motor Power [HP]*, and *parameter P-06 Base Speed*. This is the value monitored by the broken-belt function set in parameter group *AP-6#*.

DR-23 Motor Shaft Power [kW]		
Range:		**Function:**
0 kW*	[0 - 10000 kW]	Shows the power applied to the motor shaft. The showed value is an estimate based on the motor shaft torque and motor speed.

DR-24 Calibrated Stator Resistance		
Range:		**Function:**
0.0000 Ohm*	[0.0000 - 100.0000 Ohm]	

3.17.3 DR-3# Drive Status

DR-30 DC Link Voltage		
Range:		**Function:**
0 V*	[0 - 10000 V]	View a measured value. The value is filtered with a 30 ms time constant.

DR-31 System Temp.		
Range:		**Function:**
0 °C*	[-128 - 127 °C]	

DR-32 Brake Energy /s		
Range:		**Function:**
0 kW*	[0 - 10000 kW]	View the brake power transmitted to an external brake resistor, stated as an instant value.

DR-33 Brake Energy Average		
Range:		**Function:**
0 kW*	[0 - 10000 kW]	View the brake power transmitted to an external brake resistor. The mean power is calculated on an average level based on the selected time period within *parameter B-13 Braking Thermal Overload*.

DR-34 Heatsink Temp.		
Range:		**Function:**
0 °C*	[0 - 255 °C]	View the frequency converter heat sink temperature. The cut-out limit is 90 ±5 °C (194 ±9 °F), and the motor cuts back in at 60 ±5 °C (140 ±9 °F).

DR-35 Drive Thermal		
Range:		**Function:**
0 %*	[0 - 100 %]	View the thermal load on the inverter. The cut-out limit is 100%.

DR-36 Drive Nominal Current		
Range:		**Function:**
10.00 A*	[0.01 - 10000 A]	View the inverter nominal current, which should match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

DR-37 Drive Max. Current		
Range:		**Function:**
16.00 A*	[0.01 - 10000 A]	View the inverter maximum current, which should match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

DR-38 Logic Controller State		
Range:		**Function:**
0*	[0 - 100]	View the state of the event under execution by the Logic controller.

DR-39 Control Card Temp.		
Range:		**Function:**
0 °C*	[0 - 100 °C]	View the temperature on the control card, stated in °C.

DR-40 Trending Buffer Full		
Option:		**Function:**
		View whether the logging buffer is full (see *chapter 3.16.2 ID-1# Data Trending Settings*). The logging buffer is never full when *parameter ID-13 Trending Mode* is set to *[0] Log always*.
[0] *	No	
[1]	Yes	

DR-41 Keypad Bottom Statusline		
Range:		**Function:**
0*	[0 - 50]	

DR-43 Timed Actions Status		
View the timed actions mode.		
Option:		**Function:**
[0] *	Timed Actions Auto	
[1]	Timed Actions Disabled	
[2]	Constant On Actions	
[3]	Constant Off Actions	

DR-49 Current Fault Source		
Range:		**Function:**
0*	[0 - 8]	The value indicates source of current fault, including: • Short circuit. • Overcurrent. • Phase imbalance (from left): 1–4 – inverter, 5–8 – rectifier, 0 – no fault recorded.

After a short circuit alarm (I_{max2}) or overcurrent alarm (I_{max1}) or imbalance of supply voltage, this contains the power card number associated with the alarm. It only holds 1 number indicating the highest priority power card number (master first). The value persists on power cycle, but if a new alarm occurs it is overwritten by the new power card number (even if it is a lower priority number). The value is only cleared when the alarm log is cleared (that is a 3-finger reset would reset the readout to 0).

3.17.4 DR-5# Ref. & Feedb.

DR-50 External Reference		
Range:		**Function:**
0*	[-200 - 200]	View the total reference, the sum of digital, analog, preset, fieldbus, and freeze references, plus catch up and slow down.

DR-52 Feedback[Unit]		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	View value of resulting feedback value after processing of feedback 1-3 see • *Parameter DR-54 Feedback 1 [Unit].* • *Parameter DR-55 Feedback 2 [Unit].* • *Parameter DR-56 Feedback 3 [Unit].* in the feedback manager. See parameter group *CL-0# Feedback*. The value is limited by settings in *parameter F-52 Minimum Reference* and *parameter F-53 Maximum Reference*. Units as set in *parameter CL-12 Reference/ Feedback Unit*.

DR-53 Digi Pot Reference		
Range:		**Function:**
0*	[-200 - 200]	View the contribution of the digital Pot. meter to the actual reference.

DR-54 Feedback 1 [Unit]		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	View value of feedback 1. The value is limited by settings in F-53 and F-54. Units as set in *parameter CL-12 Reference/ Feedback Unit*.

3

DR-55 Feedback 2 [Unit]		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	View value of feedback 2, see parameter group *CL-0# Feedback*. The value is limited by settings in *parameter CL-13 Minimum Reference/Feedb.* and *parameter CL-14 Maximum Reference/Feedb.* Units as set in *parameter CL-12 Reference/ Feedback Unit*.

DR-56 Feedback 3 [Unit]		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	View value of feedback 3. The value is limited by settings in *parameter CL-13 Minimum Reference/Feedb.* and *parameter CL-14 Maximum Reference/Feedb.*. Units as set in *parameter CL-12 Reference/ Feedback Unit*.

DR-58 PID Output [%]		
Range:		**Function:**
0 %*	[0 - 100 %]	This parameter returns the frequency converter closed-loop PID controller output value in percent.

DR-59 Adjusted Setpoint		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Shows the value of the adjusted setpoint.

3.17.5 DR-6# Inputs and Outputs

DR-60 Digital Input		
Range:		**Function:**
0*	[0 - 1023]	View the signal states from the active digital inputs. Example: Input 18 corresponds to bit number 5, 0 = no signal, 1 = connected signal.

DR-60 Digital Input		
Range:		**Function:**
	Bit 0	Digital input terminal 33.
	Bit 1	Digital input terminal 32.
	Bit 2	Digital input terminal 29.
	Bit 3	Digital input terminal 27.
	Bit 4	Digital input terminal 19.
	Bit 5	Digital input terminal 18.
	Bit 6	Digital input terminal 37.
	Bit 7	Digital input General Purpose I/O OPCGPIO General Purpose I/O terminal X30/4 (OPCGPIO).
	Bit 8	Digital input General Purpose I/O OPCGPIO General Purpose I/O terminal X30/3 (OPCGPIO).
	Bit 9	Digital input General Purpose I/O OPCGPIO General Purpose I/O terminal X30/2 (OPCGPIO).
	Bit 10–63	Reserved for future terminals.

Table 3.18 Active Digital Inputs

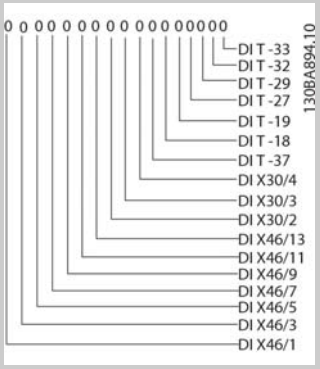


Illustration 3.37 Relay Settings

DR-61 Terminal 53 Switch Setting		
Option:		**Function:**
		View the setting of input terminal 53.
[0] *	Current	
[1]	Voltage	

DR-62 Analog Input 53		
Range:		**Function:**
0*	[-20 - 20]	View the actual value at input 53.

DR-63 Terminal 54 Switch Setting		
Option:		**Function:**
		View the setting of input terminal 54.
[0] *	Current	
[1]	Voltage	

DR-64 Analog Input 54		
Range:		**Function:**
0*	[-20 - 20]	View the actual value at input 54.

DR-65 Analog Output 42 [mA]		
Range:		**Function:**
0*	[0 - 30]	View the actual value at output 42 in mA. The value shown reflects the selection in *parameter AN-50 Terminal 42 Output*.

DR-66 Digital Output [bin]		
Range:		**Function:**
0*	[0 - 15]	View the binary value of all digital outputs.

DR-67 Freq. Input #29 [Hz]		
Range:		**Function:**
0*	[0 - 130000]	View the actual frequency rate on terminal 29.

DR-68 Freq. Input #33 [Hz]		
Range:		**Function:**
0*	[0 - 130000]	View the actual value of the frequency applied at terminal 33 as an impulse input.

DR-69 Pulse Output #27 [Hz]		
Range:		**Function:**
0*	[0 - 40000]	View the actual value of impulses applied to terminal 27 in digital output mode.

DR-70 Pulse Output #29 [Hz]		
Range:		**Function:**
0*	[0 - 40000]	View the actual value of pulses to terminal 29 in digital output mode.

DR-71 Relay Output [bin]		
Range:		**Function:**
0*	[0 - 511]	View the settings of all relays.

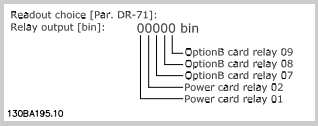


Illustration 3.38 Relay Settings

DR-72 Counter A		
Range:		**Function:**
0*	[-2147483648 - 2147483647]	View the present value of counter A. Counters are useful as comparator operands, see *parameter LC-10 Comparator Operand*. Reset or change the value either via digital inputs (parameter group *E-0#*) or by using an LC action (*parameter LC-52 Logic Controller Action*).

DR-73 Counter B		
Range:		**Function:**
0*	[-2147483648 - 2147483647]	View the present value of counter B. Counters are useful as comparator operands (*parameter LC-10 Comparator Operand*). Reset or change the value either via digital inputs (parameter group *E-0#*) or by using an LC action (*parameter LC-52 Logic Controller Action*).

DR-75 Analog In X30/11		
Range:		**Function:**
0*	[-20 - 20]	View the actual value at input X30/11 of General Purpose I/O OPCGPIO General Purpose I/O.

DR-76 Analog In X30/12		
Range:		**Function:**
0*	[-20 - 20]	View the actual value at input X30/12 of General Purpose I/O OPCGPIO General Purpose I/O.

DR-77 Analog Out X30/8 [mA]		
Range:		**Function:**
0*	[0 - 30]	View the actual value at input X30/8 .

3.17.6 DR-8# Fieldbus & Drive Port

Parameters for reporting the bus references and control words.

DR-80 Fieldbus CTW 1		
Range:		**Function:**
0*	[0 - 65535]	View the 2-byte control word (CTW) received from the fieldbus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in *parameter O-10 Control Word Profile*. For more information, refer to the relevant fieldbus manual.

DR-82 Fieldbus REF 1		
Range:		**Function:**
0*	[-200 - 200]	View the 2-byte word sent with the control word from the fieldbus master to set the reference value. For more information, refer to the relevant network manual.

DR-84 Comm. Option STW		
Range:		**Function:**
0*	[0 - 65535]	Shows the status word of the extended fieldbus communication option.

3

DR-85 Drive Port CTW 1		
Range:		**Function:**
0*	[0 - 65535]	View the 2-byte control word (CTW) received from the fieldbus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in *parameter O-10 Control Word Profile*.

DR-86 Drive Port REF 1		
Range:		**Function:**
0*	[-200 - 200]	View the 2-byte status word (STW) sent to the fieldbus master. Interpretation of the status word depends on the network option installed and the control word profile selected in *parameter O-10 Control Word Profile*.

3.17.7 DR-9# Diagnosis Readouts

NOTICE

When using DCT-10, the readout parameters can only be read online, that is as the actual status. This means that the status is not stored in the DCT-10 file.

DR-90 Alarm Word		
Range:		**Function:**
0*	[0 - 4294967295]	Shows the alarm word sent via the serial communication port in hex code.

DR-91 Alarm Word 2		
Range:		**Function:**
0*	[0 - 4294967295]	View the alarm word 2 sent via the serial communication port in hex code.

DR-92 Warning Word		
Range:		**Function:**
0*	[0 - 4294967295]	Shows the warning word sent via the serial communication port in hex code.

DR-93 Warning Word 2		
Range:		**Function:**
0*	[0 - 4294967295]	View the warning word 2 sent via the serial communication port in hex code.

DR-94 Ext. Status Word		
Range:		**Function:**
0*	[0 - 4294967295]	Returns the extended status word sent via the serial communication port in hex code.

DR-95 Ext. Status Word 2		
Range:		**Function:**
0*	[0 - 4294967295]	Returns the extended warning word 2 sent via the serial communication port in hex code.

DR-96 Maintenance Word		
Range:		**Function:**
0*	[0 - 4294967295]	Readout of the preventive maintenance word. The bits reflect the status for the programmed preventive maintenance events in parameter group *T-1#*. 13 bits represent combinations of all the possible items: • Bit 0: Motor bearings. • Bit 1: Pump bearings. • Bit 2: Fan bearings. • Bit 3: Valve. • Bit 4: Pressure transmitter. • Bit 5: Flow transmitter. • Bit 6: Temperature transmitter. • Bit 7: Pump seals. • Bit 8: Fan belt. • Bit 9: Filter. • Bit 10: Frequency converter cooling fan. • Bit 11: Frequency converter system health check. • Bit 12: Warranty. • Bit 13: Maintenance Text 0. • Bit 14: Maintenance Text 1. • Bit 15: Maintenance Text 2. • Bit 16: Maintenance Text 3. • Bit 17: Maintenance Text 4.

DR-96 Maintenance Word

Range: **Function:**

Position 4⇒	Valve	Fan bearings	Pump bearings	Motor bearings
Position 3⇒	Pump seals	Temperature transmitter	Flow transmitter	Pressure transmitter
Position 2⇒	Drive system health check	Drive cooling fan	Filter	Fan belt
Position 1⇒	–	–	–	Warranty
0_{hex}	–	–	–	–
1_{hex}	–	–	–	+
2_{hex}	–	–	+	–
3_{hex}	–	–	+	+
4_{hex}	–	+	–	–
5_{hex}	–	+	–	+
6_{hex}	–	+	+	–
7_{hex}	–	+	+	+
8_{hex}	+	–	–	–
9_{hex}	+	–	–	+
A_{hex}	+	–	+	–
B_{hex}	+	–	+	+
C_{hex}	+	+	–	–
D_{hex}	+	+	–	+
E_{hex}	+	+	+	–
F_{hex}	+	+	+	+

Table 3.19 Maintenance Word

Example:
The preventive maintenance word shows 040Ahex.

Position	1	2	3	4
Hex value	0	4	0	A

Table 3.20 Example

The first digit 0 indicates that no items from the 4th row require maintenance.
The 2nd digit 4 refers to the 3rd row indicating that the frequency converter cooling fan requires maintenance.
The 3rd digit 0 indicates that no items from the 2nd row require maintenance.
The 4th digit A refers to the top row indicating that the valve and the pump bearings require maintenance.

3.18 LG-## Logs & I/O Opt. Status

3.18.1 LG-0# Maintenance Log

This group contains the last 10 preventive maintenance events. Maintenance log 0 is the latest and maintenance log 9 the oldest.
By selecting 1 of the logs and pressing [OK], the maintenance item, action, and time of the occurrence are shown in *parameter LG-00 Maintenance Log: Item – parameter LG-03 Maintenance Log: Date and Time*.

The alarm log key allows access to both alarm log and maintenance log.

LG-00 Maintenance Log: Item

Array [10]
For details about a fault code, refer to the *design guide*.

Range:		Function:
0*	[0 - 255]	Locate the meaning of the maintenance item in the description of *parameter T-10 Maintenance Item*.

LG-01 Maintenance Log: Action

Array [10]
For details about a fault code, refer to the *design guide*.

Range:		Function:
0*	[0 - 255]	Locate the meaning of the maintenance item in the description of *parameter T-11 Maintenance Action*.

LG-02 Maintenance Log: Time

Array [10]

Range:		Function:
0 s*	[0 - 2147483647 s]	Shows when the logged event occurred. Time is measured in s since last power-up.

LG-03 Maintenance Log: Date and Time

Array [10]

Range:		Function:
0*	[0 - 0]	Shows when the logged event occurred. ***NOTICE*** **This requires that the date and time is programmed in *parameter K-70 Date and Time*.** Date format depends on the setting in *parameter K-71 Date Format*, while the time format depends on the setting in *parameter K-72 Time Format*.

LG-03 Maintenance Log: Date and Time

Array [10]

Range:		Function:
		NOTICE **The frequency converter has no back-up of the clock function, and the set date/time resets to default (2000-01-01 00:00) after a power-down unless an Analog I/O Option Module with Real Time Clock Battery Back Up (OPCAIO) is installed. In *parameter K-79 Clock Fault* it is possible to program a warning in case the clock has not been set properly, for example after a power-down. Incorrect setting of the clock affects the time stamps for the maintenance events.**

NOTICE

When mounting a Analog I/O option card, a battery back-up of date and time is included.

3.18.2 LG-1# Fire Mode Log

The log covers the latest 10 faults which have been suppressed by the Fire mode function. See parameter group *FB-0#, Fire Mode*. The log can be viewed either via the below parameters or by pressing [Alarm Log] on the keypad and select *Fire mode log*. It is not possible to reset the fire mode log.

LG-10 FireMode Log:Event

Range:		Function:
0*	[0 - 255]	This parameter contains an array with 10 elements. The number read represent an error code, which corresponds to a specific alarm. This can be found in the *Troubleshooting* section in the design guide.

LG-11 Fire Mode Log: Time

Range:		Function:
0 s*	[0 - 2147483647 s]	This parameter contains an array with 10 elements. The parameter shows at which time the logged event occurred. Time is measured in seconds since the first start of the motor.

LG-12 Fire Mode Log: Date and Time		
Range:		**Function:**
0*	[0 - 0]	This parameter contains an array with 10 elements. The parameter shows at which date and time the logged event occurred. The function relies on that the actual date and time has been set in *parameter K-70 Date and Time*. Note: There is no built-in battery back-up of the clock. An Analog I/O Option Module with Real Time Clock Battery Back Up (OPCAIO) can be used to back up the clock settings.. See parameter group 0–7* Clock Settings K-7#.

3.18.3 LG-3# I/O Option Status

Parameters for reporting the digital and analog I/O ports.

LG-30 Analog Input X42/1		
Range:		**Function:**
0*	[-20 - 20]	Readout of the value of the signal applied to terminal X42/1 on the analog I/O card. The units of the value shown in the keypad correspond to the mode selected in *parameter AO-00 Terminal X42/1 Mode*.

LG-31 Analog Input X42/3		
Range:		**Function:**
0*	[-20 - 20]	Readout of the value of the signal applied to terminal X42/3 on the analog I/O card. The units of the value shown in the keypad correspond to the mode selected in *parameter AO-01 Terminal X42/3 Mode*.

LG-32 Analog Input X42/5		
Range:		**Function:**
0*	[-20 - 20]	Readout of the value of the signal applied to terminal X42/5 on the analog I/O card. The units of the value shown in the keypad correspond to the mode selected in *parameter AO-02 Terminal X42/5 Mode*.

LG-33 Analog Out X42/7 [V]		
Range:		**Function:**
0*	[0 - 30]	Readout of the value of the signal applied to terminal X42/7 on the analog I/O card. The value shown reflects the selection in *parameter AO-40 Terminal X42/7 Output*.

LG-34 Analog Out X42/9 [V]		
Range:		**Function:**
0*	[0 - 30]	Readout of the value of the signal applied to terminal X42/9 on the analog I/O card. The value shown reflects the selection in *parameter AO-50 Terminal X42/9 Output*.

LG-35 Analog Out X42/11 [V]		
Range:		**Function:**
0*	[0 - 30]	Readout of the value of the signal applied to terminal X42/11 on the analog I/O card. The value shown reflects the selection in *parameter AO-60 Terminal X42/11 Output*.

3.19 AP-## HVAC Appl. Param.

This group contains parameters used for monitoring HVAC applications.

AP-00 External Interlock Delay		
Range:		**Function:**
0 s*	[0 - 600 s]	Only relevant if 1 of the digital inputs in parameter group *E-0#* has been programmed for *[7] External Interlock*. The external interlock timer introduces a delay after the signal has been removed from the digital input programmed for external interlock, before reaction takes place.

3.19.1 AP-2# No-Flow Detection

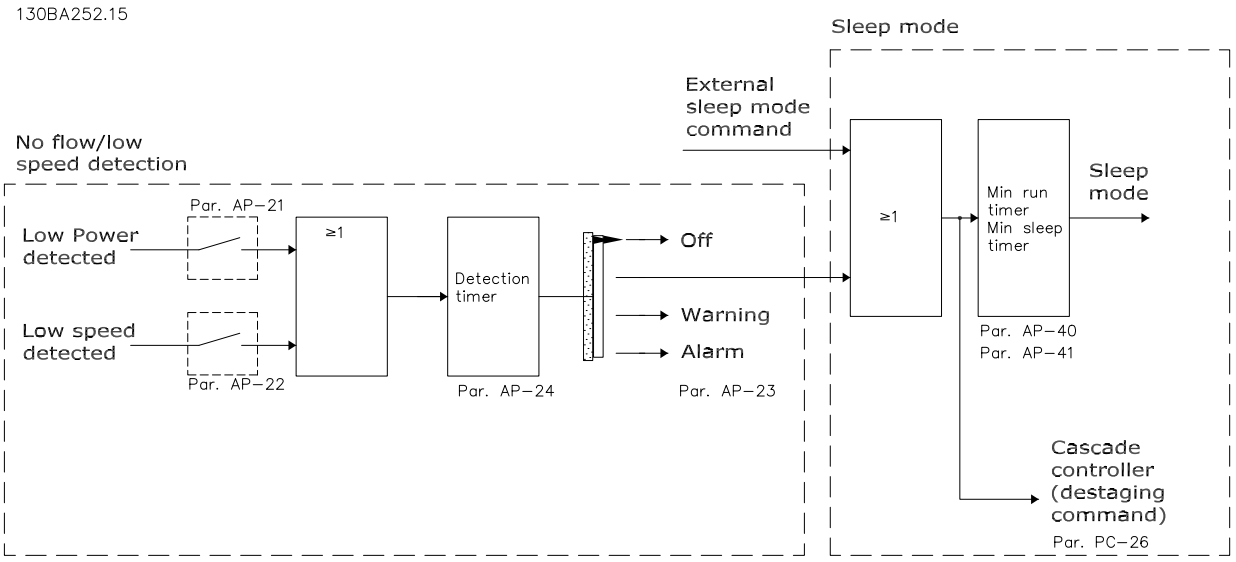


Illustration 3.39 No-flow Detection

The frequency converter includes functions for detecting if the load conditions in the system allow the motor to be stopped:

- Low power detection.
- Low speed detection.

One of these 2 signals must be active for a set time (*parameter AP-24 No-Flow Delay*) before selected action takes place. Possible actions to select (*parameter AP-23 No-Flow Function*):

- No action
- Warning
- Alarm
- Sleep mode

No-flow detection

This function is used for detecting a no-flow situation in pump systems where all valves can be closed. Can be used both when controlled by the integrated PI controller in the frequency converter or an external PI controller. Program the actual configuration in *parameter H-40 Configuration Mode*.

Configuration mode for

- Integrated PI controller: Closed loop.
- External PI controller: Open loop.

NOTICE

Carry out no-flow tuning before setting the PI controller parameters.

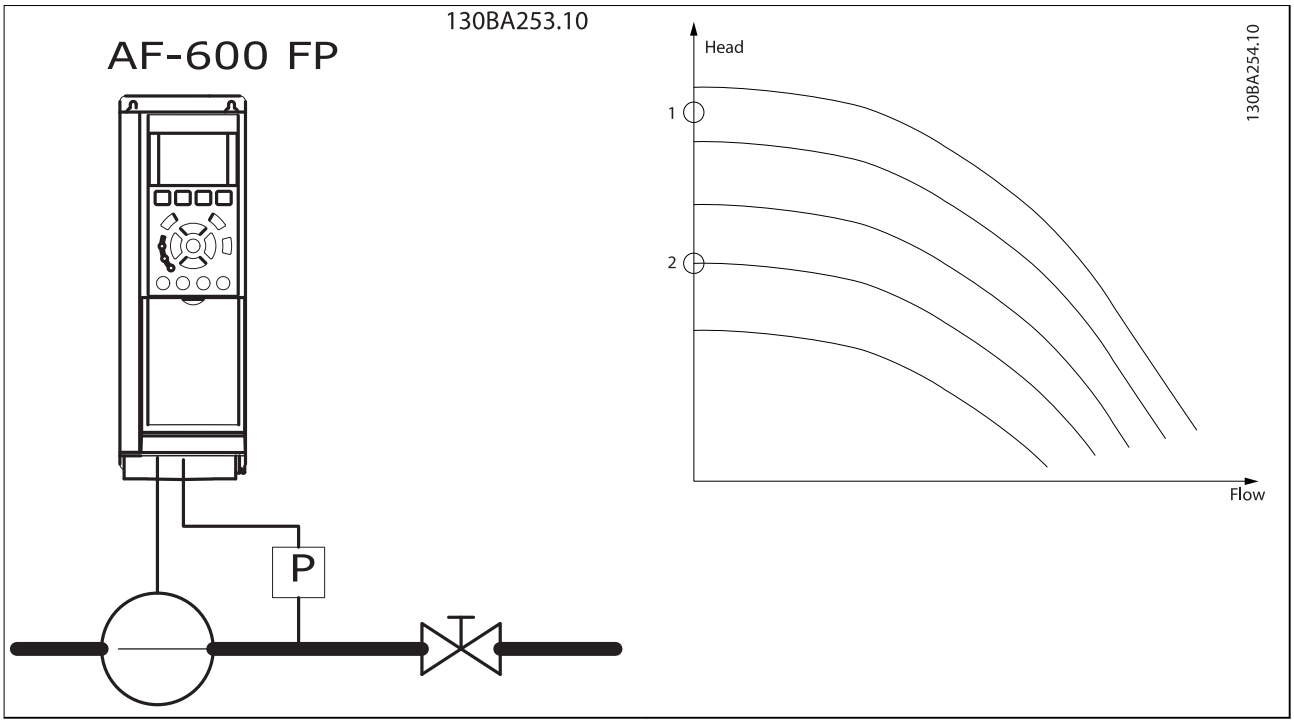


Table 3.21 No-flow Detection

No-flow detection is based on the measurement of speed and power. For a certain speed, the frequency converter calculates the power at no-flow.

This coherence is based on the adjustment of 2 sets of speed and associated power at no-flow. Monitoring power enables detection of no-flow conditions in systems with fluctuating suction pressure, or of the pump having a flat characteristic towards low speed.

The 2 sets of data must be based on measurement of power at approximately 50% and 85% of maximum speed with the valves closed. The data is programmed in parameter group AP-3#. It is also possible to run a *[0] Low Power Auto Set Up* (*parameter AP-20 Low Power Auto Set-up*) automatically stepping through the commissioning process and storing the data measured. Set the frequency converter for *[0] Open Loop* in *parameter H-40 Configuration Mode*, when carrying out the auto set-up, see *parameter group AP-3# No-flow Power Tuning*.

NOTICE

If to use the integrated PI controller, carry out no-flow tuning before setting the PI controller parameters.

Low-speed detection

Low-speed detection gives a signal if the motor operates with minimum speed as set in *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*. Actions are common with no-flow detection (individual selection not possible).

The use of low-speed detection is not limited to systems with a no-flow situation. Low-speed detection can be used in any system where operation at minimum speed allows a stop of the motor until the load calls for a speed higher than minimum speed. This could, for example, be in systems with fans and compressors.

NOTICE

In pump systems, ensure that the minimum speed in *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]* is set high enough for detection as the pump can run with a rather high speed even with valves closed.

Dry-pump detection

If the pump has run dry (low power consumption-high speed), no-flow detection can also be used for detecting. Can be used with both the integrated PI controller and an external PI controller.

The condition for dry-pump signal:

- Power consumption below no-flow level.

and

- Pump running at maximum speed or maximum reference open loop, whichever is lowest.

The signal must be active for a set time (*parameter AP-27 Dry Pump Delay*) before the selected action takes place.
Possible actions to select (*parameter AP-26 Dry Pump Function*):

- Warning
- Alarm

Enable and commission no-flow detection in *parameter AP-23 No-Flow Function* and parameter group *AP-3# No Power Tuning*.

AP-20 Low Power Auto Set-up		
Start of auto set-up of power data for no-flow power tuning.		
Option:		**Function:**
[0] *	Off	
[1]	Enabled	***NOTICE*** **Do the auto set-up when the system has reached normal operating temperature.** ***NOTICE*** **It is important that *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]* is set to the maximum operational speed of the motor.** **It is important to do the auto set-up before configuring the integrated PI controller as settings are reset when changing from closed loop to open loop in *parameter H-40 Configuration Mode*.**

AP-20 Low Power Auto Set-up		
Start of auto set-up of power data for no-flow power tuning.		
Option:		**Function:**
		NOTICE **Carry out the tuning with the same settings in *parameter H-43 Torque Characteristics* as for operation after the tuning.** An auto set-up sequence is activated, automatically setting speed to approximately 50% and 85% of nominal motor speed (*parameter F-17 Motor Speed High Limit [RPM]*, *parameter F-15 Motor Speed High Limit [Hz]*). At those 2 speeds, the power consumption is automatically measured and stored. Before enabling auto set-up: 1. Close valve(s) to create a no-flow condition. 2. Set the frequency converter to open loop (*parameter H-40 Configuration Mode*). It is important also to set *parameter H-43 Torque Characteristics*.

AP-21 Low Power Detection

Option:		Function:
[0] *	Disabled	
[1]	Enabled	To set the parameters in parameter group *AP-3#* for proper operation, carry out the low-power detection commissioning.

AP-22 Low Speed Detection

Option:		Function:
[0] *	Disabled	
[1]	Enabled	Detects when the motor operates with a speed as set in *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*.

AP-23 No-Flow Function

Common actions for low-power detection and low-speed detection (individual selections not possible).

Option:		Function:
[0] *	Off	***NOTICE*** **Do not set *parameter H-04 Auto-Reset (Times)*, to *[13] Infinite auto reset*, when *parameter AP-23 No-Flow Function* is set to *[3] Alarm*. Doing so causes the frequency converter to continuously cycle between running and stopping when a no-flow condition is detected.** ***NOTICE*** **Disable the automatic bypass function of the bypass if the frequency converter is equipped with a constant-speed bypass with an automatic bypass function starting the bypass if the frequency converter experiences a persistent alarm condition, and *[3] Alarm* is selected as the no-flow function.** The drive will not respond to a No Flow condition.
[1]	Sleep Mode	The frequency converter enters sleep mode and stops when a no-flow condition is detected. See parameter group *AP-4#* for programming options for sleep mode.
[2]	Warning	The frequency converter continues to run, but activates a no-flow warning *(warning 92, NoFlow)*. A digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The frequency converter stops running and activates a no-flow alarm *(alarm 92, NoFlow)*. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

AP-23 No-Flow Function

Common actions for low-power detection and low-speed detection (individual selections not possible).

Option:		Function:
		communication bus can communicate an alarm to other equipment.

AP-24 No-Flow Delay

Range:		Function:
10 s*	[1 - 600 s]	Set the time that low power/low speed must stay detected to activate signal for actions. If detection disappears before the timer runs out, the timer is reset.

AP-26 Dry Pump Function

Select the action for dry pump operation.

Option:		Function:
[0] *	Off	
[1]	Warning	***NOTICE*** **To use dry-pump detection:** **1. Enable low-power detection in *parameter AP-21 Low Power Detection*.** **2. Commission low-power detection using either parameter group *AP-3# No Flow Power Tuning*, or *parameter AP-20 Low Power Auto Set-up*.** ***NOTICE*** **Do not set *parameter H-04 Auto-Reset (Times)* to *[13] Infinite auto reset*, when *parameter AP-26 Dry Pump Function* is set to *[2] Alarm*. Doing so causes the frequency converter to continuously cycle between running and stopping when a dry pump condition is detected.** ***NOTICE*** **For frequency converters with constant-speed bypass** **If an automatic bypass function starts the bypass at persistent alarm conditions, disable the automatic bypass function, if *[2] Alarm* or *[3] Man. Reset Alarm* is selected as the dry pump function.** The frequency converter continues to run, but activates a dry-pump warning *(warning 93, Dry pump)*. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.

3

AP-26 Dry Pump Function		
Select the action for dry pump operation.		
Option:		**Function:**
[2]	Alarm	The frequency converter stops running and activates a dry-pump alarm *(alarm 93, Dry pump)*. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.
[3]	Man. Reset Alarm	The frequency converter stops running and activates a dry-pump alarm *(alarm 93, Dry pump)*. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.
[4]	Stop and Trip	

AP-27 Dry Pump Delay		
Range:		**Function:**
10 s*	[0 - 600 s]	Defines for how long the dry-pump condition must be active before activating a warning or an alarm. The frequency converter waits for the no-flow delay time (*parameter AP-24 No-Flow Delay*) to expire before the timer for the dry-pump delay starts.

3.19.2 AP-3# No-flow Power Tuning

If auto set-up is disabled in *parameter AP-20 Low Power Auto Set-up*, the tuning sequence is:

1. Close the main valve to stop flow.
2. Run with motor until the system has reached normal operating temperature.
3. Press [Hand] and adjust speed for approximately 85% of rated speed. Note the exact speed.
4. Read power consumption either by looking for actual power in the data line in the keypad or by viewing 1 of the following parameters:
   - 4a *Parameter DR-10 Power [kW]*.
     or
   - 4b *Parameter DR-11 Power [hp]* in the Main Menu.

   Note the power readout.
5. Change speed to approximately 50% of rated speed. Note the exact speed.
6. Read power consumption either by looking for actual power in the data line in the keypad or by viewing 1 of the following parameters:
   - 6a *Parameter DR-10 Power [kW]*.
     or
   - 6b *Parameter DR-11 Power [hp]* in the Main Menu.

   Note the power readout.
7. Program the speeds used in:
   - 7a *Parameter AP-32 Low Speed [RPM]*.
   - 7b *Parameter AP-33 Low Speed [Hz]*.
   - 7c *Parameter AP-36 High Speed [RPM]*.
   - 7d *Parameter AP-37 High Speed [Hz]*.
8. Program the associated power values in:
   - 8a *Parameter AP-34 Low Speed Power [kW]*.
   - 8b *Parameter AP-35 Low Speed Power [HP]*.
   - 8c *Parameter AP-38 High Speed Power [kW]*.
   - 8d *Parameter AP-39 High Speed Power [HP]*.
9. Switch back with [Auto] or [Off].

NOTICE

Set *parameter H-43 Torque Characteristics* before tuning takes place.

AP-30 No-Flow Power		
Range:		**Function:**
0 kW*	[0 - 0 kW]	Readout of calculated no-flow power at actual speed. If power drops to the display value, the frequency converter considers the condition as a no-flow situation.

AP-31 Power Correction Factor		
Range:		**Function:**
100 %*	[1 - 400 %]	Make corrections to the calculated power in *parameter AP-30 No-Flow Power*. If no-flow is detected when it should not be detected, decrease the setting. However, if no-flow is not detected when it should be detected, increase the setting to above 100%.

AP-32 Low Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. AP-36 RPM]	To be used if *parameter K-02 Motor Speed Unit* is set to *[0] RPM* (parameter not visible if *[1] Hz* is selected). Set used speed for the 50% level. This function is used for storing values necessary for tuning no-flow detection.

AP-33 Low Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - par. AP-37 Hz]	To be used if *parameter K-02 Motor Speed Unit* is set for *[1] Hz* (parameter not visible if *[0] RPM* is selected). Set used speed for the 50% level. The function is used for storing values necessary for tuning no-flow detection.

AP-34 Low Speed Power [kW]		
Range:		**Function:**
0 kW*	[0 - 5.50 kW]	To be used if *parameter K-03 Regional Settings* is set for *[0] International* (parameter not visible if *[1] North America* is selected). Set power consumption at 50% speed level. This function is used for storing values necessary for tuning no-flow detection.

AP-35 Low Speed Power [HP]		
Range:		**Function:**
0 hp*	[0 - 7.50 hp]	To be used if *parameter K-03 Regional Settings* is set for *[1] North America* (parameter not visible if *[0] International* is selected). Set power consumption at 50% speed level. This function is used for storing values necessary for tuning no-flow detection.

AP-36 High Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. F-17 RPM]	To be used if *parameter K-02 Motor Speed Unit* is set for *[0] RPM* (parameter not visible if *[1] Hz* is selected). Set used speed for the 85% level. The function is used for storing values necessary for tuning no-flow detection.

AP-37 High Speed [Hz]		
Range:		**Function:**
0.0 Hz*	[0 - par. F-15 Hz]	To be used if *parameter K-02 Motor Speed Unit* is set for *[1] Hz* (parameter not visible if *[0] RPM* is selected). Set used speed for the 85% level. The function is used for storing values necessary for tuning no-flow detection.

AP-38 High Speed Power [kW]		
Range:		**Function:**
0 kW*	[0 - 5.50 kW]	To be used, if *parameter K-03 Regional Settings* is set for *[0] International* (parameter not visible if *[1] North America* is selected). Set power consumption at 85% speed level. This function is used for storing values necessary for tuning no-flow detection.

AP-39 High Speed Power [HP]		
Range:		**Function:**
0 hp*	[0 - 7.50 hp]	To be used if *parameter K-03 Regional Settings* is set for *[1] North America* (parameter not visible if *[0] International* is selected). Set power consumption at 85% speed level. This function is used for storing values necessary for tuning no-flow detection.

3

3.19.3 AP-4# Sleep Mode

If the load on the system allows for stop of the motor and the load is monitored, the motor can be stopped by activating the sleep mode function. This is not a normal stop command, but ramps the motor down to 0 RPM and stops energising the motor. When in sleep mode, certain conditions are monitored to find out when load has been applied to the system again.

Sleep mode can be activated either from the no-flow detection/minimum speed detection (must be programmed via parameters for no-flow detection, see the signal flow-diagram in parameter group *AP-2#, No-Flow Detection*) or via an external signal applied to 1 of the digital inputs (must be programmed via the parameters for configuration of the digital inputs, parameter group *E-0#* selecting *[66] Sleep Mode*). Sleep mode is activated only when no wake-up conditions are present.
To enable use of, for example, an electro-mechanical flow switch to detect a no-flow condition and activate sleep mode, the action takes place at the raising edge of the external signal applied (otherwise the frequency converter would stay in sleep mode as the signal would be steadily connected).

