MAKING MODERN LIVING POSSIBLE

# Programming Guide
# VLT® AutomationDrive FC 301/302




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THE REAL DRIVE

# Contents



  

  

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# 1 Introduction

## 1.1 Software Version

| Programming Guide<br>Software version: 7.XX |
|---|
| This Programming Guide can be used for all FC 300 frequency converters with software version 7.XX.<br>The software version number can be read from *parameter 15-43 Software Version*. |

**Table 1.1 Software Version**

## 1.2 Approvals

## 1.3 Definitions

### 1.3.1 Frequency Converter

**$I_{VLT,MAX}$**
Maximum output current.

**$I_{VLT,N}$**
Rated output current supplied by the frequency converter.

**$U_{VLT,MAX}$**
Maximum output voltage.

### 1.3.2 Input

**Control command**
Start and stop the connected motor by means of LCP and digital inputs.
Functions are divided into 2 groups.

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

| | |
|---|---|
| Group 1 | Reset, Coasting stop, Reset and Coasting stop, Quick-stop, DC braking, Stop and the [OFF] key. |
| Group 2 | Start, Pulse start, Reversing, Start reversing, Jog and Freeze output. |

**Table 1.2 Function Groups**

### 1.3.3 Motor

**Motor Running**
Torque generated on output shaft and speed from zero RPM to max. 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).

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

**$n_s$**
Synchronous motor speed

$$ns = \frac{2 \times par.\ 1-23 \times 60\ s}{par.\ 1-39}$$

**$n_{slip}$**
Motor slip.

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

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

**$U_M$**
Instantaneous motor voltage.

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

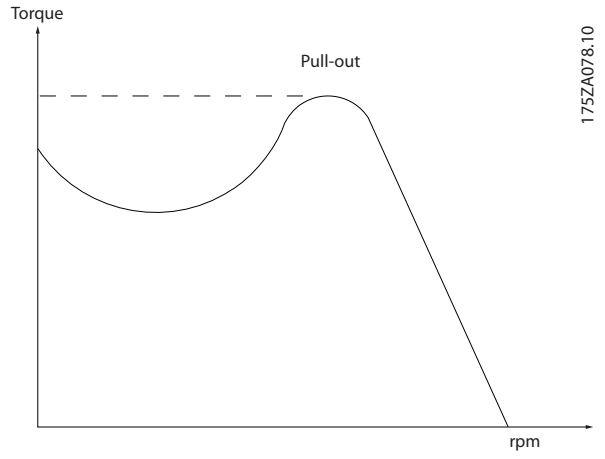


**Illustration 1.1 Break-away Torque**

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**Break-away torque**

**$\eta_{VLT}$**
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*.

## 1.3.4 References

**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 3-03 Maximum Reference*.

**$Ref_{MIN}$**
Determines the relationship between the reference input at 0% value (typically 0 V, 0 mA, 4 mA) and the resulting reference. The minimum reference value is set in *parameter 3-02 Minimum Reference*.

## 1.3.5 Miscellaneous

**Analog inputs**
The analog inputs are used for controlling various functions of the frequency converter.
There are 2 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.

**Automatic motor adaptation, AMA**
AMA algorithm determines the electrical parameters for the connected motor at standstill.

**Brake resistor**
The brake resistor is a module capable of absorbing the brake power generated in regenerative braking. This regenerative braking power increases the intermediate circuit voltage and a brake chopper ensures that the power is transmitted to the brake resistor.

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

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

**Digital outputs**
The frequency converter features 2 Solid State outputs that can supply a 24 V DC (max. 40 mA) signal.

**DSP**
Digital signal processor.

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

**Hiperface®**
Hiperface® is a registered trademark by Stegmann.

**Initialising**
If initialising is carried out (*parameter 14-22 Operation Mode*), the frequency converter returns to the default setting.

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

**LCP**
The Local Control Panel makes up a complete interface for control and programming of the frequency converter. The control panel 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.

**NLCP**
Numerical Local Control Pandel interface for control and programming of the frequency converter. The display is numerical and the panel is used to display process values. The NLCP has no storage and copy functions.

**lsb**
Least significant bit.

**msb**
Most significant bit.

**MCM**
Short for mille circular mil, an American measuring unit for cable cross-section. 1 MCM = 0.5067 $mm^2$.

  

**Online/Offline Parameters**
Changes to online 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 (LCP) 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 4 Set-ups. Change between the 4 parameter Set-ups and edit one Set-up, while another Set-up is active.

**SFAVM**
Switching pattern called stator flux oriented asynchronous vector modulation (*parameter 14-00 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.

**SLC**
The SLC (Smart Logic Control) is a sequence of user-defined actions executed when the associated user-defined events are evaluated as true by the SLC. (Parameter group *13-** Smart Logic Control (SLC)*.

**STW**
Status word.

**FC standard bus**
Includes RS-485 bus with FC protocol or MC protocol. See *8-30 Protocol*.

**THD**
Total harmonic distortion states the total contribution of harmonic.

**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 overtemperature 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 disconnecting 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. The trip locked state must not be used for personal safety.

**VT characteristics**
Variable torque characteristics used for pumps and fans.

**VVC+**
If compared with standard voltage/frequency ratio control, voltage vector control (VVC+) improves the dynamics and the stability, both when the speed reference is changed and in relation to the load torque.

**60° AVM**
Switching pattern called 60° Asynchronous vector modulation (*parameter 14-00 Switching Pattern*).

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

$$Power\ factor = \frac{\sqrt{3} \times U \times I1 \times \cos\varphi}{\sqrt{3} \times U \times IRMS}$$

The power factor for 3-phase control:

$$= \frac{I1 \times \cos\varphi 1}{IRMS} = \frac{I1}{IRMS} \ since\ \cos\varphi 1 = 1$$

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.

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

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 minimises the imposed load on the mains supply.

  

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## 1.4 Safety

**⚠WARNING**

**The voltage of the frequency converter is dangerous whenever connected to mains. Incorrect installation of the motor, frequency converter or fieldbus may cause death, serious personal injury or damage to the equipment. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.**

**Safety Regulations**

1. 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.
2. [Off] does not disconnect the mains supply and consequently, it must not be used as a safety switch.
3. Ground the equipment properly, protect the user against supply voltage and protect the motor against overload in accordance with applicable national and local regulations.
4. The earth leakage current exceeds 3.5 mA. Ensure the correct grounding of the equipment by a certified electrical installer.
5. 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.
6. 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.

**Warning against unintended start**

1. The motor can be stopped with digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. These stop functions are not sufficient to prevent unintended motor start and thus prevent personal injury caused by, e.g., contact with moving parts. To consider personal safety, disconnect the mains supply or activate the Safe Torque Off function.
2. The motor may start while setting the parameters. Prevent the motor from starting, for instance, by use of the Safe Torque Off function or secure 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 frequency converter, 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 frequency converter are not sufficient. In such cases, disconnect mains supply or activate Safe Torque Off.

***NOTICE***

**When using the Safe Torque Off, always follow the instructions in *Safe Torque Off Operating Instructions for Danfoss VLT® Frequency Converters*.**

4. Control signals from, or internally within, the frequency converter 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 must be identified by the machine builder/integrator who is responsible for taking necessary preventive means into consideration. Additional monitoring and protective devices may be included, always according to valid national safety regulations, e.g. law on mechanical tools, regulations for the prevention of accidents.**

**Crane, lifts and hoists**
The controlling of external brakes must always have a redundant system. The frequency converter can in no circumstances be the primary safety circuit. Comply with relevant standards, e.g.
Hoists and cranes: IEC 60204-32
Lifts: EN 81

**Protection mode**
Once a hardware limit on motor current or DC link voltage is exceeded, the frequency converter enters the protection mode. Protection mode means a change of the PWM modulation strategy and a low switching frequency to minimise losses. This continues for 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.
In hoist applications, protection mode is not usable because the frequency converter is usually unable to leave this mode again and therefore it extends the time before activating the brake, which is not recommended.
Protection mode can be disabled by setting *parameter 14-26 Trip Delay at Inverter Fault* to zero, which means that the frequency converter trips immediately if one of the hardware limits is exceeded.

***NOTICE***

**Disabling Protection mode in hoisting applications (*parameter 14-26 Trip Delay at Inverter Fault*=0) is recommended.**

  

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## 1.5 Electrical Wiring

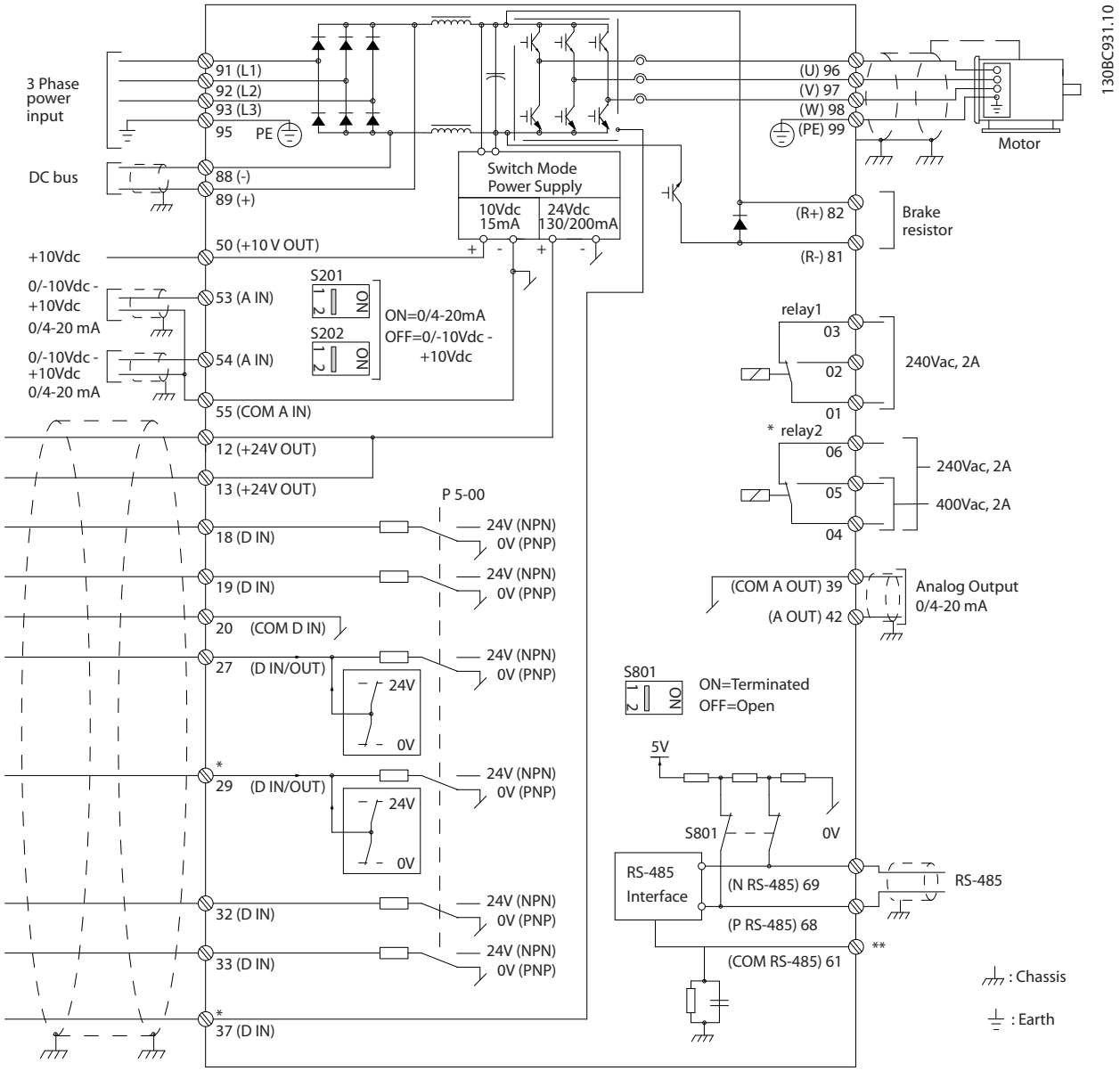



**Illustration 1.2 Basic Wiring Schematic Drawing**

A=Analog, D=Digital

Terminal 37 is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the *Operating Instructions*.

* Terminal 37 is not included in FC 301 (except enclosure type A1). Relay 2 and terminal 29 have no function in FC 301.

** Do not connect cable screen.

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

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

**Input polarity of control terminals**

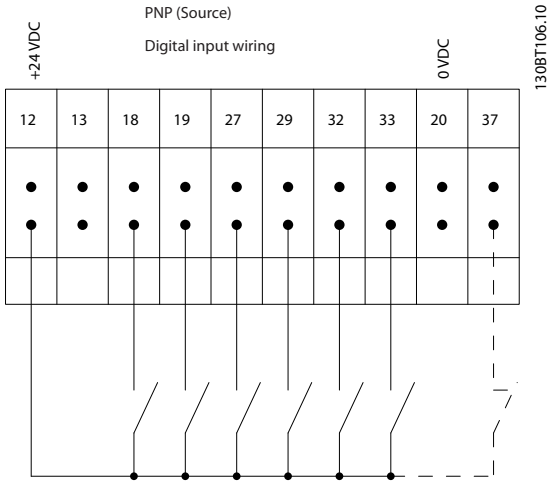



**Illustration 1.3 PNP (Source)**

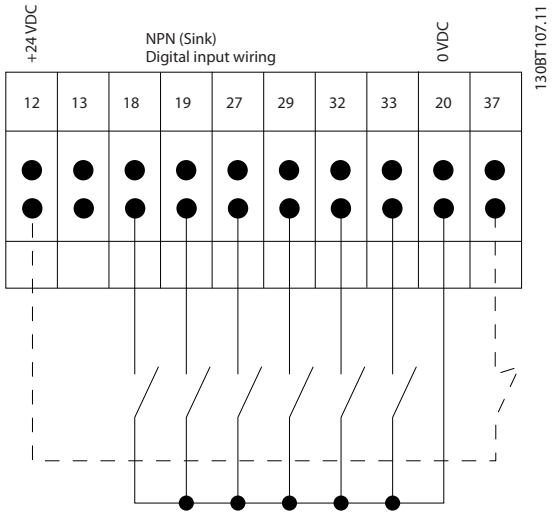



**Illustration 1.4 NPN (Sink)**

***NOTICE***

**Control cables must be screened/armoured.**

See section *Grounding of Screened Control Cables* in the *Design Guide* for the correct termination of control cables.

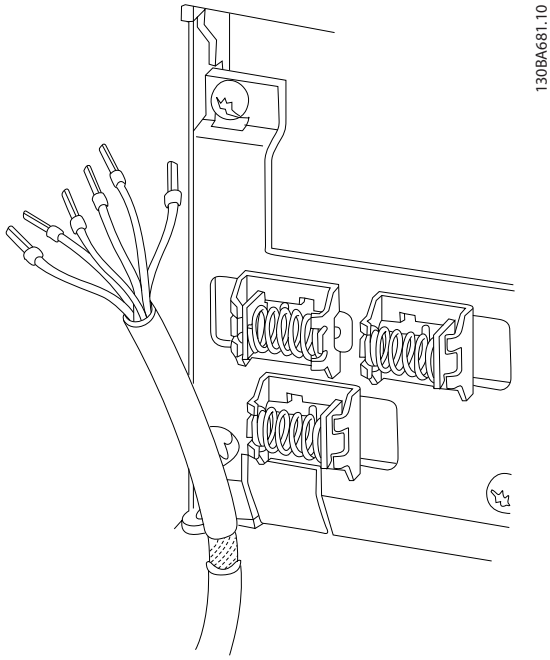



**Illustration 1.5 Grounding of Screened/Armoured Control Cables**

## 1.5.1 Start/Stop

Terminal 18=*5-10 Terminal 18 Digital Input [8] Start*
Terminal 27=*5-12 Terminal 27 Digital Input [0] No operation*
(Default *coast inverse*)
Terminal 37=Safe Torque Off (where available)

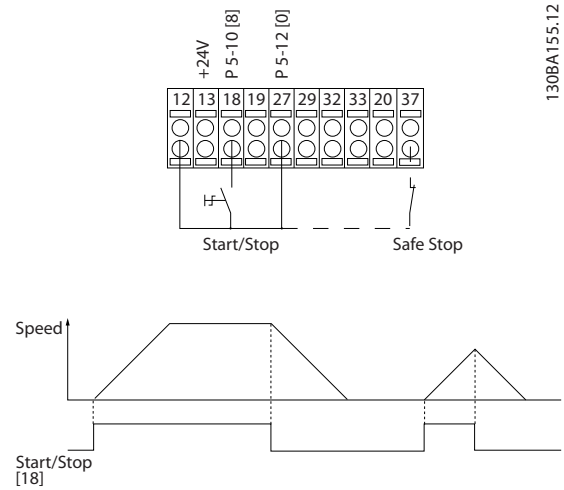
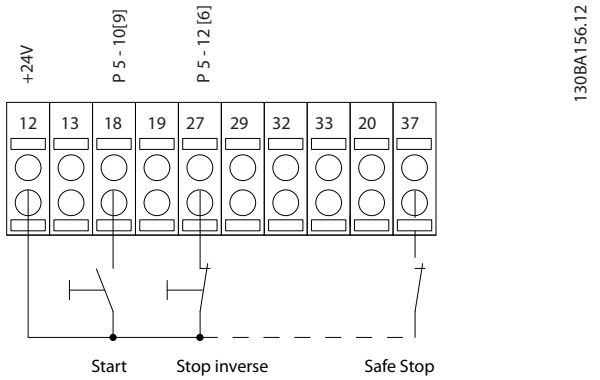



**Illustration 1.6 Start/Stop**

## 1.5.2 Pulse Start/Stop

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

Terminal 27=*5-12 Terminal 27 Digital Input*, *[6] Stop inverse*.
Terminal 37=Safe Torque Off (where available).



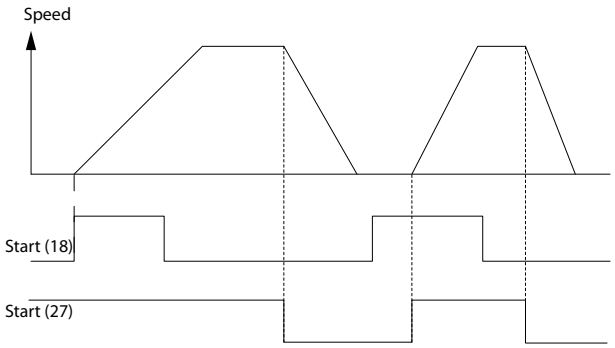




**Illustration 1.7 Pulse Start/Stop**

## 1.5.3 Speed Up/Down

**Terminals 29/32 = Speed up/down**

Terminal 18=*5-10 Terminal 18 Digital Input [9] Start* (default)

Terminal 27=*5-12 Terminal 27 Digital Input [19] Freeze reference*

Terminal 29=*5-13 Terminal 29 Digital Input [21] Speed up*

Terminal 32=*5-14 Terminal 32 Digital Input [22] Speed down*

***NOTICE***

**Terminal 29 only in FC x02 (x=series type).**

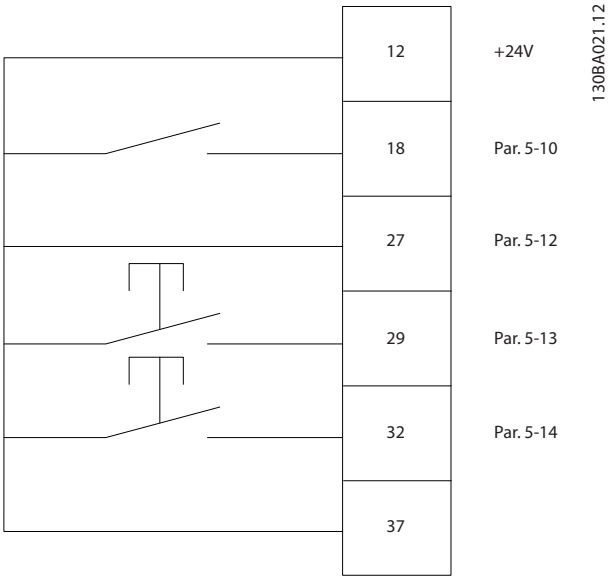



**Illustration 1.8 Speed Up/Down**

## 1.5.4 Potentiometer Reference

**Voltage reference via a potentiometer**

Reference Source 1 = *[1] Analog input 53* (default)

Terminal 53, Low Voltage = 0 V

Terminal 53, High Voltage = 10 V

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)

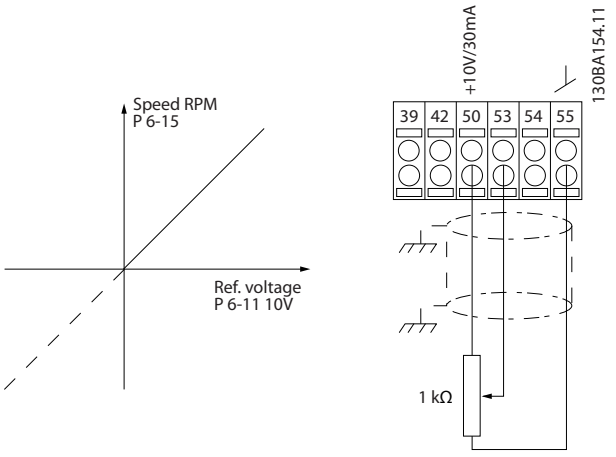



**Illustration 1.9 Potentiometer Reference**

# 2 How to Program



## 2.1 The Graphical and Numerical Local Control Panels

Easy programming of the frequency converter is performed by the graphical LCP (LCP 102). Consult the frequency converter *Design Guide*, when using the Numeric Local Control Panel (LCP 101).

**The LCP is divided into 4 functional groups:**

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

The LCP display can show up to 5 items of operating data while displaying *Status*.

**Display lines:**

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

b. **Line 1-2:** Operator data lines displaying data defined or selected by the user. By pressing [Status], up to 1 extra line can be added.

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

***NOTICE***

**If start-up is delayed, the LCP displays the INITIALISING message until it is ready. Adding or removing options may delay the start-up.**

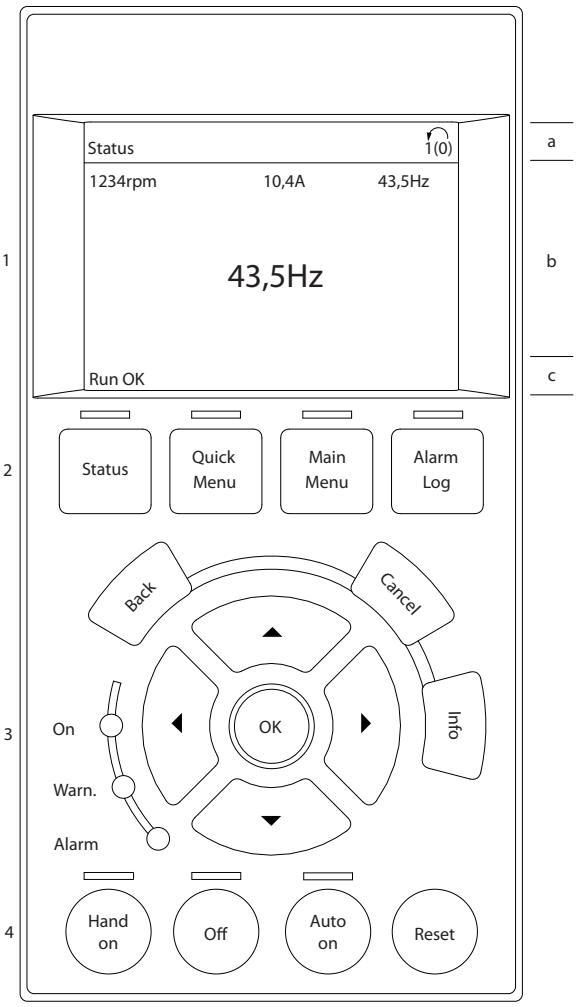



**Illustration 2.1 LCP**

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## 2.1.1 The LCD Display

The LCD display has backlight and a total of 6 alpha-numeric lines. The display lines show the direction of rotation (arrow), the selected set-up as well as the programming set-up. The display is divided into 3 sections.

**Top section**
The top section shows up to 2 measurements in normal operating status.

**Middle section**
The top line shows up to 5 measurements with related unit, regardless of status (except in the case of alarm/ warning).

**Bottom section**
The bottom section always shows the state of the frequency converter in Status mode.

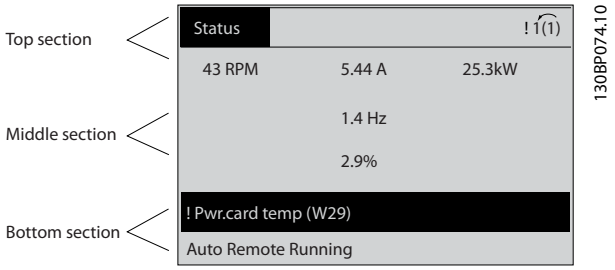


**Illustration 2.2 LCD Display**

The active set-up (selected as the active set-up in *parameter 0-10 Active Set-up*) is shown. When programming another set-up than the active set-up, the number of the programmed set-up appears to the right.

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

Most parameter set-ups can be changed immediately via the LCP, unless a password has been created via *parameter 0-60 Main Menu Password* or via *parameter 0-65 Quick Menu Password*.

**Indicator lights (LEDs)**
If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the LCP.
The ON LED is activated when the frequency converter receives mains voltage or via a DC bus terminal or 24 V external supply. At the same time, the back light is on.

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

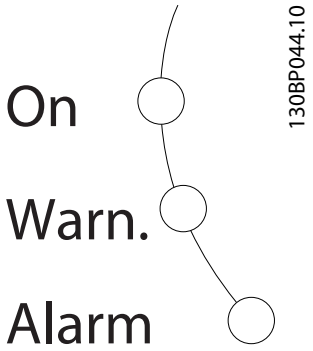


**Illustration 2.3 Indicator Lights (LEDs)**

**LCP keys**
The control keys are divided into functions. The keys below the display and indicator lamps are used for parameter set-up, including choice of display indication during normal operation.


**Illustration 2.4 LCP Keys**

**[Status]**
indicates the status of the frequency converter and/or the motor. Select between 3 different readouts by pressing [Status]: 5 line readouts, 4 line readouts or Smart Logic Control.
Press [Status] for selecting the mode of display or for changing back to Display mode from either the Quick Menu mode, the Main Menu mode or Alarm mode. Also use [Status] to toggle single or double readout mode.

**[Quick Menu]**
allows quick access to different Quick Menus such as:

- My Personal Menu
- Quick Set-up
- Changes Made
- Loggings

Press [Quick Menu] to program the parameters belonging to the Quick Menu. It is possible to switch directly between Quick Menu mode and Main Menu mode.

**[Main Menu]**
is used for programming all parameters.
It is possible to switch directly between Main Menu mode and Quick Menu mode.
Parameter shortcut can be carried out by pressing down [Main Menu] for 3 seconds. The parameter shortcut allows direct access to any parameter.

**[Alarm Log]**
displays an Alarm list of the 5 latest alarms (numbered A1-A5). To obtain additional details about an alarm, use 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.

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

**[Cancel]**
Last change or command is cancelled as long as the display has not been changed.

**[Info]**
supplies information about a command, parameter, or function in any display window. [Info] provides detailed information whenever help is needed.
Exit Info mode by pressing either [Info], [Back], or [Cancel].


**Illustration 2.5 Back**


**Illustration 2.6 Cancel**


**Illustration 2.7 Info**

**Navigation keys**
The 4 navigation keys are used to navigate between the different choices available in [Quick Menu], [Main Menu] and [Alarm Log]. Use the keys to move the cursor.

**[OK]**
is used for selecting a parameter marked by the cursor and for enabling the change of a parameter.

**Local control keys**
for local control are found at the bottom of the LCP.

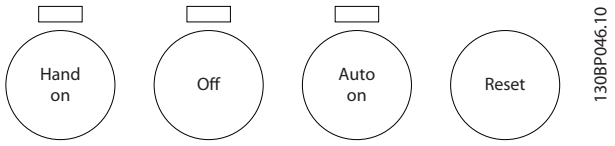


**Illustration 2.8 Local Control Keys**

**[Hand On]**
enables control of the frequency converter via the LCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data with the arrow keys. The key can be selected as *[1] Enable* or *[0] Disable* via *0-40 [Hand on] Key on LCP*

External stop signals activated with control signals or a serial bus override a start command via the LCP.
The following control signals are still active when [Hand On] is activated.

- [Hand on] - [Off] - [Auto On]
- Reset
- Coasting stop inverse
- Reversing
- Set-up select bit 0 - Set-up select bit 1
- Stop command from serial communication
- Quick stop
- DC brake

**[Off]**
stops the connected motor. The key can be selected as *[1] Enable* or *[0] Disable* via *parameter 0-41 [Off] Key on LCP*. If no external stop function is selected and the [Off] key is inactive, the motor can be stopped by disconnecting the voltage.

**[Auto On]**
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] Enable* or *[0] Disable* via *parameter 0-42 [Auto on] Key on LCP*.

***NOTICE***

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

**[Reset]**
is used for resetting the frequency converter after an alarm (trip). It can be selected as *[1] Enable* or *[0] Disable* via *parameter 0-43 [Reset] Key on LCP*.

The parameter shortcut can be carried out by holding down the [Main Menu] key for 3 seconds. The parameter shortcut provides 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 LCP or on a PC via MCT 10 Set-up Software Tool.

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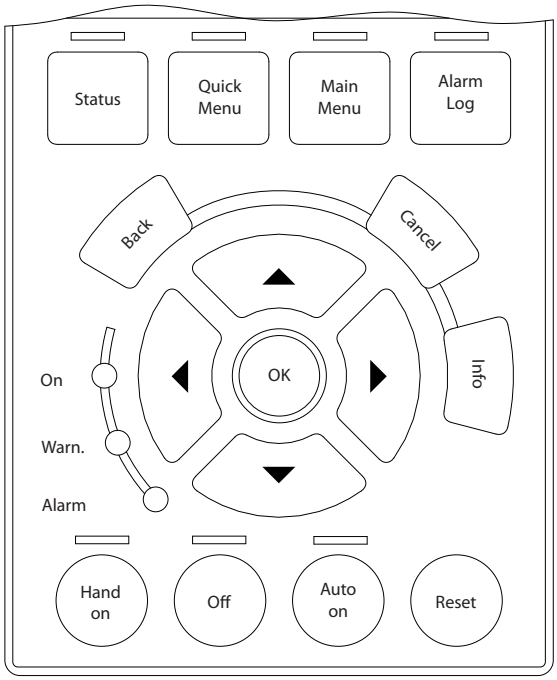



**Illustration 2.9 LCP**

**Data storage in LCP**

***NOTICE***

**Stop the motor before performing this operation.**

To store the data in the LCP:

1. Go to *0-50 LCP Copy* .
2. Press the [OK] key.
3. Select *[1] All to LCP*.
4. Press the [OK] key.

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

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

**Data transfer from LCP to frequency converter**

***NOTICE***

**Stop the motor before performing this operation.**

To store the data in the LCP:

1. Go to *0-50 LCP Copy*.
2. Press the [OK] key.
3. Select *[2] All from LCP*.
4. Press the [OK] key.

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

## 2.1.3 Display Mode

In normal operation, up to 5 different operating variables can be indicated continuously in the middle section: 1.1, 1.2, and 1.3 as well as 2 and 3.

## 2.1.4 Display Mode - Selection of Read-Outs

It is possible to toggle between 3 status read-out screens by pressing [Status].
Operating variables with different formatting are shown in each status screen further in this section.

*Table 2.1* shows the measurements that can be linked to each of the operating variables. When options are mounted, additional measurements are available. Define the links via *parameter 0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large*, and *0-24 Display Line 3 Large*.

Each readout parameter selected in *parameter 0-20 Display Line 1.1 Small* to *0-24 Display Line 3 Large* has its own scale and digits after a possible decimal point. The larger the numeric value of a parameter is, the fewer digits are displayed after the decimal point.
Ex.: Current readout 5.25 A; 15.2 A 105 A.

| Operating variable | Unit |
|---|---|
| *Parameter 16-00* Control Word | hex |
| *Parameter 16-01* Reference [Unit] | [unit] |
| *Parameter 16-02* Reference [%] | % |
| *Parameter 16-03* Status Word | hex |
| *Parameter 16-05* Main Actual Value [%] | % |
| *Parameter 16-10* Power [kW] | [kW] |
| *Parameter 16-11* Power [hp] | [hp] |
| *Parameter 16-12* Motor Voltage | [V] |
| *Parameter 16-13* Frequency | [Hz] |
| *Parameter 16-14* Motor current | [A] |
| *Parameter 16-16* Torque [Nm] | Nm |
| *Parameter 16-17* Speed [RPM] | [RPM] |
| *Parameter 16-18* Motor Thermal | % |
| *Parameter 16-20* Motor Angle | |
| *Parameter 16-30* DC Link Voltage | V |
| *Parameter 16-32* Brake Energy /s | kW |
| *Parameter 16-33* Brake Energy /2 min | kW |
| *Parameter 16-34* Heatsink Temp. | C |
| *Parameter 16-35* Inverter Thermal | % |
| *Parameter 16-36* Inv. Nom. Current | A |
| *Parameter 16-37* Inv. Max. Current | A |
| *Parameter 16-38* SL Controller State | |
| *parameter 16-39* Control Card Temp. | C |
| *Parameter 16-40* Logging Buffer Full | |
| *Parameter 16-50* External Reference | |

| Operating variable | Unit |
|---|---|
| *Parameter 16-51* Pulse Reference | |
| *Parameter 16-52* Feedback[Unit] | [Unit] |
| *Parameter 16-53* Digi Pot Reference | |
| *Parameter 16-60* Digital Input | bin |
| *Parameter 16-61* Terminal 53 Switch Setting | V |
| *Parameter 16-62* Analog Input 53 | |
| *Parameter 16-63* Terminal 54 Switch Setting | **V** |
| *Parameter 16-64* Analog Input 54 | |
| *parameter 16-65* Analog Output 42 [mA] | **[mA]** |
| *Parameter 16-66* Digital Output [bin] | **[bin]** |
| *Parameter 16-67* Pulse Input #29 [Hz] | **[Hz]** |
| *Parameter 16-68* Freq. Input #33 [Hz] | **[Hz]** |
| *Parameter 16-69* Pulse Output #27 [Hz] | **[Hz]** |
| *Parameter 16-70* Pulse Output #29 [Hz] | **[Hz]** |
| *Parameter 16-71* Relay Output [bin] | |
| *Parameter 16-72* Counter A | |
| *Parameter 16-73* Counter B | |
| *16-80 Fieldbus CTW 1* | **hex** |
| *16-82 Fieldbus REF 1* | **hex** |
| *16-84 Comm. Option STW* | **hex** |
| *16-85 FC Port CTW 1* | **hex** |
| *16-86 FC Port REF 1* | **hex** |
| *16-90 Alarm Word* | |
| *16-92 Warning Word* | |
| *Parameter 16-94* Ext. Status Word | |

**Table 2.1 Measurements**

**Status screen I**
This readout state is standard after start-up or initialisation. Press [Info] to obtain information about the measurement links to the displayed operating variables (1.1, 1.2, 1.3, 2 and 3).
See the operating variables shown in *Illustration 2.10*.

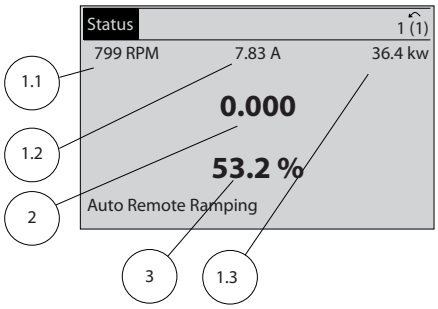



**Illustration 2.10 Status Screen I**

**Status screen II**
See the operating variables (1.1, 1.2, 1.3 and 2) shown in *Illustration 2.11*.
In the example, speed, motor current, motor power, and frequency are selected as variables in the first and second lines.

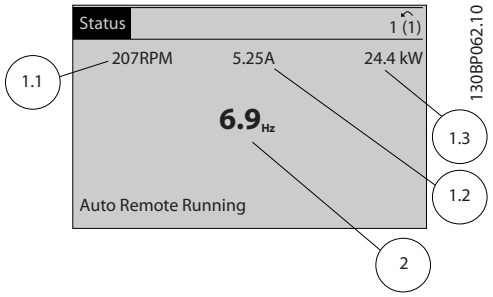



**Illustration 2.11 Status Screen II**

**Status screen III**
This state displays the event and action of the Smart Logic Control. For further information, see *chapter 3.14 Parameters: 13-** Smart Logic Control*.

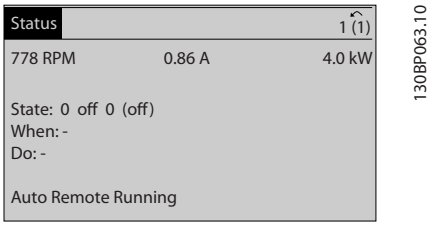



**Illustration 2.12 Status Screen III**

## 2.1.5 Parameter Set-up

The frequency converter can be used for practically all assignments. The frequency converter offers a choice between 2 programming modes - a Main Menu and a Quick Menu mode.
The former provides access to all parameters. The latter takes the user through a few parameters, making it possible to start operating the frequency converter.
Change a parameter in either Main Menu mode or Quick Menu mode.

## 2.1.6 Quick Menu Key Functions

Press [Quick Menus] to enter a list of different areas contained in the Quick menu.
Select *My Personal Menu* to display the selected personal parameters. These parameters are selected in *parameter 0-25 My Personal Menu*. Up to 50 different parameters can be added in this menu.

2

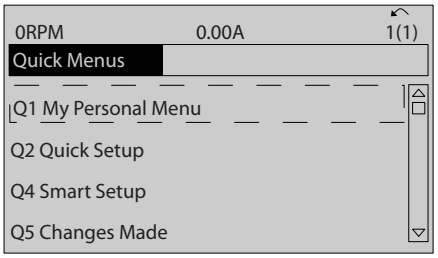



**Illustration 2.13 Quick Menus**

Select *Q2 Quick Setup* to go through a selection of parameters to get the motor running almost optimally. The default setting for the other parameters considers the desired control functions and the configuration of signal inputs/outputs (control terminals).

The parameter selection is effected with the navigation keys. The parameters in *Table 2.2* are accessible.

| Parameter | Setting |
|---|---|
| *Parameter 0-01* Language | |
| *Parameter 1-20* Motor Power [kW] | [kW] |
| *Parameter 1-22* Motor Voltage | [V] |
| *Parameter 1-23* Motor Frequency | [Hz] |
| *Parameter 1-24* Motor Current | [A] |
| *Parameter 1-25* Motor Nominal Speed | [RPM] |
| *5-12 Terminal 27 Digital Input* | [0] No function* |
| *Parameter 1-29* Automatic Motor Adaptation (AMA) | [1] Enable complete AMA |
| *Parameter 3-02* Minimum Reference | [RPM] |
| *Parameter 3-03* Maximum Reference | [RPM] |
| *Parameter 3-41* Ramp 1 Ramp Up Time | [s] |
| *Parameter 3-42* Ramp 1 Ramp Down Time | [s] |
| *3-13 Reference Site* | |

**Table 2.2 Selection of Parameter**

** If terminal 27 is set to [0] No function, no connection to +24 V on terminal 27 is necessary.*

Select *Changes made* to get information about:

- the last 10 changes. Use the [▲] [▼] navigation keys to scroll between the last 10 changed parameters.
- the changes made since default setting.

Select *Loggings* to get information about the display line readouts. The information is shown as graphs.
Only display parameters selected in *parameter 0-20 Display Line 1.1 Small* and *0-24 Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

## 2.1.7 Initial Commissioning

The easiest way of carrying out the initial commissioning is by pressing [Quick Menu] and following the quick set-up procedure using LCP 102 (read *Table 2.3* from left to right). The example applies to open loop applications.

| **Press** | | | | |
|---|---|---|---|---|
| Quick Menu | ↓ | Q2 Quick Menu | OK | ↓ |
| *Parameter 0-01* Language | OK | Set language | ↓ | |
| *Parameter 1-20* Motor Power [kW] | OK | Set motor nameplate power | ↓ | |
| *Parameter 1-22* Motor Voltage | OK | Set nameplate voltage | ↓ | |
| *Parameter 1-23* Motor Frequency | OK | Set nameplate frequency | ↓ | |
| *Parameter 1-24* Motor Current | OK | Set nameplate current | ↓ | |
| *Parameter 1-25* Motor Nominal Speed | OK | Set nameplate speed in RPM | ↓ | |
| *5-12 Terminal 27 Digital Input* | OK | If terminal default is *Coast inverse*, it is possible to change this setting to *No function*. No connection to terminal 27 is then needed for running AMA. | ↓ | |
| *Parameter 1-29* Automatic Motor Adaptation (AMA) | OK | Set desired AMA function. Enable complete AMA is recommended. | ↓ | |
| *Parameter 3-02* Minimum Reference | OK | Set the minimum speed of the motor shaft. | ↓ | |
| *Parameter 3-03* Maximum Reference | OK | Set the maximum speed of the motor shaft. | ↓ | |
| *Parameter 3-41* Ramp 1 Ramp Up Time | OK | Set the ramping up time with reference to synchronous motor speed, $n_s$. | ↓ ↓ | |
| *Parameter 3-42* Ramp 1 Ramp Down Time | OK | Set the ramping down time with reference to synchronous motor speed, $n_s$. | ↓ | |
| *3-13 Reference Site* | OK | Set the site from where the reference must work. | ↓ | |

**Table 2.3 Quick Set-up Procedure**

2

Another easy way of commissioning the frequency converter is by using the Smart Application Setup (SAS), which can also be found by pressing [Quick Menu]. Follow the instructions on the successive screens to set up the applications listed.

The [Info] key can be used throughout the SAS to see help information for various selections, settings and messages. The following 3 applications are included:

- Mechanical Brake
- Conveyor
- Pump/Fan

The following 4 field-busses can be selected:

- Profibus
- Profinet
- DeviceNet
- EthernetIP

***NOTICE***

**The frequency converter ignores the start conditions when SAS is active.**

***NOTICE***

**The *Smart Set-up* runs automatically on the first power-up of the frequency converter or after a reset to factory settings. If no action is taken, the SAS screen automatically disappears after 10 minutes.**

## 2.1.8 Main Menu Mode

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

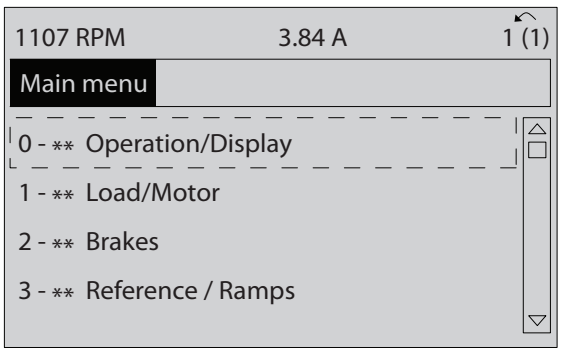



**Illustration 2.14 Main Menu Mode**

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 choice of configuration (*parameter 1-00 Configuration Mode*), some parameters can be "missing". For example, open loop hides all the PID parameters, and other enabled options make more parameter groups visible.

## 2.1.9 Parameter Selection

In the Main Menu mode, the parameters are divided into groups. Select a parameter group with the navigation keys. The following parameter groups are accessible:

| Group number | Parameter group |
|---|---|
| 0-** | Operation/Display |
| 1-** | Load/Motor |
| 2-** | Brakes |
| 3-** | References/Ramps |
| 4-** | Limits/Warnings |
| 5-** | Digital In/Out |
| 6-** | Analog In/Out |
| 7-** | Controls |
| 8-** | Comm. and Options |
| 9-** | Profibus |
| 10-** | CAN Fieldbus |
| 11-** | Reserved Com. 1 |
| 12-** | Ethernet |
| 13-** | Smart Logic |
| 14-** | Special Functions |
| 15-** | Drive Information |
| 16-** | Data Readouts |
| 17-** | Motor Feedb. Option |
| 18-** | Data Readouts 2 |
| 20-** | FC Closed Loop |
| 21-** | Extended Closed Loop |
| 22-** | Application Functions |
| 23-** | Time-based Functions |
| 24-** | Application Functions 2 |
| 25-** | Cascade Controller |
| 26-** | Analog I/O Option MCB 109 |
| 29-** | Water Application Functions |
| 30-** | Special Features |
| 32-** | MCO Basic Settings |
| 33-** | MCO Adv. Settings |
| 34-** | MCO Data Readouts |
| 35-** | Sensor Input Option |

**Table 2.4 Accessible Parameter Goups**

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

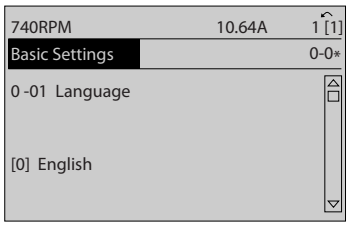



**Illustration 2.15 Parameter Selection**

## 2.1.10 Changing Data

The procedure for changing data is the same in the Quick Menu and the Main Menu mode. Press [OK] to change the selected parameter.
The procedure for changing data depends on whether the selected parameter represents a numeric data value or a text value.

## 2.1.11 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 to save and press [OK].

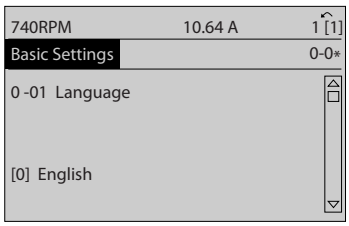



**Illustration 2.16 Changing a Text Value**

## 2.1.12 Changing a Data Value

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

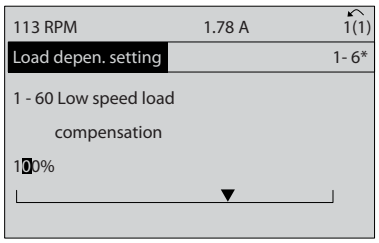



**Illustration 2.17 Changing a Data Value**

Press [▲] [▼] 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].

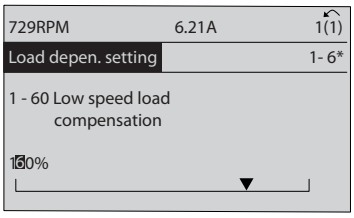



**Illustration 2.18 Saving a Data Value**

## 2.1.13 Infinitely Variable Change of Numeric Data Value

If the selected parameter represents a numeric data value, select a digit with [◄] [►].

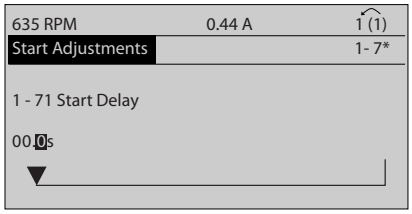



**Illustration 2.19 Selecting a Digit**

Change the selected digit infinitely variably with [▲] [▼]. The selected digit is indicated by the cursor. Place the cursor on the digit to save and press [OK].

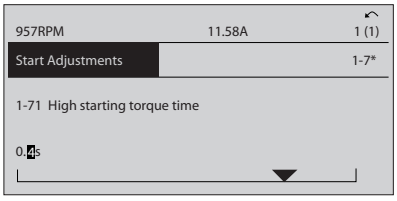



**Illustration 2.20 Saving**

2

## 2.1.14 Value, Step-by-Step

Certain parameters can be changed step by step. This applies to *1-20 Motor Power [kW]*, *1-22 Motor Voltage* and *1-23 Motor Frequency*.
The parameters are changed both as a group of numeric data values and as numeric data values that are infinitely varying.

## 2.1.15 Readout and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack.
*Parameter 15-30 Fault Log: Error Code* to *parameter 15-32 Alarm Log: Time* contain a fault log, which can be read out. Select a parameter, press [OK], and press the keys [▲] [▼] to scroll through the value log.

For example, this is how *parameter 3-10 Preset Reference* is changed:
Select the parameter, press [OK], and press [▲] [▼] to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by pressing [▲] [▼]. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.

The following instructions are valid for the Numerical LCP (LCP 101).
The control panel is divided into 4 functional groups:

1. Numerical display.
2. Menu keys and indicator lights - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

**Display line: Status messages displaying icons and numeric value**
**Indicator lights (LEDs)**

- Green LED/On: Indicates if control section is on.
- Yellow LED/Wrn.: Indicates a warning.
- Flashing red LED/Alarm: Indicates an alarm.

**LCP keys**
**[Menu]**

Select one of the following modes:

- Status
- Quick Set-up
- Main Menu

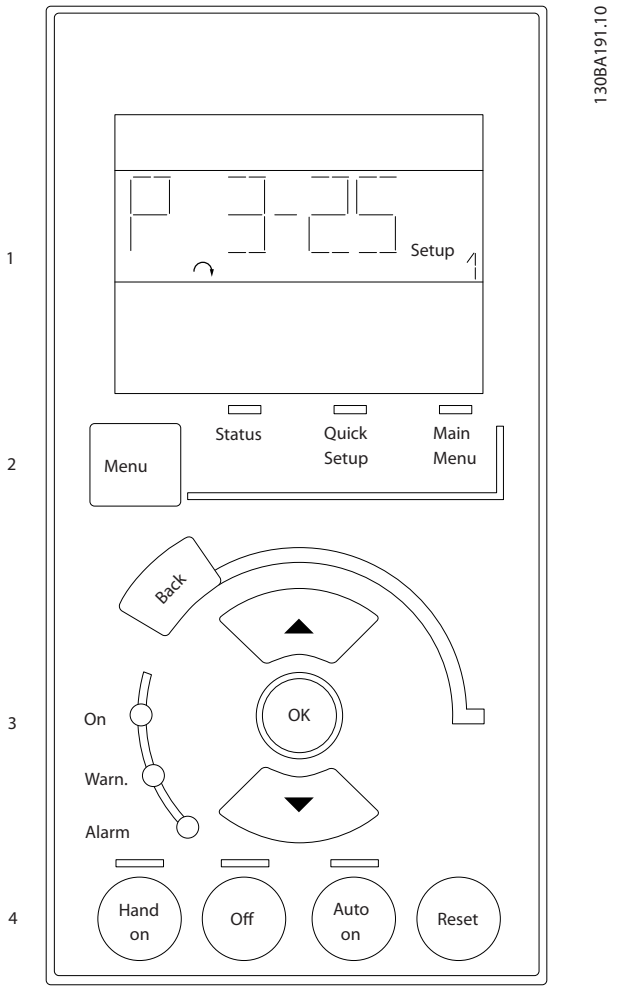



**Illustration 2.21 LCP Keys**

**Status mode**
Status mode displays the status of the frequency converter or the motor.
If an alarm occurs, the NLCP automatically switches to Status mode.
A number of alarms can be displayed.

***NOTICE***

**Parameter copy is not possible with LCP 101 numerical local control panel.**

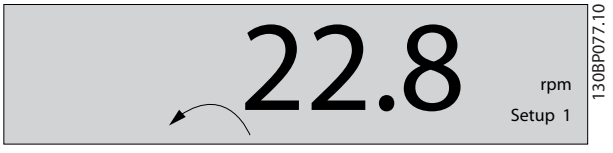



**Illustration 2.22 Status Mode**


**Illustration 2.23 Alarm**

**Main Menu/Quick Set-up**
is used for programming all parameters or only the parameters in the Quick Menu (see also description of the LCP 102 in *chapter 2.1 The Graphical and Numerical Local Control Panels*).
When the value flashes, press [▲] or [▼] to change parameter values.
Press [Menu] to select Main Menu.
Select the parameter group [xx-__] and press [OK].
Select the parameter [__-xx] and press [OK].
If the parameter is an array parameter, select the array number and press [OK].
Select the wanted data value and press [OK].
Parameters with functional options display values such as [1], [2], etc. For a description of the different options, see the individual description of the parameters in *chapter 3 Parameter Descriptions*.

**[Back]**
for stepping backwards.
**[▲] [▼]** are used for manoeuvring between commands and within parameters.

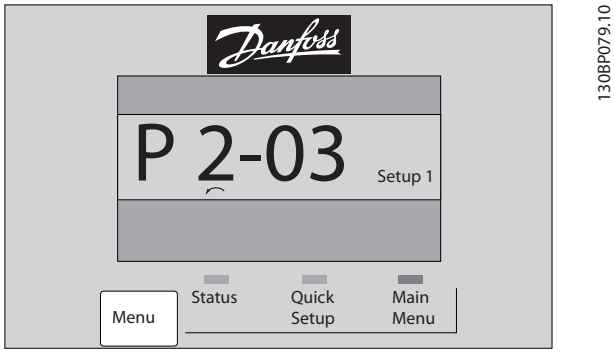



**Illustration 2.24 Main Menu/Quick Setup**

## 2.1.16 LCP Keys

Keys for local control are found at the bottom of the LCP.

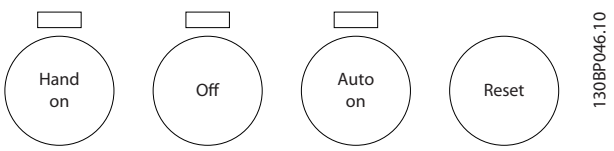



**Illustration 2.25 LCP Keys**

**[Hand On]**
enables control of the frequency converter via the LCP. [Hand On] also starts the motor and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as *[1] Enable* or *[0] Disable* via *0-40 [Hand on] Key on LCP*.
External stop signals activated with control signals or a serial bus overrides a start command via the LCP.
The following control signals are still active when [Hand On] is activated:

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

**[Off]**
stops the connected motor. The key can be selected as *[1] Enable* or *[0] Disable* via *parameter 0-41 [Off] Key on LCP*.
If no external stop function is selected and the [Off] key is inactive, the motor can be stopped by disconnecting the voltage.

**[Auto On]**
enables control of the frequency converter 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] Enable* or *[0] Disable* via *parameter 0-42 [Auto on] Key on LCP*.

***NOTICE***

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

**[Reset]**
is used for resetting the frequency converter after an alarm (trip). It can be selected as *[1] Enable* or *[0] Disable* via *parameter 0-43 [Reset] Key on LCP*.

## 2.1.17 Initialisation to Default Settings

Initialise the frequency converter to default settings in 2 ways.

**Recommended initialisation (via *Parameter parameter 14-22 Operation Mode*)**

1. Select *14-22 Operation Mode*.
2. Press [OK].

2

3. Select *[2] Initialisation*.
4. Press [OK].
5. Disconnect the mains supply and wait until the display turns off.
6. Reconnect the mains supply. The frequency converter is now reset.

14-22 Operation Mode initialises all except:

- *Parameter 14-50* RFI Filter
- *8-30 Protocol*
- *Parameter 8-31* Address
- *Parameter 8-32* FC Port Baud Rate
- *Parameter 8-35* Minimum Response Delay
- *Parameter 8-36* Max Response Delay
- *Parameter 8-37* Max Inter-Char Delay
- *Parameter 15-00* Operating hours *to Parameter parameter 15-05 Over Volt's*
- *Parameter 15-20* Historic Log: Event *to parameter 15-22* Historic Log: Time
- *Parameter 15-30* Fault Log: Error Code *to parameter 15-32* Alarm Log: Time

**Manual initialisation**

1. Disconnect from mains and wait until the display turns off.
2. 2a Press [Status] - [Main Menu] - [OK] at the same time while power-up for LCP 102, Graphical Display.

   2b Press [Menu] - [OK] while power-up for LCP 101, Numerical Display.
3. Release the keys after 5 s.
4. The frequency converter is now programmed according to default settings.

This procedure initialises all except:

- *Parameter 15-00 Operating hours*
- *Parameter 15-03 Power Up's*
- *Parameter 15-04 Over Temp's*
- *Parameter 15-05 Over Volt's*

***NOTICE***

**A manual initialisation also resets serial communication, RFI filter settings (*parameter 14-50 RFI Filter*), and fault log settings.**

# 3 Parameter Descriptions

## 3.1 Parameter Selection

Parameters are organised in various parameter groups for easy selection of correct parameters, for optimised operation of the frequency converter.

0-** Operation and Display parameters include:

- Basic Settings, set-up handling
- Display and Local Control Panel parameters for selecting readouts, setting up selections and copying functions

1-** Load and Motor parameters include all load and motor related parameters.

2-** Brake parameters.

- DC brake
- Dynamic brake (Resistor brake)
- Mechanical brake
- Overvoltage Control

3-** References and ramping parameters include DigiPot function.

4-** Limits Warnings; setting of limits and warning parameters.

5-** Digital inputs and outputs include relay controls.

6-** Analog inputs and outputs.

7-** Controls; setting parameters for speed and process controls.

8-** Communication and option parameters for setting of RS-485 and USB port parameters.

9-** Profibus parameters.

10-** DeviceNet and CAN Fieldbus parameters.

12-** Ethernet parameters.

13-** Smart Logic Control parameters.

14-** Special function parameters.

15-** Drive information parameters.

16-** Readout parameters.

17-** Encoder Option parameters.

18-** Readout 2 parameters.

30-** Special Features.

32-** MCO Basic Settings parameters.

33-** MCO Adv. Settings parameters.

34-** MCO Data Readouts.

35-** Sensor Input Option parameters.

***NOTICE***

**To see if a parameter can be used in a specific control mode, use *Table 4.3*.**

## 3.2 Parameters: 0-** Operation and Display

Parameters related to the fundamental functions of the frequency converter, function of the LCP keys and configuration of the LCP display.

3

### 3.2.1 0-0* Basic Settings

| 0-01 Language | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Defines display language. The frequency converter is delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated. |
| [0] * | English | Part of language packages 1–4 |
| [1] | Deutsch | Part of language packages 1–4 |
| [2] | Francais | Part of language package 1 |
| [3] | Dansk | Part of language package 1 |
| [4] | Spanish | Part of language package 1 |
| [5] | Italiano | Part of language package 1 |
| [6] | Svenska | Part of language package 1 |
| [7] | Nederlands | Part of language package 1 |
| [10] | Chinese | Part of language package 2 |
| [20] | Suomi | Part of language package 1 |
| [22] | English US | Part of language package 4 |
| [27] | Greek | Part of language package 4 |
| [28] | Bras.port | Part of language package 4 |
| [36] | Slovenian | Part of language package 3 |
| [39] | Korean | Part of language package 2 |
| [40] | Japanese | Part of language package 2 |
| [41] | Turkish | Part of language package 4 |
| [42] | Trad.Chinese | Part of language package 2 |
| [43] | Bulgarian | Part of language package 3 |
| [44] | Srpski | Part of language package 3 |
| [45] | Romanian | Part of language package 3 |
| [46] | Magyar | Part of language package 3 |
| [47] | Czech | Part of language package 3 |
| [48] | Polski | Part of language package 4 |
| [49] | Russian | Part of language package 3 |
| [50] | Thai | Part of language package 2 |

| 0-01 Language | | |
|---|---|---|
| **Option:** | | **Function:** |
| [51] | Bahasa Indonesia | Part of language package 2 |
| [52] | Hrvatski | Part of language package 3 |

| 0-02 Motor Speed Unit | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>The information shown in the display depends on settings in *parameter 0-02 Motor Speed Unit* and *0-03 Regional Settings*. The default setting of *parameter 0-02 Motor Speed Unit* and *0-03 Regional Settings* depends on to which region of the world the frequency converter is supplied. It can be re-programmed as required.<br>***NOTICE***<br>**Changing the motor speed unit resets certain parameters to their initial value. It is recommended to select the motor speed unit first, before modifying other parameters.** |
| [0] | RPM | Selects display of motor speed variables and parameters (i.e. references, feedbacks and limits) in terms of motor speed (RPM). |
| [1] * | Hz | Selects display of motor speed variables and parameters (i.e. references, feedbacks and limits) in terms of output frequency to the motor (Hz). |

| 0-03 Regional Settings | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |
| [0] * | Interna-tional | Activates *parameter 1-20 Motor Power [kW]* for setting the motor power in kW and sets the default value of *parameter 1-23 Motor Frequency* to 50 Hz. |
| [1] | US | Activates *parameter 1-20 Motor Power [kW]* for setting the motor power in hp and sets the default value of *parameter 1-23 Motor Frequency* to 60 Hz. |

| 0-04 Operating State at Power-up (Hand) | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Selects the operating mode upon reconnection of the frequency converter to mains voltage after power down in Hand (local) operation mode. |
| [0] | Resume | Restarts the frequency converter, maintaining the same start/stop settings (applied by [Hand On/Off]) as those selected before the power down of the frequency converter. |
| [1] * | Forced stop, ref=old | Restarts the frequency converter with a saved local reference, after mains voltage reappears and after pressing [Hand On]. |
| [2] | Forced stop, ref=0 | Resets the local reference to 0 upon restarting the frequency converter. |

## 3.2.2 0-1* 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 solve advanced control functionality problems, often saving the cost of external control equipment. Parameter set-ups these can be used to program the frequency converter to operate according to one control scheme in 1 set-up (e.g. motor 1 for horizontal movement) and another control scheme in another set-up (e.g. motor 2 for vertical movement). Alternatively parameter set-ups can be used by an OEM machine builder to identically program all their factory-fitted frequency converters for different machine types within a range to have the same parameters. During production/commissioning, simply select a specific set-up depending on which machine the frequency converter is installed on.
The active set-up (i.e. the set-up in which the frequency converter is currently operating) can be selected in *parameter 0-10 Active Set-up* and is displayed in the LCP. using 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. If it is necessary to change set-ups while running, ensure *parameter 0-12 This Set-up Linked to* is programmed as required. By using *parameter 0-11 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. By using *parameter 0-51 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.

| 0-10 Active Set-up | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the set-up to control the frequency converter functions. |
| [0] | Factory setup | Cannot be changed. It contains the Danfoss 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 separate 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 | Remote selection of set-ups using digital inputs and the serial communication port. This set-up uses the settings from *parameter 0-12 This Set-up Linked to*. Stop the frequency converter before making changes to open- and closed loop functions |

Use *parameter 0-51 Set-up Copy* to copy a set-up to 1 or all other set-ups. Stop the frequency converter before switching between set-ups where parameters marked *not changeable during operation* have different values. To avoid conflicting settings of the same parameter within 2 different set-ups, link the set-ups together using *parameter 0-12 This Set-up Linked to*. Parameters which are *not changeable during operation* are marked FALSE in the parameter lists in *chapter 4 Parameter Lists*.

| 0-11 Edit Set-up | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the set-up to be edited (i.e. programmed) during operation; either the active set-up or 1 of the inactive set-ups. |
| [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 | Can also be edited during operation. Edit the selected set-up from a range of sources: LCP, FC RS-485, FC USB or up to 5 fieldbus sites. |

3

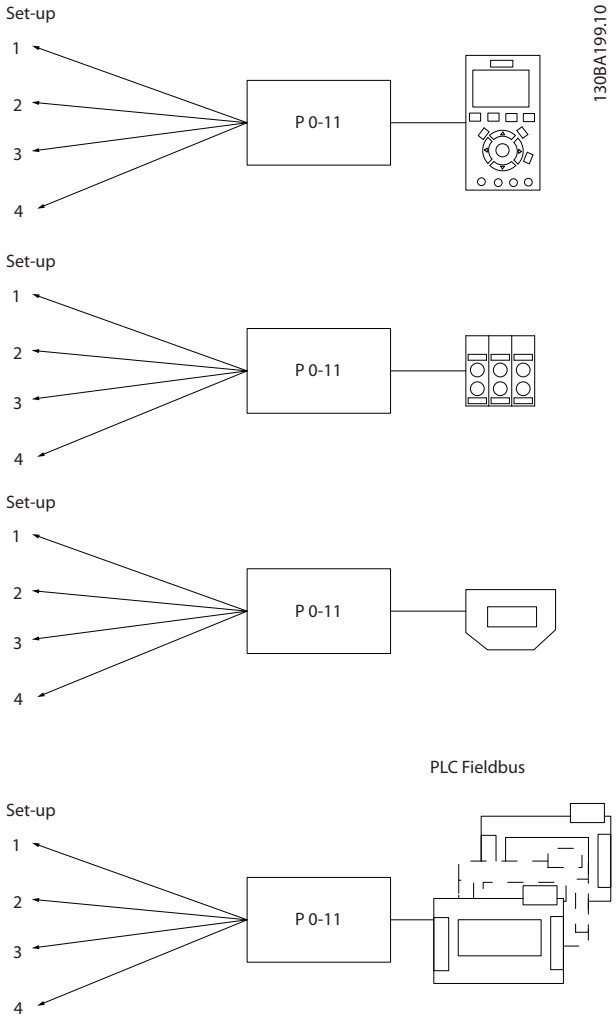
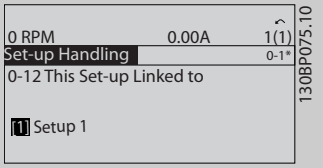
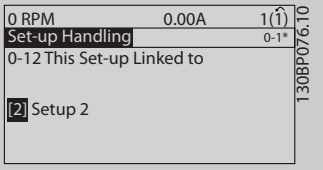



**Illustration 3.1 Edit Set-up**

| 0-12 This Set-up Linked to | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | To enable conflict-free changes from 1 set-up to another during operation, link set-ups containing parameters which are not changeable during operation. 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 4 Parameter Lists*.<br><br>*Parameter 0-12 This Set-up Linked to* is used by *[9] Multi set-up* in *parameter 0-10 Active Set-up*. Multi set-up is used to move from 1 set-up to another during operation (i.e. while the motor is running).<br>Example:<br>Use Multi set-up to shift from Set-up 1 to Set-up 2 while the motor is running. Program in Set-up 1 first, then ensure that Set-up 1 and Set-up 2 are synchronised (or 'linked'). Synchronisation can be performed in 2 ways:<br>1. Change the edit set-up to *[2] Set-up 2* in *parameter 0-11 Edit Set-up* and set *parameter 0-12 This Set-up Linked to* to *[1] Set-up 1*. This starts the linking (synchronising) process. |
| | |  |
| | | **Illustration 3.2 Set-up 1**<br><br>OR<br><br>2. While still in Set-up 1, copy Set-up 1 to Set-up 2. Then set *parameter 0-12 This Set-up Linked to* to *[2] Set-up 2*. This starts the linking process. |
| | |  |
| | | **Illustration 3.3 Set-up 2**<br><br>When completed, *parameter 0-13 Readout: Linked Set-ups* reads {1,2} 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, e.g. *parameter 1-30 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 | |

| 0-13 Readout: Linked Set-ups | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 255 ] | View a list of all the set-ups linked by means of *0-12 This Set-up Linked to*. The parameter has one index for each parameter set-up. The parameter value displayed for each index represents which set-ups are linked to that parameter set-up. |

| Index | LCP value |
|---|---|
| 0 | {0} |
| 1 | {1,2} |
| 2 | {1,2} |
| 3 | {3} |
| 4 | {4} |

**Table 3.2 Example: Set-up 1 and Set-up 2 are linked**

| 0-14 Readout: Edit Set-ups / Channel | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-2147483648 - 2147483647] | View the setting of *parameter 0-11 Edit Set-up* for each of the 4 different communication channels. When the number is displayed as a hex number, as it is in the LCP, each number represents 1 channel.<br>Numbers 1-4 represent a set-up number; F means factory setting; and A means active set-up. The channels are, from right to left: LCP, FC bus, USB, HPFB1-5.<br>Example: The number AAAAAA21h means the following:<br>• The frequency converter selected Set-up 2 via a fieldbus channel. This selection is reflected in *parameter 0-11 Edit Set-up*.<br>• A user selected Set-up 1 via the LCP.<br>• All other channels are using the active set-up. |

| 0-15 Readout: actual setup | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 255] | Makes it possible to read out the active set-up, also when multi set-up is selected in *parameter 0-10 Active Set-up*. |

## 3.2.3 0-2* LCP Display

Define the variables displayed in the LCP.