NOTICE

If sleep mode is to be based on no-flow detection/ minimum speed, select *[1] Sleep Mode* in *parameter AP-23 No-Flow Function*.

If *parameter PC-26 Destage At No-Flow* is set for *[1] Enabled*, activating sleep mode sends a command to the pump controller (if enabled) to start de-staging of lag pumps (fixed speed) before stopping the lead pump (variable speed).

When entering sleep mode, the lower status line in the keypad shows *Sleep Mode*.

3

See also signal flow chart in parameter group *AP-2# No-Flow Detection*.
There are 3 different ways of using the sleep mode function:

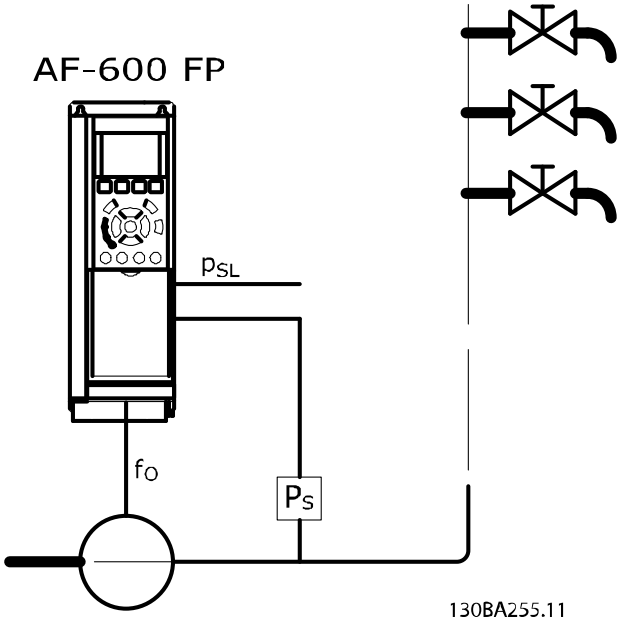


Illustration 3.40 Sleep Mode Function

1) Systems where the integrated PI controller is used for controlling pressure or temperature, for example boost systems with a pressure feedback signal applied to the frequency converter from a pressure transducer. Set *parameter H-40 Configuration Mode* for *[3] Closed Loop* and configure the PI controller configured for desired reference and feedback signals.
Example: Boost system.

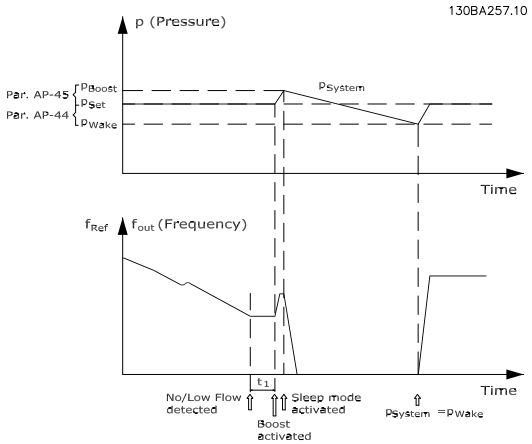


Illustration 3.41 Boost System

If no-flow is detected, the frequency converter increases the setpoint for pressure to ensure a slight overpressure in the system (boost to be set in *parameter AP-45 Setpoint Boost*).
The feedback from the pressure transducer is monitored, and when this pressure has dropped with a set percentage below the normal setpoint for pressure (P_{set}), the motor acccel again and the pressure reaches the set value (P_{set}).

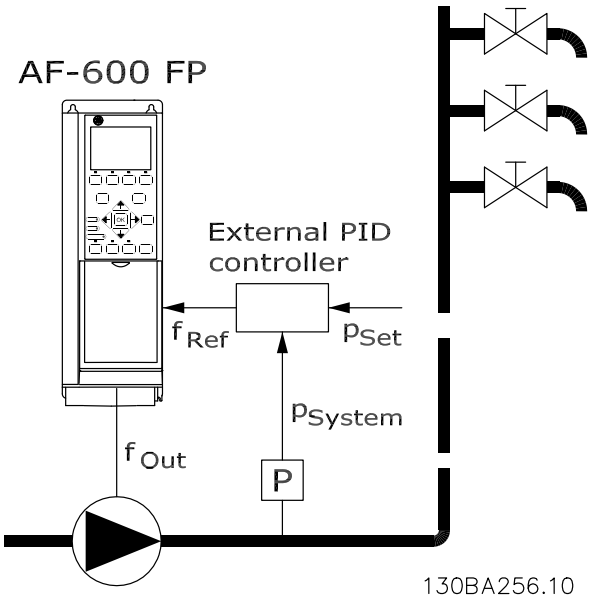


Illustration 3.42 Boost System

2) In systems where the pressure or temperature is controlled by an external PI controller, the wake-up conditions cannot be based on feedback from the pressure/temperature transducer as the setpoint is not known. In the example with a boost system, desired pressure P_{set} is not known. Set *Parameter H-40 Configuration Mode* to *[0] Open Loop*.
Example: Boost system.

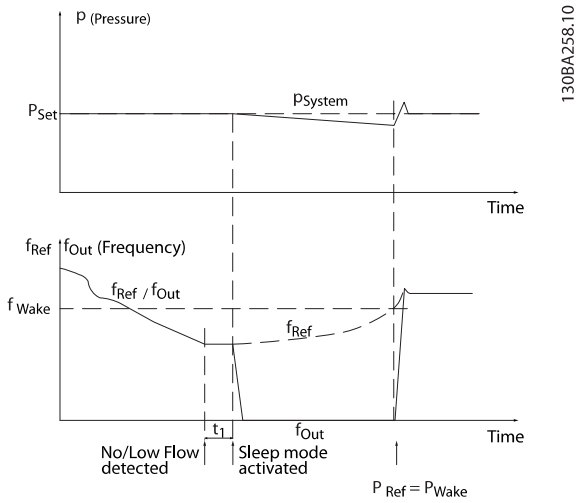


Illustration 3.43 Boost System

When low power or low speed is detected, the motor is stopped, but the reference signal (f_{ref}) from the external controller is still monitored. Because of the low pressure created, the controller increases the reference signal to gain pressure. When the reference signal has reached a set value, f_{wake}, the motor restarts.

The speed is set manually by an external reference signal (remote reference). Use default settings (parameter group *AP-3#*) for tuning of the no-flow function.

	Internal PI controller (*parameter H-40 Configuration Mode*: Closed loop)		**External PI controller or manual control (*parameter H-40 Configuration Mode*: Open loop)**	
	Sleep mode	**Wake up**	**Sleep mode**	**Wake up**
No-flow detection (pumps only)	Yes	–	Yes (except manual setting of speed)	–
Low speed detection	Yes	–	Yes	–
External signal	Yes	–	Yes	–
Pressure/temperature (transmitter connected)	–	Yes	–	No
Output frequency	–	No	–	Yes

Table 3.22 Configuration Overview

NOTICE

Sleep mode is not active when local reference is active (press the navigation keys to set speed manually). See *parameter F-02 Operation Method*.
Does not work in hand-on mode. Carry out auto set-up in open loop before setting input/output in closed loop.

AP-40 Minimum Run Time

Range:		Function:
10 s*	[0 - 600 s]	Set the minimum running time for the motor after a start command (digital input or fieldbus) before entering sleep mode.

AP-41 Minimum Sleep Time

Range:		Function:
10 s*	[0 - 600 s]	Set the minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

AP-42 Wake-up Speed [RPM]

Range:		Function:
0 RPM*	[par. F-18 - par. F-17 RPM]	To be used if *parameter K-02 Motor Speed Unit* has been set for *[0] RPM* (parameter not visible if *[1] Hz* is selected). Only to be used if *parameter H-40 Configuration Mode* is set for *[0] Open loop* and an external controller applies speed reference. Set the reference speed at which the sleep mode should be canceled.

AP-43 Wake-up Speed [Hz]

Range:		Function:
0 Hz*	[par. F-16 -	To be used if *parameter K-02 Motor Speed Unit* has been set for *[1] Hz* (parameter not visible if *[0] RPM* is selected). Only to be used if

AP-43 Wake-up Speed [Hz]

Range:		Function:
	par. F-15 Hz]	*parameter H-40 Configuration Mode* is set for *[0] Open Loop* and speed reference is applied by an external controller controlling the pressure. Set the reference speed at which the sleep mode should be canceled.

AP-44 Wake-up Ref./FB Difference

Range:		Function:
10 % *	[0 - 100 %]	Only to be used if *parameter H-40 Configuration Mode* is set for *[3] Process Closed Loop* and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (P_{set}) before canceling the sleep mode.

AP-45 Setpoint Boost

Range:		Function:
0 % *	[-100 - 100 %]	Only to be used if *parameter H-40 Configuration Mode* is set to *[3] Closed Loop* and the integrated PI controller is used. In systems with, for example, constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This extends the time in which the motor is stopped and helps to avoid frequent start/stop. Set the overpressure/temperature in percentage of setpoint for the pressure (P_{set})/temperature before entering sleep mode. If set to 5%, the boost pressure is P_{set}x1.05. The negative values can be used, for example, in cooling tower control where a negative change is needed.

3

AP-46 Maximum Boost Time		
Range:		**Function:**
60 s*	[0 - 600 s]	Only to be used if *parameter H-40 Configuration Mode* is set to *[3] Process Closed Loop* and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode is allowed. If the set time is exceeded, sleep mode is entered, not waiting for the set boost pressure to be reached.

3.19.4 AP-5# End of Curve

The end-of-curve conditions occur when a pump is yielding a too large volume to ensure the set pressure. This situation can occur if there is a leakage in the distribution pipe system after the pump causing the pump to operate at the end of the pump characteristic, valid for the maximum speed set in *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*. If the feedback is 2.5% of the programmed value in *parameter CL-14 Maximum Reference/Feedb.* (or numerical value of *parameter CL-13 Minimum Reference/Feedb.* whichever is highest) below the setpoint for the required pressure for a set time (*parameter AP-51 End of Curve Delay*), and the pump runs with maximum speed set in *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*, the function selected in *parameter AP-50 End of Curve Function* takes place.
It is possible to get a signal on 1 of the digital outputs by selecting *[192] End of Curve* in parameter group *E-2# Digital Outputs* and. The signal is present, when an end-of-curve condition occurs and the selection in *parameter AP-50 End of Curve Function* is different from *[0] Off*. The end-of-curve function can only be used when operating with the built-in PID controller (*[3] Closed loop* in *parameter H-40 Configuration Mode*).

AP-50 End of Curve Function		
Option:		**Function:**
		NOTICE **Automatic restart resets the alarm and restarts the system.** ***NOTICE*** **Do not set *parameter H-04 Auto-Reset (Times)*, to *[13] Infinite auto reset*, when *parameter AP-50 End of Curve Function* is set to *[2] Alarm*. Doing so causes the frequency converter to continuously cycle between running and stopping when an end-of-curve condition is detected.**

AP-50 End of Curve Function		
Option:		**Function:**
		NOTICE **If the frequency converter is equipped with a constant speed bypass with an automatic bypass function that starts the bypass if the frequency converter experiences a persistent alarm condition, be sure to disable the automatic bypass function, if *[2] Alarm* or *[3] Man. Reset Alarm* is selected as the end-of-curve function.**
[0] *	Off	End-of-curve monitoring is not active.
[1]	Warning	The frequency converter continues to run, but activates an end-of-curve warning *(warning 94, End of curve)*. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Alarm	The frequency converter stops running and activates an end-of-curve alarm *(alarm 94, End of curve)*. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.
[3]	Man. Reset Alarm	The frequency converter stops running and activates an end-of-curve alarm *(alarm 94, End of curve)*. A frequency converter digital output or a fieldbus can communicate an alarm to other equipment.
[4]	Stop and Trip	

AP-51 End of Curve Delay		
Range:		**Function:**
10 s*	[0 - 600 s]	When an end-of-curve condition is detected, a timer is activated. When the time set in this parameter expires, and the end-of-curve condition is steady during the entire period, the function set in *parameter AP-50 End of Curve Function* is activated. If the condition disappears before the timer expires, the timer is reset.

AP-52 End of Curve Tolerance		
Range:		**Function:**
2.5 %*	[0.5 - 20.0 %]	

3.19.5 AP-6# Broken Belt Detection

The broken-belt detection can be used in both closed-loop and open-loop systems for pumps, fans, and compressors. If the estimated motor torque is below the broken-belt torque value (*parameter AP-61 Broken Belt Torque*), and the frequency converter output frequency is above or equal to

15 Hz, the broken-belt function (*parameter AP-60 Broken Belt Function*) is performed.

AP-60 Broken Belt Function		
Selects the action to be performed if the broken-belt condition is detected.		
Option:		**Function:**
		NOTICE **Do not set *parameter H-04 Auto-Reset (Times)* to *[13] Infinite auto reset*, when *parameter AP-60 Broken Belt Function* is set to *[2] Trip*. Doing so causes the frequency converter to continuously cycle between running and stopping when a broken-belt condition is detected.** ***NOTICE*** **For frequency converters with constant-speed bypass.** **If an automatic bypass function starts the bypass at persistent alarm conditions, disable the bypass's automatic bypass function, if *[2] Alarm* or *[3] Man. Reset Alarm* is selected as the broken-belt function.**
[0] *	Off	
[1]	Warning	The frequency converter continues to run, but activates a broken-belt warning *(warning 95, Broken belt)*. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The frequency converter stops running and activates a broken-belt alarm *(alarm 95, Broken belt)*. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

AP-61 Broken Belt Torque		
Range:		**Function:**
10 %*	[0 - 100 %]	Sets the broken-belt torque as a percentage of the rated motor torque.

AP-62 Broken Belt Delay		
Range:		**Function:**
10 s	[0 - 600 s]	Sets the time for which the broken belt conditions must be active before carrying out the action selected in *parameter AP-60 Broken Belt Function*.

3.19.6 AP-7# Short Cycle Protection

When controlling refrigeration compressors, often there is a need for limiting the numbers of starts. One way to do this is to ensure a minimum run time (time between a start and a stop) and a minimum interval between starts.
This means that any normal stop command can be overridden by the minimum run time function (*parameter AP-77 Minimum Run Time*) and any normal start command (start/jog/freeze) can be overridden by the interval between starts function (*parameter AP-76 Interval between Starts*).
None of the 2 functions are active if hand-on or off modes have been activated via the keypad. If selecting hand-on or off, the 2 timers are reset to 0, and not start counting until *Auto* is pressed and an active start command applied.

AP-70 Compressor Start Max Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. F-17 RPM]	The parameter enables "High Starting Torque". This is a function, where the Current Limit and Torque Limit are ignored during start of the motor. The time, from the start signal is given until the speed exceeds the speed set in this parameter, becomes a "start-zone" where the current limit and motoric torque limit is set to what is maximum possible for the drive/motor combination. This parameter is normally set to the same value as *parameter F-18 Motor Speed Low Limit [RPM]*. When set to zero the function is inactive. In this "starting-zone" *parameter AP-73 Starting Acceleration Time* is active instead of *parameter F-07 Accel Time 1* to ensure extra acceleration during the start and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the Current Limit and Torque Limit must not exceed the value set in *parameter AP-72 Compressor Start Max Time to Trip* or the drive will trip with an alarm [A18] Start Failed. When this function is activated to get a fast start then also *parameter H-36 Trip Speed Low [RPM]* is activated to protect the application from running below minimum motor speed e.g. when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, various tricks can be done through clever use of start delay / start speed / start current.

3

AP-71 Compressor Start Max Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - par. F-15 Hz]	***NOTICE*** ***Parameter AP-71 Compressor Start Max Speed [Hz]* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** The parameter enables high starting torque. This is a function, where the current limit and torque limit are ignored during start of the motor. The time, from the start signal is given until the speed exceeds the speed set in this parameter, becomes a start-zone where the current limit and motoric torque limit is set to what is maximum possible for the frequency converter/motor combination. This parameter is normally set to the same value as *parameter F-18 Motor Speed Low Limit [RPM]*. When set to 0, the function is inactive. In this starting-zone, *parameter AP-73 Starting Acceleration Time* is active instead of *parameter F-07 Accel Time 1* to ensure extra acceleration during the start, and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the current limit and torque limit must not exceed the value set in *parameter AP-72 Compressor Start Max Time to Trip*. If the value of *parameter AP-72 Compressor Start Max Time to Trip* is exceeded, the frequency converter trips with *alarm 18 Start failed*. When this function is activated to get a fast start, *parameter H-36 Trip Speed Low [RPM]* is also activated to protect the application from running below minimum motor speed, for example when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, enter appropriate values for start delay/start speed/start current.

AP-72 Compressor Start Max Time to Trip		
Range:		**Function:**
5 s*	[0 - 10 s]	***NOTICE*** ***Parameter AP-72 Compressor Start Max Time to Trip* has no effect when *parameter P-20 Motor Construction = [1] PM, non-salient SPM*.** The time from the start signal is given, until the speed exceeds the speed set in *parameter AP-70 Compressor Start Max Speed [RPM]* must not exceed the time set in the parameter. If the time set is exceeded, the frequency converter trips with *alarm 18, Start failed*.

AP-72 Compressor Start Max Time to Trip		
Range:		**Function:**
		Any time set in *parameter F-24 Holding Time* for use of a start function must be executed within the time limit.

AP-73 Starting Acceleration Time		
Range:		**Function:**
20.00 s*	[0.01 - 3600 s]	

AP-75 Short Cycle Protection		
Option:		**Function:**
[0] *	Disabled	Timer set in *parameter AP-76 Interval between Starts* is disabled.
[1]	Enabled	Timer set in *parameter AP-76 Interval between Starts* is enabled.

AP-76 Interval between Starts		
Range:		**Function:**
par. AP-77 s*	[par. AP-77 - 3600 s]	Sets the minimum time between 2 starts. Any normal start command (start/jog/freeze) is disregarded until the timer has expired.

AP-77 Minimum Run Time		
Range:		**Function:**
0 s*	[0 - par. AP-76 s]	***NOTICE*** **Does not work in cascade mode.** Sets the minimum run time after a normal start command (start/jog/freeze). Any normal stop command is disregarded until the set time has expired. The timer starts counting following a normal start command (start/jog/freeze). A coast (inverse) or an external interlock command overrides the timer.

3.19.7 AP-8# Flow Compensation

It is sometimes the case that it is not possible for a pressure transducer to be placed at a remote point in the system and it can only be located close to the fan/pump outlet. Flow compensation operates by adjusting the setpoint according to the output frequency, which is almost proportional to flow, thus compensating for higher losses at higher flow rates.

H_{DESIGN} (required pressure) is the setpoint for closed loop (PI) operation of the frequency converter and is set as for closed-loop operation without flow compensation.

It is recommended to use slip compensation and RPM as unit.

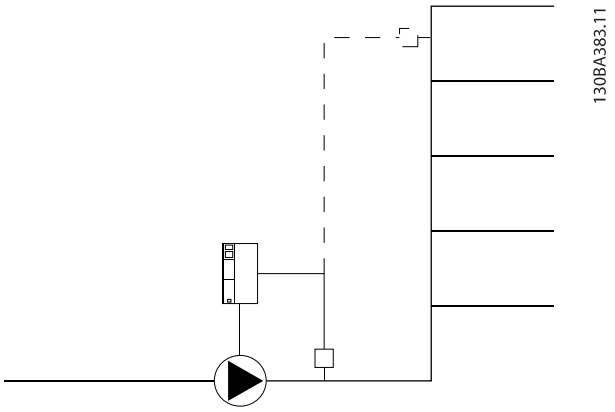


Illustration 3.44 Flow Compensation

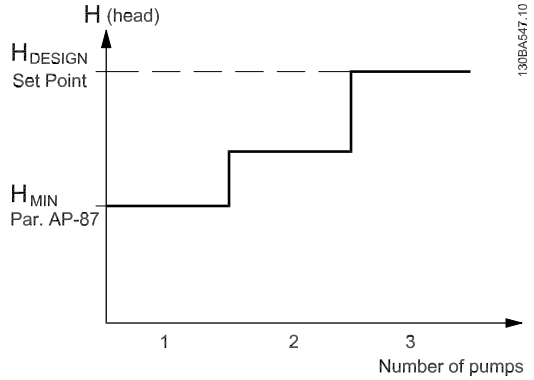


Illustration 3.45 Number of Pumps

3

NOTICE

When flow compensation is used with the Pump Controller (parameter group PC-##), the actual setpoint does not depend on speed (flow), but on the number of pumps cut in. See *Illustration 3.45*:

There are 2 methods which can be employed, depending upon whether or not the speed at system design working point is known.

Parameter used	Speed at design point KNOWN	Speed at design point UNKNOWN	Pump controller
Parameter AP-80 Flow Compensation	+	+	+
Parameter AP-81 Square-linear Curve Approximation	+	+	-
Parameter AP-82 Work Point Calculation	+	+	-
Parameter AP-83 Speed at No-Flow [RPM]/ Parameter AP-84 Speed at No-Flow [Hz]	+	+	-
Parameter AP-85 Speed at Design Point [RPM]/ Parameter AP-86 Speed at Design Point [Hz]	+	-	-
parameter AP-87 Pressure at No-Flow Speed	+	+	+
Parameter AP-88 Pressure at Rated Speed	-	+	-
Parameter AP-89 Flow at Design Point	-	+	-
Parameter AP-90 Flow at Rated Speed	-	+	-

Table 3.23 Number of Pumps

AP-80 Flow Compensation		
Option:		**Function:**
[0] *	Disabled	Setpoint compensation not active.
[1]	Enabled	Setpoint compensation is active. Enabling this parameter allows the flow-compensated setpoint operation.

AP-81 Square-linear Curve Approximation		
Range:		**Function:**
100 %*	[0 - 100 %]	***NOTICE*** **Not visible when running in cascade.** **Example 1** Adjustment of this parameter allows the shape of the control curve to be adjusted. 0=Linear 100%=Ideal shape (theoretical).

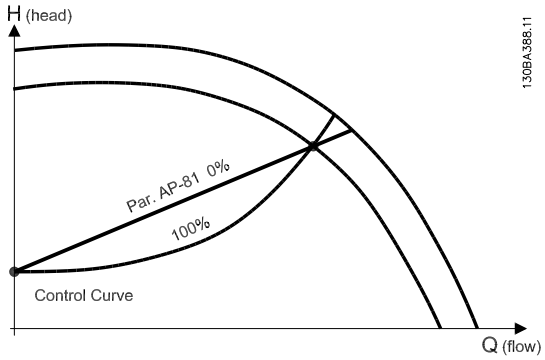
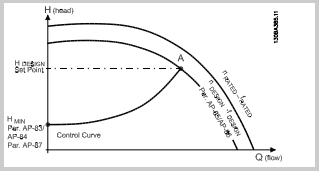
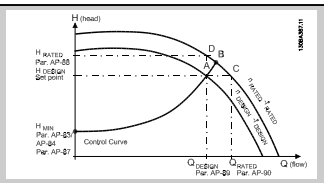


Illustration 3.46 Square-Linear Curve Approximation

AP-82 Work Point Calculation		
Option:		**Function:**
		Example 1  **Illustration 3.47 Speed at System Design Working Point is Known** From the datasheet showing characteristics for the specific equipment at different speeds, simply reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows finding point A, which is the system design working point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no-flow point to be identified. Adjustment of *parameter AP-81 Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely. **Example 2** Speed at system design working point is not known: Where the speed at system design working point is unknown, another reference point on the control curve needs to be determined based on the datasheet. By looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN}, Point C), the flow at that pressure, Q_{RATED}, can be determined. Similarly, by plotting the design flow (Q_{DESIGN}, Point D), the pressure H_{DESIGN} at that flow can be determined. Knowing these 2 points on the pump curve, along with H_{MIN} as described above, allows the frequency converter to calculate the reference point B and thus to plot the control curve, which also includes the system design working point A.

AP-82 Work Point Calculation		
Option:		**Function:**
		 **Illustration 3.48 Speed at System Design Working Point is not Known**
[0] *	Disabled	Work point calculation not active. To be used if speed at design point is known.
[1]	Enabled	Work point calculation is active. Enabling this parameter allows the calculation of the unknown system design working point at 50/60 Hz speed, from the input data set in: • *Parameter AP-83 Speed at No-Flow [RPM].* • *Parameter AP-84 Speed at No-Flow [Hz].* • *Parameter AP-87 Pressure at No-Flow Speed.* • *Parameter AP-88 Pressure at Rated Speed.* • *Parameter AP-89 Flow at Design Point.* • *Parameter AP-90 Flow at Rated Speed.*

AP-83 Speed at No-Flow [RPM]		
Range:		**Function:**
300 RPM*	[0 - par. AP-85 RPM]	Resolution 1 RPM. Enter the speed of the motor in RPM at which flow is 0 and minimum pressure H_{MIN} is achieved. Alternatively, enter the speed in Hz in *parameter AP-84 Speed at No-Flow [Hz]*. If it has been decided to use RPM in *parameter K-02 Motor Speed Unit*, *parameter AP-85 Speed at Design Point [RPM]* should also be used. Closing the valves and reducing the speed until minimum pressure H_{MIN} is achieved determines this value.

AP-84 Speed at No-Flow [Hz]		
Range:		**Function:**
50.0 Hz*	[0 - par. AP-86 Hz]	Resolution 0.033 Hz. Enter the motor speed in Hz at which flow has effectively stopped and minimum pressure H_{MIN} is achieved. Alternatively, enter the speed in RPM in *parameter AP-83 Speed at No-Flow [RPM]*. If it has been decided to use Hz in *parameter K-02 Motor Speed Unit*, *parameter AP-86 Speed at Design Point [Hz]* should also be used. Closing the valves and reducing the speed until minimum pressure H_{MIN} is achieved determines this value.

AP-85 Speed at Design Point [RPM]

Range:		Function:
1500 RPM*	[par. AP-83 - 60000 RPM]	Resolution 1 RPM. Only visible when *parameter AP-82 Work Point Calculation* is set to *[0] Disabled*. Enter the motor speed in RPM at which the system design working point is achieved. Alternatively, enter the speed in Hz in *parameter AP-86 Speed at Design Point [Hz]*. If it has been decided to use RPM in *parameter K-02 Motor Speed Unit*, *parameter AP-83 Speed at No-Flow [RPM]* should also be used.

AP-86 Speed at Design Point [Hz]

Range:		Function:
50.0 Hz*	[par. AP-84 - par. F-03 Hz]	Resolution 0.033 Hz. Only visible when *parameter AP-82 Work Point Calculation* is set to *[0] Disabled*. Enter the motor speed in Hz at which the system design working point is achieved. Alternatively, enter the speed in RPM in *parameter AP-85 Speed at Design Point [RPM]*. If it has been decided to use Hz in *parameter K-02 Motor Speed Unit*, *parameter AP-83 Speed at No-Flow [RPM]* should also be used.

AP-87 Pressure at No-Flow Speed

Range:		Function:
0*	[0 - par. AP-88]	Enter the pressure H_{MIN} corresponding to speed at no-flow in reference/feedback units.

AP-88 Pressure at Rated Speed

Also see *parameter AP-82 Work Point Calculation*.

Range:		Function:
999999.999*	[par. AP-87 - 999999.999]	Enter the value corresponding to the pressure at rated speed, in reference/feedback units. This value can be defined using the pump datasheet.

AP-89 Flow at Design Point

Also see *parameter AP-82 Work Point Calculation*.

Range:		Function:
0*	[0 - 999999.999]	Enter the value corresponding to the flow at design point. No units necessary.

AP-90 Flow at Rated Speed

Also, see *parameter AP-82 Work Point Calculation*.

Range:		Function:
0*	[0 - 999999.999]	Enter the value corresponding to flow at rated speed. This value can be defined using the pump datasheet.

3.20 FB-## Fire/Bypass Operation

3.20.1 FB-0# Fire Mode

⚠CAUTION

Note the frequency converter is only 1 component of the AF-600 FP system. Correct function of fire mode depends on the correct design and selection of system components. Ventilation systems working in life safety applications have to be approved by the local fire authorities. Non-interruption of the frequency converter due to fire mode-operation could cause overpressure and result in damage to AF-600 FP system and components, including dampers and air ducts. The frequency converter itself could be damaged and it may cause damage or fire. GE accepts no responsibility for errors, malfunctions personal injury, or any damage to the frequency converter itself or components herein, AF-600 FP systems and components herein, or other property when the frequency converter has been programmed for fire mode. In no event shall GE be liable to the end user or any other party for any direct or indirect, special or consequential damage or loss suffered by such party, which has occurred due to the frequency converter being programmed and operated in fire mode.

Background
Fire mode is for use in critical situations, where it is imperative for the motor to keep running, regardless of the frequency converter's normal protective functions. These could be ventilation fans in tunnels or stairwells for instance, where continued operation of the fan facilitates safe evacuation of personnel in the event of a fire. Some selections of the fire mode function cause alarms and trip conditions to be disregarded, enabling the motor to run without interruption.

Activation
Fire mode is activated only via digital Input terminals. See parameter group *E-0# Digital Inputs*.

Messages in display
When fire mode is activated, the display shows a status message *Fire Mode* and a warning *Fire Mode*.
Once the fire mode is again deactivated, the status messages disappears and the warning is replaced by the warning *Fire M Was Active*. This message can only be reset by power-cycling the frequency converter supply. If a warranty-affecting alarm (see *parameter FB-09 Fire Mode Alarm Handling*) should occur while the frequency converter is active in fire mode, the display shows the warning Fire M Limits Exceeded.
Digital and relay outputs can be configured for the status messages *Fire Mode Active* and the warning *Fire M Was Active*. See parameter group *E-2#*.
Fire M was Active messages can also be accessed in the warning word via serial communication. (See relevant documentation).
Access the status messages *Fire Mode* via the extended status word.

Message	Type	Keypad	Messages in display	Warning word 2	Ext. status word 2
Fire Mode	Status	+	+		+ (bit 25)
Fire Mode	Warning	+			
Fire M was Active	Warning	+	+	+ (bit 3)	
Fire M Limits Exceeded	Warning	+	+		

Table 3.24 Messages in Display

Log
To see an overview of fire mode-related events, view the fire mode-log, LG-1#, Fire mode log, or press [Alarm Log] on the LCP or via the Alarm Log button on the keypad.
The log includes up to 10 of the latest events. Warranty-affecting alarms have a higher priority than the other 2 types of events.
The log cannot be reset
Following events are logged:

- Warranty-affecting alarms (see *parameter FB-09 Fire Mode Alarm Handling*)
- Fire mode activated
- Fire mode deactivated

All other alarms occurring while fire mode is activated are logged as usual.

NOTICE

During fire mode-operation, all stop commands to the frequency converter are ignored, including coast/coast inverse and external interlock.

NOTICE

If using the live zero-function in fire mode, then it is also active for analog inputs other than that used for fire mode setpoint/feedback. Should the feedback to any of those other analog inputs be lost, for example a cable is burned, live zero-function operates. If this is not wanted, disable the live zero-function for those other inputs.
Set the wanted live zero-function in case of a missing signal when fire mode active in *parameter AN-02 Fire Mode Live Zero Timeout Function*.
Warning for live zero has a higher priority than the warning *Fire Mode*.

NOTICE

If setting the command *[11] Start Reversing* on a digital input terminal in *parameter E-01 Terminal 18 Digital Input*, the drive understands this as a reversing command.

FB-00 Fire Mode Function		
Option:		**Function:**
		NOTICE **In the above, alarms are produced or ignored in accordance with the selection in *parameter FB-09 Fire Mode Alarm Handling*.**
[0] *	Disabled	Fire mode-function is not active.
[1]	Enabled-Run Forward	In this mode the motor continues to operate in a clockwise direction. Works only in open loop. Set *parameter FB-01 Fire Mode Configuration* to *[0] Open Loop*.
[2]	Enabled-Run Reverse	In this mode the motor continues to operate in a counterclockwise direction. Works only in open loop. Set *parameter FB-01 Fire Mode Configuration* to *[0] Open Loop*.
[3]	Enabled-Coast	In this mode, the output is disabled and the motor is allowed to coast to stop.
[4]	Enabled-Run Fwd/Rev	

FB-01 Fire Mode Configuration		
Option:		**Function:**
		NOTICE **Before adjusting the PID controller set *parameter FB-09 Fire Mode Alarm Handling*, *[2] Trip, All Alarms/Test*.** **NOTICE** **If *[2] Enable-Run Reverse* is selected in *parameter FB-00 Fire Mode Function*, *[3] Closed Loop* cannot be selected in *parameter FB-01 Fire Mode Configuration*.**

FB-01 Fire Mode Configuration		
Option:		**Function:**
[0] *	Open Loop	When fire mode is active, the motor runs with a fixed speed based on a reference set. The unit is the same as selected in *parameter K-02 Motor Speed Unit*.
[3]	Closed Loop	When fire mode is active, the built-in PID controller controls the speed based on the setpoint and a feedback signal selected in *parameter FB-07 Fire Mode Feedback Source*. Select the unit in *parameter FB-02 Fire Mode Unit*. For other PID controller settings use parameter group CL-## as for normal operation. If the motor also is controlled by the built-in PID controller when in normal operation, the same transmitter can be used for both cases by selecting the same source.

FB-02 Fire Mode Unit		
Option:		**Function:**
		Select the desired unit when fire mode is active and running in closed loop.
[0]		
[1]	%	
[2]	RPM	
[3] *	Hz	
[4]	Nm	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	

3

FB-02 Fire Mode Unit		
Option:		**Function:**
[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	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

FB-03 Fire Mode Min Reference		
Range:		**Function:**
0 FireModeUnit*	[-999999.999 - par. FB-04 FireModeUnit]	Minimum value for the reference/ setpoint (limiting the sum of value in *parameter FB-05 Fire Mode Preset Reference* and value of signal on input selected in *parameter FB-06 Fire Mode Reference Source*). If running in open loop when fire mode is active, the unit is selected by the setting of *parameter K-02 Motor Speed Unit*. For closed loop, select the unit in *parameter FB-02 Fire Mode Unit*.

FB-04 Fire Mode Max Reference		
Range:		**Function:**
50.000 FireModeUnit*	[par. FB-03 - 999999.999 FireModeUnit]	Maximum value for the reference/ setpoint (limiting the sum of value in *parameter FB-05 Fire Mode Preset Reference* and value of signal on input selected in *parameter FB-06 Fire Mode Reference Source*). If running in open loop when fire mode is active, the unit is selected by the setting *parameter K-02 Motor Speed Unit*. For closed loop, select the unit in *parameter FB-02 Fire Mode Unit*.

FB-05 Fire Mode Preset Reference		
Range:		**Function:**
0 %*	[-100 - 100 %]	Enter the required preset reference/set point as a percentage of the Fire Mode Max Reference set in *parameter FB-04 Fire Mode Max Reference*. The set value is added to the value represented by the signal on the analog input selected in *parameter FB-06 Fire Mode Reference Source*.

FB-06 Fire Mode Reference Source		
Option:		**Function:**
		Select the external reference input to be used for the fire mode. This signal is added to the value set in *parameter FB-06 Fire Mode Reference Source*.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potentiometer	
[21]	Analog input X30/11	(OPCGPIO)
[22]	Analog input X30/12	(OPCGPIO)
[23]	Analog Input X42/1	(OPCAIO)
[24]	Analog Input X42/3	(OPCAIO)
[25]	Analog Input X42/5	(OPCAIO)

FB-07 Fire Mode Feedback Source		
Option:		**Function:**
		Select the feedback input to be used for the fire mode feedback signal when fire mode is active. If the motor also is controlled by the built–in PID controller when in normal operation, the same transmitter can be used for both cases by selecting the same source.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	(OPCGPIO)
[8]	Analog Input X30/12	(OPCGPIO)
[9]	Analog Input X42/1	(OPCAIO)
[10]	Analog Input X42/3	(OPCAIO)
[11]	Analog Input X42/5	(OPCAIO)
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

FB-09 Fire Mode Alarm Handling		
Option:		**Function:**
[0]	Trip+Reset, Critical Alarms	If this mode is selected, the frequency converter continues to run, ignoring most alarms, even if doing so may result in damage of the frequency converter. Critical alarms are alarms, which cannot be suppressed but a restart attempt is possible (infinity automatic reset).
[1] *	Trip, Critical Alarms	In case of a critical alarm, the frequency converter trips and does not auto-restart (manual reset).
[2]	Trip, All Alarms/Test	It is possible to test the operation of fire mode, but all alarm states are activated normally (manual reset).

NOTICE

Warranty-affecting alarms. Certain alarms can affect the lifetime of the frequency converter. Should 1 of these ignored alarms occur while in fire mode, a log of the event is stored in the fire mode-log.
Here the 10 latest events of warranty-affecting alarms, fire mode activation, and fire mode deactivation are stored.

NOTICE

The setting in *parameter H-04 Auto-Reset (Times)* is disregarded if fire mode is active (see parameter group *FB-0# Fire Mode*).

Number	Description	Critical alarms	Warranty-affecting alarms
4	Mains oh. Loss		x
7	DC overvolt	x	
8	DC undervolt	x	
9	Inverter overloaded		x
13	Over current	x	
14	Earth fault	x	
16	Short circuit	x	
29	Power card temp		x
33	Inrush fault		x
38	Internal fault		x
65	Ctrl. card temp		x

Table 3.25 Fire Mode Alarm Handling

3.20.2 FB-1# Drive Bypass

The frequency converter includes a feature, which can be used to automatically activate an external electro-mechanical bypass in case of a trip/trip lock of the frequency converter or the event of a fire mode coast (see *parameter FB-00 Fire Mode Function*).

The bypass switches the motor to operation direct on line. The external bypass is activated by 1 of the digital outputs or relays in the frequency converter, when programmed in parameter group E-2#.

To deactivate the drive bypass at normal operation (fire mode not activated), carry out 1 of following actions:

- Press [Off] on the keypad, (or program 2 of the digital inputs for Hand-Off-Auto).
- Activate external interlock via digital input
- Carry out a power cycling.

NOTICE

The drive bypass cannot be deactivated if in fire mode. It can be deactivated only by either removing the fire mode command signal or the power supply to the frequency converter.