***NOTICE***

**Refer to *0-37 Display Text 1*, *0-38 Display Text 2* and *0-39 Display Text 3* for information on how to write display texts.**

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select a variable for display in line 1, left position. |
| [0] | None | No display value selected. |
| [9] | Performance Monitor | |
| [15] | Readout: actual setup | |
| [37] | Display Text 1 | |
| [38] | Display Text 2 | |
| [39] | Display Text 3 | |
| [748] | PCD Feed Forward | |
| [953] | Profibus Warning Word | |
| [1005] | Readout Transmit Error Counter | |
| [1006] | Readout Receive Error Counter | |
| [1007] | Readout Bus Off Counter | |
| [1013] | Warning Parameter | |
| [1230] | Warning Parameter | |
| [1472] | Legacy Alarm Word | |
| [1473] | Legacy Warning Word | |
| [1474] | Leg. Ext. Status Word | |
| [1501] | Running Hours | |
| [1502] | kWh Counter | |
| [1580] | Fan Running Hours | |
| [1600] | Control Word | Present control word |
| [1601] | Reference [Unit] | Total reference (sum of digital/ analog/preset/bus/freeze ref./catch up and slow-down) in selected unit. |
| [1602] | Reference % | Total reference (sum of digital/ analog/preset/bus/freeze ref./catch up and slow-down) in percent. |
| [1603] | Status Word | Present status word. |
| [1605] | Main Actual Value [%] | Actual value as a percentage. |
| [1606] | Absolute Position | |

3

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1609] | Custom Readout | |
| [1610] | Power [kW] | Actual power consumed by the motor in kW. |
| [1611] | Power [hp] | Actual power consumed by the motor in hp. |
| [1612] | Motor Voltage | Voltage supplied to the motor. |
| [1613] | Frequency | Motor frequency, i.e. the output frequency from the frequency converter in Hz. |
| [1614] | Motor current | Phase current of the motor measured as effective value. |
| [1615] | Frequency [%] | Motor frequency, i.e. the output frequency from the frequency converter in percent. |
| [1616] | Torque [Nm] | Actual motor torque in Nm |
| [1617] * | Speed [RPM] | Speed in RPM (revolutions per minute), i.e. the motor shaft speed in closed loop. |
| [1618] | Motor Thermal | Thermal load on the motor, calculated by the ETR function. |
| [1619] | KTY sensor temperature | |
| [1620] | Motor Angle | |
| [1621] | Torque [%] High Res. | |
| [1622] | Torque [%] | Present motor load as a percentage of the rated motor torque. |
| [1623] | Motor Shaft Power [kW] | |
| [1624] | Calibrated Stator Resistance | |
| [1625] | Torque [Nm] High | |
| [1630] | DC Link Voltage | Intermediate circuit voltage in the frequency converter. |
| [1632] | Brake Energy /s | Present brake power transferred to an external brake resistor. Stated as an instantaneous value. |
| [1633] | Brake Energy Average | Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 s. |
| [1634] | 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. |
| [1635] | Inverter Thermal | Percentage load of the inverters. |

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1636] | Inv. Nom. Current | Nominal current of the frequency converter. |
| [1637] | Inv. Max. Current | Maximum current of the frequency converter. |
| [1638] | SL Controller State | State of the event executed by the control. |
| [1639] | Control Card Temp. | Temperature of the control card. |
| [1645] | Motor Phase U Current | |
| [1646] | Motor Phase V Current | |
| [1647] | Motor Phase W Current | |
| [1648] | Speed Ref. After Ramp [RPM] | |
| [1650] | External Reference | Sum of the external reference as a percentage, i.e. the sum of analog/ pulse/bus. |
| [1651] | Pulse Reference | Frequency in Hz connected to the digital inputs (18, 19 or 32, 33). |
| [1652] | Feedback[Unit] | Reference value from programmed digital input(s). |
| [1653] | Digi Pot Reference | |
| [1657] | Feedback [RPM] | |
| [1660] | Digital Input | Signal states from the 6 digital terminals (18, 19, 27, 29, 32 and 33). There are 16 bits in total, but only 6 of them are used. Input 18 corresponds to the far left of the used bits. Signal low = 0; Signal high = 1. |
| [1661] | Terminal 53 Switch Setting | Setting of input terminal 54. Current = 0; Voltage = 1. |
| [1662] | Analog Input 53 | Actual value at input 53 either as a reference or protection value. |
| [1663] | Terminal 54 Switch Setting | Setting of input terminal 54. Current = 0; Voltage = 1. |
| [1664] | Analog Input 54 | Actual value at input 54 either as reference or protection value. |
| [1665] | Analog Output 42 [mA] | Actual value at output 42 in mA. Use *parameter 6-50 Terminal 42 Output* to select the value to be shown. |
| [1666] | Digital Output [bin] | Binary value of all digital outputs. |
| [1667] | Freq. Input #29 [Hz] | Actual value of the frequency applied at terminal 29 as an impulse input. |

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1668] | Freq. Input #33 [Hz] | Actual value of the frequency applied at terminal 33 as an impulse input. |
| [1669] | Pulse Output #27 [Hz] | Actual value of impulses applied to terminal 27 in digital output mode. |
| [1670] | Pulse Output #29 [Hz] | Actual value of impulses applied to terminal 29 in digital output mode. |
| [1671] | Relay Output [bin] | |
| [1672] | Counter A | Application dependent (e.g. SLC Control). |
| [1673] | Counter B | Application dependent (e.g. SLC Control). |
| [1674] | Prec. Stop Counter | Displays the actual counter value. |
| [1675] | Analog In X30/11 | Actual value at input X30/11 either as reference or protection value. |
| [1676] | Analog In X30/12 | Actual value at input X30/12 either as reference or protection value. |
| [1677] | Analog Out X30/8 [mA] | Actual value at output X30/8 in mA. Use *parameter 6-60 Terminal X30/8 Output* to select the value to be shown. |
| [1678] | Analog Out X45/1 [mA] | |
| [1679] | Analog Out X45/3 [mA] | |
| [1680] | Fieldbus CTW 1 | Control word (CTW) received from the Bus Master. |
| [1682] | Fieldbus REF 1 | Main reference value sent with control word from the Bus Master. |
| [1684] | Comm. Option STW | Extended fieldbus communication option status word. |
| [1685] | FC Port CTW 1 | Control word (CTW) received from the Bus Master. |
| [1686] | FC Port REF 1 | Status word (STW) sent to the Bus Master. |
| [1687] | Bus Readout Alarm/ Warning | |
| [1689] | Configurable Alarm/Warning Word | |
| [1690] | Alarm Word | 1 or more alarms in a hex code. |
| [1691] | Alarm Word 2 | 1 or more alarms in a hex code. |
| [1692] | Warning Word | 1 or more warnings in a hex code. |
| [1693] | Warning Word 2 | 1 or more warnings in a hex code. |
| [1694] | Ext. Status Word | 1 or more status conditions in a hex code. |

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1836] | Analog Input X48/2 [mA] | |
| [1837] | Temp. Input X48/4 | |
| [1838] | Temp. Input X48/7 | |
| [1839] | Temp. Input X48/10 | |
| [1860] | Digital Input 2 | |
| [1890] | Process PID Error | |
| [1891] | Process PID Output | |
| [1892] | Process PID Clamped Output | |
| [1893] | Process PID Gain Scaled Output | |
| [3019] | Wobble Delta Freq. Scaled | |
| [3110] | Bypass Status Word | |
| [3111] | Bypass Running Hours | |
| [3401] | PCD 1 Write to MCO | |
| [3402] | PCD 2 Write to MCO | |
| [3403] | PCD 3 Write to MCO | |
| [3404] | PCD 4 Write to MCO | |
| [3405] | PCD 5 Write to MCO | |
| [3406] | PCD 6 Write to MCO | |
| [3407] | PCD 7 Write to MCO | |
| [3408] | PCD 8 Write to MCO | |
| [3409] | PCD 9 Write to MCO | |
| [3410] | PCD 10 Write to MCO | |
| [3421] | PCD 1 Read from MCO | |
| [3422] | PCD 2 Read from MCO | |
| [3423] | PCD 3 Read from MCO | |
| [3424] | PCD 4 Read from MCO | |
| [3425] | PCD 5 Read from MCO | |
| [3426] | PCD 6 Read from MCO | |
| [3427] | PCD 7 Read from MCO | |
| [3428] | PCD 8 Read from MCO | |



3

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [3429] | PCD 9 Read from MCO | |
| [3430] | PCD 10 Read from MCO | |
| [3440] | Digital Inputs | |
| [3441] | Digital Outputs | |
| [3450] | Actual Position | |
| [3451] | Commanded Position | |
| [3452] | Actual Master Position | |
| [3453] | Slave Index Position | |
| [3454] | Master Index Position | |
| [3455] | Curve Position | |
| [3456] | Track Error | |
| [3457] | Synchronizing Error | |
| [3458] | Actual Velocity | |
| [3459] | Actual Master Velocity | |
| [3460] | Synchronizing Status | |
| [3461] | Axis Status | |
| [3462] | Program Status | |
| [3464] | MCO 302 Status | |
| [3465] | MCO 302 Control | |
| [3470] | MCO Alarm Word 1 | |
| [3471] | MCO Alarm Word 2 | |
| [4282] | Safe Control Word | |
| [4283] | Safe Status Word | |
| [4285] | Active Safe Func. | |
| [4286] | Safe Option Info | |
| [9913] | Idle time | |
| [9914] | Paramdb requests in queue | |
| [9917] | tCon1 time | |
| [9918] | tCon2 time | |
| [9919] | Time Optimize Measure | |
| [9920] | HS Temp. (PC1) | |
| [9921] | HS Temp. (PC2) | |
| [9922] | HS Temp. (PC3) | |
| [9923] | HS Temp. (PC4) | |
| [9924] | HS Temp. (PC5) | |
| [9925] | HS Temp. (PC6) | |
| [9926] | HS Temp. (PC7) | |
| [9927] | HS Temp. (PC8) | |
| [9951] | PC Debug 0 | |
| [9952] | PC Debug 1 | |
| [9953] | PC Debug 2 | |
| [9954] | PC Debug 3 | |
| [9955] | PC Debug 4 | |

| 0-20 Display Line 1.1 Small | | |
|---|---|---|
| **Option:** | | **Function:** |
| [9956] | Fan 1 Feedback | |
| [9957] | Fan 2 Feedback | |
| [9958] | PC Auxiliary Temp | |
| [9959] | Power Card Temp. | |

**0-21 Display Line 1.2 Small**

| Option: | | Function: |
|---|---|---|
| [0] * | None | Select a variable for display in line 1, middle position. The options are the same as those listed for *parameter 0-20 Display Line 1.1 Small*. |

**0-22 Display Line 1.3 Small**

Select a variable for display in line 1, right position. The options are the same as those listed for *parameter 0-20 Display Line 1.1 Small*.

**0-23 Display Line 2 Large**

Select a variable for display in line 2. The options are the same as listed for *parameter 0-20 Display Line 1.1 Small*. The options are the same as those listed in *0-20 Display Line 1.1 Small*.

**0-24 Display Line 3 Large**

Select a variable for display in line 3.

**0-25 My Personal Menu**

| Range: | | Function: |
|---|---|---|
| Size related* | [0 - 9999] | Define up to 50 parameters to appear in the *Q1 Personal Menu*, accessible via the [Quick Menu] key on the LCP. The parameters are displayed in the *Q1 Personal Menu* 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 (e.g. for plant maintenance reasons) or by an OEM to enable simple commissioning of their equipment. |

## 3.2.4 0-3* LCP Custom Readout

It is possible to customise the display elements for various purposes: *Custom Readout. Value proportional to speed (linear, squared or cubed depending on unit selected in *0-30 Custom Readout Unit*) *Display Text. Text string stored in a parameter.

**Custom readout**
The calculated value to be displayed is based on settings in

- *0-30 Custom Readout Unit*
- *0-31 Custom Readout Min Value* (linear only)
- *Parameter 0-32 Custom Readout Max Value*
- *4-13 Motor Speed High Limit [RPM]*
- *Parameter 4-14 Motor Speed High Limit [Hz]*
- and actual speed

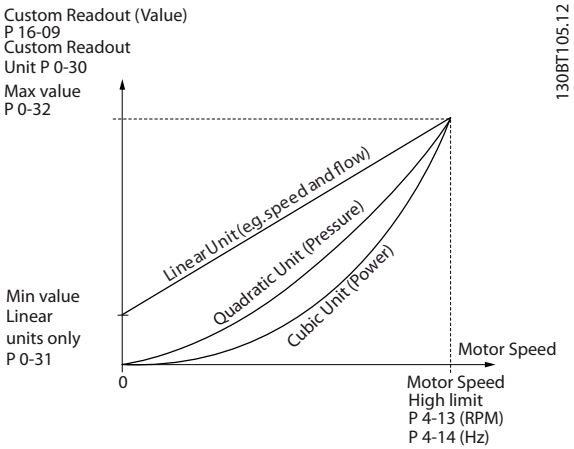



**Illustration 3.4 Custom Readout**

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

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

**Table 3.3 Speed Relations for Different Unit Types**

**0-30 Unit for User-defined Readout**

| Option: | | Function: |
|---|---|---|
| | | It is possible to program a value to be shown in the display of the LCP. The value has a linear, squared or cubed relation to speed. This relation depends on the unit selected (see *Table 3.3*). The actual calculated value can be read in *parameter 16-09 Custom Readout*, and/or shown in the display by selecting *[16-09] Custom Readout* in *parameter 0-20 Display Line 1.1 Small* to *0-24 Display Line 3 Large*. |
| [0] * | None | |
| [1] | % | |
| [5] | PPM | |

**0-30 Unit for User-defined Readout**

| Option: | | Function: |
|---|---|---|
| [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 | |
| [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 | |
| [180] | HP | |

**0-31 Min Value of User-defined Readout**

| Range: | | Function: |
|---|---|---|
| 0 CustomReadoutUnit* | [ -999999.99 - par. 0-32 CustomReadoutUnit] | This parameter sets the min. value of the custom-defined readout (occurs at zero speed). only possible to set different from 0 when selecting a linear |

3

| 0-31 Min Value of User-defined Readout | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | unit in *parameter 0-30 Unit for User-defined Readout*. For quadratic and cubic units the minimum value is 0. |

| 0-32 Custom Readout Max Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 CustomReadoutUnit* | [ par. 0-31 - 999999.99 CustomReadoutUnit] | This parameter sets the max. value to be shown when the speed of the motor has reached the set value for *4-13 Motor Speed High Limit [RPM]* or *parameter 4-14 Motor Speed High Limit [Hz]* (depends on setting in *parameter 0-02 Motor Speed Unit*). |

| 0-37 Display Text 1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 25] | Enter a text which can be viewed in the graphical display by selecting *[37] Display Text 1* in *parameter 0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large* or *0-24 Display Line 3 Large*. |

| 0-38 Display Text 2 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 25] | Enter a text which can be viewed in the graphical display by selecting *[38] Display Text 2* in *parameter 0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large* or *0-24 Display Line 3 Large*. |

| 0-39 Display Text 3 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 25] | Enter a text which can be viewed in the graphical display by selecting *[39] Display Text 3* in *parameter 0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large* or *0-24 Display Line 3 Large*. |

## 3.2.5 0-4* LCP Keypad

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

| 0-40 [Hand on] Key on LCP | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Disabled | No effect when [Hand On] is pressed. Select *[0] Disabled* to avoid accidental start of the frequency converter in *Hand on* mode. |
| [1] | Enabled | The LCP switches to *Hand on* mode directly when [Hand on] is pressed. |
| [2] | Password | After pressing [Hand on] a password is required. If *parameter 0-40 [Hand on] Key on LCP* is included in *My Personal Menu*, define the password in *parameter 0-65 Quick Menu Password*. Otherwise define the password in *0-60 Main Menu Password*. |
| [3] | Hand Off/On | When [Hand On] is pressed once, the LCP switches to *Off* mode. When pressed again, the LCP switches to *Hand on* mode. |
| [4] | Hand Off/On w. Passw. | Same as [3] but a password is required (see option *[2] Password*). |
| [9] | Enabled, ref = 0 | |

| 0-41 [Off] Key on LCP | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Disabled | Avoids accidental stop of the frequency converter. |
| [1] | Enabled | |
| [2] | Password | Avoids unauthorised stop. If *parameter 0-41 [Off] Key on LCP* is included in the Quick Menu, then define the password in *parameter 0-65 Quick Menu Password*. |

| 0-42 [Auto on] Key on LCP | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Disabled | Avoids accidental start of the frequency converter in Auto mode. |
| [1] | Enabled | |
| [2] | Password | Avoids unauthorised start in Auto mode. If *parameter 0-42 [Auto on] Key on LCP* is included in the Quick Menu, then define the password in *parameter 0-65 Quick Menu Password*. |

| 0-43 [Reset] Key on LCP | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Disabled | No effect when [Reset] is pressed. Avoids accidental alarm reset. |
| [1] | Enabled | |
| [2] | Password | Avoids unauthorised resetting. If *parameter 0-43 [Reset] Key on LCP* is included in the Quick Menu, then define the password in *parameter 0-65 Quick Menu Password*. |
| [7] | Enabled without OFF | Resets the frequency converter without setting it in *Off* mode. |

| 0-43 [Reset] Key on LCP | | |
|---|---|---|
| **Option:** | | **Function:** |
| [8] | Password without OFF | Resets the frequency converter without setting it in *Off* mode. A password is required when pressing [Reset] (see option *[2] Password*). |

## 3.2.6 0-5* Copy/Save

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

| 0-50 LCP Copy | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |
| [0] * | No copy | |
| [1] | All to LCP | Copies all parameters in all set-ups from the frequency converter memory to the LCP memory. |
| [2] | All from LCP | Copies all parameters in all set-ups from the LCP memory to the frequency converter memory. |
| [3] | Size indep. from LCP | Copy only the parameters that are independent of the motor size. The latter selection can be used to programme several frequency converters with the same function without disturbing motor data. |
| [4] | File from MCO to LCP | |
| [5] | File from LCP to MCO | |
| [6] | Data from DYN to LCP | |
| [7] | Data from LCP to DYN | |
| [9] | Safety Par. from LCP | |
| [10] | Delete LCP copy data | Use to delete the copy after the transfer is complete. |

| 0-51 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 *0-11 Programming Set-up*) to set-up 1. |

| 0-51 Set-up Copy | | |
|---|---|---|
| **Option:** | | **Function:** |
| [2] | Copy to set-up 2 | Copies all parameters in the present programming set-up (defined in *0-11 Programming Set-up*) to set-up 2. |
| [3] | Copy to set-up 3 | Copies all parameters in the present programming set-up (defined in *0-11 Programming Set-up*) to set-up 3. |
| [4] | Copy to set-up 4 | Copies all parameters in the present programming set-up (defined in *0-11 Programming 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. |

## 3.2.7 0-6* Password

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

| 0-61 Access to Main Menu w/o Password | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Full access | Disables password defined in *parameter 0-60 Main Menu Password*. |
| [1] | LCP: Read only | Prevent unauthorised editing of Main Menu parameters. |
| [2] | LCP: No access | Prevent unauthorised viewing and editing of Main Menu parameters. |
| [3] | Bus: Read only | Read-only functions for parameters on Fieldbus and/or FC standard bus. |
| [4] | Bus: No access | No access to parameters is allowed via Fieldbus and/or FC standard bus. |
| [5] | All: Read only | Read-only function for parameters on LCP, Fieldbus or FC standard bus. |
| [6] | All: No access | No access from LCP, Fieldbus or FC standard bus is allowed. |

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

***NOTICE***

**A more complex password protection is available for OEMs upon request.**

3

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

| 0-66 Access to Quick Menu w/o Password | | |
|---|---|---|
| If *0-61 Access to Main Menu w/o Password* is set to *[0] Full access* then this parameter is ignored. | | |
| **Option:** | | **Function:** |
| [0] * | Full access | Disables the password defined in *parameter 0-65 Quick Menu Password*. |
| [1] | LCP: Read only | Prevents unauthorised editing of Quick Menu parameters. |
| [3] | Bus: Read only | Read only functions for Quick Menu parameters on Fieldbus and/or FC standard bus. |
| [5] | All: Read only | Read only function for Quick Menu parameters on LCP, Fieldbus or FC standard bus. |

| 0-67 Bus Password Access | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 9999] | Writing to this parameter enables users to unlock the frequency converter from bus/MCT 10 Set-up Software. |

## 3.3 Parameters: 1-** Load and Motor

### 3.3.1 1-0* General Settings

Define whether the frequency converter operates in speed mode or torque mode, and whether the internal PID control should be active or not.

| 1-00 Configuration Mode | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the application control principle to be used when a remote reference (i.e. via analog input or fieldbus) is active. A remote reference can only be active when *3-13 Reference Site* is set to *[0] Linked to Hand/Auto* or *[1] Remote*. |
| [0] | Speed open loop | Enables speed control (without feedback signal from motor) with automatic slip compensation for almost constant speed at varying loads. Compensations are active, but can be disabled in parameter group *1-0* Load/Motor*. The speed control parameters are set in parameter group *7-0* Speed PID Ctrl*. |
| [1] | Speed closed loop | Enables speed closed loop control with feedback. Obtain full holding torque at 0 RPM. For increased speed accuracy, provide a feedback signal and set the speed PID control. The speed control parameters are set in parameter group *7-0* Speed PID Ctrl*. |
| [2] | Torque | Enables torque closed loop control with feedback. Only possible with *Flux with motor feedback* option, *parameter 1-01 Motor Control Principle*. FC 302 only. |
| [3] | Process | Enables the use of process control in the frequency converter. The process control parameters are set in parameter groups *7-2* Process Ctrl. Feedb.* and *7-3* Process PID Ctrl*. |
| [4] | Torque open loop | Enables the use of torque open loop in VVC+ mode (*parameter 1-01 Motor Control Principle*). The torque PID parameters are set in parameter group *7-1* Torque PI Control*. |
| [5] | Wobble | Enables the wobble functionality in *parameter 30-00 Wobble Mode* to *parameter 30-19 Wobble Delta Freq. Scaled*. |
| [6] | Surface Winder | Enables the surface winder control specific parameters in parameter group *7-2* Process Ctrl. Feedb.* and *7-3* Process PID Ctrl*. |
| [7] | Extended PID Speed OL | Specific parameters in parameter group *7-2* Process Ctrl. Feedb.* to *7-5* Ext. Process PID Ctrl*. |
| [8] | Extended PID Speed CL | Specific parameters in parameter group *7-2* Process Ctrl. Feedb.* to *7-5* Ext. Process PID Ctrl*. |

| 1-01 Motor Control Principle | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | **NOTICE**<br>**This parameter cannot be adjusted while the motor is running.**<br>Select which motor control principle to employ. |
| [0] | U/f | Special motor mode, for parallel connected motors in special motor applications. When U/f is selected the characteristic of the control principle can be edited in *parameter 1-55 U/f Characteristic - U* and *parameter 1-56 U/f Characteristic - F*. |
| [1] | VVC+ | Voltage Vector Control principle suitable for most applications. The main benefit of VVC+ operation is that it uses a robust motor model. |
| [2] | Flux sensorless | Flux Vector control without encoder feedback, for simple installation and robustness against sudden load changes. FC 302 only. |
| [3] | Flux w/ motor feedb | Very high accuracy speed and torque control, suitable for the most demanding applications. FC 302 only. |

The best shaft performance is normally achieved using either of the 2 Flux Vector control modes *[2] Flux sensorless* and *[3] Flux with encoder feedback*.

**NOTICE**

**An overview of possible combinations of the settings in *parameter 1-00 Configuration Mode* and *parameter 1-01 Motor Control Principle* can be found in *chapter 4.1.3 Active/Inactive Parameters in Different Drive Control Modes*.**

| 1-02 Flux Motor Feedback Source | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | **NOTICE**<br>**This parameter cannot be adjusted while the motor is running.**<br>Select the interface for which to receive feedback from the motor. |
| [1] * | 24V encoder | A and B channel encoder, which can be connected to the digital input terminals 32/33 only. Terminals 32/33 must be programmed to *No operation*. |
| [2] | MCB 102 | Encoder module option, which can be configured in parameter group *17-1* Inc. Enc. Interface*, FC 302 only. |

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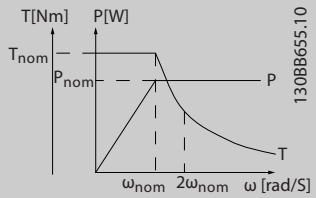
### 1-02 Flux Motor Feedback Source

| Option: | | Function: |
|---|---|---|
| [3] | MCB 103 | Optional resolver interface module, which can be configured in parameter group *17-5* Resolver Interface.* |
| [4] | MCO Encoder 1 X56 | Encoder interface 1 of the optional programmable motion controller MCO 305. |
| [5] | MCO Encoder 2 X55 | Encoder interface 2 of the optional programmable motion controller MCO 305. |

### 1-03 Torque Characteristics

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Select the torque characteristic required.<br>VT and AEO are both energy-saving operations. |
| [0] * | Constant torque | Motor shaft output provides constant torque under variable speed control. |
| [1] | Variable torque | Motor shaft output provides variable torque under variable speed control. Set the variable torque level in *parameter 14-40 VT Level*. |
| [2] | Auto Energy Optim. | Automatically optimises energy consumption by minimising magnetisation and frequency via *parameter 14-41 AEO Minimum Magnetisation* and *parameter 14-42 Minimum AEO Frequency*. |
| [5] | Constant Power | The function provides a constant power in the fieldweakening area.<br>The torque shape of motor mode is used as a limit in the generator mode. This is done to limit the power in generator mode that otherwise becomes considerably larger than in motor mode, due to the high DC link voltage available in generator mode.<br>$P_{shaft}[W] = \omega_{mech}[rad/s] \times T[Nm]$<br>This relationship with the constant power is illustrated in *Illustration 3.5*:<br>  <br>**Illustration 3.5 Constant Power** |

### 1-04 Overload Mode

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Use this parameter to configure the frequency converter for either High or Normal overload. When selecting the frequency converter size, always review the technical data in the *Operating Instructions* or the *Design Guide* to know the available output current. |
| [0] * | High torque | Allows up to 160% over torque. |
| [1] | Normal torque | For oversized motor - allows up to 110% over torque. |

### 1-05 Local Mode Configuration

| Option: | | Function: |
|---|---|---|
| | | Select which application configuration mode (*parameter 1-00 Configuration Mode*), i.e. application control principle, to use when a Local (LCP) Reference is active. A Local Reference can be active only when *3-13 Reference Site* is set to *[0] Linked to Hand/ Auto* or *[2] Local*. By default the Local Reference is active in Hand Mode only. |
| [0] | Speed open loop | |
| [1] | Speed Closed Loop | |
| [2] * | As mode par 1-00 | |

### 1-06 Clockwise Direction

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

| 1-07 Motor Angle Offset Adjust | | |
|---|---|---|
| This parameter is only valid for FC 302 and only in combination with a PM motor with feedback. | | |
| **Range:** | | **Function:** |
| 0* | [Manual] | The functionality of this option depends on the type of the feedback device. This option sets the frequency converter to use the motor angle offset entered in *parameter 1-41 Motor Angle Offset*, if an absolute feedback device is used.<br>If an incremental feedback device is selected the frequency converter automatically adjusts the motor angle offset on the first start after power-up, or when the motor data is changed. |
| [1] | Auto | The frequency converter adjusts the motor angle offset automatically on the first start after power-up, or when the motor data is changed no matter what feedback device is selected. This means that options [0] and [1] are identical for the incremental encoder. |
| [2] | Auto Every Start | The frequency converter adjusts the motor angle offset automatically on every start, or when the motor data is changed. |
| [3] | Off | Selecting this option turns the automatic offset adjustment off. |

## 3.3.2 1-1* Special Settings

***NOTICE***

**The parameters within this parameter group cannot be adjusted while the motor is running.**

## 3.3.3 Asynchronous Motor Set-up

Enter the following motor data. The information can be found on the motor nameplate.

1. *1-20 Motor Power [kW]* or *1-21 Motor Power [HP]*
2. *1-22 Motor Voltage*
3. *1-23 Motor Frequency*
4. *1-24 Motor Current*
5. *1-25 Motor Nominal Speed*

When running in Flux mode, or for optimum performance in VVC+ mode, extra motor data is required to set up the following parameters. The data can be found in the motor data sheet (this data is typically not available on the motor name plate). Run a complete AMA using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA* or enter the parameters manually. *Parameter 1-36 Iron Loss Resistance (Rfe)* is always entered manually.

1. *Parameter 1-30 Stator Resistance (Rs)*
2. *Parameter 1-31 Rotor Resistance (Rr)*
3. *Parameter 1-33 Stator Leakage Reactance (X1)*
4. *Parameter 1-34 Rotor Leakage Reactance (X2)*
5. *Parameter 1-35 Main Reactance (Xh)*
6. *Parameter 1-36 Iron Loss Resistance (Rfe)*

**Application-specific adjustment when running VVC+**
VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

**Application-specific adjustment when running Flux**
Flux mode is the preferred control mode for optimum shaft performance in dynamic applications. Perform an AMA since this control mode requires precise motor data. Depending on the application, further adjustments may be required.

See *Table 3.4* for application-related recommendations.

| Application | Settings |
|---|---|
| Low-inertia applications | Keep calculated values. |
| High-inertia applications | *Parameter 1-66 Min. Current at Low Speed*.<br>Increase current to a value between default and maximum depending on the application.<br>Set ramp times matching the application. Too fast ramp up causes an overcurrent or overtorque. Too fast ramp down causes an overvoltage trip. |
| High load at low speed | *Parameter 1-66 Min. Current at Low Speed*.<br>Increase current to a value between default and maximum depending on the application. |
| No-load application | Adjust *parameter 1-18 Min. Current at No Load* to achieve smoother motor operation by reducing torque ripple and vibration. |

| Application | Settings |
|---|---|
| Flux sensorless only | Adjust *parameter 1-53 Model Shift Frequency*.<br>Example 1: If the motor oscillates at 5 Hz and dynamics performance is required at 15 Hz, set *parameter 1-53 Model Shift Frequency* to 10 Hz.<br>Example 2: If the application involves dynamic load changes at low speed, reduce *parameter 1-53 Model Shift Frequency*. Observe the motor behaviour to make sure that the model shift frequency is not reduced too much. Symptoms of inappropriate model shift frequency are motor oscillations or frequency converter tripping. |

**Table 3.4 Recommendations for Flux Applications**

## 3.3.4 PM Motor Set-up

This section describes how to set up a PM motor.

**Initial programming steps**
To activate PM motor operation, select *[1] PM, non salient SPM* in *1-10 Motor Construction*. Valid for FC 302 only.

**Programming motor data**
After selecting a PM motor, the PM motor-related parameters in parameter groups *1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active.
The necessary data can be found on the motor nameplate and on the motor data sheet.
Program the following parameters in the order listed:

- *1-24 Motor Current*
- *1-25 Motor Nominal Speed*
- *1-26 Motor Cont. Rated Torque*
- *1-39 Motor Poles*

Run a complete AMA using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA*. If a complete AMA is not performed, the following parameters must be configured manually:

- *1-30 Stator Resistance (Rs)*
  Enter the line to common stator winding resistance (Rs). If only line-line data is available, divide the line-line value by 2 to achieve the line to common value.
- *1-37 d-axis Inductance (Ld)*
  Enter the line to common direct axis inductance of the PM motor.
  If only line-line data is available, divide the line-line value by 2 to achieve the line-common value.
- *1-40 Back EMF at 1000 RPM*
  Enter the line-to-line back EMF of the PM Motor at 1000

  rpm mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no frequency converter is connected and the shaft is turned externally. It is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows:
  If back EMF is, for example, 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows:
  Back EMF = (Voltage/RPM)*1000 = (320/1800)*1000 = 178.

**Test motor operation**

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

**Rotor detection**
This function is the recommended selection for applications where the motor starts from standstill, for example pumps or conveyors. On some motors, an acoustic sound is heard when the frequency converter performs the rotor detection. This does not harm the motor.

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

**Application-specific adjustment when running VVC+**
VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. Recommendations for various applications can be seen in *Table 3.5*.

| Application | Settings |
|---|---|
| Low inertia applications $I_{Load}/I_{Motor}$ <5 | Increase parameter *1-17 Voltage filter time const.* by factor 5 to 10.<br>Reduce parameter *1-14 Damping Gain*.<br>Reduce parameter *1-66 Min. Current at Low Speed* (<100%). |
| Low inertia applications 50>$I_{Load}/I_{Motor}$ >5 | Keep the default values. |
| High inertia applications $I_{Load}/I_{Motor}$ > 50 | Increase parameter *1-14 Damping Gain*, parameter *parameter 1-15 Low Speed Filter Time Const.*, and parameter *parameter 1-16 High Speed Filter Time Const.* |
| High load at low speed <30% (rated speed) | Increase parameter *1-17 Voltage filter time const.*<br>Increase parameter *1-66 Min. Current at Low Speed* to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of parameter *parameter 30-20 High Starting Torque Time [s]* and parameter *parameter 30-21 High Starting Torque Current [%]*). Working at a current level higher than 100% for a prolonged time can cause the motor to overheat. |

**Table 3.5 Recommendations for Various Applications**

If the motor starts oscillating at a certain speed, increase *1-14 Damping Gain*. Increase the value in small steps. Depending on the motor, this parameter can be set to between 10% and 100% higher than the default value.

**Application-specific adjustment when running Flux**
Flux mode is the preferred control mode for optimum shaft performance in dynamic applications. Perform an AMA because this control mode requires precise motor data. Depending on the application, further adjustments may be required.
See *chapter 3.3.3 Asynchronous Motor Set-up* for application-specific recommendations.

## 3.3.5 SynRM Motor Set-up with VVC+

This section describes how to set up a SynRM motor with VVC+.

**Initial programming steps**
To activate SynRM motor operation, select *[5] Sync. Reluctance* in *parameter 1-10 Motor Construction* (FC-302 only).

**Programming motor data**
After performing the initial programming steps, the SynRM motor-related parameters in parameter groups *1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active. Use the motor nameplate data and the motor data sheet to program the following parameters in the order listed:

- *Parameter 1-23 Motor Frequency*
- *Parameter 1-24 Motor Current*
- *Parameter 1-25 Motor Nominal Speed*
- *Parameter 1-26 Motor Cont. Rated Torque*

Run a complete AMA using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA* or enter the following parameters manually:

- *Parameter 1-30 Stator Resistance (Rs)*
- *Parameter 1-37 d-axis Inductance (Ld)*
- *Parameter 1-44 d-axis Inductance Sat. (LdSat)*
- *Parameter 1-45 q-axis Inductance Sat. (LqSat)*
- *Parameter 1-48 Inductance Sat. Point*

**Application-specific adjustments**
Start the motor at nominal speed. If the application does not run well, check the VVC+ SynRM settings. *Table 3.6* provides application-specific recommendations:

3

| Application | Settings |
|---|---|
| Low-inertia applications $I_{Load}/I_{Motor}$ <5 | Increase *1-17 Voltage filter time const.* by factor 5 to 10. Reduce *1-14 Damping Gain*. Reduce *1-66 Min. Current at Low Speed* (<100%). |
| Low-inertia applications 50>$I_{Load}/I_{Motor}$ >5 | Keep the default values. |
| High-inertia applications $I_{Load}/I_{Motor}$ > 50 | Increase *1-14 Damping Gain*, *parameter 1-15 Low Speed Filter Time Const.*, and *parameter 1-16 High Speed Filter Time Const.* |
| High-load at low speed <30% (rated speed) | Increase *1-17 Voltage filter time const.* Increase *1-66 Min. Current at Low Speed* to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of *parameter 30-20 High Starting Torque Time [s]* and *parameter 30-21 High Starting Torque Current [%]*. Working at a current level higher than 100% for a prolonged time can cause the motor to overheat. |
| Dynamic applications | Increase *14-41 AEO Minimum Magnetisation* for highly dynamic applications. Adjusting *14-41 AEO Minimum Magnetisation* ensures a good balance between energy efficiency and dynamics. Adjust *14-42 Minimum AEO Frequency* to specify the minimum frequency at which the frequency converter should use minimum magnetisation. |

**Table 3.6 Recommendations for Various Applications**

If the motor starts oscillating at a certain speed, increase *parameter 1-14 Damping Gain*. Increase the damping gain value in small steps. Depending on the motor, this parameter can be set to between 10% and 100% higher than the default value.

**1-10 Motor Construction**

| Option: | | Function: |
|---|---|---|
| | | Select the motor design type. |
| [0] * | Asynchron | Use for asynchronous motors. |
| [1] | PM, non salient SPM | Use for salient or non-salient PM motors. PM motors are divided into 2 groups, with either surface-mounted (SPM) / non-salient magnets or interior mounted (IPM) / salient magnets. This option is valid for FC 302 only. |
| [2] | PM, salient IPM | Use for salient or non-salient PM motors. PM motors are divided into 2 groups, with either surface-mounted (SPM) / non-salient magnets or interior mounted (IPM) / salient magnets. This option is valid for FC 302 only. |
| [5] | Sync. Reluctance | Use for synchronous reluctance motors. This option is valid for FC 302 only. **CAUTION** **This option has the following firmware version limitations:** • **Version 7.26 and earlier - do not use this option. There is a risk of damage to the frequency converter.** • **Version 7.27 - use this option only when flying start is enabled in *parameter 1-73 Flying Start*.** |

**1-11 Motor Model**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE*** **This parameter is valid for FC 302 and FCD 302 only.** Automatically sets the manufacturer's values for the selected motor. If the default value [1] is used, settings must be determined manually, according to the selection*parameter 1-10 Motor Construction*. |
| [1] | Std. Asynchron | Default motor model when *[0]* Asynchron.* is selected in *parameter 1-10 Motor Construction*. |
| [2] | Std. PM, non salient | Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*. |
| [3] | Std. PM salient | Selectable when *[2] PM, salient IPM* is selected in *parameter 1-10 Motor Construction*. |
| [10] | Danfoss OGD LA10 | Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*. Only available for T4, T5 in 1.5-3 kW. Settings are loaded automatically for this specific motor. |
| [11] | Danfoss OGD V206 | Selectable when *[1] PM, non-salient SPM* is selected in *parameter 1-10 Motor Construction*. Only available for T4, T5 in 0.75-3 kW. Settings are loaded automatically for this specific motor. |

**OGD Auto-Detection and Model Change Function**

The function is activated when one of the following options is selected: either *[10] Danfoss OGD LA10* or *[11] Danfoss OGD V206* in *parameter 1-11 Motor Model*.
The frequency converter checks if the correct OGD model is selected. If a wrong OGD model is selected, the frequency converter performs the following actions:

- Trips
- Issues an alarm
- Sets the parameters defined for the correct model type
- Waits for the Reset signal from the operator

The model check takes place every time the frequency converter gets a start signal from the LCP, a digital input or a fieldbus.

| 1-14 Damping Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 140 %* | [0 - 250 %] | The damping gain stabilises the PM machine to run smoothly and with stability. The value of damping gain controls the dynamic performance of the PM machine. High damping gain gives high dynamic performance and low damping gain gives low 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. |

| 1-15 Low Speed Filter Time Const. | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 20 s] | This time constant is used below 10% rated speed. Obtain quick control through a short damping time constant. However, if this value is too short, the control becomes unstable. |

| 1-16 High Speed Filter Time Const. | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 20 s] | This time constant is used above 10% rated speed. Obtain quick control through a short damping time constant. However, if this value is too short, the control becomes unstable. |

| 1-17 Voltage filter time const. | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.001 - 1 s] | Reduces the influence of high frequency ripple and system resonance in the calculation of supply voltage. Without this filter, the ripples in the currents can distort the calculated voltage and affect the stability of the system. |

| 1-18 Min. Current at No Load | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 50 %] | Adjust this parameter to achieve a smoother motor operation. |

## 3.3.6 1-2* Motor Data

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

***NOTICE***

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

***NOTICE***

***1-20 Motor Power [kW]*, *1-21 Motor Power [HP]*, *1-22 Motor Voltage*, and *1-23 Motor Frequency* have no effect when *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, *[2] PM, salient IPM*, *[5] Sync. Reluctance*.**

| 1-20 Motor Power [kW] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.09 - 3000.00 kW] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the frequency converter.<br>This parameter is visible in the LCP if *parameter 0-03 Regional Settings* is set to *[0] International*.<br>***NOTICE***<br>**4 sizes down, 1 size up from nominal unit rating.** |

| 1-21 Motor Power [HP] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.09 - 3000.00 hp] | 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. This parameter is visible in LCP if *parameter 0-03 Regional Settings* is *[1] US*. |

| 1-22 Motor Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 10 - 1000 V] | Enter the nominal motor voltage according to the motor nameplate |

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| 1-22 Motor Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | data. The default value corresponds to the nominal rated output of the unit. |

| 1-23 Motor Frequency | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [20 - 1000 Hz] | Minimum to maximum motor frequency: 20-1000 Hz.<br>Select the motor frequency value from the motor nameplate data. If a value other than 50 Hz or 60 Hz is selected, adapt the load-independent settings in *parameter 1-50 Motor Magnetisation at Zero Speed* to *parameter 1-53 Model Shift Frequency*. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. To run at 87 Hz, adapt *parameter 4-13 Motor Speed High Limit [RPM]* and *parameter 3-03 Maximum Reference*. |

| 1-24 Motor Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.10 - 10000.00 A] | Enter the nominal motor current value from the motor nameplate data. The data are used for calculating torque, motor protection etc. |

| 1-25 Motor Nominal Speed | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [10 - 60000 RPM] | Enter the nominal motor speed value from the motor nameplate data. The data are used for calculating motor compensations. $n_{m,n} = n_s - n_{slip}$. |

| 1-26 Motor Cont. Rated Torque | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.1 - 10000 Nm] | Enter the value from the motor nameplate data. The default value corresponds to the nominal rated output. This parameter is available when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, i.e. the parameter is valid for PM and non-salient SPM motors only. |

| 1-29 Automatic Motor Adaptation (AMA) | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |

| 1-29 Automatic Motor Adaptation (AMA) | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | The AMA function optimises dynamic motor performance by automatically optimising the advanced motor parameters (*parameter 1-30 Stator Resistance (Rs)* to *parameter 1-35 Main Reactance (Xh)*) at motor standstill.<br>Activate the AMA function by pressing [Hand on] after selecting *[1]* or *[2] Enable Reduced AMA*. See also the section *Automatic Motor Adaptation* in the *Design Guide*. After a normal sequence, the display reads: "Press [OK] to finish AMA". After pressing [OK], the frequency converter is ready for operation. |
| [0] * | Off | |
| [1] | Enable Complete AMA | Performs AMA 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 $X_h$. Do *not* select this option if an LC filter is used between the frequency converter and the motor.<br>FC 301: The Complete AMA does not include $X_h$ measurement for FC 301. Instead, the $X_h$ value is determined from the motor database. $R_S$ is the best adjustment method (see *1-3* Adv. Motor Data*).<br>It is recommended to obtain the Advanced Motor Data from the motor manufacturer to enter into *parameter 1-31 Rotor Resistance (Rr)* through *parameter 1-36 Iron Loss Resistance (Rfe)* for best performance.<br>Complete AMA cannot be performed on permanent magnet motors. |
| [2] | Enable Reduced AMA | Performs a reduced AMA of the stator resistance $R_s$ in the system only. This option is available for standard asynchronous motors and non-salient PM motors. |

***NOTICE***

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

***NOTICE***

**It is important to set motor parameter group *1-2* Motor Data* correctly, since these form part of the AMA algorithm. An AMA must be performed to achieve optimum dynamic motor performance. It may take up to 10 min, depending on the power rating of the motor.**

  

**NOTICE**

**Avoid generating external torque during AMA.**

**NOTICE**

**If one of the settings in parameter group *1-2* Motor Data* is changed, *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-39 Motor Poles*, the advanced motor parameters, return to default setting.**

**NOTICE**

**AMA works problem-free on 1 motor size down, typically works on 2 motor sizes down, rarely works on 3 sizes down and never work on 4 sizes down. Keep in mind that the accuracy of the measured motor data is poorer when operating on motors smaller than nominal frequency converter size.**

## 3.3.7 1-3* Adv. Motor Data

Parameters for advanced motor data. Ensure that the motor data in *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-39 Motor Poles* match the motor. The default settings are based on standard motor values. If the motor parameters are not set correctly, a malfunction of the frequency converter system may occur. If the motor data are unknown, running an AMA (Automatic Motor Adaptation) is recommended. See *parameter 1-29 Automatic Motor Adaptation (AMA)*. Parameter groups *1-3* Adv. Motor Data* and *1-4* Adv. Motor Data II* cannot be adjusted while the motor is running.

**NOTICE**

**A simple check of the X1 + Xh sum value is to divide the line to line motor voltage by the sqrt(3) and divide this value by the motor no load current. [VL-L/sqrt(3)]/$I_{NL}$ = X1 + Xh, see *Illustration 3.6*. These values are important to magnetise the motor properly. For high-pole motors it is highly recommended to perform this check.**

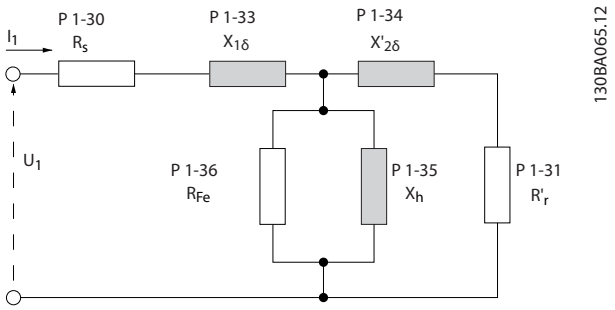


**Illustration 3.6 Motor Equivalent Diagram of an Asynchronous Motor**

| 1-30 Stator Resistance (Rs) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.0140 - 140.0000 Ohm] | Set the line to common stator resistance value. Enter the value from a motor datasheet or perform an AMA on a cold motor.<br>**NOTICE**<br>**For salient PM motors:**<br>**AMA is not available.**<br>**If only line-line data are available, divide the line-line value by 2 to achieve the line to common (starpoint) value. Alternatively, measure the value with an ohmmeter. This also takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.**<br>**NOTICE**<br>**The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in *parameter 1-47 Torque Calibration*.** |

| 1-31 Rotor Resistance (Rr) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.0100 - 100.0000 Ohm] | Set the rotor resistance value $R_r$ to improve shaft performance.<br>1. Run an AMA on a cold motor. The frequency converter measures the value from the motor. All compensations are reset to 100%.<br>2. Enter the $R_r$ value manually. Obtain the value from the motor supplier.<br>3. Use the $R_r$ default setting. The frequency converter establishes the setting based on the motor nameplate data. |

**NOTICE**

***Parameter 1-31 Rotor Resistance (Rr)* does not have effect when *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, *[5] Sync. Reluctance*.**

3

### 1-33 Stator Leakage Reactance (X1)

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0.0400 - 400.0000 Ohm] | Set the stator leakage reactance of the motor using one of these methods:<br>• Run an AMA on a cold motor. The frequency converter measures the value from the motor.<br>• Enter the $X_1$ value manually. Obtain the value from the motor supplier.<br>• Use the $X_1$ default setting. The frequency converter establishes the setting based on the motor nameplate data.<br>See *Illustration 3.6*.<br>**NOTICE**<br>**The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in *parameter 1-47 Torque Calibration*.**<br>**NOTICE**<br>**This parameter is only relevant for ASM.** |

### 1-34 Rotor Leakage Reactance (X2)

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0.0400 - 400.0000 Ohm] | Set the rotor leakage reactance of the motor using one of these methods:<br>• Run an AMA on a cold motor. The frequency converter measures the value from the motor.<br>• Enter the $X_2$ value manually. Obtain the value from the motor supplier.<br>• Use the $X_2$ default setting. The frequency converter establishes the setting based on the motor nameplate data.<br>See *Illustration 3.6*. |

### 1-34 Rotor Leakage Reactance (X2)

| Range: | | Function: |
|---|---|---|
| | | **NOTICE**<br>**The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in *parameter 1-47 Torque Calibration*.**<br>**NOTICE**<br>**This parameter is only relevant for ASM.** |

### 1-35 Main Reactance (Xh)

| Range: | | Function: |
|---|---|---|
| Size related* | [ 1.0000 - 10000.0000 Ohm] | Set the main reactance of the motor using one of these methods:<br>1. Run an AMA on a cold motor. The frequency converter measures the value from the motor.<br>2. Enter the $X_h$ value manually. Obtain the value from the motor supplier.<br>3. Use the $X_h$ default setting. The frequency converter establishes the setting based on the motor nameplate data. |

### 1-36 Iron Loss Resistance (Rfe)

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - 10000.000 Ohm] | Enter the equivalent iron loss resistance ($R_{Fe}$) value to compensate for iron loss in the motor.<br>The $R_{Fe}$ value cannot be found by performing an AMA.<br>The $R_{Fe}$ value is especially important in torque control applications. If $R_{Fe}$ is unknown, leave *parameter 1-36 Iron Loss Resistance (Rfe)* on default setting. |

### 1-37 d-axis Inductance (Ld)

| Range: | | Function: |
|---|---|---|
| Size related* | [0.0 - 1000.0 mH] | Enter line to common direct axis inductance of the PM motor. Obtain the value from the permanent magnet motor data sheet.<br>If only line-line data are available, divide the line-line value by 2 to achieve the line-common (starpoint) value. Alternatively, measure the value with an inductancemeter. This also takes the |

| 1-37 d-axis Inductance (Ld) | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | inductance of the cable into account. Divide the measured value by 2 and enter the result. This parameter is only active when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM* (Permanent Magnet Motor) or *[5] Sync. Reluctance*. For a selection with 1 decimal, use this parameter. For a selection with 3 decimals, use *parameter 30-80 d-axis Inductance (Ld)*. FC 302 only. **NOTICE** **The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in *parameter 1-47 Torque Calibration*.** |

| 1-38 q-axis Inductance (Lq) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.000 - 1000 mH] | Set the value of the q-axis inductance. See the motor data sheet. |

| 1-39 Motor Poles | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [2 - 128] | 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 3.7 Number of Poles for Normal Speed Ranges**

*Table 3.7* shows the number of poles 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 number of poles, not pairs of poles. The frequency converter creates the initial setting of *parameter 1-39 Motor Poles* based on *parameter 1-23 Motor Frequency* and *parameter 1-25 Motor Nominal Speed*.

| 1-40 Back EMF at 1000 RPM | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 9000 V] | Set the nominal back EMF for the motor when running at 1000 RPM. Back EMF is the voltage generated by a PM motor when no frequency converter is |

| 1-40 Back EMF at 1000 RPM | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows. If back EMF is e.g. 320 V at 1800 RPM, it can be calculated at 1000 RPM: **Example** Back EMF 320 V at 1800 RPM. Back EMF = (Voltage/RPM)*1000 = (320/1800)*1000 = 178. This parameter is only active when *parameter 1-10 Motor Construction* is set to *[1] PM motor* (Permanent Magnet Motor). FC 302 only. **NOTICE** **When using PM motors, it is recommended to use brake resistors.** |

| 1-41 Motor Angle Offset | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-32768 - 32767] | Enter the correct offset angle between the PM motor and the index position (single-turn) of the attached encoder or resolver. The value range of 0 - 32768 corresponds to 0 - 2 * pi (radians). To obtain the offset angle value: After frequency converter start-up apply DC-hold and enter the value of *parameter 16-20 Motor Angle* into this parameter. This parameter is only active when *parameter 1-10 Motor Construction* is set to *[1] PM, non-salient SPM* (Permanent Magnet Motor). |

| 1-44 d-axis Inductance Sat. (LdSat) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 1000 mH] | This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *parameter 1-37 d-axis Inductance (Ld)*. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value. |

| 1-45 q-axis Inductance Sat. (LqSat) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 1000 mH] | This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *parameter 1-38 q-axis Inductance (Lq)*. If the motor supplier provides an induction |

3

| 1-45 q-axis Inductance Sat. (LqSat) | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | curve, enter the induction value at 200% of the nominal value. |

| 1-46 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. |

**1-47 Torque Calibration**

Use this parameter to optimise the torque estimate in the full speed range. The estimated torque is based on the shaft power, $P_{shaft} = P_m - R_s * I^2$. This means that it is important to have the correct $R_s$ value. The $R_s$ value in this formula is equal to the power loss in both the motor, the cable, and the frequency converter. Sometimes it is not possible to adjust *parameter 1-30 Stator Resistance (Rs)* on each frequency converter to compensate for the cable length, frequency converter losses, and the temperature deviation on the motor. When enabling this function, the frequency converter calculates the $R_s$ value when it starts, ensuring the optimal torque estimate and thereby optimal performance.

| Option: | | Function: |
|---|---|---|
| [0] | Off | |
| [1] | 1st start after pwr-up | Calibrates at the first start-up after power-up and keeps this value until reset by a power cycle. |
| [2] | Every start | Calibrates at every start-up, compensating for a possible change in motor temperature since last start-up. The value is reset after a power cycle. |
| [3] | 1st start with store | The frequency converter calibrates the torque at the first start-up after power-up. This option is used to update motor parameters:<br>• *parameter 1-30 Stator Resistance (Rs)*<br>• *parameter 1-33 Stator Leakage Reactance (X1)*<br>• *parameter 1-34 Rotor Leakage Reactance (X2)*<br>• *parameter 1-37 d-axis Inductance (Ld)* |
| [4] | Every start with store | The frequency converter calibrates the torque at every start-up, compensating for a possible change in motor temperature since last start-up. This option is used to update motor parameters: |

**1-47 Torque Calibration**

Use this parameter to optimise the torque estimate in the full speed range. The estimated torque is based on the shaft power, $P_{shaft} = P_m - R_s * I^2$. This means that it is important to have the correct $R_s$ value. The $R_s$ value in this formula is equal to the power loss in both the motor, the cable, and the frequency converter. Sometimes it is not possible to adjust *parameter 1-30 Stator Resistance (Rs)* on each frequency converter to compensate for the cable length, frequency converter losses, and the temperature deviation on the motor. When enabling this function, the frequency converter calculates the $R_s$ value when it starts, ensuring the optimal torque estimate and thereby optimal performance.

| Option: | | Function: |
|---|---|---|
| | | • *parameter 1-30 Stator Resistance (Rs)*<br>• *parameter 1-33 Stator Leakage Reactance (X1)*<br>• *parameter 1-34 Rotor Leakage Reactance (X2)*<br>• *parameter 1-37 d-axis Inductance (Ld)* |

| 1-48 Inductance Sat. Point | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [1 - 500 %] | Inductance Saturation Point. |

## 3.3.8 1-5* Load Indep. Setting

**1-50 Motor Magnetisation at Zero Speed**

This parameter is not visible on the LCP.

| Range: | | Function: |
|---|---|---|
| 100 %* | [0 - 300 %] | Use this parameter along with *parameter 1-51 Min Speed Normal Magnetising [RPM]* to obtain a different thermal load on the motor when running at low speed.<br>Enter a value which is a percentage of the rated magnetising current. If the setting is too low, the torque on the motor shaft may be reduced. |

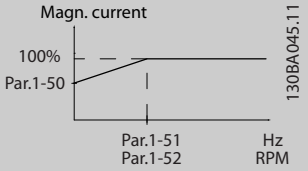


**Illustration 3.7 Motor Magnetisation**

***NOTICE***

***Parameter 1-50 Motor Magnetisation at Zero Speed* has no effect when *1-10 Motor Construction* = [1] PM, non-salient SPM.**

### 1-51 Min Speed Normal Magnetising [RPM]

This parameter is not visible on the LCP.

| Range: | | Function: |
|---|---|---|
| Size related* | [10 - 300 RPM] | **NOTICE**<br>***Parameter 1-51 Min Speed Normal Magnetising [RPM]* has no effect when *1-10 Motor Construction = [1] PM, non-salient SPM*.**<br>**NOTICE**<br>**This parameter is not visible on the LCP.**<br>Set the required speed for normal magnetising current. If the speed is set lower than the motor slip speed, *parameter 1-50 Motor Magnetisation at Zero Speed* and *parameter 1-51 Min Speed Normal Magnetising [RPM]* are of no significance.<br>Use this parameter along with *parameter 1-50 Motor Magnetisation at Zero Speed*. See *Table 3.7*. |

### 1-52 Min Speed Normal Magnetising [Hz]

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - 250.0 Hz] | Set the required frequency for normal magnetising current. If the frequency is set lower than the motor slip frequency, *parameter 1-50 Motor Magnetisation at Zero Speed* is inactive.<br>Use this parameter along with *parameter 1-50 Motor Magnetisation at Zero Speed*. See *Illustration 3.7*. |

### 1-53 Model Shift Frequency

| Range: | | Function: |
|---|---|---|
| Size related* | [ 4 - 18.0 Hz] | **NOTICE**<br>**This parameter cannot be adjusted while the motor is running.**<br>**Flux Model shift**<br>Enter the frequency value for shift between 2 models for determining motor speed. Select the value based on settings in *parameter 1-00 Configuration Mode* and *parameter 1-01 Motor Control Principle*. There are 2 options: shift between Flux model 1 and Flux model 2; or shift between Variable Current mode and Flux model 2. FC 302 only.<br>**Flux model 1 – Flux model 2**<br>This model is used when *parameter 1-00 Configuration Mode* is set to *Speed closed loop* [1] or *Torque* [2], and *parameter 1-01 Motor Control Principle* is set to *Flux w/motor feedback* [3]. With this parameter it is possible to make an adjustment of the shifting point where FC 302 changes between Flux model 1 and Flux model 2, which is useful in some sensitive speed and torque control applications. |

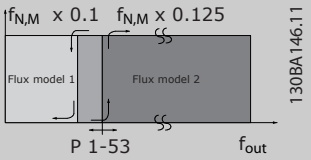


**Illustration 3.8 *Parameter 1-00 Configuration Mode* = [1] Speed closed loop or [2] Torque and *parameter 1-01 Motor Control Principle* = [3] Flux w/motor feedback**

**Variable Current - Flux model - Sensorless**
This model is used when *parameter 1-00 Configuration Mode* is set to *[0] Speed open loop* and *parameter 1-01 Motor Control Principle* is set to *[2] Flux sensorless*. In speed open loop in Flux mode, the speed is determined from the current measurement. Below $f_{norm}$ x 0.1, the frequency converter runs on a variable current model. Above $f_{norm}$ x 0.125 the frequency converter runs on a Flux model.