When the drive bypass function is activated, the display on the keypad shows the status message *Drive Bypass*. This message has a higher priority than the fire mode status messages. When the automatic drive bypass function is enabled, it cuts in the external bypass according to the sequence in *Illustration 3.49*

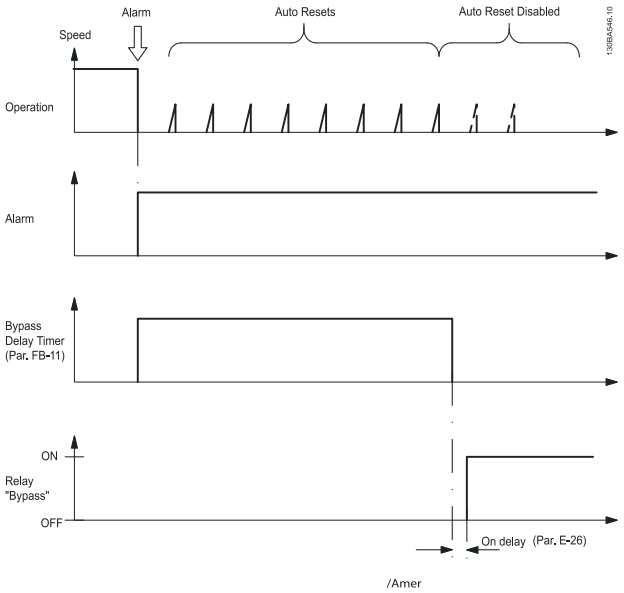


Illustration 3.49 Drive Bypass

FB-10 Drive Bypass Function		
Option:		**Function:**
		This parameter determines which circumstances activate the frequency converter bypass function.
[0] *	Disabled	
[1]	Enabled	If in normal operation, the automatic frequency converter bypass function is activated under the following conditions: • In case of a trip lock or a trip. • After the programmed number of reset attempts, programmed in *parameter H-04 Auto-Reset (Times)*. • If the bypass delay timer (*parameter FB-11 Drive Bypass Delay Time*) expires before reset attempts have been completed.
[2]	Enabled (Fire M Only)	

FB-11 Drive Bypass Delay Time		
Range:		**Function:**
0 s*	[0 - 600 s]	Programmable in 1 s increments. Once the bypass function is activated in accordance with the setting in *parameter FB-10 Drive Bypass Function*, the bypass delay timer begins to operate. If the frequency converter has been set for a number of restart attempts, the timer continues to run while the frequency converter tries to restart. Should the motor have restarted within the time period of the bypass delay timer, the timer is reset.

FB-11 Drive Bypass Delay Time		
Range:		**Function:**
		Should the motor fail to restart at the end of the bypass delay time, the frequency converter bypass relay is activated, which has been programmed for bypass in *parameter E-24 Function Relay*. If a relay delay has also been programmed in *parameter E-26 On Delay, Relay*, [Relay] or *parameter E-27 Off Delay, Relay*, [Relay], this time must also elapse before the relay action is performed. Where no restart attempts are programmed, the timer runs for the delay period set in this parameter and activates the frequency converter bypass relay, which has been programmed for bypass in *parameter E-24 Function Relay*. If a relay delay has also been programmed in *parameter E-26 On Delay, Relay* or *parameter E-27 Off Delay, Relay*, [Relay], this time must also elapse before the relay action is performed.

3.21 T-## Timed Functions

3.21.1 T-0# Timed actions

Use timed actions for actions performed on a daily or weekly basis, for example different references for working hours/non-working hours. Up to 10 timed actions can be programmed in the frequency converter. The timed action number is selected from the list when entering parameter group *T-0#* from the keypad. *Parameter T-00 ON Time* and *parameter T-04 Occurrence* then refer to the selected timed action number. Each timed action is divided into an ON time and an OFF time, in which 2 different actions may be performed.

Display lines 2 and 3 in the keypad show the status for timed actions mode (*parameter K-23 Display Line 2 Large* and *parameter K-24 Display Line 3 Large*, setting *[1243] Timed Actions Status*).

NOTICE

A change in mode via the digital inputs can only take place if *parameter T-08 Timed Actions Mode* is set for *[0] Times Actions Auto*.
If commands are applied simultaneously to the digital inputs for constant OFF and constant ON, the timed actions mode changes to timed actions auto and the 2 commands are disregarded.
If *parameter K-70 Date and Time* is not set or the frequency converter is set to *Hand* or *OFF* mode (for Example via the keypad), the timed actions mode is changed to *timed actions disabled*.
The timed actions have a higher priority than the same actions/commands activated by the digital inputs or the logic controller.

NOTICE

Programme the clock (parameter group *K-7#*) correctly for timed actions to function.

NOTICE

When mounting Analog I/O Option OPCAIO, a battery back-up of the date and time is included.

T-00 ON Time		
Array [10]		
Range:		**Function:**
0*	[0 - 0]	Sets the ON time for the timed action. ***NOTICE*** **The frequency converter has no back-up of the clock function and the set date/time resets to default (2000-01-01 00:00) after a power-down unless the Analog I/O option module (OPCAIO) with Battery Back Up of the Real Time Clock is installed. In *parameter K-79 Clock Fault*, it is possible to programme a warning if the clock has not been set properly, for example after a power-down.**

T-01 ON Action		
Array [10]		
Option:		**Function:**
		Select the action during ON time. See *parameter LC-52 Logic Controller Action* for descriptions of the options.
[0] *	Disabled	
[1]	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select Accel/Decel 1	
[19]	Select Accel/Decel 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	DC Brake	
[27]	Coast	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	

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T-01 ON Action

Array [10]

Option:		Function:
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset Counter A	
[61]	Reset Counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[80]	Sleep Mode	

T-02 OFF Time

Array [10]

Range:		Function:
0*	[0 - 0]	Sets the OFF time for the timed action. ***NOTICE*** **The frequency converter has no back-up of the clock function and the set date/time is reset to default (2000-01-01 00:00) after a power-down unless the Analog I/O option module (OPCAIO) with Battery Back Up of the Real Time Clock is installed. In *parameter K-79 Clock Fault*, it is possible to programme a warning if the clock has not been set properly, for example after a power-down.**

T-03 OFF Action

Array [10]

Option:		Function:
		Select the action during OFF time. See *parameter LC-52 Logic Controller Action* for descriptions of the options.
[1] *	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select Accel/Decel 1	
[19]	Select Accel/Decel 2	
[22]	Run	

T-03 OFF Action

Array [10]

Option:		Function:
[23]	Run reverse	
[24]	Stop	
[26]	DC Brake	
[27]	Coast	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset Counter A	
[61]	Reset Counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[80]	Sleep Mode	

T-04 Occurrence

Array [10]

Option:		Function:
		Select which day(s) the timed action applies to. Specify working/non-working days in: • *Parameter K-81 Working Days*. • *Parameter K-82 Additional Working Days*. • *Parameter K-83 Additional Non-Working Days*.
[0] *	All days	
[1]	Working days	
[2]	Non-working days	
[3]	Monday	
[4]	Tuesday	
[5]	Wednesday	
[6]	Thursday	
[7]	Friday	
[8]	Saturday	
[9]	Sunday	

T-08 Timed Actions Mode		
Used to enable and disable automatic timed actions.		
Option:		**Function:**
[0] *	Timed Actions Auto	Enable timed actions.
[1]	Timed Actions Disabled	Disable timed actions, normal operation according to control commands.
[2]	Constant On Actions	Disable timed actions. Constant On Actions activated.
[3]	Constant Off Actions	Disable timed actions. Constant Off Actions activated.

T-09 Timed Actions Reactivation		
Option:		**Function:**
[0]	Disabled	After an update of time/condition • power cycling • setting date • time • change of summertime • change of Hand Auto mode • change of Constant ON and OFF set-up change all activated ON actions are overridden to OFF actions until passing the next time for an ON action. Any OFF actions remain unchanged.
[1] *	Enabled	After an update of time/condition On and OFF actions are immediately set to the actual time programming of ON and OFF actions.

To see an example of a reactivation test, see *Illustration 3.50*.

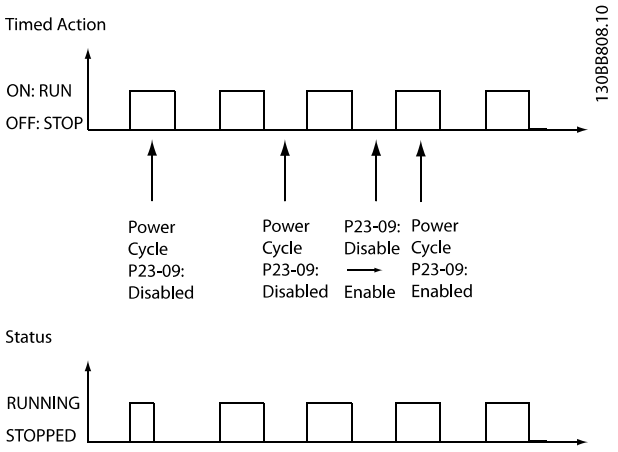


Illustration 3.50 Reactivation Test Diagram

3.21.2 T-1# Maintenance

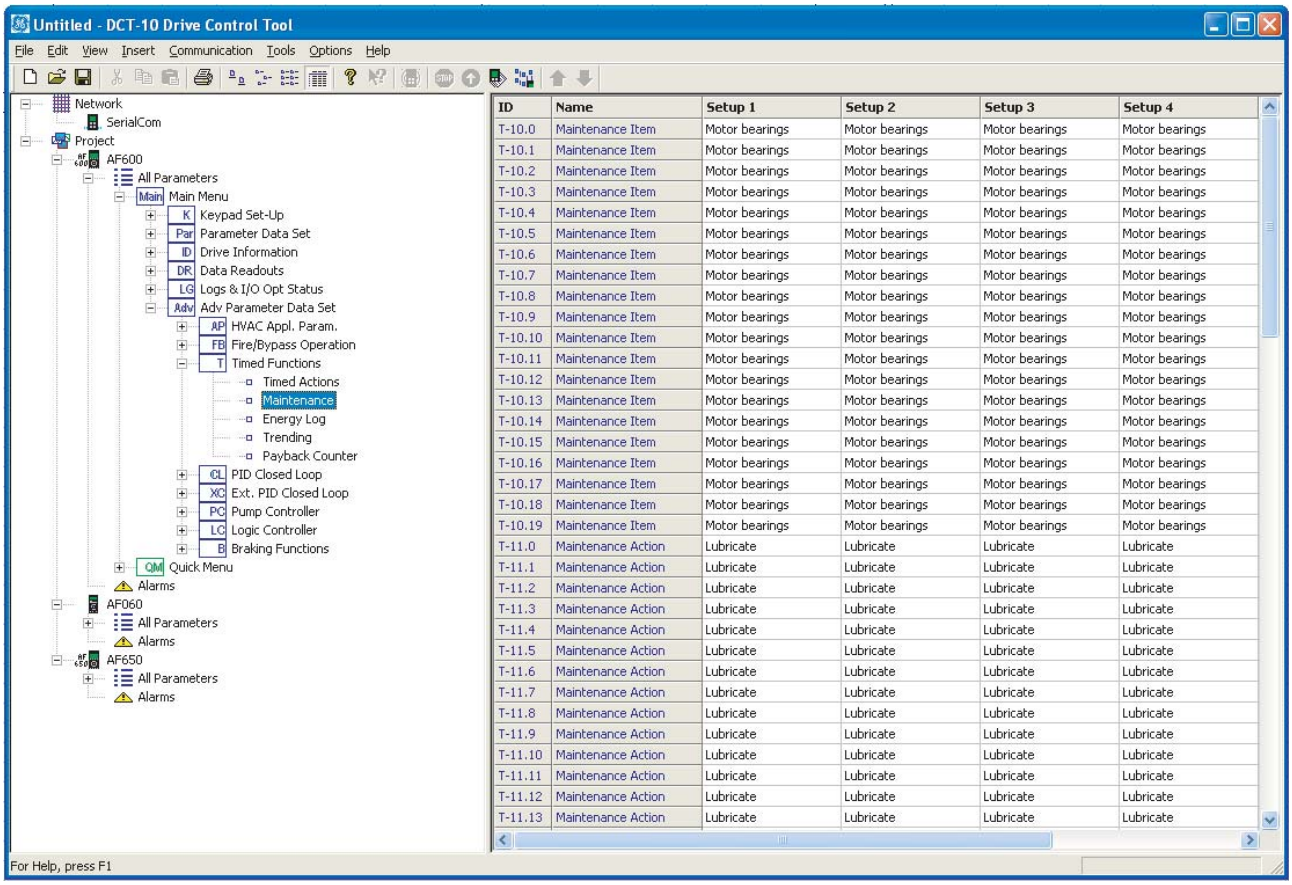
Wear and tear calls for periodic inspection and service of elements in the application, for example motor bearings, feedback sensors and seals, or filters. With preventive maintenance, the service intervals may be programmed into the frequency converter. The frequency converter gives a message when maintenance is required. 20 preventive maintenance events can be programmed into the frequency converter. Specify the following for each event:

- Maintenance item (for example *motor bearings*).
- Maintenance action (for example *replace*).
- Maintenance time base (for example *running hours* or a specific date and time).
- Maintenance time interval or the date and time of next maintenance.

NOTICE

To disable a preventive maintenance event, set the associated *parameter T-12 Maintenance Time Base* to *[0] Disabled*.

Preventive maintenance can be programmed from the keypad, but use of the PC-based Drive DCT-10 is recommended.



130BA492.10

Illustration 3.51 DCT-10

The keypad indicates (with a wrench icon and an "M") when it is time for a preventive maintenance action, and can be programmed to be indicated on a digital output in parameter group *E-##*. The preventive maintenance status may be read in *parameter DR-96 Maintenance Word*. A preventive maintenance indication can be reset from a digital input, the Drive bus, or manually from the keypad through *parameter T-15 Reset Maintenance Word*.

A maintenance log with the latest 10 trendings can be read from parameter group *LG-0#* and via the alarm log key on the keypad after selecting maintenance log.

NOTICE

The preventive maintenance events are defined in a 20-element array. Hence each preventive maintenance event must use the same array element index in *parameter T-10 Maintenance Item* to *parameter T-14 Maintenance Date and Time*.

T-10 Maintenance Item		
Array [20]		
Option:		**Function:**
		Array with 20 elements showed below parameter number in the display. Press [OK] and step between elements with [◄], [►], [▲], and [▼]. Select the item to be associated with the preventive maintenance event.
[1] *	Motor bearings	
[2]	Fan bearings	

T-10 Maintenance Item		
Array [20]		
Option:		**Function:**
[3]	Pump bearings	
[4]	Valve	
[5]	Pressure transmitter	
[6]	Flow transmitter	
[7]	Temperature transm.	
[8]	Pump seals	
[9]	Fan belt	
[10]	Filter	
[11]	Drive cooling fan	

T-10 Maintenance Item

Array [20]

Option:		Function:
[12]	System health check	
[13]	Warranty	
[20]	Maintenance Text 0	
[21]	Maintenance Text 1	
[22]	Maintenance Text 2	
[23]	Maintenance Text 3	
[24]	Maintenance Text 4	
[25]	Maintenance Text 5	

T-11 Maintenance Action

Array [20]

Option:		Function:
		Select the action to be associated with the preventive maintenance event.
[1] *	Lubricate	
[2]	Clean	
[3]	Replace	
[4]	Inspect/Check	
[5]	Overhaul	
[6]	Renew	
[7]	Check	
[20]	Maintenance Text 0	
[21]	Maintenance Text 1	
[22]	Maintenance Text 2	
[23]	Maintenance Text 3	
[24]	Maintenance Text 4	
[25]	Maintenance Text 5	

T-12 Maintenance Time Base

Array [20]

Option:		Function:
		Select the time base to be associated with the preventive maintenance event.
[0] *	Disabled	Disables the preventive maintenance event.
[1]	Running Hours	The number of hours the motor has run. Running hours are not reset at power-on. Specify the maintenance time interval in *parameter T-13 Maintenance Time Interval*.
[2]	Operating Hours	The number of hours the frequency converter has run. Operating hours are not reset at power-on. Specify the maintenance time interval in *parameter T-13 Maintenance Time Interval*.
[3]	Date & Time	Uses the internal clock. Specify the date and time of the next maintenance occurrence in *parameter T-14 Maintenance Date and Time*.

T-13 Maintenance Time Interval

Array [20]

Range:		Function:
1 h*	[1 - 2147483647 h]	Set the interval associated with the current preventive maintenance event. This parameter is only used if *[1] Running Hours* or *[2] Operating Hours* is selected in *parameter T-12 Maintenance Time Base*. The timer is reset from *parameter T-15 Reset Maintenance Word*. **Example** A preventive maintenance event is set up Monday at 8:00. *Parameter T-12 Maintenance Time Base* is *[2] Operating hours* and *parameter T-13 Maintenance Time Interval* is 7 x 24 hours=168 hours. Next maintenance event is indicated the following Monday at 8:00. If this maintenance event is not reset until Tuesday at 9:00, the next occurrence is the following Tuesday at 9:00.

T-14 Maintenance Date and Time

Array [20]

Range:		Function:
0*	[0 - 0]	Set the date and time for next maintenance occurrence if the preventive maintenance event is based on date/time. Date format depends on the setting in *parameter K-71 Date Format* while the time format depends on the setting in *parameter K-72 Time Format*. ***NOTICE*** **The frequency converter has no back-up of the clock function and the set date/time is reset to default (2000-01-01 00:00) after a power-down. In *parameter K-79 Clock Fault*, it is possible to programme a warning if the clock has not been set properly, for example after a power-down.** **Set the time at least 1 hour later than actual time!** ***NOTICE*** **When mounting an Analog I/O option option card, a battery back-up of the date and time is included.**

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T-15 Reset Maintenance Word		
Option:		**Function:**
		NOTICE **When messages are reset - maintenance item, action, and maintenance date/time are not cancelled.** ***Parameter T-12 Maintenance Time Base* is set to *[0] Disabled*.** Set this parameter to *[1] Do reset* to reset the maintenance word in *parameter DR-96 Maintenance Word* and reset the message showed in the keypad. This parameter changes back to *[0] Do not reset* when pressing [OK].
[0] *	Do not reset	
[1]	Do reset	

T-16 Maintenance Text		
Array [6]		
Range:		**Function:**
0*	[0 - 20]	6 individual texts (Maintenance Text 0...Maintenance Text 5) can be written for use in either *parameter T-10 Maintenance Item* or *parameter T-11 Maintenance Action*. The text is written according to the guidelines in *parameter K-37 Display Text 1*.

3.21.3 T-5# Energy Log

The frequency converter is continuously accumulating the consumption of the motor controlled, based on the actual power yielded by the frequency converter.

These data can be used for an energy log function allowing the user to compare and structure the information about the energy consumption related to time.

There are 2 functions:

- Data related to a pre-programmed period, defined by a set date and time for start.
- Data related to a predefined period back in time, for example last 7 days within the pre-programmed period.

For each of the above 2 functions, the data are stored in a number of counters allowing for selecting time frame and a split on hours, days, or weeks.
The period/split (resolution) can be set in *parameter T-50 Energy Log Resolution*.

The data is based on the value registered by the kWh counter in the frequency converter. This counter value can be read in *parameter ID-02 kWh Counter* containing the accumulated value since the first power-up or latest reset of the counter (*parameter ID-06 Reset kWh Counter*).

All data for the energy log is stored in counters, which can be read from *parameter T-53 Energy Log*.

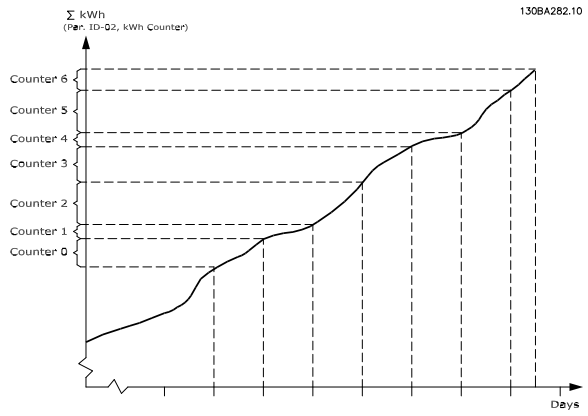


Illustration 3.52 Energy Log Graph

Counter 00 always contains the oldest data. A counter covers a period from XX:00 to XX:59 if hours or 00:00 to 23:59 if days.
If logging either the last hours or last days, the counters shift contents at XX:00 every hour or at 00:00 every day. The counter with highest index is always subject to update (containing data for the actual hour since XX:00 or the actual day since 00:00).

The contents of counters can be displayed as bars on the keypad. Select *Quick Menu*, *Trendings*, *Energy Log: Trending Continued Bin/Trending Timed Bin/Trending Comparison*.

T-50 Energy Log Resolution

Option:		Function:
		NOTICE **The frequency converter has no back-up of the clock function and the set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock-module with back-up is installed. Consequently, the logging is stopped until date/time is readjusted in *parameter K-70 Date and Time*. In *parameter K-79 Clock Fault* it is possible to programme a warning if the clock not has been set properly, for example after a power-down.** Select the type of period for logging of consumption. *[0] Hour of Day*, *[1] Day of Week*, or *[2] Day of Month*. The counters contain the logging data from the programmed date/time for start (*parameter T-51 Period Start*) and the numbers of hours/days as programmed for (*parameter T-50 Energy Log Resolution*). The logging starts on the date programmed in *parameter T-51 Period Start*, and continues until 1 day/week/month has passed. *[5] Last 24 Hours*, *[6] Last 7 Days* or *[7] Last 5 Weeks*. The counters contain data for 1 day, 1 week, or 5 weeks back in time, and up to the actual time. The logging starts at the date programmed in *parameter T-51 Period Start*. In all cases, the period split refers to operating hours (time where frequency converter is powered up).
[0]	Hour of Day	
[1]	Day of Week	
[2]	Day of Month	
[5] *	Last 24 Hours	
[6]	Last 7 Days	
[7]	Last 5 Weeks	

T-51 Period Start

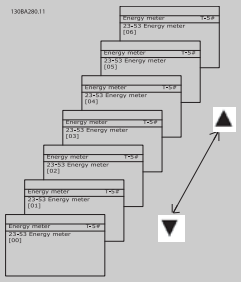
Range:		Function:
0*	[0 - 0]	***NOTICE*** **When mounting Analog I/O option , a battery back-up of the date and time is included.** Set the date and time at which the energy log starts updating the counters. First, data are stored in counter [00] and start at the time/date programmed in this parameter.

T-51 Period Start

Range:		Function:
		Date format depends on setting in *parameter K-71 Date Format* and time format on setting in *parameter K-72 Time Format*.

T-53 Energy Log

Array [31]

Range:		Function:
0*	[0 - 4294967295]	***NOTICE*** **All counters are automatically reset when changing the setting in *parameter T-50 Energy Log Resolution*. At overflow, the update of the counters stops at maximum value.** ***NOTICE*** **When mounting Analog I/O Option option card, a battery back-up of the date and time is included.** Array with a number of elements equal to the number of counters ([00]-[xx] below parameter number in display). Press [OK] and step between elements with [▲] and [▼]. Array elements:  **Illustration 3.53 Energy Log** Data from latest period are stored in the counter with the highest index. At power-down, all counter values are stored and resumed at next power-up.

3

T-54 Reset Energy Log		
Option:		**Function:**
		Select *[1] Do reset* to reset all values in the energy log-counters shown in *parameter T-53 Energy Log*. After pressing OK, the setting of the parameter value automatically changes to *[0] Do not reset*.
[0] *	Do not reset	
[1]	Do reset	

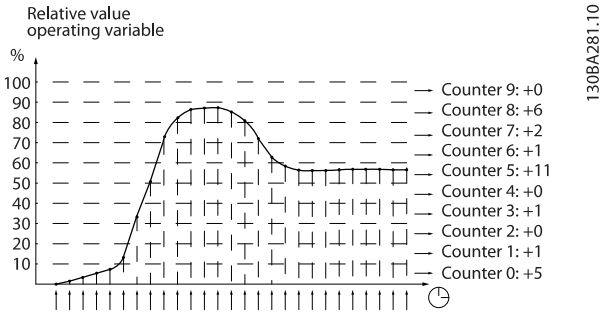


Illustration 3.54 Time and Relative Values

3.21.4 T-6# Trending

Trending is used to monitor a process variable over a period of time and record how often the data fall into each of 10 user-defined data ranges. This is a convenient tool to obtain a quick overview indicating where to focus on improvement of operation.

2 sets of data for trending can be created to make it possible to compare current values for a selected operating variable with data for a certain reference period, for the same variable. This reference period can be pre-programmed (*parameter T-63 Timed Period Start* and *parameter T-64 Timed Period Stop*). The 2 sets of data can be read from *parameter T-61 Continuous Bin Data* (current) and *parameter T-62 Timed Bin Data* (reference).

It is possible to create trending for following operation variables:

- Power.
- Current.
- Output frequency.
- Motor speed.

The trending function includes 10 counters (forming a bin) for each set of data containing the numbers of registrations reflecting how often the operating variable is within each of 10 pre-defined intervals. The sorting is based on a relative value of the variable.

The relative value for the operating variable is determined as:

- Actual/rated x 100% - for power and current.
- Actual/max x 100% - for output frequency and motor speed.

The size of each interval can be adjusted individually, but is 10% for each for default. Power and current can exceed rated value, but those registrations are included in 90–100% (MAX) counter.

Once a second, the value of the operating variable selected is registered. If a value has been registered to equal 13%, the counter 10– <20% is updated with the value 1. If the value stays at 13% for 10 s, 10 is added to the counter value.

The contents of counters can be displayed as bars on the display. Select *Quick Menu⇒Trendings*: *Trending Continued Bin/Trending Timed Bin/Trending Comparison*.

NOTICE

The counters start counting whenever the frequency converter is powered up. Power cycle shortly after a reset zeros the counters. EEPROM data are updated once per hour.

T-60 Trend Variable		
Option:		**Function:**
		Select the desired operating variable to be monitored for trending.
[0]	Power [kW]	Power yielded to the motor. Reference for the relative value is the rated motor power programmed in *parameter P-07 Motor Power [kW]* or *parameter P-02 Motor Power [HP]*. The actual value can be read in *parameter DR-10 Power [kW]* or *parameter DR-11 Power [hp]*.
[1]	Current [A]	Output current to the motor. Reference for the relative value is the rated motor current programmed in *parameter P-03 Motor Current*. The actual value can be read in *parameter DR-14 Motor current*.
[2] *	Frequency [Hz]	Output frequency to the motor. Reference for the relative value is the maximum output frequency programmed in *parameter F-15 Motor Speed High Limit [Hz]*. The actual value can be read in *parameter DR-13 Frequency*.
[3]	Motor Speed [RPM]	Reference for the relative value is the maximum motor speed programmed in *parameter F-17 Motor Speed High Limit [RPM]*.

T-61 Continuous Bin Data

Range:		Function:
0*	[0 - 4294967295]	Array with 10 elements ([0]-[9] below parameter number in display). Press [OK] and step between elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating variable monitored, sorted according to the following intervals: • Counter [0]: 0–<10%. • Counter [1]: 10–<20%. • Counter [2]. 20–<30%. • Counter [3]: 30–<40%. • Counter [4]: 40–<50%. • Counter [5]: 50–<60%. • Counter [6]. 60–<70%. • Counter [7]: 70–<80%. • Counter [8]. 80–<90%. • Counter [9]: 90–<100% or max. The above minimum limits for the intervals are the default limits. These can be changed in *parameter T-65 Minimum Bin Value*. Starts to count when the frequency converter is powered up for the first time. All counters can be reset to 0 in *parameter T-66 Reset Continuous Bin Data*.

T-62 Timed Bin Data

Array [10]

Range:		Function:
0*	[0 - 4294967295]	Array with 10 elements ([0]-[9] below parameter number in display). Press [OK] and step between elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating data monitored sorted according to the intervals as for *parameter T-61 Continuous Bin Data*. Starts to count at the date/time programmed in *parameter T-63 Timed Period Start*, and stops at the time/date programmed in *parameter T-64 Timed Period Stop*. All counters can be reset to 0 in *parameter T-67 Reset Timed Bin Data*.

T-63 Timed Period Start

Array [10]

Range:		Function:
0*	[0 - 0]	***NOTICE*** **The frequency converter has no back-up of the clock function and the set date/time is reset to default (2000-01-01 00:00) after a power-down unless the Analog I/O option module (OPCAIO) with Battery Back Up of the Real Time Clock is installed. Consequently, the logging is stopped until date/time is readjusted in *parameter K-70 Date and Time*. In *parameter K-79 Clock Fault* it is possible to programme a warning if in case the clock has not been set properly, for example after a power-down.** ***NOTICE*** **When mounting Analog I/O option , a battery back-up of the date and time is included.** Set the date and time at which the trending starts the update of the timed bin counters. Date format depends on setting in *parameter K-71 Date Format*, and time format on setting in *parameter K-72 Time Format*.

T-64 Timed Period Stop

Range:		Function:
0*	[0 - 0]	***NOTICE*** **When mounting Analog I/O Option , a battery back-up of the date and time is included.** Set the date and time at which the trend analyses must stop updating the timed bin counters. Date format depends on the setting in *parameter K-71 Date Format*, and time format on the setting in *parameter K-72 Time Format*.

T-65 Minimum Bin Value

Range:		Function:
0 % *	[0 - 100 %]	Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between elements with [▲] and [▼]. Set the minimum limit for each interval in *parameter T-61 Continuous Bin Data* and *parameter T-62 Timed Bin Data*. Example: If selecting *[1] counter* and changing setting from 10% to 12%, *[0] counter* is based on the interval 0–<12% and *[1] counter* on interval 12%–<20%.

T-66 Reset Continuous Bin Data		
Option:		**Function:**
[0] *	Do not reset	Select *[1] Do reset* to reset all values in *parameter T-61 Continuous Bin Data*. After pressing [OK], the setting of the parameter value automatically changes to *[0] Do not reset*.
[1]	Do reset	

T-67 Reset Timed Bin Data		
Option:		**Function:**
		Select *[1] Do reset* to reset all counters in *parameter T-62 Timed Bin Data*. After pressing [OK], the setting of the parameter value automatically changes to *[0] Do not reset*.
[0] *	Do not reset	
[1]	Do reset	

3.21.5 T-8# Payback Counter

The frequency converter includes a feature which can give a rough calculation on payback in cases where the frequency converter has been installed in an existing plant to ensure energy savings. Reference for the savings is a set value to represent the average power yielded before the upgrade with variable speed control.

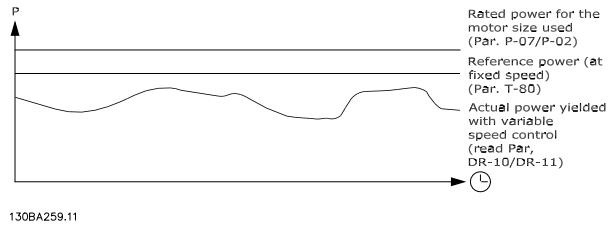


Illustration 3.55 Variable Speed Control

The difference between the reference power at fixed speed and the actual power yielded with speed control represent the actual saving.

As value for the fixed speed case, the rated motor size (kW) is multiplied with a factor (set in %) representing the power produced at fixed speed. The difference between this reference power and the actual power is accumulated and stored. The difference in energy can be read in *parameter T-83 Energy Savings*.
The accumulated value for the difference in power consumption is multiplied with the energy cost in local currency and the investment is subtracted. This calculation for cost savings can also be read in *parameter T-84 Cost Savings*.

$$Cost\ Savings = \left\{\sum_{t=0}^{t}\left[\left(Rated\ Motor\ Power * Power\ Reference\ Factor\right) - Actual\ Power\ Consumption\right] \times Energy\ Cost\right\} - Investment\ Cost$$

Break even (payback) occurs when the value read in the parameter turns from negative to positive.

It is not possible to reset the energy savings counter, but the counter can be stopped any time by setting *parameter T-80 Power Reference Factor* to 0.

Parameter for settings		Parameters for readout	
Rated motor power	*Parameter P-07 Motor Power [kW]*	Energy savings	*Parameter T-83 Energy Savings*
Power reference factor in %	*Parameter T-80 Power Reference Factor*	Actual power	*Parameter DR-10 Power [kW], parameter DR-11 Power [hp]*
Energy cost per kWh	*Parameter T-81 Energy Cost*	Cost savings	*Parameter T-84 Cost Savings*
Investment	*Parameter T-82 Investment*		

Table 3.26 Parameter Overview

T-80 Power Reference Factor		
Range:		**Function:**
100 %*	[0 - 100 %]	Set the percentage of the rated motor size (set in *parameter P-07 Motor Power [kW]* or *parameter P-02 Motor Power [HP]*), which shows the average power yielded at the time running with fixed speed (before upgrade with variable speed control). Set a value different from 0 to start counting.

T-81 Energy Cost		
Range:		**Function:**
1*	[0 - 999999.99]	Set the actual cost for a kWh in local currency. If the energy cost is changed later on, it impacts the calculation for the entire period.

T-82 Investment		
Range:		**Function:**
0*	[0 - 999999999]	Set the value of the investment spent on upgrading the plant with speed control, in same currency as used in *parameter T-81 Energy Cost*.

T-83 Energy Savings		
Range:		**Function:**
0 kWh*	[0 - 0 kWh]	This parameter allows a readout of the accumulated difference between the reference power and the actual output power. If motor size is set in hp (*parameter P-02 Motor Power [HP]*), the equivalent kW value is used for the energy savings.

T-84 Cost Savings		
Range:		**Function:**
0*	[0 - 2147483647]	This parameter allows a readout of the calculation based on the above equation (in local currency).

3.22 CL-## PID Closed Loop

This parameter group is used for configuring the closed-loop PID controller that controls the output frequency of the frequency converter.

3

3.22.1 CL-0# Feedback

This parameter group is used to configure the feedback signal for the frequency converter's closed-loop PID controller. Whether the frequency converter is in closed-loop mode or open-loop mode, the feedback signals can also be shown on the frequency converter's display, be used to control a frequency converter analog output, and be transmitted over various serial communication protocols.

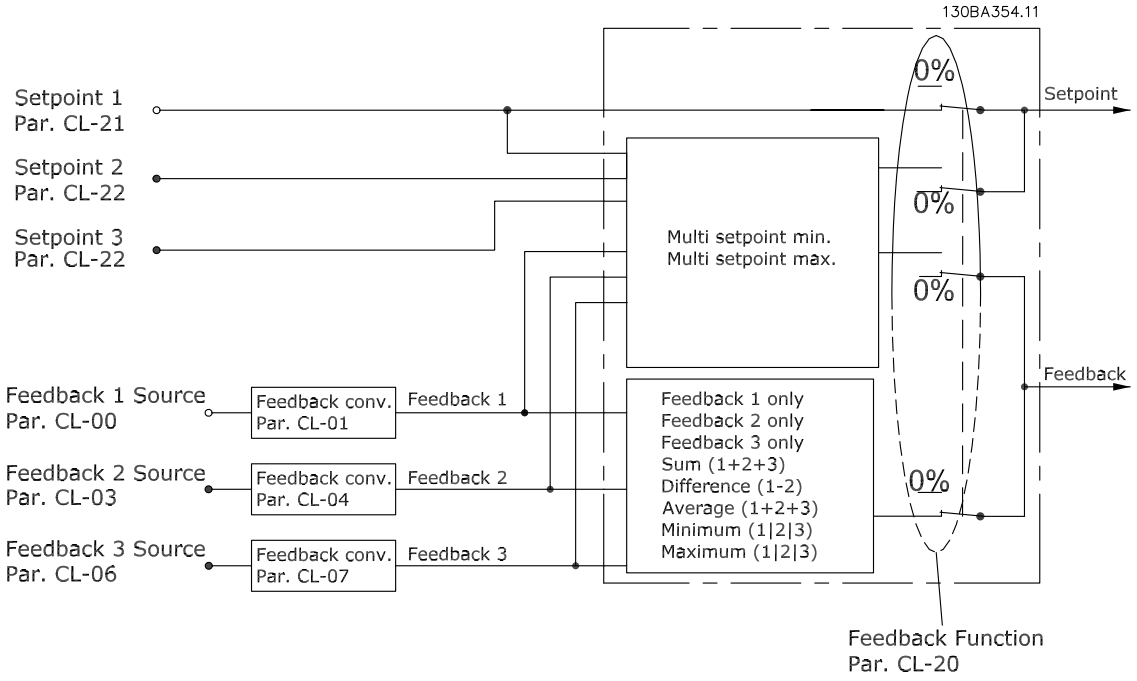


Illustration 3.56 Feedback

CL-00 Feedback 1 Source		
Option:		**Function:**
		NOTICE **If feedback is not used, set its source to *[0] No Function*.** ***Parameter CL-20 Feedback Function* determines how the PID controller uses the 3 possible feedbacks.** Up to 3 different feedback signals can be used to provide the feedback signal for the frequency converter's PID controller. This parameter defines which input is used as the source of the first feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on the optional general purpose I/O board. (OPCGPIO).

CL-00 Feedback 1 Source		
Option:		**Function:**
		Analog Inputs X42/1, X42/3, X42/5 refer to inputs on the optional analog I/O board (OPCAIO).
[0]	No function	
[1]	Analog Input 53	
[2] *	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	

CL-00 Feedback 1 Source		
Option:		**Function:**
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[15]	Analog Input X48/2	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

CL-01 Feedback 1 Conversion		
Option:		**Function:**
		This parameter allows a conversion function to be applied to feedback 1.
[0] *	Linear	No effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback $((flow \propto \sqrt{pressure}))$.
[2]	Pressure to temperature	Used in compressor applications to provide temperature feedback using a pressure sensor. The temperature of the refrigerant is calculated using the following formula: $Temperature = \frac{A2}{(ln(Pe+1)-A1)} - A3$, where A1, A2 and A3 are refrigerant-specific constants. Select the refrigerant in *parameter CL-30 Refrigerant*. *Parameter CL-21 Setpoint 1* through *parameter CL-23 Setpoint 3* allow the values of A1, A2, and A3 to be entered for a refrigerant that is not listed in *parameter CL-30 Refrigerant*.
[3]	Pressure to flow	Used in applications for controlling the air flow in a duct. A dynamic pressure measurement (pitot tube) represents the feedback signal. $Flow = Duct\ Area \times \sqrt{Dynamic\ Pressure} \times Air\ Density\ Factor$ See also *parameter CL-34 Duct 1 Area [m2]* through *parameter CL-38 Air Density Factor [%]* for setting of duct area and air density.
[4]	Velocity to flow	Used in applications for controlling the air flow in a duct. An air velocity measurement represents the feedback signal. $Flow = Duct\ Area \times Air\ Velocity$ See also *parameter CL-34 Duct 1 Area [m2]* through *parameter CL-37 Duct 2 Area [in2]* for setting of duct area.

CL-02 Feedback 1 Source Unit		
Option:		**Function:**
		NOTICE **This parameter is only available when using pressure to temperature feedback conversion. If option *[0] Linear* is selected in *parameter CL-01 Feedback 1 Conversion*, the setting of any option in *parameter CL-02 Feedback 1 Source Unit* does not matter as a conversion is 1-to-1.** This parameter determines the unit that is used for this feedback source, before applying the feedback conversion of *parameter CL-01 Feedback 1 Conversion*. This unit is not used by the PID controller.
[0]		
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	

3

CL-02 Feedback 1 Source Unit

Option:		Function:
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

CL-03 Feedback 2 Source

Option:		Function:
		See *parameter CL-00 Feedback 1 Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

CL-04 Feedback 2 Conversion

Option:		Function:
		See *parameter CL-01 Feedback 1 Conversion* for details.
[0] *	Linear	
[1]	Square root	
[2]	Pressure to temperature	
[3]	Pressure to flow	
[4]	Velocity to flow	

CL-05 Feedback 2 Source Unit

Option:		Function:
		See *parameter CL-02 Feedback 1 Source Unit* for details.

CL-06 Feedback 3 Source

Option:		Function:
		See *parameter CL-00 Feedback 1 Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

CL-07 Feedback 3 Conversion

Option:		Function:
		See *parameter CL-01 Feedback 1 Conversion* for details.
[0] *	Linear	
[1]	Square root	
[2]	Pressure to temperature	
[3]	Pressure to flow	
[4]	Velocity to flow	

CL-08 Feedback 3 Source Unit

Option:		Function:
		See *parameter CL-02 Feedback 1 Source Unit* for details.

CL-12 Reference/Feedback Unit

Option:		Function:
		See *parameter CL-02 Feedback 1 Source Unit* for details.

CL-13 Minimum Reference/Feedb.

Range:		Function:
0 ProcessCtrlUnit*	[-999999.999 - par. CL-14 ProcessCtrlUnit]	Enter the desired minimum value for the remote reference when operating with *parameter H-40 Configuration Mode* set for *[3] Closed Loop* operation. Units are set in *parameter CL-12 Reference/ Feedback Unit.* Minimum feedback is -200% of either the value set in *parameter CL-13 Minimum Reference/Feedb.* or in *parameter CL-14 Maximum Reference/Feedb.*, which ever numeric value is the highest.

CL-14 Maximum Reference/Feedb.		
Range:		**Function:**
100 ProcessCtrlUnit*	[par. CL-13 - 999999.999 ProcessCtrlUnit]	***NOTICE*** **If operating with *parameter H-40 Configuration Mode* set for *[0] Open Loop*, use *parameter F-53 Maximum Reference*.** ***NOTICE*** **The dynamics of the PID controller depends on the value set in this parameter. See also *parameter CL-93 PID Proportional Gain*. *Parameter CL-13 Minimum Reference/Feedb.* and *parameter CL-14 Maximum Reference/Feedb.* also determine the feedback range when using feedback for display readout with *parameter H-40 Configuration Mode* set for *[0] Open Loop*. Same condition as above.** Enter the maximum reference/feedback for closed loop operation. The setting determines the highest value obtainable by summing all reference sources for closed loop operation. The setting determines 100% feedback in open and closed loop (total feedback range: -200% to +200%).

3.22.2 CL-2# Feedback & Setpoint

This parameter group is used to determine how the PID controller uses the 3 possible feedback signals to control the output frequency of the frequency converter. This group is also used to store the 3 internal setpoint references.

CL-20 Feedback Function		
Option:		**Function:**
		This parameter determines how the 3 possible feedbacks are used to control the output frequency of the frequency converter.
[0]	Sum	Sets up the PID controller to use the sum of feedback 1, feedback 2, and feedback 3 as the feedback. ***NOTICE*** **Set any unused feedbacks to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source*.** • ***Parameter CL-03 Feedback 2 Source*.** • ***Parameter CL-06 Feedback 3 Source*.** The sum of setpoint 1 and any other references that are enabled (see C-30 and C-34) are used as the PID controller's setpoint reference.
[1]	Difference	Sets up the PID controller to use the difference between feedback 1 and feedback 2 as the feedback. Feedback 3 is not used with this selection. Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled (see C-30 and C-34) are used as the PID controller's setpoint reference.
[2]	Average	Sets up the PID controller to use the average of feedback 1, feedback 2, and feedback 3 as the feedback. ***NOTICE*** **Set any unused feedbacks to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source*.** • ***Parameter CL-03 Feedback 2 Source*.** • ***Parameter CL-06 Feedback 3 Source*.** **The sum of setpoint 1 and any other references that are enabled (see C-30 and C-34) are used as the PID controller's setpoint reference.**
[3]*	Minimum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3. The PID controller uses the lowest value as the feedback.

3

CL-20 Feedback Function		
Option:		Function:
		NOTICE **Set any unused feedbacks to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source.*** • ***Parameter CL-03 Feedback 2 Source.*** • ***Parameter CL-06 Feedback 3 Source.*** **Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled (see C-30 and C-34) are used as the PID controller's setpoint reference.**
[4]	Maximum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3 and use the highest value as the feedback. **NOTICE** **Set any unused feedbacks to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source.*** • ***Parameter CL-03 Feedback 2 Source.*** • ***Parameter CL-06 Feedback 3 Source.*** Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled (see C-30 and C-34) are used as the PID controller's setpoint reference.
[5]	Multi Setpoint Min	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2.

CL-20 Feedback Function		
Option:		Function:
		NOTICE **If only 2 feedback signals are used, set the non-used feedback to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source.*** • ***Parameter CL-03 Feedback 2 Source.*** • ***Parameter CL-06 Feedback 3 Source.*** **Note that each setpoint reference is the sum of its respective parameter value (*parameter CL-21 Setpoint 1*, *parameter CL-22 Setpoint 2*, and *parameter CL-23 Setpoint 3*) and any other references that are enabled (see C-30 and C-34).**
[6]	Multi Setpoint Max	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2. **NOTICE** **If only 2 feedback signals are used, set the non-used feedback to *[0] No Function* in** • ***Parameter CL-00 Feedback 1 Source.*** • ***Parameter CL-03 Feedback 2 Source.*** • ***Parameter CL-06 Feedback 3 Source.*** **Note that each setpoint reference is the sum of its respective parameter value (*parameter CL-21 Setpoint 1*, *parameter CL-22 Setpoint 2*, and *parameter CL-23 Setpoint 3*) and any other references that are enabled (see parameter group *C-30 and C-34*).**

NOTICE

Set any unused feedback to *[0] No function* in

- ***Parameter CL-00 Feedback 1 Source.***
- ***Parameter CL-03 Feedback 2 Source.***
- ***Parameter CL-06 Feedback 3 Source.***

The PID controller uses the feedback resulting from the function selected in *parameter CL-20 Feedback Function* to control the output frequency of the frequency converter. This feedback can also:

- Be shown on the frequency converter's display.
- Be used to control a frequency converter's analog output.
- Be transmitted over various serial communication protocols.

The frequency converter can be configured to handle multi-zone applications. 2 different multi-zone applications are supported:

- Multi-zone, single setpoint
- Multi-zone, multi-setpoint

Examples 1 and 2 illustrate the difference between the 2 applications:

Example 1 – Multi-zone, single setpoint
In an office building, a VAV (variable air volume) AF-600 FP system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting *parameter CL-20 Feedback Function* to *[3] Minimum*, and entering the desired pressure in *parameter CL-21 Setpoint 1*. If any feedback is below the setpoint, the PID controller increases the fan speed. If all feedbacks are above the setpoint, the PID controller decreases the fan speed.

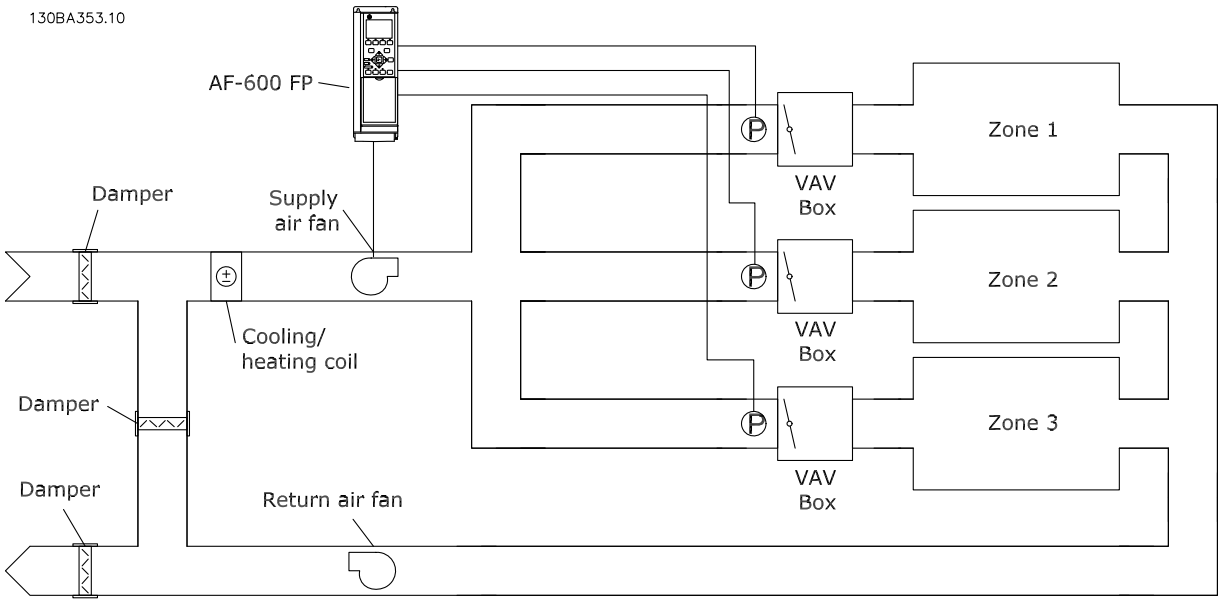


Illustration 3.57 Example, Multi-zone, Single Setpoint

Example 2 – Multi-zone, multi-setpoint
The previous example illustrates the use of multi-zone, multi-setpoint control. If the zones require different pressures for each VAV box, each setpoint may be specified in

- *Parameter CL-21 Setpoint 1*.
- *Parameter CL-22 Setpoint 2*.
- *Parameter CL-23 Setpoint 3*.

By selecting *[5] Multi-setpoint minimum* in *parameter CL-20 Feedback Function*, the PID controller increases the fan speed if any one of the feedbacks is below its setpoint. If all feedbacks are above their individual setpoints, the PID controller decreases the fan speed.

3

CL-21 Setpoint 1		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the frequency converter's PID controller. See the description of *parameter CL-20 Feedback Function*. ***NOTICE*** **The setpoint reference entered here is added to any other references that are enabled (see *parameter F-01 Frequency Setting 1*, *parameter C-30 Frequency Command 2* and *parameter C-34 Frequency Command 3*).**

CL-22 Setpoint 2		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 2 is used in closed-loop mode to enter a setpoint reference for the PID controller. See the description of *parameter CL-20 Feedback Function*. ***NOTICE*** **The setpoint reference entered here is added to any other references that are enabled (see *parameter F-01 Frequency Setting 1*, *parameter C-30 Frequency Command 2* and *parameter C-34 Frequency Command 3*).**

CL-23 Setpoint 3		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 3 is used in closed-loop mode to enter a setpoint reference that may be used by the frequency converter's PID controller. See the description of *parameter CL-20 Feedback Function*.

CL-23 Setpoint 3		
Range:		**Function:**
		NOTICE **The setpoint reference entered here is added to any other references that are enabled (see *parameter F-01 Frequency Setting 1*, *parameter C-30 Frequency Command 2* and *parameter C-34 Frequency Command 3*).**

3.22.3 CL-3# Feedback Adv. Conversion

In air conditioning compressor applications it is often useful to control the system based on the temperature of the refrigerant. However, it is generally more convenient to directly measure its pressure. This parameter group allows the frequency converter's PID controller to convert refrigerant pressure measurements into temperature values.

CL-30 Refrigerant		
Option:		**Function:**
		Select the refrigerant used in the compressor application. This parameter must be specified correctly for the pressure to temperature conversion to be accurate. If the refrigerant used is not listed in options [0] through [6], select *[7] User defined*. Then, use *parameter CL-31 User Defined Refrigerant A1*, *parameter CL-32 User Defined Refrigerant A2* and *parameter CL-33 User Defined Refrigerant A3* to provide A1, A2 and A3 for the equation below: $Temperature = \frac{A2}{(ln(Pe+1)-A1)} - A3$
[0] *	R22	
[1]	R134a	
[2]	R404A	
[3]	R407C	
[4]	R410A	
[5]	R502	
[6]	R744	
[7]	User defined	

CL-31 User Defined Refrigerant A1		
Range:		**Function:**
10*	[8 - 12]	Use this parameter to enter the value of coefficient A1 when *parameter CL-30 Refrigerant* is set to *[7] User defined*.

CL-32 User Defined Refrigerant A2		
Range:		**Function:**
-2250*	[-3000 - -1500]	Use this parameter to enter the value of coefficient A2 when *parameter CL-30 Refrigerant* is set to *[7] User defined*.

CL-33 User Defined Refrigerant A3		
Range:		**Function:**
250*	[200 - 300]	Use this parameter to enter the value of coefficient A3 when *parameter CL-30 Refrigerant* is set to *[7] User defined*.

CL-34 Duct 1 Area [m2]		
Range:		**Function:**
0.500 m2*	[0.001 - 10 m2]	Used for setting the area of the air ducts in connection with feedback conversion pressure/velocity to flow. The unit (m^2) is determined by the setting of *parameter K-03 Regional Settings*. Fan 1 is used with feedback 1. In case of flow difference control, set *parameter CL-20 Feedback Function* to *[1] Difference*, if flow fan 1 – flow fan 2 is to be controlled.

CL-35 Duct 1 Area [in2]		
Range:		**Function:**
750 in2*	[1 - 15500 in2]	Used for setting the area of the air ducts in connection with feedback conversion pressure/velocity to flow. The unit (in^2) is determined by the setting of *parameter K-03 Regional Settings*. Fan 1 is used with feedback 1. In case of flow difference control, set *parameter CL-20 Feedback Function* to *[1] Difference*, if flow fan 1 – flow fan 2 is to be controlled.

CL-36 Duct 2 Area [m2]		
Range:		**Function:**
0.500 m2*	[0.001 - 10 m2]	Used for setting the area of the air ducts in connection with feedback conversion pressure/velocity to flow. The unit (m^2) is determined by the setting of *parameter K-03 Regional Settings*. Fan 2 is used with feedback 2. In case of flow difference control, set *parameter CL-20 Feedback Function* to *[1] Difference*, if flow fan 1 – flow fan 2 is to be controlled.

CL-37 Duct 2 Area [in2]		
Range:		**Function:**
750 in2*	[1 - 15500 in2]	Used for setting the area of the air ducts in connection with feedback conversion pressure/velocity to flow. The unit (in^2) is determined by the setting of *parameter K-03 Regional Settings*.

CL-37 Duct 2 Area [in2]		
Range:		**Function:**
		Fan 2 is used with feedback 2. In case of flow difference control, set *parameter CL-20 Feedback Function* to *[1] Difference*, if flow fan 1 – flow fan 2 is to be controlled.

CL-38 Air Density Factor [%]		
Range:		**Function:**
100 %*	[50 - 150 %]	Set the air density factor for conversion from pressure to flow in % relative to the air density at sea level at 20 °C (100% ~ 1,2 kg/m^3).

3.22.4 CL-7# PID Auto Tuning

The frequency converter PID closed-loop controller (parameter group *20-** FC Closed Loop*) can be auto-tuned, simplifying and saving time during commissioning, while ensuring accurate PID control adjustment. To use auto tuning, configure the frequency converter for closed loop in *parameter H-40 Configuration Mode*.

Use a graphical keypad to react to messages during the auto tuning sequence.

Enabling *parameter CL-79 PID Autotuning* puts the frequency converter into auto tuning mode. The keypad then shows on-screen instructions.

To start the fan/pump, press [Auto] and apply a start signal. Adjust the speed manually by pressing [▲] or [▼] to a level where the feedback is around the system setpoint.

NOTICE

It is not possible to run the motor at maximum or minimum speed when manually adjusting the motor speed due to the need of giving the motor a step in the speed during auto-tuning.

PID auto tuning introduces step changes while operating at a steady state and then monitors the feedback. From the feedback response, the required values for *parameter CL-93 PID Proportional Gain* and *parameter CL-94 PID Integral Time* are calculated. *Parameter CL-95 PID Differentiation Time* is set to value 0 (zero). *Parameter CL-81 PID Normal/ Inverse Control* is determined during the tuning process.

These calculated values are presented in the keypad and can be either accepted or rejected. Once accepted, the values are written to the relevant parameters and auto tuning mode is disabled in *parameter CL-79 PID Autotuning*. Depending on the system, the time required to carry out auto tuning could be several minutes.

3

Before carrying out the PID auto tuning, set the following parameters according to the load inertia:

- *Parameter F-07 Accel Time 1*.
- *Parameter F-08 Decel Time 1*.

or

- *Parameter E-10 Accel Time 2*.
- *Parameter E-11 Decel Time 2*.

If PID auto tuning is carried out with slow ramp times, the auto-tuned parameters typically result in very slow control. Before activating PID auto tuning, remove excessive feedback sensor noise using the input filter (parameter groups AN-##, E-6# and AO-##, terminal 53/54 filter time constant/pulse filter time constant 29/33) before activating PID auto tuning. To obtain the most accurate controller parameters, carry out PID auto tuning when the application runs in typical operation, that is with a typical load.

CL-70 Closed Loop Type		
Option:		**Function:**
		Select the application response speed if it is known. The default setting is sufficient for most applications. A more precise value decreases the time needed for carrying out PID adaptation. The setting has no impact on values of parameters and only affects the auto tuning speed.
[0] *	Auto	Takes 30–60 s to complete.
[1]	Fast Pressure	Takes 10–20 s to complete.
[2]	Slow Pressure	Takes 30–60 s to complete.
[3]	Fast Temperature	Takes 10–20 minutes to complete.
[4]	Slow Temperature	Takes 30–60 minutes to complete.

CL-71 PID Performance		
Option:		**Function:**
[0] *	Normal	Normal setting of this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting is used in pumping systems, where a faster control response is wanted.

CL-72 PID Output Change		
Range:		**Function:**
0.10*	[0.01 - 0.50]	This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full speed. That is, if maximum output frequency in *parameter F-17 Motor Speed High Limit [RPM]/parameter F-15 Motor Speed High Limit [Hz]* is set to 50 Hz, 0.10 is 10% of 50 Hz, which is 5 Hz. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

CL-73 Minimum Feedback Level		
Range:		**Function:**
-999999 ProcessCtrlUnit*	[-999999.999 - par. CL-74 ProcessCtrlUnit]	Enter the minimum allowable feedback level in user units as defined in *parameter CL-12 Reference/ Feedback Unit*. If the level drops below *parameter CL-73 Minimum Feedback Level*, auto tuning is aborted and an error message appears in the keypad.

CL-74 Maximum Feedback Level		
Range:		**Function:**
999999 ProcessCtrlUnit*	[par. CL-73 - 999999.999 ProcessCtrlUnit]	Enter the maximum allowable feedback level in user units as defined in *parameter CL-12 Reference/ Feedback Unit*. If the level rises above *parameter CL-74 Maximum Feedback Level*, auto tuning is aborted and an error message appears in the keypad.

CL-79 PID Autotuning		
Option:		**Function:**
		This parameter starts the PID auto tuning sequence. Once the auto tuning has successfully completed and the settings have been accepted or rejected by pressing [OK] or [Cancel] at the end of tuning, this parameter is reset to *[0] Disabled*.
[0] *	Disabled	
[1]	Enabled	

3.22.5 CL-8# PID Basic Settings

This parameter group is used to configure the basic operation of the PID controller, including how it responds to feedback that is above or below the setpoint, the speed at which it first starts functioning, and when it indicates that the system has reached the setpoint.

CL-81 PID Normal/ Inverse Control		
Option:		**Function:**
[0] *	Normal	The frequency converter's output frequency decreases when the feedback is greater than the setpoint reference. This behaviour is common for pressure-controlled supply fan and pump applications.
[1]	Inverse	The frequency converter's output frequency increases when the feedback is greater than the

CL-81 PID Normal/ Inverse Control		
Option:		**Function:**
		setpoint reference. This behaviour is common for temperature-controlled cooling applications, such as cooling towers.

CL-82 PID Start Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. F-17 RPM]	***NOTICE*** **This parameter is only visible if *parameter K-02 Motor Speed Unit* is set to *[0] RPM*.** When the frequency converter is first started, it initially ramps up to this output speed in open-loop mode, following the active ramp-up time. When the output speed programmed is reached, the frequency converter automatically switches to closed-loop mode, and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

CL-83 PID Start Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - par. F-15 Hz]	***NOTICE*** **This parameter is only visible if *parameter K-02 Motor Speed Unit* is set to *[1] Hz*.** When the frequency converter is first started, it initially ramps up to this output frequency in open-loop mode, following the active ramp-up time. When the output frequency programmed is reached, the frequency converter automatically switches to closed-loop mode and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

CL-84 On Reference Bandwidth		
Range:		**Function:**
5 %*	[0 - 200 %]	When the difference between the feedback and the setpoint reference is less than the value of this parameter, the frequency converter's display shows *Run on Reference*. This status can be communicated externally by programming the function of a digital output for *[8] Run on Reference/No Warning*. Also, for serial communications, the *On Reference* status bit of the frequency converter status word is high (value = 1). The *On Reference Bandwidth* is calculated as a percentage of the setpoint reference.

3.22.6 CL-9# PID Controller

This group provides the ability to manually adjust the PID controller. By adjusting the PID controller parameters, the control performance may be improved. See the *AF-600 FP AF-600 FP Design Guide*, for guidelines on adjusting the PID controller parameters.

CL-91 PID Anti Windup		
Option:		**Function:**
		NOTICE **Option *[1] On* is activated automatically, if 1 of the following options is selected in parameters in group *XC-## Ext. Closed Loop*: *[0] Normal*, *[X] Enabled Ext CLX PID*.**
[0]	Off	The integrator continues to change value also after output has reached 1 of the extremes. This can afterwards cause a delay of change of the output of the controller.
[1] *	On	The integrator is locked if the output of the built-in PID controller has reached 1 of the extremes (minimum or maximum value) and therefore is not able to add further changes to the value of the process parameter controlled. This allows the controller to respond more quickly when it can control the system again.

CL-93 PID Proportional Gain		
Range:		**Function:**
0.50*	[0 - 10]	The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (Error x Gain) jumps with a value equal to what is set in *parameter CL-14 Maximum Reference/Feedb.*, the PID controller tries to change the output speed equal to what is set in *parameter F-17 Motor Speed High Limit [RPM]/ parameter F-15 Motor Speed High Limit [Hz]*. However, the output speed is limited by this setting.
Calculate the proportional band (error causing output to change from 0–100%) can be calculated with the formula:

$$\left(\frac{1}{Proportional\ Gain}\right) \times (Max\ Reference)$$

CL-94 PID Integral Time		
Range:		**Function:**
20 s*	[0.01 - 10000 s]	The integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/ setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in *parameter CL-93 PID Proportional Gain*. When no deviation is present, the output from the proportional controller is 0.

CL-95 PID Differentiation Time		
Range:		**Function:**
0 s*	[0 - 10 s]	The differentiator monitors the rate of change of the feedback. If the feedback is changing quickly, it adjusts the output of the PID Controller to reduce the rate of change of the feedback. Quick PID Controller response is obtained when this value is large. However, if too large of a value is used, the frequency converter's output frequency may become unstable. Differentiation time is useful is situations where extremely fast frequency converter response and precise speed control are required. It can be difficult to adjust this for proper system control. Differentiation time is not commonly used in HVAC applications. Therefore, it is best to leave this parameter at 0 or OFF.

CL-96 PID Diff. Gain Limit		
Range:		**Function:**
5*	[1 - 50]	The differential function of a PID controller responds to the rate of change of the feedback. As a result, an abrupt change in the feedback can cause the differential function to make a very large change in the PID controller output. This parameter limits the maximum effect that the PID controller differential function can produce. A smaller value reduces the maximum effect of the PID controller differential function. This parameter is only active when *parameter CL-95 PID Differentiation Time* is not set to OFF (0 s).

3.23 XC-## Ext. PID Closed Loop

The AF-600 FP offers 3 extended closed-loop PID controllers in addition to the PID controller. These can be configured independently to control either external actuators (valves, dampers and so on.) or be used with the internal PID controller to improve the dynamic responses to setpoint changes or load disturbances.

The extended closed-loop PID controllers may be interconnected or connected to the PID closed-loop controller to form a dual loop configuration.

To control a modulating device (for example a valve motor), this device must be a positioning servo motor with built-in electronics accepting either a 0-10 V (signal from analog I/O card) or a 0/4–20 mA (signal from control card and/or general purpose I/O card OPCGPIO General Purpose I/O) control signal.
The output function can be programmed in the following parameters:

- Control card, terminal 42:
  Parameter AN-50 Terminal 42 Output (setting [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3
- General purpose I/O card OPCGPIO General Purpose I/O, terminal X30/8:
  Parameter AN-60 Terminal X30/8 Output, (setting [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3
- Analog I/O card , terminal X42/7...11:
  Parameter AO-40 Terminal X42/7 Output, *parameter AO-50 Terminal X42/9 Output*, *parameter AO-60 Terminal X42/11 Output* (setting [113]...[115], Ext. Closed Loop 1/2/3

General purpose I/O card and analog I/O card are optional cards.

3.23.1 XC-0# Extended CL Autotuning

The extended closed-loop PID controllers can each be auto tuned, simplifying and saving time during commissioning, while ensuring accurate PID control adjustment.

To use PID auto tuning, configure the relevant extended PID controller for the application.

Use a graphical keypad to react on messages during the auto tuning sequence.

Enabling auto tuning, *parameter XC-09 PID Autotuning* puts the relevant PID controller into PID auto tuning mode. The keypad then provides on-screen instructions.

PID auto tuning functions by introducing step changes and then monitoring the feedback. Based on the feedback response, the following required values are calculated:

- PID proportional gain.
  - *Parameter XC-21 Ext. 1 Proportional Gain* for EXT CL 1.
  - *Parameter XC-41 Ext. 2 Proportional Gain* for EXT CL 2.
  - *Parameter XC-61 Ext. 3 Proportional Gain* for EXT CL 3.
- Integral time.
  - *Parameter XC-22 Ext. 1 Integral Time* for EXT CL 1.
  - *Parameter XC-42 Ext. 2 Integral Time* for EXT CL 2.
  - *Parameter XC-62 Ext. 3 Integral Time* for EXT CL 3 are calculated.

The PID differentiation time is set to 0 in the following parameters:

- *Parameter XC-23 Ext. 1 Differentation Time* for EXT CL 1.
- *Parameter XC-43 Ext. 2 Differentation Time* for EXT CL 2.
- *Parameter XC-63 Ext. 3 Differentation Time* for EXT CL 3 are set to value 0 (zero).
- *Parameter XC-20 Ext. 1 Normal/Inverse Control* for EXT CL 1.
- *Parameter XC-40 Ext. 2 Normal/Inverse Control* for EXT CL 2.
- *Parameter XC-60 Ext. 3 Normal/Inverse Control* for EXT CL 3 are determined during the tuning process.

These calculated values are presented on the keypad and can either be accepted or rejected. Once accepted, the values are written to the relevant parameters, and PID auto tuning mode is disabled in *parameter XC-09 PID Autotuning*. Depending on the system being controlled, the time required to carry out PID auto tuning could be several minutes.

Before activating the PID auto tuning, remove excessive feedback sensor noise using the input filter (parameter groups AN-##, E-6# and AO-##, terminal 53/54 filter time constant, and pulse filter time constant #29/33) before activating PID auto tuning.

3

XC-00 Closed Loop Type

Option:		Function:
		This parameter defines the application response. The default mode should be sufficient for most applications. If the relative application speed is known, it can be selected here. This decreases the time needed for carrying out PID auto tuning. The setting has no impact on the value of the tuned parameters and is used only for the PID auto tuning sequence.
[0] *	Auto	
[1]	Fast Pressure	
[2]	Slow Pressure	
[3]	Fast Temperature	
[4]	Slow Temperature	

XC-01 PID Performance

Option:		Function:
[0] *	Normal	Normal setting of this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting would generally be used in pumping systems, where a faster control response is desirable.

XC-02 PID Output Change

Range:		Function:
0.10*	[0.01 - 0.50]	This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full operating range. That is, if the maximum analog output voltage is set to 10 V, 0.10 is 10% of 10 V, which is 1 V. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

XC-03 Minimum Feedback Level

Range:		Function:
-999999*	[-999999.999 - par. XC-04]	Enter the minimum allowable feedback level in user units as defined in • *Parameter XC-10 Ext. 1 Ref./ Feedback Unit* for EXT CL 1. • *Parameter XC-30 Ext. 2 Ref./ Feedback Unit* for EXT CL 2. • *Parameter XC-50 Ext. 3 Ref./ Feedback Unit* for EXT CL 3. If the level drops below *parameter XC-03 Minimum Feedback Level*, PID auto tuning is aborted, and an error message appears in the keypad.

XC-04 Maximum Feedback Level

Range:		Function:
999999*	[par. XC-03 - 999999.999]	Enter the maximum allowable feedback level in user units as defined in: • *Parameter XC-10 Ext. 1 Ref./ Feedback Unit* for EXT CL 1. • *Parameter XC-30 Ext. 2 Ref./ Feedback Unit* for EXT CL 2. • *Parameter XC-50 Ext. 3 Ref./ Feedback Unit* for EXT CL 3. If the level rises above *parameter XC-04 Maximum Feedback Level*, PID auto tuning is aborted, and an error message appears in the keypad.

XC-09 PID Autotuning

Option:		Function:
		This parameter enables selection of the extended PID controller to be auto-tuned and starts the PID auto tuning for that controller. Once the auto tuning has successfully completed and the settings have been accepted or rejected by pressing [OK] or [Cancel] at the end of tuning, this parameter is reset to *[0] Disabled*.
[0] *	Disabled	
[1]	Enabled Ext CL1 PID	
[2]	Enabled Ext CL 2 PID	
[3]	Enabled Ext CL 3 PID	

3.23.2 XC-1# Ext. CL 1 Ref./Fb.

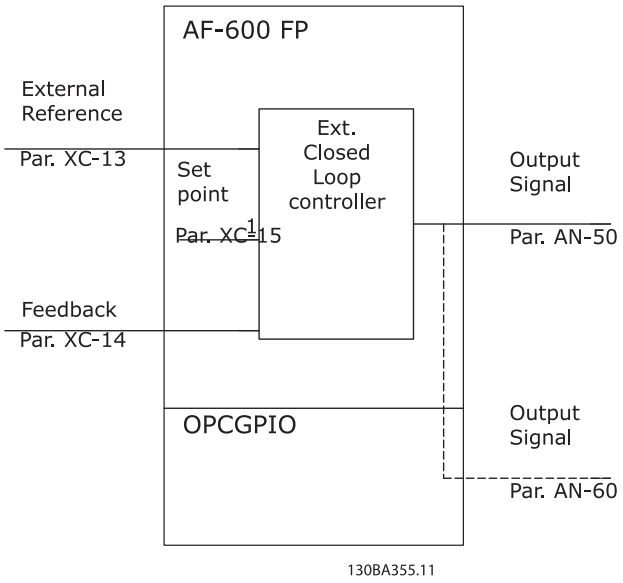


Illustration 3.58 Closed Loop 1 Ref/Feedback

XC-10 Ext. 1 Ref./Feedback Unit		
Option:		**Function:**
		Select the unit for the reference and feedback.
[0]		
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	

XC-10 Ext. 1 Ref./Feedback Unit		
Option:		**Function:**
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

XC-11 Ext. 1 Minimum Reference		
Range:		**Function:**
0 ExtPID1Unit*	[-999999.999 - par. XC-12 ExtPID1Unit]	Select the minimum reference for the closed-loop 1 controller.

XC-12 Ext. 1 Maximum Reference		
Range:		**Function:**
100 ExtPID1Unit*	[par. XC-11 - 999999.999 ExtPID1Unit]	***NOTICE*** **Set the value for *parameter XC-12 Ext. 1 Maximum Reference* before setting the values for the PID controller in parameter group *CL-9#*.** Select the maximum reference for the closed-loop 1 controller. The dynamics of the PID controller depend on the value set in this parameter. See also *parameter XC-21 Ext. 1 Proportional Gain*.

3

XC-13 Ext. 1 Reference Source		
Option:		**Function:**
		This parameter defines which input on the frequency converter that should be treated as the source of the reference signal for the closed loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the General Purpose I/O Card OPCGPIO General Purpose I/O.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potentiometer	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

XC-14 Ext. 1 Feedback Source		
Option:		**Function:**
		This parameter defines which input on the frequency converter should be treated as the source of the feedback signal for the closed-loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the General Purpose I/O Card OPCGPIO General Purpose I/O.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

XC-15 Ext. 1 Setpoint		
Range:		**Function:**
0 ExtPID1Unit*	[par. XC-11 - par. XC-12 ExtPID1Unit]	The setpoint reference is used in extended 1 closed loop. Ext.1 setpoint is added to the value from the Ext.1 Reference source selected in *parameter XC-13 Ext. 1 Reference Source*.

XC-17 Ext. 1 Reference [Unit]		
Range:		**Function:**
0 ExtPID1Unit*	[-999999.999 - 999999.999 ExtPID1Unit]	Readout of the reference value for the closed-loop 1 controller.

XC-18 Ext. 1 Feedback [Unit]		
Range:		**Function:**
0 ExtPID1Unit*	[-999999.999 - 999999.999 ExtPID1Unit]	Readout of the feedback value for the closed-loop 1 controller.

XC-19 Ext. 1 Output [%]		
Range:		**Function:**
0 %*	[0 - 100 %]	Readout of the output value for the closed-loop 1 controller.

3.23.3 XC-2# Ext. CL 1 PID

XC-20 Ext. 1 Normal/Inverse Control		
Option:		**Function:**
[0] *	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increase the output when feedback is higher than the reference.

XC-21 Ext. 1 Proportional Gain		
Range:		**Function:**
0.01*	[0 - 10]	***NOTICE*** **Always set *parameter CL-14 Maximum Reference/Feedb.* before setting the values for the PID controller in parameter group *CL-9#*.** The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (error x gain) jumps with a value equal to what is set in *parameter CL-14 Maximum Reference/Feedb.*, the PID controller tries to change the output speed equal to what is set in *parameter F-17 Motor Speed High Limit [RPM]/ parameter F-15 Motor Speed High Limit [Hz]*. However, the output speed is limited by this setting.

The proportional band (error causing output to change from 0–100%) can be calculated with the formula

$$\left(\frac{1}{Proportional\ Gain}\right) \times (Max\ Reference)$$

XC-22 Ext. 1 Integral Time		
Range:		**Function:**
10000 s*	[0.01 - 10000 s]	Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in *parameter CL-93 PID Proportional Gain*. When no deviation is present, the output from the proportional controller is 0.

XC-23 Ext. 1 Differentation Time		
Range:		**Function:**
0 s*	[0 - 10 s]	The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

XC-24 Ext. 1 Dif. Gain Limit		
Range:		**Function:**
5*	[1 - 50]	Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain when changes are slow and a constant differentiator gain when quick changes occur.

3.23.4 XC-3# Ext. CL 2 Ref./Fb.

XC-30 Ext. 2 Ref./Feedback Unit		
Option:		**Function:**
		See *parameter XC-10 Ext. 1 Ref./Feedback Unit* for details.
[0]		
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m^3/s	
[24]	m^3/min	
[25]	m^3/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft^3/s	
[126]	ft^3/min	
[127]	ft^3/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in^2	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

XC-31 Ext. 2 Minimum Reference		
Range:		**Function:**
0 ExtPID2Unit*	[-999999.999 - par. XC-32 ExtPID2Unit]	See *parameter XC-11 Ext. 1 Minimum Reference* for details.

3

XC-32 Ext. 2 Maximum Reference		
Range:		**Function:**
100 ExtPID2Unit*	[par. XC-31 - 999999.999 ExtPID2Unit]	See *parameter XC-12 Ext. 1 Maximum Reference* for details.

XC-33 Ext. 2 Reference Source		
Option:		**Function:**
		See *parameter XC-13 Ext. 1 Reference Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potentiometer	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

XC-34 Ext. 2 Feedback Source		
Option:		**Function:**
		See *parameter XC-14 Ext. 1 Feedback Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

XC-35 Ext. 2 Setpoint		
Range:		**Function:**
0 ExtPID2Unit*	[par. XC-31 - par. XC-32 ExtPID2Unit]	See *parameter XC-15 Ext. 1 Setpoint* for details.

XC-37 Ext. 2 Reference [Unit]		
Range:		**Function:**
0 ExtPID2Unit*	[-999999.999 - 999999.999 ExtPID2Unit]	See *parameter XC-17 Ext. 1 Reference [Unit]*, *Ext. 1 Reference [Unit]*, for details.

XC-38 Ext. 2 Feedback [Unit]		
Range:		**Function:**
0 ExtPID2Unit*	[-999999.999 - 999999.999 ExtPID2Unit]	See *parameter XC-18 Ext. 1 Feedback [Unit]* for details.

XC-39 Ext. 2 Output [%]		
Range:		**Function:**
0 %*	[0 - 100 %]	See *parameter XC-19 Ext. 1 Output [%]* for details.