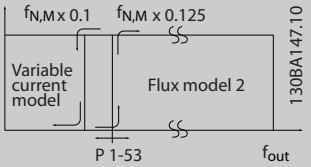


**Illustration 3.9 *Parameter 1-00 Configuration Mode* = [0] Speed open loop, *parameter 1-01 Motor Control Principle* = [2] Flux sensorless**

### 1-54 Voltage reduction in fieldweakening

| Range: | | Function: |
|---|---|---|
| 0 V* | [0 - 100 V] | The value of this parameter reduces the maximal voltage available for the Flux of the motor in fieldweakning, giving more voltage available for torque. Be aware that an excessive value may cause stall problems at high speed. |

3

| 1-55 U/f Characteristic - U | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 1000 V] | Enter the voltage at each frequency point to manually form a U/f characteristic matching the motor.<br>The frequency points are defined in *parameter 1-56 U/f Characteristic - F*.<br>This parameter is an array parameter [0-5] and is only accessible when *parameter 1-01 Motor Control Principle* is set to *[0] U/f*. |

| 1-56 U/f Characteristic - F | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 1000.0 Hz] | Enter the frequency points to manually form a U/f-characteristic matching the motor.<br>The voltage at each point is defined in *parameter 1-55 U/f Characteristic - U*.<br>This parameter is an array parameter [0-5] and is only accessible when *parameter 1-01 Motor Control Principle* is set to *[0] U/f*. |

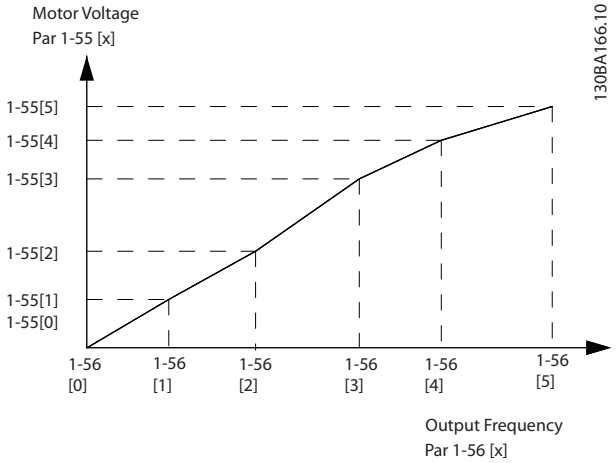


**Illustration 3.10 U/f Characteristic**

| 1-58 Flying Start Test Pulses Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 200 %] | Sets the current level for the flystart test pulses that are used to detect the motor direction. 100% means $I_{m,n}$. Adjust the value to be big enough to avoid noise influence, but low enough to avoid affecting the accuracy (current must be able to drop to zero before the next pulse). Reduce the value to reduce the generated torque.<br>Default is 30% for asynchronous motors, but may vary for PM motors. For adjusting |

| 1-58 Flying Start Test Pulses Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | PM motors, the value tunes for back EMF and d-axis inductance of the motor.<br>This parameter is only available in VVC+. |

| 1-59 Flying Start Test Pulses Frequency | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 500 %] | Sets the frequency of the flystart test pulses that are used to detect the motor direction. 100% means means 2 x fslip. Increase this value to reduce the generated torque. For PM motors, this value is the percentage nm,n of the free-running PM motor. Above this value, flystart is always performed. Below this value, the start mode is selected in *parameter 1-70 PM Start Mode*<br>This parameter is only available in VVC+. |

## 3.3.9 1-6* Load Depend. Setting

| 1-60 Low Speed Load Compensation | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 300 %] | 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 | Changeover |
|---|---|
| 0.25 kW-7.5 kW | <10 Hz |

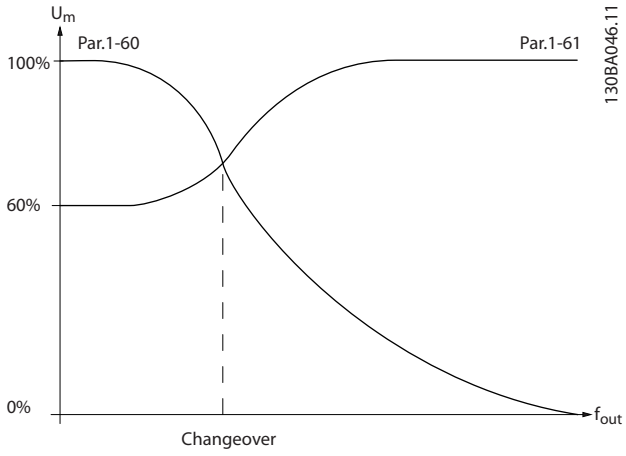


**Illustration 3.11 Changeover**

### 1-61 High Speed Load Compensation

| Range: | | Function: |
|---|---|---|
| 100 %* | [0 - 300 %] | 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 | Changeover |
|---|---|
| 0.25 kW - 7.5 kW | > 10 Hz |

**Table 3.8 Changeover Frequency**

### 1-62 Slip Compensation

| Range: | | Function: |
|---|---|---|
| Size related* | [-500 - 500 %] | Enter the % value for slip compensation, to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, i.e. on the basis of the rated motor speed $n_{M,N}$. This function is not active when *parameter 1-00 Configuration Mode* is set to *[1] Speed closed loop* or *[2] Torque* Torque control with speed feedback or when *parameter 1-01 Motor Control Principle* is set to *[0] U/f* special motor mode. |

### 1-63 Slip Compensation Time Constant

| Range: | | Function: |
|---|---|---|
| Size related* | [0.05 - 5 s] | 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. |

**NOTICE**

***Parameter 1-63 Slip Compensation Time Constant* has no effect when *1-10 Motor Construction* = [1] PM, non-salient SPM.**

### 1-64 Resonance Dampening

| Range: | | Function: |
|---|---|---|
| 100 %* | [0 - 500 %] | Enter the resonance dampening value. Set *parameter 1-64 Resonance Dampening* and *parameter 1-65 Resonance Dampening Time Constant* to help eliminate high-frequency resonance problems. To reduce resonance oscillation, increase the value of *parameter 1-64 Resonance Dampening*. |

**NOTICE**

***Parameter 1-64 Resonance Dampening* has no effect when *1-10 Motor Construction* = *[1] PM*, non-salient SPM.**

### 1-65 Resonance Dampening Time Constant

| Range: | | Function: |
|---|---|---|
| 5 ms* | [5 - 50 ms] | Set *parameter 1-64 Resonance Dampening* and *parameter 1-65 Resonance Dampening Time Constant* to help eliminate high-frequency resonance problems. Enter the time constant that provides the best dampening. |

**NOTICE**

***Parameter 1-65 Resonance Dampening Time Constant* has no effect when *1-10 Motor Construction* = *[1] PM*, non-salient SPM.**

### 1-66 Min. Current at Low Speed

This parameter is valid for FC 302 only.

| Range: | | Function: |
|---|---|---|
| Size related* | [ 1 - 200 %] | Enter the minimum motor current at low speed, see *parameter 1-53 Model Shift Frequency*. Increasing this current improves motor torque at low speed. *Parameter 1-66 Min. Current at Low Speed* is enabled when *parameter 1-00 Configuration Mode [0] Speed open loop* only. The frequency converter runs with constant current through motor for speeds below 10 Hz. For speeds above 10 Hz, the motor Flux model in the frequency converter controls the motor. *Parameter 4-16 Torque Limit Motor Mode* and/or *parameter 4-17 Torque Limit Generator Mode* automatically adjust *parameter 1-66 Min. Current at Low Speed*. The parameter with the highest value adjusts *parameter 1-66 Min. Current at Low Speed*. The current setting in *parameter 1-66 Min. Current at Low Speed* is composed of the torque generating current and the magnetising current. Example: Set *parameter 4-16 Torque Limit Motor Mode* to 100% and set *parameter 4-17 Torque Limit Generator Mode* to 60%. *Parameter 1-66 Min. Current at Low Speed* automatically adjusts to about 127%, depending on the motor size. FC 302 only. |

### 1-67 Load Type

This parameter is valid for FC 302 only.

| Option: | | Function: |
|---|---|---|
| [0] * | Passive load | For conveyors, fan and pump applications. |
| [1] | Active load | For hoisting applications, used in slip compensation at low speed. When *[1] Active Load* is selected, set *parameter 1-66 Min.* |

3

| 1-67 Load Type | | |
|---|---|---|
| This parameter is valid for FC 302 only. | | |
| **Option:** | | **Function:** |
| | | *Current at Low Speed* to a level which corresponds to maximum torque. |

| 1-68 Motor Inertia | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 kgm²* | [0.0000 - 10000.0000 kgm²] | |

| 1-69 System Inertia | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0000 - 10000.0000 kgm²] | ***NOTICE***<br>**This parameter cannot be adjusted while motor is running.**<br><br>Active in Flux Open Loop only. Used to compute the acceleration torque at low speed. Used in the torque limit controller.<br>FC 302 only. |

## 3.3.10 1-7* Start Adjustments

| 1-70 PM Start Mode | | |
|---|---|---|
| Select the PM motor start-up mode. This is done to initialise the VVC+ control core for previously free-running PM motor. Both selections estimate the speed and angle. Active for PM motors in VVC+ only. | | |
| **Option:** | | **Function:** |
| [0] * | Rotor Detection | Estimates the electrical angle of the rotor and uses this as a starting point. Standard selection for AutomationDrive applications. |
| [1] | Parking | The Parking function applies DC current across the stator winding and rotates the rotor to electrical zero position (typically selected for HVAC applications). |

| 1-71 Start Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 s* | [0 - 25.5 s] | This parameter refers to the start function selected in *parameter 1-72 Start Function*. Enter the time delay required before commencing acceleration. |

| 1-72 Start Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the start function during start delay. This parameter is linked to *parameter 1-71 Start Delay*. |
| [0] | DC Hold/ delay time | Energises motor with a DC holding current (*parameter 2-00 DC Hold Current*) during the start delay time. |
| [1] | DC Brake/ delay time | Energises motor with a DC braking current (*parameter 2-01 DC Brake Current*) during the start delay time. |
| [2] * | Coast/delay time | Motor coasted during the start delay time (inverter off). |
| [3] | Start speed cw | Only possible with VVC+.<br>Connect the function described in *parameter 1-74 Start Speed [RPM]* and *parameter 1-76 Start Current* in the start delay time.<br>Regardless of the value applied by the reference signal, the output speed applies the setting of the start speed in *parameter 1-74 Start Speed [RPM]* or *parameter 1-75 Start Speed [Hz]*, and the output current corresponds to the setting of the start current in *parameter 1-76 Start Current*. This function is typically used in hoisting applications without counterweight and especially in applications with a Cone-motor, where the start is clockwise, followed by rotation in the reference direction. |
| [4] | Horizontal operation | Only possible with VVC+.<br>For obtaining the function described in *parameter 1-74 Start Speed [RPM]* and *parameter 1-76 Start Current* during the start delay time. The motor rotates in the reference direction. If the reference signal equals zero (0), *parameter 1-74 Start Speed [RPM]* is ignored and the output speed equals zero (0). The output current corresponds to the setting of the start current in *parameter 1-76 Start Current*. |
| [5] | VVC+/Flux clockwise | For the function described in *parameter 1-74 Start Speed [RPM]* only. The start current is calculated automatically. This function uses the start speed in the start delay time only. Regardless of the value set by the reference signal, the output speed equals the setting of the start speed in *parameter 1-74 Start Speed [RPM]*. *[3] Start speed/current clockwise* and *[5] VVCplus/Flux clockwise* are typically used in hoisting applications. *[4] Start speed/current in reference direction* is particularly used in applications |

  

| 1-72 Start Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | with counterweight and horizontal movement. |
| [6] | Hoist Mech. Brake Rel | For utilising mechanical brake control functions (*parameter 2-24 Stop Delay* to *parameter 2-28 Gain Boost Factor*). This parameter is only active when *parameter 1-01 Motor Control Principle* is set to [3] *Flux w/ motor feedback (FC 302 only)*. |
| [7] | VVC+/Flux counter-cw | |

| 1-73 Flying Start | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>This function makes it possible to catch a motor which is spinning freely due to a mains drop-out. |
| [0] | Disabled | No function |
| [1] | Enabled | Enables the frequency converter to catch and control a spinning motor.<br>When *parameter 1-73 Flying Start* is enabled, *parameter 1-71 Start Delay* and *parameter 1-72 Start Function* have no function. |
| [2] | Enabled Always | |
| [3] | Enabled Ref. Dir. | |
| [4] | Enab. Always Ref. Dir. | |

***NOTICE***

**This function is not recommended for hoisting applications.**
**For power levels above 55 kW, Flux mode must be used to achieve the best performance.**

***NOTICE***

**To obtain the best flying start performance the advanced motor data, *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-35 Main Reactance (Xh)*, must be correct.**

| 1-74 Start Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 600 RPM] | Set a motor start speed. After the start signal, the output speed leaps to set value. Set the start function in *parameter 1-72 Start Function* to *[3] Start speed cw*, *[4] Horizontal operation* or *[5] VVC$^{plus}$/Flux clockwise*, and set a start delay time in *parameter 1-71 Start Delay*. |

| 1-74 Start Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | *speed cw*, *[4] Horizontal operation* or *[5] VVC$^{plus}$/Flux clockwise*, and set a start delay time in *parameter 1-71 Start Delay*. |

| 1-75 Start Speed [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 500.0 Hz] | This parameter can be used for hoist applications (cone rotor). Set a motor start speed. After the start signal, the output speed leaps to set value. Set the start function in *parameter 1-72 Start Function* to *[3] Start speed cw*, *[4] Horizontal operation* or *[5] VVC$^{plus}$/Flux clockwise*, and set a start delay time in *parameter 1-71 Start Delay*. |

| 1-76 Start Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 A* | [0 - par. 1-24 A] | Some motors, e.g. cone rotor motors, need extra current/starting speed to disengage the rotor. To obtain this boost, set the required current in *parameter 1-76 Start Current*. Set *parameter 1-74 Start Speed [RPM]*. Set *parameter 1-72 Start Function* to *[3] Start speed cw* or *[4] Horizontal operation*, and set a start delay time in *parameter 1-71 Start Delay*.<br>This parameter can be used for hoist applications (cone rotor). |

## 3.3.11 1-8* Stop Adjustments

| 1-80 Function at Stop | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the frequency converter function after a stop command or after the speed is ramped down to the settings in *parameter 1-81 Min Speed for Function at Stop [RPM]*. |
| [0] * | Coast | Leaves motor in free mode. The motor is disconnected from the frequency converter. |
| [1] | DC hold | Energises motor with a DC holding current (see *parameter 2-00 DC Hold Current*). |
| [2] | Motor check | Checks if a motor has been connected. |
| [3] | Pre-magnetizing | Builds up a magnetic field while the motor is stopped. This allows the motor to produce torque quickly at subsequent start commands (asynchronous motors only). This pre-magnetising function does not help the very first start command. 2 different solutions are available to pre-magnetise the machine for the first start command: |

3

**1-80 Function at Stop**

| Option: | | Function: |
|---|---|---|
| | | 1. Start the frequency converter with a 0 RPM reference and wait 2 to 4 rotor time constants before increasing the speed reference.<br>1a. Set *parameter 1-71 Start Delay* to the desired pre-mag. time (2 to 4 rotor time constants. See the time constants description further in this section).<br>1b. Set *parameter 1-72 Start Function* to either *[0] DC hold* or *[1] DC Brake*.<br>Set the DC hold or DC brake current magnitude (*parameter 2-00 DC Hold Current* or *parameter 2-01 DC Brake Current*) to be equal to I_pre-mag = Unom/(1.73 x Xh)<br>Sample rotor time constants = (Xh+X2)/(6.3*Freq_nom*Rr)<br>1 kW = 0.2 s<br>10 kW = 0.5 s<br>100 kW = 1.7 s<br>1000 kW = 2.5 s |
| [4] | DC Voltage U0 | When the motor is stopped, the *parameter 1-55 U/f Characteristic - U* [0] defines the voltage at 0 Hz. |
| [5] | Coast at low reference | When the reference is below *1-81 Min Speed for Function at Stop [RPM]*, the motor is disconnected from the frequency converter. |
| [6] | Motor check, alarm | |

**1-81 Min Speed for Function at Stop [RPM]**

| Range: | | Function: |
|---|---|---|
| Size related* | [0 - 600 RPM] | Set the speed at which to activate *1-80 Function at Stop*. |

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

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - 20.0 Hz] | Set the output frequency at which to activate *1-80 Function at Stop*. |

**1-83 Precise Stop Function**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>FC 302 only. |

**1-83 Precise Stop Function**

| Option: | | Function: |
|---|---|---|
| [0] * | Precise ramp stop | Only optimal when the operational speed, for example the operational speed of a conveyor belt is constant. This is an open loop control. Achieves high repetitive precision at the stopping point. |
| [1] | Cnt stop with reset | Counts the number of pulses, typically from an encoder, and generates a stop signal after a pre-programmed number of pulses, defined in parameter *parameter 1-84 Precise Stop Counter Value*,has been received at *terminal 29* or *terminal 33*.<br>This is a direct feedback with one-way closed loop control.<br>The counter function is activated (starts timing) at the edge of the start signal (when it changes from stop to start). After each precise stop, the number of pulses counted during ramp down to 0 RPM is reset. |
| [2] | Cnt stop w/o reset | Same as [1] but the number of pulses counted during ramp down to 0 RPM is deducted from the counter value entered in *parameter 1-84 Precise Stop Counter Value*.<br>This reset function can be used to compensate for the extra distance done during ramping down and to reduce the impacts of gradual wear of mechanical parts. |
| [3] | Speed comp stop | Stops at precisely the same point, regardless of the present speed. The stop signal is delayed internally when the present speed is lower than the maximum speed (set in *parameter 4-19 Max Output Frequency*).<br>The delay is calculated on the basis of the reference speed of the frequency converter and not on the basis of the actual speed. Make sure that the frequency converter has ramped up before activating the speed compensated stop. |
| [4] | Com cnt stop w/rst | Same as [3] but after each precise stop, the number of pulses counted during ramp down to 0 RPM is reset. |
| [5] | Comp cnt stop w/o r | Same as [3] but the number of pulses counted during ramp down to 0 RPM is deducted from the counter value entered in *parameter 1-84 Precise Stop Counter Value*.<br>This reset function can be used to compensate for the extra distance done during ramping down and to reduce the impacts of gradual wear of mechanical parts. |

The precise stop functions are advantageous in applications where high precision is required.
If using a standard stop command, the accuracy is determined by the internal task time. That is not the case when using the precise stop function; it eliminates the task time dependence and increases the accuracy substantially.

The frequency converter tolerance is normally given by its task time. However, by using its special precise stop function, the tolerance is independent of the task time because the stop signal immediately interrupts the execution of the frequency converter program. The precise stop function gives a highly reproducible delay from the stop signal is given until the ramping down starts. A test must be done to find this delay as it is a sum of sensor, PLC, frequency converter, and mechanical parts.
To ensure optimum accuracy there should be at least 10 cycles during ramping down, see *parameter 3-42 Ramp 1 Ramp Down Time*, *parameter 3-52 Ramp 2 Ramp Down Time*, *parameter 3-62 Ramp 3 Ramp down Time*, and *parameter 3-72 Ramp 4 Ramp Down Time*.
The precise stop function is set up here and enabled from DI at *terminal 29* or *terminal 33*.

| 1-84 Precise Stop Counter Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100000* | [0 - 999999999] | Enter the counter value to be used in the integrated precise stop function, *parameter 1-83 Precise Stop Function*. The maximum permissible frequency at terminal 29 or 33 is 110 kHz.<br>***NOTICE***<br>**Not used for selections *[0] Precise ramp stop* and *[3] Speed comp stop* in *parameter 1-83 Precise Stop Function*.** |

| 1-85 Precise Stop Speed Compensation Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 ms* | [0 - 100 ms] | Enter the delay time for sensors, PLCs, etc. for use in *parameter 1-83 Precise Stop Function*. In speed compensated stop mode, the delay time at different frequencies has a major influence on the stop function.<br>***NOTICE***<br>**Not used for selections *[0] Precise ramp stop*, *[1] Cnt stop with reset*, and *[2] Cnt stop w/o reset* in *parameter 1-83 Precise Stop Function*.** |

## 3.3.12 1-9* Motor Temperature

| 1-90 Motor Thermal Protection | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Thermal motor protection can be implemented using a range of techniques:<br>• Via a PTC sensor in the motor windings connected to one of the analog or digital inputs (*parameter 1-93 Thermistor Source*). See *chapter 3.3.13.1 PTC Thermistor Connection*.<br>• Via a KTY sensor in the motor winding connected to an analog input (*parameter 1-96 KTY Thermistor Resource*). See *chapter 3.3.13.2 KTY Sensor Connection*.<br>• Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. See *chapter 3.3.13.3 ETR* and *chapter 3.3.13.4 ATEX ETR*.<br>• Via a mechanical thermal switch (Klixon type). See *chapter 3.3.13.5 Klixon*.<br>For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC. |
| [0] | No protection | Continuously overloaded motor, when no warning or trip of the frequency converter is required. |
| [1] | Thermistor warning | Activates a warning when the connected thermistor or KTY sensor in the motor reacts in the event of motor overtemperature. |
| [2] | Thermistor trip | Stops (trips) the frequency converter when connected thermistor or KTY sensor in the motor reacts in the event of motor over-temperature.<br>The thermistor cut-out value must be > 3 kΩ.<br>Integrate a thermistor (PTC sensor) in the motor for winding protection. |
| [3] | ETR warning 1 | Calculates the load when set-up 1 is active and activates a warning on the display when the motor is overloaded. Program a warning signal via one of the digital outputs. |
| [4] | ETR trip 1 | Calculates the load when set-up 1 is active and stops (trips) the frequency converter when the motor is overloaded. Program a warning signal via one of the digital outputs. The signal appears in the event of a warning and if the frequency converter trips (thermal warning). |
| [5] | ETR warning 2 | |
| [6] | ETR trip 2 | |

3

| 1-90 Motor Thermal Protection | | |
|---|---|---|
| **Option:** | | **Function:** |
| [7] | ETR warning 3 | |
| [8] | ETR trip 3 | |
| [9] | ETR warning 4 | |
| [10] | ETR trip 4 | |
| [20] | ATEX ETR | Activates the thermal monitoring function for Ex-e motors for ATEX. Enables *parameter 1-94 ATEX ETR cur.lim. speed reduction, parameter 1-98 ATEX ETR interpol. points freq.* and *parameter 1-99 ATEX ETR interpol points current.* |
| [21] | Advanced ETR | |

***NOTICE***

**If *[20] ATEX ETR* is selected, follow the instructions in the dedicated chapter of the *VLT® AutomationDrive Design Guide* and the instructions provided by the motor manufacturer.**

***NOTICE***

**If *[20] ATEX ETR* is selected, *parameter 4-18 Current Limit* must be set to 150%.**

### 3.3.13.1 PTC Thermistor Connection

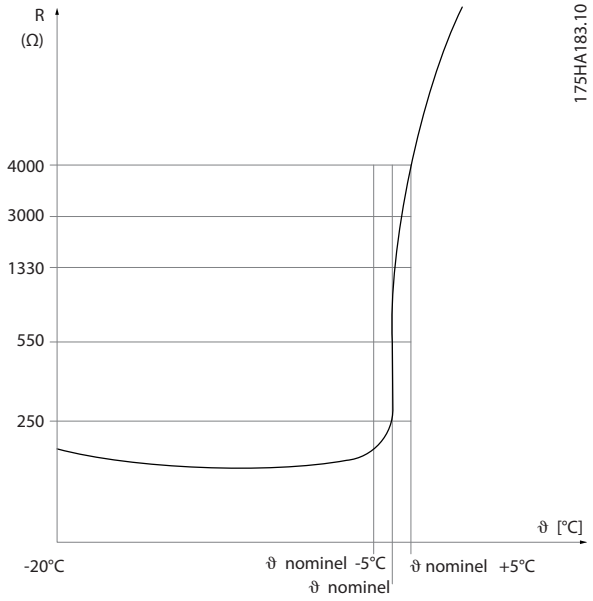


**Illustration 3.12 PTC Profile**

Using a digital input and 10 V as power supply:
Example: The frequency converter trips when the motor temperature is too high.
Parameter set-up:
Set *parameter 1-90 Motor Thermal Protection* to *[2] Thermistor Trip*
Set *parameter 1-93 Thermistor Source* to *[6] Digital Input*

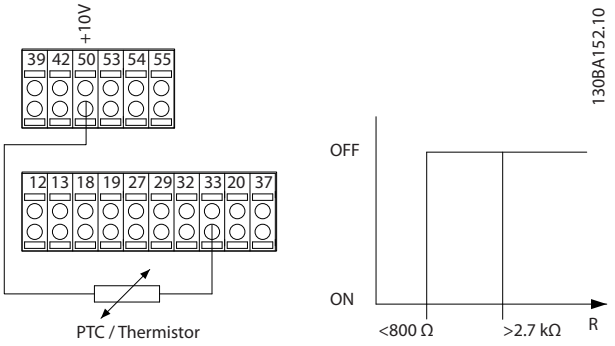


**Illustration 3.13 PTC Thermistor Connection - Digital Input**

Using an analog input and 10 V as power supply:
Example: The frequency converter trips when the motor temperature is too high.
Parameter set-up:
Set *parameter 1-90 Motor Thermal Protection* to *[2] Thermistor Trip*
Set *parameter 1-93 Thermistor Source* to *[2] Analog Input 54*

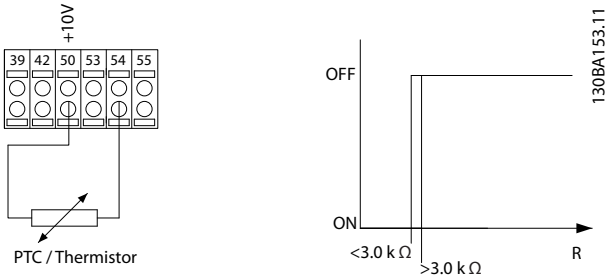


**Illustration 3.14 PTC Thermistor Connection - Analog Input**

| 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 |

***NOTICE***

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

### 3.3.13.2 KTY Sensor Connection

(FC 302 only)

KTY sensors are used especially in permanent magnet servo motors (PM motors) for dynamic adjusting of motor parameters as stator resistance (*parameter 1-30 Stator Resistance (Rs)*) for PM motors and also rotor resistance (*parameter 1-31 Rotor Resistance (Rr)*) for asynchronous motors, depending on winding temperature. The calculation is:

$Rs = Rs20^{\circ}C \times (1 + \alpha cu \times \Delta T)\ [\Omega]$ where $\alpha cu = 0.00393$

KTY sensors can be used for motor protecting (*parameter 1-97 KTY Threshold level*).
FC 302 can handle 3 types of KTY sensors, defined in *parameter 1-95 KTY Sensor Type*. The actual sensor temperature can be read out from *parameter 16-19 KTY sensor temperature*.

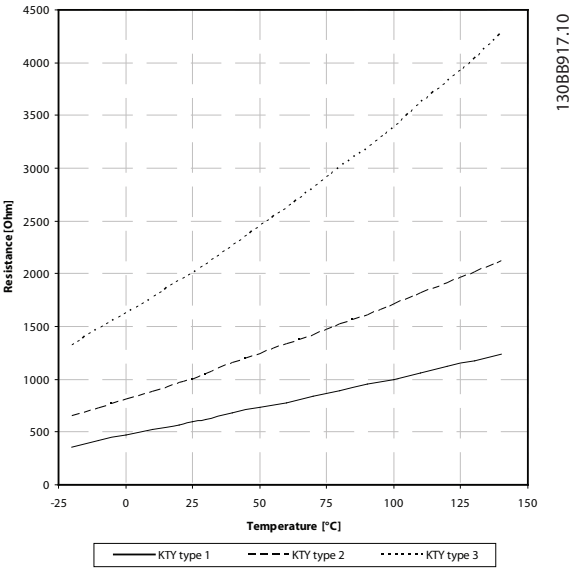


**Illustration 3.15 KTY Type Selection**

KTY Sensor 1: 1 kΩ at 100 °C (e.g. Philips KTY 84-1)
KTY Sensor 2: 1 kΩ at 25 °C (e.g. Philips KTY 83-1)
KTY Sensor 3: 2 kΩ at 25 °C (e.g. Infineon KTY-10

***NOTICE***

**If the temperature of the motor is utilised through a thermistor or KTY sensor, the PELV is not complied with in case of short circuits between motor windings and sensor. To comply with PELV the sensor must be extra isolated.**

### 3.3.13.3 ETR

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

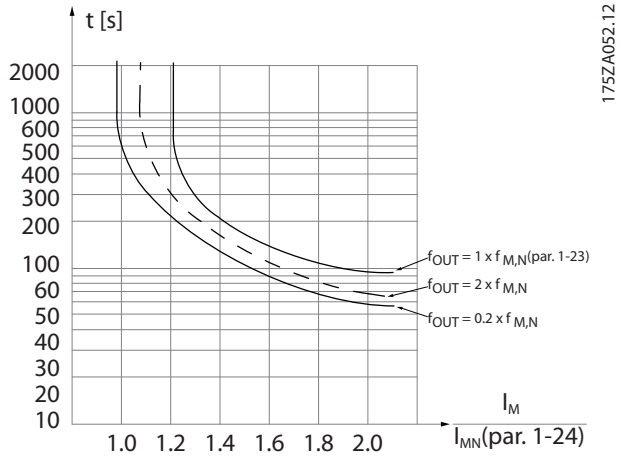


**Illustration 3.16 ETR Profile**

### 3.3.13.4 ATEX ETR

The B option MCB 112 PTC Thermistor option offers ATEX approved monitoring of motor temperature. Alternatively, an external ATEX approved PTC protection device can be used.

***NOTICE***

**Only ATEX Ex-e approved motors may be used for this function. See motor nameplate, approval certificate, data sheet or contact motor supplier.**

When controlling an Ex-e motor with “Increased Safety”, it is important to ensure certain limitations. The parameters that must be programmed are presented in the following application example.

| Function | Setting |
|---|---|
| Parameter 1-90 Motor Thermal Protection | [20] ATEX ETR |
| Parameter 1-94 ATEX ETR cur.lim. speed reduction | 20% |
| Parameter 1-98 ATEX ETR interpol. points freq. | Motor name plate. |
| Parameter 1-99 ATEX ETR interpol points current | |
| Parameter 1-23 Motor Frequency | Enter the same value as for *parameter 4-19 Max Output Frequency*. |
| Parameter 4-19 Max Output Frequency | Motor name plate, possibly reduced for long motor cables, sinus filter or reduced supply voltage. |
| parameter 4-18 Current Limit | Forced to 150% by 1-90 [20] |
| 5-15 Terminal 33 Digital Input | [80] PTC Card 1 |
| Parameter 5-19 Terminal 37 Safe Stop | [4] PTC 1 Alarm |
| Parameter 14-01 Switching Frequency | Check that the default value fulfils the requirement from motor name plate. If not, use sine-wave filter. |
| Parameter 14-26 Trip Delay at Inverter Fault | 0 |

**Table 3.9 Parameters**

**⚠CAUTION**

**Compare the minimum switching frequency requirement stated by the motor manufacturer to the minimum switching frequency of the frequency converter, the default value in *parameter 14-01 Switching Frequency*. If the frequency converter does not meet this requirement, use a sine-wave filter.**

More information about ATEX ETR Thermal Monitoring can be found in the Application Note MN33G.

### 3.3.13.5 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 power supply:
Example: The frequency converter trips when the motor temperature is too high.
Parameter set-up:
Set *parameter 1-90 Motor Thermal Protection* to *[2] Thermistor Trip*.
Set *parameter 1-93 Thermistor Source* to *[6] Digital Input*.

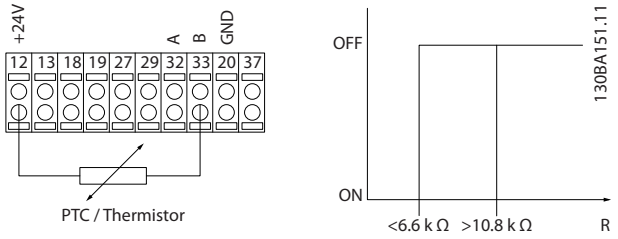


**Illustration 3.17 Thermistor Connection**

| 1-91 Motor External Fan | | |
|---|---|---|
| **Option:** | **Function:** | |
| [0] * | No | No external fan is required, i.e. 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 3.16* ($f_{out}$ = 1 x $f_{M,N}$) is followed if the motor current is lower than nominal motor current (see *1-24 Motor Current*). If the motor current exceeds nominal current, the operation time still decreases as if no fan were installed. |

| 1-93 Thermistor Source | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>***NOTICE***<br>**Set digital input to *[0] PNP - Active at 24 V* in *5-00 Digital I/O Mode*.**<br>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 *3-15 Reference 1 Source*, *3-16 Reference 2 Source* or *3-17 Reference 3 Source*).<br>When using VLT® PTC thermistor card MCB 112, *[0] None* must always be selected. |
| [0] * | None | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [3] | Digital input 18 | |
| [4] | Digital input 19 | |
| [5] | Digital input 32 | |

  

| 1-93 Thermistor Source | | |
|---|---|---|
| **Option:** | | **Function:** |
| [6] | Digital input 33 | |

| 1-94 ATEX ETR cur.lim. speed reduction | | |
|---|---|---|
| FC 302 only.<br>Only visible if *parameter 1-90 Motor Thermal Protection* is set to [20]. | | |
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | |

The reaction for operating in Ex-e current limit must be configured.
0%: The frequency converter does not change anything besides issuing warning 163 ATEX ETR cur.lim.warning.
>0%: The frequency converter issues warning 163 and reduces motor speed following ramp 2 (parameter group *3-5* Ramp 2*).

Example:
Actual reference = 50 RPM
*Parameter 1-94 ATEX ETR cur.lim. speed reduction* = 20%
Resulting reference = 40 RPM

| 1-95 KTY Sensor Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the used type of KTY sensor. FC 302 only. |
| [0] * | KTY Sensor 1 | 1 kΩ at 100 °C |
| [1] | KTY Sensor 2 | 1 kΩ at 25 °C |
| [2] | KTY Sensor 3 | 2 kΩ at 25 °C |

| 1-96 KTY Thermistor Resource | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Selecting analog input terminal 54 to be used as KTY sensor input. Terminal 54 cannot be selected as KTY source if otherwise used as reference (see *parameter 3-15 Reference Resource 1* to *parameter 3-17 Reference Resource 3*).<br>FC 302 only.<br>***NOTICE***<br>**Connection of KTY sensor between term. 54 and 55 (GND). See *Illustration 3.15*.** |
| [0] * | None | |
| [2] | Analog Input 54 | |

| 1-97 KTY Threshold level | | |
|---|---|---|
| **Range:** | | **Function:** |
| 80 °C* | [-40 - 140 °C] | Select the KTY sensor threshold level for motor thermal protection.<br>FC 302 only. |

| 1-98 ATEX ETR interpol. points freq. | | |
|---|---|---|
| FC 302 only.<br>Only visible if *parameter 1-90 Motor Thermal Protection* is set to [20]. | | |
| **Range:** | | **Function:** |
| Size related* | [ 0 - 1000.0 Hz] | |

Enter the 4 frequency points [Hz] from the motor name plate into this array. Together with *parameter 1-99 ATEX ETR interpol points current*, these can be presented in *Table 3.10*.

***NOTICE***

**All frequency/current limit points from the motor name plate or motor data sheet must be programmed.**

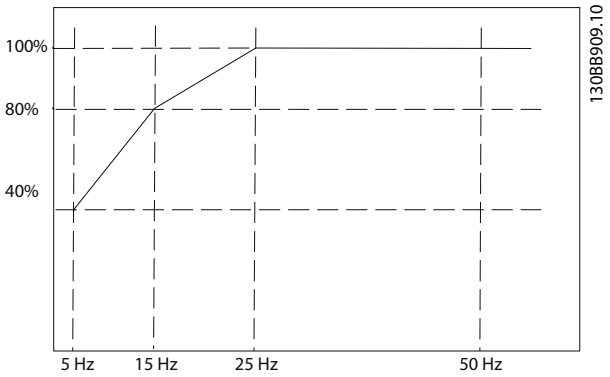


**Illustration 3.18 Example of ATEX ETR Thermal Limitation Curve.**
**x-axis: $f_m$ [Hz]**
**y-axis: $I_m/I_{m,n}$ x 100 [%]**

| Parameter 1-98 ATEX ETR interpol. points freq. | Parameter 1-99 ATEX ETR interpol points current |
|---|---|
| [0]=5 Hz | [0]=40% |
| [1]=15 Hz | [1]=80% |
| [2]=25 Hz | [2]=100% |
| [3]=50 Hz | [3]=100% |

All operating points underneath the curve are allowed continuously. Above the line, however, these are only allowed for a limited time calculated as a function of the overload. In the event of a machine current greater than 1.5 times the rated current, shut-down is immediate.

| 1-99 ATEX ETR interpol points current | | |
|---|---|---|
| FC 302 only.<br>Only visible if *parameter 1-90 Motor Thermal Protection* is set to [20] or [21]. | | |
| **Range:** | | **Function:** |
| Size related* | [0 - 100 %] | Definition of thermal limitation curve. For example, see *parameter 1-98 ATEX ETR interpol. points freq.* |

Use the 4 current points [A] from the motor name plate. Calculate the values as percentage of nominal motor current, $I_m/I_{m,n}$ x 100 [%], and enter into this array.

Together with *parameter 1-98 ATEX ETR interpol. points freq.*, these constitute a table (f [Hz],I [%]).

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***NOTICE***

**All frequency/current limit points from the motor name plate or motor data sheet must be programmed.**

### 3.3.14 PM Settings

If *[2] Std. PM, non-salient* is selected in *parameter 1-10 Motor Construction*, enter the motor parameters manually, in the following order:

1. *Parameter 1-24 Motor Current*.
2. *Parameter 1-26 Motor Cont. Rated Torque*.
3. *Parameter 1-25 Motor Nominal Speed*.
4. *Parameter 1-39 Motor Poles*.
5. *Parameter 1-30 Stator Resistance (Rs)*.
6. *Parameter 1-37 d-axis Inductance (Ld)*.
7. *Parameter 1-40 Back EMF at 1000 RPM*.

The following parameters have been added for PM motors.

1. *Parameter 1-41 Motor Angle Offset*.
2. *Parameter 1-07 Motor Angle Offset Adjust*.
3. *Parameter 1-14 Damping Gain*.
4. *Parameter 1-47 Torque Calibration*.
5. *Parameter 1-58 Flying Start Test Pulses Current*.
6. *Parameter 1-59 Flying Start Test Pulses Frequency*.
7. *Parameter 1-70 PM Start Mode*.
8. Parameter 30-20 High Starting Torque Time [s].
9. Parameter 30-21 High Starting Torque Current [%].

***NOTICE***

**Standard parameters still need configuration (e.g. *parameter 4-19 Max Output Frequency* etc.).**

| Application | Settings |
|---|---|
| Low inertia applications $I_{Load}/I_{Motor}$ <5 | *1-17 Voltage filter time const.* to be increased by factor 5 to 10.<br>*1-14 Damping Gain* should be reduced.<br>*1-66 Min. Current at Low Speed* should be reduced (<100%). |
| Low inertia applications 50>$I_{Load}/I_{Motor}$ >5 | Keep calculated values. |
| High inertia applications $I_{Load}/I_{Motor}$ > 50 | *1-14 Damping Gain*, *parameter 1-15 Low Speed Filter Time Const.* and *parameter 1-16 High Speed Filter Time Const.* should be increased. |
| High load at low speed <30% (rated speed) | *1-17 Voltage filter time const.* should be increased.<br>*1-66 Min. Current at Low Speed* should be increased (>100% for longer time can overheat the motor). |

**Table 3.10 Recommendations for VVC+ Applications**

If the motor starts oscillating at a certain speed, increase *1-14 Damping Gain*. Increase the value in small steps. Depending on the motor, a good value for this parameter can be 10% or 100% higher than the default value.

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

| Application | Settings |
|---|---|
| Low inertia applications | Keep calculated values. |
| High inertia applications | *Parameter 1-66 Min. Current at Low Speed*<br>Increase speed to a value between default and maximum depending on application.<br>Set ramp times matching the application. Too fast ramp up causes an overcurrent/overtorque. Too fast ramp down causes an overvoltage trip. |
| High load at low speed | *Parameter 1-66 Min. Current at Low Speed*<br>Increase speed to a value between default and maximum depending on application. |

**Table 3.11 Recommendations for Flux Applications**

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

  

## 3.4 Parameters: 2-** Brakes

### 3.4.1 2-0* DC-Brakes

Parameter group for configuring the DC brake and DC hold functions.

| 2-00 DC Hold Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 0 - 160 %] | Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in *parameter 1-24 Motor Current*. 100% DC holding current corresponds to $I_{M,N}$. This parameter holds the motor function (holding torque) or pre-heats the motor. This parameter is active if *DC hold* is selected in *parameter 1-72 Start Function* [0] or *parameter 1-80 Function at Stop* [1]. |

**NOTICE**

**The maximum value depends on the rated motor current.**
**Avoid 100% current for too long. It may damage the motor.**
**Low values of DC hold produces larger than expected currents with larger motor power sizes. This error increases as the motor power increases.**

| 2-01 DC Brake Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 0 - 1000 %] | Enter a value for current as a percentage of the rated motor current $I_{M,N}$, see *parameter 1-24 Motor Current*. 100% DC braking 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 2-03 DC Brake Cut In Speed [RPM]*; 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 2-02 DC Braking Time*. |

**NOTICE**

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

| 2-02 DC Braking Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 s* | [0 - 60 s] | Set the duration of the DC braking current set in *2-01 DC Brake Current*, once activated. |

| 2-03 DC Brake Cut In Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 60000 RPM] | Set the DC brake cut-in speed for activation of the DC braking current set in *parameter 2-01 DC Brake Current*, upon a stop command. |

| 2-04 DC Brake Cut In Speed [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 1000.0 Hz] | Set the DC brake cut-in speed for activation of the DC braking current set in *parameter 2-01 DC Brake Current*, upon a stop command. |

**NOTICE**

***Parameter 2-04 DC Brake Cut In Speed [Hz]* has no effect when *1-10 Motor Construction=[1] PM, non-salient SPM*.**

| 2-05 Maximum Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ par. 3-02 - 999999.999 ReferenceFeed-backUnit] | This is an access parameter to *parameter 3-03 Maximum Reference* for legacy products. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the choice of configuration in *parameter 1-00 Configuration Mode* and the unit in *parameter 3-01 Reference/Feedback Unit*. |

| 2-06 Parking Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 0 - 1000 %] | Set current as percentage of rated motor current, *parameter 1-24 Motor Current*. Is used when enabled in *parameter 1-70 PM Start Mode*. |

| 2-07 Parking Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 3 s* | [0.1 - 60 s] | Set the duration of the parking current set in *parameter 2-06 Parking Current*, once activated. |

### 3.4.2 2-1* Brake Energy Funct.

Parameter group for selecting dynamic braking parameters. Only valid for frequency converters with brake chopper.

| 2-10 Brake Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Off | No brake resistor is installed. |

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| 2-10 Brake Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1] | Resistor brake | A brake resistor is incorporated in the system, for dissipation of surplus 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 | Is selected to improve braking without using a brake resistor. This parameter controls an overmagnetisation of the motor when running with a generatoric load. This function can improve the OVC-function. Increasing the electrical losses in the motor allows the OVC function to increase the braking torque without exceeding the overvoltage limit.<br>***NOTICE***<br>**The AC brake is not as efficient as dynamic braking with resistor.**<br>**AC brake is for VVC+ mode in both open and closed loop.** |

| 2-11 Brake Resistor (ohm) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 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 *2-13 Brake Power Monitoring*. This parameter is only active in frequency converters with an integral dynamic brake.<br>Use this parameter for values without decimals. For a selection with 2 decimals, use *parameter 30-81 Brake Resistor (ohm)*. |

| 2-12 Brake Power Limit (kW) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.001 - 2000.000 kW] | *Parameter 2-12 Brake Power Limit (kW)* is the expected average power dissipated in the brake resistor over a period of 120 s. It is used as the monitoring limit for *16-33 Brake Energy Average* and thereby specifies when a warning/alarm is to be given.<br>To calculate *parameter 2-12 Brake Power Limit (kW)*, the following formula can be used.<br>$P_{br,avg}[W] = \frac{U_{br}^2[V] \times t_{br}[s]}{R_{br}[\Omega] \times T_{br}[s]}$<br>$P_{br,avg}$ 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, $T_{br}$. |

| 2-12 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:<br>T2 units: 390 V<br>T4 units: 778 V<br>T5 units: 810 V<br>T6 units: 943 V/1099 V for D – F frames<br>T7 units: 1099 V<br>***NOTICE***<br>**If $R_{br}$ is not known, or if $T_{br}$ is different from 120 s, the practical approach is to run the brake application, read out *16-33 Brake Energy Average* and then enter this + 20% in *2-12 Brake Power Limit (kW)*.** |

| 2-13 Brake Power Monitoring | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | This parameter is only active in frequency converters with a brake.<br>This parameter enables monitoring of the power to the brake resistor. The power is calculated on the basis of the resistance (*parameter 2-11 Brake Resistor (ohm)*), the DC link voltage, and the resistor duty time. |
| [0] * | Off | No brake power monitoring required. |
| [1] | Warning 120s | Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (*parameter 2-12 Brake Power Limit (kW)*. The warning disappears when the transmitted power falls below 80% of the monitoring limit. |
| [2] | Trip 120s | Trips frequency converter and displays an alarm when the calculated power exceeds 100% of the monitoring limit. |
| [3] | Warning & trip 120s | Activates both of the above, including warning, trip and alarm. |
| [4] | Warning 30s | |
| [5] | Trip 30s | |
| [6] | Warning & trip 30s | |
| [7] | Warning 60s | |
| [8] | Trip 60s | |
| [9] | Warning & trip 60s | |
| [10] | Warning 300s | |
| [11] | Trip 300s | |

| 2-13 Brake Power Monitoring | | |
|---|---|---|
| **Option:** | | **Function:** |
| [12] | Warning & trip 300s | |
| [13] | Warning 600s | |
| [14] | Trip 600s | |
| [15] | Warning & trip 600s | |

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 outputs. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than ±20%).

| 2-15 Brake Check | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | *Parameter 2-15 Brake Check* is only active in frequency converters with an integral dynamic brake.<br>Select type of test and monitoring function to check the connection to the brake resistor, or whether a brake resistor is present, and then display a warning or an alarm in the event of a fault.<br>***NOTICE***<br>**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.**<br>The testing sequence is as follows:<br>1. The DC link ripple amplitude is measured for 300 ms without braking.<br>2. The DC link ripple amplitude is measured for 300 ms with the brake turned on.<br>3. If the DC link ripple amplitude while braking is lower than the DC link ripple amplitude before braking + 1%: *Brake check has failed by returning a warning or alarm.*<br>4. If the DC link ripple amplitude while braking is higher than the DC link ripple amplitude before braking + 1%: *Brake check is OK.* |
| [0] * | Off | Monitors brake resistor and brake IGBT for a short circuit during operation. If a short circuit occurs, warning 25 appears. |

| 2-15 Brake Check | | |
|---|---|---|
| **Option:** | | **Function:** |
| [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 displaying an alarm (trip locked). |
| [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 displayed (e.g. warning 25, 27 or 28). |
| [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 ramp-down. This option is available for FC 302 only. |
| [5] | Trip Lock | |

***NOTICE***

**Remove a warning arising in connection with *[0] Off* or *[1] Warning* by cycling the mains supply. The fault must be corrected first. For *[0] Off* or *[1] Warning*, the frequency converter keeps running even if a fault is located.**

| 2-16 AC brake Max. Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [ 0 - 1000.0 %] | Enter the maximum permissible current when using AC brake to avoid overheating of motor windings. |

***NOTICE***

***Parameter 2-16 AC brake Max. Current* has no effect when *1-10 Motor Construction* [1] PM, non salient SPM.**

| 2-17 Over-voltage Control | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | 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. |
| [0] * | Disabled | No OVC required. |
| [1] | Enabled (not at stop) | Activates OVC except when using a stop signal to stop the frequency converter. |
| [2] | Enabled | Activates OVC. |

***NOTICE***

**Do not enable OVC in hoisting applications.**

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| 2-18 Brake Check Condition | | |
|---|---|---|
| **Range:** | | **Function:** |
| [0] * | At Power Up | Brake check is performed at power-up. |
| [1] | After Coast Situations | Brake check is performed after coast situations. |

| 2-19 Over-voltage Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 200 %] | Select overvoltage gain. |

## 3.4.3 2-2* Mechanical Brake

Parameters for controlling operation of an electro-magnetic (mechanical) brake, typically required in hoisting applications.
To control a mechanical brake, a relay output (relay 01 or relay 02) or a programmed digital output (terminal 27 or 29) is required. Normally, this output must be closed during periods when the frequency converter is unable to 'hold' the motor, e.g. due to an excessive load. Select *[32] Mechanical Brake Control* for applications with an electro-magnetic brake in *parameter 5-40 Function Relay*, *5-30 Terminal 27 Digital Output*, or *5-31 Terminal 29 Digital Output*. When selecting *[32] Mechanical brake control*, the mechanical brake is closed from start-up until the output current is above the level selected in *parameter 2-20 Release Brake Current*. During stop, the mechanical brake activates when the speed falls below the level specified in *parameter 2-21 Activate Brake Speed [RPM]*. If the frequency converter enters an alarm condition or an overcurrent or overvoltage situation, the mechanical brake immediately cuts in. This is also the case during Safe Torque Off.

***NOTICE***

**Protection mode and trip delay features (*parameter 14-25 Trip Delay at Torque Limit* and *parameter 14-26 Trip Delay at Inverter Fault*) may delay the activation of the mechanical brake in an alarm condition. These features must be disabled in hoisting applications.**

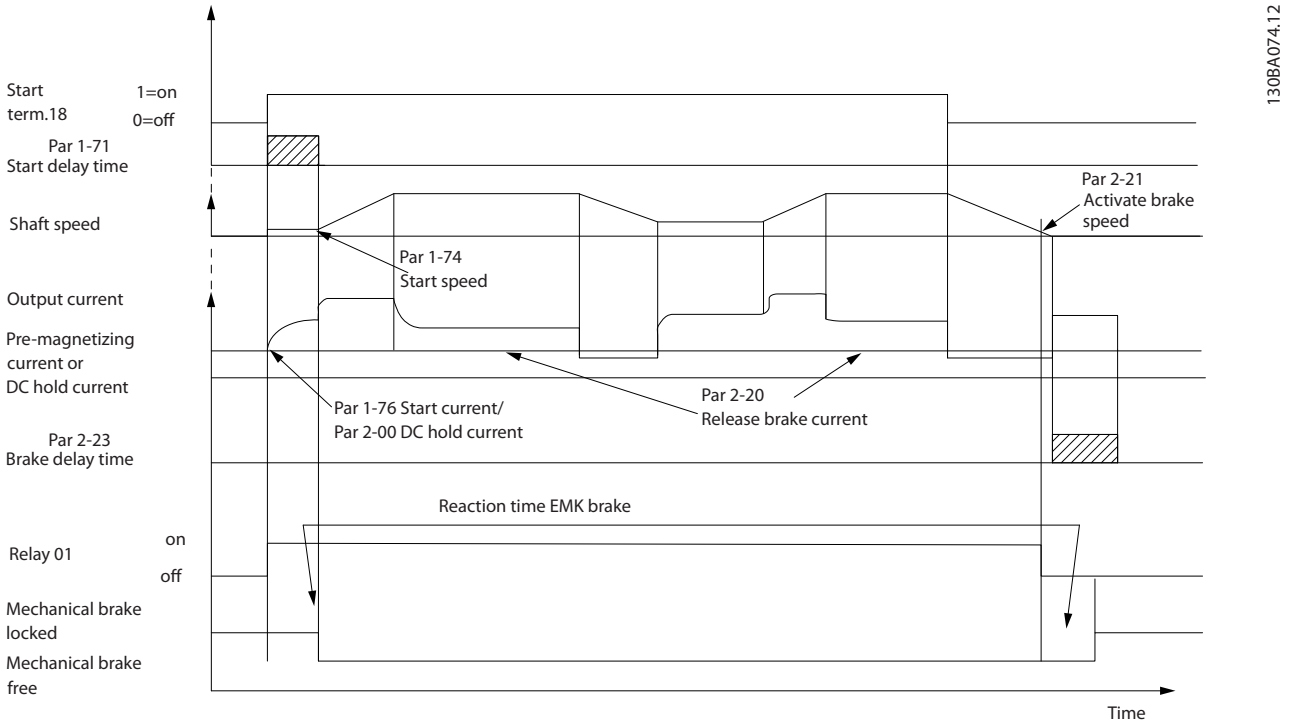



**Illustration 3.19 Mechanical Brake**

| 2-20 Release Brake Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 16-37 A] | Set the motor current for release of the mechanical brake when a start condition is present. The default value is the maximum current the inverter can provide for the particular power size. The upper limit is specified in *parameter 16-37 Inv. Max. Current*.<br>***NOTICE***<br>**When mechanical brake control output is selected, but no mechanical brake is connected, the function does not work by default setting due to too low motor current.** |

| 2-21 Activate Brake Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 30000 RPM] | Set the motor speed for activation of the mechanical brake, when a stop condition is present. The upper speed limit is specified in *parameter 4-53 Warning Speed High*. |

| 2-22 Activate Brake Speed [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 5000.0 Hz] | Set the motor frequency for activation of the mechanical brake when a stop condition is present. |

| 2-23 Activate Brake Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 s* | [0 - 5 s] | Enter the brake delay time of the coast after ramp-down time. The shaft is held at zero speed with full holding torque. Ensure that the mechanical brake has locked the load before the motor enters coast mode. See *Mechanical Brake Control* section in the *Design Guide*.<br>To adjust transition of the load to the mechanical brake, set *parameter 2-23 Activate Brake Delay* and *parameter 2-24 Stop Delay*.<br>Setting of brake delay parameters does not impact the torque. The frequency converter does not register that mechanical brake is holding the load.<br>After setting *parameter 2-23 Activate Brake Delay*, the torque drops to zero after a few minutes. The sudden torque change leads to movement and noise. |

| 2-23 Activate Brake Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | sudden torque change leads to movement and noise. |

| 2-24 Stop Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 s* | [0 - 5 s] | Set the time interval from the moment when the motor is stopped until the brake closes.<br>To adjust transition of the load to the mechanical brake, set *parameter 2-23 Activate Brake Delay* and *parameter 2-24 Stop Delay*.<br>This parameter is a part of the stopping function. |

| 2-25 Brake Release Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.20 s* | [0 - 5 s] | This value defines the time it takes for the mechanical brake to open. This parameter must act as a time out when brake feedback is activated. |

## 3.4.4 Hoist Mechanical Brake

The hoist mechanical break control supports the following functions:

- 2 channels for mechanical brake feedback to offer further protection against unintended behaviour resulting from broken cable.
- Monitoring of mechanical brake feedback throughout the complete cycle. This helps protect the mechanical brake, especially if more frequency converters are connected to the same shaft.
- No ramp-up until feedback confirms mechanical brake is open.
- Improved load control at stop. If the value of *parameter 2-23 Activate Brake Delay* is too small, W22 is activated and the torque is not allowed to ramp down.
- The transition when motor takes over the load from the brake can be configured. *2-28 Gain Boost Factor* can be increased to minimise the movement. To achieve smooth transition, change the setting from the speed control to the position control during the change-over.
    - Set *2-28 Gain Boost Factor* to 0 to enable Position Control during *2-02 DC Braking Time*. This enables parameters 2-30 to 2-33, which are PID parameters for the Position Control.

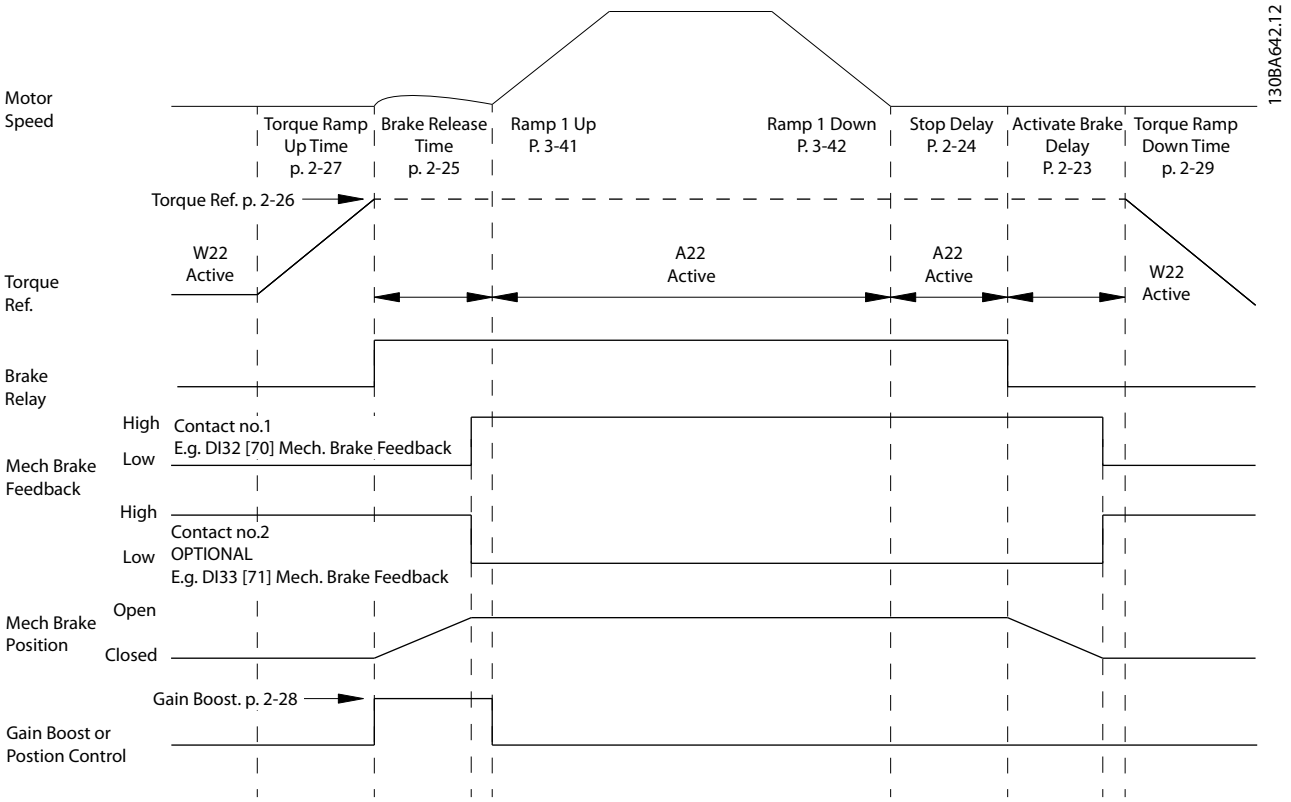



**Illustration 3.20 Brake release sequence for hoist mechanical brake control. This brake control is available in Flux with motor feedback only, available for asynchronous and non-salient PM motors.**

Parameters 2-26 to 2-33 are only available for the hoist mechanical brake control (FLUX with motor feedback).

| 2-26 Torque Ref | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [ -300 - 300 %] | The value defines the torque applied against the closed mechanical brake, before release.<br>The torque/load on a crane is positive and between 10% and 160%. To obtain the best starting point, set *parameter 2-26 Torque Ref* to approximately 70%.<br>The torque/load on a lift can be both positive and negative and between -160% and 160% To obtain the best starting point, set *parameter 2-26 Torque Ref* to 0%.<br>The higher the torque error is (*parameter 2-26 Torque Ref* vs. actual torque), the more movement during load takeover. |

| 2-27 Torque Ramp Up Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.2 s* | [0 - 5 s] | The value defines the duration of the torque ramp in clockwise direction. |

| 2-28 Gain Boost Factor | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1* | [0 - 4] | Only active in Flux closed loop. The function ensures a smooth transition from torque control mode to speed control mode when the motor takes over the load from the brake.<br>Increase to minimise the movement. Activate the Advanced Mechanical Brake (parameter group *2-3* Adv. Mech Brake*) by setting *parameter 2-28 Gain Boost Factor* to 0. |

| 2-29 Torque Ramp Down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 s* | [0 - 5 s] | Torque Ramp Down Time. |

Parameters 2-30 to 2-33 can be set up for very smooth transition change from speed control to position control during *2-25 Brake Release Time* - the time when the load is transferred from the mechanical brake to the frequency converter. Parameters 2-30 to 2-33 are activated when *2-28 Gain Boost Factor* is set to 0. See *Illustration 3.20* for more information.

| 2-30 Position P Start Proportional Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.0000* | [0.0000 - 1.0000] | |

| 2-31 Speed PID Start Proportional Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.0150* | [0.0000 - 1.0000] | |

| 2-32 Speed PID Start Integral Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 200.0 ms* | [1.0 - 20000.0 ms] | |

| 2-33 Speed PID Start Lowpass Filter Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10.0 ms* | [0.1 - 100.0 ms] | |

## 3.5 Parameters: 3-** Reference/Ramps

Parameters for reference handling, definition of limitations, and configuration of the reaction of the frequency converter to changes.

3

### 3.5.1 3-0* Reference Limits

| 3-00 Reference Range | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. The minimum limit may have a negative value, unless *[1] Speed closed loop* control or *[3] Process* is selected in *parameter 1-00 Configuration Mode*. |
| [0] | Min - Max | Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. The minimum limit may have a negative value, unless *[1] Speed closed loop* control or *[3] Process* is selected in *parameter 1-00 Configuration Mode*. |
| [1] | -Max - +Max | For both positive and negative values (both directions, relative to *parameter 4-10 Motor Speed Direction*). |

| 3-01 Reference/Feedback Unit | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the unit to be used in Process PID Control references and feedbacks. *Parameter 1-00 Configuration Mode* must be either *[3] Process* or *[8] Extended PID Control*. |
| [0] | None | |
| [1] | % | |
| [2] | RPM | |
| [3] | Hz | |
| [4] | Nm | |
| [5] | PPM | |
| [10] | 1/min | |
| [12] | Pulse/s | |
| [20] | l/s | |
| [21] | l/min | |
| [22] | l/h | |
| [23] | $m^3/s$ | |
| [24] | $m^3/min$ | |
| [25] | $m^3/h$ | |
| [30] | kg/s | |
| [31] | kg/min | |
| [32] | kg/h | |
| [33] | t/min | |
| [34] | t/h | |
| [40] | m/s | |
| [41] | m/min | |
| [45] | m | |

| 3-01 Reference/Feedback Unit | | |
|---|---|---|
| **Option:** | | **Function:** |
| [60] | °C | |
| [70] | mbar | |
| [71] | bar | |
| [72] | Pa | |
| [73] | kPa | |
| [74] | m WG | |
| [80] | kW | |
| [120] | GPM | |
| [121] | gal/s | |
| [122] | gal/min | |
| [123] | gal/h | |
| [124] | CFM | |
| [125] | $ft^3/s$ | |
| [126] | $ft^3/min$ | |
| [127] | $ft^3/h$ | |
| [130] | lb/s | |
| [131] | lb/min | |
| [132] | lb/h | |
| [140] | ft/s | |
| [141] | ft/min | |
| [145] | ft | |
| [150] | lb ft | |
| [160] | °F | |
| [170] | psi | |
| [171] | $lb/in^2$ | |
| [172] | in WG | |
| [173] | ft WG | |
| [180] | HP | |

| 3-02 Minimum Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ -999999.999 - par. 3-03 ReferenceFeedbackUnit] | Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references.<br>Minimum reference is active only when *parameter 3-00 Reference Range* is set to *[0] Min.- Max.*<br>The minimum reference unit matches:<br>• The configuration of *parameter 1-00 Configuration Mode*: for *[1] Speed closed loop*, RPM; for *[2] Torque*, Nm.<br>• The unit selected in *parameter 3-01 Reference/ Feedback Unit*. |

| 3-03 Maximum Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ par. 3-02 - 999999.999 ReferenceFeedbackUnit] | Enter the maximum reference. The maximum reference is the highest value obtainable by summing all references.<br>The maximum reference unit matches:<br>• The choice of configuration in *parameter 1-00 Configuration Mode*: for *[1] Speed closed loop*, RPM; for *[2] Torque*, Nm.<br>• The unit selected in *parameter 3-00 Reference Range*. |

| 3-04 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.<br>Shift between external and preset via a command or a digital input. |

## 3.5.2 3-1* References

Select the preset reference(s). Select *Preset ref. bit 0/1/2 [16], [17] or [18]* for the corresponding digital inputs in parameter group *5-1* Digital Inputs*.

| 3-10 Preset Reference | | |
|---|---|---|
| Array [8]<br>Range: 0-7 | | |
| **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 3-03 Maximum Reference*). If a $Ref_{MIN}$ different from 0 (*parameter 3-02 Minimum Reference*) is programmed, the preset reference is calculated as a percentage of the full reference range, i.e. on the basis of the difference between $Ref_{MAX}$ and $Ref_{MIN}$. Afterwards, the value is added to $Ref_{MIN}$. When using preset references, select Preset ref. bit 0/1/2 [16], [17] or [18] for the corresponding digital inputs in parameter group *5-1* Digital Inputs*. |

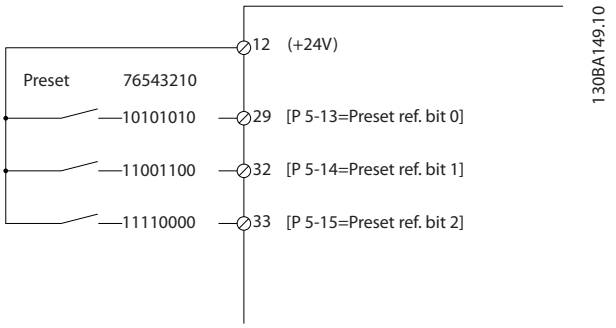



**Illustration 3.21 Preset Reference**

| 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 3.12 Preset Ref. Bit**

| 3-11 Jog Speed [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-14 Hz] | The jog speed is a fixed output speed at which the frequency converter is running, when the jog function is activated.<br>See also *parameter 3-80 Jog Ramp Time*. |

| 3-12 Catch up/slow Down Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Enter a percentage (relative) value to be either added to or deducted from the actual reference for Catch up or Slow down respectively. If *Catch up* is selected via one of the digital inputs (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*), the percentage (relative) value is added to the total reference. If *Slow down* is selected via one of the digital inputs (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*), the percentage (relative) value is deducted from the total reference. Obtain extended functionality with the DigiPot function. See parameter group *3-9* Digital Potentiometer*. |



3

| 3-13 Reference Site | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select which reference site to activate. |
| [0] * | Linked to Hand / Auto | Use local reference when in Hand mode, or remote reference when in Auto mode. |
| [1] | Remote | Use remote reference in both Hand mode and Auto mode. |
| [2] | Local | Use local reference in both Hand mode and Auto mode.<br>***NOTICE***<br>**When set to *[2] Local*, the frequency converter starts with this setting again following a 'powerdown'.** |
| [3] | Linked to H/A MCO | Select this option to enable the FFACC factor in parameter *32-66 Acceleration Feed-Forward*. Enabling FFACC reduces jitter and makes the transmission from the motion controller to the control card of the frequency converter faster. This leads to faster response times for dynamic applications and position control. For more information about FFACC, see *Programmable Motion Controller MCO 305 Operating Instructions*. |

| 3-14 Preset Relative Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-100 - 100 %] | The actual reference, X, is increased or decreased with the percentage Y, set in *parameter 3-14 Preset Relative Reference*. This results in the actual reference Z. Actual reference (X) is the sum of the inputs selected in *3-15 Reference 1 Source*, *3-16 Reference 2 Source*, *3-17 Reference 3 Source*, and *8-02 Control Source*. |

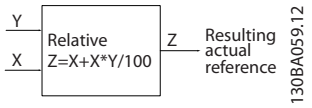



**Illustration 3.22 Preset Relative Reference**

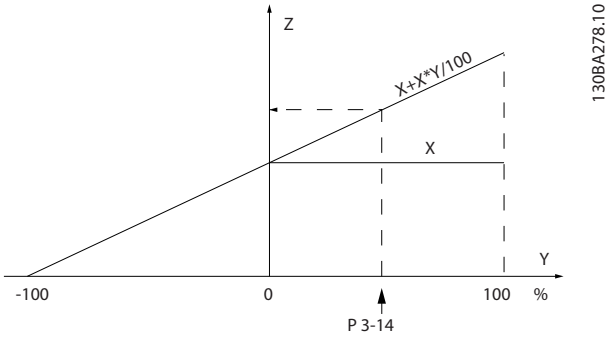



**Illustration 3.23 Actual Reference**

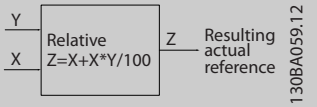
| 3-15 Reference Resource 1 | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the reference input to be used for the first reference signal. *Parameter 3-15 Reference Resource 1*, *parameter 3-16 Reference Resource 2*, and *parameter 3-17 Reference Resource 3* define up to 3 different reference signals. The sum of these reference signals defines the actual reference. |
| [0] | No function | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [7] | Frequency input 29 | |
| [8] | Frequency input 33 | |
| [11] | Local bus reference | |
| [20] | Digital pot.meter | |
| [21] | Analog input X30/11 | (General Purpose I/O Option Module) |
| [22] | Analog input X30/12 | (General Purpose I/O Option Module) |
| [29] | Analog Input X48/2 | |

| 3-16 Reference Resource 2 | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the reference input to be used for the second reference signal. *Parameter 3-15 Reference Resource 1*, *parameter 3-16 Reference Resource 2*, and *parameter 3-17 Reference Resource 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] | Frequency input 29 | |

| 3-16 Reference Resource 2 | | |
|---|---|---|
| **Option:** | | **Function:** |
| [8] | Frequency input 33 | |
| [11] | Local bus reference | |
| [20] | Digital pot.meter | |
| [21] | Analog input X30/11 | |
| [22] | Analog input X30/12 | |
| [29] | Analog Input X48/2 | |

| 3-17 Reference Resource 3 | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the reference input to be used for the third reference signal. *Parameter 3-15 Reference Resource 1*, *parameter 3-16 Reference Resource 2*, and *parameter 3-17 Reference Resource 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] | Frequency input 29 | |
| [8] | Frequency input 33 | |
| [11] | Local bus reference | |
| [20] | Digital pot.meter | |
| [21] | Analog input X30/11 | |
| [22] | Analog input X30/12 | |
| [29] | Analog Input X48/2 | |

| 3-18 Relative Scaling Reference Resource | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Select a variable value to be added to the fixed value (defined in *parameter 3-14 Preset Relative Reference*). The sum of the fixed and variable values (labelled Y in *Illustration 3.24*) is multiplied with the actual reference (labelled X in *Illustration 3.24*). This product is then added to the actual reference (X+X*Y/100) to give the resulting actual reference. |

| 3-18 Relative Scaling Reference Resource | | |
|---|---|---|
| **Option:** | | **Function:** |
| | |  <br>**Illustration 3.24 Resulting Actual Reference** |
| [0] * | No function | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [7] | Frequency input 29 | |
| [8] | Frequency input 33 | |
| [11] | Local bus reference | |
| [20] | Digital pot.meter | |
| [21] | Analog input X30/11 | |
| [22] | Analog input X30/12 | |
| [29] | Analog Input X48/2 | |

| 3-19 Jog Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-13 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 4-13 Motor Speed High Limit [RPM]*.<br>See also *parameter 3-80 Jog Ramp Time*. |

## 3.5.3 Ramps
### 3-4* Ramp 1

For each of 4 ramps (parameter groups *3-4* Ramp 1*, *3-5* Ramp 2*, *3-6* Ramp 3* and *3-7* Ramp 4*) configure the ramp parameters: ramp type, ramping times (duration of acceleration and deceleration) and level of jerk compensation for S-ramps.

Start by setting the linear ramping times corresponding to *Illustration 3.25* and *Illustration 3.26*.

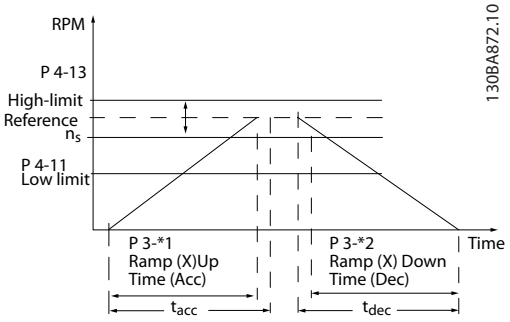



**Illustration 3.25 Linear Ramping Times**

If S-ramps are selected, then set the level of non-linear jerk compensation required. Set jerk compensation by defining the proportion of ramp-up and ramp-down times where acceleration and deceleration are variable (i.e. increasing or decreasing). The S-ramp acceleration and deceleration settings are defined as a percentage of the actual ramp time.

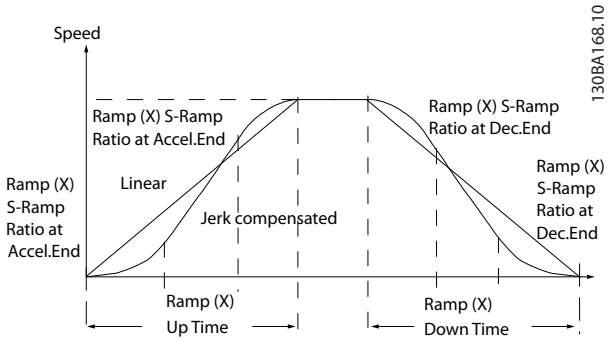



**Illustration 3.26 Linear Ramping Times**

| 3-40 Ramp 1 Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application. |
| [0] * | Linear | |
| [1] | S-ramp Const Jerk | Acceleration with lowest possible jerk. |
| [2] | S-ramp Const Time | S-ramp based on the values set in *parameter 3-41 Ramp 1 Ramp Up Time* and *parameter 3-42 Ramp 1 Ramp Down Time*. |

***NOTICE***

**If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realise a jerk-free movement, which may result in a longer start or stop time.**
**Additional adjustment of the S-ramp ratios or switching initiators may be necessary.**

| 3-41 Ramp 1 Ramp Up Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the synchronous motor speed $n_S$. Select a ramp-up time which prevents the output current from exceeding the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*. $Par.\ 3-41 = \frac{tacc\ [s]\ x\ ns\ [RPM]}{ref\ [RPM]}$ |

| 3-42 Ramp 1 Ramp Down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-down time, i.e. the deceleration time from the synchronous motor speed $n_s$ to 0 RPM. Select a ramp-down time such that no overvoltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time*. $Par.\ 3-42 = \frac{tdec\ [s]\ x\ ns\ [RPM]}{ref\ [RPM]}$ |

| 3-45 Ramp 1 S-ramp Ratio at Accel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-41 Ramp 1 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks occurring in the application. |

| 3-46 Ramp 1 S-ramp Ratio at Accel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-41 Ramp 1 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-47 Ramp 1 S-ramp Ratio at Decel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-48 Ramp 1 S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

## 3.5.4 3-5* Ramp 2

To select ramp parameters, see parameter group *3-4* Ramp 1*.

| 3-50 Ramp 2 Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application. |
| [0] * | Linear | |
| [1] | S-ramp Const Jerk | Acceleration with lowest possible jerk. |
| [2] | S-ramp Const Time | S-ramp based on the values set in *parameter 3-51 Ramp 2 Ramp Up Time* and *parameter 3-52 Ramp 2 Ramp Down Time*. |

***NOTICE***

**If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realise a jerk-free movement, which may result in a longer start or stop time.**
**Additional adjustment of the S-ramp ratios or switching initiators may be necessary.**

| 3-51 Ramp 2 Ramp Up Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed $n_s$. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-52 Ramp 2 Ramp Down Time*. $Par.\ 3-51 = \frac{tacc\ [s]\ x\ ns\ [RPM]}{ref\ [RPM]}$ |

| 3-52 Ramp 2 Ramp Down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-down time, i.e. the deceleration time from the rated motor speed $n_s$ to 0 RPM. Select a ramp-down time such that no overvoltage arises in the frequency converter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-51 Ramp 2 Ramp Up Time*. $Par.\ 3-52 = \frac{tdec\ [s]\ x\ ns\ [RPM]}{ref\ [RPM]}$ |

| 3-55 Ramp 2 S-ramp Ratio at Accel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-51 Ramp 2 Ramp Up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-56 Ramp 2 S-ramp Ratio at Accel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-51 Ramp 2 Ramp Up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-57 Ramp 2 S-ramp Ratio at Decel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-52 Ramp 2 Ramp Down Time*) where the deceleration torque increases The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-58 Ramp 2 S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-52 Ramp 2 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the |

| 3-58 Ramp 2 S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | jerk compensation achieved, and thus the lower the torque jerks in the application. |

3

## 3.5.5 3-6* Ramp 3

Configure ramp parameters, see *3-4* Ramp 1*.

| 3-60 Ramp 3 Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application. |
| [0] * | Linear | |
| [1] | S-ramp Const Jerk | Accelerates with lowest possible jerk. |
| [2] | S-ramp Const Time | S-ramp based on the values set in *parameter 3-61 Ramp 3 Ramp up Time* and *parameter 3-62 Ramp 3 Ramp down Time*. |

***NOTICE***

**If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realise a jerk-free movement, which may result in a longer start or stop time.**
**Additional adjustment of the S-ramp ratios or switching initiators may be necessary.**

| 3-61 Ramp 3 Ramp up Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed $n_s$. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-62 Ramp 3 Ramp down Time*. |

| 3-62 Ramp 3 Ramp down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-down time, i.e. the deceleration time from the rated motor speed $n_s$ to 0 RPM. Select a ramp-down time such that no overvoltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-61 Ramp 3 Ramp up Time*. $Par.\ 3-62 = \frac{tdec\ [s]\ x\ ns\ [RPM]}{ref\ [RPM]}$ |

| 3-65 Ramp 3 S-ramp Ratio at Accel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-61 Ramp 3 Ramp up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-66 Ramp 3 S-ramp Ratio at Accel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-61 Ramp 3 Ramp up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-67 Ramp 3 S-ramp Ratio at Decel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-62 Ramp 3 Ramp down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-68 Ramp 3 S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down decel time (*parameter 3-62 Ramp 3 Ramp down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

## 3.5.6 3-7* Ramp 4

Configure ramp parameters, see parameter group *3-4* Ramp 1*.

| 3-70 Ramp 4 Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear |

| 3-70 Ramp 4 Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | acceleration, compensating for jerk in the application. |
| [0] * | Linear | |
| [1] | S-ramp Const Jerk | Accelerates with lowest possible jerk. |
| [2] | S-ramp Const Time | S-ramp based on the values set in *parameter 3-71 Ramp 4 Ramp up Time* and *parameter 3-72 Ramp 4 Ramp Down Time*. |

**NOTICE**

**If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed, the ramp time may be prolonged to realise a jerk-free movement, which may result in a longer start or stop time.**
**Additional adjustment of the S-ramp ratios or switching initiators may be necessary.**

| 3-71 Ramp 4 Ramp up Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed $n_s$. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-72 Ramp 4 Ramp Down Time*. $Par.\ 3-71 = \frac{tacc\,[s] \times ns\,[RPM]}{ref\,[RPM]}$ |

| 3-72 Ramp 4 Ramp Down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 3600 s] | Enter the ramp-down time, i.e. the deceleration time from the rated motor speed $n_s$ to 0 RPM. Select a ramp-down time such that no overvoltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *parameter 4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-71 Ramp 4 Ramp up Time*. $Par.\ 3-72 = \frac{tdec\,[s] \times ns\,[RPM]}{ref\,[RPM]}$ |

| 3-75 Ramp 4 S-ramp Ratio at Accel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-71 Ramp 4 Ramp up Time*) in which the acceleration torque increases. The larger the percentage value, the greater the |



| 3-75 Ramp 4 S-ramp Ratio at Accel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | jerk compensation achieved, and thus the lower the torque jerks in the application. |



| 3-76 Ramp 4 S-ramp Ratio at Accel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-up time (*parameter 3-71 Ramp 4 Ramp up Time*) in which the acceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-77 Ramp 4 S-ramp Ratio at Decel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-72 Ramp 4 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-78 Ramp 4 S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-72 Ramp 4 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

## 3.5.7 3-8* Other Ramps

| 3-80 Jog Ramp Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 3600 s] | Enter the jog ramp time, i.e. the acceleration/deceleration time between 0 RPM and the rated motor frequency $n_s$. Ensure that the resultant output current required for the given jog ramp time does not exceed the current limit in *parameter 4-18 Current Limit*. The jog ramp time starts upon activation of a jog signal via the LCP, a selected digital input, or the serial communication port. When jog state is disabled then the normal ramping times are valid. |

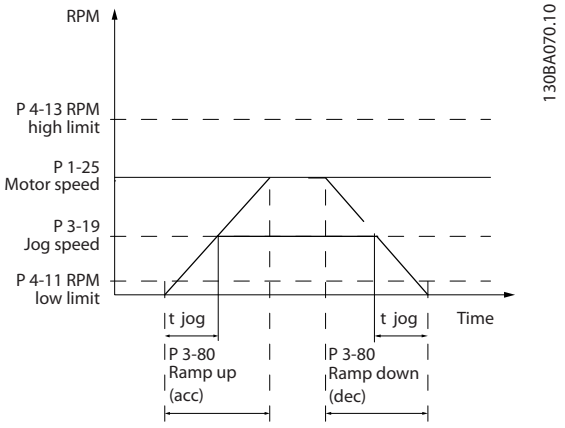



**Illustration 3.27 Jog Ramp Time**

$$Par.\ 3-80 = \frac{tjog\ [s]\ x\ ns\ [RPM]}{\Delta\ jog\ speed\ (par.\ 3-19)\ [RPM]}$$

| 3-81 Quick Stop Ramp Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 3600 s] | Enter the quick–stop ramp-down time, i.e. the deceleration time from the synchronous motor speed to 0 RPM. Ensure that no resultant over-voltage arises in the inverter due to regenerative operation of the motor required to achieve the given ramp-down time. Ensure also that the generated current required to achieve the given ramp-down time does not exceed the current limit (set in *parameter 4-18 Current Limit*). Quick stop is activated by means of a signal on a selected digital input, or via the serial communication port. |

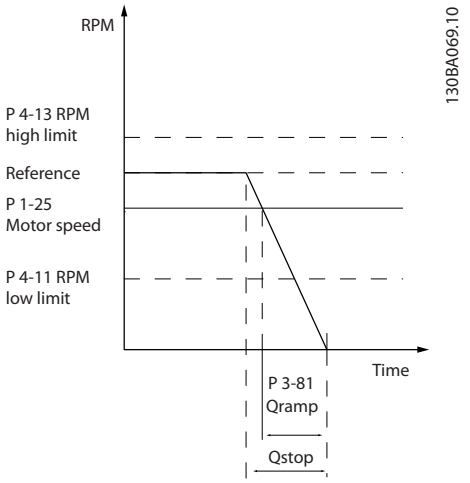



**Illustration 3.28 Quick Stop Ramp Time**

| 3-82 Quick Stop Ramp Type | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp gives constant acceleration during ramping. An S-ramp gives non-linear acceleration, compensating for jerk in the application. |
| [0] * | Linear | |
| [1] | S-ramp Const Jerk | |
| [2] | S-ramp Const Time | |

| 3-83 Quick Stop S-ramp Ratio at Decel. Start | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*parameter 3-42 Ramp 1 Ramp Down Time*) where the deceleration torque increases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

| 3-84 Quick Stop S-ramp Ratio at Decel. End | | |
|---|---|---|
| **Range:** | | **Function:** |
| 50 %* | [ 1 - 99 %] | Enter the proportion of the total ramp-down time (*3-42 Ramp 1 Ramp Down Time*) where the deceleration torque decreases. The larger the percentage value, the greater the jerk compensation achieved, and thus the lower the torque jerks in the application. |

## 3.5.8 3-9* Digital Pot.Meter

The digital potentiometer enables increase or decrease of 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*.

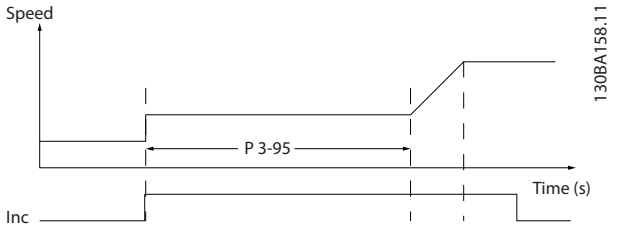



**Illustration 3.29 Increase Actual Reference**

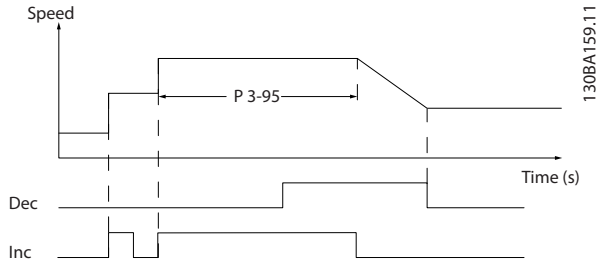



**Illustration 3.30 Increase/Decrease Actual Reference**

| 3-90 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/decreased by the amount set in this parameter. |

| 3-91 Ramp Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1 s* | [0 - 3600 s] | Enter the ramp time, i.e. the time for adjustment of the reference from 0% to 100% of the specified digital potentiometer function (Increase, Decrease or Clear).<br>If Increase/Decrease is activated for longer than the ramp delay period specified in *parameter 3-95 Ramp Delay*, the actual reference is ramped up/down according to this ramp time. The ramp time is defined as the time used to adjust the reference by the step size specified in *parameter 3-90 Step Size*. |

| 3-92 Power Restore | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Off | Resets the digital potentiometer reference to 0% after power-up. |
| [1] | On | Restores the most recent digital potentiometer reference at power-up. |

| 3-93 Maximum Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [-200 - 200 %] | Set the maximum permissible value for the resultant reference. This is advisable if the digital potentiometer is used for fine-tuning of the resulting reference. |

| 3-94 Minimum Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| -100 %* | [-200 - 200 %] | Set the minimum permissible value for the resulting reference. This is advisable if the Digital Potentiometer is used for fine-tuning of the resulting reference. |

| 3-95 Ramp Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 0] | 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 3-91 Ramp Time*. |

3

## 3.6 Parameters: 4-** Limits/Warnings

### 3.6.1 4-1* Motor Limits

Define torque, current and speed limits for the motor, and the reaction of the frequency converter when the limits are exceeded.
A limit may generate a message in the display. A warning always generates a message in the display or on the fieldbus. A monitoring function may initiate a warning or a trip, upon which the frequency converter stops and generates an alarm message.

**4-10 Motor Speed Direction**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Select the motor speed direction(s) required. Use this parameter to prevent unwanted reversing. When *parameter 1-00 Configuration Mode* is set to *[3] Process*, *parameter 4-10 Motor Speed Direction* is set to *[0] Clockwise* as default. The setting in *parameter 4-10 Motor Speed Direction* does not limit options for setting *parameter 4-13 Motor Speed High Limit [RPM]*. |
| [0] | Clockwise | The reference is set to CW rotation. Reversing input (default term 19) must be open. |
| [1] | Counter clockwise | The reference is set to CCW rotation. Reversing input (default term 19) must be closed. If reversing is required with 'Reverse' input open, the motor direction can be changed by *parameter 1-06 Clockwise Direction* |
| [2] | Both directions | Allows the motor to rotate in both directions. |

**4-11 Motor Speed Low Limit [RPM]**

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - par. 4-13 RPM] | Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in *parameter 4-13 Motor Speed High Limit [RPM]*. |

**4-12 Motor Speed Low Limit [Hz]**

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - par. 4-14 Hz] | Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the minimum output frequency of the motor shaft. The Motor Speed Low Limit must not exceed the |

**4-12 Motor Speed Low Limit [Hz]**

| Range: | | Function: |
|---|---|---|
| | | setting in *parameter 4-14 Motor Speed High Limit [Hz]*. |

**4-13 Motor Speed High Limit [RPM]**

| Range: | | Function: |
|---|---|---|
| Size related* | [ par. 4-11 - 60000 RPM] | Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor speed. The Motor Speed High Limit must exceed the setting in *parameter 4-11 Motor Speed Low Limit [RPM]*. |

**4-14 Motor Speed High Limit [Hz]**

| Range: | | Function: |
|---|---|---|
| Size related* | [ par. 4-12 - par. 4-19 Hz] | Enter the maximum limit for motor speed in Hz. *Parameter 4-14 Motor Speed High Limit [Hz]* can match the manufacturer's recommended maximum motor speed. The motor speed high limit must exceed the value in *4-12 Motor Speed Low Limit [Hz]*. The output frequency must not exceed 10% of the switching frequency (*14-01 Switching Frequency*). |

**4-16 Torque Limit Motor Mode**

| Range: | | Function: |
|---|---|---|
| Size related*<br>Application dependent* | [ 0 - 1000.0 %]<br>[Application dependent] | This function limits the torque on the shaft to protect the mechanical installation. |

***NOTICE***

**Changing *parameter 4-16 Torque Limit Motor Mode* when *parameter 1-00 Configuration Mode* is set to *[0] Speed open loop*, *parameter 1-66 Min. Current at Low Speed* is automatically readjusted.**

***NOTICE***

**The torque limit reacts on the actual, non-filtrated torque, including torque spikes. This is not the torque that is seen from the LCP or the Fieldbus as that is filtered.**

**4-17 Torque Limit Generator Mode**

| Range: | | Function: |
|---|---|---|
| 100 %* | [ 0 - 1000.0 %] | This function limits the torque on the shaft to protect the mechanical installation. |

### 4-18 Current Limit

| Range: | | Function: |
|---|---|---|
| Size related* | [ 1.0 - 1000.0 %] | This is a true current limit function that continues in the oversynchronous range. However, due to field weakening the motor torque at current limit will drop accordingly when the voltage increase stops above the synchronised speed of the motor. |

### 4-19 Max Output Frequency

| Range: | | Function: |
|---|---|---|
| Size related* | [ 1 - 590 Hz] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>***NOTICE***<br>**Max. output frequency cannot exceed 10% of the inverter switching frequency (*parameter 14-01 Switching Frequency*).**<br>Provides a final limit on the output frequency for improved safety in applications where accidental overspeeding is to be avoided. This limit is final in all configurations (independent of the setting in *parameter 1-00 Configuration Mode*). |

### 4-20 Torque Limit Factor Source

| Option: | | Function: |
|---|---|---|
| | | Select an analog input for scaling the settings in *parameter 4-16 Torque Limit Motor Mode* and *parameter 4-17 Torque Limit Generator Mode* from 0% to 100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, e.g. parameter group *6-1* Analog Input 1*. This parameter is only active when *parameter 1-00 Configuration Mode* is in *Speed Open Loop* or *Speed Closed Loop*. |
| [0] * | No function | |
| [2] | Analog in 53 | |
| [4] | Analog in 53 inv | |
| [6] | Analog in 54 | |
| [8] | Analog in 54 inv | |
| [10] | Analog in X30-11 | |
| [12] | Analog in X30-11 inv | |
| [14] | Analog in X30-12 | |
| [16] | Analog in X30-12 inv | |

### 4-21 Speed Limit Factor SourceOption

| Option: | | Function: |
|---|---|---|
| | | Select an analog input for scaling the settings in *parameter 4-19 Max Output Frequency* from 0% to 100% (or vice versa). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, e.g. parameter group *6-1* Analog Input 1*. This parameter is only active when *parameter 1-00 Configuration Mode* is in *Torque Mode*. |
| [0] * | No function | |
| [2] | Analog input 53 | |
| [4] | Analog input 53 inv | |
| [6] | Analog input 54 | |
| [8] | Analog input 54 inv | |
| [10] | Analog input X30-11 | |
| [12] | Analog input X30-11 inv | |
| [14] | Analog input X30-12 | |
| [16] | Analog input X30-12 inv | |

### 4-23 Brake Check Limit Factor Source

Select the input source for the function in *parameter 2-15 Brake Check*. If several frequency converters are carrying out a brake check simultaneously, the resistance in the grid leads to a voltage drop on the mains or DC-link and a false brake check can occur. Use an external current sensor on every brake resistor. If an application requires a 100% valid brake check, connect the sensor to an analog input.

| Option: | | Function: |
|---|---|---|
| [0] * | DC-link voltage | The frequency converter performs the brake check by monitoring the DC-link voltage. The frequency converter injects current in the brake resistor which lowers the DC-link voltage. |
| [1] | Analog Input 53 | Select to use an external current sensor for brake monitoring. |
| [2] | Analog Input 54 | Select to use an external current sensor for brake monitoring. |

3

| 4-24 Brake Check Limit Factor | | |
|---|---|---|
| Enter the limit factor that *parameter 2-15 Brake Check* uses when performing the brake check. The frequency converter uses the limit factor depending on the selection in *parameter 4-23 Brake Check Limit Factor Source*:<br>*[0] DC-link voltage* - the frequency converter applies the factor to the EEPROM data in the DC-link.<br>*[1] Analog Input 53* or *[2] Analog Input 54* - the brake check fails if the input current on the analog input is lower than the maximum input current multiplied by the limit factor. For example, in the following configuration the brake check fails if the input current is lower than 16 mA:<br>• A current transducer with a range of 4-20 mA is connected to analogue input 53.<br>• *parameter 4-24 Brake Check Limit Factor* is set to 80%. | | |
| **Range:** | | **Function:** |
| 98 %* | [0 - 100 %] | |

## 3.6.2 4-3* Motor Feedback Monitoring

The parameter group includes monitoring and handling of motor feedback devices, such as encoders, resolvers etc.

| 4-30 Motor Feedback Loss Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | This function is used to monitor consistency in feedback signal, i.e. if the feedback signal is available.<br>Select which reaction the frequency converter should take if a feedback fault is detected. The selected action is to take place when the feedback signal differs from the output speed by the value set in *parameter 4-31 Motor Feedback Speed Error* for longer than the value set in *parameter 4-32 Motor Feedback Loss Timeout*. |
| [0] | Disabled | |
| [1] | Warning | |
| [2] * | Trip | |
| [3] | Jog | |
| [4] | Freeze Output | |
| [5] | Max Speed | |
| [6] | Switch to Open Loop | |
| [7] | Select Setup 1 | |
| [8] | Select Setup 2 | |
| [9] | Select Setup 3 | |
| [10] | Select Setup 4 | |
| [11] | Stop & Trip | |

Warning 90 is active as soon as the value in *parameter 4-31 Motor Feedback Speed Error* is exceeded, regardless of the setting of *parameter 4-32 Motor Feedback Loss Timeout*. Warning/Alarm 61 Feedback Error is related to the Motor Feedback Loss Function.

| 4-31 Motor Feedback Speed Error | | |
|---|---|---|
| **Range:** | | **Function:** |
| 300 RPM* | [1 - 600 RPM] | Select the max. allowed error in speed (output speed vs. feedback). |

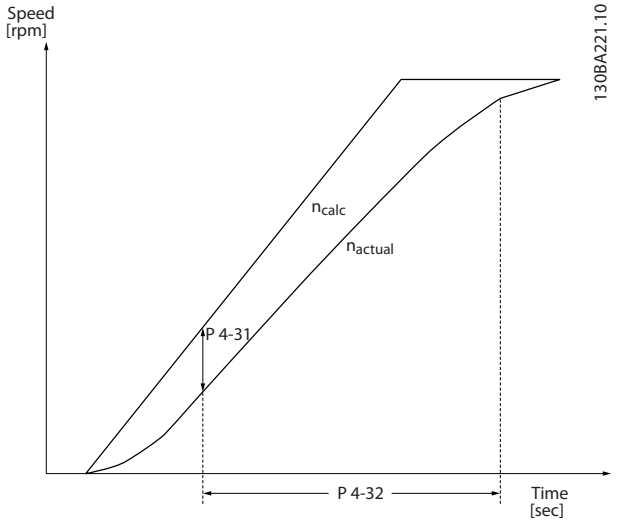



**Illustration 3.31 Motor Feedback Speed Error**

| 4-32 Motor Feedback Loss Timeout | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.05 s* | [0 - 60 s] | Set the timeout value allowing the speed error set in *parameter 4-31 Motor Feedback Speed Error* to be exceeded before enabling the function selected in *parameter 4-30 Motor Feedback Loss Function*. |

| 4-34 Tracking Error Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | This function is used to monitor that the application follows the expected speed profile. In closed loop the speed reference to the PID is compared to the encoder feedback (filtered). In open loop the speed reference to the PID is compensated for slip and compared to the frequency that is sent to the motor (*16-13 Frequency*).<br>The reaction is activated if the measured difference is more than the value specified in *parameter 4-35 Tracking Error* for the time specified in *parameter 4-36 Tracking Error Timeout*.<br>A tracking error in closed loop does not imply that there is a problem with the feedback signal. A tracking error can be the result of torque limit at too heavy loads. |
| [0] | Disable | |
| [1] | Warning | |

| 4-34 Tracking Error Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| [2] | Trip | |
| [3] | Trip after stop | |

Warning/Alarm 78 Tracking Error is related to the Tracking Error Function.

| 4-35 Tracking Error | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 RPM* | [1 - 600 RPM] | Enter the maximum permissible speed error between the motor speed and the output of the ramp when not ramping. In open loop the motor speed is estimated and in closed loop it is the feedback from encoder/resolver. |

| 4-36 Tracking Error Timeout | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1 s* | [0 - 60 s] | Enter the timeout period during which an error greater than the value set in *parameter 4-35 Tracking Error* is permissible. |

| 4-37 Tracking Error Ramping | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 RPM* | [1 - 600 RPM] | Enter the maximum permissible speed error between the motor speed and the output of the ramp when ramping. In open loop the motor speed is estimated and in closed loop the encoder measures the speed. |

| 4-38 Tracking Error Ramping Timeout | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1 s* | [0 - 60 s] | Enter the timeout period during which an error greater than the value set in *parameter 4-37 Tracking Error Ramping* while ramping is permissible. |

| 4-39 Tracking Error After Ramping Timeout | | |
|---|---|---|
| **Range:** | | **Function:** |
| 5 s* | [0 - 60 s] | Enter the timeout period after ramping where *parameter 4-37 Tracking Error Ramping* and *parameter 4-38 Tracking Error Ramping Timeout* are still active. |

## 3.6.3 4-5* Adjustable Warnings

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

Warnings are shown on the LCP and can be programmed to be outputs or to be read out via serial bus in the Extended Status Word.

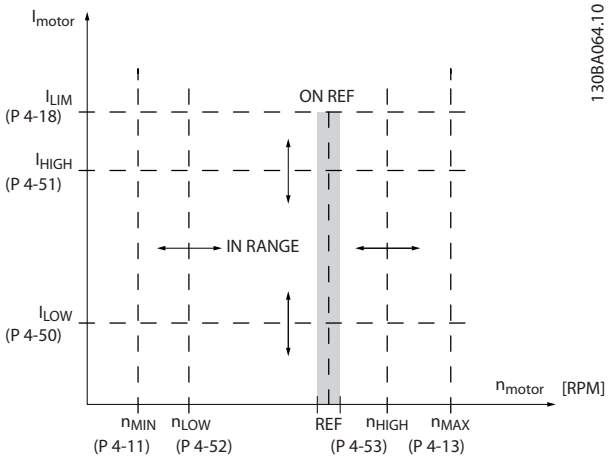



**Illustration 3.32 Adjustable Warnings**

| 4-50 Warning Current Low | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 A* | [0 - par. 4-51 A] | Enter the $I_{LOW}$ value. When the motor current falls below this limit, the display reads *Current Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). Refer to *Illustration 3.32*. |

| 4-51 Warning Current High | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [par. 4-50 - par. 16-37 A] | Enter the $I_{HIGH}$ value. When the motor current exceeds this limit, the display reads *Current High*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). Refer to *Illustration 3.32*. |

| 4-52 Warning Speed Low | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 RPM* | [0 - par. 4-53 RPM] | Enter the $n_{LOW}$ value. When the motor speed exceeds this limit, the display reads *Speed Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). |

| 4-53 Warning Speed High | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [par. 4-52 - 60000 RPM] | Enter the $n_{HIGH}$ value. When the motor speed exceeds this value, the display reads *SPEED HIGH*. The signal outputs can be programmed to produce a status signal on terminals 27 or 29 and on relay outputs 01 or 02. |

3

| 4-54 Warning Reference Low | | |
|---|---|---|
| **Range:** | | **Function:** |
| -999999.999* | [ -999999.999 - par. 4-55] | Enter the lower reference limit. When the actual reference falls below this limit, the display indicates *Ref$_{LOW}$*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). |

| 4-55 Warning Reference High | | |
|---|---|---|
| **Range:** | | **Function:** |
| 999999.999* | [ par. 4-54 - 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 (FC 302 only) and on relay output 01 or 02 (FC 302 only). |

| 4-56 Warning Feedback Low | | |
|---|---|---|
| **Range:** | | **Function:** |
| -999999.999 ReferenceFeedbackUnit* | [ -999999.999 - par. 4-57 ReferenceFeedbackUnit] | Enter the lower feedback limit. When the feedback falls below this limit, the display reads Feedb$_{Low}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). |

| 4-57 Warning Feedback High | | |
|---|---|---|
| **Range:** | | **Function:** |
| 999999.999 ReferenceFeedbackUnit* | [ par. 4-56 - 999999.999 ReferenceFeedbackUnit] | Enter the upper feedback limit. When the feedback exceeds this limit, the display reads Feedb High. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 (FC 302 only) and on relay output 01 or 02 (FC 302 only). |

| 4-58 Missing Motor Phase Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |

| 4-58 Missing Motor Phase Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Displays alarm 30, 31 or 32 in the event of a missing motor phase. It is strongly recommended to enable this function to avoid motor damage. |
| [0] | Disabled | The frequency converter does not issue a missing motor phase alarm. Not recommended due to risk of motor damage. |
| [1] | Trip 100 ms | For a quick detection time and alarm in the event of a missing motor phase. |
| [2] | Trip 1000 ms | |
| [3] | Trip 100ms 3ph detec. | Special option relevant for crane applications when lowering a small load that lets the frequency converter avoid false detections of missing motor phase.<br>This option is a reduced version of option *[1] Trip 100 ms*.<br>1-phase missing is handled as in option *[1] Trip 100 ms*. 3-phase detection is reduced compared to option *[1] Trip 100 ms*.<br>The 3-phase detection is only working at start-up and in the low speed range where a significant current is running, avoiding false trips during small motor current.<br>Only available for FC 302 Flux closed loop. |
| [5] | Motor Check | The frequency converter detects automatically when the motor is disconnected and resumes operation once the motor is connected again. Valid for FC 302 only. |

## 3.6.4 4-6* Speed Bypass

Some systems call for avoiding certain output frequencies or speeds, due to resonance problems in the system. A maximum of 4 frequency or speed ranges can be avoided.

| 4-60 Bypass Speed From [RPM] | | |
|---|---|---|
| Array [4] | | |
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-13 RPM] | Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided. |

| 4-61 Bypass Speed From [Hz] | | |
|---|---|---|
| Array [4] | | |
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-14 Hz] | Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided. |

| 4-62 Bypass Speed To [RPM] | | |
|---|---|---|
| Array [4] | | |
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-13 RPM] | Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided. |

| 4-63 Bypass Speed To [Hz] | | |
|---|---|---|
| Array [4] | | |
| **Range:** | | **Function:** |
| Size related* | [ 0 - par. 4-14 Hz] | Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided. |



3

## 3.7 Parameters: 5-** Digital In/Out

### 3.7.1 5-0* Digital I/O Mode

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

**5-00 Digital I/O Mode**

| Option: | | Function: |
|---|---|---|
| | | Digital inputs and programmed digital outputs are pre-programmable for operation either in PNP or NPN systems. |
| [0] * | PNP | Action on positive directional pulses (↕). PNP systems are pulled down to GND. |
| [1] | NPN | Action on negative directional pulses (↕). NPN systems are pulled up to +24 V, internally in the frequency converter. |

***NOTICE***

**Once this parameter has been changed, it must be activated by performing a power cycle.**

**5-01 Terminal 27 Mode**

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

**5-02 Terminal 29 Mode**

| Option: | | Function: |
|---|---|---|
| [0] * | Input | Defines terminal 29 as a digital input. |
| [1] | Output | Defines terminal 29 as a digital output. |

This parameter is available for FC 302 only.

### 3.7.2 5-1* Digital Inputs

The digital inputs are used for selecting various functions in the frequency converter. All digital inputs can be set to the following functions:

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

| | |
|---|---|
| Group 1 | Reset, Coasting stop, Reset and Coasting stop, Quick stop, DC braking, Stop and the [Off] key. |
| Group 2 | Start, Pulse start, Reversing, Start reversing, Jog and Freeze output. |

**Table 3.13 Function Groups**

| Digital input function | Select | Terminal |
|---|---|---|
| No operation | [0] | All *term 32, 33 |
| Reset | [1] | All |
| Coast inverse | [2] | All *term 27 |
| Coast and reset inverse | [3] | All |
| Quick stop inverse | [4] | All |
| DC brake inverse | [5] | All |
| Stop inverse | [6] | All |
| Start | [8] | All *term 18 |
| Latched start | [9] | All |
| Reversing | [10] | All *term 19 |
| Start reversing | [11] | All |
| Enable start forward | [12] | All |
| Enable start reverse | [13] | All |
| Jog | [14] | All *term 29 |
| Preset reference on | [15] | All |
| Preset ref bit 0 | [16] | All |
| Preset ref bit 1 | [17] | All |
| Preset ref bit 2 | [18] | All |
| Freeze reference | [19] | All |
| Freeze output | [20] | All |
| Speed up | [21] | All |
| Speed down | [22] | All |
| Set-up select bit 0 | [23] | All |
| Set-up select bit 1 | [24] | All |
| Precise stop inverse | [26] | 18, 19 |
| Precises start, stop | [27] | 18, 19 |
| Catch up | [28] | All |
| Slow down | [29] | All |
| Counter input | [30] | 29, 33 |
| Pulse input edge trigged | [31] | 29, 33 |
| Pulse input time based | [32] | 29, 33 |
| Ramp bit 0 | [34] | All |
| Ramp bit 1 | [35] | All |
| Latched precise start | [40] | 18, 19 |
| Latched precise stop inverse | [41] | 18, 19 |
| External interlock | [51] | |
| DigiPot increase | [55] | All |
| DigiPot decrease | [56] | All |
| DigiPot clear | [57] | All |
| Digipot hoist | [58] | All |
| Counter A (up) | [60] | 29, 33 |
| Counter A (down) | [61] | 29, 33 |
| Reset Counter A | [62] | All |
| Counter B (up) | [63] | 29, 33 |
| Counter B (down) | [64] | 29, 33 |
| Reset counter B | [65] | All |
| Mech. brake feedb. | [70] | All |
| Mech. brake feedb. inv. | [71] | All |
| PID error inv. | [72] | All |
| PID reset I-part | [73] | All |
| PID enable | [74] | All |
| MCO specific | [75] | |

| Digital input function | Select | Terminal |
|---|---|---|
| PTC card 1 | [80] | All |
| Profidrive OFF2 | [91] | |
| Profidrive OFF3 | [92] | |
| Start edge triggered | [98] | |
| Safe option reset | [100] | Resets the safety option. Available only when the safety option is mounted. |

**Table 3.14 Digital Input Function**

FC 300 standard terminals are 18, 19, 27, 29, 32 and 33.
MCB 101 terminals are X30/2, X30/3 and X30/4.
Terminal 29 functions as an output only in FC 302.

Functions dedicated to only 1 digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

| | | |
|---|---|---|
| [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 | (Default Digital input 27): Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic '0' ⇒ coasting stop. |
| [3] | Coast and reset inverse | Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets frequency converter. Logic '0' ⇒ coasting stop and reset. |
| [4] | Quick stop inverse | Inverted input (NC). Generates a stop in accordance with quick stop ramp time set in *parameter 3-81 Quick Stop Ramp Time*. When motor stops, the shaft is in free mode. Logic '0' ⇒ Quick-stop. |
| [5] | DC brake inverse | Inverted input for DC braking (NC). Stops motor by energising it with a DC current for a certain time period. See *parameter 2-01 DC Brake Current* to *parameter 2-03 DC Brake Cut In Speed [RPM]*. The function is only active when the value in *parameter 2-02 DC Braking Time* is different from 0. Logic '0' ⇒ DC braking. |
| [6] | Stop inverse | Stop inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (*parameter 3-42 Ramp 1 Ramp Down Time*, *parameter 3-52 Ramp 2 Ramp Down Time*, *parameter 3-62 Ramp 3 Ramp down Time*, *parameter 3-72 Ramp 4 Ramp Down Time*). |
| | | ***NOTICE*** **When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit and stop* and connect this digital output to a digital input that is configured as coast.** |
| [8] | Start | (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 or a reset command (via DI) is given. |
| [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 4-10 Motor Speed Direction*. The function is not active in process closed loop. |
| [11] | Start reversing | Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time. |
| [12] | Enable start forward | Disengages the counterclockwise movement and allows for the clockwise direction. |
| [13] | Enable start reverse | Disengages the clockwise movement and allows for the counterclockwise direction. |
| [14] | Jog | (Default Digital input 29): Use to activate jog speed. See *parameter 3-11 Jog Speed [Hz]*. |
| [15] | Preset reference on | Shifts between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *parameter 3-04 Reference Function*. Logic '0' = external reference active; logic '1' = one of the 8 preset references is active. |
| [16] | Preset ref bit 0 | Preset ref. bit 0, 1, and 2 enables a choice between 1 of the 8 preset references according to *Table 3.15*. |
| [17] | Preset ref bit 1 | Same as Preset ref bit 0 [16]. |
| [18] | Preset ref bit 2 | Same as Preset ref bit 0 [16]. |

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| 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 3.15 Preset Ref. Bit**

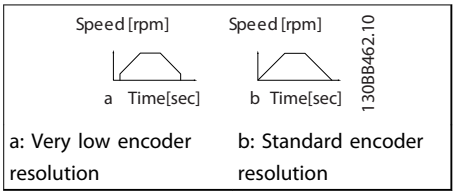
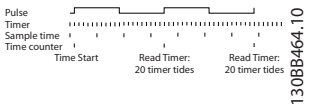
| | | |
|---|---|---|
| [19] | Freeze ref | Freezes the actual reference, which is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (*parameter 3-51 Ramp 2 Ramp Up Time* and *parameter 3-52 Ramp 2 Ramp Down Time*) in the range 0 - *parameter 3-03 Maximum Reference*. |
| [20] | Freeze output | 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 (*parameter 3-51 Ramp 2 Ramp Up Time* and *parameter 3-52 Ramp 2 Ramp Down Time*) in the range 0 - *parameter 1-23 Motor Frequency*.<br>***NOTICE***<br>**When Freeze output is active, the frequency converter cannot be stopped via a low *[8] Start* signal. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] 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 *[19] Freeze ref* or *[20] Freeze output*. When Speed up/down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If Speed up/down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down parameter 3-x1/3-x2. |

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

**Table 3.16 Shut Down/Catch Up**

| | | |
|---|---|---|
| [22] | Speed down | Same as *[21] Speed up*. |
| [23] | Set-up select bit 0 | Select Set-up select bit 0 or select Set-up select bit 1 to select 1 of the 4 set-ups. Set *parameter 0-10 Active Set-up* to Multi Set-up. |
| [24] | Set-up select bit 1 | (Default Digital input 32): Same as *[23] Set-up select bit 0*. |
| [26] | Precise stop inv. | Sends an inverted stop signal when the precise stop function is activated in *parameter 1-83 Precise Stop Function*. Precise stop inverse function is available for terminals 18 or 19. |
| [27] | Precise start, stop | Use when *[0] Precise ramp stop* is selected in *parameter 1-83 Precise Stop Function*. Precise start, stop is available for terminals 18 and 19. Precise start makes sure that the angle that the rotor turns from standing still to reference is the same for each start (for same ramp time, same set-point). This is the equivalent to the precise stop where the angle that the rotor turns from reference to standing still is the same for each stop. When using *parameter 1-83 Precise Stop Function* option [1] or [2]: The frequency converter needs a Precise stop signal before the value of *parameter 1-84 Precise Stop Counter Value* is reached. If this is not supplied, the frequency converter does not stop when the value in *parameter 1-84 Precise Stop Counter Value* is reached. Precise start, stop must be triggered by a Digital input and is available for terminals 18 and 19. |
| [28] | Catch up | Increases reference value by percentage (relative) set in *parameter 3-12 Catch up/slow Down Value*. |
| [29] | Slow down | Reduces reference value by percentage (relative) set in *parameter 3-12 Catch up/slow Down Value*. |
| [30] | Counter input | Precise stop function in *parameter 1-83 Precise Stop Function* acts as counter stop or speed compensated counter stop with or without reset. The counter value must be set in *parameter 1-84 Precise Stop Counter Value*. |
| [31] | Pulse edge triggered | Counts the number of pulse flanks per sample time. This gives a higher resolution at high frequencies, but is not as precise at lower frequencies. Use this pulse principle for encoders with very low resolution (e.g. 30 ppr).<br>  <br>**Illustration 3.33 Pulse Flanks per Sample Time** |
| [32] | Pulse time-based | Measures the duration between pulse flanks. This gives a higher resolution at lower frequencies, but is not as precise at higher frequencies. This principle has a cut-off frequency, which makes it unsuited for encoders |

| | | |
|---|---|---|
| | | with very low resolutions (e.g. 30 ppr) at low speeds.<br>  <br>a: Very low encoder resolution b: Standard encoder resolution<br>  <br>**Illustration 3.34 Duration Between Pulse Flanks** |
| [34] | Ramp bit 0 | Enables a choice between 1 of the 4 ramps available, according to *Table 3.17*. |
| [35] | Ramp bit 1 | Same as Ramp bit 0. |

| **Preset ramp bit** | **1** | **0** |
|---|---|---|
| Ramp 1 | 0 | 0 |
| Ramp 2 | 0 | 1 |
| Ramp 3 | 1 | 0 |
| Ramp 4 | 1 | 1 |

**Table 3.17 Preset Ramp Bit**

| | | |
|---|---|---|
| [40] | Latched Precise Start | A Latched Precise Start only requires a pulse of 3 ms on Terminals 18 or 19.<br>When using for *1-83 Precise Stop Function [1] Cnt stop with reset* or *[2] Cnt stop w/o reset*: When the reference is reached, the frequency converter internally enables the Precise Stop signal. This means that the frequency converter does the Precise Stop when the counter value of *parameter 1-84 Precise Stop Counter Value* is reached. |
| [41] | Latched Precise Stop inverse | Sends a latched stop signal when the Precise Stop function is activated in *parameter 1-83 Precise Stop Function*. The Latched Precise Stop inverse function is available for terminals 18 or 19. |
| [51] | External interlock | This function makes it possible to give an external fault to the frequency converter. This fault is treated in the same way as an internally generated alarm. |
| [55] | DigiPot Increase | Increase signal to the Digital Potentiometer function described in parameter group *3-9* Digital Pot. Meter*. |
| [56] | DigiPot Decrease | Decrease signal to the Digital Potentiometer function described in parameter group *3-9* Digital Pot. Meter*. |
| [57] | DigiPot Clear | Clears the Digital Potentiometer reference described in parameter group *3-9* Digital Pot. Meter*. |
| [60] | Counter A | (Terminal 29 or 33 only) Input for increment counting in the SLC counter. |
| [61] | Counter A | (Terminal 29 or 33 only) Input for decrement counting in the SLC counter. |
| [62] | Reset Counter A | Input for reset of counter A. |
| [63] | Counter B | (Terminal 29 or 33 only) Input for increment counting in the SLC counter. |
| [64] | Counter B | (Terminal 29 or 33 only) Input for decrement counting in the SLC counter. |
| [65] | Reset Counter B | Input for reset of counter B. |
| [70] | Mech. Brake Feedback | Brake feedback for hoisting applications: Set *parameter 1-01 Motor Control Principle* to *[3] Flux w/ motor feedback*; set *parameter 1-72 Start Function* to *[6] Hoist mech brake Ref.* |
| [71] | Mech. Brake Feedback inv. | Inverted brake feedback for hoisting applications. |
| [72] | PID error inverse | When enabled, it inverts the resulting error from the process PID controller. Available only if "Configuration Mode" is set to "Surface Winder", "Extended PID Speed OL" or "Extended PID Speed CL". |
| [73] | PID reset I-part | When enabled, resets the I-part of the Process PID controller. Equivalent to *parameter 7-40 Process PID I-part Reset*. Available only if "Configuration Mode" is set to "Surface Winder", "Extended PID Speed OL" or "Extended PID Speed CL". |
| [74] | PID enable | When enabled, enables the extended process PID controller. Equivalent to *parameter 7-50 Process PID Extended PID*. Available only if "Configuration Mode" is set "Extended PID Speed OL" or "Extended PID Speed CL". |
| [80] | PTC Card 1 | All Digital inputs can be set to *[80] PTC Card 1*. However, only one Digital input must be set to this choice. |
| [91] | Profidrive OFF2 | The functionality is the same as the corresponding control word bit of the Profibus/Profinet option. |
| [92] | Profidrive OFF3 | The functionality is the same as the corresponding control word bit of the Profibus/Profinet option. |
| [98] | Start edge triggered | Edge triggered start command. Keeps the start command alive. It can be used for a start push button. |
| [100] | Safe Option Reset | Resets the safety option. Available only when the safety option is mounted. |

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### 5-10 Terminal 18 Digital Input

| Option: | | Function: |
|---|---|---|
| [8] * | Start | Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-11 Terminal 19 Digital Input

| Option: | | Function: |
|---|---|---|
| [10] * | Reversing | Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-12 Terminal 27 Digital Input

| Option: | | Function: |
|---|---|---|
| [2] * | Coast inverse | Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-13 Terminal 29 Digital Input

| Option: | | Function: |
|---|---|---|
| | | Select the function from the available digital input range and the additional options [60], [61], [63] and [64]. Counters are used in Smart Logic Control functions. This parameter is available for FC 302 only. |
| [14] * | Jog | Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-14 Terminal 32 Digital Input

| Option: | | Function: |
|---|---|---|
| | | Select the function from the available digital input range. |
| | No operation | Functions are described under *5-1* Digital Inputs*. |

### 5-15 Terminal 33 Digital Input

| Option: | | Function: |
|---|---|---|
| | | Select the function from the available digital input range and the additional options [60], [61], [63] and [64]. Counters are used in Smart Logic Control functions. |
| [0] * | No operation | Functions are described under *5-1* Digital Inputs*. |

### 5-16 Terminal X30/2 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 101 is installed in the frequency converter. Functions are described under *5-1* Digital Inputs*. |

### 5-17 Terminal X30/3 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 101 is installed in the frequency converter. Functions are described under *5-1* Digital Inputs*. |

### 5-18 Terminal X30/4 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 101 is installed in the frequency converter. Functions are described under *5-1* Digital Inputs*. |

### 5-19 Terminal 37 Safe Stop

Use this parameter to configure the safe stop functionality. A warning message makes the frequency converter coast the motor and enables the automatic restart. An alarm message makes the frequency converter coast the motor and requires a manual restart (via a fieldbus, Digital I/O, or by pressing RESET on the LCP). When the *MCB 112 PTC Thermistor Card* is mounted, the PTC options should be configured to get the full benefit from the alarm handling.

| Option: | | Function: |
|---|---|---|
| [1] | Safe Stop Alarm | Coasts frequency converter when safe stop is activated. Manual reset from LCP, digital input or fieldbus. |
| [3] | Safe Stop Warning | Coasts frequency converter when safe stop is activated (T-37 off). When safe stop circuit is reestablished, the frequency converter will continue without manual reset. |
| [4] | PTC 1 Alarm | Coasts frequency converter when Safe Torque Off is activated. Manual reset from LCP, digital input or fieldbus. |
| [5] | PTC 1 Warning | Coasts frequency converter when Safe Torque Off is activated (T-37 off). When Safe Torque Off circuit is reestablished, the frequency converter continues without manual reset, unless a Digital input set to *[80] PTC Card 1* is still enabled. |
| [6] | PTC 1 & Relay A | This choice is used when the PTC option is gated together with a stop button through a Safety relay to T-37. Coasts frequency converter when safe stop is activated. Manual reset from LCP, digital input or fieldbus. |
| [7] | PTC 1 & Relay W | This option is used when the PTC option is gated together with a stop button through a Safety relay to T-37. Coasts frequency converter when Safe Torque Off is activated (T-37 off). When safe stop circuit is reestablished, the frequency converter continues without manual reset, unless a Digital input set to *[80] PTC Card 1* is (still) enabled. |

### 5-19 Terminal 37 Safe Stop

Use this parameter to configure the safe stop functionality. A warning message makes the frequency converter coast the motor and enables the automatic restart. An alarm message makes the frequency converter coast the motor and requires a manual restart (via a fieldbus, Digital I/O, or by pressing RESET on the LCP). When the *MCB 112 PTC Thermistor Card* is mounted, the PTC options should be configured to get the full benefit from the alarm handling.

| Option: | | Function: |
|---|---|---|
| [8] | PTC 1 & Relay A/W | This option makes it possible to use a combination of Alarm and Warning. |
| [9] | PTC 1 & Relay W/A | This option makes it possible to use a combination of Alarm and Warning. |

**NOTICE**

**Options [4]-[9] are only available when the MCB 112 PTC Thermistor Card is connected.**

**NOTICE**

**When Auto Reset/Warning is selected, the frequency converter opens up for automatic restart.**

| Function | Number | PTC | Relay |
|---|---|---|---|
| No Function | [0] | - | - |
| Safe Stop Alarm | [1]* | - | Safe Stop [A68] |
| Safe Stop Warning | [3] | - | Safe Stop [W68] |
| PTC 1 Alarm | [4] | PTC 1 Safe Stop [A71] | - |
| PTC 1 Warning | [5] | PTC 1 Safe Stop [W71] | - |
| PTC 1 & Relay A | [6] | PTC 1 Safe Stop [A71] | Safe Stop [A68] |
| PTC 1 & Relay W | [7] | PTC 1 Safe Stop [W71] | Safe Stop [W68] |
| PTC 1 & Relay A/W | [8] | PTC 1 Safe Stop [A71] | Safe Stop [W68] |
| PTC 1 & Relay W/A | [9] | PTC 1 Safe Stop [W71] | Safe Stop [A68] |

**Table 3.18 Overview of Functions, Alarms and Warnings**

*W means warning and A means alarm. For further information, see Alarms and Warnings in the Troubleshooting section in the Design Guide or the Operating Instructions.*

A dangerous failure related to Safe Torque Off issues *Alarm: Dangerous Failure [A72]*.

Refer to *Table 5.1*.

### 5-20 Terminal X46/1 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-21 Terminal X46/3 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-22 Terminal X46/5 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-23 Terminal X46/7 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-24 Terminal X46/9 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter group *5-1* Digital Inputs*. |

### 5-25 Terminal X46/11 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter *group 5-1* Digital Inputs*. |

### 5-26 Terminal X46/13 Digital Input

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | This parameter is active when option module MCB 113 is installed in the frequency converter. Functions are described under parameter *group 5-1* Digital Inputs*. |



  

3

## 3.7.3 5-3* Digital Outputs

The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in *parameter 5-01 Terminal 27 Mode*, and set the I/O function for terminal 29 in *parameter 5-02 Terminal 29 Mode*.

***NOTICE***

**These parameters cannot be adjusted while the motor is running.**

| | | |
|---|---|---|
| [0] | No operation | Default for all digital outputs and relay outputs. |
| [1] | Control ready | The control card is ready, for example: Feedback from a frequency converter where the control is supplied by an external 24 V (MCB 107) and the main power to the unit is not detected. |
| [2] | Drive ready | The frequency converter is ready for operation and applies a supply signal on the control board. |
| [3] | Drive ready/ remote control | The frequency converter is ready for operation and is in [Auto On] mode. |
| [4] | Enable/no warning | Ready for operation. No start or stop command has been given (start/disable). No warnings are active. |
| [5] | VLT running | Motor is running and shaft torque is present. |
| [6] | Running/no warning | Output speed is higher than the speed set in *parameter 1-81 Min Speed for Function at Stop [RPM]*. The motor is running and there are no warnings. |
| [7] | Run in range/no warning | Motor is running within the programmed current and speed ranges set in *parameter 4-50 Warning Current Low* to *parameter 4-53 Warning Speed High*. There are no warnings. |
| [8] | Run on reference/no warning | Motor runs at reference speed. No warnings. |
| [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 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode* has been exceeded. |
| [12] | Out of current range | The motor current is outside the range set in *parameter 4-18 Current Limit*. |
| [13] | Below current, low | Motor current is lower than set in *parameter 4-50 Warning Current Low*. |
| [14] | Above current, high | Motor current is higher than set in *parameter 4-51 Warning Current High*. |
| [15] | Out of range | Output frequency is outside the frequency range set in *parameter 4-52 Warning Speed Low* and *parameter 4-53 Warning Speed High*. |
| [16] | Below speed, low | Output speed is lower than the setting in *parameter 4-52 Warning Speed Low*. |
| [17] | Above speed, high | Output speed is higher than the setting in *parameter 4-53 Warning Speed High*. |
| [18] | Out of feedback range | Feedback is outside the range set in *parameter 4-56 Warning Feedback Low* and *parameter 4-57 Warning Feedback High*. |
| [19] | Below feedback low | Feedback is below the limit set in *parameter 4-56 Warning Feedback Low*. |
| [20] | Above feedback high | Feedback is above the limit set in *parameter 4-57 Warning Feedback High*. |
| [21] | Thermal warning | The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor. |
| [22] | Ready, no thermal warning | Frequency converter is ready for operation and there is no overtemperature warning. |
| [23] | Remote, ready, no thermal warning | Frequency converter is ready for operation and is in [Auto On] mode. There is no overtemperature warning. |
| [24] | Ready, no over/ undervoltage | Frequency converter is ready for operation and the mains voltage is within the specified voltage range (see *General Specifications* section in the *Design Guide*). |
| [25] | Reverse | The motor runs (or is ready to run) clockwise when logic=0 and counter-clockwise when logic=1. The output changes as soon as the reversing signal is applied. |
| [26] | Bus OK | Active communication (no time-out) via the serial communication port. |
| [27] | Torque limit and 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 warning | 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. |
| [31] | Relay 123 | Relay is activated when Control Word [0] is selected in parameter group *8-** Communications and Options*. |
| [32] | Mechanical brake control | Enables control of an external mechanical brake, see description in the section *Control of Mechanical Brake*, and parameter group *2-2* Mechanical Brake* |

| | | |
|---|---|---|
| [33] | Safe stop activated (FC 302 only) | Indicates that the Safe Torque Off on terminal 37 has been activated. |
| [40] | Out of ref range | Active when the actual speed is outside settings in *parameter 4-52 Warning Speed Low* to *parameter 4-55 Warning Reference High*. |
| [41] | Below reference low | Active when actual speed is below speed reference setting. |
| [42] | Above reference high | Active when actual speed is above speed reference setting. |
| [43] | Extended PID Limit | |
| [45] | Bus Ctrl | Controls output via bus. The state of the output is set in *parameter 5-90 Digital & Relay Bus Control*. The output state is retained in the event of bus time-out. |
| [46] | Bus Ctrl On at timeout | Controls output via bus. The state of the output is set in *parameter 5-90 Digital & Relay Bus Control*. In the event of bus timeout, the output state is set high (On). |
| [47] | Bus Ctrl Off at timeout | Controls output via bus. The state of the output is set in *parameter 5-90 Digital & Relay Bus Control*. In the event of bus timeout, the output state is set low (Off). |
| [51] | MCO-controlled | Active when an MCO 302 or MCO 305 is connected. The output is controlled from option. |
| [55] | Pulse output | |
| [60] | Comparator 0 | See parameter group *13-1* Comparators*. If Comparator 0 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [61] | Comparator 1 | See parameter group *13-1* Comparators*. If Comparator 1 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [62] | Comparator 2 | See parameter group *13-1* Comparators*. If Comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [63] | Comparator 3 | See parameter group *13-1* Comparators*. If Comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [64] | Comparator 4 | See parameter group *13-1* Comparators*. If Comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [65] | Comparator 5 | See parameter group *13-1* Comparators*. If Comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [70] | Logic Rule 0 | See parameter group *13-4* Logic Rules*. If Logic Rule 0 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [71] | Logic Rule 1 | See parameter group *13-4* Logic Rules*. If Logic Rule 1 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [72] | Logic Rule 2 | See parameter group *13-4* Logic Rules*. If Logic Rule 2 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [73] | Logic Rule 3 | See parameter group *13-4* Logic Rules*. If Logic Rule 3 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [74] | Logic Rule 4 | See parameter group *13-4* Logic Rules*. If Logic Rule 4 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [75] | Logic Rule 5 | See parameter group *13-4* Logic Rules*. If Logic Rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [80] | SL Digital Output A | See *parameter 13-52 SL Controller Action*. The output goes high whenever the Smart Logic Action *[38] Set dig. out. A high* is executed. The output goes low whenever the Smart Logic Action *[32] Set dig. out. A* low is executed. |
| [81] | SL Digital Output B | See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[39] Set dig. out. B high* is executed. The input goes low whenever the Smart Logic Action *[33] Set dig. out. B low* is executed. |
| [82] | SL Digital Output C | See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[40] Set dig. out. C high* is executed. The input goes low whenever the Smart Logic Action *[34] Set dig. out. C low* is executed. |
| [83] | SL Digital Output D | See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[41] Set dig. out. D* high is executed. The input goes low whenever the Smart Logic Action *[35] Set dig. out. D low* is executed. |
| [84] | SL Digital Output E | See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[42] Set dig. out. E high* is executed. The input goes low whenever the Smart Logic Action *[36] Set dig. out. E low* is executed. |
| [85] | SL Digital Output F | See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[43] Set dig. out. F high* is executed. The input goes low whenever the Smart Logic Action *[37] Set dig. out. F low* is executed. |
| [90] | kWh counter pulse | Sends a pulse (200 ms pulse width) to output terminal whenever kWh counter changes (*15-02 kWh Counter*). |
| [120] | Local referen-ce active | Output is high when *3-13 Reference Site = [2] Local* or when *3-13 Reference Site = [0] Linked to hand auto* at the same time as the LCP is in Hand On mode. |

3

| | | |
|---|---|---|
| | | **Reference site set in *3-13 Reference Site*** / **Local reference active [120]** / **Remote reference active [121]** |
| | | Reference site: Local *3-13 Reference Site* [2] / 1 / 0 |
| | | Reference site: Remote *3-13 Reference Site* [1] / 0 / 1 |
| | | Reference site: Linked to Hand/ Auto / / |
| | | Hand / 1 / 0 |
| | | Hand ⇒ off / 1 / 0 |
| | | Auto ⇒ off / 0 / 0 |
| | | Auto / 0 / 1 |

**Table 3.19 Local Reference Active**

| | | |
|---|---|---|
| [121] | Remote reference active | Output is high when *3-13 Reference Site* = *[1] Remote* or *[0] Linked to hand/auto* while the LCP is in Auto on mode. See above. |
| [122] | No alarm | Output is high when no alarm is present. |
| [123] | Start command active | Output is high when there is an active start command (i.e. via digital input bus connection or Hand on or Auto on), and no stop or start command is active. |
| [124] | Running reverse | Output is high when the frequency converter is running counterclockwise (the logical product of the status bits 'running' AND 'reverse'). |
| [125] | Drive in hand mode | Output is high when the frequency converter is in Hand On mode (as indicated by the LED light above [Hand on]). |
| [126] | Drive in auto mode | Output is high when the frequency converter is in Hand On mode (as indicated by the LED light above Auto On). |
| [151] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [152] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [153] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [154] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [188] | AHF Capacitor Connect | The capacitors are turned on at 20% (hysteresis of 50% gives an interval of 10% - 30%). The capacitors are disconnected below 10%. The off delay is 10 s and restarts if the nominal power goes above 10% during the delay. *Parameter 5-80 AHF Cap Reconnect Delay* is used to guarantee a minimum off-time for the capacitors. |
| [189] | External fan control | The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for HP duct cooling). |
| [190] | Safe Function active | |
| [191] | Safe Opt. Reset req. | |
| [192] | RS Flipflop 0 | See parameter group *13-1* Comparators* |
| [193] | RS Flipflop 1 | See parameter group *13-1* Comparators* |
| [194] | RS Flipflop 2 | See parameter group *13-1* Comparators* |
| [195] | RS Flipflop 3 | See parameter group *13-1* Comparators* |
| [196] | RS Flipflop 4 | See parameter group *13-1* Comparators* |
| [197] | RS Flipflop 5 | See parameter group *13-1* Comparators* |
| [198] | RS Flipflop 6 | See parameter group *13-1* Comparators* |
| [199] | RS Flipflop 7 | See parameter group *13-1* Comparators* |

### 5-30 Terminal 27 Digital Output

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | Functions are described under parameter group *5-3* Digital Outputs*. |

### 5-31 Terminal 29 Digital Output

| Option: | | Function: |
|---|---|---|
| [0] * | No operation | Functions are described under parameter group *5-3* Digital Outputs*. This parameter is applicable for FC 302 only. |

### 5-32 Term X30/6 Digi Out (MCB 101)

| Option: | | Function: |
|---|---|---|
| [0] | No operation | This parameter is active when option module MCB 101 is mounted in the frequency converter. Functions are described under parameter group *5-3* Digital Outputs*. |
| [1] | Control Ready | |
| [2] | Drive ready | |
| [3] | Drive rdy/rem ctrl | |
| [4] | Enable / no warning | |

| 5-32 Term X30/6 Digi Out (MCB 101) | | |
|---|---|---|
| **Option:** | | **Function:** |
| [5] | Running | |
| [6] | Running / no warning | |
| [7] | Run in range/no warn | |
| [8] | Run on ref/no warn | |
| [9] | Alarm | |
| [10] | Alarm or warning | |
| [11] | At torque limit | |
| [12] | Out of current range | |
| [13] | Below current, low | |
| [14] | Above current, high | |
| [15] | Out of speed range | |
| [16] | Below speed, low | |
| [17] | Above speed, high | |
| [18] | Out of feedb. range | |
| [19] | Below feedback, low | |
| [20] | Above feedback, high | |
| [21] | Thermal warning | |
| [22] | Ready,no thermal W | |
| [23] | Remote,ready,no TW | |
| [24] | Ready, Voltage OK | |
| [25] | Reverse | |
| [26] | Bus OK | |
| [27] | Torque limit & stop | |
| [28] | Brake, no brake war | |
| [29] | Brake ready, no fault | |
| [30] | Brake fault (IGBT) | |
| [31] | Relay 123 | |
| [32] | Mech brake ctrl | |
| [33] | Safe stop active | |
| [38] | Motor feedback error | |
| [39] | Tracking error | |
| [40] | Out of ref range | |
| [41] | Below reference, low | |
| [42] | Above ref, high | |
| [43] | Extended PID Limit | |
| [45] | Bus ctrl. | |
| [46] | Bus ctrl, 1 if timeout | |
| [47] | Bus ctrl, 0 if timeout | |
| [51] | MCO controlled | |
| [55] | Pulse output | |
| [60] | Comparator 0 | |
| [61] | Comparator 1 | |
| [62] | Comparator 2 | |
| [63] | Comparator 3 | |
| [64] | Comparator 4 | |
| [65] | Comparator 5 | |
| [70] | Logic rule 0 | |
| [71] | Logic rule 1 | |
| [72] | Logic rule 2 | |
| [73] | Logic rule 3 | |
| [74] | Logic rule 4 | |
| [75] | Logic rule 5 | |

| 5-32 Term X30/6 Digi Out (MCB 101) | | |
|---|---|---|
| **Option:** | | **Function:** |
| [80] | SL digital output A | |
| [81] | SL digital output B | |
| [82] | SL digital output C | |
| [83] | SL digital output D | |
| [84] | SL digital output E | |
| [85] | SL digital output F | |
| [90] | kWh counter pulse | Sends a pulse (200 ms pulse width) to output terminal whenever kWh counter changes (*15-02 kWh Counter*). |
| [120] | Local ref active | |
| [121] | Remote ref active | |
| [122] | No alarm | |
| [123] | Start command activ | |
| [124] | Running reverse | |
| [125] | Drive in hand mode | |
| [126] | Drive in auto mode | |
| [151] | ATEX ETR cur. alarm | |
| [152] | ATEX ETR freq. alarm | |
| [153] | ATEX ETR cur. warning | |
| [154] | ATEX ETR freq. warning | |
| [188] | AHF Capacitor Connect | |
| [189] | External Fan Control | |
| [190] | Safe Function active | |
| [191] | Safe Opt. Reset req. | |
| [192] | RS Flipflop 0 | |
| [193] | RS Flipflop 1 | |
| [194] | RS Flipflop 2 | |
| [195] | RS Flipflop 3 | |
| [196] | RS Flipflop 4 | |
| [197] | RS Flipflop 5 | |
| [198] | RS Flipflop 6 | |
| [199] | RS Flipflop 7 | |

| 5-33 Term X30/7 Digi Out (MCB 101) | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | No operation | This parameter is active when option module option module MCB 101 is mounted in the frequency converter. Functions are described under parameter group *5-3* Digital Outputs*. |
| [1] | Control Ready | |
| [2] | Drive ready | |
| [3] | Drive rdy/rem ctrl | |
| [4] | Enable / no warning | |
| [5] | Running | |
| [6] | Running / no warning | |
| [7] | Run in range/no warn | |
| [8] | Run on ref/no warn | |
| [9] | Alarm | |
| [10] | Alarm or warning | |



  

3

| 5-33 Term X30/7 Digi Out (MCB 101) | | |
|---|---|---|
| **Option:** | | **Function:** |
| [11] | At torque limit | |
| [12] | Out of current range | |
| [13] | Below current, low | |
| [14] | Above current, high | |
| [15] | Out of speed range | |
| [16] | Below speed, low | |
| [17] | Above speed, high | |
| [18] | Out of feedb. range | |
| [19] | Below feedback, low | |
| [20] | Above feedback, high | |
| [21] | Thermal warning | |
| [22] | Ready,no thermal W | |
| [23] | Remote,ready,no TW | |
| [24] | Ready, Voltage OK | |
| [25] | Reverse | |
| [26] | Bus OK | |
| [27] | Torque limit & stop | |
| [28] | Brake, no brake war | |
| [29] | Brake ready, no fault | |
| [30] | Brake fault (IGBT) | |
| [31] | Relay 123 | |
| [32] | Mech brake ctrl | |
| [33] | Safe stop active | |
| [39] | Tracking error | |
| [40] | Out of ref range | |
| [41] | Below reference, low | |
| [42] | Above ref, high | |
| [43] | Extended PID Limit | |
| [45] | Bus ctrl. | |
| [46] | Bus ctrl, 1 if timeout | |
| [47] | Bus ctrl, 0 if timeout | |
| [51] | MCO controlled | |
| [60] | Comparator 0 | |
| [61] | Comparator 1 | |
| [62] | Comparator 2 | |
| [63] | Comparator 3 | |
| [64] | Comparator 4 | |
| [65] | Comparator 5 | |
| [70] | Logic rule 0 | |
| [71] | Logic rule 1 | |
| [72] | Logic rule 2 | |
| [73] | Logic rule 3 | |
| [74] | Logic rule 4 | |
| [75] | Logic rule 5 | |
| [80] | SL digital output A | |
| [81] | SL digital output B | |
| [82] | SL digital output C | |
| [83] | SL digital output D | |
| [84] | SL digital output E | |
| [85] | SL digital output F | |
| [120] | Local ref active | |
| [121] | Remote ref active | |

| 5-33 Term X30/7 Digi Out (MCB 101) | | |
|---|---|---|
| **Option:** | | **Function:** |
| [122] | No alarm | |
| [123] | Start command activ | |
| [124] | Running reverse | |
| [125] | Drive in hand mode | |
| [126] | Drive in auto mode | |
| [151] | ATEX ETR cur. alarm | |
| [152] | ATEX ETR freq. alarm | |
| [153] | ATEX ETR cur. warning | |
| [154] | ATEX ETR freq. warning | |
| [189] | External Fan Control | |
| [190] | Safe Function active | |
| [191] | Safe Opt. Reset req. | |
| [192] | RS Flipflop 0 | |
| [193] | RS Flipflop 1 | |
| [194] | RS Flipflop 2 | |
| [195] | RS Flipflop 3 | |
| [196] | RS Flipflop 4 | |
| [197] | RS Flipflop 5 | |
| [198] | RS Flipflop 6 | |
| [199] | RS Flipflop 7 | |

## 3.7.4 5-4* Relays

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

**5-40 Function Relay**

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

| **Option:** | | **Function:** |
|---|---|---|
| [0] | No operation | All digital and relay outputs are by default set to “No Operation”. |
| [1] | Control Ready | The control card is ready, for example: Feedback from a frequency converter where the control is supplied by an external 24 V (MCB 107) and the main power to frequency converter is not detected. |
| [2] | Drive ready | Frequency converter is ready to operate. Mains and control supplies are OK. |
| [3] | Drive rdy/rem ctrl | The frequency converter is ready for operation and is in Auto On mode |
| [4] | Enable / no warning | Ready for operation. No start or stop commands have been applied (start/ disable). No warnings are active. |
| [5] | Running | Motor is running, and shaft torque is present. |