3.23.5 XC-4# Ext. CL 2 PID

XC-40 Ext. 2 Normal/Inverse Control		
Option:		**Function:**
		See *parameter XC-20 Ext. 1 Normal/Inverse Control* for details.
[0] *	Normal	
[1]	Inverse	

XC-41 Ext. 2 Proportional Gain		
Range:		**Function:**
0.01*	[0 - 10]	See *parameter XC-21 Ext. 1 Proportional Gain* for details.

XC-42 Ext. 2 Integral Time		
Range:		**Function:**
10000 s*	[0.01 - 10000 s]	See *parameter XC-22 Ext. 1 Integral Time* for details.

XC-43 Ext. 2 Differentation Time		
Range:		**Function:**
0 s*	[0 - 10 s]	See *parameter XC-23 Ext. 1 Differentation Time* for details.

XC-44 Ext. 2 Dif. Gain Limit		
Range:		**Function:**
5*	[1 - 50]	See *parameter XC-24 Ext. 1 Dif. Gain Limit* for details.

3.23.6 XC-5# Ext. CL 3 Ref./Fb.

XC-50 Ext. 3 Ref./Feedback Unit		
Option:		**Function:**
		See *parameter XC-10 Ext. 1 Ref./Feedback Unit* for details.
[0]		
[1] *	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	

XC-50 Ext. 3 Ref./Feedback Unit

Option:	Function:
[21]	l/min
[22]	l/h
[23]	m^3/s
[24]	m^3/min
[25]	m^3/h
[30]	kg/s
[31]	kg/min
[32]	kg/h
[33]	t/min
[34]	t/h
[40]	m/s
[41]	m/min
[45]	m
[60]	°C
[70]	mbar
[71]	bar
[72]	Pa
[73]	kPa
[74]	m WG
[75]	mm Hg
[80]	kW
[120]	GPM
[121]	gal/s
[122]	gal/min
[123]	gal/h
[124]	CFM
[125]	ft^3/s
[126]	ft^3/min
[127]	ft^3/h
[130]	lb/s
[131]	lb/min
[132]	lb/h
[140]	ft/s
[141]	ft/min
[145]	ft
[160]	°F
[170]	psi
[171]	lb/in^2
[172]	in WG
[173]	ft WG
[174]	in Hg
[180]	HP

XC-51 Ext. 3 Minimum Reference

Range:		Function:
0 ExtPID3Unit*	[-999999.999 - par. XC-52 ExtPID3Unit]	See *parameter XC-11 Ext. 1 Minimum Reference* for details.

XC-52 Ext. 3 Maximum Reference

Range:		Function:
100 ExtPID3Unit*	[par. XC-51 - 999999.999 ExtPID3Unit]	See *parameter XC-12 Ext. 1 Maximum Reference* for details.

XC-53 Ext. 3 Reference Source

Option:		Function:
		See *parameter XC-13 Ext. 1 Reference Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital Potentiometer	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

XC-54 Ext. 3 Feedback Source

Option:		Function:
		See *parameter XC-14 Ext. 1 Feedback Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	

XC-55 Ext. 3 Setpoint

Range:		Function:
0 ExtPID3Unit*	[par. XC-51 - par. XC-52 ExtPID3Unit]	See *parameter XC-15 Ext. 1 Setpoint* for details.

XC-57 Ext. 3 Reference [Unit]

Range:		Function:
0 ExtPID3Unit*	[-999999.999 - 999999.999 ExtPID3Unit]	See *parameter XC-17 Ext. 1 Reference [Unit]* for details.

XC-58 Ext. 3 Feedback [Unit]		
Range:		**Function:**
0 ExtPID3Unit*	[-999999.999 - 999999.999 ExtPID3Unit]	See *parameter XC-18 Ext. 1 Feedback [Unit]* for details.

XC-59 Ext. 3 Output [%]		
Range:		**Function:**
0 %*	[0 - 100 %]	See *parameter XC-19 Ext. 1 Output [%]* for details.

3.23.7 XC-6# Ext. CL 3 PID

XC-60 Ext. 3 Normal/Inverse Control		
Option:		**Function:**
		See *parameter XC-20 Ext. 1 Normal/Inverse Control* for details.
[0] *	Normal	
[1]	Inverse	

XC-61 Ext. 3 Proportional Gain		
Range:		**Function:**
0.01*	[0 - 10]	See *parameter XC-21 Ext. 1 Proportional Gain* for details.

XC-62 Ext. 3 Integral Time		
Range:		**Function:**
10000 s*	[0.01 - 10000 s]	See *parameter XC-22 Ext. 1 Integral Time* for details.

XC-63 Ext. 3 Differentation Time		
Range:		**Function:**
0 s*	[0 - 10 s]	See *parameter XC-23 Ext. 1 Differentation Time* for details.

XC-64 Ext. 3 Dif. Gain Limit		
Range:		**Function:**
5*	[1 - 50]	See *parameter XC-24 Ext. 1 Dif. Gain Limit* for details.

3.24 PC-## Pump Controller

Parameters for configuring the basic Pump Controller for sequence control of multiple pumps. For a more application-oriented description and wiring examples, see *Application Examples, Pump Controller* in the *design guide*.

To configure the Pump Controller to the actual system and the desired control strategy, follow the sequence starting with parameter group *PC-0# System Settings* and next parameter group *PC-5# Alternation Settings*. These parameters can normally be set in advance.
Parameters in parameter group *PC-2# Bandwidth Settings* and *PC-4# Staging Settings* often depend on the dynamic of the system and final adjustment to be done at the commissioning of the plant.

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NOTICE

The Pump Controller is supposed to operate in closed loop controlled by the built-in PI controller (*[3] closed loop* selected in *parameter H-40 Configuration Mode*). If *[0] open loop* is selected in *parameter H-40 Configuration Mode*, all fixed speed pumps are destaged, but the variable speed pump is still controlled by the frequency converter, now as an open-loop configuration:

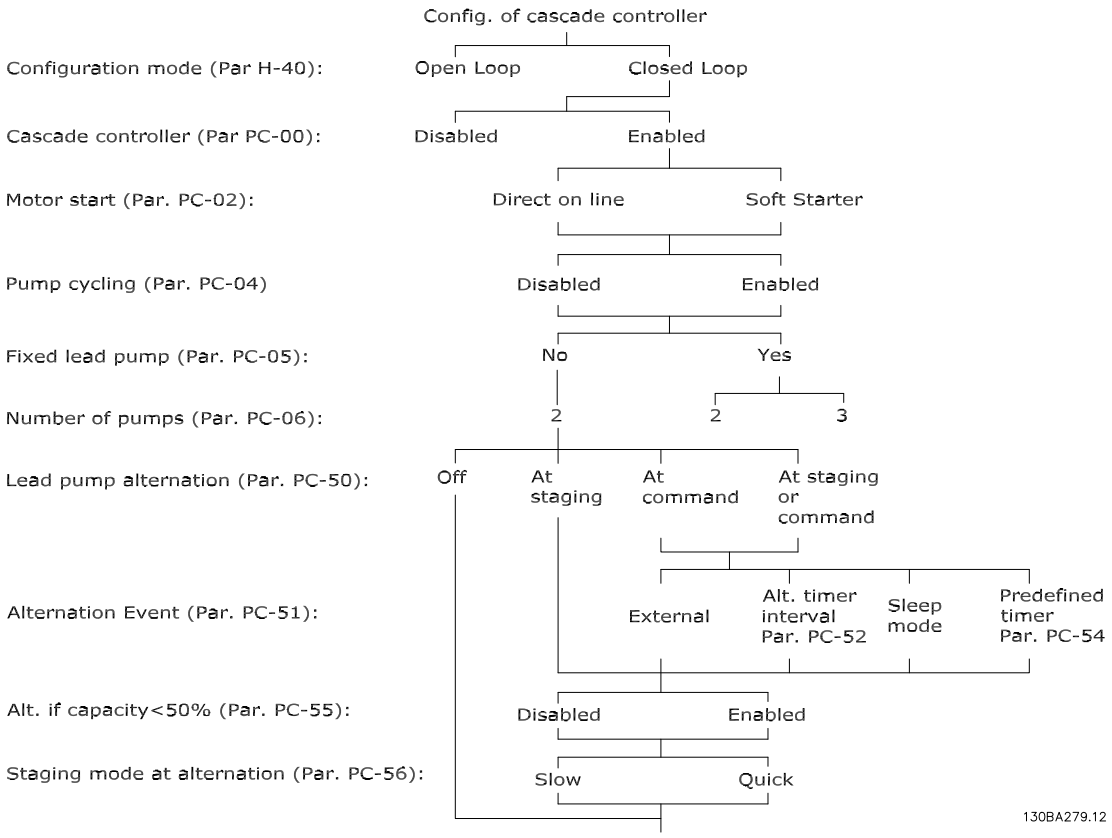


Illustration 3.59 Cascade Controller Sample Set-up

3

3.24.1 PC-0# System Settings

Parameters related to control principles and configuration of the system.

PC-00 Pump Controller		
Option:		**Function:**
		For operation of multiple devices (pump/fan) systems where capacity is adapted to actual load with speed control combined with on/off control of the devices. For simplicity, only pump systems are described.
[0] *	Disabled	The Pump Controller is not active. All built-in relays assigned to pump motors in the cascade function are de-energised. If a variable speed pump is connected to the frequency converter directly (not controlled by a built-in relay), this pump/fan is controlled as a single-pump system.
[1]	Enabled	The Pump Controller is active and stages/ destages pump according to load on the system.

PC-02 Motor Start		
Option:		**Function:**
		Motors are connected to the mains directly with a contactor or with a soft starter. When the value of *parameter PC-02 Motor Start* is set to an option other than *[0] Direct on Line*, then *parameter PC-50 Lead Pump Alternation* is automatically set to the default of *[0] Direct on Line*.
[0] *	Direct on Line	Each fixed speed pump is connected to mains directly via a contactor.
[1]	Soft Starter	Each fixed speed pump is connected to mains via a soft starter.
[2]	Star-Delta	Fixed pumps connected with star-delta starters are staged in the same way as pumps connected with soft starters. They are destaged in the same way as pumps connected directly to mains.

PC-04 Pump Cycling		
Option:		**Function:**
		To provide equal hours of operation with fixed speed pumps, the pump used can be cycled. The selection of pump cycling is either *first in – last out* or equal running hours for each pump.
[0] *	Disabled	The fixed speed pumps are connected in the order 1–2 and disconnected in the order 2–1 (first in–last out).
[1]	Enabled	The fixed speed pumps are connected/disconnected to have equal running hours for each pump.

PC-05 Fixed Lead Pump		
Option:		**Function:**
		Fixed lead pump is a configuration when the variable speed pump is connected directly to the frequency converter, and if a contactor is applied between frequency converter and pump, this contactor is not controlled by the frequency converter. If operating with *parameter PC-50 Lead Pump Alternation* set to other than *[0] Off*, set this parameter to *[0] No*.
[0]	No	The lead pump function can alternate between the pumps controlled by the 2 built-in relays. Connect 1 pump to the built-in *RELAY* 1, and the other pump to *RELAY* 2. The pump function (cascade pump1 and cascade pump2) is automatically assigned to the relays (maximum 2 pumps can in this case be controlled by the frequency converter).
[1] *	Yes	The lead pump is fixed (no alternation) and connected directly to the frequency converter. The *parameter PC-50 Lead Pump Alternation* is automatically set to *[0] Off*. Built-in relays *RELAY* 1 and *RELAY* 2 can be assigned to separate fixed speed pumps. In total, 3 pumps can be controlled by the frequency converter.

PC-06 Number of Pumps		
Range:		**Function:**
2*	[2 - 3]	The number of pumps connected to the Pump Controller including the variable speed pump. If the variable speed pump is connected directly to the frequency converter, and the other fixed speed pumps (lag pumps) are controlled by the 2 built-in relays, 3 pumps can be controlled. If both the variable speed and fixed speed pumps are to be controlled by built-in relays, only 2 pumps can be connected. If *parameter PC-05 Fixed Lead Pump* is set to *[0] No*: 1 variable speed pump and 1 fixed speed pump; both controlled by built-in relay. If *parameter PC-05 Fixed Lead Pump* is set to *[1] Yes*: 1 variable speed pump and 1 fixed speed pump controlled by built-in relays. 1 lead pump, see *parameter PC-05 Fixed Lead Pump*. 2 fixed speed pumps controlled by built-in relays.

3.24.2 PC-1#

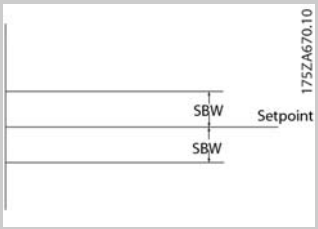
PC-10 Minimum Run Time Override		
Option:		**Function:**
[0] *	Disabled	
[1]	Enabled	

PC-11 Minimum Run Time Override Value		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	

3.24.3 PC-2# Bandwidth Settings

Parameters for setting the bandwidth within which the pressure is allowed to operate before staging/destaging fixed speed pumps. Also includes various timers to stabilise the control.

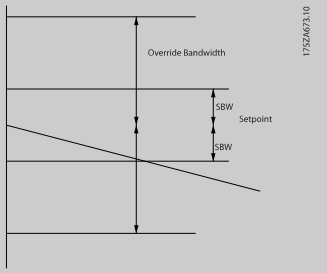
PC-20 Staging Bandwidth

Range:		Function:
10 %*	[1 - par. PC-21 %]	Set the staging bandwidth (SBW) percentage to accommodate normal system pressure fluctuation. In cascade control systems, to avoid frequent switching of fixed speed pumps, the desired system pressure is typically kept within a bandwidth rather than at a constant level. The SBW is programmed as a percentage of *parameter CL-13 Minimum Reference/Feedb.* and *parameter CL-14 Maximum Reference/Feedb.* For example, if the setpoint is 5 bar and the SBW is set to 10%, a system pressure between 4.5 and 5.5 bar is tolerated. No staging or de-staging occur within this bandwidth.  **Illustration 3.61 Staging Bandwidth**

PC-21 Override Bandwidth

Range:		Function:
100 %*	[par. PC-20 - 100 %]	When a large and quick change in the system demand occurs (such as a sudden water demand), the system pressure rapidly changes and an immediate staging or destaging of a fixed speed pump becomes necessary to match the requirement. The override bandwidth (OBW) is programmed to override the staging/destaging timer (*parameter PC-23 SBW Staging Delay* and *parameter PC-24 SBW Destaging Delay*) for immediate response. The OBW must always be programmed to a higher value than the value set in *parameter PC-20 Staging Bandwidth*. The OBW is a percentage of *parameter F-52 Minimum Reference* and *parameter F-53 Maximum Reference*.

PC-21 Override Bandwidth

Range:		Function:
		 **Illustration 3.63** Setting the OBW too close to the SBW could defeat the purpose with frequent staging at momentary pressure changes. Setting the OBW too high might lead to unacceptably high or low pressure in the system while the SBW timers are running. The value can be optimised with increased familiarity with the system. See *parameter PC-25 OBW Time*. To avoid unintended staging during the commissioning phase and fine-tuning of the controller, initially leave the OBW at the factory setting of 100% (Off). When the fine-tuning is completed, set the OBW to the required value. Initial value of 10% is suggested.

PC-22 Fixed Speed Bandwidth

Range:		Function:
par. PC-20 %*	[par. PC-20 - par. PC-21 %]	When the cascade control system runs normally and the frequency converter issues a trip alarm, it is important to maintain the system head. The cascade controller does this by continuing to stage/destage the fixed speed pump on and off. As keeping the head at the setpoint would require frequent staging and destaging when only a fixed speed pump is running, a wider fixed speed bandwidth (FSBW) is used instead of SBW. In alarm situations, or if the start signal on the digital input goes low, it is possible to stop the fixed speed pumps by pressing [Off] or [Hand]. If the issued alarm is a trip lock alarm, the cascade controller stops the system immediately by cutting out all the fixed speed pumps. This is basically the same as emergency stop (coast/coast inverse command) for the cascade controller.

3

PC-23 SBW Staging Delay

Range:		Function:
15 s*	[0 - 3000 s]	Immediate staging of a fixed speed pump is not desirable when a momentary pressure drop in the system exceeds the staging bandwidth (SBW). Staging is delayed by the length of time programmed. If the pressure increases within the SBW before the timer has elapsed, the timer is reset.

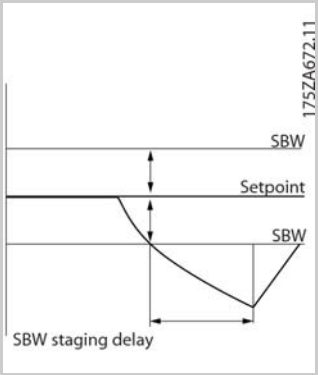


Illustration 3.64 SBW Staging Delay

PC-24 SBW Destaging Delay

Range:		Function:
15 s*	[0 - 3000 s]	Immediate destaging of a fixed speed pump is not desirable when a momentary pressure increases in the system that exceeds the staging bandwidth (SBW). Destaging is delayed by the length of time programmed. If the pressure decreases within the SBW before the timer has elapsed, the timer is reset.

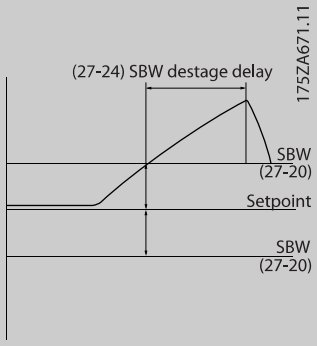


Illustration 3.65 SBW Destaging Delay

PC-25 OBW Time

Range:		Function:
10 s*	[0 - 300 s]	Staging a fixed speed pump creates a momentary pressure peak in the system, which might exceed the override bandwidth (OBW). It is not recommended to destage a pump in response to a staging pressure peak. The OBW time can be programmed to prevent staging until the system pressure has stabilised and normal control established. Set the timer to a value that allows the system to stabilise after staging. The 10 s factory setting is appropriate in most applications. In highly dynamic systems, a shorter time may be wanted.

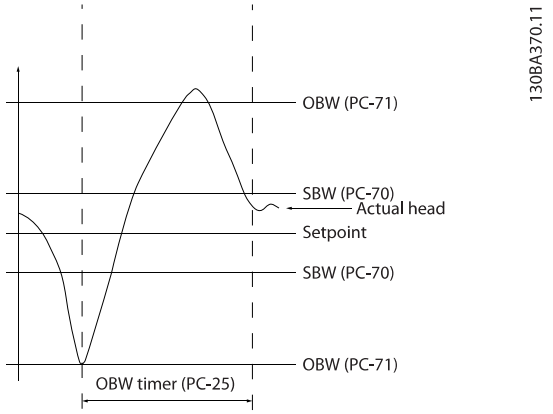


Illustration 3.66 OBW Time

PC-26 Destage At No-Flow

Option:		Function:
		This parameter ensures that when a no-flow situation occurs, the fixed speed pumps are destaged 1-by-1 until the no-flow signal disappears. This requires that no-flow detection is active. See parameter group *AP-2#*. If *[0] Disabled* is selected, the Pump Controller does not change the normal behaviour of the system.
[0] *	Disabled	
[1]	Enabled	

PC-27 Stage Function

Option:		Function:
		If the stage function is set to *[0] Disabled*, *parameter PC-28 Stage Function Time* is not activated.
[0]	Disabled	
[1] *	Enabled	

PC-28 Stage Function Time		
Range:		**Function:**
15 s*	[0 - 300 s]	The stage function time is programmed to avoid frequent staging of the fixed speed pumps. The stage function time starts if it is *[1] Enabled* by *parameter PC-27 Stage Function*, and when the variable speed pump runs at motor speed high limit, *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*, with at least 1 fixed speed pump in the stop position. When the programmed value of the timer expires, a fixed speed pump is staged.

PC-29 Destage Function		
Option:		**Function:**
		The destage function ensures that the lowest numbers of pumps are running to save energy and to avoid dead head water circulation in the variable speed pump. If the destage function is set to *[0] Disabled*, *parameter PC-30 Destage Function Time* is not activated.
[0]	Disabled	
[1] *	Enabled	

PC-30 Destage Function Time		
Range:		**Function:**
15 s*	[0 - 300 s]	The destage function timer is programmable to avoid frequent staging/destaging of the fixed speed pumps. The destage function time starts when the adjustable speed pump is running at *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*, with 1 or more fixed speed pumps in operation and system requirements satisfied. In this situation, the adjustable speed pump contributes a little to the system. When the programmed value of the timer expires, a stage is removed, avoiding dead head water circulation in the adjustable speed pump.

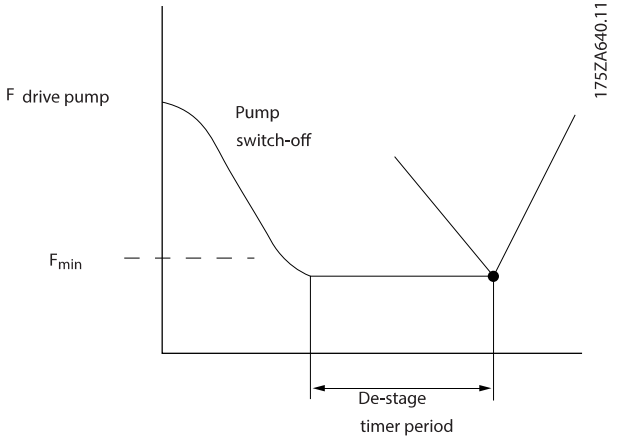


Illustration 3.67 Destage Function Time

3.24.4 PC-4# Staging Settings

Parameters determining conditions for staging/destaging the pumps.

PC-40 Decel Ramp Delay		
Range:		**Function:**
10 s*	[0 - 120 s]	When adding a fixed speed pump controlled by a soft starter or a star-delta starter, it is possible to delay the decel of the lead pump until a preset time after the start of the fixed speed pump to eliminate pressure surges or water hammer in the system. Use this option only if *[1] Soft Starter* or *[2] Star Delta* is selected in *parameter PC-02 Motor Start*.

PC-41 Accel Ramp Delay		
Range:		**Function:**
2 s*	[0 - 12 s]	When removing a fixed speed pump controlled by a soft starter, it is possible to delay the accel of the lead pump until a preset time after the stop of the fixed speed pump to eliminate pressure surges or water hammer in the system. Only to be used if *[1] Soft Starter* is selected in *parameter PC-02 Motor Start*.

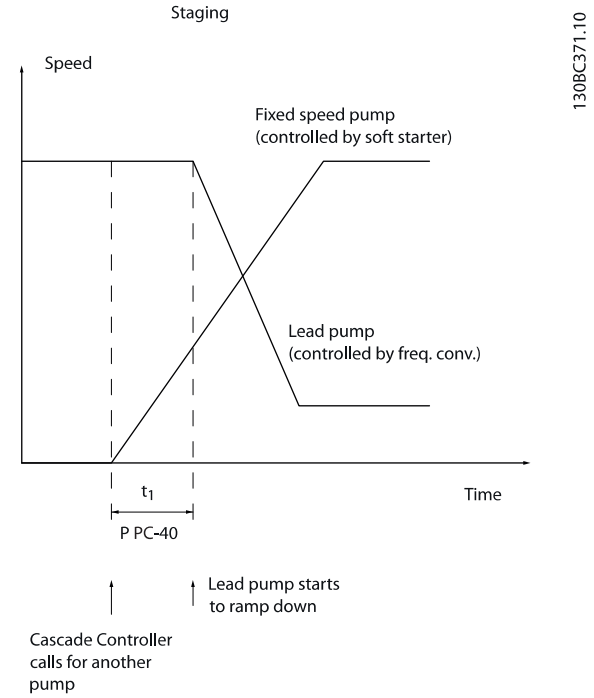


Illustration 3.68 Staging

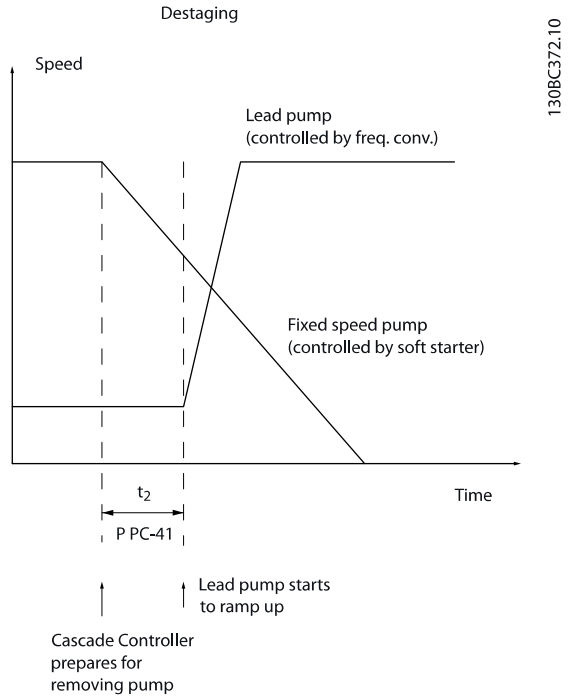


Illustration 3.69 Destaging

NOTICE

Fixed pumps connected with star-delta starters are staged in the same way as pumps connected with soft starters. They are destaged in the same way as pumps connected directly to mains.

PC-42 Staging Threshold		
Range:		**Function:**
90 %*	[0 - 100 %]	When adding a fixed speed pump to prevent an overshoot of pressure, the variable speed pump ramps down to a lower speed. When the variable speed pump reaches the staging speed the fixed speed pump is staged on. The staging threshold is used to calculate the speed of the variable speed pump when the cut-in point of the fixed speed pump occurs. The calculation of the staging threshold is the ratio of *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*, to the *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*, expressed in percent. Staging threshold must range from $_{STAGE\,\%} = \frac{LOW}{HIGH} \times 100\,\%$ to 100%, where n_{LOW} is motor speed low limit and n_{HIGH} is Motor Speed High Limit.

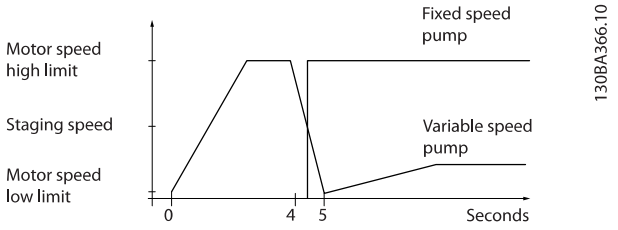


Illustration 3.70 Staging Threshold

NOTICE

If the setpoint is reached after staging before the variable speed pump reaches its minimum speed - the system enters the state closed loop as soon as the feedback pressure is crossing the set-point.

PC-43 Destaging Threshold		
Range:		**Function:**
50 %*	[0 - 100 %]	When removing a fixed speed pump to prevent an undershoot of pressure, the variable speed pump ramps up to a higher speed. When the variable speed pump reaches the destaging speed, the fixed speed pump is destaged. The destaging threshold is used to calculate the speed of the variable speed pump when the destaging of the fixed speed pump occurs. The calculation of the destaging threshold is the ratio of *parameter F-18 Motor Speed Low Limit [RPM]* or *parameter F-16 Motor Speed Low Limit [Hz]*, to *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*, expressed in percent. Destaging threshold must range from $STAGE\,\% = \frac{LOW}{HIGH} \times 100\,\%$ to 100%, where n_{LOW} is motor speed low limit and n_{HIGH} is motor speed high limit.

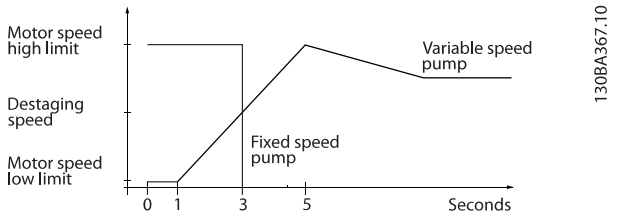


Illustration 3.71 Destaging Threshold

PC-44 Staging Speed [RPM]		
Range:		**Function:**
0 RPM*	[000 - 0 RPM]	Readout of the calculated value for staging speed. When adding a fixed speed pump to prevent an overshoot of pressure, the variable speed pump decels to a lower speed. When the variable speed pump reaches the staging speed, the fixed speed pump is staged on. Staging speed calculation is based on *parameter PC-42 Staging Threshold* and *parameter F-17 Motor Speed High Limit [RPM]*. Staging speed is calculated with the following formula: $\eta_{STAGE} = \eta_{HIGH}\frac{\eta_{STAGE\,\%}}{100}$ where n_{HIGH} is motor speed high limit and $n_{STAGE100\%}$ is the value of staging threshold.

PC-45 Staging Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - 0 Hz]	Readout of the calculated value for staging speed. When adding a fixed speed pump to prevent an overshoot of pressure, the variable speed pump decels to a lower speed. When the variable speed pump reaches the staging speed, the fixed speed pump is staged on. Staging speed calculation is based on *parameter PC-42 Staging Threshold* and *parameter F-15 Motor Speed High Limit [Hz]*. Staging speed is calculated with the following formula: $STAGE = HIGH\frac{STAGE\,\%}{100}$ where n_{HIGH} is motor speed high limit and $n_{STAGE100\%}$ is the value of staging threshold.

PC-46 Destaging Speed [RPM]		
Range:		**Function:**
0 RPM*	[000 - 0 RPM]	Readout of the calculated value for destaging speed. When removing a fixed speed pump to prevent an undershoot of pressure, the variable speed pump acccels to a higher speed. When the variable speed pump reaches the destaging speed, the fixed speed pump is destaged. Destaging speed is calculated based on *parameter PC-43 Destaging Threshold* and *parameter F-17 Motor Speed High Limit [RPM]*. Destaging speed is calculated with the following formula: $DESTAGE = HIGH\frac{DESTAGE\,\%}{100}$ where n_{HIGH} is motor speed high limit and $n_{DESTAGE100\%}$ is the value of destaging threshold.

PC-47 Destaging Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - 0 Hz]	Readout of the calculated value for destaging speed. When removing a fixed speed pump to prevent an undershoot of pressure, the variable speed pump acccels to a higher speed. When the variable speed pump reaches the destaging speed, the fixed speed pump is destaged. Destaging speed is calculated based on *parameter PC-43 Destaging Threshold* and *parameter F-15 Motor Speed High Limit [Hz]*. Destaging speed is calculated with the following formula: $DESTAGE = HIGH\frac{DESTAGE\,\%}{100}$ where n_{HIGH} is motor speed high limit and $n_{DESTAGE100\%}$ is the value of destaging threshold.

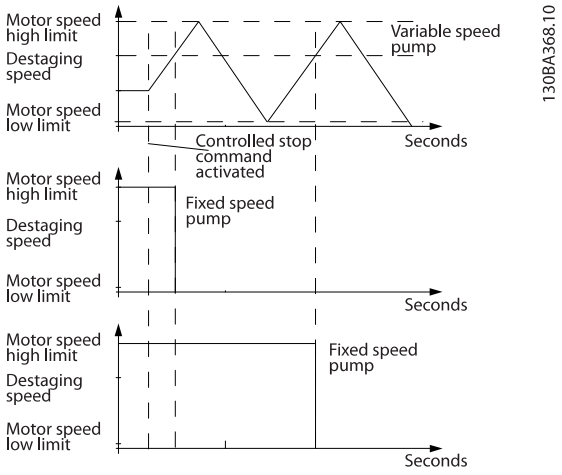


Illustration 3.72 Destaging Speed

3.24.5 PC-5# Alternation Settings

Parameters for defining the conditions for alternation of the variable speed pump (lead), if selected as control strategy.

PC-50 Lead Pump Alternation		
Option:		**Function:**
		NOTICE **It is not possible to select other than *[0] Off* if *parameter PC-05 Fixed Lead Pump* is set to *[1] Yes*.** Lead pump alternation equalises the use of pumps by periodically changing the pump that is speed-controlled. This ensures that pumps are equally used over time. Alternation equalises the usage of pumps by always selecting the pump with the lowest number of used hours to stage on next.

3

PC-50 Lead Pump Alternation

Option:		Function:
[0] *	Off	No alternation of lead pump function takes place. It is not possible to set this parameter to options other than *[0] Off* if *parameter PC-02 Motor Start* is set other than *[0] Direct on Line*.
[1]	At staging	Alternation of the lead pump function takes place when staging another pump.
[2]	At command	Alternation of the lead pump function takes place at an external command signal or a pre-programmed event. See *parameter PC-51 Alternation Event* for available options.
[3]	At staging or command	Alternation of the variable speed (lead) pump takes place at staging or the At command-signal (see above).

PC-51 Alternation Event

Option:		Function:
		This parameter is only active if the options *[2] At Command* or *[3] At Staging or Command* have been selected in *parameter PC-50 Lead Pump Alternation*. If an alternation event is selected, the alternation of lead pump takes place every time the event occurs.
[0] *	External	Alternation takes place when a signal is applied to 1 of the digital inputs on the terminal strip and this input has been assigned to *[121] Lead Pump Alternation* in *Digital Inputs*.
[1]	Alternation Time Interval	Alternation takes place every time *parameter PC-52 Alternation Time Interval* expires.
[2]	Sleep Mode	Alternation takes place each time the lead pump goes into sleep mode. Set *parameter CL-23 Setpoint 3* to *[1] Sleep Mode* or apply an external signal must be applied for this function.
[3]	Predefined Time	Alternation takes place at a defined time of the day. If *parameter PC-54 Alternation Predefined Time* is set, the alternation is carried out every day at the specified time. Default time is midnight (00:00 or 12:00AM depending on the time format).

PC-52 Alternation Time Interval

Range:		Function:
24 h*	[1 - 999 h]	If selecting *[1] Alternation Time Interval* in *parameter PC-51 Alternation Event*, the alternation of the variable speed pump takes place every time the alternation time interval expires (can be checked in *parameter PC-53 Alternation Timer Value*).

PC-53 Alternation Timer Value

Range:		Function:
0*	[0 - 7]	Read-out parameter for the alternation time interval value set in *parameter PC-52 Alternation Time Interval*.

PC-54 Alternation Predefined Time

Range:		Function:
0*	[0 - 0]	If selecting *[3] Predefined Time* in *parameter PC-51 Alternation Event*, the variable speed pump alternation is carried out every day at the specified time set in alternation predefined time. Default time is midnight (00:00 or 12:00AM depending on the time format).

PC-55 Alternate if Load < 50%

Option:		Function:
		NOTICE **Only valid if *parameter PC-50 Lead Pump Alternation* is different from *[0] Off*.** If selecting *[1] Enabled*, the pump alternation can only occur if the capacity is equal to or below 50%. The capacity calculation is the ratio of running pumps (including the variable speed pump) to the total number of available pumps (including variable speed pump, but not those that are interlocked). $Capacity = \frac{N_{RUNNING}}{N_{TOTAL}} \times 100\,\%$ For the basic Pump Controller all pumps are equal size.
[0]	Disabled	The lead pump alternation takes place at any pump capacity.
[1] *	Enabled	The lead pump function is alternated only if the number of pumps running are providing less than 50% of total pump capacity.

PC-56 Staging Mode at Alternation

Option:		Function:
		This parameter is only active if the option selected in *parameter PC-50 Lead Pump Alternation* is different from *[0] Off*. 2 types of staging and destaging of pumps are possible. Slow transfer makes staging and destaging smooth. Quick transfer makes staging and destaging as fast as possible; the variable speed pump is just cut out (coasted).
[0] *	Slow	At alternation, the variable speed pump is accceled to maximum speed and then deceled to a stand still.
[1]	Quick	At alternation, the variable speed pump is accceled to maximum speed and then coasted to stand still.

Illustration 3.73 is an example of the slow transfer-staging. The variable speed pump (top graph) and 1 fixed speed pump (bottom graph) run before the staging command. When the *[0] Slow* transfer command is activated, an alternation is carried out by ramping the variable speed pump to *parameter F-17 Motor Speed High Limit [RPM]* or *parameter F-15 Motor Speed High Limit [Hz]*, and then decelerated to zero speed. After a delay before starting next pump (*parameter PC-58 Run Next Pump Delay*), the next lead pump (middle graph) is accelerated and another original lead pump (top graph) is added after the delay before running on mains (*parameter PC-59 Run on Line Delay*) as a fixed speed pump. The next lead pump (middle graph) is decelerated to motor speed low limit and then allowed to vary speed to maintain system pressure.

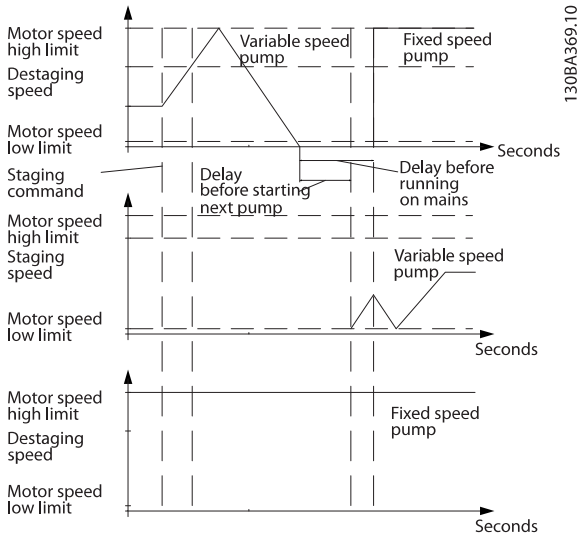


Illustration 3.73 Staging Mode at Alternation

PC-58 Run Next Pump Delay		
Range:		**Function:**
0.1 s*	[0.1 - 5 s]	This parameter is only active if the option selected in *parameter PC-50 Lead Pump Alternation* is different from *[0] Off*. This parameter sets the time between stopping the old variable speed pump and starting another pump as a new variable speed pump. Refer to *parameter PC-56 Staging Mode at Alternation*, *Illustration 3.73*, for description of staging and alternation.

PC-59 Run on Line Delay		
Range:		**Function:**
0.5 s*	[par. PC-58 - 5 s]	This parameter is only active if the option selected in *parameter PC-50 Lead Pump Alternation*, is different from *[0] Off*. This parameter sets the time between stopping the old variable speed pump and starting this pump as a new fixed speed pump. Refer to *Illustration 3.73* for description of staging and alternation.

PC-59 Run on Line Delay		
Range:		**Function:**
		pump. Refer to *Illustration 3.73* for description of staging and alternation.

3.24.6 PC-8# Status

Readout parameters informing about the operating status of the Pump Controller and the pumps controlled.

PC-80 Pump Status		
Range:		**Function:**
0*	[0 - 25]	Readout of the status of the Pump Controller.