**5-40 Function Relay**

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

| Option: | | Function: |
|---|---|---|
| [6] | Running / no warning | Output speed is higher than the speed set in *1-81 Min Speed for Function at Stop [RPM]*. The motor is running and no warnings. |
| [7] | Run in range/no warn | Motor is running within the programmed current and speed ranges set in *parameter 4-50 Warning Current Low* and *parameter 4-53 Warning Speed High*. No warnings. |
| [8] | Run on ref/no warn | Motor runs at reference speed. No warnings. |
| [9] | Alarm | An alarm activates the output. No warnings. |
| [10] | Alarm or warning | An alarm or a warning activates the output. |
| [11] | At torque limit | The torque limit set in *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode* has been exceeded. |
| [12] | Out of current range | The motor current is outside the range set in *parameter 4-18 Current Limit*. |
| [13] | Below current, low | Motor current is lower than set in *parameter 4-50 Warning Current Low*. |
| [14] | Above current, high | Motor current is higher than set in *parameter 4-51 Warning Current High*. |
| [15] | Out of speed range | Output speed/frequency is outside the frequency range set in *parameter 4-52 Warning Speed Low* and *parameter 4-53 Warning Speed High*. |
| [16] | Below speed, low | Output speed is lower than the setting in *parameter 4-52 Warning Speed Low*. |
| [17] | Above speed, high | Output speed is higher than the setting in *parameter 4-53 Warning Speed High*. |
| [18] | Out of feedb. range | Feedback is outside the range set in *parameter 4-56 Warning Feedback Low* and *parameter 4-57 Warning Feedback High*. |
| [19] | Below feedback, low | Feedback is below the limit set in *parameter 4-56 Warning Feedback Low*. |

**5-40 Function Relay**

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

| Option: | | Function: |
|---|---|---|
| [20] | Above feedback, high | Feedback is above the limit set in *parameter 4-57 Warning Feedback High*. |
| [21] | Thermal warning | Thermal warning turns on when the temperature exceeds the limit either in motor, frequency converter, brake resistor, or connected thermistor. |
| [22] | Ready,no thermal W | Frequency converter is ready for operation and there is no overtemperature warning. |
| [23] | Remote,ready,no TW | Frequency converter is ready for operation and is in Auto On mode. There is no overtemperature warning. |
| [24] | Ready, Voltage OK | Frequency converter is ready for operation and the mains voltage is within the specified voltage range (see *General Specifications* section in *Design Guide*). |
| [25] | Reverse | The motor runs (or is ready to run) clockwise when logic=0 and counterclockwise when logic=1. The output changes as soon as the reversing signal is applied. |
| [26] | Bus OK | Active communication (no time-out) via the serial communication port. |
| [27] | Torque limit & stop | Use in performing a coasted stop and frequency converter in torque limit condition. If the frequency converter has received a stop signal and is in 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 module. Use the digital output/relay to cut out the main voltage from the frequency converter. |
| [31] | Relay 123 | Digital output/relay is activated when *[0] Control Word* is selected in parameter group *8-** Comm. and Options*. |
| [32] | Mech brake ctrl | Selection of mechanical brake control. When selected parameters in |

  

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| 5-40 Function Relay | | |
|---|---|---|
| Array [9] (Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105)) | | |
| **Option:** | | **Function:** |
| | | parameter group *2-2* Mechanical Brake* are active. The output must be reinforced to carry the current for the coil in the brake. Usually, solved by connecting an external relay to the selected digital output. |
| [33] | Safe stop active | (FC 302 only) Indicates that the Safe Torque Off on terminal 37 has been activated. |
| [36] | Control word bit 11 | Activate relay 1 by control word from fieldbus. No other functional impact in the frequency converter. Typical application: controlling auxiliary device from fieldbus. The function is valid when *[0] FC profile* in *parameter 8-10 Control Word Profile* is selected. |
| [37] | Control word bit 12 | Activate relay 2 (FC 302 only) by control word from fieldbus. No other functional impact in the frequency converter. Typical application: controlling auxiliary device from fieldbus. The function is valid when *[0] FC profile* in *parameter 8-10 Control Word Profile* is selected. |
| [38] | Motor feedback error | Failure in the speed feedback loop from motor running in closed loop. The output can eventually be used to prepare switching the frequency converter in open loop in emergency case. |
| [39] | Tracking error | When the difference between calculated speed and actual speed in *parameter 4-35 Tracking Error* is larger than selected, the digital output/relay is active. |
| [40] | Out of ref range | Active when the actual speed is outside settings in *parameter 4-52 Warning Speed Low* to *parameter 4-55 Warning Reference High*. |
| [41] | Below reference, low | Active when actual speed is below speed reference setting. |
| [42] | Above ref, high | Active when actual speed is above speed reference setting. |
| [43] | Extended PID Limit | |

| 5-40 Function Relay | | |
|---|---|---|
| Array [9] (Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105)) | | |
| **Option:** | | **Function:** |
| [45] | Bus ctrl. | Controls digital output/relay via bus. The state of the output is set in *parameter 5-90 Digital & Relay Bus Control*. The output state is retained in the event of bus timeout. |
| [46] | Bus ctrl, 1 if timeout | Controls output via bus. The state of the output is set in *parameter 5-90 Digital & Relay Bus Control*. In the event of bus timeout, 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 5-90 Digital & Relay Bus Control*. In the event of bus timeout, the output state is set low (Off). |
| [51] | MCO controlled | Active when an MCO 302 or MCO 305 is connected. The output is controlled from option. |
| [60] | Comparator 0 | See parameter group *13-1* Comparators*. If Comparator 0 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [61] | Comparator 1 | See parameter group *13-1* Comparators*. If Comparator 1 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [62] | Comparator 2 | See parameter group *13-1* Comparators*. If Comparator 2 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [63] | Comparator 3 | See parameter group *13-1* Comparators*. If Comparator 3 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [64] | Comparator 4 | See parameter group *13-1* Comparators*. If Comparator 4 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [65] | Comparator 5 | See parameter group *13-1* Smart Logic Control*. If Comparator 5 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [70] | Logic rule 0 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 0 in SLC is TRUE, the output goes high. Otherwise, it is low. |

**5-40 Function Relay**

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

| Option: | | Function: |
|---|---|---|
| [71] | Logic rule 1 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 1 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [72] | Logic rule 2 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 2 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [73] | Logic rule 3 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 3 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [74] | Logic rule 4 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 4 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [75] | Logic rule 5 | See parameter group *13-4* Smart Logic Control*. If Logic Rule 5 in SLC is TRUE, the output goes high. Otherwise, it is low. |
| [80] | SL digital output A | See *parameter 13-52 SL Controller Action*. Output A is low on Smart Logic Action *[32]*. Output A is high on Smart Logic Action *[38]*. |
| [81] | SL digital output B | See *parameter 13-52 SL Controller Action*. Output B is low on Smart Logic Action *[33]*. Output B is high on Smart Logic Action *[39]*. |
| [82] | SL digital output C | See *parameter 13-52 SL Controller Action*. Output C is low on Smart Logic Action *[34]*. Output C is high on Smart Logic Action *[40]*. |
| [83] | SL digital output D | See *parameter 13-52 SL Controller Action*. Output D is low on Smart Logic Action *[35]*. Output D is high on Smart Logic Action *[41]*. |
| [84] | SL digital output E | See *parameter 13-52 SL Controller Action*. Output E is low on Smart Logic Action *[36]*. Output E is high on Smart Logic Action *[42]*. |
| [85] | SL digital output F | See *parameter 13-52 SL Controller Action*. Output F is low on Smart Logic Action *[37]*. Output F is high on Smart Logic Action *[43]*. |
| [120] | Local ref active | Output is high when *parameter 3-13 Reference Site = [2] Local* or when *parameter 3-13 Reference Site = [0] Linked to hand auto* at the same time as the LCP is in Hand On mode. |

| Reference site set in parameter 3-13 Reference Site | Local reference active [120] | Remote reference active [121] |
|---|---|---|
| Reference site: Local parameter 3-13 Reference Site [2] | 1 | 0 |
| Reference site: Remote parameter 3-13 Reference Site [1] | 0 | 1 |
| Reference site: Linked to Hand/ Auto | | |
| Hand | 1 | 0 |
| Hand ⇒ off | 1 | 0 |
| Auto ⇒ off | 0 | 0 |
| Auto | 0 | 1 |

**Table 3.20 Local Reference Active**

| | | |
|---|---|---|
| [121] | Remote ref active | Output is high when *parameter 3-13 Reference Site = [1] Remote* or *[0] Linked to hand/auto* while the LCP is in Auto On mode. See above. |
| [122] | No alarm | Output is high when no alarm is present. |
| [123] | Start command activ | Output is high when the start command is high (i.e. via digital input, bus connection or [Hand On] or [Auto On]), and a stop has been last command. |
| [124] | Running reverse | Output is high when the frequency converter is running counter clockwise (the logical product of the status bits 'running' AND 'reverse'). |
| [125] | Drive in hand mode | Output is high when the frequency converter is in [Hand on] mode (as |

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### 5-40 Function Relay

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

| Option: | | Function: |
|---|---|---|
| | | indicated by the LED light above [Hand on]). |
| [126] | Drive in auto mode | Output is high when the frequency converter is in 'Auto' mode (as indicated by LED on above [Auto on]). |
| [151] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [152] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [153] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [154] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [188] | AHF Capacitor Connect | |
| [189] | External Fan Control | The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for HP duct cooling). |
| [190] | Safe Function active | |
| [191] | Safe Opt. Reset req. | |
| [192] | RS Flipflop 0 | See *13-1* Comparators*. |
| [193] | RS Flipflop 1 | See *13-1* Comparators*. |
| [194] | RS Flipflop 2 | See *13-1* Comparators*. |
| [195] | RS Flipflop 3 | See *13-1* Comparators*. |
| [196] | RS Flipflop 4 | See *13-1* Comparators*. |
| [197] | RS Flipflop 5 | See *13-1* Comparators*. |
| [198] | RS Flipflop 6 | See *13-1* Comparators*. |
| [199] | RS Flipflop 7 | See *13-1* Comparators*. |

### 5-41 On Delay, Relay

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

| Range: | | Function: |
|---|---|---|
| 0.01 s* | [0.01 - 600 s] | Enter the delay of the relay cut-in time. Select one of 2 internal mechanical relays in an array function. See *5-40 Function Relay* for details. |

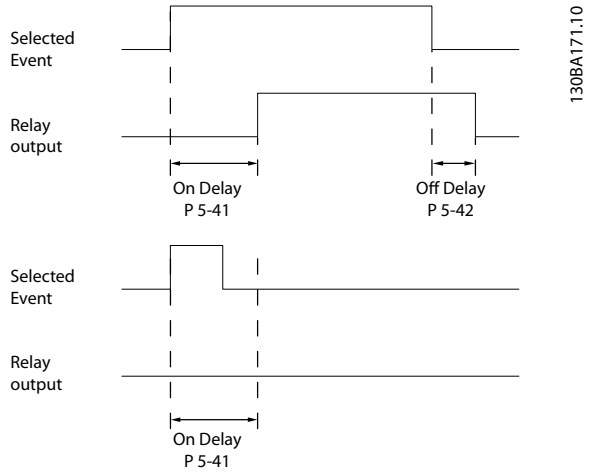


**Illustration 3.35 On Delay, Relay**

### 5-42 Off Delay, Relay

Array[2]: Relay1[0], Relay2[1]

| Range: | | Function: |
|---|---|---|
| 0.01 s* | [0.01 - 600 s] | Enter the delay of the relay cut-out time. Select one of 2 internal mechanical relays in an array function. See *5-40 Function Relay* for details. If the selected event condition changes before a delay timer expires, the relay output is unaffected. |

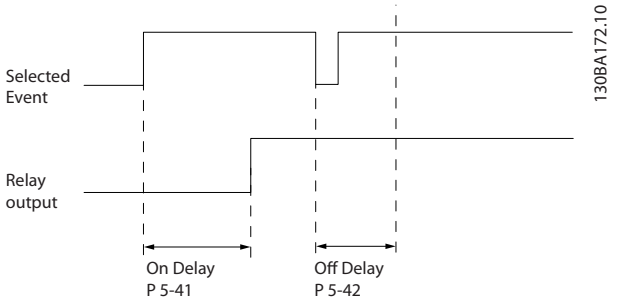


**Illustration 3.36 Off Delay, Relay**

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

## 3.7.5 5-5* Pulse Input

The pulse input parameters are used to define an appropriate window for the impulse reference area by configuring the scaling and filter settings for the pulse inputs. Input terminals 29 or 33 act as frequency reference inputs. Set terminal 29 (*5-13 Terminal 29 Digital Input*) or terminal 33 (*5-15 Terminal 33 Digital Input*) to *[32] Pulse input*. If terminal 29 is used as an input, set *parameter 5-01 Terminal 27 Mode* to *[0] Input*.

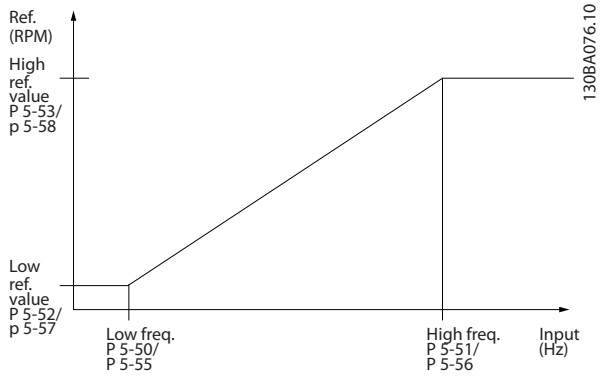


**Illustration 3.37 Pulse Input**

**5-50 Term. 29 Low Frequency**

| Range: | | Function: |
|---|---|---|
| 100 Hz* | [0 - 110000 Hz] | Enter the low frequency limit corresponding to the low motor shaft speed (i.e. low reference value) in *parameter 5-52 Term. 29 Low Ref./Feedb. Value*. Refer to *Illustration 3.37*. This parameter is available for FC 302 only. |

**5-51 Term. 29 High Frequency**

| Range: | | Function: |
|---|---|---|
| 100 Hz* | [0 - 110000 Hz] | Enter the high frequency limit corresponding to the high motor shaft speed (i.e. high reference value) in *parameter 5-53 Term. 29 High Ref./Feedb. Value*. This parameter is available for FC 302 only. |

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

| Range: | | Function: |
|---|---|---|
| 0 ReferenceFeedbackUnit* | [-999999.999 - 999999.999 ReferenceFeedbackUnit] | Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also *parameter 5-57 Term. 33 Low Ref./Feedb. Value*. Set terminal 29 to digital input |

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

| Range: | | Function: |
|---|---|---|
| | | (*parameter 5-02 Terminal 29 Mode = [0] input* (default) and *5-13 Terminal 29 Digital Input* = applicable value). This parameter is available for FC 302 only. |

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

| Range: | | Function: |
|---|---|---|
| Size related* | [-999999.999 - 999999.999 ReferenceFeedbackUnit] | Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also *parameter 5-58 Term. 33 High Ref./Feedb. Value*. Select terminal 29 as a digital input (*parameter 5-02 Terminal 29 Mode = [0] input* (default) and *5-13 Terminal 29 Digital Input* = applicable value). This parameter is available for FC 302 only. |

**5-54 Pulse Filter Time Constant #29**

| Range: | | Function: |
|---|---|---|
| 100 ms* | [1 - 1000 ms] | 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. |

**5-55 Term. 33 Low Frequency**

| Range: | | Function: |
|---|---|---|
| 100 Hz* | [0 - 110000 Hz] | Enter the low frequency corresponding to the low motor shaft speed (i.e. low reference value) in *parameter 5-57 Term. 33 Low Ref./Feedb. Value*. |

**5-56 Term. 33 High Frequency**

| Range: | | Function: |
|---|---|---|
| 100 Hz* | [0 - 110000 Hz] | Enter the high frequency corresponding to the high motor shaft speed (i.e. high reference value) in *5-58 Term. 33 High Ref./Feedb. Value*. |

**5-57 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 *5-52 Term. 29 Low Ref./Feedb. Value*. |



  

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| 5-58 Term. 33 High Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [-999999.999 - 999999.999 ReferenceFeedbackUnit] | Enter the high reference value [RPM] for the motor shaft speed. See also *parameter 5-53 Term. 29 High Ref./Feedb. Value*. |

| 5-59 Pulse Filter Time Constant #33 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 ms* | [1 - 1000 ms] | 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. |

## 3.7.6 5-6* Pulse Outputs

***NOTICE***

**These parameters cannot be adjusted while the motor is running.**

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

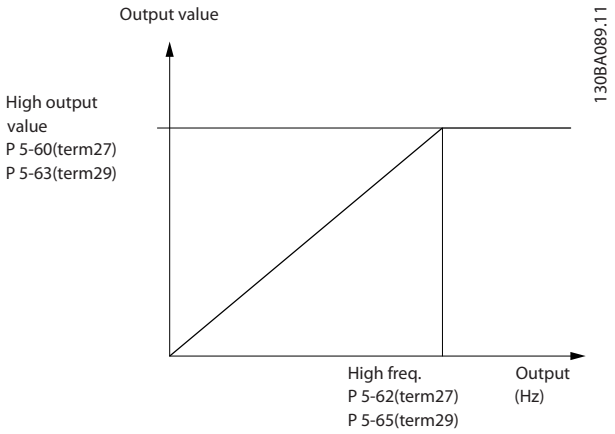


**Illustration 3.38 Configuration of Pulse Outputs**

Options for readout output variables:

| | | |
|---|---|---|
| | | Parameters for configuring the scaling and output functions of pulse outputs. The pulse outputs are designated to terminals 27 or 29. Select terminal 27 output in *parameter 5-01 Terminal 27 Mode* and terminal 29 output in *parameter 5-02 Terminal 29 Mode*. |
| [0] | No operation | |
| [45] | Bus control | |
| [48] | Bus control timeout | |
| [51] | MCO-controlled | |
| [100] | Output frequency | |
| [101] | Reference | |
| [102] | Feedback | |
| [103] | Motor current | |
| [104] | Torque relative to limit | |
| [105] | Torque relative to rated | |
| [106] | Power | |
| [107] | Speed | |
| [108] | Torque | |
| [109] | Max. out freq | |

| 5-60 Terminal 27 Pulse Output Variable | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | No operation | Select the desired display output for terminal 27. |
| [45] | Bus ctrl. | |
| [48] | Bus ctrl., timeout | |
| [51] | MCO controlled | |
| [100] | Output frequency | |
| [101] | Reference | |
| [102] | Feedback | |
| [103] | Motor Current | |
| [104] | Torque rel to limit | |
| [105] | Torq relate to rated | |
| [106] | Power | |
| [107] | Speed | |
| [108] | Torque | |
| [109] | Max Out Freq | |
| [119] | Torque % lim | |

| 5-62 Pulse Output Max Freq #27 | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 32000 Hz] | Set the maximum frequency for terminal 27, corresponding to the output variable selected in *parameter 5-60 Terminal 27 Pulse Output Variable*. |

| 5-63 Terminal 29 Pulse Output Variable | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | No operation | Select the desired display output for terminal 29. This parameter is available for FC 302 only. |
| [45] | Bus ctrl. | |
| [48] | Bus ctrl., timeout | |
| [51] | MCO controlled | |
| [100] | Output frequency | |
| [101] | Reference | |
| [102] | Feedback | |

| 5-63 Terminal 29 Pulse Output Variable | | |
|---|---|---|
| **Option:** | | **Function:** |
| [103] | Motor Current | |
| [104] | Torque rel to limit | |
| [105] | Torq relate to rated | |
| [106] | Power | |
| [107] | Speed | |
| [108] | Torque | |
| [109] | Max Out Freq | |
| [119] | Torque % lim | |

| 5-65 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 *5-63 Terminal 29 Pulse Output Variable*. |

| 5-66 Terminal X30/6 Pulse Output Variable | | |
|---|---|---|
| Select the variable for readout on terminal X30/6.<br>This parameter is active when option module MCB 101 is installed in the frequency converter.<br>Same options and functions as parameter group *5-6* Pulse Outputs*. | | |
| **Option:** | | **Function:** |
| [0] | No operation | |
| [45] | Bus ctrl. | |
| [48] | Bus ctrl., timeout | |
| [51] | MCO controlled | |
| [100] | Output frequency | |
| [101] | Reference | |
| [102] | Feedback | |
| [103] | Motor Current | |
| [104] | Torque rel to limit | |
| [105] | Torq relate to rated | |
| [106] | Power | |
| [107] | Speed | |
| [108] | Torque | |
| [109] | Max Out Freq | |
| [119] | Torque % lim | |

| 5-68 Pulse Output Max Freq #X30/6 | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 32000 Hz] | Select the maximum frequency on terminal X30/6 referring to the output variable in *5-66 Terminal X30/6 Pulse Output Variable*.<br>This parameter is active when option module MCB 101 is mounted in the frequency converter. |

## 3.7.7 5-7* 24 V Encoder Input

Connect the 24 V encoder to terminal 12 (24 V DC supply), terminal 32 (Channel A), terminal 33 (Channel B), and terminal 20 (GND). The digital inputs 32/33 are active for encoder inputs when *[1] 24 V encoder* is selected in *parameter 1-02 Flux Motor Feedback Source* and *parameter 7-00 Speed PID Feedback Source*. The encoder used is a dual-channel (A and B) 24 V type. Max input frequency: 110 kHz.

**Encoder connection to the frequency converter**
24 V incremental encoder. Max. cable length 5 m.

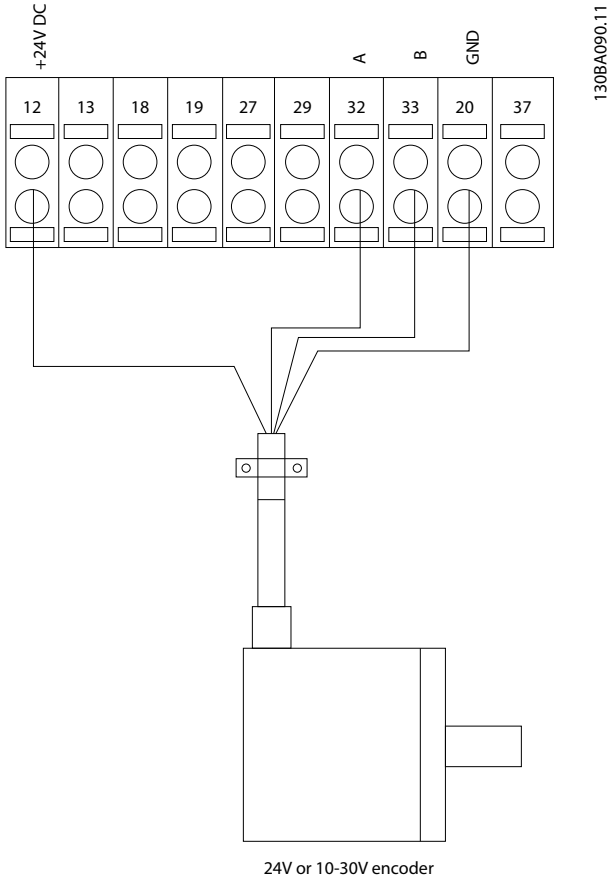


**Illustration 3.39 Encoder Connection**

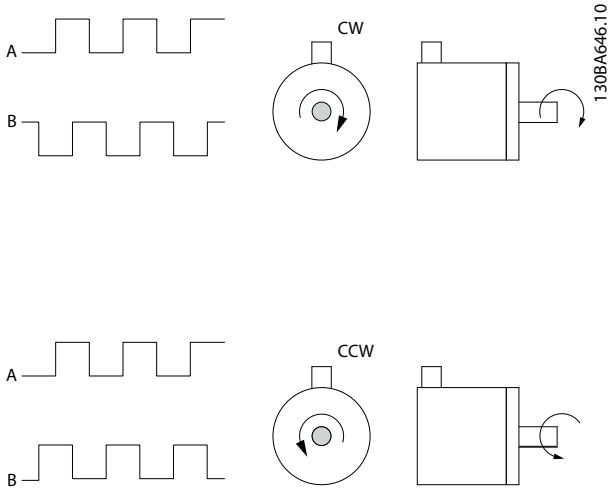


**Illustration 3.40 Encoder Rotation Direction**

| 5-70 Term 32/33 Pulses Per Revolution | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1024* | [1 - 4096] | Set the encoder pulses per revolution on the motor shaft. Read the correct value from the encoder. |

| 5-71 Term 32/33 Encoder Direction | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Change the detected encoder rotation direction without changing the wiring to the encoder. |
| [0] * | Clockwise | Sets channel A 90° (electrical degrees) behind channel B upon clockwise rotation of the encoder shaft. |
| [1] | Counter clockwise | Sets channel A 90° (electrical degrees) ahead of channel B upon clockwise rotation of the encoder shaft. |

## 3.7.8 5-8* I/O Options

| 5-80 AHF Cap Reconnect Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 25 s* | [1 - 120 s] | Guarantees a minimum off-time for the capacitors. The timer starts once the AHF capacitor disconnects and needs to expire before the output is allowed to be on again. It will only turn on again if the drive power is between 20% and 30%. |

## 3.7.9 5-9* Bus-Controlled

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

| 5-90 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.<br>A logical '1' indicates that the output is high or active.<br>A logical '0' indicates that the output is low or inactive. |

| | |
|---|---|
| Bit 0 | Digital output terminal 27 |
| Bit 1 | Digital output terminal 29 |
| Bit 2 | Digital output terminal X 30/6 |
| Bit 3 | Digital output terminal X 30/7 |
| Bit 4 | Relay 1 output terminal |
| Bit 5 | 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 9-15 | Reserved for future terminals |
| Bit 16 | Option C Relay 1 output terminal |
| Bit 17 | Option C Relay 2 output terminal |
| Bit 18 | Option C Relay 3 output terminal |
| Bit 19 | Option C Relay 4 output terminal |
| Bit 20 | Option C Relay 5 output terminal |
| Bit 21 | Option C Relay 6 output terminal |
| Bit 22 | Option C Relay 7 output terminal |
| Bit 23 | Option C Relay 8 output terminal |
| Bit 24-31 | Reserved for future terminals |

**Table 3.21 Bus-controlled Digital Outputs and Relays**

| 5-93 Pulse Out #27 Bus Control | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal 27 when the terminal is configured as *[45] Bus Controlled* in *parameter 5-60 Terminal 27 Pulse Output Variable*. |

| 5-94 Pulse Out #27 Timeout Preset | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal 27 when the terminal is configured as *[48] Bus Ctrl Timeout* in *parameter 5-60 Terminal 27 Pulse Output Variable* and a timeout is detected. |

| 5-95 Pulse Out #29 Bus Control | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal 29 when the terminal is configured as *[45] Bus Controlled* in *parameter 5-63 Terminal 29 Pulse Output Variable*.<br>This parameter only applies for FC 302. |

| 5-96 Pulse Out #29 Timeout Preset | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal 29 when the terminal is configured as *[48] Bus Ctrl Timeout* in *parameter 5-63 Terminal 29 Pulse Output Variable* and a timeout is detected.<br>This parameter only applies for FC 302. |

| 5-97 Pulse Out #X30/6 Bus Control | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal X30/6 when the terminal is configured as *[45] Bus ctrl.* in *parameter 5-66 Terminal X30/6 Pulse Output Variable*. |

| 5-98 Pulse Out #X30/6 Timeout Preset | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Set the output frequency transferred to output terminal X30/6 when the terminal is configured as *[48] Bus Ctrl Timeout* in *parameter 5-66 Terminal X30/6 Pulse Output Variable* and a timeout is detected. |

## 3.8 Parameters: 6-** Analog In/Out

### 3.8.1 6-0* Analog I/O Mode

The analog inputs can freely be allocated to be either voltage (FC 301: 0..10 V, FC 302: 0..± 10 V) or current (FC 301/FC 302: 0/4..20 mA) input.

***NOTICE***

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

| 6-00 Live Zero Timeout Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 s* | [1 - 99 s] | Enter the live zero timeout time period. 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 *6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *6-20 Terminal 54 Low Voltage* or *6-22 Terminal 54 Low Current* for a time period longer than the time set in *parameter 6-00 Live Zero Timeout Time*, the function selected in *6-01 Live Zero Timeout Function* is activated. |

| 6-01 Live Zero Timeout Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the timeout function. The function set in *parameter 6-01 Live Zero Timeout Function* is activated, if the input signal on terminal 53 or 54 is below 50% of the value in *parameter 6-10 Terminal 53 Low Voltage*, *parameter 6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage* or *parameter 6-22 Terminal 54 Low Current* for a time period defined in *parameter 6-00 Live Zero Timeout Time*. If several timeouts occur simultaneously, the frequency converter prioritises the timeout functions as follows:<br>1. *Parameter 6-01 Live Zero Timeout Function*.<br>2. *Parameter 8-04 Control Word Timeout Function*. |
| [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. |
| [5] | Stop and trip | Overruled to stop with subsequent trip. |
| [20] | Coast | |

| 6-01 Live Zero Timeout Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| [21] | Coast and trip | |

### 3.8.2 6-1* Analog Input 1

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

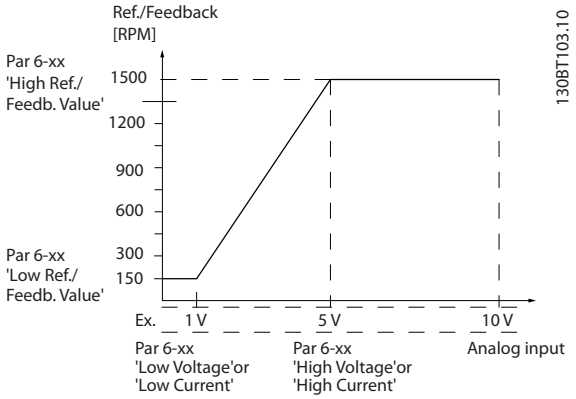


**Illustration 3.41 Analog Input 1**

| 6-10 Terminal 53 Low Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.07 V* | [ -10.00 - par. 6-11 V] | Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value, set in *parameter 6-14 Terminal 53 Low Ref./Feedb. Value*. See also the section *Reference Handling*. |

| 6-11 Terminal 53 High Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 V* | [ par. 6-10 - 10 V] | Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *6-15 Terminal 53 High Ref./Feedb. Value*. |

| 6-12 Terminal 53 Low Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.14 mA* | [ 0 - par. 6-13 mA] | Enter the low current value. This reference signal should correspond to the minimum reference value, set in *parameter 3-02 Minimum Reference*. The value must be set at >2 mA in order to activate the Live Zero Timeout Function in *parameter 6-01 Live Zero Timeout Function*. |

| 6-13 Terminal 53 High Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 20 mA* | [ par. 6-12 - 20 mA] | Enter the high current value corresponding to the high reference/ feedback set in *6-15 Terminal 53 High Ref./Feedb. Value*. |

| 6-14 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 *6-10 Terminal 53 Low Voltage* and *6-12 Terminal 53 Low Current*. |

| 6-15 Terminal 53 High Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [-999999.999 - 999999.999 ReferenceFeed-backUnit] | Enter the analog input scaling value that corresponds to the maximum reference feedback value set in *parameter 6-11 Terminal 53 High Voltage* and *parameter 6-13 Terminal 53 High Current*. |

| 6-16 Terminal 53 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>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. |

## 3.8.3 6-2* Analog Input 2

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

| 6-20 Terminal 54 Low Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.07 V* | [ -10.00 - par. 6-21 V] | Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value, set in *parameter 3-02 Minimum Reference*. See also *chapter 3.5 Parameters: 3-** Reference/ Ramps*. |

| 6-21 Terminal 54 High Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 V* | [ par. 6-20 - 10 V] | Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *6-25 Terminal 54 High Ref./Feedb. Value*. |

| 6-22 Terminal 54 Low Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.14 mA* | [ 0 - par. 6-23 mA] | Enter the low current value. This reference signal should correspond to the minimum reference value, set in *parameter 3-02 Minimum Reference*. The value must be set at >2 mA in order to activate the Live Zero Timeout Function in *parameter 6-01 Live Zero Timeout Function*. |

| 6-23 Terminal 54 High Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 20 mA* | [ par. 6-22 - 20 mA] | Enter the high current value corresponding to the high reference/ feedback value set in *6-25 Terminal 54 High Ref./Feedb. Value*. |

| 6-24 Terminal 54 Low Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 ReferenceFeed-backUnit* | [-999999.999 - 999999.999 ReferenceFeed-backUnit] | Enter the analog input scaling value that corresponds to the minimum reference feedback value set in *parameter 3-02 Minimum Reference*. |

| 6-25 Terminal 54 High Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [-999999.999 - 999999.999 ReferenceFeed-backUnit] | Enter the analog input scaling value that corresponds to the maximum reference feedback value set in *parameter 3-03 Maximum Reference*. |

3

| 6-26 Terminal 54 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening but also increases the time delay through the filter. |

## 3.8.4 6-3* Analog Input 3 MCB 101

Parameter group for configuring the scale and limits for analog input 3 (X30/11) placed on option module MCB 101.

| 6-30 Terminal X30/11 Low Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.07 V* | [ 0 - par. 6-31 V] | Sets the analog input scaling value to correspond to the low reference/feedback value (set in *parameter 6-34 Term. X30/11 Low Ref./Feedb. Value*). |

| 6-31 Terminal X30/11 High Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 V* | [ par. 6-30 - 10 V] | Sets the analog input scaling value to correspond to the high reference/feedback value (set in *parameter 6-35 Term. X30/11 High Ref./Feedb. Value*). |

| 6-34 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 6-30 Terminal X30/11 Low Voltage*). |

| 6-35 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 6-31 Terminal X30/11 High Voltage*). |

| 6-36 Term. X30/11 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |

| 6-36 Term. X30/11 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | 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. |

## 3.8.5 6-4* Analog Input 4 MCB 101

Parameter group for configuring the scale and limits for analog input 4 (X30/12) placed on option module MCB 101.

| 6-40 Terminal X30/12 Low Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.07 V* | [ 0 - par. 6-41 V] | Sets the analog input scaling value to correspond to the low reference/feedback value set in *parameter 6-44 Term. X30/12 Low Ref./Feedb. Value*. |

| 6-41 Terminal X30/12 High Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 V* | [ par. 6-40 - 10 V] | Sets the analog input scaling value to correspond to the high reference/feedback value set in *parameter 6-45 Term. X30/12 High Ref./Feedb. Value*. |

| 6-44 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 6-40 Terminal X30/12 Low Voltage*. |

| 6-45 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 6-41 Terminal X30/12 High Voltage*. |

| 6-46 Term. X30/12 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>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. |

## 3.8.6 6-5* Analog Output 1

Parameters for configuring the scaling and limits for analog output 1, i.e. terminal 42. Analog outputs are current outputs: 0/4 to 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.

| 6-50 Terminal 42 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the function of Terminal 42 as an analog current output. Depending on the selection the output is either a 0-20mA or 4-20mA output. The current value can be read out in in *parameter 16-65 Analog Output 42 [mA]*. |
| [0] | No operation | When no signal on the analog output. |
| [52] | MCO 0-20mA | |
| [53] | MCO 4-20mA | |
| [100] | Output frequency | 0Hz = 0mA; 100Hz = 20mA. |
| [101] | Reference | *Parameter 3-00 Reference Range* [Min - Max] 0% = 0mA; 100% = 20mA<br>*Parameter 3-00 Reference Range* [-Max - Max] -100% = 0mA; 0% = 10mA; +100% = 20mA |
| [102] | Feedback | |
| [103] | Motor Current | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20mA.<br>Example: Inverter norm current (11kW) = 24A. 160% = 38.4A. Motor norm current = 22A Read-out 11.46mA.<br>$\frac{20\ mA \times 22\ A}{38.4\ A} = 11.46\ mA$<br>In case the norm motor current is equal to 20mA, the output setting of |

| 6-50 Terminal 42 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | *parameter 6-52 Terminal 42 Output Max Scale* is:<br>$\frac{IVLTMax \times 100}{IMotorNorm} = \frac{38.4 \times 100}{22} = 175\%$ |
| [104] | Torque rel to limit | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode* |
| [105] | Torq relate to rated | The torque is related to the motor torque setting. |
| [106] | Power | Taken from *parameter 1-20 Motor Power [kW]*. |
| [107] | Speed | Taken from *parameter 3-03 Maximum Reference*. 20mA = value in *parameter 3-03 Maximum Reference* |
| [108] | Torque | Torque reference related to 160% torque. |
| [109] | Max Out Freq | 0Hz = 0mA,*parameter 4-19 Max Output Frequency* = 20mA. |
| [113] | PID Clamped Output | |
| [119] | Torque % lim | |
| [130] | Output freq. 4-20mA | 0Hz = 4mA, 100Hz = 20mA |
| [131] | Reference 4-20mA | *Parameter 3-00 Reference Range* [Min-Max] 0% = 4mA; 100% = 20mA<br>*Parameter 3-00 Reference Range* [-Max-Max] -100% = 4mA; 0% = 12mA; +100% = 20mA |
| [132] | Feedback 4-20mA | |
| [133] | Motor cur. 4-20mA | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20mA.<br>Example: Inverter norm current (11kW) = 24A. 160% = 38.4A. Motor norm current = 22A Read-out 11.46mA.<br>$\frac{16\ mA \times 22\ A}{38.4\ A} + 4\ mA = 13.17\ mA$<br>In case the norm motor current is equal to 20mA, the output setting of *parameter 6-62 Terminal X30/8 Max. Scale* is:<br>$\frac{IVLTMax \times 100}{IMotorNorm} = \frac{38.4 \times 100}{22} = 175\%$ |
| [134] | Torq.% lim 4-20 mA | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode*. |
| [135] | Torq.% nom 4-20mA | The torque setting is related to the motor torque setting. |
| [136] | Power 4-20mA | Taken from *parameter 1-20 Motor Power [kW]* |

3

### 6-50 Terminal 42 Output

| Option: | | Function: |
|---|---|---|
| [137] | Speed 4-20mA | Taken from *parameter 3-03 Maximum Reference*. 20mA = Value in *parameter 3-03 Maximum Reference*. |
| [138] | Torque 4-20mA | Torque reference related to 160% torque. |
| [139] | Bus ctrl. 0-20 mA | An output value set from fieldbus process data. The output will work independently of internal functions in the . |
| [140] | Bus ctrl. 4-20 mA | An output value set from fieldbus process data. The output will work independently of internal functions in the . |
| [141] | Bus ctrl 0-20mA t.o. | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out. |
| [142] | Bus ctrl 4-20mA t.o. | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out. |
| [147] | Main act val 0-20mA | |
| [148] | Main act val 4-20mA | |
| [149] | Torque % lim 4-20mA | Analog output at zero torque = 12mA. Motoric torque will increase the output current to max torque limit 20mA (set in *parameter 4-16 Torque Limit Motor Mode*). Generative torque will decrease the output to torque limit Generator Mode (set in *parameter 4-17 Torque Limit Generator Mode*) Ex: *parameter 4-16 Torque Limit Motor Mode*: 200% and *parameter 4-17 Torque Limit Generator Mode*: 200%. 20mA = 200% Motoric and 4mA = 200% Generatoric. |
| [150] | Max Out Fr 4-20mA | 0hz = 0mA,*parameter 4-19 Max Output Frequency* = 20mA. |

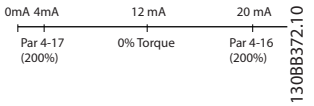


**Illustration 3.42**

### 6-51 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 *6-50 Terminal 42 Output*. |

### 6-52 Terminal 42 Output Max Scale

| Range: | | Function: |
|---|---|---|
| 100 %* | [0 - 200 %] | Scale the maximum output of the selected analog signal at terminal 42. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale; or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the desired output current at a value between 0 - 100% of the full-scale output, program the percentage value in the parameter, i.e. 50% = 20 mA. If a current between 4 and 20 mA is desired at maximum output (100%), calculate the percentage value as follows: |

20 *mA* / *desired maximum current* x 100%

*i.e.* 10 *mA* : $\frac{20}{10}$ x 100 = 200%

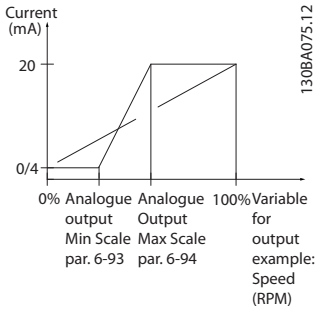


**Illustration 3.43 Output Max. Scale**

### 6-53 Terminal 42 Output Bus Control

| Range: | | Function: |
|---|---|---|
| 0 %* | [0 - 100 %] | Holds the level of output 42 if controlled by bus. |

### 6-54 Terminal 42 Output Timeout Preset

| Range: | | Function: |
|---|---|---|
| 0 %* | [0 - 100 %] | Holds the preset level of output 42. In case of a bus timeout and a timeout function is selected in *6-50 Terminal 42 Output*, the output is preset to this level. |

### 6-55 Analog Output Filter

| Option: | | Function: |
|---|---|---|
| | | The following readout analog parameters from selection in *parameter 6-50 Terminal 42 Output* have a filter selected when *parameter 6-55 Analog Output Filter* is on: |

| 6-55 Analog Output Filter | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | **Selection** / **0-20 mA** / **4-20 mA**<br>Motor current (0 - $I_{max}$) / [103] / [133]<br>Torque limit (0 - $T_{lim}$) / [104] / [134]<br>Rated torque (0 - $T_{nom}$) / [105] / [135]<br>Power (0 - $P_{nom}$) / [106] / [136]<br>Speed (0 - $Speed_{max}$) / [107] / [137]<br>**Table 3.22 Readout Analog Parameters** |
| [0] * | Off | Filter off |
| [1] | On | Filter on |

## 3.8.7 6-6* Analog Output 2 MCB 101

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.

| 6-60 Terminal X30/8 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the function of terminal X30/8 as an analog current output. Depending on the selection, the output is either a 0-20 mA or 4-20 mA output. The current value can be read out in LCP in *parameter 16-65 Analog Output 42 [mA]*. |
| [0] | No operation | When no signal on the analog output is present. |
| [52] | MCO 0-20mA | |
| [100] | Output frequency | 0 Hz = 0 mA; 100 Hz = 20 mA. |
| [101] | Reference | *Parameter 3-00 Reference Range* [Min. - Max.] 0% = 0 mA; 100% = 20 mA<br>*Parameter 3-00 Reference Range* [-Max. - Max.] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA |
| [102] | Feedback | |
| [103] | Motor Current | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA.<br>Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Readout 11.46 mA.<br>$\frac{20\ mA\ x\ 22\ A}{38.4\ A} = 11.46\ mA$<br>In case the norm motor current is equal to 20 mA, the output setting of *parameter 6-62 Terminal X30/8 Max. Scale* is:<br>$\frac{IVLTMax.\ x\ 100}{IMotorNorm} = \frac{38.4\ x\ 100}{22} = 175\%$ |

| 6-60 Terminal X30/8 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| [104] | Torque rel to limit | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode*. |
| [105] | Torq relate to rated | The torque is related to the motor torque setting. |
| [106] | Power | Taken from *parameter 1-20 Motor Power [kW]*. |
| [107] | Speed | Taken from *parameter 3-03 Maximum Reference*. 20 mA = value in *parameter 3-03 Maximum Reference* |
| [108] | Torque | Torque reference related to 160% torque. |
| [109] | Max Out Freq | In relation to *parameter 4-19 Max Output Frequency*. |
| [113] | PID Clamped Output | |
| [119] | Torque % lim | |
| [130] | Output freq. 4-20mA | 0 Hz = 4 mA, 100 Hz = 20 mA |
| [131] | Reference 4-20mA | *Parameter 3-00 Reference Range* [Min.-Max.] 0% = 4 mA; 100% = 20 mA<br>*Parameter 3-00 Reference Range* [-Max-Max.] -100% = 4 mA; 0% = 12 mA; +100% = 20 mA |
| [132] | Feedback 4-20mA | |
| [133] | Motor cur. 4-20mA | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA.<br>Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Readout 11.46 mA.<br>$\frac{16\ mA\ x\ 22\ A}{38.4\ A} = 9.17\ mA$<br>In case the norm motor current is equal to 20 mA, the output setting of *parameter 6-62 Terminal X30/8 Max. Scale* is:<br>$\frac{IVLTMax.\ x\ 100}{IMotorNorm} = \frac{38.4\ x\ 100}{22} = 175\%$ |
| [134] | Torq.% lim 4-20 mA | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode*. |
| [135] | Torq.% nom 4-20mA | The torque setting is related to the motor torque setting. |
| [136] | Power 4-20mA | Taken from *parameter 1-20 Motor Power [kW]*. |
| [137] | Speed 4-20mA | Taken from *parameter 3-03 Maximum Reference*. 20 mA = Value in *parameter 3-03 Maximum Reference*. |
| [138] | Torque 4-20mA | Torque reference related to 160% torque. |

3

| 6-60 Terminal X30/8 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| [139] | Bus ctrl. 0-20 mA | An output value set from fieldbus process data. The output works independently of internal functions in the frequency converter. |
| [140] | Bus ctrl. 4-20 mA | An output value set from fieldbus process data. The output works independently of internal functions in the frequency converter. |
| [141] | Bus ctrl 0-20mA t.o. | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus timeout. |
| [142] | Bus ctrl 4-20mA t.o. | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus timeout. |
| [149] | Torque % lim 4-20mA | Torque %Lim 4-20 mA: Torque reference. *parameter 3-00 Reference Range* [Min.-Max.] 0% = 4 mA; 100% = 20 mA *Parameter 3-00 Reference Range* [-Max. - Max.] -100% = 4 mA; 0% = 12 mA; +100% = 20 mA |
| [150] | Max Out Fr 4-20mA | In relation to *parameter 4-19 Max Output Frequency*. |

| 6-61 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, i.e. 0 mA (or 0 Hz) is desired at 25% of the maximum output value and 25% is programmed. The value can never be higher than the corresponding setting in *6-62 Terminal X30/8 Max. Scale* if value is below 100%. This parameter is active when option module MCB 101 is mounted in the frequency converter. |

| 6-62 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 desired 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 desired output current at a value between 0 - 100% of the full-scale output, program the percentage value in the parameter, i.e. 50% = 20 mA. If a current between 4 and 20 mA is desired at maximum output (100%), calculate the percentage value as follows: $20\ mA\ /\ desired\ maximum\ current\ x\ 100\%$ $i.e.\ 10\ mA: \frac{20-4}{10}\ x\ 100\ =\ 160\%$ |

| 6-63 Terminal X30/8 Bus Control | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Holds the level of output X30/8 if controlled by bus. |

| 6-64 Terminal X30/8 Output Timeout Preset | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | Holds the preset level of output X30/8. In case of a bus timeout and a timeout function is selected in *parameter 6-60 Terminal X30/8 Output*, the output is preset to this level. |

## 3.8.8 6-7* Analog Output 3 MCB 113

Parameters for configuring the scaling and limits for analog output 3, terminals X45/1 and X45/2. Analog outputs are current outputs: 0/4–20 mA. Resolution on analog output is 11 bit.

| 6-70 Terminal X45/1 Output | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the function of terminal X45/1 as an analog current output. |
| [0] | No operation | When no signal on the analog output is present. |
| [52] | MCO 305 0-20 mA | |
| [53] | MCO 305 4-20 mA | |
| [100] | Output frequency 0-20 mA | 0 Hz = 0 mA; 100 Hz = 20 mA. |
| [101] | Reference 0-20 mA | *Parameter 3-00 Reference Range* [Min. - Max.] 0% = 0 mA; 100% = 20 mA *Parameter 3-00 Reference Range* [-Max. - Max.] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA |
| [102] | Feedback | |
| [103] | Motor current 0-20 mA | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA. Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Readout 11.46 mA. $\frac{20\ mA\ x\ 22\ A}{38.4\ A} = 11.46\ mA$ In case the norm motor current is equal to 20 mA, the output setting of *parameter 6-52 Terminal 42 Output Max Scale* is: $\frac{IVLTMax\ x\ 100}{IMotorNorm} = \frac{38.4\ x\ 100}{22} = 175\%$ |
| [104] | Torque rel to lim 0-20 mA | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode*. |
| [105] | Torque rel to rated motor | The torque is related to the motor torque setting. |

### 6-70 Terminal X45/1 Output

| Option: | | Function: |
|---|---|---|
| | torque 0-20 mA | |
| [106] | Power 0-20 mA | Taken from *parameter 1-20 Motor Power [kW]*. |
| [107] | Speed 0-20 mA | Taken from *parameter 3-03 Maximum Reference*. 20 mA = value in *parameter 3-03 Maximum Reference*. |
| [108] | Torque ref. 0-20 mA | Torque reference related to 160% torque. |
| [109] | Max. out freq 0-20 mA | In relation to *parameter 4-19 Max Output Frequency*. |
| [130] | Output freq. 4-20 mA | 0 Hz = 4 mA, 100 Hz = 20 mA |
| [131] | Reference 4-20 mA | *Parameter 3-00 Reference Range* [Min.-Max.] 0% = 4 mA; 100% = 20 mA *Parameter 3-00 Reference Range* [-Max-Max.] -100% = 4 mA; 0% = 12 mA; +100% = 20 mA |
| [132] | Feedback 4-20 mA | |
| [133] | Motor cur. 4-20 mA | Value is taken from *parameter 16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA. Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Readout 11.46 mA. $\frac{16\ mA \times 22\ A}{38.4\ A} = 9.17\ mA$ In case the norm motor current is equal to 20 mA, the output setting of *parameter 6-52 Terminal 42 Output Max Scale* is: $\frac{IVLTMax \times 100}{IMotorNorm} = \frac{38.4 \times 100}{22} = 175\%$ |
| [134] | Torque % lim. 4-20 mA | The torque setting is related to setting in *parameter 4-16 Torque Limit Motor Mode*. |
| [135] | Torque % nom 4-20 mA | The torque setting is related to the motor torque setting. |
| [136] | Power 4-20 mA | Taken from *parameter 1-20 Motor Power [kW]*. |
| [137] | Speed 4-20 mA | Taken from *parameter 3-03 Maximum Reference*. 20 mA = Value in *parameter 3-03 Maximum Reference*. |
| [138] | Torque 4-20 mA | Torque reference related to 160% torque. |
| [139] | Bus ctrl. 0-20 mA | An output value set from fieldbus process data. The output works independently of internal functions in the frequency converter. |
| [140] | Bus ctrl. 4-20 mA | An output value set from fieldbus process data. The output works independently of internal functions in the frequency converter. |

### 6-70 Terminal X45/1 Output

| Option: | | Function: |
|---|---|---|
| [141] | Bus ctrl. 0-20 mA, timeout | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus timeout. |
| [142] | Bus ctrl. 4-20 mA, timeout | *Parameter 4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus timeout. |
| [150] | Max. out freq 4-20 mA | In relation to *parameter 4-19 Max Output Frequency*. |

### 6-71 Terminal X45/1 Output Min. Scale

| Range: | | Function: |
|---|---|---|
| 0.00%* | [0.00 - 200.00%] | Scale the minimum output of the selected analog signal at terminal X45/1, as a percentage of the maximum signal value. For example, if 0 mA (or 0 Hz) is desired at 25% of the maximum output value, then program 25%. Scaling values up to 100% can never be higher than the corresponding setting in *6-72 Terminal X45/1 Max. Scale*. |

### 6-72 Terminal X45/1 Output Max. Scale

| Range: | | Function: |
|---|---|---|
| 100%* | [0.00 - 200.00%] | Scale the maximum output of the selected analog signal at terminal X45/1. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the desired output current at a value between 0 - 100% of the full-scale output, program the percentage value in the parameter, i.e. 50% = 20 mA. If a current between 4 and 20 mA is desired at maximum output (100%), calculate the percentage value as follows (example where desired max. output is 10 mA): |
| | | $\frac{IRANGE\ [mA]}{IDESIRED\ MAX\ [mA]} \times 100\%$ $= \frac{20 - 4\ mA}{10\ mA} \times 100\% = 160\%$ |

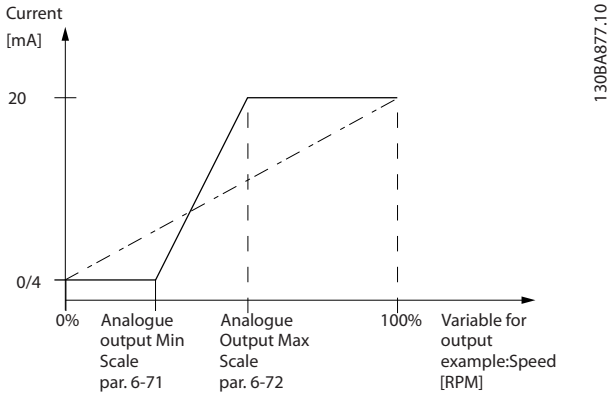


**Illustration 3.44 Output Max. Scale**

### 6-73 Terminal X45/1 Output Bus Control

| Range: | | Function: |
|---|---|---|
| 0.00%* | [0.00 - 100.00%] | Holds the level of Analog Output 3 (terminal X45/1) if controlled by bus. |

### 6-74 Terminal X45/1 Output Timeout Preset

| Range: | | Function: |
|---|---|---|
| 0.00%* | [0.00 - 100.00%] | Holds the preset level of Analog Output 3 (terminal X45/1). In case of a bus timeout and a timeout function is selected in *6-70 Terminal X45/1 Output*, the output is preset to this level. |

## 3.8.9 6-8* Analog Output 4 MCB 113

Parameters for configuring the scaling and limits for analog output 4, terminals X45/3 and X45/4. Analog outputs are current outputs: 0/4 to 20 mA. Resolution on analog output is 11 bit.

### 6-80 Terminal X45/3 Output

| Option: | | Function: |
|---|---|---|
| | | Select the function of terminal X45/3 as an analog current output. |
| [0] * | No operation | Same selections available as for *6-70 Terminal X45/1 Output*. |

### 6-81 Terminal X45/3 Output Min. Scale

| Option: | | Function: |
|---|---|---|
| [0.00%] * | 0.00 - 200.00% | Scales the minimum output of the selected analog signal on terminal X45/3. Scale the minimum value as a percentage of the maximum signal value, i.e. 0 mA (or 0 Hz) is desired at 25% of the maximum output value and 25% is programmed. The value can never be higher than the corresponding setting in *6-82 Terminal X45/3 Max. Scale* if value is below 100%. |

### 6-81 Terminal X45/3 Output Min. Scale

| Option: | | Function: |
|---|---|---|
| | | This parameter is active when option module MCB 113 is mounted in the frequency converter. |

### 6-82 Terminal X45/3 Output Max. Scale

| Option: | | Function: |
|---|---|---|
| [0.00%] * | 0.00 - 200.00% | Scales the maximum output of the selected analog signal on terminal X45/3. Scale the value to the desired 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 desired output current at a value between 0 - 100% of the full-scale output, program the percentage value in the parameter, i.e. 50% = 20 mA. If a current between 4 and 20 mA is desired at maximum output (100%), calculate the percentage value as follows (example where desired max. output is 10 mA): |
| | | $\frac{IRANGE\,[mA]}{IDESIRED\ MAX\ [mA]} \times 100\%$ $= \frac{20\ -\ 4\ mA}{10\ mA} \times 100\% = 160\%$ |

### 6-83 Terminal X45/3 Output Bus Control

| Option: | | Function: |
|---|---|---|
| [0.00%] * | 0.00 - 100.00% | Holds the level of output 4 (X45/3) if controlled by bus. |

### 6-84 Terminal X45/3 Output Timeout Preset

| Option: | | Function: |
|---|---|---|
| [0.00%] * | 0.00 - 100.00% | Holds the present level of output 4 (X45/3). In case of a bus timeout and a timeout function is selected in *6-80 Terminal X45/3 Output*, the output is preset to this level. |

## 3.9 Parameters: 7-** Controllers

### 3.9.1 7-0* Speed PID Ctrl.

**7-00 Speed PID Feedback Source**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Select the encoder for closed loop feedback.<br>The feedback may come from a different encoder (typically mounted on the application itself) than the motor-mounted encoder feedback selected in *parameter 1-02 Flux Motor Feedback Source*. |
| [0] | Motor feedb. P1-02 | |
| [1] | 24V encoder | |
| [2] | MCB 102 | |
| [3] | MCB 103 | |
| [4] | MCO Encoder 1 X56 | |
| [5] | MCO Encoder 2 X55 | |
| [6] | Analog Input 53 | |
| [7] | Analog Input 54 | |
| [8] | Frequency input 29 | |
| [9] | Frequency input 33 | |
| [11] | MCB 15X | |

***NOTICE***

**If separate encoders are used (FC 302 only), the ramp settings parameters in parameter groups 3-4*, 3-5*, 3-6*, 3-7* and 3-8* must be adjusted according to the gear ratio between the 2 encoders.**

**7-01 Speed PID Droop**

The droop function allows the frequency converter to decrease the motor speed by the droop value. The droop value is directly proportional to the load value. This parameter defines the droop value at 100% load. Use the droop function when several motors are mechanically connected and the load on motors can differ. To use this parameter, set *parameter 1-62 Slip Compensation* to [0], otherwise *parameter 7-01 Speed PID Droop* is ignored.

| Range: | | Function: |
|---|---|---|
| 0 RPM* | [0 - 200 RPM] | Enter the droop value at 100% load. |

**7-02 Speed PID Proportional Gain**

| Range: | | Function: |
|---|---|---|
| Size related* | [0 - 1] | Enter the speed controller proportional gain. The proportional gain amplifies the error (i.e. the deviation between the feedback signal and the set-point). This parameter is used with *parameter 1-00 Configuration Mode [0] Speed open loop* and *[1] Speed closed loop* control. Quick control is obtained at high amplification. However, if the amplification is too great, the process may become unstable.<br>Use this parameter for values with 3 decimals. For a selection with 4 decimals, use *parameter 3-83 Quick Stop S-ramp Ratio at Decel. Start*. |

**7-02 Speed PID Proportional Gain**

| Range: | | Function: |
|---|---|---|
| | | the set-point). This parameter is used with *parameter 1-00 Configuration Mode [0] Speed open loop* and *[1] Speed closed loop* control. Quick control is obtained at high amplification. However, if the amplification is too great, the process may become unstable.<br>Use this parameter for values with 3 decimals. For a selection with 4 decimals, use *parameter 3-83 Quick Stop S-ramp Ratio at Decel. Start*. |

**7-03 Speed PID Integral Time**

| Range: | | Function: |
|---|---|---|
| Size related* | [1.0 - 20000 ms] | Enter the speed controller integral time, which determines the time the internal PID control takes to correct errors. The greater the error, the more quickly the gain increases. The integral time causes a delay of the signal and therefore a dampening effect and can be used to eliminate steady-state speed error. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action, leading to major deviations from the required reference, since the process regulator takes too long to regulate errors. This parameter is used with *[0] Speed open loop* and *[1] Speed closed loop* control, set in *parameter 1-00 Configuration Mode*. |

**7-04 Speed PID Differentiation Time**

| Range: | | Function: |
|---|---|---|
| Size related* | [0 - 200 ms] | Enter the speed controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the speed feedback. The quicker the error changes, the stronger the gain from the differentiator. The gain is proportional with the speed at which errors change. Setting this parameter to zero disables the differentiator. This parameter is used with *parameter 1-00 Configuration Mode [1] Speed closed loop* control. |

**7-05 Speed PID Diff. Gain Limit**

| Range: | | Function: |
|---|---|---|
| 5* | [1 - 20] | Set a limit for the gain provided by the differentiator. Since the differential gain increases at higher frequencies, limiting the gain may be useful. For example, set up a pure D-link at low frequencies and a constant D-link at higher frequencies. This |

3

| 7-05 Speed PID Diff. Gain Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | parameter is used with *parameter 1-00 Configuration Mode [1] Speed closed loop* control. |

| 7-06 Speed PID Lowpass Filter Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.1 - 100 ms] | Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. This is an advantage if there is a great amount of noise in the system, see *Illustration 3.45*. For example, if a time constant (τ) of 100 ms is programmed, the cut-off frequency for the low-pass filter is 1/0.1= 10 RAD/s, corresponding to (10/2 x π) = 1.6 Hz. The PID regulator only regulates a feedback signal that varies by a frequency of less than 1.6 Hz. If the feedback signal varies by a higher frequency than 1.6 Hz, the PID regulator does not react.<br>Practical settings of *parameter 7-06 Speed PID Lowpass Filter Time* taken from the number of pulses per revolutions from encoder: |

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

## *NOTICE*

**Severe filtering can be detrimental to dynamic performance.**
**This parameter is used with *parameter 1-00 Configuration Mode [1] Speed closed loop* and *[2] Torque* control.**
**Adjust the filter time in Flux Sensorless to 3-5 ms.**

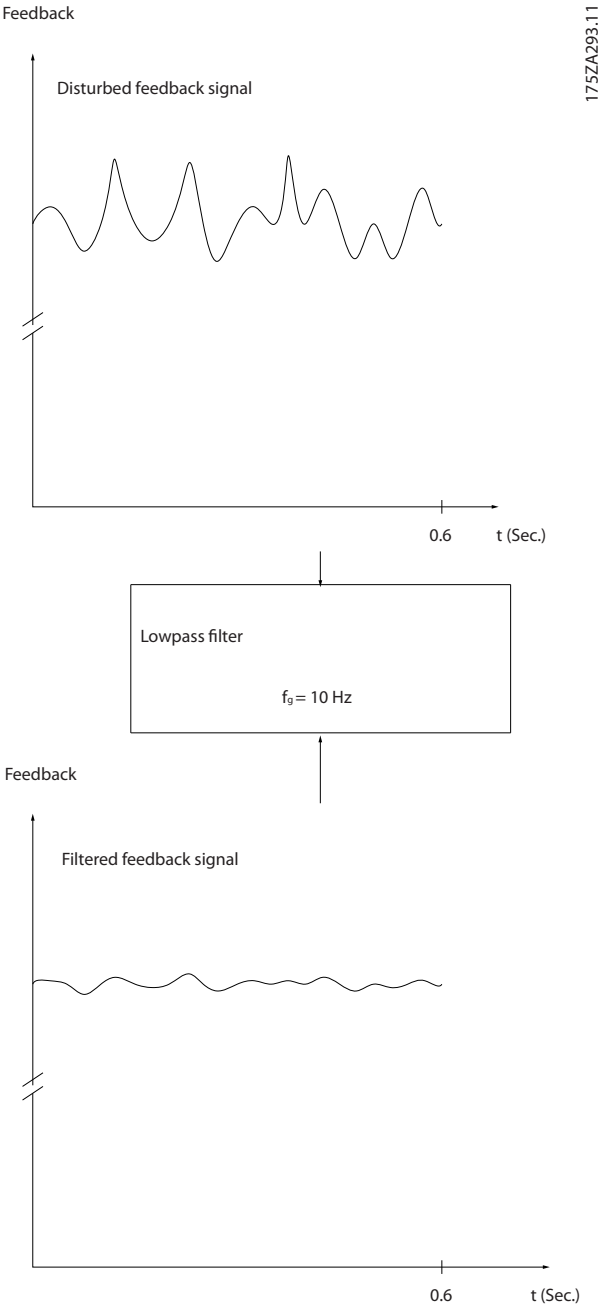


**Illustration 3.45 Feedback Signal**

| 7-07 Speed PID Feedback Gear Ratio | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1* | [ 0.0001 - 32.0000] | The frequency converter multiplies the speed feedback by this ratio. |

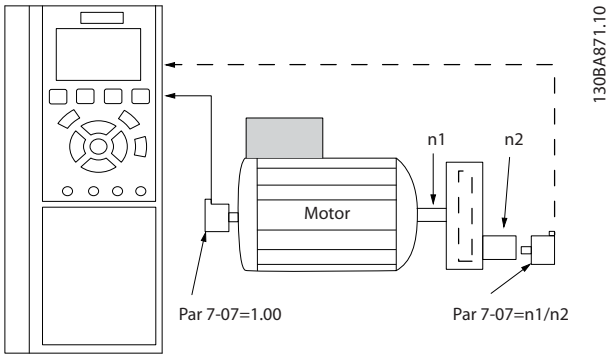


**Illustration 3.46 Speed PID Feedback Gear Ratio**

| 7-08 Speed PID Feed Forward Factor | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 500 %] | The reference signal bypasses the speed controller by the amount specified. This feature increases the dynamic performance of the speed control loop. |

| 7-09 Speed PID Error Correction w/ Ramp | | |
|---|---|---|
| **Range:** | | **Function:** |
| 300 RPM* | [10 - 100000 RPM] | The speed error between ramp and actual speed is held up against the setting in this parameter. If the speed error exceeds this parameter entry, the speed error is corrected via ramping in a controlled way. |

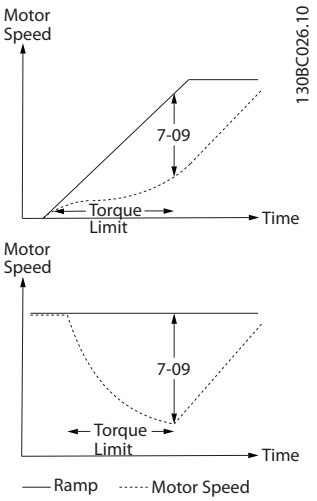


**Illustration 3.47 Speed Error between Ramp and Actual Speed**

## 3.9.2 7-1* Torque PI Control

Parameters for configuring the torque PI control.

| 7-10 Torque PI Feedback Source | | |
|---|---|---|
| Select the feedback source for the torque controller. | | |
| **Option:** | | **Function:** |
| [0] * | Controller Off | Select to operate in open loop. |
| [1] | Analog Input 53 | Select to use torque feedback from the analogue input. |
| [2] | Analog Input 54 | Select to use torque feedback from the analogue input. |
| [3] | Estimed Torque | Select to use the torque feedback estimated by the frequency converter. |

| 7-12 Torque PI Proportional Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 500 %] | Enter the proportional gain value for the torque controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability. |

| 7-13 Torque PI Integration Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.020 s* | [0.002 - 2 s] | Enter the integration time for the torque controller. Selection of a low value makes the controller react faster. Too low a setting leads to controller instability. |

| 7-16 Torque PI Lowpass Filter Time | | |
|---|---|---|
| Enter the time constant for the torque control lowpass filter. | | |
| **Range:** | | **Function:** |
| 5 ms* | [0.1 - 100 ms] | |

| 7-18 Torque PI Feed Forward Factor | | |
|---|---|---|
| Enter the torque feed forward factor value. The reference signal bypasses the torque controller by this value. | | |
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | |

| 7-19 Current Controller Rise Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [15 - 100 %] | Enter the value for the rise time of the current controller as a percentage of the control period. |

3

## 3.9.3 7-2* Process Ctrl. Feedb.

Select the feedback sources for the Process PID Control, and how this feedback should be handled.

**7-20 Process CL Feedback 1 Resource**

| Option: | | Function: |
|---|---|---|
| | | The effective feedback signal is made up of the sum of up to 2 different input signals. Select which frequency converter input should be treated as the source of the first of these signals. The second input signal is defined in *parameter 7-22 Process CL Feedback 2 Resource*. |
| [0] * | No function | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [3] | Frequency input 29 | |
| [4] | Frequency input 33 | |
| [7] | Analog Input X30/11 | |
| [8] | Analog Input X30/12 | |
| [15] | Analog Input X48/2 | |

**7-22 Process CL Feedback 2 Resource**

| Option: | | Function: |
|---|---|---|
| | | The effective feedback signal is made up of the sum of up to 2 different input signals. Select which frequency converter input should be treated as the source of the second of these signals. The first input signal is defined in *parameter 7-20 Process CL Feedback 1 Resource*. |
| [0] * | No function | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [3] | Frequency input 29 | |
| [4] | Frequency input 33 | |
| [7] | Analog Input X30/11 | |
| [8] | Analog Input X30/12 | |
| [15] | Analog Input X48/2 | |

## 3.9.4 7-3* Process PID Ctrl.

**7-30 Process PID Normal/ Inverse Control**

| Option: | | Function: |
|---|---|---|
| | | Normal and inverse control are implemented by introducing a difference between the reference signal and the feedback signal. |
| [0] * | Normal | Sets process control to increase the output frequency. |
| [1] | Inverse | Sets process control to reduce the output frequency. |

**7-31 Process PID Anti Windup**

| Option: | | Function: |
|---|---|---|
| [0] | Off | Continues regulation of an error even when the output frequency cannot be increased or decreased. |
| [1] * | On | Ceases regulation of an error when the output frequency can no longer be adjusted. |

**7-32 Process PID Start Speed**

| Range: | | Function: |
|---|---|---|
| 0 RPM* | [0 - 6000 RPM] | Enter the motor speed to be attained as a start signal for commencement of PID control. When the power is switched on, the frequency converter commences ramping and then operates under speed open loop control. When the Process PID start speed is reached, the frequency converter changes to Process PID control. |

**7-33 Process PID Proportional Gain**

| Range: | | Function: |
|---|---|---|
| 0.01* | [0 - 10] | Enter the PID proportional gain. The proportional gain multiplies the error between the set-point and the feedback signal. |

**7-34 Process PID Integral Time**

| Range: | | Function: |
|---|---|---|
| 10000 s* | [0.01 - 10000 s] | Enter the PID integral time. The integrator provides an increasing gain at a constant error between the set-point and the feedback signal. The integral time is the time needed by the integrator to reach the same gain as the proportional gain. |

**7-35 Process PID Differentiation Time**

| Range: | | Function: |
|---|---|---|
| 0 s* | [0 - 10 s] | Enter the PID differentiation time. The differentiator does not react to a constant error, but provides a gain only when the error changes. The shorter the PID differentiation time, the stronger the gain from the differentiator. |

| 7-36 Process PID Diff. Gain Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| 5* | [1 - 50] | Enter a limit for the differentiator gain (DG). If there is no limit, the DG increases when there are fast changes. Limit the DG to obtain a pure differentiator gain at slow changes and a constant differentiator gain where fast changes occur. |

| 7-38 Process PID Feed Forward Factor | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 200 %] | Enter the PID feed forward (FF) factor. The FF factor sends a constant fraction of the reference signal to bypass the PID control, so the PID control only affects the remaining fraction of the control signal. Any change to this parameter will thus affect the motor speed. When the FF factor is activated, it provides less overshoot and high dynamics when changing the set-point. *parameter 7-38 Process PID Feed Forward Factor* is active when *parameter 1-00 Configuration Mode* is set to *[3] Process*. |

| 7-39 On Reference Bandwidth | | |
|---|---|---|
| **Range:** | | **Function:** |
| 5 %* | [0 - 200 %] | Enter the On reference bandwidth. When the PID Control Error (the difference between the reference and the feedback) is less than the set value of this parameter, the On reference status bit is high, i.e. =1. |

## 3.9.5 7-4* Advanced Process PID Ctrl.

This parameter group is only used if *parameter 1-00 Configuration Mode* is set to *[7] Extended PID speed CL* or *[8] Extended PID Speed OL*.

| 7-40 Process PID I-part Reset | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | No | |
| [1] | Yes | Select *[1] Yes* to reset the I-part of the process PID controller. The selection automatically returns to *[0] No*. Resetting the I-part makes it possible to start from a well-defined point after changing something in the process, e.g. changing a textile roll. |

| 7-41 Process PID Output Neg. Clamp | | |
|---|---|---|
| **Range:** | | **Function:** |
| -100 %* | [ -100 - par. 7-42 %] | Enter a negative limit for the process PID controller output. |

| 7-42 Process PID Output Pos. Clamp | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [ par. 7-41 - 100 %] | Enter a positive limit for the process PID controller output. |

| 7-43 Process PID Gain Scale at Min. Ref. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 100 %] | Enter a scaling percentage to apply to the process PID output when operating at the minimum reference. The scaling percentage is adjusted linearly between the scale at min. ref. (*parameter 7-43 Process PID Gain Scale at Min. Ref.*) and the scale at max. ref. (*parameter 7-44 Process PID Gain Scale at Max. Ref.*). |

| 7-44 Process PID Gain Scale at Max. Ref. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 100 %] | Enter a scaling percentage to apply to the process PID output when operating at the maximum reference. The scaling percentage is adjusted linearly between the scale at min. ref. (*parameter 7-43 Process PID Gain Scale at Min. Ref.*) and the scale at max. ref. (*parameter 7-44 Process PID Gain Scale at Max. Ref.*). |

| 7-45 Process PID Feed Fwd Resource | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | No function | Select which frequency converter input should be used as the feed forward factor. The FF factor is added directly to the output of the PID controller. This increases dynamic performance. |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [7] | Frequency input 29 | |
| [8] | Frequency input 33 | |
| [11] | Local bus reference | |
| [20] | Digital pot.meter | |
| [21] | Analog input X30/11 | |
| [22] | Analog input X30/12 | |
| [29] | Analog Input X48/2 | |
| [32] | Bus PCD | Selects a bus reference configured by *parameter 8-02 Control Word Source*. Change *parameter 8-42 PCD Write Configuration* for the bus used to make the feed-forward available in *parameter 7-48 PCD Feed Forward*. Use index 1 for feed forward [748] (and index 2 for reference [1682]). |
| [36] | MCO | |

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| 7-46 Process PID Feed Fwd Normal/ Inv. Ctrl. | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Normal | Select *[0] Normal* to set the feed-forward factor to treat the FF resource as a positive value. |
| [1] | Inverse | Select *[1] Inverse* to treat the feed forward resource as a negative value. |

| 7-48 PCD Feed Forward | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | Readout parameter where the bus *parameter 7-45 Process PID Feed Fwd Resource* [32]) can be read. |

| 7-49 Process PID Output Normal/ Inv. Ctrl. | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Normal | Select *[0] Normal* to use the resulting output from the process PID controller as is. |
| [1] | Inverse | Select *[1] Inverse* to invert the resulting output from the process PID controller. This operation is performed after the feed-forward factor is applied. |

## 3.9.6 7-5* Ext. Process PID Ctrl.

This parameter group is only used if *parameter 1-00 Configuration Mode* is set to *[7] Extended PID speed CL* or *[8] Extended PID Speed OL*.

| 7-50 Process PID Extended PID | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Disabled | Disables the extended parts of the process PID controller. |
| [1] * | Enabled | Enables the extended parts of the PID controller. |

| 7-51 Process PID Feed Fwd Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1* | [0 - 100] | The feed forward is used to obtain the desired level, based on a well-known signal available. The PID controller then only takes care of the smaller part of the control, necessary because of unknown characters. The standard feed-forward factor in *parameter 7-38 Process PID Feed Forward Factor* is always related to the reference whereas *parameter 7-51 Process PID Feed Fwd Gain* has more choices. In winder applications, the feed-forward factor is typically the line speed of the system. |

| 7-52 Process PID Feed Fwd Ramp up | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.01 s* | [0.01 - 10 s] | Controls the dynamics of the feed-forward signal when ramping up. |

| 7-53 Process PID Feed Fwd Ramp down | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.01 s* | [0.01 - 10 s] | Controls the dynamics of the feed-forward signal when ramping down. |

| 7-56 Process PID Ref. Filter Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 1 s] | Set a time constant for the reference first-order low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the reference/feedback signals. However, severe filtering can be detrimental to dynamic performance. |

| 7-57 Process PID Fb. Filter Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 1 s] | Set a time constant for the feedback first-order low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the reference/feedback signals. However, severe filtering can be detrimental to dynamic performance. |

## 3.10 Parameters: 8-** Communications and Options

### 3.10.1 8-0* General Settings

**8-01 Control Site**

| Option: | | Function: |
|---|---|---|
| | | The setting in this parameter overrides the settings in *parameter 8-50 Coasting Select* to *parameter 8-56 Preset Reference Select*. |
| [0] | Digital and ctrl.word | Control by using both digital input and control word. |
| [1] | Digital only | Control by using digital inputs only. |
| [2] | Controlword only | Control by using control word only. |

**8-02 Control Word Source**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>Select the source of the control word: 1 of 2 serial interfaces or 4 installed options. During initial power-up, the frequency converter automatically sets this parameter to *[3] Option A*, if it detects a valid fieldbus option installed in slot A. When the option is removed, the frequency converter detects a configuration change, sets *parameter 8-02 Control Word Source* back to default setting RS-485, and trips. If an option is installed after initial power-up, the setting of *parameter 8-02 Control Word Source* does not change, but the frequency converter trips and displays: Alarm 67 *Option Changed*.<br>When retrofitting a bus option into a frequency converter that did not have a bus option installed to begin with, take an active decision to move the control to bus-based. This is required for safety reasons to avoid an accidental change. |
| [0] | None | |
| [1] | FC RS485 | |
| [2] | FC USB | |
| [3] | Option A | |
| [4] | Option B | |
| [5] | Option C0 | |
| [6] | Option C1 | |
| [30] | External Can | |

**8-03 Control Word Timeout Time**

| Range: | | Function: |
|---|---|---|
| [1.0 s] | 0.1-18000.0 s | Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *parameter 8-04 Control Word Timeout Function* is then carried out. A valid control word triggers the timeout counter. |
| 20 s* | [0.1 - 18000.0 s] | Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *parameter 8-04 Control Word Timeout Function* is then carried out. A valid control word triggers the timeout counter. |

**8-04 Control Word Timeout Function**

Select the timeout function. The timeout function activates when the control word fails to be updated within the time period specified in *8-03 Control Word Timeout Time*.

| Option: | | Function: |
|---|---|---|
| [0] | Off | Resumes control via serial bus (fieldbus or standard) using the most recent control word. |
| [1] | Freeze output | Freezes output frequency until communication resumes. |
| [2] | Stop | Stops with auto restart when communication resumes. |
| [3] | Jogging | Runs the motor at jog frequency until communication resumes. |
| [4] | Max. speed | Runs the motor at maximum frequency until communication resumes. |
| [5] | Stop and trip | Stops the motor, then resets the frequency converter to restart: Via the fieldbus, via [Reset], or via a digital input. |
| [7] | Select setup 1 | Changes the set-up upon reestablishment of communication following a control word timeout. If communication resumes after a timeout, *parameter 8-05 End-of-Timeout Function* defines whether to resume the set-up used before the timeout, or to retain the set-up endorsed by the timeout function. |
| [8] | Select setup 2 | See *[7] Select set-up 1* |
| [9] | Select setup 3 | See *[7] Select set-up 1* |
| [10] | Select setup 4 | See *[7] Select set-up 1* |
| [26] | Trip | |



  

3

***NOTICE***

**To change the set-up after a timeout, configure as follows:**
**Set *parameter 0-10 Active Set-up* to *[9] Multi set-up* and select the relevant link in *parameter 0-12 This Set-up Linked to*.**

**8-05 End-of-Timeout Function**

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

**8-06 Reset Control Word Timeout**

This parameter is active only when *[0] Hold set-up* has been selected in *parameter 8-05 End-of-Timeout Function*.

| Option: | | Function: |
|---|---|---|
| [0] * | Do not reset | Retains the set-up specified in *parameter 8-04 Control Word Timeout Function*, following a control word timeout. |
| [1] | Do reset | Returns the frequency converter to the original set-up following a control word timeout. The frequency converter performs the reset and then immediately reverts to the *[0] Do not reset* setting. |

**8-07 Diagnosis Trigger**

This parameter has no function for DeviceNet.

| Option: | | Function: |
|---|---|---|
| [0] * | Disable | |
| [1] | Trigger on alarms | |
| [2] | Trigger alarm/warn. | This parameter has no function for DeviceNet. |

**8-08 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. | Select *[0]* for normal bus readouts. |
| [1] | Motor Data LP-Filter | Select *[1]* for filtered bus readouts of the following parameters:<br>*16-10 Power [kW]*<br>*16-11 Power [hp]*<br>*16-12 Motor Voltage* |

**8-08 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: |
|---|---|---|
| | | *16-14 Motor current*<br>*Parameter 16-16 Torque [Nm]*<br>*Parameter 16-17 Speed [RPM]*<br>*Parameter 16-22 Torque [%]*<br>*Parameter 16-25 Torque [Nm] High* |

## 3.10.2 8-1* Ctrl. Word Settings

**8-10 Control Word Profile**

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LCP display. For guidelines in selection of *[0] FC profile* and *[1] PROFIdrive profile*, refer to the *Serial communication via RS-485 Interface* section in the Design Guide.
For additional guidelines in the selection of *[1] PROFIdrive profile*, refer to the *Operating Instructions* for the installed fieldbus.

| Option: | | Function: |
|---|---|---|
| [0] * | FC profile | |
| [1] | PROFIdrive profile | |
| [5] | ODVA | |
| [7] | CANopen DSP 402 | |
| [8] | MCO | |

**8-13 Configurable Status Word STW**

The status word has 16 bits (0-15). Bits 5 and 12-15 are configurable. Each of these bits can be configured to any of the following options.

| Option: | | Function: |
|---|---|---|
| [0] | No function | The input is always low. |
| [1] | Profile Default | Depending on the profile set in *8-10 Control Profile*. |
| [2] | Alarm 68 Only | The input goes high whenever Alarm 68 is active and goes low whenever no alarm 68 is activated. |
| [3] | Trip excl Alarm 68 | |
| [10] | T18 DI status | |
| [11] | T19 DI status | |
| [12] | T27 DI status | |
| [13] | T29 DI status | |
| [14] | T32 DI status | |
| [15] | T33 DI status | |
| [16] | T37 DI status | The input goes high whenever terminal 37 has 0 V and goes low whenever terminal 37 has 24 V. |
| [21] | Thermal warning | |

  

### 8-13 Configurable Status Word STW

The status word has 16 bits (0-15). Bits 5 and 12-15 are configurable. Each of these bits can be configured to any of the following options.

| Option: | | Function: |
|---|---|---|
| [30] | Brake fault (IGBT) | |
| [40] | Out of ref range | |
| [41] | Load throttle active | |
| [60] | Comparator 0 | |
| [61] | Comparator 1 | |
| [62] | Comparator 2 | |
| [63] | Comparator 3 | |
| [64] | Comparator 4 | |
| [65] | Comparator 5 | |
| [70] | Logic Rule 0 | |
| [71] | Logic Rule 1 | |
| [72] | Logic Rule 2 | |
| [73] | Logic Rule 3 | |
| [74] | Logic Rule 4 | |
| [75] | Logic Rule 5 | |
| [80] | SL digital out A | |
| [81] | SL digital out B | |
| [82] | SL digital out C | |
| [83] | SL digital out D | |
| [84] | SL digital out E | |
| [85] | SL digital out F | |
| [86] | ATEX ETR cur. alarm | |
| [87] | ATEX ETR freq. alarm | |
| [88] | ATEX ETR cur. warning | |
| [89] | ATEX ETR freq. warning | |
| [90] | Safe Function active | |
| [91] | Safe Opt. Reset req. | |

### 8-14 Configurable Control Word CTW

| Option: | | Function: |
|---|---|---|
| | | Selection of control word bit 10, if it is active low or active high. |
| [0] | None | |
| [1] * | Profile default | |
| [2] | CTW Valid, active low | |
| [3] | Safe Option Reset | |
| [4] | PID error inverse | When enabled, it inverts the resulting error from the process PID controller. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL* or *[8] Extended PID Speed CL*. |
| [5] | PID reset I part | When enabled, resets the I-part of the Process PID controller. Equivalent to *parameter 7-40 Process PID I-part Reset*. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL* or *[8] Extended PID Speed CL*. |
| [6] | PID enable | When enabled, enables the extended process PID controller. Equivalent to *parameter 7-50 Process PID Extended PID*. Available only if *parameter 1-00 Configuration Mode* is set to *[6] Surface Winder*, *[7] Extended PID Speed OL* or *[8] Extended PID Speed CL*. |

### 8-17 Configurable Alarm and Warningword

The Configurable Alarm and Warning Word has 16 bits (0-15). Each of those bits can be configured to any of the following options.

| Option: | | Function: |
|---|---|---|
| [0] * | Off | |
| [1] | 10 Volts low warning | |
| [2] | Live zero warning | |
| [3] | No motor warning | |
| [4] | Mains phase loss warning | |
| [5] | DC link voltage high warning | |
| [6] | DC link voltage low warning | |
| [7] | DC overvoltage warning | |
| [8] | DC undervoltage warning | |
| [9] | Inverter overloaded warning | |
| [10] | Motor ETR overtemp warning | |
| [11] | Motor thermistor overtemp warning | |
| [12] | Torque limit warning | |
| [13] | Over current warning | |
| [14] | Earth fault warning | |
| [17] | Controlword timeout warning | |
| [19] | Discharge temp high warning | |
| [22] | Hoist mech brake warning | |
| [23] | Internal fans warning | |
| [24] | External fans warning | |
| [25] | Brake resistor short circuit warning | |
| [26] | Brake powerlimit warning | |
| [27] | Brake chopper short circuit warning | |
| [28] | Brake check warning | |
| [29] | Heatsink temperature warning | |
| [30] | Motor phase U warning | |
| [31] | Motor phase V warning | |
| [32] | Motor phase W warning | |
| [34] | Fieldbus communication warning | |
| [36] | Mains failure warning | |
| [40] | T27 overload warning | |
| [41] | T29 overload warning | |
| [45] | Earth fault 2 warning | |
| [47] | 24V supply low warning | |
| [58] | AMA internal fault warning | |
| [59] | Current limit warning | |
| [60] | External interlock warning | |
| [61] | Feedback error warning | |

3

| 8-17 Configurable Alarm and Warningword | | |
|---|---|---|
| The Configurable Alarm and Warning Word has 16 bits (0-15). Each of those bits can be configured to any of the following options. | | |
| **Option:** | | **Function:** |
| [62] | Frequency max warning | |
| [64] | Voltage limit warning | |
| [65] | Controlboard overtemp warning | |
| [66] | Heatsink temp low warning | |
| [68] | Safe stop warning | |
| [73] | Safe stop autorestart warning | |
| [76] | Power unit setup warning | |
| [77] | Reduced powermode warning | |
| [78] | Tracking error warning | |
| [89] | Mech brake sliding warning | |
| [163] | ATEX ETR cur limit warning | |
| [165] | ATEX ETR freq limit warning | |
| [10002] | Live zero error alarm | |
| [10004] | Mains phase loss alarm | |
| [10007] | DC overvoltage alarm | |
| [10008] | DC undervoltage alarm | |
| [10009] | Inverter overload alarm | |
| [10010] | ETR overtemperature alarm | |
| [10011] | Thermistor overtemp alarm | |
| [10012] | Torque limit alarm | |
| [10013] | Overcurrent alarm | |
| [10014] | Earth fault alarm | |
| [10016] | Short circuit alarm | |
| [10017] | CTW timeout alarm | |
| [10022] | Hoist brake alarm | |
| [10026] | Brake powerlimit alarm | |
| [10027] | Brakechopper shortcircuit alarm | |
| [10028] | Brake check alarm | |
| [10029] | Heatsink temp alarm | |
| [10030] | Phase U missing alarm | |
| [10031] | Phase V missing alarm | |
| [10032] | Phase W missing alarm | |
| [10033] | Inrush fault alarm | |
| [10034] | Fieldbus com faul alarm | |
| [10036] | Mains failure alarm | |
| [10037] | Phase imbalance alarm | |
| [10038] | Internal fault | |
| [10039] | Heatsink sensor alarm | |
| [10045] | Earth fault 2 alarm | |
| [10046] | Powercard supply alarm | |
| [10047] | 24V supply low alarm | |
| [10048] | 1.8V supply low alarm | |
| [10049] | Speed limit alarm | |
| [10060] | Ext interlock alarm | |
| [10061] | Feedback error alarm | |
| [10063] | Mech brake low alarm | |
| [10065] | Controlboard overtemp alarm | |
| [10067] | Option config changed alarm | |
| [10068] | Safe stop alarm | |

| 8-17 Configurable Alarm and Warningword | | |
|---|---|---|
| The Configurable Alarm and Warning Word has 16 bits (0-15). Each of those bits can be configured to any of the following options. | | |
| **Option:** | | **Function:** |
| [10069] | Powercard temp alarm | |
| [10073] | Safestop auto restart alarm | |
| [10074] | PTC thermistor alarm | |
| [10075] | Illegal profile alarm | |
| [10078] | Tracking error alarm | |
| [10079] | Illegal PS config alarm | |
| [10081] | CSIV corrupt alarm | |
| [10082] | CSIV param error alarm | |
| [10084] | No safety option alarm | |
| [10090] | Feedback monitor alarm | |
| [10091] | AI54 settings alarm | |
| [10164] | ATEX ETR current lim alarm | |
| [10166] | ATEX ETR freq limit alarm | |

| 8-19 Product Code | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 2147483647] | Select [0] to readout the actual fieldbus product code according to the mounted fieldbus option. Select [1] to read out the actual Vendor ID. |

## 3.10.3 8-3* FC Port Settings

| 8-30 Protocol | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the protocol to be used. Changing protocol is not effective until after powering off the frequency converter. |
| [0] * | FC | |
| [1] | FC MC | |
| [2] | Modbus RTU | |

| 8-31 Address | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 1 - 255 ] | Enter the address for the FC (standard) port. Valid range: 1-126. |

| 8-32 FC Port Baud Rate | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | 2400 Baud | Baud rate selection for the FC (standard) port. |
| [1] | 4800 Baud | |
| [2] | 9600 Baud | |
| [3] | 19200 Baud | |
| [4] | 38400 Baud | |
| [5] | 57600 Baud | |
| [6] | 76800 Baud | |

| 8-32 FC Port Baud Rate | | |
|---|---|---|
| **Option:** | | **Function:** |
| [7] | 115200 Baud | |

| 8-33 Parity / Stop Bits | | |
|---|---|---|
| **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 | |

| 8-34 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. |

| 8-35 Minimum Response Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 ms* | [1 - 10000 ms] | Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays. |

| 8-36 Max Response Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [11 - 10001 ms] | Specify the maximum permissible delay time between transmitting a request and receiving a response. If a response from the frequency converter is exceeding the time setting, then it is discarded. |

| 8-37 Max Inter-Char Delay | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.00 - 35.00 ms] | Specify the maximum permissible time interval between receipt of 2 bytes. This parameter activates timeout if transmission is interrupted. This parameter is active only when *8-30 Protocol* is set to *[1] FC MC* protocol. |

## 3.10.4 8-4* FC MC Protocol Set

| 8-40 Telegram Selection | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1] * | Standard telegram 1 | Enables use of freely configurable telegrams or standard telegrams for the FC port. |
| [100] | None | |
| [101] | PPO 1 | |
| [102] | PPO 2 | |
| [103] | PPO 3 | |
| [104] | PPO 4 | |
| [105] | PPO 5 | |
| [106] | PPO 6 | |
| [107] | PPO 7 | |
| [108] | PPO 8 | |
| [200] | Custom telegram 1 | Enables use of freely configurable telegrams or standard telegrams for the FC port. |
| [202] | Custom telegram 3 | |

| 8-41 Parameters for Signals | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | None | This parameter contains a list of signals available for selection in *parameter 8-42 PCD Write Configuration* and *parameter 8-43 PCD Read Configuration*. |
| [15] | Readout: actual setup | |
| [302] | Minimum Reference | |
| [303] | Maximum Reference | |
| [312] | Catch up/slow Down Value | |
| [341] | Ramp 1 Ramp Up Time | |
| [342] | Ramp 1 Ramp Down Time | |
| [351] | Ramp 2 Ramp Up Time | |
| [352] | Ramp 2 Ramp Down Time | |
| [380] | Jog Ramp Time | |
| [381] | Quick Stop Ramp Time | |
| [411] | Motor Speed Low Limit [RPM] | |
| [412] | Motor Speed Low Limit [Hz] | |
| [413] | Motor Speed High Limit [RPM] | |
| [414] | Motor Speed High Limit [Hz] | |
| [416] | Torque Limit Motor Mode | |
| [417] | Torque Limit Generator Mode | |
| [553] | Term. 29 High Ref./Feedb. Value | |
| [558] | Term. 33 High Ref./Feedb. Value | |
| [590] | Digital & Relay Bus Control | |
| [593] | Pulse Out #27 Bus Control | |
| [595] | Pulse Out #29 Bus Control | |
| [597] | Pulse Out #X30/6 Bus Control | |
| [615] | Terminal 53 High Ref./Feedb. Value | |
| [625] | Terminal 54 High Ref./Feedb. Value | |
| [653] | Term 42 Output Bus Ctrl | |
| [663] | Terminal X30/8 Bus Control | |
| [673] | Terminal X45/1 Bus Control | |
| [683] | Terminal X45/3 Bus Control | |

3

| 8-41 Parameters for Signals | | |
|---|---|---|
| Option: | | Function: |
| [748] | PCD Feed Forward | |
| [890] | Bus Jog 1 Speed | |
| [891] | Bus Jog 2 Speed | |
| [1472] | Legacy Alarm Word | |
| [1473] | Legacy Warning Word | |
| [1474] | Leg. Ext. Status Word | |
| [1500] | Operating hours | |
| [1501] | Running Hours | |
| [1502] | kWh Counter | |
| [1600] | Control Word | |
| [1601] | Reference [Unit] | |
| [1602] | Reference % | |
| [1603] | Status Word | |
| [1605] | Main Actual Value [%] | |
| [1606] | Absolute Position | |
| [1609] | Custom Readout | |
| [1610] | Power [kW] | |
| [1611] | Power [hp] | |
| [1612] | Motor Voltage | |
| [1613] | Frequency | |
| [1614] | Motor current | |
| [1615] | Frequency [%] | |
| [1616] | Torque [Nm] | |
| [1617] | Speed [RPM] | |
| [1618] | Motor Thermal | |
| [1619] | KTY sensor temperature | |
| [1620] | Motor Angle | |
| [1621] | Torque [%] High Res. | |
| [1622] | Torque [%] | |
| [1623] | Motor Shaft Power [kW] | |
| [1624] | Calibrated Stator Resistance | |
| [1625] | Torque [Nm] High | |
| [1630] | DC Link Voltage | |
| [1632] | Brake Energy /s | |
| [1633] | Brake Energy Average | |
| [1634] | Heatsink Temp. | |
| [1635] | Inverter Thermal | |
| [1638] | SL Controller State | |
| [1639] | Control Card Temp. | |
| [1645] | Motor Phase U Current | |
| [1646] | Motor Phase V Current | |
| [1647] | Motor Phase W Current | |
| [1648] | Speed Ref. After Ramp [RPM] | |
| [1650] | External Reference | |
| [1651] | Pulse Reference | |
| [1652] | Feedback[Unit] | |
| [1653] | Digi Pot Reference | |
| [1657] | Feedback [RPM] | |
| [1660] | Digital Input | |
| [1661] | Terminal 53 Switch Setting | |
| [1662] | Analog Input 53 | |
| [1663] | Terminal 54 Switch Setting | |

| 8-41 Parameters for Signals | | |
|---|---|---|
| Option: | | Function: |
| [1664] | Analog Input 54 | |
| [1665] | Analog Output 42 [mA] | |
| [1666] | Digital Output [bin] | |
| [1667] | Freq. Input #29 [Hz] | |
| [1668] | Freq. Input #33 [Hz] | |
| [1669] | Pulse Output #27 [Hz] | |
| [1670] | Pulse Output #29 [Hz] | |
| [1671] | Relay Output [bin] | |
| [1672] | Counter A | |
| [1673] | Counter B | |
| [1674] | Prec. Stop Counter | |
| [1675] | Analog In X30/11 | |
| [1676] | Analog In X30/12 | |
| [1677] | Analog Out X30/8 [mA] | |
| [1678] | Analog Out X45/1 [mA] | |
| [1679] | Analog Out X45/3 [mA] | |
| [1680] | Fieldbus CTW 1 | |
| [1682] | Fieldbus REF 1 | |
| [1684] | Comm. Option STW | |
| [1685] | FC Port CTW 1 | |
| [1686] | FC Port REF 1 | |
| [1687] | Bus Readout Alarm/Warning | |
| [1689] | Configurable Alarm/Warning Word | |
| [1690] | Alarm Word | |
| [1691] | Alarm Word 2 | |
| [1692] | Warning Word | |
| [1693] | Warning Word 2 | |
| [1694] | Ext. Status Word | |
| [1836] | Analog Input X48/2 [mA] | |
| [1837] | Temp. Input X48/4 | |
| [1838] | Temp. Input X48/7 | |
| [1839] | Temp. Input X48/10 | |
| [1860] | Digital Input 2 | |
| [3310] | Sync Factor Master | |
| [3311] | Sync Factor Slave | |
| [3401] | PCD 1 Write to MCO | |
| [3402] | PCD 2 Write to MCO | |
| [3403] | PCD 3 Write to MCO | |
| [3404] | PCD 4 Write to MCO | |
| [3405] | PCD 5 Write to MCO | |
| [3406] | PCD 6 Write to MCO | |
| [3407] | PCD 7 Write to MCO | |
| [3408] | PCD 8 Write to MCO | |
| [3409] | PCD 9 Write to MCO | |
| [3410] | PCD 10 Write to MCO | |
| [3421] | PCD 1 Read from MCO | |
| [3422] | PCD 2 Read from MCO | |
| [3423] | PCD 3 Read from MCO | |
| [3424] | PCD 4 Read from MCO | |
| [3425] | PCD 5 Read from MCO | |
| [3426] | PCD 6 Read from MCO | |
| [3427] | PCD 7 Read from MCO | |

| 8-41 Parameters for Signals | | |
|---|---|---|
| **Option:** | | **Function:** |
| [3428] | PCD 8 Read from MCO | |
| [3429] | PCD 9 Read from MCO | |
| [3430] | PCD 10 Read from MCO | |
| [3440] | Digital Inputs | |
| [3441] | Digital Outputs | |
| [3450] | Actual Position | |
| [3451] | Commanded Position | |
| [3452] | Actual Master Position | |
| [3453] | Slave Index Position | |
| [3454] | Master Index Position | |
| [3455] | Curve Position | |
| [3456] | Track Error | |
| [3457] | Synchronizing Error | |
| [3458] | Actual Velocity | |
| [3459] | Actual Master Velocity | |
| [3460] | Synchronizing Status | |
| [3461] | Axis Status | |
| [3462] | Program Status | |
| [3464] | MCO 302 Status | |
| [3465] | MCO 302 Control | |
| [3470] | MCO Alarm Word 1 | |
| [3471] | MCO Alarm Word 2 | |
| [4280] | Safe Option Status | |
| [4282] | Safe Control Word | |
| [4283] | Safe Status Word | |
| [4285] | Active Safe Func. | |

| 8-42 PCD Write Configuration | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 9999] | Select the parameters to be assigned to PCD's telegrams. The number of available PCDs depends on the telegram type. The values in PCDs are then written to the selected parameters as data values. |

| 8-43 PCD Read Configuration | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 9999] | Select the parameters to be assigned to PCDs of the telegrams. The number of available PCDs depends on the telegram type. PCDs contain the actual data values of the selected parameters. |

| 8-45 BTM Transaction Command | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE*** **This parameter cannot be adjusted while the motor is running.** |
| [0] * | Off | |

| 8-45 BTM Transaction Command | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1] | Start Transaction | |
| [2] | Commit transaction | |
| [3] | Clear error | |

| 8-46 BTM Transaction Status | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Off | |
| [1] | Transaction Started | |
| [2] | Transaction Comitting | |
| [3] | Transaction Timeout | |
| [4] | Err. Non-existing Par. | |
| [5] | Err. Par. Out of Range | |
| [6] | Transaction Failed | |

| 8-47 BTM Timeout | | |
|---|---|---|
| **Range:** | | **Function:** |
| 60 s* | [1 - 360 s] | Select the BTM Timeout after a BTM transaction has been started. |

| 8-48 BTM Maximum Errors | | |
|---|---|---|
| **Range:** | | **Function:** |
| 21* | [0 - 21] | Selects the maximum allowed number of Bulk Transfer Mode errors before aborting. If it is set to maximum, there is no abort. |

| 8-49 BTM Error Log | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.255* | [0.000 - 9999.255] | List of parameters that failed during Bulk Transfer Mode. The value after the decimal break is the error code (255 means no error). |

## 3.10.5 8-5* Digital/Bus

Parameters for configuring the control word digital/bus merging.

***NOTICE***

**These parameters are active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**

| 8-50 Coasting Select | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select control of the coasting function via the terminals (digital input) and/or via the bus. |
| [0] | Digital input | Activates start command via a digital input. |
| [1] | Bus | Activates start command via the serial communication port or fieldbus option. |

3

### 8-50 Coasting Select

| Option: | | Function: |
|---|---|---|
| [2] | Logic AND | Activates start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs. |
| [3] * | Logic OR | Activates start command via the fieldbus/serial communication port OR via one of the digital inputs. |

### 8-51 Quick Stop Select

Select control of the Quick Stop function via the terminals (digital input) and/or via the bus.

| Option: | | Function: |
|---|---|---|
| [0] | Digital input | |
| [1] | Bus | |
| [2] | Logic AND | |
| [3] * | Logic OR | |

### 8-52 DC Brake Select

| Option: | | Function: |
|---|---|---|
| | | Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.<br>***NOTICE***<br>**Only selection *[0] Digital input* is available when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.** |
| [0] | Digital input | Activates start command via a digital input. |
| [1] | Bus | Activates start command via the serial communication port or fieldbus option. |
| [2] | Logic AND | Activates start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs. |
| [3] | Logic OR | Activates start command via the fieldbus/serial communication port OR via one of the digital inputs. |

### 8-53 Start Select

| Option: | | Function: |
|---|---|---|
| | | Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus. |
| [0] | Digital input | Activates a start command via a digital input. |
| [1] | Bus | Activates a start command via the serial communication port or fieldbus option. |
| [2] | Logic AND | Activates a start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs. |

### 8-53 Start Select

| Option: | | Function: |
|---|---|---|
| [3] * | Logic OR | Activates a start command via the fieldbus/serial communication port OR via one of the digital inputs. |

### 8-54 Reversing Select

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

### 8-55 Set-up Select

| Option: | | Function: |
|---|---|---|
| | | Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus. |
| [0] | Digital input | Activates the set-up selection via a digital input. |
| [1] | Bus | Activates the set-up selection via the serial communication port or fieldbus option. |
| [2] | Logic AND | Activates the set-up selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs. |
| [3] * | Logic OR | Activate the set-up selection via the fieldbus/serial communication port OR via one of the digital inputs. |

### 8-56 Preset Reference Select

| Option: | | Function: |
|---|---|---|
| | | Select control of the preset reference selection via the terminals (digital input) and/or via the fieldbus. |
| [0] | Digital input | Activates preset reference selection via a digital input. |
| [1] | Bus | Activates preset reference selection via the serial communication port or fieldbus option. |
| [2] | Logic AND | Activates preset reference selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs. |
| [3] * | Logic OR | Activates the preset reference selection via the fieldbus/serial communication port OR via one of the digital inputs. |

**8-57 Profidrive OFF2 Select**

Select control of the frequency converter OFF2 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and ctrl. word* and *parameter 8-10 Control Word Profile* is set to *[1] Profidrive profile*.

| Option: | | Function: |
|---|---|---|
| [0] | Digital input | |
| [1] | Bus | |
| [2] | Logic AND | |
| [3] * | Logic OR | |

**8-58 Profidrive OFF3 Select**

Select control of the frequency converter OFF3 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and ctrl. word* and *parameter 8-10 Control Word Profile* is set to *[1] Profidrive profile*.

| Option: | | Function: |
|---|---|---|
| [0] | Digital input | |
| [1] | Bus | |
| [2] | Logic AND | |
| [3] * | Logic OR | |

### 3.10.6 8-8* FC Port Diagnostics

These parameters are used for monitoring the bus communication via the FC Port.

**8-80 Bus Message Count**

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 0 ] | This parameter shows the number of valid telegrams detected on the bus. |

**8-81 Bus Error Count**

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 0 ] | This parameter shows the number of telegrams with faults (e.g. CRC fault), detected on the bus. |

**8-82 Slave Messages Rcvd**

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 0 ] | This parameter shows the number of valid telegrams addressed to the follower, sent by the frequency converter. |

**8-83 Slave Error Count**

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

### 3.10.7 8-9* Bus Jog

**8-90 Bus Jog 1 Speed**

| Range: | | Function: |
|---|---|---|
| 100 RPM* | [ 0 - par. 4-13 RPM] | Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option. |

**8-91 Bus Jog 2 Speed**

| Range: | | Function: |
|---|---|---|
| 200 RPM* | [ 0 - par. 4-13 RPM] | Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option. |

## 3.11 Parameters: 9-** Profibus

For Profibus parameter descriptions, see the *Profibus Operating Instructions*.

## 3.12 Parameters: 10-** DeviceNET CAN Fieldbus

For DeviceNET parameter descriptions, see the *DeviceNET Operating Instructions*.

## 3.13 Parameters: 12-** Ethernet

For Ethernet parameter descriptions, see the *Ethernet Operating Instructions*.



  

3

## 3.14 Parameters: 13-** Smart Logic Control

Smart Logic Control (SLC) is essentially a sequence of user-defined actions (see *parameter 13-52 SL Controller Action* [x]) executed by the SLC when the associated user-defined *event* (see *parameter 13-51 SL Controller Event* [x]) is evaluated as TRUE by the SLC.
The condition for an event can be a particular status or that the output from a Logic Rule or a Comparator Operand becomes TRUE. That leads to an associated action as illustrated:

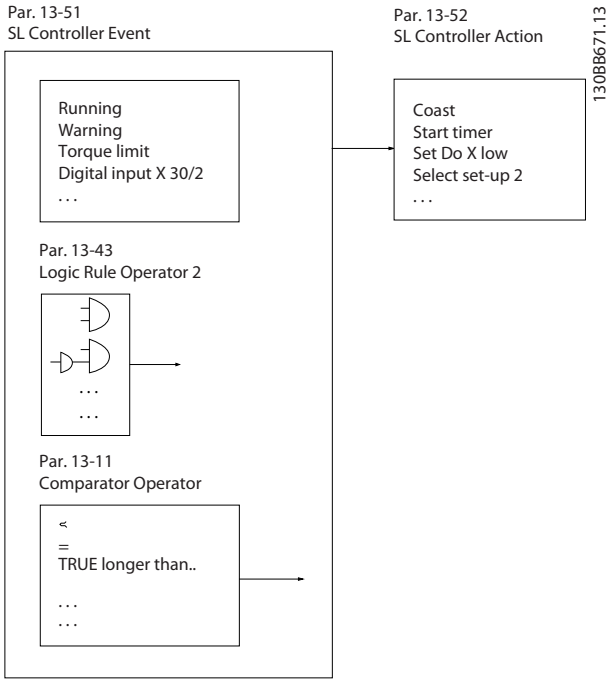


**Illustration 3.48 Smart Logic Control (SLC)**

*Events* and *actions* are each numbered and linked in pairs (states). This means that when *event* [0] is fulfilled (attains the value TRUE), *action* [0] is executed. After this, the conditions of *event* [1] are evaluated and if evaluated TRUE, *action* [1] is executed and so on. Only 1 *event* is evaluated at any time. If an *event* is evaluated as FALSE, nothing happens (in the SLC) during the current scan interval and no other *events* are evaluated. This means that when the SLC starts, it evaluates *event* [0] (and only *event* [0]) each scan interval. Only when *event* [0] is evaluated TRUE, the SLC executes *action* [0] and starts evaluating *event* [1]. 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 *event* [0]/*action* [0]. *Illustration 3.49* shows an example with 3 *events/actions*:

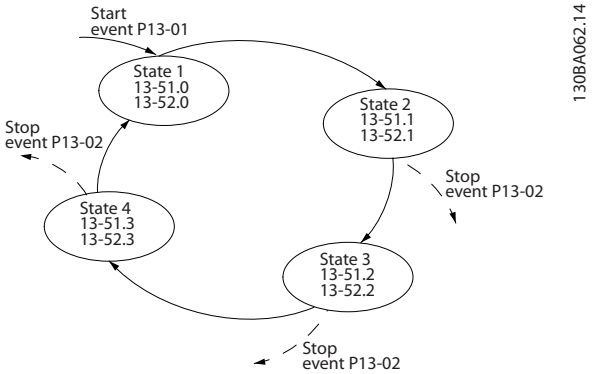


**Illustration 3.49 Events and Actions**

**Starting and stopping the SLC**
Start and stop the SLC by selecting *[1] On* or *[0] Off* in *parameter 13-00 SL Controller Mode*. The SLC always starts in state 0 (where it evaluates *event* [0]). The SLC starts when the *Start Event* (defined in *parameter 13-01 Start Event*) is evaluated as TRUE (provided that *[1] On* is selected in *parameter 13-00 SL Controller Mode*). The SLC stops when the *stop event* (*parameter 13-02 Stop Event*) is TRUE. *Parameter 13-03 Reset SLC* resets all SLC parameters and starts programming from scratch.

***NOTICE***

**SLC is only active in Auto mode, not Hand On mode.**

### 3.14.1 13-0* SLC Settings

Use the SLC settings to activate, deactivate and reset the smart logic control sequence. The logic functions and comparators are always running in the background, which opens for separate control of digital inputs and outputs.

**13-00 SL Controller Mode**

| Option: | | Function: |
|---|---|---|
| [0] | Off | Disables the Smart Logic Controller. |
| [1] | On | Enables the Smart Logic Controller. |

**13-01 Start Event**

Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.

| Option: | | Function: |
|---|---|---|
| [0] | False | Select the boolean (TRUE or FALSE) input to activate Smart Logic Control. Enters the fixed value - FALSE |
| [1] | True | Enters the fixed value - TRUE. |
| [2] | Running | The motor is running. |
| [3] | In range | The motor is running within the programmed current and speed ranges set in *parameter 4-50 Warning Current* |

| 13-01 Start Event | | |
|---|---|---|
| Select the boolean (TRUE or FALSE) input to activate Smart Logic Control. | | |
| **Option:** | | **Function:** |
| | | *Low* to *parameter 4-53 Warning Speed High*. |
| [4] | On reference | The motor is running on reference. |
| [5] | Torque limit | The torque limit, set in *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode*, has been exceeded. |
| [6] | Current Limit | The motor current limit, set in *parameter 4-18 Current Limit*, has been exceeded. |
| [7] | Out of current range | The motor current is outside the range set in *parameter 4-18 Current Limit*. |
| [8] | Below I low | The motor current is lower than set in *parameter 4-50 Warning Current Low*. |
| [9] | Above I high | The motor current is higher than set in *parameter 4-51 Warning Current High*. |
| [10] | Out of speed range | The speed is outside the range set in *parameter 4-52 Warning Speed Low* and *parameter 4-53 Warning Speed High*. |
| [11] | Below speed low | The output speed is lower than the setting in *parameter 4-52 Warning Speed Low*. |
| [12] | Above speed high | The output speed is higher than the setting in *parameter 4-53 Warning Speed High*. |
| [13] | Out of feedb. range | The feedback is outside the range set in *parameter 4-56 Warning Feedback Low* and *parameter 4-57 Warning Feedback High*. |
| [14] | Below feedb. low | The feedback is below the limit set in *parameter 4-56 Warning Feedback Low*. |
| [15] | Above feedb. high | The feedback is above the limit set in *parameter 4-57 Warning Feedback High*. |
| [16] | 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. |
| [17] | Mains out of range | The mains voltage is outside the specified voltage range. |
| [18] | Reversing | The output is high when the frequency converter is running counterclockwise (the logical product of the status bits “running” AND “reverse”). |
| [19] | Warning | A warning is active. |
| [20] | Alarm (trip) | A (trip) alarm is active. |

| 13-01 Start Event | | |
|---|---|---|
| Select the boolean (TRUE or FALSE) input to activate Smart Logic Control. | | |
| **Option:** | | **Function:** |
| [21] | Alarm (trip lock) | A (Trip lock) alarm is active. |
| [22] | Comparator 0 | Use the result of comparator 0. |
| [23] | Comparator 1 | Use the result of comparator 1. |
| [24] | Comparator 2 | Use the result of comparator 2. |
| [25] | Comparator 3 | Use the result of comparator 3. |
| [26] | Logic rule 0 | Use the result of logic rule 0. |
| [27] | Logic rule 1 | Use the result of logic rule 1. |
| [28] | Logic rule 2 | Use the result of logic rule 2. |
| [29] | Logic rule 3 | Use the result of logic rule 3. |
| [33] | Digital input DI18 | Use the result of digital input 18. |
| [34] | Digital input DI19 | Use the result of digital input 19. |
| [35] | Digital input DI27 | Use the result of digital input 27. |
| [36] | Digital input DI29 | Use the result of digital input 29. |
| [37] | Digital input DI32 | Use the result of digital input 32. |
| [38] | Digital input DI33 | Use the result of digital input 33. |
| [39] | Start command | A start command is issued. |
| [40] | Drive stopped | A stop command (Jog, Stop, Quick Stop, Coast) is issued – and not from the SLC itself. |
| [41] | Reset Trip | A reset is issued. |
| [42] | Auto-reset Trip | An Auto reset is performed. |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | Use the result of comparator 4. |
| [51] | Comparator 5 | Use the result of comparator 5. |
| [60] | Logic rule 4 | Use the result of logic rule 4. |
| [61] | Logic rule 5 | Use the result of logic rule 5. |

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### 13-01 Start Event

Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.

| Option: | | Function: |
|---|---|---|
| [76] | Digital input x30/2 | Use the value of x30/2 (MCB 101 GPIO). |
| [77] | Digital input x30/3 | Use the value of x30/3 (MCB 101 GPIO). |
| [78] | Digital input x30/4 | Use the value of x30/4 (MCB 101 GPIO). |
| [79] | Digital input x46/1 | Use the value of x46/1 (MCB 113 Ext. Relay Card). |
| [80] | Digital input x46/3 | Use the value of x46/3 (MCB 113 Ext. Relay Card). |
| [81] | Digital input x46/5 | Use the value of x46/5 (MCB 113 Ext. Relay Card). |
| [82] | Digital input x46/7 | Use the value of x46/7 (MCB 113 Ext. Relay Card). |
| [83] | Digital input x46/9 | Use the value of x46/9 (MCB 113 Ext. Relay Card). |
| [84] | Digital input x46/11 | Use the value of x46/11 (MCB 113 Ext. Relay Card). |
| [85] | Digital input x46/13 | Use the value of x46/13 (MCB 113 Ext. Relay Card). |
| [94] | RS Flipflop 0 | See parameter group *13-1* Comparators.* |
| [95] | RS Flipflop 1 | See parameter group *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See parameter group *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See parameter group *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See parameter group *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See parameter group *13-1* Comparators.* |
| [100] | RS Flipflop 6 | See parameter group *13-1* Comparators.* |
| [101] | RS Flipflop 7 | See parameter group *13-1* Comparators.* |

### 13-02 Stop Event

Select the boolean (TRUE or FALSE) input to deactivate Smart Logic Control.

| Option: | | Function: |
|---|---|---|
| [0] | False | For descriptions [0]-[61], see *parameter 13-01 Start Event Start Event.* |
| [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 | |

### 13-02 Stop Event

Select the boolean (TRUE or FALSE) input to deactivate Smart Logic Control.

| Option: | | Function: |
|---|---|---|
| [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] | Mains out of range | |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [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 | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |

| 13-02 Stop Event | | |
|---|---|---|
| Select the boolean (TRUE or FALSE) input to deactivate Smart Logic Control. | | |
| **Option:** | | **Function:** |
| [70] | SL Time-out 3 | Smart Logic Controller timer 3 is timed out. |
| [71] | SL Time-out 4 | Smart Logic Controller timer 4 is timed out. |
| [72] | SL Time-out 5 | Smart Logic Controller timer 5 is timed out. |
| [73] | SL Time-out 6 | Smart Logic Controller timer 6 is timed out. |
| [74] | SL Time-out 7 | Smart Logic Controller timer 7 is timed out. |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [91] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [92] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [93] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [94] | RS Flipflop 0 | See parameter group *13-1* Comparators.* |

| 13-02 Stop Event | | |
|---|---|---|
| Select the boolean (TRUE or FALSE) input to deactivate Smart Logic Control. | | |
| **Option:** | | **Function:** |
| [95] | RS Flipflop 1 | See parameter group *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See parameter group *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See parameter group *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See parameter group *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See parameter group *13-1* Comparators.* |
| [100] | RS Flipflop 6 | See parameter group *13-1* Comparators* |
| [101] | RS Flipflop 7 | See parameter group *13-1* Comparators.* |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

| 13-03 Reset SLC | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Do not reset SLC | Retains programmed settings in all parameter group *13-** Smart Logic Control.* |
| [1] | Reset SLC | Resets all parameters in parameter group *13-** Smart Logic Control* to default settings. |

## 3.14.2 13-1* Comparators

Comparators are used for comparing continuous variables (i.e. output frequency, output current, analog input etc.) to fixed preset values.

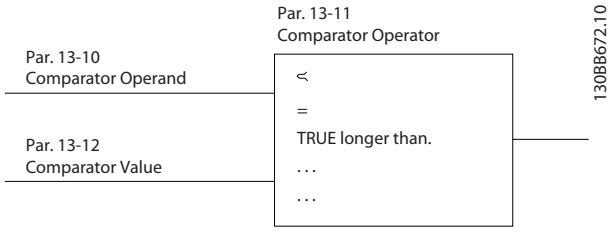


**Illustration 3.50 Comparators**

There are digital values that are compared to fixed time values. See explanation in *parameter 13-10 Comparator Operand*. Comparators are evaluated once in each scan interval. Use the result (TRUE or FALSE) directly. All parameters in this parameter group are array parameters with index 0 to 5. Select index 0 to program comparator 0, select index 1 to program comparator 1, and so on.

| 13-10 Comparator Operand | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| | | Options [1] to [31] are variables which are compared based on their values. Options [50] to [186] are digital values (TRUE/FALSE) where the comparison is based on the amount of time during which they are set to TRUE or FALSE, respectively. See *parameter 13-11 Comparator Operator*. Select the variable to be monitored by the comparator. |
| [0] | DISABLED | The comparator is disabled. |
| [1] | Reference % | The resulting remote reference (not local) as a percentage. |
| [2] | Feedback % | [RPM] or [Hz], as set in parameter *0-02 Motor Speed Unit*. |
| [3] | Motor speed | [RPM] or [Hz], as set in parameter *0-02 Motor Speed Unit*. |
| [4] | Motor Current | [A] |
| [5] | Motor torque | [Nm] |
| [6] | Motor power | [kW] or [hp] |
| [7] | Motor voltage | [V] |
| [8] | DC-link voltage | [V] |
| [9] | Motor Thermal | Expressed as a percentage. |
| [10] | Drive thermal | Expressed as a percentage. |
| [11] | Heat sink temp. | Expressed as a percentage. |
| [12] | Analog input AI53 | Expressed as a percentage. |
| [13] | Analog input AI54 | Expressed as a percentage. |
| [14] | Analog input AIFB10 | [V]. AIFB10 is internal 10 V supply. |
| [15] | Analog input AIS24V | [V] Analog input AICCT [17] [°]. AIS24V is switch mode power supply: SMPS 24V. |
| [17] | Analog input AICCT | [°]. AICCT is control card temperature. |
| [18] | Pulse input FI29 | Expressed as a percentage. |
| [19] | Pulse input FI33 | Expressed as a percentage. |
| [20] | Alarm number | The error number. |
| [21] | Warning number | |
| [22] | Analog input x30 11 | |
| [23] | Analog input x30 12 | |
| [30] | Counter A | Number of counts. |
| [31] | Counter B | Number of counts. |
| [32] | Process PID Error | Value of the PID Error (*parameter 18-90 Process PID Error*). |
| [33] | Process PID Output | Value of the PID Output (*parameter 18-91 Process PID Output*). |
| [50] | FALSE | Enters the fixed value of false in the comparator. |
| [51] | TRUE | Enters the fixed value of true in the comparator. |
| [52] | Control ready | The control board receives supply voltage. |
| [53] | Drive ready | The frequency converter is ready for operation and applies a supply signal on the control board. |
| [54] | Running | The motor is running. |
| [55] | Reversing | The output is high when the frequency converter is running counterclockwise (the logical product of the status bits "running" AND "reverse"). |
| [56] | In range | The motor is running within the programmed current and speed ranges set in *parameter 4-50 Warning Current Low* to *parameter 4-53 Warning Speed High*. |
| [60] | On reference | The motor is running on reference. |
| [61] | Below reference, low | The motor is running below the value given in *parameter 4-54 Warning Reference Low*. |
| [62] | Above ref, high | The motor is running above the value given in *parameter 4-55 Warning Reference High*. |

| 13-10 Comparator Operand | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [65] | Torque limit | The torque limit, set in *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode*, has been exceeded. |
| [66] | Current Limit | The motor current limit, set in *parameter 4-18 Current Limit*, has been exceeded. |
| [67] | Out of current range | The motor current is outside the range set in *parameter 4-18 Current Limit*. |
| [68] | Below I low | The motor current is lower than set in *parameter 4-50 Warning Current Low*. |
| [69] | Above I high | The motor current is higher than set in *parameter 4-51 Warning Current High*. |
| [70] | Out of speed range | The speed is outside the range set in *parameter 4-52 Warning Speed Low* and *parameter 4-53 Warning Speed High*. |
| [71] | Below speed low | The output speed is lower than the setting in *parameter 4-52 Warning Speed Low*. |
| [72] | Above speed high | The output speed is higher than the setting in *parameter 4-53 Warning Speed High*. |
| [75] | Out of feedback range | The feedback is outside the range set in *parameter 4-56 Warning Feedback Low* and *parameter 4-57 Warning Feedback High*. |
| [76] | Below feedback low | The feedback is below the limit set in *parameter 4-56 Warning Feedback Low*. |
| [77] | Above feedback high | The feedback is above the limit set in *parameter 4-57 Warning Feedback High*. |
| [80] | Thermal warning | This operand becomes true when the frequency converter detects any thermal warning, for instance, when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor or thermistor. |
| [82] | Mains out of range | The mains voltage is outside the specified voltage range. |
| [85] | Warning | If a warning is triggered, this operand gets the warning number. |
| [86] | Alarm (trip) | A (trip) alarm is active. |
| [87] | Alarm (trip lock) | A (Trip lock) alarm is active. |
| [90] | Bus OK | Active communication (no timeout) via the serial communication port. |

| 13-10 Comparator Operand | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [91] | Torque limit & stop | If the frequency converter has received a stop signal and is at the torque limit, the signal is logic "0". |
| [92] | Brake fault (IGBT) | The brake IGBT is short-circuited. |
| [93] | Mech. brake control | The mechanical brake is active. |
| [94] | Safe stop active | |
| [100] | Comparator 0 | The result of comparator 0. |
| [101] | Comparator 1 | The result of comparator 1. |
| [102] | Comparator 2 | The result of comparator 2. |
| [103] | Comparator 3 | The result of comparator 3. |
| [104] | Comparator 4 | The result of comparator 4. |
| [105] | Comparator 5 | The result of comparator 5. |
| [110] | Logic rule 0 | The result of logic rule 0. |
| [111] | Logic rule 1 | The result of logic rule 1. |
| [112] | Logic rule 2 | The result of logic rule 2. |
| [113] | Logic rule 3 | The result of logic rule 3. |
| [114] | Logic rule 4 | The result of logic rule 4. |
| [115] | Logic rule 5 | The result of logic rule 5. |
| [120] | SL Time-out 0 | The result of SLC timer 0. |
| [121] | SL Time-out 1 | The result of SLC timer 1. |
| [122] | SL Time-out 2 | The result of SLC timer 2. |
| [123] | SL Time-out 3 | The result of SLC timer 3. |
| [124] | SL Time-out 4 | The result of SLC timer 4. |
| [125] | SL Time-out 5 | The result of SLC timer 5. |
| [126] | SL Time-out 6 | The result of SLC timer 6. |
| [127] | SL Time-out 7 | The result of SLC timer 7. |
| [130] | Digital input DI18 | Digital input 18. High = True. |
| [131] | Digital input DI19 | Digital input 19. High = True. |
| [132] | Digital input DI27 | Digital input 27. High = True. |
| [133] | Digital input DI29 | Digital input 29. High = True. |
| [134] | Digital input DI32 | Digital input 32. High = True. |
| [135] | Digital input DI33 | Digital input 33. High = True. |
| [150] | SL digital output A | Use the result of the SLC output A. |
| [151] | SL digital output B | Use the result of the SLC output B. |



  

3

| 13-10 Comparator Operand | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [152] | SL digital output C | Use the result of the SLC output C. |
| [153] | SL digital output D | Use the result of the SLC output D. |
| [154] | SL digital output E | Use the result of the SLC output E. |
| [155] | SL digital output F | Use the result of the SLC output F. |
| [160] | Relay 1 | Relay 1 is active |
| [161] | Relay 2 | Relay 2 is active |
| [162] | Relay 3 | |
| [163] | Relay 4 | |
| [164] | Relay 5 | |
| [165] | Relay 6 | |
| [166] | Relay 7 | |
| [167] | Relay 8 | |
| [168] | Relay 9 | |
| [180] | Local referecnce active | High when *parameter 3-13 Reference Site = [2] Local* or when *parameter 3-13 Reference Site* is *[0] Linked to hand Auto*, at the same time as the LCP is in Hand On mode. |
| [181] | Remote reference active | High when *parameter 3-13 Reference Site= [1] Remote* or *[0] Linked to hand/auto*, while the LCP is in Auto On mode. |
| [182] | Start command | High when there is an active start command, and no stop command. |
| [183] | Drive stopped | A stop command (Jog, Stop, Qstop, Coast) is issued – and not from the SLC itself. |
| [185] | Drive in hand mode | High when the frequency converter is in Hand mode. |
| [186] | Drive in auto mode | High when the frequency converter is in Auto mode. |
| [187] | Start command given | |
| [190] | Digital input x30/2 | |
| [191] | Digital input x30/3 | |
| [192] | Digital input x30/4 | |
| [193] | Digital input x46/1 | |
| [194] | Digital input x46/3 | |
| [195] | Digital input x46/5 | |
| [196] | Digital input x46/7 | |

| 13-10 Comparator Operand | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [197] | Digital input x46/9 | |
| [198] | Digital input x46/11 | |
| [199] | Digital input x46/13 | |

| 13-11 Comparator Operator | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| | | Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0 to 5. |
| [0] | < | The result of the evaluation is TRUE, when the variable selected in *parameter 13-10 Comparator Operand* is smaller than the fixed value in *13-12 Comparator Value*. The result is FALSE, if the variable selected in *parameter 13-10 Comparator Operand* is greater than the fixed value in *13-12 Comparator Value*. |
| [1] | ≈ (equal) | The result of the evaluation is TRUE, when the variable selected in *parameter 13-10 Comparator Operand* is approximately equal to the fixed value in *13-12 Comparator Value*. |
| [2] | > | Inverse logic of option < [0]. |
| [5] | TRUE longer than.. | |
| [6] | FALSE longer than.. | |
| [7] | TRUE shorter than.. | |
| [8] | FALSE shorter than.. | |

| 13-12 Comparator Value | | |
|---|---|---|
| Array [6] | | |
| **Range:** | | **Function:** |
| Size related* | [-100000 - 100000 ] | Enter the 'trigger level' for the variable that is monitored by this comparator. This is an array parameter containing comparator values 0 to 5. |

## 3.14.3 13-1* RS Flip Flops

The Reset/Set Flip Flops hold the signal until set/reset.

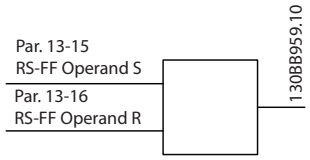


**Illustration 3.51 Reset/Set Flip Flops**

2 parameters are used and the output can be used in the logic rules and as events.

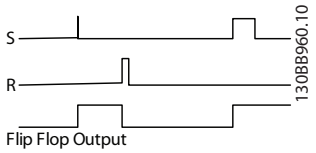


**Illustration 3.52 Flip Flop Outputs**

The 2 operators can be selected from a long list. As a special case, the same digital input can be used as both Set and Reset, making it possible to use the same digital input as start/stop. The following settings can be used to set up the same digital input as start/stop (example given with DI32 but is not a requirement).

| Parameter | Setting | Notes |
|---|---|---|
| *Parameter 13-00 SL Controller Mode* | On | |
| *Parameter 13-01 Start Event* | TRUE | |
| *Parameter 13-02 Stop Event* | FALSE | |
| | | |
| *Parameter 13-40 Logic Rule Boolean 1* [0] | [37] Digital Input DI32 | |
| *Parameter 13-42 Logic Rule Boolean 2* [0] | [2] Running | |
| *Parameter 13-41 Logic Rule Operator 1* [0] | [3] AND NOT | |
| | | |
| *Parameter 13-40 Logic Rule Boolean 1* [1] | [37] Digital Input DI32 | |
| *Parameter 13-42 Logic Rule Boolean 2* [1] | [2] Running | |
| *Parameter 13-41 Logic Rule Operator 1* [1] | [1] AND | |
| | | |
| *Parameter 13-15 RS-FF Operand S* [0] | [26] Logicrule 0 | Output from 13-41 [0] |
| *Parameter 13-16 RS-FF Operand R* [0] | [27] Logicrule 1 | Output from 13-41 [1] |
| | | |

| Parameter | Setting | Notes |
|---|---|---|
| *Parameter 13-51 SL Controller Event* [0] | [94] RS Flipflop 0 | Output from evaluating 13-15 and 13-16 |
| *Parameter 13-52 SL Controller Action* [0] | [22] Run | |
| | | |
| *Parameter 13-51 SL Controller Event* [1] | [27] Logicrule 1 | |
| *Parameter 13-52 SL Controller Action* [1] | [24] Stop | |

**Table 3.23 Operators**

| 13-15 RS-FF Operand S | |
|---|---|
| **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] | Mains out of range |
| [18] | Reversing |
| [19] | Warning |
| [20] | Alarm (trip) |
| [21] | Alarm (trip lock) |
| [22] | Comparator 0 |
| [23] | Comparator 1 |
| [24] | Comparator 2 |
| [25] | Comparator 3 |
| [26] | Logic rule 0 |
| [27] | Logic rule 1 |
| [28] | Logic rule 2 |
| [29] | Logic rule 3 |
| [30] | SL Time-out 0 |
| [31] | SL Time-out 1 |
| [32] | SL Time-out 2 |
| [33] | Digital input DI18 |
| [34] | Digital input DI19 |
| [35] | Digital input DI27 |
| [36] | Digital input DI29 |
| [37] | Digital input DI32 |
| [38] | Digital input DI33 |

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| 13-15 RS-FF Operand S | | |
|---|---|---|
| **Option:** | | **Function:** |
| [39] | Start command | |
| [40] | Drive stopped | |
| [41] | Reset Trip | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | |
| [91] | ATEX ETR cur. alarm | |
| [92] | ATEX ETR freq. warning | |
| [93] | ATEX ETR freq. alarm | |
| [94] | RS Flipflop 0 | |
| [95] | RS Flipflop 1 | |
| [96] | RS Flipflop 2 | |
| [97] | RS Flipflop 3 | |
| [98] | RS Flipflop 4 | |
| [99] | RS Flipflop 5 | |
| [100] | RS Flipflop 6 | |
| [101] | RS Flipflop 7 | |
| [102] | Relay 1 | |
| [103] | Relay 2 | |

| 13-15 RS-FF Operand S | | |
|---|---|---|
| **Option:** | | **Function:** |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

| 13-16 RS-FF Operand R | | |
|---|---|---|
| **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] | Mains out of range | |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [34] | Digital input DI19 | |
| [35] | Digital input DI27 | |
| [36] | Digital input DI29 | |
| [37] | Digital input DI32 | |
| [38] | Digital input DI33 | |
| [39] | Start command | |

| 13-16 RS-FF Operand R | | |
|---|---|---|
| **Option:** | | **Function:** |
| [40] | Drive stopped | |
| [41] | Reset Trip | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | |
| [91] | ATEX ETR cur. alarm | |
| [92] | ATEX ETR freq. warning | |
| [93] | ATEX ETR freq. alarm | |
| [94] | RS Flipflop 0 | |
| [95] | RS Flipflop 1 | |
| [96] | RS Flipflop 2 | |
| [97] | RS Flipflop 3 | |
| [98] | RS Flipflop 4 | |
| [99] | RS Flipflop 5 | |
| [100] | RS Flipflop 6 | |
| [101] | RS Flipflop 7 | |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |

| 13-16 RS-FF Operand R | | |
|---|---|---|
| **Option:** | | **Function:** |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

## 3.14.4 13-2* Timers

Use the result (TRUE or FALSE) from *timers* directly to define an *event* (see *13-51 SL Controller Event*), or as boolean input in a *logic rule* (see *13-40 Logic Rule Boolean 1*, *13-42 Logic Rule Boolean 2* or *13-44 Logic Rule Boolean 3*). A timer is only FALSE when started by an action (i.e. *[29] Start timer 1*) until the timer value entered in this parameter has elapsed. Then it becomes TRUE again. All parameters in this parameter group are array parameters with index 0 to 2. Select index 0 to program timer 0, select index 1 to program timer 1, and so on.

| 13-20 SL Controller Timer | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [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 (i.e. *[29] Start timer 1*) and until the given timer value has elapsed. |

## 3.14.5 13-4* Logic Rules

Combine up to 3 boolean inputs (TRUE/FALSE inputs) from timers, comparators, digital inputs, status bits and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in *13-40 Logic Rule Boolean 1*, *13-42 Logic Rule Boolean 2* and *13-44 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *parameter 13-41 Logic Rule Operator 1* and *parameter 13-43 Logic Rule Operator 2*.

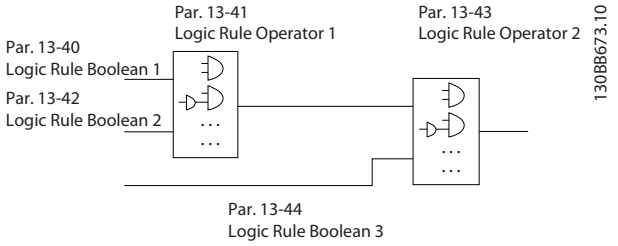


**Illustration 3.53 Logic Rules**

3

**Priority of calculation**

The results of *13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1* and *13-42 Logic Rule Boolean 2* are calculated first. The outcome (TRUE/FALSE) of this calculation is combined with the settings of *parameter 13-43 Logic Rule Operator 2* and *13-44 Logic Rule Boolean 3*, yielding the final result (TRUE/FALSE) of the logic rule.