PC-81 Pump Status		
Range:		**Function:**
0*	[0 - 25]	Pump status shows the status for the number of pumps selected in *parameter PC-06 Number of Pumps*. It is a readout of the status for each of the pumps showing a string, which consists of pump number and the current status of the pump. Example: Readout is with the abbreviation like "1:D 2:O" This means that pump 1 is running and speed controlled by the frequency converter and pump 2 is stopped.

PC-82 Lead Pump		
Range:		**Function:**
0*	[0 - par. PC-06]	Readout parameter for the actual variable speed pump in the system. The lead pump parameter is updated to reflect the current variable speed pump in the system when an alternation takes place. If no lead pump is selected (Pump Controller disabled or all pumps interlocked), the display shows N1.

PC-83 Relay Status		
Array [9]		
Range:		**Function:**
0*	[0 - 4]	Readout of the status for each of the relays assigned to control the pumps. Every element in the array shows a relay. If a relay is activated, the corresponding element is set to On. If a relay is deactivated, the corresponding element is set to Off.

3

PC-84 Pump ON Time		
Array [10]		
Range:		**Function:**
0 h*	[0 - 2147483647 h]	Readout of the value for pump ON time. The Pump Controller has separate counters for the pumps and for the relays that control the pumps. Pump ON time monitors the operating hours of each pump. The value of each pump ON time counter can be reset to 0 by writing in the parameter, for example, if the pump is replaced in case of service.

PC-85 Relay ON Time		
Array [9]		
Range:		**Function:**
0 h*	[0 - 2147483647 h]	Readout of the value for relay ON time. The Pump Controller has separate counters for the pumps and for the relays that control the pumps. Pump cycling is always done based on the relay counters, otherwise it would always use the new pump if a pump is replaced and its value in *parameter PC-84 Pump ON Time* is reset. To use *parameter PC-04 Pump Cycling*, the Pump Controller is monitoring the relay ON time.

PC-86 Reset Relay Counters		
Option:		**Function:**
		Resets all elements in *parameter PC-85 Relay ON Time* counters.
[0] *	Do not reset	
[1]	Do reset	

3.24.7 PC-9# Service

Parameters used in case of service on 1 or more of the pumps controlled.

PC-90 Pump Interlock		
Array [10]		
Option:		**Function:**
		In this parameter, it is possible to disable 1 or more of the fixed lead pumps. For example, the pump is not selected for staging on even if it is the next pump in the operation sequence. It is not possible to disable the lead pump with the pump interlock command. The digital input interlocks are selected as *[130] Pump 1 Interlock – [132] Pump 1 Interlock* in parameter group *E-1# Digital In/Out*.
[0] *	Off	The pump is active for staging/destaging.

PC-90 Pump Interlock		
Array [10]		
Option:		**Function:**
[1]	On	The pump interlock command is given. If a pump runs it is immediately destaged. If the pump does not run, it is not allowed to stage on.

PC-91 Manual Alternation		
Range:		**Function:**
0*	[0 - par. PC-06]	Readout parameter for the actual variable speed pump in the system. When an alternation takes place, the lead pump parameter is updated to reflect the current variable speed pump in the system. If no lead pump is selected (Pump Controller disabled or all pumps interlocked), the display shows N1.

3.25 LC-## Logic Controller

3.25.1 LC-## Logic Controller

Logic Controller (LC) is a sequence of user-defined actions (see *parameter LC-52 Logic Controller Action* [x]) executed by the LC when the associated user-defined event (see *parameter LC-51 Logic Controller Event* [x]) is evaluated as TRUE by the LC. Events and actions are each numbered and linked together in pairs. This means that when [0] event is fulfilled (attains the value TRUE), [0] action is executed. After this, the conditions of [1] event are evaluated and if evaluated TRUE, [1] action is executed and so on. Only 1 event is evaluated at any time. If an event is evaluated as FALSE, nothing happens (in the LC) during the current scan interval and no other events are evaluated. This means that when the LC starts, it evaluates [0] event (and only [0] event) at each scan interval. Only when [0] event is evaluated TRUE, the LC executes [0] action and starts evaluating [1] event. It is possible to program from 1 to 20 events and actions.
When the last event/action has been executed, the sequence starts over again from [0] event/[0] action.
Illustration 3.74 shows an example with 3 events/actions

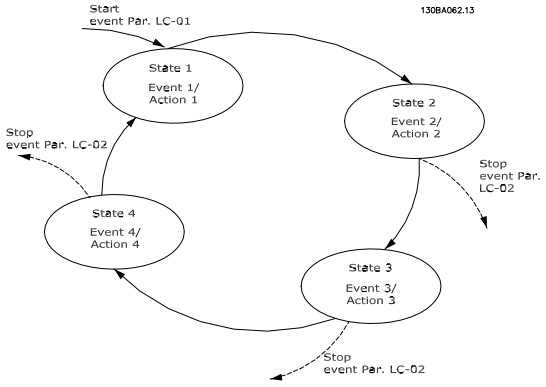


Illustration 3.74 Example with 3 Events/Actions

Starting and stopping the LC
Start and stop the LC by selecting *[1] On* or *[0] Off* in *parameter LC-00 Logic Controller Mode*. The LC always starts in state 0 (where it evaluates *[0] event*). The LC starts when the start event (defined in *parameter LC-01 Start Event*) is evaluated as TRUE (provided that *[1] On* is selected in *parameter LC-00 Logic Controller Mode*). The LC stops when the stop event (*parameter LC-02 Stop Event*) is TRUE. *Parameter LC-03 Reset Logic Controller* resets all LC parameters and starts programming from scratch.

3.25.2 LC-0# LC Settings

Use the LC settings to activate, deactivate, and reset the Logic Controller.

LC-00 Logic Controller Mode		
Option:		**Function:**
[0] *	Off	Disables the logic controller.
[1]	On	Enables the logic controller.

LC-01 Start Event		
Option:		**Function:**
		Select the boolean (TRUE or FALSE) input to activate Logic Controller.
[0]	False	Enters the fixed value of FALSE in the logic rule.
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	See parameter group *E-2#* for further description.
[3]	In range	See parameter group *E-2#* for further description.
[4]	On reference	See parameter group *E-2#* for further description.
[5]	Torque limit	See parameter group *E-2#* for further description.
[6]	Current Limit	See parameter group *E-2#* for further description.
[7]	Out of current range	See parameter group *E-2#* for further description.
[8]	Below I low	See parameter group *E-2#* for further description.
[9]	Above I high	See parameter group *E-2#* for further description.
[10]	Out of speed range	
[11]	Below speed low	See parameter group *E-2#* for further description.
[12]	Above speed high	See parameter group *E-2#* for further description.
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	See parameter group *E-2#* for further description.
[17]	Line voltage out of range	See parameter group *E-2#* for further description.
[18]	Reversing	See parameter group *E-2#* for further description.
[19]	Warning	See parameter group *E-2#* for further description.

LC-01 Start Event		
Option:		**Function:**
[20]	Alarm (trip)	See parameter group *E-2#* for further description.
[21]	Alarm (trip lock)	See parameter group *E-2#* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (High = TRUE).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (High = TRUE).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (High = TRUE).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (High = TRUE).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (High = TRUE).
[39] *	Start command	This event is TRUE if the frequency converter is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is TRUE if the frequency converter is stopped or coasted (either via digital input, fieldbus, or other).
[41]	Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and [Reset] is pressed.
[42]	Auto Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and an automatic reset is issued.
[43]	OK Key	This event is TRUE if [OK] is pressed.

LC-01 Start Event		
Option:		**Function:**
[44]	Reset Key	This event is TRUE if [Reset] is pressed.
[45]	Left Key	This event is TRUE if [◄] is pressed.
[46]	Right Key	This event is TRUE if [►] is pressed.
[47]	Up Key	This event is TRUE if [▲] is pressed.
[48]	Down Key	This event is TRUE if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[76]	Digital Input x30 2	
[77]	Digital Input x30 3	
[78]	Digital Input x30 4	
[90]	ECB Drive Mode	
[91]	ECB Bypass Mode	
[92]	ECB Test Mode	
[100]	Fire Mode	See *parameter LC-15 RS-FF Operand S*, *parameter LC-16 RS-FF Operand R*.

LC-02 Stop Event		
Option:		**Function:**
		Select the boolean (TRUE or FALSE) input to deactivate logic control.
[0]	False	Enters the fixed value of FALSE in the logic rule.
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	See parameter group *E-2#* for further description.
[3]	In range	See parameter group *E-2#* for further description.
[4]	On reference	See parameter group *E-2#* for further description.
[5]	Torque limit	See parameter group *E-2#* for further description.
[6]	Current Limit	See parameter group *E-2#* for further description.
[7]	Out of current range	See parameter group *E-2#* for further description.

LC-02 Stop Event		
Option:		**Function:**
[8]	Below I low	See parameter group *E-2#* for further description.
[9]	Above I high	See parameter group *E-2#* for further description.
[10]	Out of speed range	
[11]	Below speed low	See parameter group *E-2#* for further description.
[12]	Above speed high	See parameter group *E-2#* for further description.
[13]	Out of feedb. range	See parameter group *E-2#* for further description.
[14]	Below feedb. low	See parameter group *E-2#* for further description.
[15]	Above feedb. high	See parameter group *E-2#* for further description.
[16]	Thermal warning	See parameter group *E-2#* for further description.
[17]	Line voltage out of range	See parameter group *E-2#* for further description.
[18]	Reversing	See parameter group *E-2#* for further description.
[19]	Warning	See parameter group *E-2#* for further description.
[20]	Alarm (trip)	See parameter group *E-2#* for further description.
[21]	Alarm (trip lock)	See parameter group *E-2#* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	Logic Controller Time-out 0	Use the result of timer 0 in the logic rule.

LC-02 Stop Event		
Option:		**Function:**
[31]	Logic Controller Time-out 1	Use the result of timer 1 in the logic rule.
[32]	Logic Controller Time-out 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI 18 in the logic rule (High = TRUE).
[34]	Digital input DI19	Use the value of DI 19 in the logic rule (High = TRUE).
[35]	Digital input DI27	Use the value of DI 27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI 29 in the logic rule (High = TRUE).
[37]	Digital input DI32	Use the value of DI 32 in the logic rule (High = TRUE).
[38]	Digital input DI33	Use the value of DI 33 in the logic rule (High = TRUE).
[39]	Start command	This event is TRUE if the frequency converter is started (either via digital input, network or other).
[40] *	Drive stopped	This event is TRUE if the frequency converter is stopped or coasted (either via digital input, network or other).
[41]	Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and [Reset] is pressed.
[42]	Auto Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and an automatic reset is issued.
[43]	OK Key	This event is TRUE if [OK] is pressed.
[44]	Reset Key	This event is TRUE if [Reset] is pressed.
[45]	Left Key	This event is TRUE if [◄] is pressed.
[46]	Right Key	This event is TRUE if [►] is pressed.
[47]	Up Key	This event is TRUE if [▲] is pressed.
[48]	Down Key	This event is TRUE if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	Logic Controller Time-out 3	Use the result of timer 3 in the logic rule.

3

LC-02 Stop Event		
Option:		**Function:**
[71]	Logic Controller Time-out 4	Use the result of timer 4 in the logic rule.
[72]	Logic Controller Time-out 5	Use the result of timer 5 in the logic rule.
[73]	Logic Controller Time-out 6	Use the result of timer 6 in the logic rule.
[74]	Logic Controller Time-out 7	Use the result of timer 7 in the logic rule.
[76]	Digital Input x30 2	
[77]	Digital Input x30 3	
[78]	Digital Input x30 4	
[80]	No Flow	
[81]	Dry Pump	
[82]	End of Curve	
[83]	Broken Belt	
[90]	ECB Drive Mode	
[91]	ECB Bypass Mode	
[92]	ECB Test Mode	
[100]	Fire Mode	See *parameter LC-15 RS-FF Operand S*, *parameter LC-16 RS-FF Operand R*.
[140]	ATEX ETR cur. warning	
[141]	ATEX ETR cur. alarm	
[142]	ATEX ETR freq. warning	
[143]	ATEX ETR freq. alarm	

LC-03 Reset Logic Controller		
Option:		**Function:**
[0] *	Do not reset Logic Controller	Retains programmed settings in parameter group *LC-## Logic Controller*.
[1]	Reset Logic Controller	Resets all parameters in parameter group *LC-## Logic Controller* to default settings.

3.25.3 Comparators

Comparators are used for comparing continuous variables (that is output frequency, output current, analog input, and so on.) to fixed preset values.

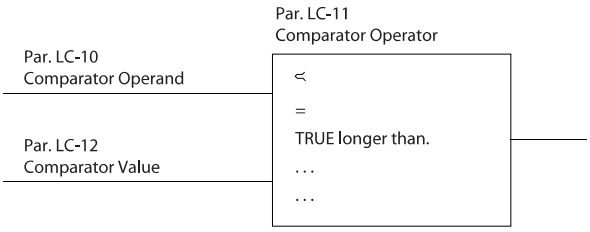


Illustration 3.75 Comparators

There are digital values that are compared to fixed time values. See explanation in *parameter LC-10 Comparator Operand*. Comparators are evaluated once in each scan interval. Use the result (true or false) directly. All parameters in this parameter group are array parameters with index 0–5. Select index 0 to program comparator 0, select index 1 to program comparator 1, and so on.

LC-10 Comparator Operand		
Array [6]		
Option:		**Function:**
		Select the variable to be monitored by the comparator.
[0] *	DISABLED	
[1]	Reference %	
[2]	Feedback %	
[3]	Motor speed	
[4]	Motor Current	
[5]	Motor torque	
[6]	Motor power	
[7]	Motor Rated Voltage	
[8]	DC-link voltage	
[9]	Motor Thermal	
[10]	Drive thermal	
[11]	Heat sink temp.	
[12]	Analog input AI53	
[13]	Analog input AI54	
[14]	Analog input AIFB10	
[15]	Analog input AIS24V	
[17]	Analog input AICCT	
[18]	Pulse input FI29	
[19]	Pulse input FI33	
[20]	Alarm number	
[21]	Warning number	
[22]	Analog input x30 11	
[23]	Analog input x30 12	
[29]	Number Of Pump Running	
[30]	Counter A	
[31]	Counter B	
[40]	Analog input x42/1	
[41]	Analog input x42/3	
[42]	Analog input x42/5	
[50]	FALSE	
[51]	TRUE	

LC-10 Comparator Operand		
Array [6]		
Option:		**Function:**
[52]	Control ready	
[53]	Drive ready	
[54]	Running	
[55]	Reversing	
[56]	In range	
[60]	On reference	
[61]	Below reference, low	
[62]	Above ref, high	
[65]	Torque limit	
[66]	Current Limit	
[67]	Out of current range	
[68]	Below I low	
[69]	Above I high	
[70]	Out of speed range	
[71]	Below speed low	
[72]	Above speed high	
[75]	Out of feedback range	
[76]	Below feedback low	
[77]	Above feedback high	
[80]	Thermal warning	
[82]	Mains out of range	
[85]	Warning	
[86]	Alarm (trip)	
[87]	Alarm (trip lock)	
[90]	Bus OK	
[91]	Torque limit & stop	
[92]	Brake fault (IGBT)	
[93]	Mech. brake control	
[94]	Safe stop active	
[100]	Comparator 0	
[101]	Comparator 1	
[102]	Comparator 2	
[103]	Comparator 3	
[104]	Comparator 4	
[105]	Comparator 5	
[110]	Logic rule 0	
[111]	Logic rule 1	
[112]	Logic rule 2	
[113]	Logic rule 3	
[114]	Logic rule 4	
[115]	Logic rule 5	
[120]	Logic Controller Time-out 0	
[121]	Logic Controller Time-out 1	
[122]	Logic Controller Time-out 2	
[123]	Logic Controller Time-out 3	
[124]	Logic Controller Time-out 4	
[125]	Logic Controller Time-out 5	
[126]	Logic Controller Time-out 6	
[127]	Logic Controller Time-out 7	
[130]	Digital input DI18	
[131]	Digital input DI19	

LC-10 Comparator Operand		
Array [6]		
Option:		**Function:**
[132]	Digital input DI27	
[133]	Digital input DI29	
[134]	Digital input DI32	
[135]	Digital input DI33	
[150]	Logic Controller digital output A	
[151]	Logic Controller digital output B	
[152]	Logic Controller digital output C	
[153]	Logic Controller digital output D	
[154]	Logic Controller digital output E	
[155]	Logic Controller digital output F	
[160]	Relay 1	
[161]	Relay 2	
[180]	Local referecnce active	
[181]	Remote reference active	
[182]	Start command	
[183]	Drive stopped	
[185]	Drive in hand mode	
[186]	Drive in auto mode	
[187]	Start command given	
[190]	Digital input x30/2	
[191]	Digital input x30/3	
[192]	Digital input x30/4	
[205]	No Flow	
[206]	Dry Pump	
[207]	End of Curve	
[208]	Broken Belt	
[212]	Fire Mode	

LC-11 Comparator Operator		
Array [6]		
Option:		**Function:**
[0]	<	Select *[0]* < for the result of the evaluation to be TRUE, when the variable selected in *parameter LC-10 Comparator Operand* is smaller than the fixed value in *parameter LC-12 Comparator Value*. The result is FALSE, if the variable selected in *parameter LC-10 Comparator Operand* is greater than the fixed value in *parameter LC-12 Comparator Value*.
[1] *	≈ (equal)	Select *[1]* ≈ for the result of the evaluation to be TRUE, when the variable selected in *parameter LC-10 Comparator Operand* is approximately equal to the fixed value in *parameter LC-12 Comparator Value*.
[2]	>	Select *[2]* > for the inverse logic of option *[0]* <.
[5]	TRUE longer than..	

3

LC-11 Comparator Operator		
Array [6]		
Option:		**Function:**
[6]	FALSE longer than..	
[7]	TRUE shorter than..	
[8]	FALSE shorter than..	

LC-12 Comparator Value		
Array [6]		
Range:		**Function:**
0*	[-100000 - 100000]	Enter the trigger level for the variable that is monitored by this comparator. This is an array parameter containing comparator values 0–5.

3.25.4 LC-2# Timers

Use the result (true or false) from timers directly to define an event (see *parameter LC-51 Logic Controller Event*), or as boolean input in a logic rule (see *parameter LC-40 Logic Rule Boolean 1*, *parameter LC-42 Logic Rule Boolean 2*, or *parameter LC-44 Logic Rule Boolean 3*). A timer is only false when started by an action (for example *[29] Start timer 1*) until the timer value entered in this parameter has elapsed. Then it becomes true again.
All parameters in this parameter group are array parameters with index 0–2. Select index 0 to program timer 0, select index 1 to program timer 1, and so on.

LC-20 Logic Controller Timer		
Array [8]		
Range:		**Function:**
0*	[0 - 0]	Enter the value to define the duration of the FALSE output from the programmed timer. A timer is only FALSE if it is started by an action (for example *[29] Start timer 1*) and until the given timer value has elapsed.

3.25.5 LC-4# Logic Rules

Combine up to 3 boolean inputs (true/false inputs) from timers, comparators, digital inputs, status bits, and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in *parameter LC-40 Logic Rule Boolean 1*, *parameter LC-42 Logic Rule Boolean 2*, and *parameter LC-44 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *parameter LC-41 Logic Rule Operator 1* and *parameter LC-43 Logic Rule Operator 2*.

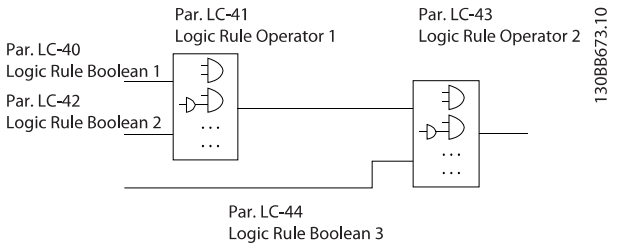


Illustration 3.76 Logic Rules

Priority of calculation
The results of *parameter LC-40 Logic Rule Boolean 1*, *parameter LC-41 Logic Rule Operator 1*, and *parameter LC-42 Logic Rule Boolean 2* are calculated 1st. The outcome (true/false) of this calculation is combined with the settings of *parameter LC-43 Logic Rule Operator 2* and *parameter LC-44 Logic Rule Boolean 3*, yielding the final result (true/false) of the logic rule.

LC-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[0] *	False	Enters the fixed value of FALSE in the logic rule.
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	See *E-2#* for further description.
[3]	In range	See *E-2#* for further description.
[4]	On reference	See *E-2#* for further description.
[5]	Torque limit	See *E-2#* for further description.
[6]	Current Limit	See *E-2#* for further description.
[7]	Out of current range	See *E-2#* for further description.
[8]	Below I low	See *E-2#* for further description.
[9]	Above I high	See *E-2#* for further description.
[10]	Out of speed range	
[11]	Below speed low	See *E-2#* for further description.
[12]	Above speed high	See *E-2#* for further description.
[13]	Out of feedb. range	See *E-2#* for further description.
[14]	Below feedb. low	See *E-2#* for further description.
[15]	Above feedb. high	See *E-2#* for further description.
[16]	Thermal warning	See *E-2#* for further description.
[17]	Line voltage out of range	See *E-2#* for further description.
[18]	Reversing	See *E-2#* for further description.

LC-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[19]	Warning	See *E-2#* for further description.
[20]	Alarm (trip)	See *E-2#* for further description.
[21]	Alarm (trip lock)	See *E-2#* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	Logic Controller Time-out 0	Use the result of timer 0 in the logic rule.
[31]	Logic Controller Time-out 1	Use the result of timer 1 in the logic rule.
[32]	Logic Controller Time-out 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI 18 in the logic rule (High = TRUE).
[34]	Digital input DI19	Use the value of DI 19 in the logic rule (High = TRUE).
[35]	Digital input DI27	Use the value of DI 27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI 29 in the logic rule (High = TRUE).
[37]	Digital input DI32	Use the value of DI 32 in the logic rule (High = TRUE).
[38]	Digital input DI33	Use the value of DI 33 in the logic rule (High = TRUE).
[39]	Start command	This logic rule is TRUE if the frequency converter is started either via digital input, fieldbus, or other.
[40]	Drive stopped	This logic rule is TRUE if the frequency converter is stopped or coasted either via digital input, fieldbus, or other.

LC-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[41]	Reset Trip	This logic rule is TRUE if the frequency converter is tripped (but not trip-locked) and [Reset] is pressed.
[42]	Auto Reset Trip	This logic rule is TRUE if the frequency converter is tripped (but not trip-locked) and an automatic reset is issued.
[43]	OK Key	This logic rule is TRUE if [OK] is pressed.
[44]	Reset Key	This logic rule is TRUE if [Reset] is pressed.
[45]	Left Key	This logic rule is TRUE if [◄] is pressed.
[46]	Right Key	This logic rule is TRUE if [►] is pressed.
[47]	Up Key	This logic rule is TRUE if [▲] is pressed.
[48]	Down Key	This logic rule is TRUE if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	Logic Controller Time-out 3	Use the result of timer 3 in the logic rule.
[71]	Logic Controller Time-out 4	Use the result of timer 4 in the logic rule.
[72]	Logic Controller Time-out 5	Use the result of timer 5 in the logic rule.
[73]	Logic Controller Time-out 6	Use the result of timer 6 in the logic rule.
[74]	Logic Controller Time-out 7	Use the result of timer 7 in the logic rule.
[76]	Digital Input x30 2	
[77]	Digital Input x30 3	
[78]	Digital Input x30 4	
[80]	No Flow	
[81]	Dry Pump	
[82]	End of Curve	
[83]	Broken Belt	
[90]	ECB Drive Mode	
[91]	ECB Bypass Mode	
[92]	ECB Test Mode	

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LC-40 Logic Rule Boolean 1

Array [6]

Option:		Function:
[100]	Fire Mode	See *parameter LC-15 RS-FF Operand S*, *parameter LC-16 RS-FF Operand R*.
[140]	ATEX ETR cur. warning	
[141]	ATEX ETR cur. alarm	
[142]	ATEX ETR freq. warning	
[143]	ATEX ETR freq. alarm	

LC-41 Logic Rule Operator 1

Array [6]

Option:		Function:
		Select the 1st logical operator to use on the boolean inputs from *parameter LC-40 Logic Rule Boolean 1* and *parameter LC-42 Logic Rule Boolean 2*. Parameter numbers in square brackets stand for the boolean inputs of parameters in *LC-## Logic Controller* .
[0] *	DISABLED	Ignores: • *Parameter LC-42 Logic Rule Boolean 2*. • *Parameter LC-43 Logic Rule Operator 2*. • *Parameter LC-44 Logic Rule Boolean 3*.
[1]	AND	Evaluates the expression [LC-40] AND [LC-42].
[2]	OR	Evaluates the expression [LC-40] OR [LC-42].
[3]	AND NOT	Evaluates the expression [LC-40] AND NOT [LC-42].
[4]	OR NOT	Evaluates the expression [LC-40] OR NOT [LC-42].
[5]	NOT AND	Evaluates the expression NOT [LC-40] AND [LC-42].
[6]	NOT OR	Evaluates the expression NOT [LC-40] OR [LC-42].
[7]	NOT AND NOT	Evaluates the expression NOT [LC-40] AND NOT [LC-42].
[8]	NOT OR NOT	Evaluates the expression NOT [LC-40] OR NOT [LC-42].

LC-42 Logic Rule Boolean 2

Array [6]

Option:		Function:
		Select the second boolean (TRUE or FALSE) input for the selected logic rule. See *parameter LC-40 Logic Rule Boolean 1* for further descriptions of choices and their functions.

LC-43 Logic Rule Operator 2

Array [6]

Option:		Function:
		Select the 2nd logical operator to be used on the boolean input calculated in: • *Parameter LC-40 Logic Rule Boolean 1*. • *Parameter LC-41 Logic Rule Operator 1*. • *Parameter LC-42 Logic Rule Boolean 2*. and the boolean input coming from *parameter LC-42 Logic Rule Boolean 2*. [LC-44] signifies the boolean input of *parameter LC-44 Logic Rule Boolean 3*. [LC-40/LC-42] signifies the boolean input calculated in: • *Parameter LC-40 Logic Rule Boolean 1*. • *Parameter LC-41 Logic Rule Operator 1*. • *Parameter LC-42 Logic Rule Boolean 2*.
[0] *	DISABLED	Select this option to ignore *parameter LC-44 Logic Rule Boolean 3*.
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

LC-44 Logic Rule Boolean 3

Array [6]

Option:		Function:
		Select the third boolean (TRUE or FALSE) input for the selected logic rule. See *parameter LC-40 Logic Rule Boolean 1* for further descriptions of choices and their functions.

3.25.6 LC-5# States

LC-51 Logic Controller Event		
Array [20]		
Option:		**Function:**
		Select the boolean input (TRUE or FALSE) to define the logic controller event. See *parameter LC-02 Stop Event* for further descriptions of options and their functions.
[0] *	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current Limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Line voltage out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	Logic Controller Time-out 0	
[31]	Logic Controller Time-out 1	
[32]	Logic Controller Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	

LC-51 Logic Controller Event		
Array [20]		
Option:		**Function:**
[42]	Auto Reset Trip	
[43]	OK Key	
[44]	Reset Key	
[45]	Left Key	
[46]	Right Key	
[47]	Up Key	
[48]	Down Key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	Logic Controller Time-out 3	
[71]	Logic Controller Time-out 4	
[72]	Logic Controller Time-out 5	
[73]	Logic Controller Time-out 6	
[74]	Logic Controller Time-out 7	
[76]	Digital Input x30 2	
[77]	Digital Input x30 3	
[78]	Digital Input x30 4	
[80]	No Flow	
[81]	Dry Pump	
[82]	End of Curve	
[83]	Broken Belt	
[90]	ECB Drive Mode	
[91]	ECB Bypass Mode	
[92]	ECB Test Mode	
[100]	Fire Mode	See *parameter LC-15 RS-FF Operand S*, *parameter LC-16 RS-FF Operand R*.
[140]	ATEX ETR cur. warning	
[141]	ATEX ETR cur. alarm	
[142]	ATEX ETR freq. warning	
[143]	ATEX ETR freq. alarm	

LC-52 Logic Controller Action		
Array [20]		
Option:		**Function:**
		Select the action corresponding to the LC event. Actions are executed when the corresponding event (defined in *parameter LC-51 Logic Controller Event*) is evaluated as true. The following actions are available for selection:
[0] *	Disabled	
[1]	No action	
[2]	Select set-up 1	Changes the active set-up (*parameter K-10 Active Set-up*) to 1.
[3]	Select set-up 2	Changes the active set-up (*parameter K-10 Active Set-up*) to 2.

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LC-52 Logic Controller Action		
Array [20]		
Option:		**Function:**
[4]	Select set-up 3	Changes the active set-up (*parameter K-10 Active Set-up*) to 3.
[5]	Select set-up 4	Changes the active set-up (*parameter K-10 Active Set-up*) to 4. If the set-up is changed, it merges with other set-up commands coming from either the digital inputs or via a fieldbus.
[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. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus.
[18]	Select Accel/ Decel 1	Selects ramp 1.
[19]	Select Accel/ Decel 2	Selects ramp 2.
[22]	Run	Issues a start command to the frequency converter.
[23]	Run reverse	Issues a start reverse command to the frequency converter.
[24]	Stop	Issues a stop command to the frequency converter.
[26]	DC Brake	Issues a DC stop command to the frequency converter.
[27]	Coast	The frequency converter coasts immediately. All stop commands including the coast command stop the LC.
[28]	Freeze output	Freezes the output frequency of the frequency converter.
[29]	Start timer 0	Starts timer 0, see *parameter LC-20 Logic Controller Timer* for further description.
[30]	Start timer 1	Starts timer 1, see *parameter LC-20 Logic Controller Timer* for further description.

LC-52 Logic Controller Action		
Array [20]		
Option:		**Function:**
[31]	Start timer 2	Starts timer 2, see *parameter LC-20 Logic Controller Timer* for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off).
[33]	Set digital out B low	Any output with digital output 2 selected is low (off).
[34]	Set digital out C low	Any output with digital output 3 selected is low (off).
[35]	Set digital out D low	Any output with digital output 4 selected is low (off).
[36]	Set digital out E low	Any output with digital output 5 selected is low (off).
[37]	Set digital out F low	Any output with digital output 6 selected is low (off).
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset Counter A	Resets counter A to 0.
[61]	Reset Counter B	Resets counter B to 0.
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start Timer 3	Starts timer 3, see *parameter LC-20 Logic Controller Timer* for further description.
[71]	Start Timer 4	Starts timer 4, see *parameter LC-20 Logic Controller Timer* for further description.
[72]	Start Timer 5	Starts timer 5, see *parameter LC-20 Logic Controller Timer* for further description.
[73]	Start Timer 6	Starts timer 6, see *parameter LC-20 Logic Controller Timer* for further description.
[74]	Start Timer 7	Starts timer 7, see *parameter LC-20 Logic Controller Timer* for further description.
[80]	Sleep Mode	Starts the sleep mode.

LC-52 Logic Controller Action		
Array [20]		
Option:		**Function:**
[90]	Set ECB Bypass Mode	
[91]	Set ECB Drive Mode	
[100]	Reset Alarms	

3.25.7 LC-9#

LC-90 Alert Trigger		
Array [10]		
Select the event that triggers the user-defined action and message.		
Option:		**Function:**
[0] *	False	
[1]	True	
[18]	Reversing	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	Logic Controller Time-out 0	
[31]	Logic Controller Time-out 1	
[32]	Logic Controller Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	Logic Controller Time-out 3	
[71]	Logic Controller Time-out 4	
[72]	Logic Controller Time-out 5	
[73]	Logic Controller Time-out 6	
[74]	Logic Controller Time-out 7	
[90]	ECB Drive Mode	
[91]	ECB Bypass Mode	

LC-91 Alert Action		
Array [10]		
Select the action that the frequency converter performs when the event defined in *parameter LC-90 Alert Trigger* occurs.		
Option:		**Function:**
[0] *	Info	
[1]	Warning	
[2]	Freeze output	
[3]	Freeze output & warn	
[4]	Stop	
[5]	Stop & warning	
[6]	Jogging	
[7]	Jogging & warning	
[8]	Max speed	
[9]	Max speed & warn	
[10]	Stop and trip	
[11]	Stop and trip w manual reset	
[12]	Trip	
[13]	Trip w manual reset	
[14]	Trip Lock	

LC-92 Alert Text		
Array [10]		
Range:	**Function:**	
0*	[0 - 20]	Enter the text that the frequency converter shows in the display when the event defined in *parameter 13-90 Alert Trigger* occurs.

LC-97 Alert Alarm Word		
Range:		**Function:**
0*	[0 - 4294967295]	Shows the alarm word of a user-defined alarm in hex code.

LC-98 Alert Warning Word		
Range:		**Function:**
0*	[0 - 4294967295]	Shows the warning word of a user-defined alarm in hex code.

LC-99 Alert Status Word		
Range:		**Function:**
0*	[0 - 4294967295]	Shows the status word of a user-defined alarm in hex code.

3.26 B-## Braking Functions

3.26.1 B-0# DC brakes

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

3

B-00 DC Hold Current

Range:		Function:
50 %*	[0 - 160 %]	***NOTICE*** ***Parameter B-00 DC Hold Current* has no effect when *parameter P-20 Motor Construction=[1] PM, non-salient SPM*.** ***NOTICE*** **The maximum value depends on the rated motor current.** **Avoid 100% current for too long. It may damage the motor.** Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in *parameter P-03 Motor Current*. 100% DC hold current corresponds to $I_{M,N}$. This parameter holds the motor (holding torque) or preheats the motor. This parameter is active if *[1] DC hold/Motor Preheat* is selected in *parameter H-80 Function at Stop*.

B-01 DC Brake Current

Range:		Function:
50 %*	[0 - 1000 %]	***NOTICE*** **The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor.** Enter a value for current as a percentage of the rated motor current $I_{M,N}$, see *parameter P-03 Motor Current*. 100% DC brake current corresponds to $I_{M,N}$. DC brake current is applied on a stop command, when the speed is lower than the limit set in: • *Parameter B-03 DC Brake Cut In Speed [RPM].* • *Parameter B-04 DC Brake Cut In Speed [Hz]*, when the DC brake inverse function is active, or via the serial communication port. The braking current is active during the time period set in *parameter B-02 DC Braking Time*.

B-02 DC Braking Time

Range:		Function:
10 s*	[0 - 60 s]	Set the duration of the DC brake current set in *parameter B-01 DC Brake Current*, once activated.

B-03 DC Brake Cut In Speed [RPM]

Range:		Function:
0 RPM*	[0 - 0 RPM]	Set the DC brake cut-in speed for activation of the DC braking current set in *parameter B-01 DC Brake Current*, upon a stop command. When *parameter P-20 Motor Construction* is set to *[1] PM non-salient SPM*, this value is limited to 0 RPM (OFF).

B-04 DC Brake Cut In Speed [Hz]

Range:		Function:
0.0 Hz*	[0 - 0.0 Hz]	This parameter is for setting the DC brake cut-in speed at which the DC braking current (*parameter B-01 DC Brake Current*) is to be active in connection with a stop command.

B-06 Parking Current

Range:		Function:
50 %*	[0 - 1000 %]	***NOTICE*** ***Parameter B-06 Parking Current* and *parameter B-07 Parking Time*: Only active if *[1] PM, non salient SPM* is selected in *parameter P-20 Motor Construction*.** Set current as percentage of rated motor current, *parameter P-03 Motor Current*. Active in connection with *parameter H-09 Start Mode*. The parking current is active during the time period set in *parameter B-07 Parking Time*.

B-07 Parking Time

Range:		Function:
3 s*	[0.1 - 60 s]	Set the duration of the parking current time set in *parameter B-06 Parking Current*. Active in connection with *parameter H-09 Start Mode*. ***NOTICE*** ***Parameter B-07 Parking Time* is only active when *[1] PM, non-salient SPM* is selected in *parameter P-20 Motor Construction*.**

3.26.2 B-1# Brake Energy Funct.

Parameter group for selecting dynamic brake parameters.

B-10 Brake Function

Option:		Function:
		Available options depend on *parameter P-20 Motor Construction*: *[0] Asynchron*: • *[0] Off* • *[2] AC brake* *[1] PM non-salient*: • *[0] Off*
[0] *	Off	No brake resistor installed.
[1]	Resistor brake	Brake resistor incorporated in the system for dissipation of excess brake energy as heat. Connecting a brake resistor allows a higher DC-link voltage during braking (generating operation). The resistor brake function is only active in frequency converters with an integral dynamic brake.
[2]	AC brake	AC brake only works in compressor torque mode in *parameter H-43 Torque Characteristics*.

B-11 Brake Resistor (ohm)

Range:		Function:
50.00 Ohm*	[5.00 - 65535.00 Ohm]	Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor in *parameter B-13 Braking Thermal Overload*. This parameter is only active in frequency converters with an integral dynamic brake. Use this parameter for values without decimals. For a selection with 2 decimals, use *parameter B-11 Brake Resistor (ohm)*.

B-12 Brake Power Limit (kW)

Range:		Function:
5.000 kW*	[0.001 - 2000.000 kW]	*Parameter B-12 Brake Power Limit (kW)* is the expected average power dissipated in the brake resistor over a period of 120 s. It is used as the monitoring limit for *parameter DR-33 Brake Energy Average* and thereby specifies when a warning/alarm is to be given. To calculate *parameter B-12 Brake Power Limit (kW)*, the following formula can be used. $P_{\mathrm{br,avg}}[W] = \frac{U_{\mathrm{br}}^2[V] \times t_{\mathrm{br}}[s]}{R_{\mathrm{br}}[\Omega] \times T_{\mathrm{br}}[s]}$ $P_{br,avg}$ is the average power dissipated in the brake resistor, R_{br} is the resistance of the brake resistor. t_{br} is the active breaking time within the 120 s period, T_{br}.