**13-40 Logic Rule Boolean 1**

Array [6]

| Option: | | Function: |
|---|---|---|
| [0] | False | Select the first boolean (TRUE or FALSE) input for the selected logic rule. See *parameter 13-01 Start Event* ([0] - [61]) and *parameter 13-02 Stop Event* ([70] - [75]) for further description. |
| [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] | Mains out of range | |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [34] | Digital input DI19 | |
| [35] | Digital input DI27 | |
| [36] | Digital input DI29 | |

**13-40 Logic Rule Boolean 1**

Array [6]

| Option: | | Function: |
|---|---|---|
| [37] | Digital input DI32 | |
| [38] | Digital input DI33 | |
| [39] | Start command | |
| [40] | Drive stopped | |
| [41] | Reset Trip | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [91] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR |

  

### 13-40 Logic Rule Boolean 1

Array [6]

| Option: | | Function: |
|---|---|---|
| | | freq.lim.alarm is active, the output is 1. |
| [92] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [93] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [94] | RS Flipflop 0 | See parameter group*13-1* Comparators.* |
| [95] | RS Flipflop 1 | See parameter group *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See parameter group *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See parameter group *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See parameter group *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See parameter group *13-1* Comparators.* |
| [100] | RS Flipflop 6 | See parameter group *13-1* Comparators* |
| [101] | RS Flipflop 7 | See parameter group *13-1* Comparators.* |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

### 13-41 Logic Rule Operator 1

Array [6]

| Option: | | Function: |
|---|---|---|
| | | Select the first logical operator to use on the boolean inputs from *13-40 Logic Rule Boolean 1* and *13-42 Logic Rule Boolean 2*. |

### 13-41 Logic Rule Operator 1

Array [6]

| Option: | | Function: |
|---|---|---|
| | | Parameter numbers in square brackets stand for the boolean inputs of parameters in group *13-** Smart Logic Control*. |
| [0] | DISABLED | Ignores *13-42 Logic Rule Boolean 2*, *parameter 13-43 Logic Rule Operator 2*, and *13-44 Logic Rule Boolean 3*. |
| [1] | AND | Evaluates the expression [13-40] AND [13-42]. |
| [2] | OR | Evaluates the expression [13-40] OR [13-42]. |
| [3] | AND NOT | Evaluates the expression [13-40] AND NOT [13-42]. |
| [4] | OR NOT | Evaluates the expression [13-40] OR NOT [13-42]. |
| [5] | NOT AND | Evaluates the expression NOT [13-40] AND [13-42]. |
| [6] | NOT OR | Evaluates the expression NOT [13-40] OR [13-42]. |
| [7] | NOT AND NOT | Evaluates the expression NOT [13-40] AND NOT [13-42]. |
| [8] | NOT OR NOT | Evaluates the expression NOT [13-40] OR NOT [13-42]. |

### 13-42 Logic Rule Boolean 2

Array [6]

| Option: | | Function: |
|---|---|---|
| [0] | False | Select the second boolean (TRUE or FALSE) input for the selected logic rule. See *parameter 13-01 Start Event* ([0] - [61]) and *parameter 13-02 Stop Event* ([70] - [75]) for further description. |
| [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] | Mains out of range | |

  

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| 13-42 Logic Rule Boolean 2 | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [34] | Digital input DI19 | |
| [35] | Digital input DI27 | |
| [36] | Digital input DI29 | |
| [37] | Digital input DI32 | |
| [38] | Digital input DI33 | |
| [39] | Start command | |
| [40] | Drive stopped | |
| [41] | Reset Trip | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |

| 13-42 Logic Rule Boolean 2 | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [91] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [92] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [93] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [94] | RS Flipflop 0 | See *13-1* Comparators.* |
| [95] | RS Flipflop 1 | See *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See *13-1* Comparators.* |
| [100] | RS Flipflop 6 | See *13-1* Comparators* |
| [101] | RS Flipflop 7 | See *13-1* Comparators.* |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |

  

### 13-42 Logic Rule Boolean 2

Array [6]

| Option: | | Function: |
|---|---|---|
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

### 13-43 Logic Rule Operator 2

Array [6]

| Option: | | Function: |
|---|---|---|
| | | Select the second logical operator to be used on the boolean input calculated in *13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1*, and *13-42 Logic Rule Boolean 2*, and the boolean input coming from *13-42 Logic Rule Boolean 2*.<br>[13-44] signifies the boolean input of *13-44 Logic Rule Boolean 3*.<br>[13-40/13-42] signifies the boolean input calculated in *13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1*, and *13-42 Logic Rule Boolean 2 [0] Disabled* (factory setting). Select this option to ignore *13-44 Logic Rule Boolean 3*. |
| [0] | DISABLED | |
| [1] | AND | |
| [2] | OR | |
| [3] | AND NOT | |
| [4] | OR NOT | |
| [5] | NOT AND | |
| [6] | NOT OR | |
| [7] | NOT AND NOT | |
| [8] | NOT OR NOT | |

### 13-44 Logic Rule Boolean 3

Array [6]

| Option: | | Function: |
|---|---|---|
| [0] | False | Select the third boolean (TRUE or FALSE) input for the selected logic rule. See *parameter 13-01 Start Event* ([0] - [61]) and *parameter 13-02 Stop Event* ([70] - [75]) for further description. |
| [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 | |

### 13-44 Logic Rule Boolean 3

Array [6]

| Option: | | Function: |
|---|---|---|
| [12] | Above speed high | |
| [13] | Out of feedb. range | |
| [14] | Below feedb. low | |
| [15] | Above feedb. high | |
| [16] | Thermal warning | |
| [17] | Mains out of range | |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [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 | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |



  

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| 13-44 Logic Rule Boolean 3 | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [91] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [92] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [93] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*]. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [94] | RS Flipflop 0 | See parameter group *13-1* Comparators.* |
| [95] | RS Flipflop 1 | See parameter group *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See parameter group *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See parameter group *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See parameter group *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See parameter group *13-1* Comparators.* |

| 13-44 Logic Rule Boolean 3 | | |
|---|---|---|
| Array [6] | | |
| **Option:** | | **Function:** |
| [100] | RS Flipflop 6 | See parameter group *13-1* Comparators* |
| [101] | RS Flipflop 7 | See parameter group *13-1* Comparators.* |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

## 3.14.6 13-5* States

| 13-51 SL Controller Event | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [0] | False | Select the boolean input (TRUE or FALSE) to define the Smart Logic Controller event. See *parameter 13-01 Start Event* ([0] - [61]) and *parameter 13-02 Stop Event* ([70] - [74]) for further description. |
| [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] | Mains out of range | |
| [18] | Reversing | |
| [19] | Warning | |
| [20] | Alarm (trip) | |
| [21] | Alarm (trip lock) | |

| 13-51 SL Controller Event | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [22] | Comparator 0 | |
| [23] | Comparator 1 | |
| [24] | Comparator 2 | |
| [25] | Comparator 3 | |
| [26] | Logic rule 0 | |
| [27] | Logic rule 1 | |
| [28] | Logic rule 2 | |
| [29] | Logic rule 3 | |
| [30] | SL Time-out 0 | |
| [31] | SL Time-out 1 | |
| [32] | SL Time-out 2 | |
| [33] | Digital input DI18 | |
| [34] | Digital input DI19 | |
| [35] | Digital input DI27 | |
| [36] | Digital input DI29 | |
| [37] | Digital input DI32 | |
| [38] | Digital input DI33 | |
| [39] | Start command | |
| [40] | Drive stopped | |
| [41] | Reset Trip | |
| [42] | Auto-reset Trip | |
| [43] | Ok key | [OK] is pressed. Only available on the graphical LCP. |
| [44] | Reset key | [Reset] is pressed. Only available on the graphical LCP. |
| [45] | Left key | [◄] is pressed. Only available on the graphical LCP. |
| [46] | Right key | [►] is pressed. Only available on the graphical LCP. |
| [47] | Up key | [▲] is pressed. Only available on the graphical LCP. |
| [48] | Down key | [▼] is pressed. Only available on the graphical LCP. |
| [50] | Comparator 4 | |
| [51] | Comparator 5 | |
| [60] | Logic rule 4 | |
| [61] | Logic rule 5 | |
| [70] | SL Time-out 3 | |
| [71] | SL Time-out 4 | |
| [72] | SL Time-out 5 | |
| [73] | SL Time-out 6 | |
| [74] | SL Time-out 7 | |
| [75] | Start command given | |
| [76] | Digital input x30/2 | |
| [77] | Digital input x30/3 | |
| [78] | Digital input x30/4 | |
| [79] | Digital input x46/1 | |
| [80] | Digital input x46/3 | |
| [81] | Digital input x46/5 | |

| 13-51 SL Controller Event | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [82] | Digital input x46/7 | |
| [83] | Digital input x46/9 | |
| [84] | Digital input x46/11 | |
| [85] | Digital input x46/13 | |
| [90] | ATEX ETR cur. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output is 1. |
| [91] | ATEX ETR cur. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output is 1. |
| [92] | ATEX ETR freq. warning | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output is 1. |
| [93] | ATEX ETR freq. alarm | Selectable, if *parameter 1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output is 1. |
| [94] | RS Flipflop 0 | See parameter group *13-1* Comparators.* |
| [95] | RS Flipflop 1 | See parameter group *13-1* Comparators.* |
| [96] | RS Flipflop 2 | See parameter group *13-1* Comparators.* |
| [97] | RS Flipflop 3 | See parameter group *13-1* Comparators.* |
| [98] | RS Flipflop 4 | See parameter group *13-1* Comparators.* |
| [99] | RS Flipflop 5 | See parameter group *13-1* Comparators.* |
| [100] | RS Flipflop 6 | See parameter group *13-1* Comparators* |
| [101] | RS Flipflop 7 | See parameter group *13-1* Comparators.* |
| [102] | Relay 1 | |
| [103] | Relay 2 | |
| [104] | Relay 3 | X47/MCB 113 |
| [105] | Relay 4 | X47/MCB 113 |

3

| 13-51 SL Controller Event | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [106] | Relay 5 | X47/MCB 113 |
| [107] | Relay 6 | X47/MCB 113 |
| [108] | Relay 7 | X34/MCB 105 |
| [109] | Relay 8 | X34/MCB 105 |
| [110] | Relay 9 | X34/MCB 105 |

| 13-52 SL Controller Action | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [0] | DISABLED | Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in *parameter 13-51 SL Controller Event*) is evaluated as true. The following actions are available for selection:<br>*[0] *DISABLED* |
| [1] | No action | |
| [2] | Select set-up 1 | Changes the active set-up (*parameter 0-10 Active Set-up*) to '1'. If the set-up is changed, it merges with other set-up commands coming from either the digital inputs or via a fieldbus. |
| [3] | Select set-up 2 | Changes the active set-up *parameter 0-10 Active Set-up*) to '2'. If the set-up is changed, it merges with other set-up commands coming from either the digital inputs or via a fieldbus. |
| [4] | Select set-up 3 | Changes the active set-up (*parameter 0-10 Active Set-up*) to '3'. If the set-up is changed, it merges with other set-up commands coming from either the digital inputs or via a fieldbus. |
| [5] | Select set-up 4 | Changes the active set-up (*parameter 0-10 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. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [11] | Select preset ref 1 | Selects preset reference 1. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [12] | Select preset ref 2 | Selects preset reference 2. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [13] | Select preset ref 3 | Selects preset reference 3. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [14] | Select preset ref 4 | Selects preset reference 4. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [15] | Select preset ref 5 | Selects preset reference 5. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [16] | Select preset ref 6 | Selects preset reference 6. If the active preset reference is changed, it merges with other preset reference commands coming from either the digital inputs or via a fieldbus. |
| [17] | Select preset ref 7 | 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 ramp 1 | Selects ramp 1. |
| [19] | Select ramp 2 | Selects ramp 2. |
| [20] | Select ramp 3 | Selects ramp 3. |
| [21] | Select ramp 4 | Selects ramp 4. |
| [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. |
| [25] | Qstop | Issues a quick stop command to the frequency converter. |
| [26] | Dcstop | 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 SLC. |

| 13-52 SL Controller Action | | |
|---|---|---|
| Array [20] | | |
| **Option:** | | **Function:** |
| [28] | Freeze output | Freezes the output frequency of the frequency converter. |
| [29] | Start timer 0 | Starts timer 0, see *parameter 13-20 SL Controller Timer* for further description. |
| [30] | Start timer 1 | Starts timer 1, see *parameter 13-20 SL Controller Timer* for further description. |
| [31] | Start timer 2 | Starts timer 2, see *parameter 13-20 SL Controller Timer* for further description. |
| [32] | Set digital out A low | Any output with SL output A is low. |
| [33] | Set digital out B low | Any output with SL output B is low. |
| [34] | Set digital out C low | Any output with SL output C is low. |
| [35] | Set digital out D low | Any output with SL output D is low. |
| [36] | Set digital out E low | Any output with SL output E is low. |
| [37] | Set digital out F low | Any output with SL output F is low. |
| [38] | Set digital out A high | Any output with SL output A is high. |
| [39] | Set digital out B high | Any output with SL output B is high. |
| [40] | Set digital out C high | Any output with SL output C is high. |
| [41] | Set digital out D high | Any output with SL output D is high. |
| [42] | Set digital out E high | Any output with SL output E is high. |
| [43] | Set digital out F high | Any output with SL output F is high. |
| [60] | Reset Counter A | Resets Counter A to zero. |
| [61] | Reset Counter B | Resets Counter B to zero. |
| [70] | Start timer 3 | Start Timer 3, see *parameter 13-20 SL Controller Timer* for further description. |
| [71] | Start timer 4 | Start Timer 4, see *parameter 13-20 SL Controller Timer* for further description. |
| [72] | Start timer 5 | Start Timer 5, see *parameter 13-20 SL Controller Timer* for further description. |
| [73] | Start timer 6 | Start Timer 6, see *parameter 13-20 SL Controller Timer* for further description. |
| [74] | Start timer 7 | Start Timer 7, see *parameter 13-20 SL Controller Timer* for further description. |

3

## 3.15 Parameters: 14-** Special Functions

### 3.15.1 14-0* Inverter Switching

| 14-00 Switching Pattern | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select the switching pattern: 60° AVM or SFAVM. |
| [0] | 60 AVM | |
| [1] * | SFAVM | |

**NOTICE**

**The switching pattern may be automatically adapted by the frequency converter in order to avoid a trip. See application note on derating for more details.**

| 14-01 Switching Frequency | | |
|---|---|---|
| Select the converter switching frequency. Changing the switching frequency reduces acoustic noise from the motor. Default values depend on power size. | | |
| **Option:** | | **Function:** |
| [0] | 1.0 kHz | |
| [1] | 1.5 kHz | Default switching frequency for 355-1200 kW [500-1600 hp], 690 V. |
| [2] | 2.0 kHz | Default switching frequency for 250-800 kW [350-1075 hp], 400 V and 37-315 kW [50-450 hp], 690 V. |
| [3] | 2.5 kHz | |
| [4] | 3.0 kHz | Default switching frequency for 18.5-37 kW [25-50 hp], 200 V and 37-200 kW [50-300 hp], 400 V. |
| [5] | 3.5 kHz | |
| [6] | 4.0 kHz | Default switching frequency for 5.5–15 kW [7.5-20 hp], 200 V and 11-30 kW [15-40], 400 V. |
| [7] | 5.0 kHz | Default switching frequency for 0.25–3.7 kW [0.34-5 hp], 200 V and 0.37-7.5 kW [0.5-10 hp], 400 V. |
| [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 | |

**NOTICE**

**The output frequency value of the frequency converter must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in *parameter 14-01 Switching Frequency* to minimise motor noise.**

**NOTICE**

**To avoid a trip, the frequency converter is able to adapt the switching frequency automatically.**

| 14-03 Overmodulation | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Off | Select *[0] Off* for no overmodulation of the output voltage, to avoid torque ripple on the motor shaft. This feature may be useful for applications such as grinding machines. |
| [1] * | On | Select *[1] On* to enable the overmodulation function for the output voltage. This is the right choice when it is required that the output voltage is higher than 95% of the input voltage (typically when running over-synchronously). The output voltage is increased according to the degree of overmodulation.<br>**NOTICE**<br>**Overmodulation leads to increased torque ripple as harmonics are increased.**<br>Control in Flux mode provides an output current of up to 98% of the input current, regardless of *parameter 14-03 Overmodulation*. |

| 14-04 PWM Random | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Off | No change of the acoustic motor switching noise. |
| [1] | On | Transforms the acoustic motor switching noise from a clear ringing tone to a less noticeable 'white' noise. This is achieved by slightly and randomly altering the synchronism of the pulse width modulated output phases. |

| 14-06 Dead Time Compensation | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | Off | No compensation. |
| [1] * | On | Activates dead time compensation. |

### 3.15.2 14-1* Mains On/Off

Parameters for configuring mains failure monitoring and handling. If a mains failure appears, the frequency converter tries to continue in a controlled way until the power in the DC link has been exhausted.

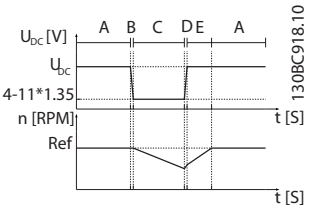
**14-10 Mains Failure**

Options [1], [2], [5], [7] are not active when the option *[2] Torque* is selected in parameter *1-00 Configuration Mode*.

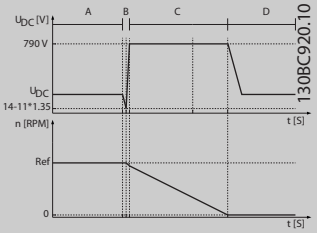
| Option: | | Function: |
|---|---|---|
| | | *Parameter 14-10 Mains Failure* is typically used where very short mains interruptions (voltage dips) are present. At 100% load and a short voltage interruption, the DC voltage on the main capacitors drops quickly. For larger frequency converters, it only takes a few milliseconds before the DC level drops to about 373 V DC, and the IGBTs cut off and loose the control of the motor. When mains is restored, and the IGBTs start again, the output frequency and voltage vector do not correspond to the speed/frequency of the motor, and the result is normally an overvoltage or overcurrent, mostly resulting in a trip lock. *Parameter 14-10 Mains Failure* can be programmed to avoid this situation.<br><br>Select the function according to which the frequency converter must act when the threshold in *parameter 14-11 Mains Voltage at Mains Fault* has been reached.<br><br>***NOTICE***<br><br>***Parameter 14-10 Mains Failure* cannot be changed while motor is running.** |
| [0] * | No function | The frequency converter does not compensate for a mains interruption. The voltage on the DC link drops quickly and motor control is lost within milliseconds to seconds. Trip lock is the result. |
| [1] | Ctrl. ramp-down | Control of the motor remains with the frequency converter, and the frequency converter performs a controlled ramp down from *parameter 14-11 Mains Voltage at Mains Fault* level. If *parameter 2-10 Brake Function* is *[0] Off* or *[2] AC brake*, the ramp follows the overvoltage ramping. If *parameter 2-10 Brake Function* is *[1] Resistor Brake*, the ramp follows the setting in *parameter 3-81 Quick Stop Ramp Time*. This selection is particularly useful in pump applications, where the inertia is low and the friction is high. When mains is restored, the output frequency ramps the motor up to the reference speed (if the mains interruption is prolonged, the controlled ramp down might bring the output frequency all the way down to 0 RPM, and when the mains is restored, the application is ramped up from 0 RPM to the previous reference speed via the normal ramp up). If the energy in the DC link disappears before the motor is ramped to zero, the motor is coasted.<br>**Limitation:** |

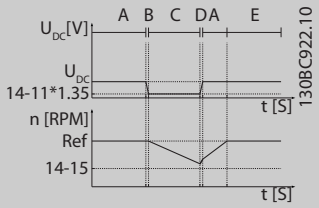
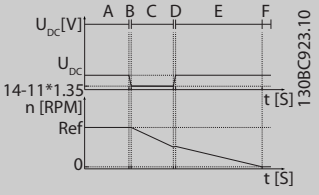
**14-10 Mains Failure**

Options [1], [2], [5], [7] are not active when the option *[2] Torque* is selected in parameter *1-00 Configuration Mode*.

| Option: | | Function: |
|---|---|---|
| | | See the introduction text in *parameter 14-10 Mains Failure*. |
| [2] | Ctrl. ramp-down, trip | This selection is similar to selection [1] except that in [2] a reset is necessary for starting up after power-up.<br>**Limitation:**<br>See the introduction text in *parameter 14-10 Mains Failure*. |
| [3] | Coasting | Centrifuges can run for 1 hour without power supply. In those situations, it is possible to select a coast function at mains interruption, together with a flying start, which occurs when the mains is restored. |
| [4] | Kinetic back-up | Kinetic back-up ensures that the frequency converter keeps running as long as there is energy in the system due to the inertia from motor and load. This is done by converting the mechanical energy to the DC link and thereby maintaining control of the frequency converter and motor. This can extend the controlled operation, depending on the inertia in the system. For fans it is typically several seconds; for pumps up to 2 seconds; and for compressors only for a fraction of a second. Many industry applications can extend controlled operation for many seconds, which is often enough time for the mains to return.<br><br>  <br><br>A Normal operation<br>B Mains failure<br>C Kinetic back-up<br>D Mains return<br>E Normal operation: ramping<br><br>**Illustration 3.54 Kinetick Back-up**<br><br>The DC level during *[4] Kinetic back-up* equals to *parameter 14-11 Mains Voltage at Mains Fault* * 1.35.<br>If the mains do not return, $U_{DC}$ is maintained as long as possible by ramping the speed down towards 0 RPM. Finally, the frequency converter coasts. |

3

| 14-10 Mains Failure | | |
|---|---|---|
| Options [1], [2], [5], [7] are not active when the option *[2] Torque* is selected in parameter *1-00 Configuration Mode*. | | |
| **Option:** | | **Function:** |
| | | If the mains return while in kinetic back-up, $U_{DC}$ increases above *parameter 14-11 Mains Voltage at Mains Fault**1.35. This is detected in one of the following ways.<br>1. If $U_{DC}$ > *parameter 14-11 Mains Voltage at Mains Fault**1.35*1.05.<br>2. If the speed is above the reference. This is relevant if the mains come back at a lower level than before, e.g. *parameter 14-11 Mains Voltage at Mains Fault**1.35*1.02. This does not fulfil the criterion in point 1, and the frequency converter tries to reduce $U_{DC}$ to *parameter 14-11 Mains Voltage at Mains Fault**1.35 by increasing the speed. This will not succeed as the mains cannot be lowered.<br>3. If running mechanically. The same mechanism as in point 2 applies, but the inertia prevents the speed from going above the reference speed. This leads to the motor running mechanically until the speed is above the reference speed and the situation in point 2 occurs. Instead of waiting for that criterion, 3 is introduced. |
| [5] | Kinetic back-up, trip | The difference between kinetic back-up with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains return or not.<br>The function does not detect if mains return. This is the reason for the relatively high level on the DC link during ramp down.<br>  <br><br>A Normal operation<br>B Mains failure<br>C Kinetic back-up<br>D Trip<br>**Illustration 3.55 Kinetic Back-up Trip**<br>**Limitation:** |

| 14-10 Mains Failure | | |
|---|---|---|
| Options [1], [2], [5], [7] are not active when the option *[2] Torque* is selected in parameter *1-00 Configuration Mode*. | | |
| **Option:** | | **Function:** |
| | | See the introduction text in *parameter 14-10 Mains Failure*. |
| [6] | Alarm | |
| [7] | Kin. back-up, trip w recovery | Kinetic back-up with recovery combines the features of kinetic back-up and kinetic back-up with trip. This feature makes it possible to select between kinetic back-up and kinetic back-up with trip, based on a recovery speed, configurable in *parameter 14-15 Kin. Backup Trip Recovery Level* to enable detection of mains returning. If mains do not return, the frequency converter ramps down to 0 RPM and trips. If mains return while in kinetic back-up at a speed above the value in *parameter 14-15 Kin. Backup Trip Recovery Level*, normal operation is resumed. This is equal to *[4] Kinetic Back-up*. The DC level during *[7] Kinetic back-up* is *parameter 14-11 Mains Voltage at Mains Fault** 1.35.<br>  <br><br>A Normal operation<br>B Mains failure<br>C Kinetic back-up<br>D Mains return<br>E Normal operation: ramping<br>**Illustration 3.56 [7] Kinetic Back-Up, Trip with Recovery where mains return above *parameter 14-15 Kin. Backup Trip Recovery Level***<br>If mains return while in kinetic back-up at a speed below *parameter 14-15 Kin. Backup Trip Recovery Level*, the frequency converter ramps down to 0 RPM using the ramp and then trips. If the ramp is slower than the system ramping down on its own, the ramping is done mechanically and $U_{DC}$ is at the normal level ($U_{DC,\ m}$*1.35).<br>  <br> |

### 14-10 Mains Failure

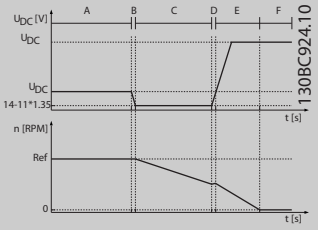
Options [1], [2], [5], [7] are not active when the option *[2] Torque* is selected in parameter *1-00 Configuration Mode*.

**Option:** **Function:**

| | |
|---|---|
| A | Normal operation |
| B | Mains failure |
| C | Kinetic back-up |
| D | Mains return |
| E | Kinetic back-up, ramping to trip |
| F | Trip |

**Illustration 3.57 [7] Kinetic Back-Up, Trip with Recovery, Trip Slow Ramp where Mains Return below *parameter 14-15 Kin. Backup Trip Recovery Level*, in this Illustration a Slow Ramp is Used**

If the ramp is quicker than the system's ramp down on, the ramping generates current. This results in a higher $U_{DC}$ which is limited using the brake chopper/resistor brake.




| | |
|---|---|
| A | Normal operation |
| B | Mains failure |
| C | Kinetic back-up |
| D | Mains return |
| E | Kinetic back-up ramping to trip |
| F | Trip |

**Illustration 3.58 [7] Kinetic Back-Up, Trip with Recovery where Mains Return below *parameter 14-15 Kin. Backup Trip Recovery Level*, in this Illustration a Quick Ramp is Used**

**Limitation:**
See the introduction text in *parameter 14-10 Mains Failure*.

### 14-11 Mains Voltage at Mains Fault

| Range: | | Function: |
|---|---|---|
| Size related* | [180 - 600 V] | This parameter defines the threshold voltage at which the selected function in *14-10 Mains Failure* should be activated. It may be considered to select 90% of the nominal mains as the detection level, depending on the supply quality. For a supply of 380 V, |

### 14-11 Mains Voltage at Mains Fault

| Range: | | Function: |
|---|---|---|
| | | *parameter 14-11 Mains Voltage at Mains Fault* should thus be set to 342 V. This results in a DC detection level of 462 V (*parameter 14-11 Mains Voltage at Mains Fault* * 1.35). |

***NOTICE***

**Converting from VLT 5000 to FC 300: Even though the setting of the mains voltage at mains fault is the same for VLT 5000 and FC 300, the detection level is different. Use the following formula to obtain the same detection level as in VLT 5000: *parameter 14-11 Mains Voltage at Mains Fault* (VLT 5000 level) = Value used in VLT 5000 * 1.35/sqrt(2).**

### 14-12 Function at Mains Imbalance

Operation under severe main imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (e.g. a pump or fan running near full speed).

| Option: | | Function: |
|---|---|---|
| [0] * | Trip | Trips the frequency converter. |
| [1] | Warning | Issues a warning. |
| [2] | Disabled | No action. |

### 14-14 Kin. Backup Time Out

| Range: | | Function: |
|---|---|---|
| 60 s* | [0 - 60 s] | This parameter defines the Kinetic Back-up Timeout in Flux mode when running on low voltage grids. If the supply voltage does not increase above the value defined in *14-11 Mains Voltage at Mains Fault* +5% within the specified time, the frequency converter will then automatically run a controlled ramp-down profile before stopping. |

### 14-15 Kin. Backup Trip Recovery Level

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - 60000.000 ReferenceFeedbackUnit] | This parameter specifies the Kinetic Back-up Trip Recovery Level. The unit is defined in *parameter 0-02 Motor Speed Unit*. |

3

## 3.15.3 14-16 Kin. Backup Gain

| 14-16 Kin. Backup Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100 %* | [0 - 500 %] | Enter the Kinetic Back-up Gain value in percent. |

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

| 14-20 Reset Mode | | |
|---|---|---|
| **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 *[1]-[12] Automatic reset x 1… x20* to perform between 1 and 20 automatic resets after tripping. |
| [2] | Automatic reset x 2 | |
| [3] | Automatic reset x 3 | |
| [4] | Automatic reset x 4 | |
| [5] | Automatic reset x 5 | |
| [6] | Automatic reset x 6 | |
| [7] | Automatic reset x 7 | |
| [8] | Automatic reset x 8 | |
| [9] | Automatic reset x 9 | |
| [10] | Automatic reset x 10 | |
| [11] | Automatic reset x 15 | |
| [12] | Automatic reset x 20 | |
| [13] | Infinite auto reset | Select *[13] Infinite Automatic Reset* for continuous resetting after tripping. |
| [14] | Reset at power-up | |

***NOTICE***

**The motor may start without warning. If the specified number of automatic resets is reached within 10 minutes, the frequency converter enters *[0] Manual reset* mode. After the manual reset is performed, the setting of *14-20 Reset Mode* returns to the original selection. If the number of automatic resets are not reached within 10 minutes, or when a manual reset is performed, the internal automatic reset counter returns to zero.**

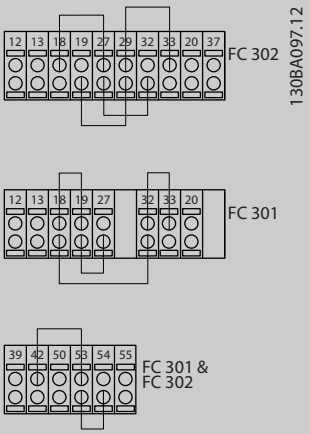
***NOTICE***

**Automatic reset is also active for resetting the Safe Torque Off function in firmware version < 4.3x.**

| 14-21 Automatic Restart Time | | |
|---|---|---|
| **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 *14-20 Reset Mode* is set to *[1] - [13] Automatic reset*. |

| 14-22 Operation Mode | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Use this ameter to specify normal operation; to perform tests; or to initialise all parameters except *parameter 15-03 Power Up's*, *parameter 15-04 Over Temp's* and *parameter 15-05 Over Volt's*. This function is active only when the power is cycled to the frequency converter.<br>Select *[0] Normal operation* for normal operation of the frequency converter with the motor in the selected application.<br>Select *[1] Control card test* to test the analog and digital inputs and outputs and the +10 V control voltage. The test requires a test connector with internal connections. Use the following procedure for the control card test:<br>1. Select *[1] Control card test*.<br>2. Disconnect the mains supply and wait for the light in the display to go out.<br>3. Set switches S201 (A53) and S202 (A54) = 'ON'/I.<br>4. Insert the test plug (see *Illustration 3.59*).<br>5. Connect to mains supply.<br>6. Carry out various tests.<br>7. The results are displayed on the LCP and the frequency converter moves into an infinite loop.<br>8. *Parameter 14-22 Operation Mode* is automatically set to normal operation. Carry out a power cycle to start up in normal operation after a control card test.<br>**If the test is OK**<br>LCP readout: Control card OK.<br>Disconnect the mains supply and remove the test plug. The green LED on the control card lights up.<br>**If the test fails**<br>LCP readout: Control card I/O failure.<br>Replace the frequency converter or Control card. The red LED on the control card is turned on. Test plugs (connect the following terminals to each other): 18 - 27 - 32; 19 - 29 - 33; 42 - 53 - 54 |

**14-22 Operation Mode**

| Option: | | Function: |
|---|---|---|
| | |  **Illustration 3.59 Test Plugs** Select *[2] Initialisation* to reset all parameter values to default settings, except for: *parameter 15-03 Power Up's*, *parameter 15-04 Over Temp's*, and *parameter 15-05 Over Volt's*. The frequency converter resets during the next power-up. *Parameter 14-22 Operation Mode* also returns to the default setting *[0] Normal operation*. |
| [0] * | Normal operation | |
| [1] | Control card test | Remember to set switches S201 (A53) and S202 (A54) as specified in the parameter description when performing a control card test. Otherwise, the test fails. |
| [2] | Initiali-sation | |
| [3] | Boot mode | |

**14-23 Typecode Setting**

| Option: | | Function: |
|---|---|---|
| [256] | Dummy_dd00113806 | For use by service technicians only. |

**14-24 Trip Delay at Current Limit**

| Range: | | Function: |
|---|---|---|
| 60 s* | [0 - 60 s] | Enter the current limit trip delay in seconds. When the output current reaches the current limit (*parameter 4-18 Current Limit*), a warning is triggered. When the current limit warning has been continuously present for the period specified in this parameter, the frequency converter trips. To run continuously in current limit without tripping, set the parameter to 60 s = Off. Thermal monitoring of the frequency converter still remains active. |

**14-25 Trip Delay at Torque Limit**

| Range: | | Function: |
|---|---|---|
| 60 s* | [0 - 60 s] | Enter the torque limit trip delay in seconds. When the output torque reaches the torque limits (*parameter 4-16 Torque Limit Motor Mode* and *parameter 4-17 Torque Limit Generator Mode*), a warning is triggered. When the torque limit warning has been continuously present for the period specified in this parameter, the frequency converter trips. Disable the trip delay by setting the parameter to 60 s = Off. Thermal monitoring of the frequency converter still remains active. |

**14-26 Trip Delay at Inverter Fault**

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0 - 35 s] | When the frequency converter detects an overvoltage in the set time, trip is effected after the set time. If value = 0, *protection mode* is disabled. ***NOTICE*** **It is recommended to disable *protection mode* in hoisting applications.** |

**14-28 Production Settings**

| Range: | | Function: |
|---|---|---|
| 0* | [No action] | |
| 1 | [Service reset] | |
| [2] | Set Production Mode | |

**14-29 Service Code**

| Range: | | Function: |
|---|---|---|
| 0* | [-2147483647 - 2147483647] | For internal service only. |

## 3.15.4 14-3* 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 4-16 Torque Limit Motor Mode* and *parameter 4-17 Torque Limit Generator Mode*.
When the current limit is reached during motor operation or regenerative operation, the 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 signals on terminals 18 to 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 ramp-down time, since the frequency converter is coasted. If a quick stop is necessary, use the mechanical brake control

function along with an external electro-mechanical brake attached to the application.

| 14-30 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. |

| 14-31 Current Lim Ctrl, Integration Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [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. |

| 14-32 Current Lim Ctrl, Filter Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [1 - 100 ms] | Controls the current limit control low-pass filter.<br>This makes it possible to react to peak values or to average values. When selecting average values, it is sometimes possible to run with higher output current and instead trip on the hardware limit for current. However, the control reacts slower as it does not react on immediate values. |

| 14-35 Stall Protection | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | *Parameter 14-35 Stall Protection* is active in Flux mode only. |
| [0] | Disabled | Disables stall protection in fieldweakening Flux mode and might cause the motor to be lost. |
| [1] * | Enabled | Enables stall protection in fieldweakening Flux mode. |

| 14-36 Fieldweakening Function | | |
|---|---|---|
| Select the fieldweakening function mode in Flux mode. | | |
| **Range:** | | **Function:** |
| 0* | [Auto] | In this mode, the frequency converter calculates the optimal torque output.<br>Measured DC link voltage determines the phase-to-phase motor voltage. Magnetising reference is based on the actual voltage and utilises the information about the model of the motor. |
| 1 | [1/x] | The frequency converter reduces torque output. The frequency converter sets the magnetising reference inversely proportional to the speed using a static curve that represents the relationship between DC link voltage and the speed. |

## 3.15.5 14-4* Energy Optimising

Parameters for adjusting the energy optimisation level in both Variable Torque (VT) and Automatic Energy Optimisation (AEO) mode in *parameter 1-03 Torque Characteristics*.

| 14-40 VT Level | | |
|---|---|---|
| **Range:** | | **Function:** |
| 66 %* | [40 - 90 %] | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Enter the level of motor magnetisation at low speed. Selection of a low value reduces energy loss in the motor, but also reduces load capability. |

***NOTICE***

**This parameter is not active when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**

| 14-41 AEO Minimum Magnetisation | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [40 - 75 %] | Enter the minimum allowable magnetisation for AEO. Selection of a low value reduces energy loss in the motor, but can also reduce resistance to sudden load changes. |

***NOTICE***

**This parameter is not active when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**

| 14-42 Minimum AEO Frequency | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 Hz* | [5 - 40 Hz] | Enter the minimum frequency at which the Automatic Energy Optimisation (AEO) is to be active. |

***NOTICE***

**This parameter is not active when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**

| 14-43 Motor Cosphi | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.40 - 0.95] | The Cos(phi) setpoint is automatically set for optimum AEO performance. This parameter should normally not be altered. However, in some situations it may be necessary to enter a new value to fine-tune. |

## 3.15.6 14-5* Environment

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

**14-50 RFI Filter**

This parameter is available for FC 302 only. It is not relevant to FC 301 due to different design and shorter motor cables.

| Option: | | Function: |
|---|---|---|
| [0] | Off | Select *[0] Off* if the frequency converter is fed by an isolated mains source (IT mains).<br>If a filter is used, select *[0] Off* during charging to prevent a high leakage current making the RCD switch.<br>In this mode, the internal RFI filter capacitors between chassis 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. |

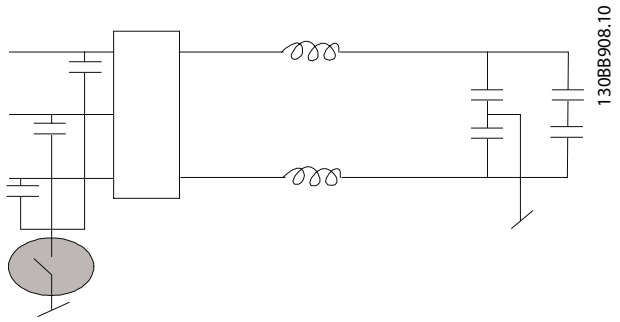



**Illustration 3.60 RFI Filter**

**14-51 DC Link Compensation**

| Option: | | Function: |
|---|---|---|
| | | The rectified AC-DC voltage at 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 at DC link. In general, DC link compensation is recommended for most applications, but care must be taken when operating in fieldweakening as it can generate speed oscillations at the motor shaft. In fieldweakening, it is recommended to turn DC link compensation off. |
| [0] | Off | Disables DC link compensation. |
| [1] | On | Enables DC link compensation. |

**14-52 Fan Control**

Select minimum speed of the main fan.

| Option: | | Function: |
|---|---|---|
| [0] * | Auto | Select *[0] Auto* to run fan only when internal temperature in frequency converter is in range 35 °C to approx. 55 °C.<br>Fan runs at low speed below 35 °C, and at full speed at approx. 55 °C. |
| [1] | On 50% | The fan always runs at 50% speed or above. The fan runs at 50% speed at 35 °C, and at full speed at approx. 55 °C. |
| [2] | On 75% | The fan always runs at 75% speed or above. The fan runs at 75% speed at 35 °C, and at full speed at approx. 55 °C. |
| [3] | On 100% | The fan runs at 100% speed always. |
| [4] | Auto (Low temp env.) | This selection is the same as *[0] Auto*, but with special considerations around and below 0°C. In selection *[0] Auto* there is a risk that the fan starts running around 0 °C as the frequency converter detects a sensor fault and thus protect the frequency converter while reporting warning 66 "Heat sink Temperature Low". Selection *[4] Auto (Low temp env.)* can be used in very cold environments and prevent the negative effects of this further cooling and avoid warning 66. |

**14-53 Fan Monitor**

| Option: | | Function: |
|---|---|---|
| | | Select which reaction the frequency converter should take in case a fan fault is detected. |
| [0] | Disabled | |
| [1] * | Warning | |
| [2] | Trip | |

**14-55 Output Filter**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while motor is running.**<br><br>Select the type of output filter connected. |
| [0] * | No Filter | This is the default setting and should be used with dU/dt filters or high-frequency common-mode (HF-CM) filters. |
| [1] | Sine-Wave Filter | This setting is only for backwards compatibility. It enables operation with Flux control principle when *parameter 14-56 Capacitance Output Filter* and *parameter 14-57 Inductance Output Filter* are programmed with the output filter capacitance and inductance. It DOES NOT limit the range of the switching frequency. |

3

| 14-55 Output Filter | | |
|---|---|---|
| **Option:** | | **Function:** |
| [2] | Sine-Wave Filter Fixed | This parameter sets a minimum allowed limit to the switching frequency and ensures that the filter is operated within the safe range of switching frequencies. Operation is possible with all control principles. For Flux control principle *parameter 14-56 Capacitance Output Filter* and *parameter 14-57 Inductance Output Filter* have to be programmed (these parameters have no effect in VVC$^{plus}$ and U/f). The modulation pattern is set to SFAVM, which gives the lowest acoustic noise in the filter.<br>***NOTICE***<br>**Reset the frequency converter after selecting *[2] Sine-Wave Filter Fixed*.**<br>**⚠CAUTION**<br>**Always set *parameter 14-55 Output Filter* to *[2] Sine-wave fixed* when using a sine-wave filter. Failure to do so can result in overheating of the frequency converter, which can result in personal injury and equipment damage.** |

| 14-56 Capacitance Output Filter | | |
|---|---|---|
| Compensation function of the LC filter requires the per phase equivalent star-connected capacitance of the filter (3 times the capacity between 2 phases when capacitance is 'Delta' connection). | | |
| **Range:** | | **Function:** |
| Size related* | [0.1 - 6500 uF] | Set the capacitance of the output filter. The value can be found on the filter label.<br>***NOTICE***<br>**This is required for correct compensation in Flux mode (*parameter 1-01 Motor Control Principle*).** |

| 14-57 Inductance Output Filter | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.001 - 65 mH] | Set the inductance of the output filter. The value can be found on the filter label.<br>***NOTICE***<br>**This is required for correct compensation in Flux mode (*parameter 1-01 Motor Control Principle*).** |

| 14-59 Actual Number of Inverter Units | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 1 - 1] | Set the actual number of power units. |

## 3.15.7 14-7* Compatibility

The parameters in this group are for setting of compatibility for VLT 3000, VLT 5000 to FC 300.

| 14-72 VLT Alarm Word | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | 0 - 4294967295 | Read out the alarm word corresponding to VLT 5000. |

| 14-73 VLT Warning Word | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | 0 - 4294967295 | Read out the warning word corresponding to VLT 5000. |

| 14-74 Leg. Ext. Status Word | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295] | Read out the ext. status word corresponding to VLT 5000. |

## 3.15.8 14-8* Options

| 14-80 Option Supplied by External 24VDC | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] | No | Select *[0] No* to use the frequency converter's 24 V DC supply. |
| [1] * | Yes | Select *[1] Yes* if an external 24 V DC supply is used to power the option. Inputs/outputs are galvanically isolated from the frequency converter when operated from an external supply. |

***NOTICE***

**This parameter is only changing function by performing a power cycle.**

| 14-88 Option Data Storage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | This parameter stores information about options over a power cycle. |

| 14-89 Option Detection | | |
|---|---|---|
| Selects the behaviour of the frequency converter when a change in the option configuration is detected. | | |
| **Option:** | | **Function:** |
| [0] * | Protect Option Config. | Freezes the current settings and prevents unwanted changes when missing or defective options are detected. |

### 14-89 Option Detection

Selects the behaviour of the frequency converter when a change in the option configuration is detected.

| Option: | | Function: |
|---|---|---|
| [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. |

### 14-90 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. |

### 14-90 Fault Level

Use this parameter to customise fault levels.

| Option: | | Function: |
|---|---|---|
| [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 |
|---|---|---|---|---|---|
| 10 V low | 1 | X | D | | |
| 24 V low | 47 | X | | | D |
| 1.8 V supply low | 48 | X | | | D |
| Voltage limit | 64 | X | D | | |
| Earth fault during ramping | 14 | | | D | X |
| Earth fault 2 during cont. operation | 45 | | | D | X |
| Torque limit | 12 | X | D | | |
| Over current | 13 | | | X | D |
| Short circuit | 16 | | | X | D |
| Heatsink temperature | 29 | | | X | D |
| Heatsink sensor | 39 | | | X | D |
| Control card temperature | 65 | | | X | D |
| Power card temperature | 69 | | 2) | X | D |
| Heat sink temperature 1) | 244 | | | X | D |
| Heat sink sensor 1) | 245 | | | X | D |
| Power card temperature 1) | 247 | | | | |
| Motor phase missing | 30-32 | | | X | D |
| Locked rotor | 99 | | | X | D |

**Table 3.24 Selection of Choice of Action when Selected Alarm Appears**

*D = Default setting.*

*x = Possible selection.*

*1) Only high power drives.*

*2) In small and medium power frequency converters, A69 is only a warning.*

3

## 3.16 Parameters: 15-** Drive Information

### 3.16.1 15-0* Operating Data

| 15-00 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. |

| 15-01 Running Hours | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 h* | [0 - 2147483647 h] | View how many hours the motor has run. Reset the counter in *15-07 Reset Running Hours Counter*. The value is saved when the frequency converter is turned off. |

| 15-02 kWh Counter | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 kWh* | [0 - 2147483647 kWh] | Registering the power consumption of the motor as a mean value over 1 hour. Reset the counter in *parameter 15-06 Reset kWh Counter*. |

| 15-03 Power Up's | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 2147483647 ] | View the number of times the frequency converter has been powered up. |

| 15-04 Over Temp's | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535 ] | View the number of frequency converter temperature faults, which have occurred. |

| 15-05 Over Volt's | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535 ] | View the number of frequency converter overvoltages, which have occurred. |

| 15-06 Reset kWh Counter | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Do not reset | No reset of the kWh counter is desired. |
| [1] | Reset counter | Press [OK] to reset the kWh counter to zero (see *parameter 15-02 kWh Counter*). |

***NOTICE***

**The reset is carried out by pressing [OK].**

| 15-07 Reset Running Hours Counter | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Do not reset | |

| 15-07 Reset Running Hours Counter | | |
|---|---|---|
| **Option:** | | **Function:** |
| [1] | Reset counter | Select *[1] Reset* and press [OK] to reset the running hours counter to zero (see *parameter 15-01 Running Hours*). This parameter cannot be selected via the serial port, RS485.<br>Select *[0] Do not reset* if no reset of the running hours counter is desired. |

### 3.16.2 15-1* Data Log Settings

The data log enables continuous logging of up to 4 data sources (*15-10 Logging Source*) at individual rates (*parameter 15-11 Logging Interval*). A trigger event (*15-12 Trigger Event*) and window (*15-14 Samples Before Trigger*) are used to start and stop the logging conditionally.

| 15-10 Logging Source | | |
|---|---|---|
| Array [4] | | |
| **Option:** | | **Function:** |
| | | Select which variables are to be logged. |
| [0] * | None | |
| [15] | Readout: actual setup | |
| [1472] | Legacy Alarm Word | |
| [1473] | Legacy Warning Word | |
| [1474] | Leg. Ext. Status Word | |
| [1600] | Control Word | |
| [1601] | Reference [Unit] | |
| [1602] | Reference % | |
| [1603] | Status Word | |
| [1606] | Absolute Position | |
| [1610] | Power [kW] | |
| [1611] | Power [hp] | |
| [1612] | Motor Voltage | |
| [1613] | Frequency | |
| [1614] | Motor current | |
| [1616] | Torque [Nm] | |
| [1617] | Speed [RPM] | |
| [1618] | Motor Thermal | |
| [1620] | Motor Angle | |
| [1621] | Torque [%] High Res. | |
| [1622] | Torque [%] | |
| [1624] | Calibrated Stator Resistance | |
| [1625] | Torque [Nm] High | |
| [1630] | DC Link Voltage | |
| [1632] | Brake Energy /s | |
| [1633] | Brake Energy Average | |
| [1634] | Heatsink Temp. | |
| [1635] | Inverter Thermal | |
| [1648] | Speed Ref. After Ramp [RPM] | |
| [1650] | External Reference | |

**15-10 Logging Source**

Array [4]

| Option: | | Function: |
|---|---|---|
| [1651] | Pulse Reference | |
| [1652] | Feedback[Unit] | |
| [1657] | Feedback [RPM] | |
| [1660] | Digital Input | |
| [1662] | Analog Input 53 | |
| [1664] | Analog Input 54 | |
| [1665] | Analog Output 42 [mA] | |
| [1666] | Digital Output [bin] | |
| [1675] | Analog In X30/11 | |
| [1676] | Analog In X30/12 | |
| [1677] | Analog Out X30/8 [mA] | |
| [1689] | Configurable Alarm/Warning Word | |
| [1690] | Alarm Word | |
| [1692] | Warning Word | |
| [1694] | Ext. Status Word | |
| [1860] | Digital Input 2 | |
| [3110] | Bypass Status Word | |
| [3470] | MCO Alarm Word 1 | |
| [3471] | MCO Alarm Word 2 | |

**15-11 Logging Interval**

Array [4]

| Range: | | Function: |
|---|---|---|
| Size related* | [ 0.000 - 0.000 ] | Enter the interval in ms between each sampling of the variables to be logged. |

**15-12 Trigger Event**

Select 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 15-14 Samples Before Trigger*).

| 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] | Mains out of range | |

**15-12 Trigger Event**

Select 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 15-14 Samples Before Trigger*).

| Option: | | Function: |
|---|---|---|
| [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 | |

**15-13 Logging Mode**

| Option: | | Function: |
|---|---|---|
| [0] * | Log always | Select *[0] Log always* for continuous logging. |
| [1] | Log once on trigger | Select *[1] Log once on trigger* to conditionally start and stop logging using *15-12 Trigger Event* and *15-14 Samples Before Trigger*. |

**15-14 Samples Before Trigger**

| Range: | | Function: |
|---|---|---|
| 50* | [0 - 100] | Before a trigger event, enter the percentage of all samples which are to be retained in the log. See also *parameter 15-12 Trigger Event* and *parameter 15-13 Logging Mode*. |

## 3.16.3 15-2* Historic Log

View up to 50 logged data items via the array parameters in this parameter group. For all parameters in the group, [0] is the most recent data, and [49] is the oldest data. Data is logged every time an *event* occurs (not to be confused with SLC events). *Events* in this context are defined as a change in one of the following areas:

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1. Digital input
2. Digital outputs (not monitored in this SW release)
3. Warning word
4. Alarm word
5. Status word
6. Control word
7. 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.

**15-20 Historic Log: Event**

Array [50]

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 255 ] | View the event type of the logged events. |

**15-21 Historic Log: Value**

Array [50]

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 2147483647 ] | View the value of the logged event. Interpret the event values according to this table: |

| | |
|---|---|
| Digtal input | Decimal value. See *parameter 16-60 Digital Input* for description after converting to binary value. |
| Digital output (not monitored in this SW release) | Decimal value. See *parameter 16-66 Digital Output [bin]* for description after converting to binary value. |
| Warning word | Decimal value. See *16-92 Warning Word* for description. |
| Alarm word | Decimal value. See *16-90 Alarm Word* for description. |
| Status word | Decimal value. See *parameter 16-03 Status Word* for description after converting to binary value. |

**15-21 Historic Log: Value**

Array [50]

| Range: | | Function: |
|---|---|---|
| | | Control word: Decimal value. See *parameter 16-00 Control Word* for description. |
| | | Extended status word: Decimal value. See *parameter 16-94 Ext. Status Word* for description. |

**15-22 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 max. value corresponds to approx. 24 days, which means that the count restarts at zero after this time period. |

## 3.16.4 15-3* 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. Error codes, values, and time stamp can be viewed for all logged data.

**15-30 Fault Log: Error Code**

Array [10]

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 255] | View the fault code and look up its meaning in *chapter 5 Troubleshooting*. |

**15-31 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*. |

**15-32 Alarm Log: Time**

Array [10]

| Range: | | Function: |
|---|---|---|
| 0 s* | [0 - 2147483647 s] | View the time when the logged event occurred. Time is measured in seconds from frequency converter start-up. |

## 3.16.5 15-4* Drive Identification

Parameters containing read-only information about the hardware and software configuration of the frequency converter.

  

| 15-40 FC Type | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 6] | View the frequency converter type. The readout is identical to the FC 300 Series power field of the type code definition, characters 1-6. |

| 15-41 Power Section | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 20] | View the FC type. The readout is identical to the FC 300 Series power field of the type code definition, characters 7-10. |

| 15-42 Voltage | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 20] | View the FC type. The readout is identical to the FC 300 Series power field of the type code definition, characters 11-12. |

| 15-43 Software Version | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 5 ] | View the combined SW version (or 'package version') consisting of power SW and control SW. |

| 15-44 Ordered Typecode String | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 40 ] | View the type code string used for re-ordering the frequency converter in its original configuration. |

| 15-45 Actual Typecode String | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 40 ] | View the actual type code string. |

| 15-46 Frequency Converter Ordering No | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 8 ] | View the 8-digit ordering number used for re-ordering the frequency converter in its original configuration. |

| 15-47 Power Card Ordering No | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 8 ] | View the power card ordering number. |

| 15-48 LCP Id No | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 20 ] | View the LCP ID number. |

| 15-49 SW ID Control Card | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 20 ] | View the control card software version number. |

| 15-50 SW ID Power Card | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 20 ] | View the power card software version number. |

| 15-51 Frequency Converter Serial Number | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 10 ] | View the frequency converter serial number. |

| 15-53 Power Card Serial Number | | |
|---|---|---|
| **Range:** | **Function:** | |
| 0* | [0 - 19 ] | View the power card serial number. |

| 15-58 Smart Setup Filename | | |
|---|---|---|
| **Range:** | **Function:** | |
| Size related* | [0 - 20] | Shows the currently used smart application set-up filename. |

| 15-59 CSIV Filename | | |
|---|---|---|
| **Range:** | **Function:** | |
| Size related* | [0 - 16] | Shows the currently used CSIV (Costumer Specific Initial Values) filename. |

## 3.16.6 15-6* Option Ident.

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A, B, C0 and C1.

| 15-60 Option Mounted | | |
|---|---|---|
| Array [8] | | |
| **Range:** | **Function:** | |
| 0* | [0 - 30 ] | View the installed option type. |

| 15-61 Option SW Version | | |
|---|---|---|
| Array [8] | | |
| **Range:** | **Function:** | |
| 0* | [0 - 20 ] | View the installed option software version. |

| 15-62 Option Ordering No | | |
|---|---|---|
| Array [8] | | |
| **Range:** | **Function:** | |
| 0* | [0 - 8 ] | Shows the ordering number for the installed options. |

| 15-63 Option Serial No | | |
|---|---|---|
| Array [8] | | |
| **Range:** | **Function:** | |
| 0* | [0 - 18 ] | View the installed option serial number. |

| 15-70 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'. |

3

| 15-71 Slot A Option SW Version | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 20] | View the software version for the option installed in slot A. |

| 15-72 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'. |

| 15-73 Slot B Option SW Version | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 20] | View the software version for the option installed in slot B. |

| 15-74 Option in Slot C0/E0 | | |
|---|---|---|
| **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'. |

| 15-75 Slot C0/E0 Option SW Version | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 20] | View the software version for the option installed in slot C. |

| 15-76 Option in Slot C1/E1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 30] | Displays the type code string for the option in slot C1 (CXXXX if no option) and the translation i.e. >No option<. |

| 15-77 Slot C1/E1 Option SW Version | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 20] | Displays the software version for the installed option in option slot C. |

| 15-80 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. |

| 15-81 Preset Fan Running Hours | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 h* | [0 - 99999 h] | Enter value to preset the fan running hours counter, see *parameter 15-80 Fan Running Hours*. This parameter cannot be selected via the serial port, RS-485. |

| 15-89 Configuration Change Counter | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | ***NOTICE*** **This parameter cannot be adjusted while the motor is running.** |

## 3.16.7 15-9* Parameter Info

| 15-92 Defined Parameters | | |
|---|---|---|
| Array [1000] | | |
| **Range:** | | **Function:** |
| 0* | [0 - 9999 ] | View a list of all defined parameters in the frequency converter. The list ends with 0. |

| 15-93 Modified Parameters | | |
|---|---|---|
| Array [1000] | | |
| **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. |

| 15-98 Drive Identification | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 40] | This parameter contains data that is used by the MCT 10 Set-up Software. |

| 15-99 Parameter Metadata | | |
|---|---|---|
| Array [30] | | |
| **Range:** | | **Function:** |
| 0* | [0 - 9999] | This parameter contains data used by the MCT 10 Set-up Software. |

## 3.17 Parameters: 16-** Data Read-outs

### 3.17.1 16-0* General Status

**16-00 Control Word**

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 65535 ] | View the Control word sent from the frequency converter via the serial communication port in hex code. |

**16-01 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 *1-00 Configuration Mode* (Hz, Nm, or RPM). |

**16-02 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. |

**16-03 Status Word**

| Range: | | Function: |
|---|---|---|
| 0* | [0 - 65535 ] | View the status word sent from the frequency converter via the serial communication port in hex code. |

**16-05 Main Actual Value [%]**

| Range: | | Function: |
|---|---|---|
| 0 %* | [-100 - 100 %] | View the 2-byte word sent with the status word to the Bus Master reporting the main actual value. |

**16-06 Absolute Position**

| Range: | | Function: |
|---|---|---|
| 0 CustomReadoutUnit2* | [-2000000000 - 2000000000 CustomReadoutUnit2] | This parameter shows the absolute position. For information about configuring the readouts, see *chapter 3.18.5 17-7* Absolute Position*. |

**16-09 Custom Readout**

| Range: | | Function: |
|---|---|---|
| 0 CustomReadoutUnit* | [0 - 0 CustomReadoutUnit] | View the value of custom readout from *parameter 0-30 Unit for User-defined Readout* to *parameter 0-32 Custom Readout Max Value* |

**16-09 Custom Readout**

| Range: | | Function: |
|---|---|---|
| | | *defined Readout* to *parameter 0-32 Custom Readout Max Value* |

### 3.17.2 16-1* Motor Status

**16-10 Power [kW]**

| Range: | | Function: |
|---|---|---|
| 0 kW* | [0 - 10000 kW] | Displays motor power in kW. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approx. 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. |

**16-11 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 30 ms may pass from when an input value changes to when the data readout values change. |

**16-12 Motor Voltage**

| Range: | | Function: |
|---|---|---|
| 0 V* | [0 - 6000 V] | View the motor voltage, a calculated value used for controlling the motor. |

**16-13 Frequency**

| Range: | | Function: |
|---|---|---|
| 0 Hz* | [0 - 6500 Hz] | View the motor frequency, without resonance dampening. |

**16-14 Motor current**

| Range: | | Function: |
|---|---|---|
| 0 A* | [0 - 10000 A] | View the motor current measured as a mean value, $I_{RMS}$. The value is filtered, and thus approximately 1.3 s may pass from when an input value changes to when the data readout values change. |

**16-15 Frequency [%]**

| Range: | | Function: |
|---|---|---|
| 0 %* | [-100 - 100 %] | View a 2-byte word reporting the actual motor frequency (without resonance dampening) as a percentage (scale 0000-4000 Hex) of *parameter 4-19 Max Output Frequency*. Set *9-16 PCD Read Configuration* index 1 to send it with the status word instead of the MAV. |

3

| 16-16 Torque [Nm] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 Nm* | [-3000 - 3000 Nm] | View the torque value with sign, applied to the motor shaft. Linearity is not exact between 160% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Consequently, the min. value and the max. value depend on the max. motor current as well as the motor used. The value is filtered, and thus approx. 30 ms may pass from when an input changes value to when the data readout values change. |

| 16-17 Speed [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 RPM* | [-30000 - 30000 RPM] | View the actual motor RPM. In open loop or closed loop process control, the motor RPM is estimated. In speed closed loop modes, the motor RPM is measured. |

| 16-18 Motor Thermal | | |
|---|---|---|
| **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 ETR function selected in *1-90 Motor Thermal Protection*. |

| 16-19 KTY sensor temperature | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 °C* | [0 - 0 °C] | Returning the actual temperature on KTY sensor built into the motor. See parameter group *1-9* Motor Temperature*. |

| 16-20 Motor Angle | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | View the current encoder/resolver angle offset relative to the index position. The value range of 0-65535 corresponds to 0-2*pi (radian). |

| 16-21 Torque [%] High Res. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | The value shown is the torque in percent of nominal torque, with sign and 0.1% resolution, applied to the motor shaft. |

| 16-22 Torque [%] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | Value shown is the torque in percent of nominal torque, with sign, applied to the motor shaft. |

| 16-23 Motor Shaft Power [kW] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 kW* | [0 - 10000 kW] | Readout of the mechanical power applied to the motor shaft. |

| 16-24 Calibrated Stator Resistance | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.0000 Ohm* | [0.0000 - 100.0000 Ohm] | Displays the Calibrated Stator Resistance. |

| 16-25 Torque [Nm] High | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 Nm* | [-200000000 - 200000000 Nm] | View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. Consequently, the min. value and the max. value depend on the max. motor current as well as the motor used. This specific readout has been adapted to be able to show higher values than the standard readout in *parameter 16-16 Torque [Nm]*. |

## 3.17.3 16-3* Drive Status

| 16-30 DC Link Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 V* | [0 - 10000 V] | View a measured value. The value is filtered with a 30 ms time constant. |

| 16-32 Brake Energy /s | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 kW* | [0 - 10000 kW] | View the brake power transmitted to an external brake resistor, stated as an instantaneous value. |

| 16-33 Brake Energy /2 min | | |
|---|---|---|
| **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 2-13 Brake Power Monitoring*. |

| 16-34 Heatsink Temp. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 °C* | [0 - 255 °C] | View the frequency converter heat sink temperature. The cut-out limit is 90 ±5 °C, and the motor cuts back in at 60 ±5 °C. |

| 16-35 Inverter Thermal | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | View the percentage load on the inverter. |

| 16-36 Inv. Nom. Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 10000 A] | View the inverter nominal current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor protection, etc. |

| 16-37 Inv. Max. Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.01 - 10000 A] | View the inverter maximum current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor protection, etc. |

| 16-38 SL Controller State | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 100] | View the state of the event under execution by the SL controller. |

| 16-39 Control Card Temp. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 °C* | [0 - 100 °C] | View the temperature on the control card, stated in °C |

| 16-40 Logging Buffer Full | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | View whether the logging buffer is full (see parameter group *15-1* Data Log Settings*). The logging buffer is never full when setting *parameter 15-13 Logging Mode* to *[0] Log always*. |
| [0] * | No | |
| [1] | Yes | |

| 16-41 Logging Buffer Full | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 50 ] | |

| 16-45 Motor Phase U Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 A* | [0 - 10000 A] | Displays the Motor Phase $U_{RMS}$ current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings. |

| 16-46 Motor Phase V Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 A* | [0 - 10000 A] | Displays the Motor Phase $V_{RMS}$ current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings. |

| 16-47 Motor Phase W Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 A* | [0 - 10000 A] | Displays the Motor Phase $W_{RMS}$ current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in motor windings. |

| 16-48 Speed Ref. After Ramp [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 RPM* | [-30000 - 30000 RPM] | This parameter specifies the reference given to the frequency converter after the speed ramp. |

| 16-49 Current Fault Source | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 8] | Value indicates source of current faults including short circuit, overcurrent, and phase imbalance (from left):<br>1-4 Inverter<br>5-8 Rectifier<br>0 No fault recorded |

## 3.17.4 16-5* Ref. & Feedb.

| 16-50 External Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-200 - 200] | View the total reference, the sum of digital, analog, preset, bus and freeze references, plus catch-up and slow-down. |

| 16-51 Pulse Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-200 - 200] | View the reference value from programmed digital input(s). The readout can also reflect the impulses from an incremental encoder. |

| 16-52 Feedback[Unit] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 Reference-FeedbackUnit* | [-999999.999 - 999999.999 ReferenceFeed-backUnit] | View the feedback unit resulting from the selection of unit and scaling in *parameter 3-00 Reference Range*, *parameter 3-01 Reference/ Feedback Unit*, *parameter 3-02 Minimum Reference*, and *parameter 3-03 Maximum Reference*. |

| 16-53 Digi Pot Reference | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-200 - 200] | View the contribution of the Digital Potenti-ometer to the actual reference. |

3

| 16-57 Feedback [RPM] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 RPM* | [-30000 - 30000 RPM] | Readout parameter where the actual motor RPM from the feedback source can be read in both closed loop and open loop. The feedback source is selected by *parameter 7-00 Speed PID Feedback Source*. |

## 3.17.5 16-6* Inputs and Outputs

| 16-60 Digital Input | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 1023 ] | View the signal states from the active digital inputs. Example: Input 18 corresponds to bit no. 5, 0=no signal, 1=connected signal. Bit 6 works in the opposite way, on=0, off=1 (safe stop input). |

| | |
|---|---|
| Bit 0 | Digital input term. 33 |
| Bit 1 | Digital input term. 32 |
| Bit 2 | Digital input term. 29 |
| Bit 3 | Digital input term. 27 |
| Bit 4 | Digital input term. 19 |
| Bit 5 | Digital input term. 18 |
| Bit 6 | Digital input term. 37 |
| Bit 7 | Digital input GP I/O term. X30/4 |
| Bit 8 | Digital input GP I/O term. X30/3 |
| Bit 9 | Digital input GP I/O term. X30/2 |
| Bit 10-63 | Reserved for future terminals |

**Table 3.25 Active Digital Inputs**

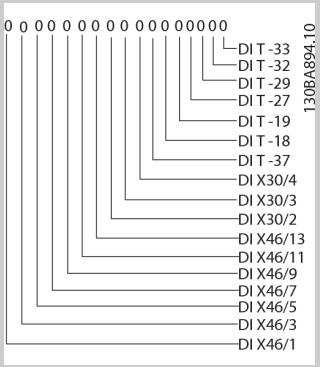


**Illustration 3.61 Relay Settings**

| 16-61 Terminal 53 Switch Setting | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | View the setting of input terminal 53. |
| [0] * | Current | |
| [1] | Voltage | |

| 16-62 Analog Input 53 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-20 - 20] | View the actual value at input 53. |

| 16-63 Terminal 54 Switch Setting | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | View the setting of input terminal 54. |
| [0] * | Current | |
| [1] | Voltage | |

| 16-64 Analog Input 54 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-20 - 20] | View the actual value at input 54. |

| 16-65 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 6-50 Terminal 42 Output*. |

| 16-66 Digital Output [bin] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 15] | View the binary value of all digital outputs. |

| 16-67 Pulse Input #29 [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 130000 ] | View the actual frequency rate on terminal 29. |

| 16-68 Freq. Input #33 [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 130000] | View the actual value of the frequency applied at terminal 33 as an impulse input. |

| 16-69 Pulse Output #27 [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 40000] | View the actual value of pulses applied to terminal 27 in digital output mode. |

| 16-70 Pulse Output #29 [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 40000] | View the actual value of pulses at terminal 29 in digital output mode. This parameter is available for FC 302 only. |

| 16-71 Relay Output [bin] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 511 ] | View the settings of all relays. |

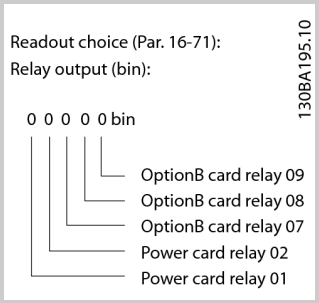


**Illustration 3.63 Relay Settings**

| 16-72 Counter A | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-2147483648 - 2147483647] | View the present value of Counter A. Counters are useful as comparator operands, see *parameter 13-10 Comparator Operand*. The value can be reset or changed either via digital inputs (parameter group *5-1* Digital Inputs*) or by using an SLC action (*parameter 13-52 SL Controller Action*). |

| 16-73 Counter B | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-2147483648 - 2147483647] | View the present value of Counter B. Counters are useful as comparator operands (*parameter 13-10 Comparator Operand*). The value can be reset or changed either via digital inputs (parameter group *5-1* Digital Inputs*) or by using an SLC action (*parameter 13-52 SL Controller Action*). |

| 16-74 Prec. Stop Counter | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 2147483647] | Returns the actual counter value of precise counter (*parameter 1-84 Precise Stop Counter Value*). |

| 16-75 Analog In X30/11 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-20 - 20 ] | View the actual value at input X30/11 of MCB 101. |

| 16-76 Analog In X30/12 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-20 - 20 ] | View the actual value at input X30/12 of MCB 101. |

| 16-77 Analog Out X30/8 [mA] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 30 ] | View the actual value at input X30/8 in mA. |

| 16-78 Analog Out X45/1 [mA] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 30] | View the actual value at output X45/1. The value shown reflects the selection in *6-70 Terminal X45/1 Output*. |

| 16-79 Analog Out X45/3 [mA] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 30] | View the actual value at output X45/3. The value shown reflects the selection in *6-80 Terminal X45/3 Output*. |

## 3.17.6 16-8* Fieldbus & FC Port

Parameters for reporting the bus references and control words.

| 16-80 Fieldbus CTW 1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535 ] | View the 2-byte control word (CTW) received from the bus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in *8-10 Control Profile*. For more information, refer to the relevant fieldbus manual. |

| 16-82 Fieldbus REF 1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-200 - 200 ] | View the 2-byte word sent with the control word from the bus master to set the reference value. For more information, refer to the relevant fieldbus manual. |

| 16-84 Comm. Option STW | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535 ] | View the extended fieldbus comm. option status word. For more information, refer to the relevant fieldbus manual. |

| 16-85 FC Port CTW 1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535 ] | View the 2-byte control word (CTW) received from the bus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in *8-10 Control Profile*. |

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| 16-86 FC Port REF 1 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-200 - 200 ] | View the 2-byte status word (STW) sent to the bus master. Interpretation of the status word depends on the fieldbus option installed and the control word profile selected in *8-10 Control Profile*. |

| 16-87 Bus Readout Alarm/Warning | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | Alarm and warning numbers in hex as displayed in the Alarm log. The high byte contains the alarm, the low byte the warning. The alarm number is the first one that occurred after the last reset. |

| 16-89 Configurable Alarm/Warning Word | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | This alarm/warning word is configured in parameter *parameter 8-17 Configurable Alarm and Warningword* to match the actual requirements. |

## 3.17.7 16-9* Diagnosis Readouts

***NOTICE***

**When using MCT 10 Set-up Software, the readout parameters can only be read online, i.e. as the actual status. This means that the status is not stored in the MCT 10 Set-up Software file.**

| 16-90 Alarm Word | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295 ] | View the alarm word sent via the serial communication port in hex code. |

| 16-91 Alarm Word 2 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295] | View the alarm word sent via the serial communication port in hex code. |

| 16-92 Warning Word | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295 ] | View the warning word sent via the serial communication port in hex code. |

| 16-93 Warning Word 2 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295] | View the warning word sent via the serial communication port in hex code. |

| 16-94 Ext. Status Word | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 4294967295] | Returns the extended warning word sent via the serial communication port in hex code. |

## 3.18 Parameters: 17-** Feedback

Additional parameters to configure the feedback from the encoder (MCB 102), resolver (MCB 103) or the frequency converter itself.