B-12 Brake Power Limit (kW)

Range:		Function:
		U_{br} is the DC voltage where the brake resistor is active. This depends on the unit as follows: 200–240 V: 390 V 380–500 V: 810 V 525–600 V: 943 V 525–690 V: 1099 V ***NOTICE*** **If R_{br} is not known, or if T_{br} is different from 120 s, the practical approach is to run the brake application, readout *parameter DR-33 Brake Energy Average* and then enter this + 20% in *parameter B-12 Brake Power Limit (kW)*.**

B-13 Braking Thermal Overload

Option:		Function:
		NOTICE **This parameter is only active in frequency converters with an integral dynamic brake.** This parameter enables monitoring of the power to the brake resistor. The power is calculated based on the resistance (*parameter B-11 Brake Resistor (ohm)*), the DC-link voltage, and the resistor duty time.
[0] *	Off	No brake power monitoring is required. If power monitoring is set to *[0] Off* or *[1] Warning*, the brake function remains active even if the monitoring limit is exceeded. This may lead to thermal overload of the resistor. It is also possible to generate a warning via a relay/digital output. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than ±20%).
[1]	Warning	Activates a warning when the power transmitted over 120 s exceeds 100% of the monitoring limit (*parameter B-12 Brake Power Limit (kW)*). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[2]	Trip	Trips the frequency converter and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[3]	Warning and trip	Activates both of the above, including warning, trip, and alarm.
[4]	Warning 30s	

3

B-15 Brake Check		
Option:		**Function:**
		NOTICE **Remove a warning arising in connection with *[0] Off* or *[1] Warning* by cycling the mains supply. Correct the fault first. For *[0] Off* or *[1] Warning*, the frequency converter keeps running even if a fault is located.** Select the type of test and monitoring function to check the connection to the brake resistor, or whether a brake resistor is present. Then and then show a warning or an alarm if a fault occurs. The brake resistor disconnection function is tested during power-up. However, the brake IGBT test is performed when there is no braking. A warning or trip disconnects the brake function. The testing sequence is as follows: 1. Measure the DC link ripple amplitude for 300 ms without braking. 2. Measure the DC link ripple amplitude for 300 ms with the brake turned on. 3. If the DC link ripple amplitude while braking is lower than the DC link ripple amplitude before braking +1%, the brake check fails. If brake check fails, a warning or alarm is returned. 4. If the DC link ripple amplitude while braking is higher than the DC link ripple amplitude before braking +1%, the brake check is OK.
[0] *	Off	Monitors brake resistor and brake IGBT for a short circuit during operation. If a short circuit occurs, a warning appears.
[1]	Warning	Monitors brake resistor and brake IGBT for a short circuit, and runs a test for brake resistor disconnection during power-up.
[2]	Trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the frequency converter cuts out while showing an alarm (trip lock).
[3]	Stop and trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the frequency converter ramps down to coast and then trips. A trip lock alarm is shown.
[4]	AC brake	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the frequency converter performs a controlled decel.

B-16 AC brake Max. Current		
Range:		**Function:**
100 %*	[0 - 1000.0 %]	Enter the maximum permissible current when using AC braking to avoid overheating of motor windings.

NOTICE

Parameter B-16 AC brake Max. Current* has no effect when *parameter P-20 Motor Construction=[1] PM, non salient SPM.

B-17 Over-voltage Control		
Overvoltage control (OVC) reduces the risk of the frequency converter tripping due to an overvoltage on the DC link caused by generative power from the load.		
Option:		**Function:**
		NOTICE **The ramp time is automatically adjusted to avoid tripping of the frequency converter.**
[0]	Disabled	No OVC required.
[2] *	Enabled	Activates OVC.

4 Troubleshooting

4.1 Status Messages

4.1.1 Alarms and Warnings

A warning or an alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the frequency converter will have tripped. Alarms must be reset to restart operation once their cause has been rectified. This may be done in four ways:

1. By pressing [RESET] on the keypad.
2. Via a digital input with the “Reset” function.
3. Via serial communication/optional network.
4. By resetting automatically using the [Auto Reset] function, which is a default setting for frequency converter. see *parameter H-04 Auto-Reset (Times)* in AF-600 FP Programming Guide,

NOTICE

After a manual reset pressing [RESET] on the keypad, the [AUTO] button must be pressed to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).

Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in *parameter H-04 Auto-Reset (Times)* (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in *parameter F-10 Electronic Overload*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		Parameter AN-01 Live Zero Timeout Function
3	No motor	(X)			Parameter H-80 Functio n at Stop
4	Mains phase loss	(X)	(X)	(X)	Parameter SP-12 Functi on at Line Imbalance
5	DC link voltage high	X			
6	DC link voltage low	X			

7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor Electronic Overload over temperature	(X)	(X)		Parameter F-10 Electronic Overload
11	Motor thermistor over temperature	(X)	(X)		Parameter F-10 Electronic Overload
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth fault	X	X	X	
15	Incomp. HW		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		Parameter O-04 Control Word Timeout Function
18	Start Failed		X		
23	Internal fans	X			
24	External fans	X			Parameter SP-53 Fan Monitor
29	Power board over temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	Parameter H-78 Missing Motor Phase Function
31	Motor phase V missing	(X)	(X)	(X)	Parameter H-78 Missing Motor Phase Function
32	Motor phase W missing	(X)	(X)	(X)	Parameter H-78 Missing Motor Phase Function
33	Inrush fault		X	X	
34	Network communication fault	X	X		
35	Option fault		X		
36	Mains failure	X	X		parameter SP-10 Line failure
38	Internal fault		X	X	
40	Overload T27	X			
41	Overload T29	X			
42	Overload X30/6-7	X			
45	Earth fault 2	X	X		
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit				
50	Auto Tune calibration failed		X		
51	Auto Tune check U_{nom} and I_{nom}		X		
52	Auto Tune low I_{nom}		X		
53	Auto Tune motor too big		X		
54	Auto Tune motor too small		X		
55	Auto Tune parameter out of range		X		
56	Auto Tune interrupted by user		X		
57	Auto Tune timeout		X		
58	Auto Tune internal fault	X	X		
59	Current limit	X			
60	External interlock				
62	Output Frequency at Maximum Limit	X			

65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
70	Illegal Drive configuration			X	
80	Drive restored to Default Value		X		
92	No-Flow	X	X		Par. AP-2#
93	Dry Pump	X	X		Par. AP-2#
94	End of Curve	X	X		Par. AP-5#
95	Broken Belt	X	X		Par. AP-6#
96	Start Delayed	X			Par. AP-7#
97	Stop Delayed	X			Par. AP-7#
98	Clock Fault	X			K-7#
200	Fire Mode	X			FB-0#
201	Fire Mode was Active	X			K-7#
202	Fire Mode Limits Exceeded	X			K-7#
250	New spare part		X	X	
251	New model number		X	X	

Table 4.1 Alarm/Warning code list

(X) Dependent on parameter

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 4.2

4.1.2 Alarm Words

Bit (hex)	Alarm word (*parameter DR-90 Alarm Word*)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
00000080	Motor thermistor over temp.
00000100	Motor Electronic Thermal Overload over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	Short circuit
00002000	
00004000	Mains phase loss
00008000	Auto Tune not OK
00010000	Live zero error
00020000	Internal fault
00040000	
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00800000	Control Voltage Fault
01000000	
02000000	VDD, supply low
04000000	Not used
08000000	Not used
10000000	Earth fault DESAT
20000000	Drive restored
80000000	

Table 4.3 ***Parameter DR-90 Alarm Word***

Bit (hex)	Alarm word 2 (*parameter DR-91 Alarm Word 2*)
00000001	
00000002	Reserved
00000004	Service Trip, Typecode / Sparepart
00000008	Reserved
00000010	Reserved
00000020	
00000040	
00000080	
00000100	Broken Belt
00000200	Not used
00000400	Not used
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans error
00080000	Reserved
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved

Table 4.4 ***Parameter DR-91 Alarm Word 2***

4.1.3 Warning Words

Bit (Hex)	Warning Word (parameter DR-92 Warning Word)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
00000080	Motor thermistor over temp.
00000100	Motor Electronic Thermal Overload over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	
00002000	
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	
00040000	
00080000	
00100000	
00200000	
00400000	
00800000	
01000000	
02000000	Current limit
04000000	
08000000	
10000000	
20000000	
80000000	Not used

Table 4.5 parameter DR-92 Warning Word

Bit (Hex)	Warning Word 2 (parameter DR-93 Warning Word 2)
00000001	
00000002	
00000004	Clock Failure
00000008	Reserved
00000010	Reserved
00000020	
00000040	
00000080	End of Curve
00000100	Broken Belt
00000200	Not used
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans warning
00080000	
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
80000000	Reserved

Table 4.6 parameter DR-93 Warning Word 2

4.1.4 Extended Status Words

Bit (hex)	Extended status word (*parameter DR-94 Ext. Status Word*)
00000001	Ramping
00000002	Auto Tune tuning
00000004	Start CW/CCW
00000008	Not used
00000010	Not used
00000020	Feedback high
00000040	Feedback low
00000080	Output current high
00000100	Output current low
00000200	Output frequency high
00000400	Output frequency low
00000800	Not used
00001000	Not used
00002000	Not used
00004000	Out of speed range
00008000	OVC active
00010000	AC brake
00020000	Password Timelock
00040000	Password Protection
00080000	Reference high
00100000	Reference low
00200000	Local Ref./Remote Ref.
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

Table 4.7 Parameter DR-94 Ext. Status Word

Bit (hex)	Extended status word 2 (*parameter DR-95 Ext. Status Word 2*)
00000001	Off
00000002	Hand / Auto
00000004	Not used
00000008	Not used
00000010	Not used
00000020	Relay 123 active
00000040	Start Prevented
00000080	Control ready
00000100	Drive ready
00000200	Quick Stop
00000400	DC Brake
00000800	Stop
00001000	Standby
00002000	Freeze Output Request
00004000	Freeze Output
00008000	Jog Request
00010000	Jog
00020000	Start Request
00040000	Start
00080000	Start Applied
00100000	Start Delay
00200000	Sleep
00400000	Sleep Boost
00800000	Running
01000000	Bypass
02000000	Fire Mode
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

Table 4.8 Parameter DR-95 Ext. Status Word 2

4.2 Fault Messages

WARNING 1, 10 Volts low
The control card voltage is less than 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or incorrect wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live zero error
This warning or alarm only appears if programmed in *parameter AN-01 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all analog mains terminals.
  - Control card terminals 53 and 54 for signals, terminal 55 common.
  - OPCGPIO terminals 11 and 12 for signals, terminal 10 common.
  - OPCAIO terminals 1, 3, and 5 for signals, terminals 2, 4, and 6 common.
- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

WARNING/ALARM 3, No motor
No motor is connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in *parameter SP-12 Function at Line Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high
The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the frequency converter voltage rating. The unit is still active.

WARNING 6, DC link voltage low
The DC-link voltage (DC) is lower than the low voltage warning limit. The limit depends on the frequency converter voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage
If the DC-link voltage exceeds the limit, the frequency converter trips after a certain time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter B-10 Brake Function*.
- Increase *parameter SP-26 Trip Delay at Drive Fault*.
- If the alarm/warning occurs during a power sag, use kinetic back-up (*parameter SP-10 Line failure*).

WARNING/ALARM 8, DC under voltage
If the DC-link voltage drops below the undervoltage limit, the frequency converter checks for 24 V DC back-up supply. If no 24 V DC back-up supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the frequency converter voltage.
- Perform an input voltage test.
- Perform a soft-charge circuit test.

WARNING/ALARM 9, Inverter overload
The frequency converter has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100% with an alarm. The frequency converter cannot be reset until the counter is below 90%.

Troubleshooting

- Compare the output current shown on the keypad with the frequency converter rated current.
- Compare the output current shown on the keypad with the measured motor current.
- Show the thermal frequency converter load on the keypad and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the frequency converter continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor overload temperature
According to the electronic thermal protection, the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter is >90% if *parameter F-10 Electronic Overload* is set to warning options, or whether the frequency converter trips when the counter reaches 100% if *parameter F-10 Electronic Overload* is set to trip options. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *parameter P-03 Motor Current* is correct.

- Ensure that the motor data in *parameters* P-02, P-03, P-06, P-07, F-04, and F-05 are set correctly.
- If an external fan is in use, check that it is selected in *parameter F-11 Motor External Fan*.
- Running Auto tune in *parameter P-04 Auto Tune* tunes the frequency converter to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor over temp
Check whether the thermistor is disconnected. Select whether the frequency converter issues a warning or an alarm in *parameter F-10 Electronic Overload*.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that *parameter F-12 Motor Thermistor Input* selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter F-12 Motor Thermistor Input*.

WARNING/ALARM 12, Torque limit
The torque has exceeded the value in *parameter F-40 Torque Limiter (Driving)* or the value in *parameter F-41 Torque Limiter (Braking)*. *Parameter SP-25 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

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

WARNING/ALARM 13, Over current
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or quick acceleration with high-inertia loads can cause this fault. If the acceleration during ramp-up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, a trip can be reset externally.

Troubleshooting

- Remove the power and check if the motor shaft can be turned.
- Check that the motor size matches the frequency converter.
- Check that the motor data is correct in *parameters* P-02, P-03, P-06, P-07, F-04, and F-05.

ALARM 14, Earth (ground) fault
There is current from the output phase to ground, either in the cable between the frequency converter and the motor, or in the motor itself. Ground fault is detected by the current transducers that measure current going out from the frequency converter and current going into the frequency converter from the motor. Ground fault is issued if the deviation of the 2 currents is too large (the current going out of the frequency converter should be the same as the current going into the frequency converter).

Troubleshooting

- Remove power to the frequency converter and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.
- Reset any potential individual offset in the 3 current transducers in AF-650 GP. Perform the manual initialization or perform a complete AMA. This method is most relevant after changing the power card.

ALARM 15, Hardware mismatch
A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact GE:

- *Parameter ID-40 Drive Type*.
- *Parameter ID-41 Power Section*.
- *Parameter ID-42 Voltage*.
- *Parameter ID-43 Software Version*.
- *Parameter ID-45 Actual Typecode String*.
- *Parameter ID-49 SW ID Control Card*.
- *Parameter ID-50 SW ID Power Card*.
- *Parameter ID-60 Option Mounted*.
- *Parameter ID-61 Option SW Version* (for each option slot).

ALARM 16, Short circuit
There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove the power to the frequency converter and repair the short circuit.

⚠WARNING

HIGH VOLTAGE

Frequency converters 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.

- **Disconnect power before proceeding.**

WARNING/ALARM 17, Control word timeout

There is no communication to the frequency converter. The warning is only active when *parameter O-04 Control Word Timeout Function* is NOT set to *[0] Off*.
If *parameter O-04 Control Word Timeout Function* is set to *[5] Stop and Trip*, a warning appears, and the frequency converter ramps down to a stop and shows an alarm.

Troubleshooting

- Check the connections on the serial communication cable.
- Increase *parameter O-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

ALARM 18, Start failed

The speed has not been able to exceed *parameter AP-70 Compressor Start Max Speed [RPM]* during start within the allowed time. (set in *parameter AP-72 Compressor Start Max Time to Trip*). This may be caused by a blocked motor.

WARNING 23, Internal fan fault

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter SP-53 Fan Monitor* (*[0] Disabled*).

For frequency converters with DC fans, there is a feedback sensor mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For frequency converters with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the frequency converter and check that the fan operates briefly at start-up.
- Check the sensors on the control card.

WARNING 24, External fan fault

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter SP-53 Fan Monitor* (*[0] Disabled*).

For frequency converters with DC fans, there is a feedback sensor mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For frequency converters with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the frequency converter and check that the fan operates briefly at start-up.
- Check the sensors on the heat sink.

ALARM 29, Heatsink temp

The maximum temperature of the heat sink is exceeded. The temperature fault is not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different based on the frequency converter power size.

Troubleshooting

Check for the following conditions.

- The ambient temperature is too high.
- The motor cables are too long.
- Incorrect airflow clearance above and below the frequency converter.
- Blocked airflow around the frequency converter.
- Damaged heat sink fan.
- Dirty heat sink.

ALARM 30, Motor phase U missing

Motor phase U between the frequency converter and the motor is missing.

⚠WARNING

HIGH VOLTAGE

Frequency converters 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.

- **Disconnect power before proceeding.**

Troubleshooting

- Remove the power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the frequency converter and the motor is missing.

⚠WARNING

HIGH VOLTAGE

Frequency converters 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.

- **Disconnect power before proceeding.**

Troubleshooting

- Remove the power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing
Motor phase W between the frequency converter and the motor is missing.

⚠WARNING

HIGH VOLTAGE

Frequency converters 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.

- **Disconnect power before proceeding.**

Troubleshooting

- Remove the power from the frequency converter and check motor phase W.

ALARM 33, Inrush fault
Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault
The network on the communication option card is not working.

WARNING/ALARM 36, Mains failure
This warning/alarm is only active if the supply voltage to the frequency converter is lost and *parameter SP-10 Line failure* is not set to *[0] No Function*.

Troubleshooting

- Check the fuses to the frequency converter and mains supply to the unit.

ALARM 37, Phase imbalance
There is a current imbalance between the power units.

ALARM 38, Internal fault
When an internal fault occurs, a code number defined in *Table 4.9* is shown.

Troubleshooting

- Cycle power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

It may be necessary to contact the GE supplier or service department. Note the code number for further troubleshooting directions.

Number	Text
0	Serial port cannot be restore. Contact your GE supplier or GE service department.
256–258	Power EEPROM data is defective or too old. Replace power card.
512–519	Internal fault. Contact your GE supplier or GE service department.
783	Parameter value outside of min/max limits
1024–1284	Internal fault. Contact your GE supplier or the GE service department.
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1379–2819	Internal fault. Contact your GE supplier or GE service department.
2561	Replace control card
2820	Keypad stack overflow
2821	Serial port overflow
2822	USB port overflow
3072–5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware
5376–6231	Internal fault. Contact your GE supplier or GE service department.

Table 4.9 Internal Fault Codes

ALARM 39, Heatsink sensor
No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gatedrive card, or the ribbon cable between the power card and gatedrive card.

WARNING 40, Overload of digital output terminal 27
Check the load connected to terminal 27 or remove the short circuit connection. Check *parameter E-00 Digital I/O Mode* and *parameter E-51 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29
Check the load connected to terminal 29 or remove the short circuit connection. Also check *parameter E-00 Digital I/O Mode* and *parameter E-52 Terminal 29 Mode*.

ALARM 45, Earth fault 2
Ground fault.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7
For terminal X30/6, check the load connected to terminal X30/6 or remove the short circuit connection. Also check *parameter E-56 Term X30/6 Digi Out (OPCGPIO)* (General Purpose I/O OPCGPIO General Purpose I/O).

For terminal X30/7, check the load connected to terminal X30/7 or remove the short circuit connection. Check *parameter E-57 Term X30/7 Digi Out (OPCGPIO)* (General Purpose I/O OPCGPIO General Purpose I/O).

ALARM 46, Power card supply
The supply on the power card is out of range.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ±18 V.

When powered with 3-phase mains voltage, all 3 supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.
- Check for a defective option card.
- If a 24 V DC supply is used, verify proper supply power.

WARNING 47, 24 V supply low
The supply on the power card is out of range.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ±18 V.

Troubleshooting

- Check for a defective power card.

WARNING 48, 1.8 V supply low
The 1.8 V DC supply used on the control card is outside of the allowable limits. The supply is measured on the control card.

Troubleshooting

- Check for a defective control card.
- If an option card is present, check for overvoltage.

WARNING 49, Speed limit
The warning is shown when the speed is outside of the specified range in F-18 and F-17. When the speed is below the specified limit in *parameter H-36 Trip Speed Low [RPM]* (except when starting or stopping), the frequency converter trips.

ALARM 50, Auto tune calibration failed
Contact the GE supplier or GE service department.

ALARM 51, Auto tune check U_{nom} and I_{nom}
The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check the settings in *parameters* P-02, P-03, P-06, P-07, F-04, and F-05.

ALARM 52, Auto tune low I_{nom}
The motor current is too low.

Troubleshooting

- Check the settings in *parameter P-03 Motor Current*.

ALARM 53, Auto tune motor too big
The motor is too large for the Auto tune to operate.

ALARM 54, Auto tune motor too small
The motor is too small for the Auto tune to operate.

ALARM 55, Auto tune parameter out of range
Auto tune cannot run because the parameter values of the motor are outside of the acceptable range.

ALARM 56, Auto tune interrupted by user
The AMA is manually interrupted.

ALARM 57, Auto tune internal fault
Try to restart Auto tune. Repeated restarts can overheat the motor.

ALARM 58, Internal fault
Contact the GE supplier.

WARNING 59, Current limit
The current is higher than the value in *parameter F-43 Current Limit*. Ensure that motor data in *parameters* P-02, P-03, P-06, P-07, F-04, and F-05 is set correctly. Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

WARNING 60, External interlock
A digital input signal indicates a fault condition external to the frequency converter. An external interlock has commanded the frequency converter to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock, and reset the frequency converter.

WARNING 62, Output frequency at maximum limit
The output frequency has reached the value set in *parameter F-03 Max Output Frequency 1*. Check the application for possible causes. Possibly increase the output frequency limit. Be sure that the system can

operate safely at a higher output frequency. The warning clears when the output drops below the maximum limit.

WARNING/ALARM 65, Control card over temperature
The cut-out temperature of the control card is 85 °C (185 °F).

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check for clogged filters.
- Check the fan operation.
- Check the control card.

WARNING 66, Heatsink temperature low
The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module. Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting *parameter B-00 DC Hold Current* to 5% and *parameter H-80 Function at Stop*.

ALARM 67, Option module configuration has changed
One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 69, Power card temperature
The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check for clogged filters.
- Check fan operation.
- Check the power card.

ALARM 70, Illegal drive configuration
The control card and power card are incompatible. To check compatibility, contact the GE supplier with the model number from the unit nameplate and the part numbers of the cards.

ALARM 80, Drive initialised to default value
Parameter settings are restored to factory settings after a manual reset. To clear the alarm, reset the unit.

ALARM 91, Analog input 54 wrong settings
Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

ALARM 92, No flow
A no-flow condition is detected in the system. *Parameter AP-23 No-Flow Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 93, Dry pump
A no-flow condition in the system with the frequency converter operating at high speed may indicate a dry pump. *Parameter AP-26 Dry Pump Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 94, End of curve
The feedback is lower than the setpoint. This may indicate leakage in the system. *Parameter AP-50 End of Curve Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 95, Broken belt
Torque is below the torque level set for no load, indicating a broken belt. *Parameter AP-60 Broken Belt Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 96, Start delayed
Motor start has been delayed due to short-cycle protection. *Parameter AP-76 Interval between Starts* is enabled.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

WARNING 97, Stop delayed
Stopping the motor has been delayed because the motor has been running for less than the minimum time specified in *parameter AP-77 Minimum Run Time*.

WARNING 98, Clock fault
Time is not set, or the RTC clock has failed. Reset the clock in *parameter K-70 Date and Time*.

WARNING 200, Fire mode
The frequency converter is operating in fire mode. The warning clears when fire mode is removed. Refer to the fire mode data in the alarm log.

WARNING 201, Fire mode was active
The frequency converter has entered fire mode. Cycle power to the unit to remove the warning. Refer to the fire mode data in the alarm log.

WARNING 202, Fire mode limits exceeded
While operating in fire mode, 1 or more alarm conditions that would normally trip the unit have been ignored. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. Refer to the fire mode data in the alarm log.

WARNING 250, New spare part
The power or switch mode supply has been exchanged. Restore the frequency converter type code in the EEPROM. Select the correct type code in *parameter SP-23 Typecode Setting* according to the label on the frequency converter. Remember to select Save to EEPROM at the end.

WARNING 251, New typecode
The power card or other components are replaced, and the type code has changed.

5 Parameter Lists

5.1 Parameter Options

5.1.1 Main Menu Structure

Parameters for the frequency converter are grouped into various parameter groups for easy selection of the correct parameters for optimised operation of the frequency converter.
To programme most AF-600 FP applications, press [Quick Menu] and select the parameters under *Quick Set-up*.
Descriptions and default settings of parameters may be found in *chapter 5.1 Parameter Options*.

K-## Keypad Set-up

F-## Fundamental Parameters

E-## Digital In/Outs

C-## Frequency Control Functions

P-## Motor Data

H-## High Perf Parameters

AN-## Analog In/Out

SP-## Special Functions

O-## Options/Comms

AO-## Analog I/O Options

PB-## PROFIdrive

EN-## Ethernet

LN-## LonWorks

BN-## BACnet

DN-## DeviceNet

ID-## Drive Information

DR-## Data Readouts

LG-## Logs & I/O Opt. Status

AP-## HVAC Appl. Param.

FB-## Fire/Bypass Operation

T-## Timed Functions

CL-## PID Closed Loop

XC-## Ext. PID Closed Loop

PC-## Pump Controller

LC-## Logic Controller

B-## Braking Functions

5.1.2 K-## Keypad Set-up

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
K-0#						
K-01	Language	[0] English	1 set-up	TRUE	-	Uint8
K-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
K-03	Regional Settings	[1] US	2 set-ups	FALSE	-	Uint8
K-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
K-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
K-1#						
K-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
K-11	Edit Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
K-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
K-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
K-14	Readout: Edit Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
K-15	Readout: Actual Set-up	0 N/A	All set-ups	FALSE	0	Uint8
K-2#						
K-20	Display Line 1.1 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-21	Display Line 1.2 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-22	Display Line 1.3 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-23	Display Line 2 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-24	Display Line 3 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
K-25	Quick Start	ExpressionLimit	1 set-up	TRUE	0	Uint16
K-3#						
K-30	Unit for Custom Readout	[1] %	All set-ups	TRUE	-	Uint8
K-31	Min Value of Custom Readout	ExpressionLimit	All set-ups	TRUE	-2	Int32
K-32	Max Value of Custom Readout	100 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
K-37	Display Text 1	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-38	Display Text 2	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-39	Display Text 3	0 N/A	1 set-up	TRUE	0	VisStr[25]
K-4#						
K-40	[Hand] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-41	[Off] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-42	[Auto] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-43	[Reset] Button on Keypad	[1] Enabled	All set-ups	TRUE	-	Uint8
K-5#						
K-50	Keypad Copy	[0] No copy	All set-ups	FALSE	-	Uint8
K-51	Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8
K-6#						
K-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Int16
K-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-65	Quick Menu Password	200 N/A	1 set-up	TRUE	0	Int16
K-66	Access to Quick Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
K-67	Bus Password Access	0 N/A	All set-ups	TRUE	0	Uint16
K-7#						
K-70	Date and Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay
K-71	Date Format	ExpressionLimit	1 set-up	TRUE	-	Uint8
K-72	Time Format	ExpressionLimit	1 set-up	TRUE	-	Uint8
K-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
K-76	DST/Summertime Start	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
K-77	DST/Summertime End	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-79	Clock Fault	ExpressionLimit	1 set-up	TRUE	-	Uint8
K-8#						
K-81	Working Days	ExpressionLimit	1 set-up	TRUE	-	Uint8
K-82	Additional Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
K-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

5.1.3 F-## Fundamental Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
F-0#						
F-01	Frequency Setting 1	[1] Analog Input 53	All set-ups	TRUE	-	Uint8
F-02	Operation Method	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
F-03	Max Output Frequency 1	ExpressionLimit	All set-ups	FALSE	-1	Uint16
F-04	Base Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
F-05	Motor Rated Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16
F-07	Accel Time 1	ExpressionLimit	All set-ups	TRUE	-2	Uint32
F-08	Decel Time 1	ExpressionLimit	All set-ups	TRUE	-2	Uint32
F-09	Torque Boost	100 %	All set-ups	TRUE	0	Int16
F-1#						
F-10	Electronic Overload	ExpressionLimit	All set-ups	TRUE	-	Uint8
F-11	Motor External Fan	[0] No	All set-ups	TRUE	-	Uint8
F-12	Motor Thermistor Input	[0] None	All set-ups	TRUE	-	Uint8
F-15	Motor Speed High Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-16	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-17	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
F-18	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
F-2#						
F-20	PM Start Mode	[1] Parking	All set-ups	TRUE	-	Uint8
F-24	Holding Time	00 s	All set-ups	TRUE	-1	Uint16
F-26	Motor Noise (Carrier Freq)	ExpressionLimit	All set-ups	TRUE	-	Uint8
F-27	Motor Tone Random	[0] Off	All set-ups	TRUE	-	Uint8
F-3#						
F-37	Adv. Switching Pattern	ExpressionLimit	All set-ups	TRUE	-	Uint8
F-38	Overmodulation	[0] Off	All set-ups	FALSE	-	Uint8
F-4#						
F-40	Torque Limiter (Driving)	ExpressionLimit	All set-ups	TRUE	-1	Uint16
F-41	Torque Limiter (Braking)	100 %	All set-ups	TRUE	-1	Uint16
F-43	Current Limit	ExpressionLimit	All set-ups	TRUE	-1	Uint32
F-5#						
F-52	Minimum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
F-53	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
F-54	Reference Function	ExpressionLimit	All set-ups	TRUE	-	Uint8
F-6#						
F-64	Preset Relative Reference	0 %	All set-ups	TRUE	-2	Int32

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
F-9#						
F-90	Step Size	0.10 %	All set-ups	TRUE	-2	Uint16
F-91	Accel/Decel Time	1 s	All set-ups	TRUE	-2	Uint32
F-92	Power Restore	[0] Off	All set-ups	TRUE	-	Uint8
F-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16
F-94	Minimum Limit	0 %	All set-ups	TRUE	0	Int16
F-95	Accel/Decel Ramp Delay	ExpressionLimit	All set-ups	TRUE	-3	TimD

5.1.4 E-## Digital In/Outs

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
E-0#						
E-00	Digital I/O Mode	[0] PNP - Active at 24V	All set-ups	FALSE	-	Uint8
E-01	Terminal 18 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-02	Terminal 19 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-03	Terminal 27 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-04	Terminal 29 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-05	Terminal 32 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-06	Terminal 33 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-1#						
E-10	Accel Time 2	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-11	Decel Time 2	ExpressionLimit	All set-ups	TRUE	-2	Uint32
E-2#						
E-20	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
E-21	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
E-24	Function Relay	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-26	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
E-27	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
E-5#						
E-51	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
E-52	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
E-53	Terminal X30/2 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-54	Terminal X30/3 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-55	Terminal X30/4 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
E-56	Term X30/6 Digi Out (OPCGPIO)	[0] No operation	All set-ups	TRUE	-	Uint8
E-57	Term X30/7 Digi Out (OPCGPIO)	[0] No operation	All set-ups	TRUE	-	Uint8
E-6#						
E-60	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-61	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-62	Term. 29 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
E-63	Term. 29 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
E-64	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
E-65	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-66	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
E-67	Term. 33 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
E-68	Term. 33 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
E-69	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
E-7#						
E-70	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
E-71	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
E-72	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
E-74	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
E-75	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
E-76	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
E-9#						
E-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
E-93	Pulse Out #27 Bus Control	0 %	All set-ups	TRUE	-2	N2
E-94	Pulse Out #27 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
E-95	Pulse Out #29 Bus Control	0 %	All set-ups	TRUE	-2	N2
E-96	Pulse Out #29 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
E-97	Pulse Out #X30/6 Bus Control	0 %	All set-ups	TRUE	-2	N2
E-98	Pulse Out #X30/6 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16

5.1.5 C-## Frequency Control Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
C-0#						
C-01	Jump Frequency From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-02	Jump Speed From [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-03	Jump Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-04	Jump Frequency To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-05	Multi-step Frequency 1 - 8	0 %	All set-ups	TRUE	-2	Int16
C-2#						
C-20	Jog Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
C-21	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
C-22	Jog Accel/Decel Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
C-23	Quick Stop Decel Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
C-3#						
C-30	Frequency Command 2	[20] Digital Potentiometer	All set-ups	TRUE	-	Uint8
C-34	Frequency Command 3	[0] No function	All set-ups	TRUE	-	Uint8
C-4#						
C-40	Semi-Auto Jump Freq Set-up	[0] Off	All set-ups	FALSE	-	Uint8

5.1.6 P-## Motor Data

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
P-0#						
P-02	Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32
P-03	Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
P-04	Auto Tune	[0] Off	All set-ups	FALSE	-	Uint8
P-06	Base Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
P-07	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
P-08	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
P-09	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
P-1#						
P-10	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
P-2#						
P-20	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
P-24	Damping Gain	120 %	All set-ups	TRUE	0	Int16
P-25	Low Speed Filter Time Const.	ExpressionLimit	All set-ups	TRUE	-2	Uint16
P-26	High Speed Filter Time Const.	ExpressionLimit	All set-ups	TRUE	-2	Uint16
P-27	Voltage filter time const.	ExpressionLimit	All set-ups	TRUE	-3	Uint16
P-3#						
P-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-31	Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
P-36	Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
P-37	d-axis Inductance (Ld)	ExpressionLimit	All set-ups	FALSE	-6	Int32
P-38	q-axis Inductance (Lq)	ExpressionLimit	All set-ups	FALSE	-6	Int32
P-39	Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint8
P-4#						
P-44	d-axis Inductance Sat. (LdSat)	ExpressionLimit	All set-ups	FALSE	-6	Int32
P-45	q-axis Inductance Sat. (LqSat)	ExpressionLimit	All set-ups	FALSE	-6	Int32
P-46	Position Detection Gain	100 %	All set-ups	TRUE	0	Uint16
P-47	Torque Calibration	ExpressionLimit	All set-ups	TRUE	-	Uint8
P-48	Inductance Sat. Point	ExpressionLimit	All set-ups	TRUE	0	Int16
P-6#						
P-62	Locked Rotor Protection	ExpressionLimit	All set-ups	TRUE	-	Uint8
P-63	Locked Rotor Detection Time [s]	ExpressionLimit	All set-ups	TRUE	-2	Uint8

5.1.7 H-## High Perf Parameters

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
H-0#						
H-01	Option Detection	[0] Protect Option Config.	1 set-up	TRUE	-	Uint8
H-03	Restore Factory Settings	[0] Normal operation	All set-ups	TRUE	-	Uint8
H-04	Auto-Reset (Times)	ExpressionLimit	All set-ups	TRUE	-	Uint8
H-05	Auto-Reset (Reset Interval)	10 s	All set-ups	TRUE	0	Uint16
H-06	Fan Operation	[0] Auto	All set-ups	TRUE	-	Uint8
H-08	Reverse Lock	[2] Both directions	All set-ups	FALSE	-	Uint8
H-09	Start Mode	ExpressionLimit	All set-ups	TRUE	-	Uint8
H-3#						
H-36	Trip Speed Low [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-37	Trip Speed Low [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-4#						
H-40	Configuration Mode	ExpressionLimit	All set-ups	TRUE	-	Uint8
H-43	Torque Characteristics	[1] Variable torque	All set-ups	TRUE	-	Uint8
H-48	Clockwise Direction	[0] Normal	All set-ups	FALSE	-	Uint8
H-5#						
H-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
H-51	Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-52	Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-58	Flying Start Test Pulses Current	ExpressionLimit	All set-ups	FALSE	0	Uint16
H-59	Flying Start Test Pulses Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
H-6#						

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
H-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
H-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
H-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
H-7#						
H-70	Warning Current Low	0 A	All set-ups	TRUE	-2	Uint32
H-71	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
H-72	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
H-73	Warning Speed High	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-74	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32
H-75	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32
H-76	Warning Feedback Low	-999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
H-77	Warning Feedback High	999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
H-78	Missing Motor Phase Function	[2] Trip 1000 ms	All set-ups	TRUE	-	Uint8
H-8#						
H-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
H-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
H-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
H-9#						
H-94	ATEX ETR cur.lim. speed reduction	0 %	2 set-ups	TRUE	-1	Uint16
H-98	ATEX ETR interpol. points freq.	ExpressionLimit	1 set-up	TRUE	-1	Uint16
H-99	ATEX ETR interpol points current	ExpressionLimit	2 set-ups	TRUE	0	Uint16

5.1.8 AN-## Analog In / Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AN-0#						
AN-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
AN-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
AN-02	Fire Mode Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
AN-1#						
AN-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-11	Terminal 53 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AN-12	Terminal 53 Low Current	4 mA	All set-ups	TRUE	-5	Int16
AN-13	Terminal 53 High Current	20 mA	All set-ups	TRUE	-5	Int16
AN-14	Terminal 53 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AN-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
AN-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-2#						
AN-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-21	Terminal 54 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AN-22	Terminal 54 Low Current	4 mA	All set-ups	TRUE	-5	Int16
AN-23	Terminal 54 High Current	20 mA	All set-ups	TRUE	-5	Int16
AN-24	Terminal 54 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AN-25	Terminal 54 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AN-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-3#						
AN-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AN-31	Terminal X30/11 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AN-34	Term. X30/11 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AN-35	Term. X30/11 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AN-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-4#						
AN-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AN-41	Terminal X30/12 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AN-44	Term. X30/12 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AN-45	Term. X30/12 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AN-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AN-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AN-5#						
AN-50	Terminal 42 Output	ExpressionLimit	All set-ups	TRUE	-	Uint8
AN-51	Terminal 42 Output Min Scale	0 %	All set-ups	TRUE	-2	Int16
AN-52	Terminal 42 Output Max Scale	100 %	All set-ups	TRUE	-2	Int16
AN-53	Terminal 42 Output Bus Control	0 %	All set-ups	TRUE	-2	N2
AN-54	Terminal 42 Output Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
AN-55	Terminal 42 Output Filter	[0] Off	1 set-up	TRUE	-	Uint8
AN-6#						
AN-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AN-61	Terminal X30/8 Min. Scale	0 %	All set-ups	TRUE	-2	Int16
AN-62	Terminal X30/8 Max. Scale	100 %	All set-ups	TRUE	-2	Int16
AN-63	Terminal X30/8 Output Bus Control	0 %	All set-ups	TRUE	-2	N2
AN-64	Terminal X30/8 Output Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16

5.1.9 SP-## Special Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
SP-0#						
SP-00	Fault Level	ExpressionLimit	1 set-up	TRUE	-	Uint8
SP-1#						
SP-10	Line failure	[0] No function	All set-ups	FALSE	-	Uint8
SP-11	Line Voltage at Input Fault	ExpressionLimit	All set-ups	TRUE	0	Uint16
SP-12	Function at Line Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
SP-16	Kin. Backup Gain	100 %	All set-ups	TRUE	0	Uint32
SP-2#						
SP-23	Typecode Setting	ExpressionLimit	2 set-ups	FALSE	-	Uint16
SP-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
SP-26	Trip Delay at Drive Fault	ExpressionLimit	All set-ups	TRUE	0	Uint8
SP-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
SP-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
SP-3#						
SP-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
SP-31	Current Lim Ctrl, Integration Time	ExpressionLimit	All set-ups	FALSE	-3	Uint16
SP-32	Current Lim Ctrl, Filter Time	ExpressionLimit	All set-ups	TRUE	-4	Uint16
SP-4#						
SP-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
SP-41	Energy Savings Min. Magnetization	ExpressionLimit	All set-ups	TRUE	0	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
SP-42	Energy Savings Min. Frequency	ExpressionLimit	All set-ups	TRUE	0	Uint8
SP-43	Motor Cosphi	ExpressionLimit	All set-ups	TRUE	-2	Uint16
SP-5#						
SP-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
SP-51	DC Link Compensation	ExpressionLimit	All set-ups	TRUE	-	Uint8
SP-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
SP-54	AHF Cap Reconnect Delay	25 s	2 set-ups	TRUE	0	Uint16
SP-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
SP-59	Actual Number of Inverter Units	ExpressionLimit	1 set-up	FALSE	0	Uint8
SP-6#						
SP-60	Function at Over Temperature	[0] Trip	All set-ups	TRUE	-	Uint8
SP-61	Function at Drive Overload	[0] Trip	All set-ups	TRUE	-	Uint8
SP-62	Drive Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

5.1.10 O-## Options/Comms

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
O-0#						
O-01	Control Site	ExpressionLimit	All set-ups	TRUE	-	Uint8
O-02	Control Word Source	ExpressionLimit	All set-ups	TRUE	-	Uint8
O-03	Control Word Timeout Time	ExpressionLimit	1 set-up	TRUE	-1	Uint32
O-04	Control Word Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
O-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
O-06	Reset Control Word Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
O-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
O-08	Readout Filtering	ExpressionLimit	All set-ups	TRUE	-	Uint8
O-09	Communication Charset	[1] ANSI X3.4	2 set-ups	TRUE	-	Uint8
O-1#						
O-10	Control Word Profile	[0] Drive Profile	All set-ups	TRUE	-	Uint8
O-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
O-16	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
O-19	Product Code	ExpressionLimit	1 set-up	TRUE	0	Uint32
O-3#						
O-30	Protocol	ExpressionLimit	1 set-up	TRUE	-	Uint8
O-31	Address	ExpressionLimit	1 set-up	TRUE	0	Uint8
O-32	Drive Port Baud Rate	ExpressionLimit	1 set-up	TRUE	-	Uint8
O-33	Drive Port Parity	ExpressionLimit	1 set-up	TRUE	-	Uint8
O-34	Estimated cycle time	0 ms	2 set-ups	TRUE	-3	Uint32
O-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-36	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-37	Maximum Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
O-4#						
O-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
O-42	PCD Write Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
O-43	PCD Read Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
O-5#						
O-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-52	DC Brake Select	ExpressionLimit	All set-ups	TRUE	-	Uint8
O-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
O-54	Reversing Select	ExpressionLimit	All set-ups	TRUE	-	Uint8
O-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-8#						
O-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
O-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
O-82	Slave Messages Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
O-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
O-89	Diagnostics Count	0 N/A	1 set-up	TRUE	0	Int32
O-9#						
O-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
O-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
O-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
O-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
O-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

5.1.11 AO-## Analog I/O Option

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AO-0#						
AO-00	Terminal X42/1 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-01	Terminal X42/3 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-02	Terminal X42/5 Mode	[1] Voltage	All set-ups	TRUE	-	Uint8
AO-1#						
AO-10	Terminal X42/1 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-11	Terminal X42/1 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AO-14	Term. X42/1 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AO-15	Term. X42/1 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AO-16	Term. X42/1 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-17	Term. X42/1 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-2#						
AO-20	Terminal X42/3 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-21	Terminal X42/3 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AO-24	Term. X42/3 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AO-25	Term. X42/3 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AO-26	Term. X42/3 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-27	Term. X42/3 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-3#						
AO-30	Terminal X42/5 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
AO-31	Terminal X42/5 High Voltage	10 V	All set-ups	TRUE	-2	Int16
AO-34	Term. X42/5 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
AO-35	Term. X42/5 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
AO-36	Term. X42/5 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
AO-37	Term. X42/5 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
AO-4#						
AO-40	Terminal X42/7 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-41	Terminal X42/7 Min. Scale	0 %	All set-ups	TRUE	-2	Int16
AO-42	Terminal X42/7 Max. Scale	100 %	All set-ups	TRUE	-2	Int16
AO-43	Terminal X42/7 Bus Control	0 %	All set-ups	TRUE	-2	N2

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AO-44	Terminal X42/7 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
AO-5#						
AO-50	Terminal X42/9 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-51	Terminal X42/9 Min. Scale	0 %	All set-ups	TRUE	-2	Int16
AO-52	Terminal X42/9 Max. Scale	100 %	All set-ups	TRUE	-2	Int16
AO-53	Terminal X42/9 Bus Control	0 %	All set-ups	TRUE	-2	N2
AO-54	Terminal X42/9 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
AO-6#						
AO-60	Terminal X42/11 Output	[0] No operation	All set-ups	TRUE	-	Uint8
AO-61	Terminal X42/11 Min. Scale	0 %	All set-ups	TRUE	-2	Int16
AO-62	Terminal X42/11 Max. Scale	100 %	All set-ups	TRUE	-2	Int16
AO-63	Terminal X42/11 Bus Control	0 %	All set-ups	TRUE	-2	N2
AO-64	Terminal X42/11 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16

5.1.12 DN-## DevicNet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DN-0#						
DN-00	DeviceNet Protocol	[1] DeviceNet	2 set-ups	FALSE	-	Uint8
DN-01	Baud Rate Select	ExpressionLimit	2 set-ups	TRUE	-	Uint8
DN-02	MAC ID	ExpressionLimit	2 set-ups	TRUE	0	Uint8
DN-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-07	Readout Bus Off Counter	0 N/A	All set-ups	TRUE	0	Uint8
DN-1#						
DN-10	Process Data Type Selection	ExpressionLimit	All set-ups	TRUE	-	Uint8
DN-11	Process Data Config Write	ExpressionLimit	2 set-ups	TRUE	-	Uint16
DN-12	Process Data Config Read	ExpressionLimit	2 set-ups	TRUE	-	Uint16
DN-13	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
DN-14	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
DN-15	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
DN-18	internal_process_data_config_write	ExpressionLimit	All set-ups	TRUE	0	Uint16
DN-19	internal_process_data_config_read	ExpressionLimit	All set-ups	TRUE	0	Uint16
DN-2#						
DN-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
DN-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
DN-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
DN-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
DN-3#						
DN-30	Array Index	0 N/A	2 set-ups	TRUE	0	Uint8
DN-31	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
DN-32	Devicenet Revision	0 N/A	All set-ups	TRUE	0	Uint16
DN-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
DN-34	DeviceNet Product Code	120 N/A	1 set-up	TRUE	0	Uint16
DN-39	Devicenet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

5.1.13 PB-## Profibus

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
PB-0#						
PB-00	Setpoint	0 N/A	All set-ups	TRUE	0	Uint16
PB-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16
PB-1#						
PB-15	PCD Write Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
PB-16	PCD Read Configuration	ExpressionLimit	2 set-ups	TRUE	-	Uint16
PB-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8
PB-2#						
PB-22	Telegram Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8
PB-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16
PB-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
PB-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
PB-4#						
PB-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16
PB-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16
PB-47	Fault Number	0 N/A	All set-ups	TRUE	0	Uint16
PB-5#						
PB-52	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16
PB-53	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2
PB-6#						
PB-63	Actual Baud Rate	[255] No baudrate found	All set-ups	TRUE	-	Uint8
PB-64	Device Identification	0 N/A	All set-ups	TRUE	0	Uint16
PB-65	Profile Number	0 N/A	All set-ups	TRUE	0	OctStr[2]
PB-67	Control Word 1	0 N/A	All set-ups	TRUE	0	V2
PB-68	Status Word 1	0 N/A	All set-ups	TRUE	0	V2
PB-7#						
PB-70	Edit Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
PB-71	Profibus Save Data Values	[0] Off	All set-ups	TRUE	-	Uint8
PB-72	ProfibusDriveReset	[0] No action	1 set-up	FALSE	-	Uint8
PB-75	DO Identification	0 N/A	All set-ups	TRUE	0	Uint16
PB-8#						
PB-80	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
PB-81	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
PB-82	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
PB-83	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
PB-84	Defined Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16
PB-85	Defined Parameters (6)	0 N/A	All set-ups	FALSE	0	Uint16
PB-9#						
PB-90	Changed Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
PB-91	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
PB-92	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
PB-93	Changed Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
PB-94	Changed Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16
PB-99	Profibus Revision Counter	0 N/A	All set-ups	TRUE	0	Uint16

5.1.14 EN-## EtherNet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
EN-0#						
EN-00	IP Address Assignment	ExpressionLimit	2 set-ups	TRUE	-	Uint8
EN-01	IP Address	0 N/A	1 set-up	TRUE	0	OctStr[4]
EN-02	Subnet Mask	0 N/A	1 set-up	TRUE	0	OctStr[4]
EN-03	Default Gateway	0 N/A	1 set-up	TRUE	0	OctStr[4]
EN-04	DHCP Server	0 N/A	2 set-ups	TRUE	0	OctStr[4]
EN-05	Lease Expires	ExpressionLimit	All set-ups	TRUE	0	TimD
EN-06	Name Servers	0 N/A	1 set-up	TRUE	0	OctStr[4]
EN-07	Domain Name	0 N/A	1 set-up	TRUE	0	VisStr[48]
EN-08	Host Name	0 N/A	1 set-up	TRUE	0	VisStr[48]
EN-09	Physical Address	0 N/A	1 set-up	TRUE	0	VisStr[17]
EN-1#						
EN-10	Link Status	[0] No Link	All set-ups	TRUE	-	Uint8
EN-11	Link Duration	ExpressionLimit	All set-ups	TRUE	0	TimD
EN-12	Auto Negotiation	[1] On	2 set-ups	TRUE	-	Uint8
EN-13	Link Speed	[0] None	2 set-ups	TRUE	-	Uint8
EN-14	Link Duplex	[1] Full Duplex	2 set-ups	TRUE	-	Uint8
EN-2#						
EN-20	Control Instance	ExpressionLimit	1 set-up	TRUE	0	Uint8
EN-21	Process Data Config Write	ExpressionLimit	All set-ups	TRUE	-	Uint16
EN-22	Process Data Config Read	ExpressionLimit	All set-ups	TRUE	-	Uint16
EN-27	Primary Master	0 N/A	1 set-up	TRUE	0	OctStr[4]
EN-28	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
EN-29	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
EN-3#						
EN-30	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
EN-31	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
EN-32	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
EN-33	CIP Revision	ExpressionLimit	All set-ups	TRUE	0	Uint16
EN-34	CIP Product Code	ExpressionLimit	1 set-up	TRUE	0	Uint16
EN-35	EDS Parameter	0 N/A	All set-ups	TRUE	0	Uint32
EN-37	COS Inhibit Timer	0 N/A	All set-ups	TRUE	0	Uint16
EN-38	COS Filter	0 N/A	All set-ups	TRUE	0	Uint16
EN-4#						
EN-40	Status Parameter	0 N/A	All set-ups	TRUE	0	Uint16
EN-41	Slave Message Count	0 N/A	All set-ups	TRUE	0	Uint32
EN-42	Slave Exception Message Count	0 N/A	All set-ups	TRUE	0	Uint32
EN-8#						
EN-80	FTP Server	[0] Disabled	2 set-ups	TRUE	-	Uint8
EN-81	HTTP Server	[0] Disabled	2 set-ups	TRUE	-	Uint8
EN-82	SMTP Service	[0] Disabled	2 set-ups	TRUE	-	Uint8
EN-89	Transparent Socket Channel Port	ExpressionLimit	2 set-ups	TRUE	0	Uint16
EN-9#						
EN-90	Cable Diagnostic	[0] Disabled	2 set-ups	TRUE	-	Uint8
EN-91	MDI-X	[1] Enabled	2 set-ups	TRUE	-	Uint8
EN-92	IGMP Snooping	[1] Enabled	2 set-ups	TRUE	-	Uint8
EN-93	Cable Error Length	0 N/A	1 set-up	TRUE	0	Uint16
EN-94	Broadcast Storm Protection	-1 %	2 set-ups	TRUE	0	Int8
EN-95	Broadcast Storm Filter	[0] Broadcast only	2 set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
EN-96	Port Mirroring	ExpressionLimit	2 set-ups	TRUE	-	Uint8
EN-98	Interface Counters	4000 N/A	All set-ups	TRUE	0	Uint32
EN-99	Media Counters	0 N/A	All set-ups	TRUE	0	Uint32

5.1.15 BN-## BACnet

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
BN-7#						
BN-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
BN-72	MS/TP Max Masters	127 N/A	1 set-up	TRUE	0	Uint8
BN-73	MS/TP Max Info Frames	1 N/A	1 set-up	TRUE	0	Uint16
BN-74	"I-Am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
BN-75	Initialization Password	ExpressionLimit	1 set-up	TRUE	0	VisStr[20]

5.1.16 LN-## LonWorks

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
LN-0#						
LN-00	Neuron ID	0 N/A	All set-ups	TRUE	0	OctStr[6]
LN-1#						
LN-10	Drive Profile	[0] VSD profile	All set-ups	TRUE	-	Uint8
LN-15	LON Warning Word	0 N/A	All set-ups	TRUE	0	Uint16
LN-17	XIF Revision	0 N/A	All set-ups	TRUE	0	VisStr[5]
LN-18	LonWorks Revision	0 N/A	All set-ups	TRUE	0	VisStr[5]
LN-2#						
LN-21	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8

5.1.17 ID-## Drive Information

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
ID-0#						
ID-00	Operating hours	0 h	All set-ups	FALSE	74	Uint32
ID-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
ID-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
ID-03	Power Up's	0 N/A	All set-ups	FALSE	0	Uint32
ID-04	Over Temp's	0 N/A	All set-ups	FALSE	0	Uint16
ID-05	Over Volt's	0 N/A	All set-ups	FALSE	0	Uint16
ID-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
ID-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
ID-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
ID-1#						
ID-10	Trending Source	0	2 set-ups	TRUE	-	Uint16
ID-11	Trending Interval	ExpressionLimit	2 set-ups	TRUE	-3	TimD
ID-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
ID-13	Trending Mode	[0] Trend always	2 set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
ID-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
ID-2#						
ID-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
ID-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
ID-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
ID-23	Historic log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
ID-3#						
ID-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint16
ID-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
ID-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
ID-33	Alarm Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
ID-4#						
ID-40	Drive Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
ID-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
ID-44	GE Model Number	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-46	GE Product No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-47	GE Power Card Model No	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-48	Keypad ID Number	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-5#						
ID-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-51	Drive Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[10]
ID-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]
ID-59	Filename	ExpressionLimit	1 set-up	FALSE	0	VisStr[16]
ID-6#						
ID-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-61	Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
ID-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]
ID-7#						
ID-70	Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-71	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-72	Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-73	Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-74	Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-75	Slot C0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-76	Option in Slot C2	0 N/A	All set-ups	FALSE	0	VisStr[30]
ID-77	Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
ID-8#						
ID-80	Fan Running Hours	0 h	All set-ups	TRUE	74	Uint32
ID-81	Preset Fan Running Hours	0 h	All set-ups	TRUE	74	Uint32
ID-9#						
ID-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
ID-93	Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16
ID-98	Drive Identification	0 N/A	All set-ups	FALSE	0	VisStr[40]
ID-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

5.1.18 DR-## Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DR-0#						
DR-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
DR-01	Reference [Unit]	0 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
DR-02	Reference [%]	0 %	All set-ups	FALSE	-1	Int16
DR-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
DR-05	Main Actual Value [%]	0 %	All set-ups	FALSE	-2	N2
DR-09	Custom Readout	0 CustomReadoutUnit	All set-ups	FALSE	-2	Int32
DR-1#						
DR-10	Power [kW]	0 kW	All set-ups	FALSE	1	Int32
DR-11	Power [hp]	0 hp	All set-ups	FALSE	-2	Int32
DR-12	Motor Voltage	0 V	All set-ups	FALSE	-1	Uint16
DR-13	Frequency	0 Hz	All set-ups	FALSE	-1	Uint16
DR-14	Motor current	0 A	All set-ups	FALSE	-2	Int32
DR-15	Frequency [%]	0 %	All set-ups	FALSE	-2	N2
DR-16	Torque [Nm]	0 Nm	All set-ups	FALSE	-1	Int32
DR-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
DR-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
DR-2#						
DR-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
DR-23	Motor Shaft Power [kW]	0 kW	All set-ups	TRUE	1	Int32
DR-24	Calibrated Stator Resistance	0.0000 Ohm	All set-ups	TRUE	-4	Uint32
DR-3#						
DR-30	DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16
DR-31	System Temp.	0 °C	All set-ups	TRUE	100	Int8
DR-32	Brake Energy /s	0 kW	All set-ups	FALSE	0	Uint32
DR-33	Brake Energy Average	0 kW	All set-ups	FALSE	0	Uint32
DR-34	Heatsink Temp.	0 °C	All set-ups	FALSE	100	Uint8
DR-35	Drive Thermal	0 %	All set-ups	FALSE	0	Uint8
DR-36	Drive Nominal Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
DR-37	Drive Max. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
DR-38	Logic Controller State	0 N/A	All set-ups	FALSE	0	Uint8
DR-39	Control Card Temp.	0 °C	All set-ups	FALSE	100	Uint8
DR-4#						
DR-40	Trending Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
DR-41	Keypad Bottom Statusline	0 N/A	All set-ups	TRUE	0	VisStr[50]
DR-43	Timed Actions Status	[0] Timed Actions Auto	All set-ups	TRUE	-	Uint8
DR-49	Current Fault Source	0 N/A	All set-ups	TRUE	0	Uint8
DR-5#						
DR-50	External Reference	0 N/A	All set-ups	FALSE	-1	Int16
DR-52	Feedback[Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-53	Digi Pot Reference	0 N/A	All set-ups	FALSE	-2	Int16
DR-54	Feedback 1 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-55	Feedback 2 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-56	Feedback 3 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
DR-58	PID Output [%]	0 %	All set-ups	TRUE	-1	Int16
DR-59	Adjusted Setpoint	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
DR-6#						
DR-60	Digital Input	0 N/A	All set-ups	FALSE	0	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
DR-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
DR-62	Analog Input 53	0 N/A	All set-ups	FALSE	-3	Int32
DR-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
DR-64	Analog Input 54	0 N/A	All set-ups	FALSE	-3	Int32
DR-65	Analog Output 42 [mA]	0 N/A	All set-ups	FALSE	-3	Int16
DR-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
DR-67	Freq. Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-68	Freq. Input #33 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-7#						
DR-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
DR-71	Relay Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
DR-72	Counter A	0 N/A	All set-ups	TRUE	0	Int32
DR-73	Counter B	0 N/A	All set-ups	TRUE	0	Int32
DR-75	Analog In X30/11	0 N/A	All set-ups	FALSE	-3	Int32
DR-76	Analog In X30/12	0 N/A	All set-ups	FALSE	-3	Int32
DR-77	Analog Out X30/8 [mA]	0 N/A	All set-ups	FALSE	-3	Int16
DR-8#						
DR-80	Fieldbus CTW 1	0 N/A	All set-ups	FALSE	0	V2
DR-82	Fieldbus REF 1	0 N/A	All set-ups	FALSE	0	N2
DR-84	Comm. Option STW	0 N/A	All set-ups	FALSE	0	V2
DR-85	Drive Port CTW 1	0 N/A	All set-ups	FALSE	0	V2
DR-86	Drive Port REF 1	0 N/A	All set-ups	FALSE	0	N2
DR-9#						
DR-90	Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-91	Alarm Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-92	Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-93	Warning Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32
DR-95	Ext. Status Word 2	0 N/A	All set-ups	FALSE	0	Uint32
DR-96	Maintenance Word	0 N/A	All set-ups	FALSE	0	Uint32

5.1.19 LG-## Logs & I/O Opt. Status

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
LG-0#						
LG-00	Maintenance Log: Item	0 N/A	All set-ups	FALSE	0	Uint8
LG-01	Maintenance Log: Action	0 N/A	All set-ups	FALSE	0	Uint8
LG-02	Maintenance Log: Time	0 s	All set-ups	FALSE	0	Uint32
LG-03	Maintenance Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
LG-1#						
LG-10	FireMode Log:Event	0 N/A	All set-ups	FALSE	0	Uint8
LG-11	Fire Mode Log: Time	0 s	All set-ups	FALSE	0	Uint32
LG-12	Fire Mode Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
LG-3#						
LG-30	Analog Input X42/1	0 N/A	All set-ups	FALSE	-3	Int32
LG-31	Analog Input X42/3	0 N/A	All set-ups	FALSE	-3	Int32

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
LG-32	Analog Input X42/5	0 N/A	All set-ups	FALSE	-3	Int32
LG-33	Analog Out X42/7 [V]	0 N/A	All set-ups	FALSE	-3	Int16
LG-34	Analog Out X42/9 [V]	0 N/A	All set-ups	FALSE	-3	Int16
LG-35	Analog Out X42/11 [V]	0 N/A	All set-ups	FALSE	-3	Int16

5.1.20 AP-## HVAC Appl. Param.

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
AP-0#						
AP-00	External Interlock Delay	0 s	All set-ups	TRUE	0	Uint16
AP-2#						
AP-20	Low Power Auto Set-up	[0] Off	All set-ups	FALSE	-	Uint8
AP-21	Low Power Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-22	Low Speed Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-23	No-Flow Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-24	No-Flow Delay	10 s	All set-ups	TRUE	0	Uint16
AP-26	Dry Pump Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-27	Dry Pump Delay	10 s	All set-ups	TRUE	0	Uint16
AP-3#						
AP-30	No-Flow Power	0 kW	All set-ups	TRUE	1	Uint32
AP-31	Power Correction Factor	100 %	All set-ups	TRUE	0	Uint16
AP-32	Low Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-33	Low Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-34	Low Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
AP-35	Low Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
AP-36	High Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-37	High Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-38	High Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
AP-39	High Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
AP-4#						
AP-40	Minimum Run Time	10 s	All set-ups	TRUE	0	Uint16
AP-41	Minimum Sleep Time	10 s	All set-ups	TRUE	0	Uint16
AP-42	Wake-up Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-43	Wake-up Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-44	Wake-up Ref./FB Difference	10 %	All set-ups	TRUE	0	Int8
AP-45	Setpoint Boost	0 %	All set-ups	TRUE	0	Int8
AP-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
AP-5#						
AP-50	End of Curve Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-51	End of Curve Delay	10 s	All set-ups	TRUE	0	Uint16
AP-52	End of Curve Tolerance	2.5 %	All set-ups	TRUE	-1	Int16
AP-6#						
AP-60	Broken Belt Function	[0] Off	All set-ups	TRUE	-	Uint8
AP-61	Broken Belt Torque	10 %	All set-ups	TRUE	0	Uint8
AP-62	Broken Belt Delay	10 s	All set-ups	TRUE	0	Uint16
AP-7#						
AP-70	Compressor Start Max Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-71	Compressor Start Max Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-72	Compressor Start Max Time to Trip	5 s	All set-ups	TRUE	-1	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
AP-73	Starting Acceleration Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
AP-75	Short Cycle Protection	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-76	Interval between Starts	start_to_start_min_on_time (P2277)	All set-ups	TRUE	0	Uint16
AP-77	Minimum Run Time	0 s	All set-ups	TRUE	0	Uint16
AP-8#						
AP-80	Flow Compensation	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-81	Square-linear Curve Approximation	100 %	All set-ups	TRUE	0	Uint8
AP-82	Work Point Calculation	[0] Disabled	All set-ups	TRUE	-	Uint8
AP-83	Speed at No-Flow [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-84	Speed at No-Flow [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-85	Speed at Design Point [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
AP-86	Speed at Design Point [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
AP-87	Pressure at No-Flow Speed	0 N/A	All set-ups	TRUE	-3	Int32
AP-88	Pressure at Rated Speed	999999.999 N/A	All set-ups	TRUE	-3	Int32
AP-89	Flow at Design Point	0 N/A	All set-ups	TRUE	-3	Int32
AP-9#						
AP-90	Flow at Rated Speed	0 N/A	All set-ups	TRUE	-3	Int32

5.1.21 FB-## Fire/Bypass Operation

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
FB-0#						
FB-00	Fire Mode Function	[0] Disabled	2 set-ups	TRUE	-	Uint8
FB-01	Fire Mode Configuration	[0] Open Loop	All set-ups	TRUE	-	Uint8
FB-02	Fire Mode Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
FB-03	Fire Mode Min Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
FB-04	Fire Mode Max Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
FB-05	Fire Mode Preset Reference	0 %	All set-ups	TRUE	-2	Int16
FB-06	Fire Mode Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
FB-07	Fire Mode Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
FB-09	Fire Mode Alarm Handling	[1] Trip, Critical Alarms	2 set-ups	FALSE	-	Uint8
FB-1#						
FB-10	Drive Bypass Function	[0] Disabled	2 set-ups	TRUE	-	Uint8
FB-11	Drive Bypass Delay Time	0 s	2 set-ups	TRUE	0	Uint16

5.1.22 T-## Timed Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
T-0#						
T-00	ON Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDayWoDate
T-01	ON Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
T-02	OFF Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDayWoDate
T-03	OFF Action	[1] No action	2 set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
T-04	Occurrence	[0] All days	2 set-ups	TRUE	-	Uint8
T-08	Timed Actions Mode	[0] Timed Actions Auto	2 set-ups	TRUE	-	Uint8
T-09	Timed Actions Reactivation	[1] Enabled	2 set-ups	TRUE	-	Uint8
T-1#						
T-10	Maintenance Item	[1] Motor bearings	1 set-up	TRUE	-	Uint8
T-11	Maintenance Action	[1] Lubricate	1 set-up	TRUE	-	Uint8
T-12	Maintenance Time Base	[0] Disabled	1 set-up	TRUE	-	Uint8
T-13	Maintenance Time Interval	1 h	1 set-up	TRUE	74	Uint32
T-14	Maintenance Date and Time	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
T-15	Reset Maintenance Word	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-16	Maintenance Text	0 N/A	1 set-up	TRUE	0	VisStr[20]
T-5#						
T-50	Energy Log Resolution	[5] Last 24 Hours	2 set-ups	TRUE	-	Uint8
T-51	Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-53	Energy Log	0 N/A	All set-ups	TRUE	0	Uint32
T-54	Reset Energy Log	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-6#						
T-60	Trend Variable	[2] Frequency [Hz]	2 set-ups	TRUE	-	Uint8
T-61	Continuous Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
T-62	Timed Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
T-63	Timed Period Start	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-64	Timed Period Stop	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
T-65	Minimum Bin Value	ExpressionLimit	2 set-ups	TRUE	0	Uint8
T-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-67	Reset Timed Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
T-8#						
T-80	Power Reference Factor	100 %	2 set-ups	TRUE	0	Uint8
T-81	Energy Cost	1 N/A	2 set-ups	TRUE	-2	Uint32
T-82	Investment	0 N/A	2 set-ups	TRUE	0	Uint32
T-83	Energy Savings	0 kWh	All set-ups	TRUE	75	Int32
T-84	Cost Savings	0 N/A	All set-ups	TRUE	0	Int32

5.1.23 CL-## PID Closed Loop

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
CL-0#						
CL-00	Feedback 1 Source	[2] Analog Input 54	All set-ups	TRUE	-	Uint8
CL-01	Feedback 1 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-02	Feedback 1 Source Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
CL-03	Feedback 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
CL-04	Feedback 2 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-05	Feedback 2 Source Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
CL-06	Feedback 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
CL-07	Feedback 3 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
CL-08	Feedback 3 Source Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
CL-1#						
CL-12	Reference/Feedback Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
CL-13	Minimum Reference/Feedb.	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-14	Maximum Reference/Feedb.	100 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-2#						

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
CL-20	Feedback Function	[3] Minimum	All set-ups	TRUE	-	Uint8
CL-21	Setpoint 1	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-22	Setpoint 2	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-23	Setpoint 3	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
CL-3#						
CL-30	Refrigerant	[0] R22	All set-ups	TRUE	-	Uint8
CL-31	User Defined Refrigerant A1	10 N/A	All set-ups	TRUE	-4	Uint32
CL-32	User Defined Refrigerant A2	-2250 N/A	All set-ups	TRUE	-2	Int32
CL-33	User Defined Refrigerant A3	250 N/A	All set-ups	TRUE	-3	Uint32
CL-34	Duct 1 Area [m2]	0.500 m2	All set-ups	TRUE	-3	Uint32
CL-35	Duct 1 Area [in2]	750 in2	All set-ups	TRUE	0	Uint32
CL-36	Duct 2 Area [m2]	0.500 m2	All set-ups	TRUE	-3	Uint32
CL-37	Duct 2 Area [in2]	750 in2	All set-ups	TRUE	0	Uint32
CL-38	Air Density Factor [%]	100 %	All set-ups	TRUE	0	Uint32
CL-7#						
CL-70	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
CL-71	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
CL-72	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
CL-73	Minimum Feedback Level	-999999 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
CL-74	Maximum Feedback Level	999999 ProcessCtrlUnit	2 set-ups	TRUE	-3	Int32
CL-79	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
CL-8#						
CL-81	PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
CL-82	PID Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
CL-83	PID Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
CL-84	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8
CL-9#						
CL-91	PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
CL-93	PID Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
CL-94	PID Integral Time	20 s	All set-ups	TRUE	-2	Uint32
CL-95	PID Differentiation Time	0 s	All set-ups	TRUE	-2	Uint16
CL-96	PID Diff. Gain Limit	5 N/A	All set-ups	TRUE	-1	Uint16

5.1.24 XC-## Ext. PID Closed Loop

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
XC-0#						
XC-00	Closed Loop Type	[0] Auto	2 set-ups	TRUE	-	Uint8
XC-01	PID Performance	[0] Normal	2 set-ups	TRUE	-	Uint8
XC-02	PID Output Change	0.10 N/A	2 set-ups	TRUE	-2	Uint16
XC-03	Minimum Feedback Level	-999999 N/A	2 set-ups	TRUE	-3	Int32
XC-04	Maximum Feedback Level	999999 N/A	2 set-ups	TRUE	-3	Int32
XC-09	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
XC-1#						
XC-10	Ext. 1 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-11	Ext. 1 Minimum Reference	0 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-12	Ext. 1 Maximum Reference	100 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-13	Ext. 1 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-14	Ext. 1 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
XC-15	Ext. 1 Setpoint	0 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-17	Ext. 1 Reference [Unit]	0 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-18	Ext. 1 Feedback [Unit]	0 ExtPID1Unit	All set-ups	TRUE	-3	Int32
XC-19	Ext. 1 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-2#						
XC-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-21	Ext. 1 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-22	Ext. 1 Integral Time	10000 s	All set-ups	TRUE	-2	Uint32
XC-23	Ext. 1 Differentation Time	0 s	All set-ups	TRUE	-2	Uint16
XC-24	Ext. 1 Dif. Gain Limit	5 N/A	All set-ups	TRUE	-1	Uint16
XC-3#						
XC-30	Ext. 2 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-31	Ext. 2 Minimum Reference	0 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-32	Ext. 2 Maximum Reference	100 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-33	Ext. 2 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-34	Ext. 2 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-35	Ext. 2 Setpoint	0 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-37	Ext. 2 Reference [Unit]	0 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-38	Ext. 2 Feedback [Unit]	0 ExtPID2Unit	All set-ups	TRUE	-3	Int32
XC-39	Ext. 2 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-4#						
XC-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-41	Ext. 2 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-42	Ext. 2 Integral Time	10000 s	All set-ups	TRUE	-2	Uint32
XC-43	Ext. 2 Differentation Time	0 s	All set-ups	TRUE	-2	Uint16
XC-44	Ext. 2 Dif. Gain Limit	5 N/A	All set-ups	TRUE	-1	Uint16
XC-5#						
XC-50	Ext. 3 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
XC-51	Ext. 3 Minimum Reference	0 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-52	Ext. 3 Maximum Reference	100 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-53	Ext. 3 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-54	Ext. 3 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
XC-55	Ext. 3 Setpoint	0 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-57	Ext. 3 Reference [Unit]	0 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-58	Ext. 3 Feedback [Unit]	0 ExtPID3Unit	All set-ups	TRUE	-3	Int32
XC-59	Ext. 3 Output [%]	0 %	All set-ups	TRUE	0	Int32
XC-6#						
XC-60	Ext. 3 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
XC-61	Ext. 3 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
XC-62	Ext. 3 Integral Time	10000 s	All set-ups	TRUE	-2	Uint32
XC-63	Ext. 3 Differentation Time	0 s	All set-ups	TRUE	-2	Uint16
XC-64	Ext. 3 Dif. Gain Limit	5 N/A	All set-ups	TRUE	-1	Uint16

5.1.25 PC-## Pump Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
PC-0#						
PC-00	Pump Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
PC-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
PC-04	Pump Cycling	[0] Disabled	All set-ups	TRUE	-	Uint8
PC-05	Fixed Lead Pump	[1] Yes	2 set-ups	FALSE	-	Uint8
PC-06	Number of Pumps	2 N/A	2 set-ups	FALSE	0	Uint8
PC-1#						
PC-10	Minimum Run Time Override	[0] Disabled	All set-ups	FALSE	-	Uint8
PC-11	Minimum Run Time Override Value	0 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
PC-2#						
PC-20	Staging Bandwidth	10 %	All set-ups	TRUE	0	Uint8
PC-21	Override Bandwidth	100 %	All set-ups	TRUE	0	Uint8
PC-22	Fixed Speed Bandwidth	casco_staging_bandwidth (PC-20)	All set-ups	TRUE	0	Uint8
PC-23	SBW Staging Delay	15 s	All set-ups	TRUE	0	Uint16
PC-24	SBW Destaging Delay	15 s	All set-ups	TRUE	0	Uint16
PC-25	OBW Time	10 s	All set-ups	TRUE	0	Uint16
PC-26	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
PC-27	Stage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
PC-29	Destage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-3#						
PC-30	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
PC-4#						
PC-40	Decel Ramp Delay	10 s	All set-ups	TRUE	-1	Uint16
PC-41	Accel Ramp Delay	2 s	All set-ups	TRUE	-1	Uint16
PC-42	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
PC-43	Destaging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
PC-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
PC-45	Staging Speed [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
PC-46	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
PC-47	Destaging Speed [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
PC-5#						
PC-50	Lead Pump Alternation	[0] Off	All set-ups	TRUE	-	Uint8
PC-51	Alternation Event	[0] External	All set-ups	TRUE	-	Uint8
PC-52	Alternation Time Interval	24 h	All set-ups	TRUE	74	Uint16
PC-53	Alternation Timer Value	0 N/A	All set-ups	TRUE	0	VisStr[7]
PC-54	Alternation Predefined Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDayWoDate
PC-55	Alternate if Load < 50%	[1] Enabled	All set-ups	TRUE	-	Uint8
PC-56	Staging Mode at Alternation	[0] Slow	All set-ups	TRUE	-	Uint8
PC-58	Run Next Pump Delay	0.1 s	All set-ups	TRUE	-1	Uint16
PC-59	Run on Line Delay	0.5 s	All set-ups	TRUE	-1	Uint16
PC-8#						
PC-80	Pump Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
PC-81	Pump Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
PC-82	Lead Pump	0 N/A	All set-ups	TRUE	0	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
PC-83	Relay Status	0 N/A	All set-ups	TRUE	0	VisStr[4]
PC-84	Pump ON Time	0 h	All set-ups	TRUE	74	Uint32
PC-85	Relay ON Time	0 h	All set-ups	TRUE	74	Uint32
PC-86	Reset Relay Counters	[0] Do not reset	All set-ups	TRUE	-	Uint8
PC-9#						
PC-90	Pump Interlock	[0] Off	All set-ups	TRUE	-	Uint8
PC-91	Manual Alternation	0 N/A	All set-ups	TRUE	0	Uint8

5.1.26 LC-## Logic Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
LC-0#						
LC-00	Logic Controller Mode	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-01	Start Event	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-02	Stop Event	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-03	Reset Logic Controller	[0] Do not reset Logic Controller	All set-ups	TRUE	-	Uint8
LC-1#						
LC-10	Comparator Operand	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-11	Comparator Operator	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-12	Comparator Value	ExpressionLimit	2 set-ups	TRUE	-3	Int32
LC-2#						
LC-20	Logic Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD
LC-4#						
LC-40	Logic Rule Boolean 1	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-41	Logic Rule Operator 1	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-42	Logic Rule Boolean 2	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-43	Logic Rule Operator 2	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-44	Logic Rule Boolean 3	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-5#						
LC-51	Logic Controller Event	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-52	Logic Controller Action	ExpressionLimit	2 set-ups	TRUE	-	Uint8
LC-9#						
LC-90	Alert Trigger	[0] False	2 set-ups	TRUE	-	Uint8
LC-91	Alert Action	[0] Info	2 set-ups	TRUE	-	Uint8
LC-92	Alert Text	ExpressionLimit	2 set-ups	TRUE	0	VisStr[20]
LC-97	Alert Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32
LC-98	Alert Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
LC-99	Alert Status Word	0 N/A	All set-ups	FALSE	0	Uint32

5.1.27 B-## Braking Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
B-0#						
B-00	DC Hold Current	50 %	All set-ups	TRUE	0	Uint8
B-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
B-02	DC Braking Time	10 s	All set-ups	TRUE	-1	Uint16
B-03	DC Brake Cut In Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
B-04	DC Brake Cut In Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
B-06	Parking Current	50 %	All set-ups	TRUE	0	Uint16
B-07	Parking Time	3 s	All set-ups	TRUE	-1	Uint16
B-1#						
B-10	Brake Function	ExpressionLimit	All set-ups	TRUE	-	Uint8
B-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	TRUE	-2	Uint32
B-12	Brake Power Limit (kW)	ExpressionLimit	All set-ups	TRUE	0	Uint32
B-13	Braking Thermal Overload	[0] Off	All set-ups	TRUE	-	Uint8
B-15	Brake Check	[0] Off	All set-ups	TRUE	-	Uint8
B-16	AC brake Max. Current	ExpressionLimit	All set-ups	TRUE	-1	Uint32
B-17	Over-voltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

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The instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE company.

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