### 3.18.1 17-1* Inc. Enc. Interface

Parameters in this group configure the incremental interface of the MCB 102 option. Note that both the incremental and absolute interfaces are active at the same time.

***NOTICE***

**These parameters cannot be adjusted while the motor is running.**

**17-10 Signal Type**

Select the incremental type (A/B channel) of the encoder in use. Find the information on the encoder data sheet.
Select *[0] None* if the feedback sensor is an absolute encoder only.

| Option: | | Function: |
|---|---|---|
| [0] | None | |
| [1] * | RS422 (5V TTL) | |
| [2] | Sinusoidal 1Vpp | |

**17-11 Resolution (PPR)**

| Range: | | Function: |
|---|---|---|
| 1024* | [10 - 10000] | Enter the resolution of the incremental track, i.e. the number of pulses or periods per revolution. |

### 3.18.2 17-2* Abs. Enc. Interface

Parameters in this group configure the absolute interface of the MCB 102 option. Note that both the incremental and absolute interfaces are active at the same time.

**17-20 Protocol Selection**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.** |
| [0] * | None | Select *[0] None* if the feedback sensor is an incremental encoder only. |
| [1] | HIPERFACE | Select *[1] HIPERFACE* if the encoder is absolute only. |
| [2] | EnDat | |
| [4] | SSI | |

**17-21 Resolution (Positions/Rev)**

| Range: | | Function: |
|---|---|---|
| Size related* | [ 4 - 131072] | Select the resolution of the absolute encoder, i.e. the number of counts per revolution.<br>The value depends on setting in *parameter 17-20 Protocol Selection*. |

**17-24 SSI Data Length**

| Range: | | Function: |
|---|---|---|
| 13* | [13 - 25] | Set the number of bits for the SSI telegram. Choose 13 bits for single-turn encoders and 25 bits for multi-turn encoders. |

**17-25 Clock Rate**

| Range: | | Function: |
|---|---|---|
| Size related* | [ 100 - 260 kHz] | Set the SSI clock rate. With long encoder cables the clock rate must be reduced. |

**17-26 SSI Data Format**

| Option: | | Function: |
|---|---|---|
| [0] * | Gray code | |
| [1] | Binary code | Set the data format of the SSI data. Choose between gray or binary format. |

**17-34 HIPERFACE Baudrate**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br><br>Select the baud rate of the attached encoder. The parameter is only accessible when *parameter 17-20 Protocol Selection* is set to *[1] HIPERFACE*. |
| [0] | 600 | |
| [1] | 1200 | |
| [2] | 2400 | |
| [3] | 4800 | |
| [4] * | 9600 | |
| [5] | 19200 | |
| [6] | 38400 | |

### 3.18.3 17-5* Resolver Interface

This parameter group is used for setting parameters for the Resolver Option MCB 103.
Usually the resolver feedback is used as motor feedback from permanent magnet motors with *parameter 1-01 Motor Control Principle* set to Flux with motor feedback.
Resolver parameters cannot be adjusted while the motor is running.

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| 17-50 Poles | | |
|---|---|---|
| **Range:** | | **Function:** |
| 2* | [2 - 8] | Set the number of poles on the resolver.<br>The value is stated in the data sheet for resolvers. |

| 17-51 Input Voltage | | |
|---|---|---|
| **Range:** | | **Function:** |
| 7 V* | [2 - 8 V] | Set the input voltage to the resolver. The voltage is stated as RMS value.<br>The value is stated in the data sheet for resolvers. |

| 17-52 Input Frequency | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 kHz* | [2 - 15 kHz] | Set the input frequency to the resolver.<br>The value is stated in the data sheet for resolvers. |

| 17-53 Transformation Ratio | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.5* | [0.1 - 1.1] | Set the transformation ratio for the resolver.<br>The transformation ration is:<br>$Tratio = \frac{VOut}{VIn}$<br>The value is stated in the data sheet for resolvers. |

**17-56 Encoder Sim. Resolution**

Set the resolution and activate the encoder emulation function (generation of encoder signals from the measured position from a resolver). Needed when necessary to transfer the speed or position information from one frequency converter to another. To disable the function, select *[0] Disabled*.

| Option: | | Function: |
|---|---|---|
| [0] * | Disabled | |
| [1] | 512 | |
| [2] | 1024 | |
| [3] | 2048 | |
| [4] | 4096 | |

**17-59 Resolver Interface**

Activate the MCB 103 resolver option when the resolver parameters are selected.
To avoid damage to resolvers *parameter 17-50 Poles* and *parameter 17-53 Transformation Ratio* must be adjusted before activating this parameter.

| Option: | | Function: |
|---|---|---|
| [0] * | Disabled | |
| [1] | Enabled | |

## 3.18.4 17-6* Monitoring and Application

This parameter group is for selecting additional functions when encoder option MCB 102 or resolver option MCB 103 is fitted into option slot B as speed feedback.

Monitoring and Application parameters cannot be adjusted while the motor is running.

**17-60 Feedback Direction**

| Option: | | Function: |
|---|---|---|
| | | ***NOTICE***<br>**This parameter cannot be adjusted while the motor is running.**<br>Change the detected encoder rotation direction without changing the wiring to the encoder. |
| [0] * | Clockwise | |
| [1] | Counter clockwise | |

**17-61 Feedback Signal Monitoring**

Select which reaction the frequency converter should take in case a faulty encoder signal is detected.
The encoder function in *parameter 17-61 Feedback Signal Monitoring* is an electrical check of the hardware circuit in the encoder system.

| Option: | | Function: |
|---|---|---|
| [0] | Disabled | |
| [1] * | Warning | |
| [2] | Trip | |
| [3] | Jog | |
| [4] | Freeze Output | |
| [5] | Max Speed | |
| [6] | Switch to Open Loop | |
| [7] | Select Setup 1 | |
| [8] | Select Setup 2 | |
| [9] | Select Setup 3 | |
| [10] | Select Setup 4 | |
| [11] | Stop & Trip | |

## 3.18.5 17-7* Absolute Position

Parameters in this group show the absolute position of the shaft, which is available directly from the frequency converter.

**17-70 Absolute Position Display Unit**

Select the readout unit for the absolute position display.

| Option: | | Function: |
|---|---|---|
| [0] * | None | |
| [1] | m | |
| [2] | mm | |
| [3] | Inc | |
| [4] | ° | |
| [5] | rad | |
| [6] | % | |

### 17-71 Absolute Position Display Scale

Select the decimal power of the readout scale. The readout scale is 1:10^(VALUE). For instance, the default value 0 means that the scale is 1:10^0 = 1:1.

| Range: | | Function: |
|---|---|---|
| 0* | [-7 - 7] | |

### 17-72 Absolute Position Numerator

If there are gears between the motor shaft and the application shaft, the absolute position of the motor shaft should be multiplied by a ratio to get the absolute position of the application shaft. Enter the numerator of the ratio. Scaling ration equals to (*parameter 17-72 Absolute Position Numerator*)/ (*parameter 17-73 Absolute Position Denominator*).

| Range: | | Function: |
|---|---|---|
| 4096* | [-2000000000 - 2000000000] | |

### 17-73 Absolute Position Denominator

If there are gears between the motor shaft and the application shaft, the absolute position of the motor shaft should be multiplied by a ratio to get the absolute position of the application shaft. Enter the denominator of the ratio. Scaling ration equals to (*parameter 17-72 Absolute Position Numerator*)/ (*parameter 17-73 Absolute Position Denominator*).

| Range: | | Function: |
|---|---|---|
| 1* | [-2000000000 - 2000000000] | |

### 17-74 Absolute Position Offset

Enter the absolute position offset. Use this parameter if manual adjustment of the absolute position readout is required.

| Range: | | Function: |
|---|---|---|
| 0* | [-2000000000 - 2000000000] | |

  

3

## 3.19 Parameters: 18-** Data Readouts 2

| 18-36 Analog Input X48/2 [mA] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-20 - 20] | View the actual current measured at input X48/2. |

| 18-37 Temp. Input X48/4 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-500 - 500] | View the actual temperature measured at input X48/4. The temperature unit is based on the selection in *parameter 35-00 Term. X48/4 Temperature Unit*. |

| 18-38 Temp. Input X48/7 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-500 - 500] | View the actual temperature measured at input X48/7. The temperature unit is based on the selection in *parameter 35-02 Term. X48/7 Temperature Unit*. |

| 18-39 Temp. Input X48/10 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-500 - 500] | View the actual temperature measured at input X48/10. The temperature unit is based on the selection in *parameter 35-04 Term. X48/10 Temperature Unit*. |

### 3.19.1 18-5* Active Alarms/Warnings

The parameters in this group show the numbers of currently active alarms or warnings.

| 18-55 Active Alarm Numbers | | |
|---|---|---|
| This parameter contains an array of up to 20 alarms that are currently active. The value 0 means no alarm. | | |
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | |

| 18-56 Active Warning Numbers | | |
|---|---|---|
| This parameter contains an array of up to 20 warnings that are currently active. The value 0 means no warning. | | |
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | |

| 18-60 Digital Input 2 | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [0 - 65535] | View the signal states from the active digital inputs. '0' = no signal, '1' = connected signal. |

| 18-90 Process PID Error | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | |

| 18-91 Process PID Output | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | |

| 18-92 Process PID Clamped Output | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | |

| 18-93 Process PID Gain Scaled Output | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [-200 - 200 %] | |

## 3.20 Parameters: 30-** Special Features

### 3.20.1 30-0* Wobble Function

The wobble function is primarily used for synthetic yarn winding applications. The wobble option is installed in the frequency converter controlling the traverse drive. The yarn moves back and forth in a diamond pattern across the surface of the yarn package. To prevent a build-up of yarn at the same points at the surface, this pattern must be altered. The wobble option can accomplish this by continuously varying the traverse velocity in a programmable cycle. The wobble function is created by superimposing a delta frequency around a centre frequency. To compensate for the inertia in the system, a quick frequency jump can be included. Especially suitable for elastic yarn applications, the option features a randomised wobble ratio.

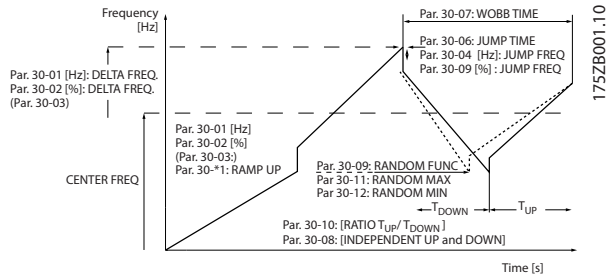


**Illustration 3.64 Wobble Function**

| 30-00 Wobble Mode | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | ***NOTICE***<br>**This parameter cannot be adjusted while running.**<br><br>The standard speed open loop mode in *parameter 1-00 Configuration Mode* is extended with a wobble function. In this parameter, it is possible to select which method to be used for the wobbler. The parameters can be set as absolute values (direct frequencies) or as relative values (percentage of other parameter). The wobble cycle time can be set as an absolute value or as independent up and down times. When using an absolute cycle time, the up and down times are configured through the wobble ratio. |
| [0] * | Abs. Freq., Abs. Time | |
| [1] | Abs. Freq., Up/ Down Time | |
| [2] | Rel. Freq., Abs. Time | |

| 30-00 Wobble Mode | | |
|---|---|---|
| **Option:** | | **Function:** |
| [3] | Rel. Freq., Up/ Down Time | |

### 3.20.2 Centre Frequency

***NOTICE***

**The setting of "Centre Frequency" takes place via the normal reference handling parameter group, *3-1* References*.**

| 30-01 Wobble Delta Frequency [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 5 Hz* | [0 - 25 Hz] | The delta frequency determines the magnitude of the wobble frequency. The delta frequency is superimposed on the centre frequency. *Parameter 30-01 Wobble Delta Frequency [Hz]* selected both the positive and negative delta frequency. The setting of *parameter 30-01 Wobble Delta Frequency [Hz]* must thus not be higher than the setting of the centre frequency. The initial ramp up time from standstill until the wobble sequence is running is determined by parameter group *3-1* References*. |

| 30-02 Wobble Delta Frequency [%] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 25 %* | [0 - 100 %] | The delta frequency can also be expressed as percentage of the centre frequency and can thus be maximum 100%. The function is the same as for *parameter 30-01 Wobble Delta Frequency [Hz]*. |

| 30-03 Wobble Delta Freq. Scaling Resource | | |
|---|---|---|
| **Option:** | | **Function:** |
| | | Select which frequency converter input should be used to scale the delta frequency setting. |
| [0] * | No function | |
| [1] | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [3] | Frequency input 29 | FC 302 only |
| [4] | Frequency input 33 | |
| [7] | Analog Input X30/11 | |
| [8] | Analog Input X30/12 | |
| [15] | Analog Input X48/2 | |

| 30-04 Wobble Jump Frequency [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 Hz* | [ 0 - 20.0 Hz] | The jump frequency is used to compensate for the inertia in the traverse system. If a jump in |

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| 30-04 Wobble Jump Frequency [Hz] | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | the output frequency is required at the boundaries of the wobble sequence, the frequency jump is set in this parameter. If the traverse system has a very high inertia, a high jump frequency may create a torque limit warning or trip (warning/alarm 12) or an overvoltage warning or trip (warning/alarm 7). This parameter can only be changed in stop mode. |

| 30-05 Wobble Jump Frequency [%] | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 %* | [0 - 100 %] | The jump frequency can also be expressed as percentage of the centre frequency. The function is the same as for *parameter 30-04 Wobble Jump Frequency [Hz]*. |

| 30-06 Wobble Jump Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.005 - 5.000 s] | |

| 30-07 Wobble Sequence Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10 s* | [1 - 1000 s] | This parameter determines the wobble sequence period. This parameter can only be changed in stop mode. Wobble time = $t_{up}$ + $t_{down}$ |

| 30-08 Wobble Up/ Down Time | | |
|---|---|---|
| **Range:** | | **Function:** |
| 5 s* | [0.1 - 1000 s] | Defines the individual up and down times for each wobble cycle. |

| 30-09 Wobble Random Function | | |
|---|---|---|
| **Option:** | | **Function:** |
| [0] * | Off | |
| [1] | On | |

| 30-10 Wobble Ratio | | |
|---|---|---|
| **Range:** | | **Function:** |
| 1* | [0.1 - 10] | If the ratio 0.1 is selected: $t_{down}$ is 10 times greater than $t_{up}$. If the ratio 10 is selected: $t_{up}$ is 10 times greater than $t_{down}$. |

| 30-11 Wobble Random Ratio Max. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 10* | [ par. 17-53 - 10] | Enter the maximum allowed wobble ratio. |

| 30-12 Wobble Random Ratio Min. | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.1* | [ 0.1 - par. 30-11] | Enter the minimum allowed wobble ratio. |

| 30-19 Wobble Delta Freq. Scaled | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0 Hz* | [0 - 1000 Hz] | Readout parameter. View the actual wobble delta frequency after scaling has been applied. |

## 3.20.3 30-2* Adv. Start Adjust

| 30-20 High Starting Torque Time [s] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 60 s] | High starting torque time for PM Motor in Flux mode without feedback. This parameter is available for FC 302 only. |

| 30-21 High Starting Torque Current [%] | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0 - 200.0 %] | High starting torque current for PM Motor in and Flux mode without feedback. This parameter is available for FC 302 only. |

**30-22 Locked Rotor Protection**

This parameter is available for FC 302 only. Available for PM motors only, in Flux Sensorless mode and VVC$^{plus}$ open loop mode.

| **Option:** | | **Function:** |
|---|---|---|
| [0] | Off | |
| [1] | On | Protects the motor from the locked rotor condition. The control algorithm detects a possible locked rotor condition in motor and trips the frequency converter to protect the motor. |

**30-23 Locked Rotor Detection Time [s]**

This parameter is available for FC 302 only. Available for PM motors only, in Flux Sensorless mode and VVC$^{plus}$ open loop mode.

| **Range:** | | **Function:** |
|---|---|---|
| Size related* | [0.05 - 1 s] | Time period for detecting the locked rotor condition. A low parameter value leads to faster detection. |

**30-24 Locked Rotor Detection Speed Error [%]**

This parameter is available for FC 302 only.

| **Range:** | | **Function:** |
|---|---|---|
| 25 %* | [0 - 100 %] | |

## 3.20.4 30-8* Compatibility

| 30-80 d-axis Inductance (Ld) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0.000 - 1000.000 mH] | Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor data sheet. The d-axis inductance cannot be found by performing an AMA. |

| 30-81 Brake Resistor (ohm) | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ 0.01 - 65535.00 Ohm] | Set the brake resistor value in Ω. This value is used for monitoring the power to the brake resistor in *parameter 2-13 Brake Power Monitoring*. This parameter is only active in frequency converters with an integral dynamic brake. |

| 30-83 Speed PID Proportional Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [0 - 1] | Enter the speed controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable. |

| 30-84 Process PID Proportional Gain | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.100* | [0 - 10] | Enter the process controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too great, the process may become unstable. |

3

## 3.21 Parameters: 35-** Sensor Input Option

### 3.21.1 35-0* Temp. Input Mode (MCB 114)

**35-00 Term. X48/4 Temperature Unit**

Select the unit to be used with temperature input X48/4 settings and readouts:

| Option: | | Function: |
|---|---|---|
| [60] * | °C | |
| [160] | °F | |

**35-01 Term. X48/4 Input Type**

View the temperature sensor type detected at input X48/4:

| Option: | | Function: |
|---|---|---|
| [0] * | Not Connected | |
| [1] | PT100 2-wire | |
| [3] | PT1000 2-wire | |
| [5] | PT100 3-wire | |
| [7] | PT1000 3-wire | |

**35-02 Term. X48/7 Temperature Unit**

Select the unit to be used with temperature input X48/7 settings and readouts:

| Option: | | Function: |
|---|---|---|
| [60] * | °C | |
| [160] | °F | |

**35-03 Term. X48/7 Input Type**

View the temperature sensor type detected at input X48/7:

| Option: | | Function: |
|---|---|---|
| [0] * | Not Connected | |
| [1] | PT100 2-wire | |
| [3] | PT1000 2-wire | |
| [5] | PT100 3-wire | |
| [7] | PT1000 3-wire | |

**35-04 Term. X48/10 Temperature Unit**

Select the unit to be used with temperature input X48/10 settings and readouts:

| Option: | | Function: |
|---|---|---|
| [60] * | °C | |
| [160] | °F | |

**35-05 Term. X48/10 Input Type**

View the temperature sensor type detected at input X48/10:

| Option: | | Function: |
|---|---|---|
| [0] * | Not Connected | |
| [1] | PT100 2-wire | |
| [3] | PT1000 2-wire | |
| [5] | PT100 3-wire | |
| [7] | PT1000 3-wire | |

**35-06 Temperature Sensor Alarm Function**

Select the alarm function:

| Option: | | Function: |
|---|---|---|
| [0] | Off | |
| [2] | Stop | |
| [5] * | Stop and trip | |

### 3.21.2 35-1* Temp. Input X48/4 (MCB 114)

**35-14 Term. X48/4 Filter Time Constant**

| Range: | | Function: |
|---|---|---|
| 0.001 s* | [0.001 - 10 s] | Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/4. A high time constant value improves dampening but also increases the time delay through the filter. |

**35-15 Term. X48/4 Temp. Monitor**

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. The temperature limits can be set in *parameter 35-16 Term. X48/4 Low Temp. Limit* and *parameter 35-17 Term. X48/4 High Temp. Limit*.

| Option: | | Function: |
|---|---|---|
| [0] * | Disabled | |
| [1] | Enabled | |

**35-16 Term. X48/4 Low Temp. Limit**

| Range: | | Function: |
|---|---|---|
| Size related* | [-50 - par. 35-17] | Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4. |

**35-17 Term. X48/4 High Temp. Limit**

| Range: | | Function: |
|---|---|---|
| Size related* | [par. 35-16 - 204] | Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4. |

### 3.21.3 35-2* Temp. Input X48/7 (MCB 114)

**35-24 Term. X48/7 Filter Time Constant**

| Range: | | Function: |
|---|---|---|
| 0.001 s* | [0.001 - 10 s] | Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/7. A high time constant value improves dampening but also |

| 35-24 Term. X48/7 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| | | increases the time delay through the filter. |

| 35-25 Term. X48/7 Temp. Monitor | | |
|---|---|---|
| This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/7. The temperature limits can be set in *parameter 35-26 Term. X48/7 Low Temp. Limit* and *parameter 35-27 Term. X48/7 High Temp. Limit*. | | |
| **Option:** | | **Function:** |
| [0] * | Disabled | |
| [1] | Enabled | |

| 35-26 Term. X48/7 Low Temp. Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ -50 - par. 35-27] | Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7. |

| 35-27 Term. X48/7 High Temp. Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ par. 35-26 - 204] | Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7. |

## 3.21.4 35-3* Temp. Input X48/10 (MCB 114)

| 35-34 Term. X48/10 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/10. A high time constant value improves dampening but also increases the time delay through the filter. |

| 35-35 Term. X48/10 Temp. Monitor | | |
|---|---|---|
| This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/10. The temperature limits can be set in *parameter 35-36 Term. X48/10 Low Temp. Limit/parameter 35-37 Term. X48/10 High Temp. Limit*. | | |
| **Option:** | | **Function:** |
| [0] * | Disabled | |
| [1] | Enabled | |

| 35-36 Term. X48/10 Low Temp. Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ -50 - par. 35-37] | Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10. |

| 35-37 Term. X48/10 High Temp. Limit | | |
|---|---|---|
| **Range:** | | **Function:** |
| Size related* | [ par. 35-36 - 204] | Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10. |

## 3.21.5 35-4* Analog Input X48/2 (MCB 114)

| 35-42 Term. X48/2 Low Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 4 mA* | [ 0 - par. 35-43 mA] | Enter the current (mA) that corresponds to the low reference value, set in *parameter 35-44 Term. X48/2 Low Ref./Feedb. Value*. The value must be set at >2 mA to activate the Live Zero Timeout Function in *parameter 6-01 Live Zero Timeout Function*. |

| 35-43 Term. X48/2 High Current | | |
|---|---|---|
| **Range:** | | **Function:** |
| 20 mA* | [ par. 35-42 - 20 mA] | Enter the current (mA) that corresponds to the high reference value (set in *parameter 35-45 Term. X48/2 High Ref./ Feedb. Value*). |

| 35-44 Term. X48/2 Low Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0* | [-999999.999 - 999999.999] | Enter the reference or feedback value (in RPM, Hz, bar, etc.) that corresponds to the voltage or current set in *parameter 35-42 Term. X48/2 Low Current*. |

| 35-45 Term. X48/2 High Ref./Feedb. Value | | |
|---|---|---|
| **Range:** | | **Function:** |
| 100* | [-999999.999 - 999999.999] | Enter the reference or feedback value (in RPM, Hz, bar, etc.) that corresponds to the voltage or current set in *parameter 35-43 Term. X48/2 High Current*. |

| 35-46 Term. X48/2 Filter Time Constant | | |
|---|---|---|
| **Range:** | | **Function:** |
| 0.001 s* | [0.001 - 10 s] | Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise |

| 35-46 Term. X48/2 Filter Time Constant | | |
|---|---|---|
| Range: | | Function: |
| | | in terminal X48/2. A high time constant value improves dampening but also increases the time delay through the filter. |



## 3.22 Parameters: 42-** Safety Functions

The parameters in group 42 are available when a safety option is installed in the frequency converter. For information about the safety related parameters, see the operating instructions for the safety options:

- *Safety Option MCB 150/151 Operating Instructions*.
- *Safety Option MCB 152 Operating Instructions*.

# 4 Parameter Lists

## 4.1 Parameter Lists and Options

### 4.1.1 Introduction

**Frequency converter series**
All = valid for FC 301 and FC 302 series
01 = valid for FC 301 only
02 = valid for FC 302 only

**Changes during operation**
"TRUE" means that the parameter can be changed while the frequency converter is in operation and "FALSE" means that the frequency converter must be stopped before a change can be made.

**4 Set-up**
'All set-ups': the parameter can be set individually in each of the 4 set-ups, i. e. 1 single parameter can have 4 different data values.
'1 set-up': data value is the same in all set-ups.

| Data type | Description | Type |
|---|---|---|
| 2 | Integer 8 | Int8 |
| 3 | Integer 16 | Int16 |
| 4 | Integer 32 | Int32 |
| 5 | Unsigned 8 | Uint8 |
| 6 | Unsigned 16 | Uint16 |
| 7 | Unsigned 32 | Uint32 |
| 9 | Visible string | VisStr |
| 33 | Normalised value 2 bytes | N2 |
| 35 | Bit sequence of 16 boolean variables | V2 |
| 54 | Time difference w/o date | TimD |

**Table 4.1 Data Type**

## 4.1.2 Conversion

The various attributes of each parameter are displayed in factory setting. Parameter values are transferred as whole numbers only. Conversion factors are therefore used to transfer decimals.

A conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 is therefore read as 10.0.

Examples:
0 s⇒conversion index 0
0.00 s⇒conversion index -2
0 ms⇒conversion index -3
0.00 ms⇒conversion index -5

| Conversion index | Conversion factor |
|---|---|
| 100 | |
| 75 | |
| 74 | |
| 67 | |
| 6 | 1000000 |
| 5 | 100000 |
| 4 | 10000 |
| 3 | 1000 |
| 2 | 100 |
| 1 | 10 |
| 0 | 1 |
| -1 | 0.1 |
| -2 | 0.01 |
| -3 | 0.001 |
| -4 | 0.0001 |
| -5 | 0.00001 |
| -6 | 0.000001 |
| -7 | 0.0000001 |

**Table 4.2 Conversion Table**

## 4.1.3 Active/Inactive Parameters in Different Drive Control Modes

+ = active
- = not active

| ***Parameter 1-10 Motor Construction*** | **AC motor** | | | | **PM non-salient motor** | | | |
|---|---|---|---|---|---|---|---|---|
| ***Parameter 1-01 Motor Control Principle*** | **U/f mode** | **VVC+** | **Flux sensorless** | **Flux w/ motor feedback** | **U/f mode** | **VVC+** | **Flux sensorless** | **Flux w/ motor feedback** |
| 0-** Operation and Display (all parameters) | + | + | + | + | | | | |
| *Parameter 1-00 Configuration Mode* | | | | | | | | |
| [0] Speed open loop | + | + | + | - | | | | |
| [1] Speed closed ;oop | - | + | - | + | | | | |
| [2] Torque | - | - | - | + | | | | |
| [3] Process | + | + | + | - | | | | |
| [4] Torque open loop | - | + | - | - | | | | |
| [5] Wobble | + | + | + | + | | | | |
| [6] Surface winder | + | + | + | - | | | | |
| [7] Ext. PID open loop | + | + | + | - | | | | |
| [8] Ext. PID closed loop | - | + | - | + | | | | |
| | | | | | | | | |
| *Parameter 1-02 Flux Motor Feedback Source* | - | - | - | + | | | | |
| *Parameter 1-03 Torque Characteristics* | - | + see 1, 2, 3) | + see 1, 3, 4) | + see 1, 3, 4) | | | | |
| *Parameter 1-04 Overload Mode* | + | + | + | + | + | | + | + |
| *Parameter 1-05 Local Mode Configuration* | + | + | + | + | + | | + | + |
| *Parameter 1-06 Clockwise Direction* | + | + | + | + | + | | + | + |

  

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 1-20 Motor Power [kW]* (Par. 023 = International) | + | + | + | + | | | | |
| *Parameter 1-21 Motor Power [HP]* (Par. 023 = US) | + | + | + | + | | | | |
| *Parameter 1-22 Motor Voltage* | + | + | + | + | | | | |
| *Parameter 1-23 Motor Frequency* | + | + | + | + | | | | |
| *Parameter 1-24 Motor Current* | + | + | + | + | | | | |
| *Parameter 1-25 Motor Nominal Speed* | + | + | + | + | | | | |
| *Parameter 1-26 Motor Cont. Rated Torque* | - | - | - | - | + | | + | + |
| *Parameter 1-29 Automatic Motor Adaptation (AMA)* | + | + | + | + | | | | |
| *Parameter 1-30 Stator Resistance (Rs)* | + | + | + | + | + | | | |
| *Parameter 1-31 Rotor Resistance (Rr)* | - | + see 5) | + | + | | | | |
| *Parameter 1-33 Stator Leakage Reactance (X1)* | + | + | + | + | + | | | |
| *Parameter 1-34 Rotor Leakage Reactance (X2)* | - | + see 5) | + | + | | | | |
| *Parameter 1-35 Main Reactance (Xh)* | + | + | + | + | + | | | |
| *Parameter 1-36 Iron Loss Resistance (Rfe)* | - | - | + | + | - | | - | - |
| *Parameter 1-37 d-axis Inductance (Ld)* | - | - | - | - | | | + | + |
| *Parameter 1-39 Motor Poles* | + | + | + | + | | | | |
| *Parameter 1-40 Back EMF at 1000 RPM* | - | - | - | - | + | | + | + |
| *Parameter 1-41 Motor Angle Offset* | - | - | - | - | | | | + |
| *1-50 Motor Magnetisation at Zero Speed* | - | + | - | - | - | | - | - |
| *1-51 Min Speed Normal Magnetising [RPM]* (Par. 002 = rmp) | - | + | - | - | - | | - | - |
| *Parameter 1-52 Min Speed Normal Magnetising [Hz]* (Par. 002 = Hz) | - | + | - | - | - | | - | - |
| *Parameter 1-53 Model Shift Frequency* | - | - | + | + | - | | + | + |
| *Parameter 1-54 Voltage reduction in fieldweakening* | - | - | + see 6) | + | - | | - | - |
| *Parameter 1-55 U/f Characteristic - U* | + | - | - | - | + | | - | - |
| *Parameter 1-56 U/f Characteristic - F* | + | - | - | - | + | | - | - |
| *Parameter 1-58 Flying Start Test Pulses Current* | - | + | - | - | - | | - | - |

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 1-59 Flying Start Test Pulses Frequency* | - | + | - | - | - | | - | - |
| *Parameter 1-60 Low Speed Load Compensation* | - | + | - | - | - | | - | - |
| *Parameter 1-61 High Speed Load Compensation* | - | + | - | - | - | | - | - |
| *Parameter 1-62 Slip Compensation* | - | + see 7) | + | - | - | | - | - |
| *1-63 Slip Compensation Time Constant* | + see 8) | + | + see 8) | - | + see 8) | | + see 8) | - |
| *1-64 Resonance Damping* | + | + | + | - | + | | + | - |
| *1-65 Resonance Damping Time Constant* | + | + | + | - | + | | + | - |
| *Parameter 1-66 Min. Current at Low Speed* | - | - | + | + | - | | + | + |
| *Parameter 1-67 Load Type* | - | - | + | - | - | | - | - |
| *Parameter 1-68 Motor Inertia* | - | - | + | - | - | | - | - |
| *Parameter 1-69 System Inertia* | - | - | + | - | - | | - | - |
| *Parameter 1-71 Start Delay* | + | + | + | + | + | | + | + |
| *Parameter 1-72 Start Function* | + | + | + | + | + | | + | + |
| *Parameter 1-73 Flying Start* | - | + | + | + | - | | - | - |
| *Parameter 1-74 Start Speed [RPM]* (Par. 002 = rmp) | - | + | - | - | - | | - | - |
| *Parameter 1-75 Start Speed [Hz]* (Par. 002 = Hz) | - | + | - | - | - | | - | - |
| *Parameter 1-76 Start Current* | - | + | - | - | - | | - | - |
| *Parameter 1-80 Function at Stop* | + | + | + | + | + | | + | + |
| *1-81 Min Speed for Function at Stop [RPM]* (Par. 002 = rpm) | + | + | + | + | + | | + | + |
| *1-82 Min Speed for Function at Stop [Hz]* (Par. 002 = Hz) | + | + | + | + | + | | + | + |
| *Parameter 1-83 Precise Stop Function* | + | + | + | + | + | | + | + |
| *Parameter 1-84 Precise Stop Counter Value* | + | + | + | + | + | | + | + |
| *Parameter 1-85 Precise Stop Speed Compensation Delay* | + | + | + | + | + | | + | + |
| *Parameter 1-90 Motor Thermal Protection* | + | + | + | + | | | | |
| *1-91 Motor External Fan* | + | + | + | + | | | | |
| *1-93 Thermistor Resource* | + | + | + | + | | | | |
| *Parameter 1-95 KTY Sensor Type* | + | + | + | + | | | | |
| *Parameter 1-96 KTY Thermistor Resource* | + | + | + | + | | | | |
| *Parameter 1-97 KTY Threshold level* | + | + | + | + | | | | |
| *Parameter 1-98 ATEX ETR interpol. points freq.* | + | + | + | + | | | | |

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 1-99 ATEX ETR interpol points current* | + | + | + | + | | | | |
| *Parameter 2-00 DC Hold Current* | + | + | + | + | | | | |
| *Parameter 2-01 DC Brake Current* | + | + | + | + | | | | |
| *2-02 DC Braking Time* | + | + | + | + | | | | |
| *Parameter 2-03 DC Brake Cut In Speed [RPM]* | + | + | + | + | | | | |
| *Parameter 2-04 DC Brake Cut In Speed [Hz]* | + | + | + | + | | | | |
| *Parameter 2-05 Maximum Reference* | + | + | + | + | | | | |
| *Parameter 2-10 Brake Function* | + see [9] | + | + | + | | | | |
| *2-11 Brake Resistor (ohm)* | + | + | + | + | | | | |
| *2-12 Brake Power Limit (kW)* | + | + | + | + | | | | |
| *Parameter 2-13 Brake Power Monitoring* | + | + | + | + | | | | |
| *Parameter 2-15 Brake Check* | + see [9] | + | + | + | | | | |
| *Parameter 2-16 AC brake Max. Current* | - | + | + | + | | | | |
| *Parameter 2-17 Over-voltage Control* | + | + | + | + | | | | |
| *Parameter 2-18 Brake Check Condition* | + | + | + | + | | | | |
| *Parameter 2-19 Over-voltage Gain* | + | + | + | - | | | | |
| *Parameter 2-20 Release Brake Current* | + | + | + | + | | | | |
| *Parameter 2-21 Activate Brake Speed [RPM]* | + | + | + | + | | | | |
| *Parameter 2-22 Activate Brake Speed [Hz]* | + | + | + | + | | | | |
| *Parameter 2-23 Activate Brake Delay* | + | + | + | + | | | | |
| *Parameter 2-24 Stop Delay* | - | - | - | + | | | | |
| *Parameter 2-25 Brake Release Time* | - | - | - | + | | | | |
| *Parameter 2-26 Torque Ref* | - | - | - | + | | | | + |
| *Parameter 2-27 Torque Ramp Up Time* | - | - | - | + | | | | |
| *Parameter 2-28 Gain Boost Factor* | - | - | - | + | | | | + |
| *Parameter 2-29 Torque Ramp Down Time* | | | | + | | | | + |
| *Parameter 2-30 Position P Start Proportional Gain* | | | | + | | | | + |
| *Parameter 2-31 Speed PID Start Proportional Gain* | | | | + | | | | + |
| *Parameter 2-32 Speed PID Start Integral Time* | | | | + | | | | + |

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 2-33 Speed PID Start Lowpass Filter Time* | | | | + | | | | + |
| 3-** Reference/ramps (all parameters) | + | + | + | + | | | | |
| *Parameter 4-10 Motor Speed Direction* | + | + | + | + | | | | |
| *Parameter 4-11 Motor Speed Low Limit [RPM]* | + | + | + | + | | | | |
| *Parameter 4-12 Motor Speed Low Limit [Hz]* | + | + | + | + | | | | |
| *Parameter 4-13 Motor Speed High Limit [RPM]* | + | + | + | + | | | | |
| *Parameter 4-14 Motor Speed High Limit [Hz]* | + | + | + | + | | | | |
| *Parameter 4-16 Torque Limit Motor Mode* | + | + | + | + | | | | |
| *Parameter 4-17 Torque Limit Generator Mode* | + | + | + | + | | | | |
| *Parameter 4-18 Current Limit* | + | + | + | + | | | | |
| *Parameter 4-19 Max Output Frequency* | + | + | + | + | | | | |
| *Parameter 4-20 Torque Limit Factor Source* | + | + | + | + | | | | |
| *4-21 Speed Limit Factor Source* | - | + see [10] | - | + see [11] | | | | |
| *Parameter 4-30 Motor Feedback Loss Function* | - | + see [12] | - | + see [12] | | | | |
| *Parameter 4-31 Motor Feedback Speed Error* | - | + see [12] | - | + see [12] | | | | |
| *Parameter 4-32 Motor Feedback Loss Timeout* | - | + see [12] | - | + see [12] | | | | |
| *Parameter 4-34 Tracking Error Function* | + | + | + | + | | | | |
| *Parameter 4-35 Tracking Error* | + | + | + | + | | | | |
| *Parameter 4-36 Tracking Error Timeout* | + | + | + | + | | | | |
| *Parameter 4-37 Tracking Error Ramping* | + | + | + | + | | | | |
| *Parameter 4-38 Tracking Error Ramping Timeout* | + | + | + | + | | | | |
| *Parameter 4-39 Tracking Error After Ramping Timeout* | + | + | + | + | | | | |
| *Parameter 4-50 Warning Current Low* | + | + | + | + | | | | |
| *Parameter 4-51 Warning Current High* | + | + | + | + | | | | |
| *Parameter 4-52 Warning Speed Low* | + | + | + | + | | | | |
| *Parameter 4-53 Warning Speed High* | + | + | + | + | | | | |

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 4-54 Warning Reference Low* | + | + | + | + | | | | |
| *Parameter 4-55 Warning Reference High* | + | + | + | + | | | | |
| *Parameter 4-56 Warning Feedback Low* | + | + | + | + | | | | |
| *Parameter 4-57 Warning Feedback High* | + | + | + | + | | | | |
| *Parameter 4-58 Missing Motor Phase Function* | + | + | + | + | | | | |
| *Parameter 4-60 Bypass Speed From [RPM]* | + | + | + | + | | | | |
| *Parameter 4-61 Bypass Speed From [Hz]* | + | + | + | + | | | | |
| *Parameter 4-62 Bypass Speed To [RPM]* | + | + | + | + | | | | |
| *Parameter 4-63 Bypass Speed To [Hz]* | + | + | + | + | | | | |
| 5-** Digital in/out (all parameters except 5-70 and 71) | + | + | + | + | | | | |
| *Parameter 5-70 Term 32/33 Pulses Per Revolution* | - | + see 12) | - | + | | | | |
| *Parameter 5-71 Term 32/33 Encoder Direction* | - | + see 12) | - | + | | | | |
| 6-** Analog in/out (all parameters) | + | + | + | + | | | | |
| *Parameter 7-00 Speed PID Feedback Source* | - | + see 12) | - | + | | | | |
| *Parameter 7-02 Speed PID Proportional Gain* | - | + see 12) | + | + | | | | |
| *Parameter 7-03 Speed PID Integral Time* | - | + see 12) | + | + | | | | |
| *Parameter 7-04 Speed PID Differentiation Time* | - | + see 12) | + | + | | | | |
| *Parameter 7-05 Speed PID Diff. Gain Limit* | - | + see 12) | + | + | | | | |
| *Parameter 7-06 Speed PID Lowpass Filter Time* | - | + see 12) | + | + | | | | |
| *Parameter 7-07 Speed PID Feedback Gear Ratio* | - | + see 12) | - | + | | | | |
| *Parameter 7-08 Speed PID Feed Forward Factor* | - | + see 12) | - | - | | | | |
| *Parameter 7-12 Torque PI Proportional Gain* | - | + see 10) | - | - | | | | |
| *Parameter 7-13 Torque PI Integration Time* | - | + see 10) | - | - | | | | |
| *Parameter 7-20 Process CL Feedback 1 Resource* | + | + | + | + | | | | |
| *Parameter 7-22 Process CL Feedback 2 Resource* | + | + | + | + | | | | |



  

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 7-30 Process PID Normal/ Inverse Control* | + | + | + | + | | | | |
| *Parameter 7-31 Process PID Anti Windup* | + | + | + | + | | | | |
| *Parameter 7-32 Process PID Start Speed* | + | + | + | + | | | | |
| *Parameter 7-33 Process PID Proportional Gain* | + | + | + | + | | | | |
| *Parameter 7-34 Process PID Integral Time* | + | + | + | + | | | | |
| *Parameter 7-35 Process PID Differentiation Time* | + | + | + | + | | | | |
| *Parameter 7-36 Process PID Diff. Gain Limit* | + | + | + | + | | | | |
| *Parameter 7-38 Process PID Feed Forward Factor* | + | + | + | + | | | | |
| *Parameter 7-39 On Reference Bandwidth* | + | + | + | + | | | | |
| *Parameter 7-40 Process PID I-part Reset* | + | + | + | + | | | | |
| *Parameter 7-41 Process PID Output Neg. Clamp* | + | + | + | + | | | | |
| *Parameter 7-42 Process PID Output Pos. Clamp* | + | + | + | + | | | | |
| *Parameter 7-43 Process PID Gain Scale at Min. Ref.* | + | + | + | + | | | | |
| *Parameter 7-44 Process PID Gain Scale at Max. Ref.* | + | + | + | + | | | | |
| *Parameter 7-45 Process PID Feed Fwd Resource* | + | + | + | + | | | | |
| *Parameter 7-46 Process PID Feed Fwd Normal/ Inv. Ctrl.* | + | + | + | + | | | | |
| *Parameter 7-48 PCD Feed Forward* | + | + | + | + | | | | |
| *Parameter 7-49 Process PID Output Normal/ Inv. Ctrl.* | + | + | + | + | | | | |
| *Parameter 7-50 Process PID Extended PID* | + | + | + | + | | | | |
| *Parameter 7-51 Process PID Feed Fwd Gain* | + | + | + | + | | | | |
| *Parameter 7-52 Process PID Feed Fwd Ramp up* | + | + | + | + | | | | |
| *Parameter 7-53 Process PID Feed Fwd Ramp down* | + | + | + | + | | | | |
| *Parameter 7-56 Process PID Ref. Filter Time* | + | + | + | + | | | | |
| *Parameter 7-57 Process PID Fb. Filter Time* | + | + | + | + | | | | |

  

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| 8-** Communications and options (all parameters) | + | + | + | + | | | | |
| 13-** Smart logic control (all parameters) | + | + | + | + | | | | |
| *Parameter 14-00 Switching Pattern* | + | + | + | + | | | | |
| *Parameter 14-01 Switching Frequency* | + | + | + | + | | | | |
| *Parameter 14-03 Overmodulation* | + | + | + | + | | | | |
| *Parameter 14-04 PWM Random* | + | + | + | + | | | | |
| *Parameter 14-06 Dead Time Compensation* | + | + | + | + | | | | |
| *Parameter 14-10 Mains Failure* | | | | | | | | |
| [0] No function | + | + | + | + | | | | |
| [1] Ctrl. ramp down | - | + | + | + | | | | |
| [2] Ctrl. ramp down, trip | - | + | + | + | | | | |
| [3] Coasting | + | + | + | + | | | | |
| [4] Kinetic back-up | - | + | + | + | | | | |
| [5] Kinetic back-up, trip | - | + | + | + | | | | |
| [6] Alarm | + | + | + | + | | | | |
| *Parameter 14-11 Mains Voltage at Mains Fault* | + | + | + | + | | | | |
| *Parameter 14-12 Function at Mains Imbalance* | + | + | + | + | | | | |
| *Parameter 14-14 Kin. Backup Time Out* | - | - | + | + | | | | |
| *Parameter 14-15 Kin. Backup Trip Recovery Level* | + | + | + | + | | | | |
| *Parameter 14-20 Reset Mode* | + | + | + | + | | | | |
| *Parameter 14-21 Automatic Restart Time* | + | + | + | + | | | | |
| *Parameter 14-22 Operation Mode* | + | + | + | + | | | | |
| *Parameter 14-24 Trip Delay at Current Limit* | + | + | + | + | | | | |
| *Parameter 14-25 Trip Delay at Torque Limit* | + | + | + | + | | | | |
| *Parameter 14-26 Trip Delay at Inverter Fault* | + | + | + | + | | | | |
| *Parameter 14-29 Service Code* | + | + | + | + | | | | |
| *Parameter 14-30 Current Lim Ctrl, Proportional Gain* | + | + | + | + | | | | |
| *Parameter 14-31 Current Lim Ctrl, Integration Time* | + | + | + | + | | | | |
| *Parameter 14-32 Current Lim Ctrl, Filter Time* | + | + | + | + | | | | |
| *Parameter 14-35 Stall Protection* | - | - | + | + | | | | |
| *Parameter 14-36 Fieldweakening Function* | | | + | + | | | + | + |
| *Parameter 14-40 VT Level* | - | + | + | + | | | | |

| *Parameter 1-10 Motor Construction* | AC motor | | | | PM non-salient motor | | | |
|---|---|---|---|---|---|---|---|---|
| *Parameter 1-01 Motor Control Principle* | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback | U/f mode | VVC+ | Flux sensorless | Flux w/ motor feedback |
| *Parameter 14-41 AEO Minimum Magnetisation* | - | + | + | + | | | | |
| *Parameter 14-42 Minimum AEO Frequency* | - | + | + | + | | | | |
| *Parameter 14-43 Motor Cosphi* | - | + | + | + | | | | |
| *Parameter 14-50 RFI Filter* | + | + | + | + | | | | |
| *Parameter 14-51 DC Link Compensation* | + | + | + | + | | | | |
| *Parameter 14-52 Fan Control* | + | + | + | + | | | | |
| *Parameter 14-53 Fan Monitor* | + | + | + | + | | | | |
| *Parameter 14-55 Output Filter* | + | + | + | + | | | | |
| *Parameter 14-56 Capacitance Output Filter* | - | - | + | + | | | | |
| *Parameter 14-57 Inductance Output Filter* | - | - | + | + | | | | |
| *Parameter 14-74 Leg. Ext. Status Word* | + | + | + | + | | | | |
| *Parameter 14-80 Option Supplied by External 24VDC* | + | + | + | + | | | | |
| *Parameter 14-89 Option Detection* | + | + | + | + | | | | |
| *Parameter 14-90 Fault Level* | + | + | + | + | | | | |

**Table 4.3 Active/Inactive Parameters in Different Drive Control Modes**

*1) Constant torque*
*2) Variable torque*
*3) AEO*
*4) Constant power*
*5) Used in flystart*
*6) Used when parameter 1-03 Torque Characteristics is constant power*
*7) Not used when parameter 1-03 Torque Characteristics = VT*
*8) Part of resonance damping*
*9) Not AC brake*
*10) Torque open loop*
*11) Torque*
*12) Speed closed loop*

## 4.1.4 0-** Operation/Display

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **0-0* Basic Settings** | | | | | | | |
| 0-01 | Language | [0] English | 1 set-up | | TRUE | - | Uint8 |
| 0-02 | Motor Speed Unit | [0] RPM | 2 set-ups | | FALSE | - | Uint8 |
| 0-03 | Regional Settings | [0] International | 2 set-ups | | FALSE | - | Uint8 |
| 0-04 | Operating State at Power-up (Hand) | [1] Forced stop, ref=old | All set-ups | | TRUE | - | Uint8 |
| 0-09 | Performance Monitor | 0% | All set-ups | | TRUE | -1 | Uint16 |
| **0-1* Set-up Operations** | | | | | | | |
| 0-10 | Active Set-up | [1] Set-up 1 | 1 set-up | | TRUE | - | Uint8 |
| 0-11 | Edit Set-up | [1] Set-up 1 | All set-ups | | TRUE | - | Uint8 |
| 0-12 | This Set-up Linked to | [0] Not linked | All set-ups | | FALSE | - | Uint8 |
| 0-13 | Readout: Linked Set-ups | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 0-14 | Readout: Edit Set-ups/Channel | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 0-15 | Readout: actual setup | 0 N/A | All set-ups | | FALSE | 0 | Uint8 |
| **0-2* LCP Display** | | | | | | | |
| 0-20 | Display Line 1.1 Small | 1617 | All set-ups | | TRUE | - | Uint16 |
| 0-21 | Display Line 1.2 Small | 1614 | All set-ups | | TRUE | - | Uint16 |
| 0-22 | Display Line 1.3 Small | 1610 | All set-ups | | TRUE | - | Uint16 |
| 0-23 | Display Line 2 Large | 1613 | All set-ups | | TRUE | - | Uint16 |
| 0-24 | Display Line 3 Large | 1602 | All set-ups | | TRUE | - | Uint16 |
| 0-25 | My Personal Menu | ExpressionLimit | 1 set-up | | TRUE | 0 | Uint16 |
| **0-3* LCP Custom Readout** | | | | | | | |
| 0-30 | Unit for User-defined Readout | [0] None | All set-ups | | TRUE | - | Uint8 |
| 0-31 | Min. Value of User-defined Readout | 0 CustomReadoutUnit | All set-ups | | TRUE | -2 | Int32 |
| 0-32 | Max. Value of User-defined Readout | 100 CustomReadoutUnit | All set-ups | | TRUE | -2 | Int32 |
| 0-37 | Display Text 1 | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[25] |
| 0-38 | Display Text 2 | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[25] |
| 0-39 | Display Text 3 | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[25] |
| **0-4* LCP Keypad** | | | | | | | |
| 0-40 | [Hand on] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 0-41 | [Off] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 0-42 | [Auto on] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 0-43 | [Reset] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 0-44 | [Off/Reset] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 0-45 | [Drive Bypass] Key on LCP | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| **0-5* Copy/Save** | | | | | | | |
| 0-50 | LCP Copy | [0] No copy | All set-ups | | FALSE | - | Uint8 |
| 0-51 | Set-up Copy | [0] No copy | All set-ups | | FALSE | - | Uint8 |
| **0-6* Password** | | | | | | | |
| 0-60 | Main Menu Password | 100 N/A | 1 set-up | | TRUE | 0 | Int16 |
| 0-61 | Access to Main Menu w/o Password | [0] Full access | 1 set-up | | TRUE | - | Uint8 |
| 0-65 | Quick Menu Password | 200 N/A | 1 set-up | | TRUE | 0 | Int16 |
| 0-66 | Access to Quick Menu w/o Password | [0] Full access | 1 set-up | | TRUE | - | Uint8 |
| 0-67 | Bus Password Access | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 0-68 | Safety Parameters Password | 300 N/A | 1 set-up | | TRUE | 0 | Uint16 |
| 0-69 | Password Protection of Safety Parameters | [0] Disabled | 1 set-up | | TRUE | - | Uint8 |

  

## 4.1.5 1-** Load/Motor

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **1-0* General Settings** | | | | | | | |
| 1-00 | Configuration Mode | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 1-01 | Motor Control Principle | ExpressionLimit | All set-ups | | FALSE | - | Uint8 |
| 1-02 | Flux Motor Feedback Source | [1] 24 V encoder | All set-ups | x | FALSE | - | Uint8 |
| 1-03 | Torque Characteristics | [0] Constant torque | All set-ups | | TRUE | - | Uint8 |
| 1-04 | Overload Mode | [0] High torque | All set-ups | | FALSE | - | Uint8 |
| 1-05 | Local Mode Configuration | [2] As mode par 1-00 | All set-ups | | TRUE | - | Uint8 |
| 1-06 | Clockwise Direction | [0] Normal | All set-ups | | FALSE | - | Uint8 |
| 1-07 | Motor Angle Offset Adjust | [0] Manual | All set-ups | x | FALSE | - | Uint8 |
| **1-1* Special Settings** | | | | | | | |
| 1-10 | Motor Construction | [0] Asynchron. | All set-ups | | FALSE | - | Uint8 |
| 1-11 | Motor Model | ExpressionLimit | All set-ups | x | FALSE | - | Uint8 |
| 1-14 | Damping Gain | 140% | All set-ups | | TRUE | 0 | Int16 |
| 1-15 | Low Speed Filter Time Const. | ExpressionLimit | All set-ups | | TRUE | -2 | Uint16 |
| 1-16 | High Speed Filter Time Const. | ExpressionLimit | All set-ups | | TRUE | -2 | Uint16 |
| 1-17 | Voltage filter time const. | ExpressionLimit | All set-ups | | TRUE | -3 | Uint16 |
| 1-18 | Min. Current at No Load | 0% | All set-ups | | TRUE | 0 | Uint16 |
| **1-2* Motor Data** | | | | | | | |
| 1-20 | Motor Power [kW] | ExpressionLimit | All set-ups | | FALSE | 1 | Uint32 |
| 1-21 | Motor Power [hp] | ExpressionLimit | All set-ups | | FALSE | -2 | Uint32 |
| 1-22 | Motor Voltage | ExpressionLimit | All set-ups | | FALSE | 0 | Uint16 |
| 1-23 | Motor Frequency | ExpressionLimit | All set-ups | | FALSE | 0 | Uint16 |
| 1-24 | Motor Current | ExpressionLimit | All set-ups | | FALSE | -2 | Uint32 |
| 1-25 | Motor Nominal Speed | ExpressionLimit | All set-ups | | FALSE | 67 | Uint16 |
| 1-26 | Motor Cont. Rated Torque | ExpressionLimit | All set-ups | | FALSE | -1 | Uint32 |
| 1-29 | Automatic Motor Adaptation (AMA) | [0] Off | All set-ups | | FALSE | - | Uint8 |
| **1-3* Adv. Motor Data** | | | | | | | |
| 1-30 | Stator Resistance (Rs) | ExpressionLimit | All set-ups | | FALSE | -4 | Uint32 |
| 1-31 | Rotor Resistance (Rr) | ExpressionLimit | All set-ups | | FALSE | -4 | Uint32 |
| 1-33 | Stator Leakage Reactance (X1) | ExpressionLimit | All set-ups | | FALSE | -4 | Uint32 |
| 1-34 | Rotor Leakage Reactance (X2) | ExpressionLimit | All set-ups | | FALSE | -4 | Uint32 |
| 1-35 | Main Reactance (Xh) | ExpressionLimit | All set-ups | | FALSE | -4 | Uint32 |
| 1-36 | Iron Loss Resistance (Rfe) | ExpressionLimit | All set-ups | | FALSE | -3 | Uint32 |
| 1-37 | d-axis Inductance (Ld) | ExpressionLimit | All set-ups | x | FALSE | -4 | Int32 |
| 1-38 | q-axis Inductance (Lq) | ExpressionLimit | All set-ups | x | FALSE | -6 | Int32 |
| 1-39 | Motor Poles | ExpressionLimit | All set-ups | | FALSE | 0 | Uint8 |
| 1-40 | Back EMF at 1000 RPM | ExpressionLimit | All set-ups | x | FALSE | 0 | Uint16 |
| 1-41 | Motor Angle Offset | 0 N/A | All set-ups | | FALSE | 0 | Int16 |
| 1-44 | d-axis Inductance Sat. (LdSat) | ExpressionLimit | All set-ups | x | FALSE | -4 | Int32 |
| 1-45 | q-axis Inductance Sat. (LqSat) | ExpressionLimit | All set-ups | x | FALSE | -4 | Int32 |
| 1-46 | Position Detection Gain | 100% | All set-ups | | TRUE | 0 | Uint16 |
| 1-47 | Low Speed Torque Calibration | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 1-48 | Inductance Sat. Point | 35% | All set-ups | x | TRUE | 0 | Int16 |
| **1-5* Load Indep. Setting** | | | | | | | |
| 1-50 | Motor Magnetisation at Zero Speed | 100% | All set-ups | | TRUE | 0 | Uint16 |
| 1-51 | Min. Speed Normal Magnetising [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 1-52 | Min. Speed Normal Magnetising [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 1-53 | Model Shift Frequency | ExpressionLimit | All set-ups | x | FALSE | -1 | Uint16 |
| 1-54 | Voltage reduction in fieldweakening | 0 V | All set-ups | | FALSE | 0 | Uint8 |
| 1-55 | U/f Characteristic - U | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 1-56 | U/f Characteristic - F | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 1-58 | Flystart Test Pulses Current | ExpressionLimit | All set-ups | | FALSE | 0 | Uint16 |
| 1-59 | Flystart Test Pulses Frequency | ExpressionLimit | All set-ups | | FALSE | 0 | Uint16 |
| **1-6* Load Depen. Setting** | | | | | | | |
| 1-60 | Low Speed Load Compensation | 100% | All set-ups | | TRUE | 0 | Int16 |
| 1-61 | High Speed Load Compensation | 100% | All set-ups | | TRUE | 0 | Int16 |
| 1-62 | Slip Compensation | ExpressionLimit | All set-ups | | TRUE | 0 | Int16 |
| 1-63 | Slip Compensation Time Constant | ExpressionLimit | All set-ups | | TRUE | -2 | Uint16 |
| 1-64 | Resonance Damping | 100% | All set-ups | | TRUE | 0 | Uint16 |
| 1-65 | Resonance Damping Time Constant | 5 ms | All set-ups | | TRUE | -3 | Uint8 |
| 1-66 | Min. Current at Low Speed | ExpressionLimit | All set-ups | x | TRUE | 0 | Uint32 |
| 1-67 | Load Type | [0] Passive load | All set-ups | x | TRUE | - | Uint8 |
| 1-68 | Minimum Inertia | ExpressionLimit | All set-ups | x | FALSE | -4 | Uint32 |
| 1-69 | Maximum Inertia | ExpressionLimit | All set-ups | x | FALSE | -4 | Uint32 |
| **1-7* Start Adjustments** | | | | | | | |
| 1-70 | PM Start Mode | [0] Rotor Detection | All set-ups | | TRUE | - | Uint8 |
| 1-71 | Start Delay | 0 s | All set-ups | | TRUE | -1 | Uint8 |
| 1-72 | Start Function | [2] Coast/delay time | All set-ups | | TRUE | - | Uint8 |
| 1-73 | Flying Start | ExpressionLimit | All set-ups | | FALSE | - | Uint8 |
| 1-74 | Start Speed [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 1-75 | Start Speed [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 1-76 | Start Current | 0 A | All set-ups | | TRUE | -2 | Uint32 |
| **1-8* Stop Adjustments** | | | | | | | |
| 1-80 | Function at Stop | [0] Coast | All set-ups | | TRUE | - | Uint8 |
| 1-81 | Min. Speed for Function at Stop [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 1-82 | Min. Speed for Function at Stop [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 1-83 | Precise Stop Function | [0] Precise ramp stop | All set-ups | | FALSE | - | Uint8 |
| 1-84 | Precise Stop Counter Value | 100000 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 1-85 | Precise Stop Speed Compensation Delay | 10 ms | All set-ups | | TRUE | -3 | Uint8 |
| **1-9* Motor Temperature** | | | | | | | |
| 1-90 | Motor Thermal Protection | [0] No protection | All set-ups | | TRUE | - | Uint8 |
| 1-91 | Motor External Fan | ExpressionLimit | All set-ups | | TRUE | - | Uint16 |
| 1-93 | Thermistor Resource | [0] None | All set-ups | | TRUE | - | Uint8 |
| 1-94 | ATEX ETR cur.lim. speed reduction | 0% | 2 set-ups | x | TRUE | -1 | Uint16 |
| 1-95 | KTY Sensor Type | [0] KTY Sensor 1 | All set-ups | x | TRUE | - | Uint8 |
| 1-96 | KTY Thermistor Resource | [0] None | All set-ups | x | TRUE | - | Uint8 |
| 1-97 | KTY Threshold level | 80 °C | 1 set-up | x | TRUE | 100 | Int16 |
| 1-98 | ATEX ETR interpol. points freq. | ExpressionLimit | 1 set-up | x | TRUE | -1 | Uint16 |
| 1-99 | ATEX ETR interpol points current | ExpressionLimit | 2 set-ups | x | TRUE | 0 | Uint16 |

## 4.1.6 2-** Brakes

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **2-0* DC-Brake** | | | | | | | |
| 2-00 | DC Hold Current | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 2-01 | DC Brake Current | 50% | All set-ups | | TRUE | 0 | Uint16 |
| 2-02 | DC Braking Time | 10 s | All set-ups | | TRUE | -1 | Uint16 |
| 2-03 | DC Brake Cut In Speed [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 2-04 | DC Brake Cut In Speed [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 2-05 | Maximum Reference | MaxReference (P303) | All set-ups | | TRUE | -3 | Int32 |
| 2-06 | Parking Current | 50% | All set-ups | | TRUE | 0 | Uint16 |
| 2-07 | Parking Time | 3 s | All set-ups | | TRUE | -1 | Uint16 |
| **2-1* Brake Energy Funct.** | | | | | | | |
| 2-10 | Brake Function | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 2-11 | Brake Resistor (ohm) | ExpressionLimit | All set-ups | | TRUE | 0 | Uint16 |
| 2-12 | Brake Power Limit (kW) | ExpressionLimit | All set-ups | | TRUE | 0 | Uint32 |
| 2-13 | Brake Power Monitoring | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 2-15 | Brake Check | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 2-16 | AC brake Max. Current | 100% | All set-ups | | TRUE | -1 | Uint32 |
| 2-17 | Over voltage Control | [0] Disabled | All set-ups | | TRUE | - | Uint8 |
| 2-18 | Brake Check Condition | [0] At Power-up | All set-ups | | TRUE | - | Uint8 |
| 2-19 | Over voltage Gain | 100% | All set-ups | | TRUE | 0 | Uint16 |
| **2-2* Mechanical Brake** | | | | | | | |
| 2-20 | Release Brake Current | $I_{maxVLT}$ (P1637) | All set-ups | | TRUE | -2 | Uint32 |
| 2-21 | Activate Brake Speed [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 2-22 | Activate Brake Speed [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 2-23 | Activate Brake Delay | 0 s | All set-ups | | TRUE | -1 | Uint8 |
| 2-24 | Stop Delay | 0 s | All set-ups | | TRUE | -1 | Uint8 |
| 2-25 | Brake Release Time | 0.20 s | All set-ups | | TRUE | -2 | Uint16 |
| 2-26 | Torque Ref | 0% | All set-ups | | TRUE | -2 | Int16 |
| 2-27 | Torque Ramp Up Time | 0.2 s | All set-ups | | TRUE | -1 | Uint8 |
| 2-28 | Gain Boost Factor | 1 N/A | All set-ups | | TRUE | -2 | Uint16 |
| 2-29 | Torque Ramp Down Time | 0 s | All set-ups | | TRUE | -1 | Uint8 |
| **2-3* Adv. Mech Brake** | | | | | | | |
| 2-30 | Position P Start Proportional Gain | 0.0000 N/A | All set-ups | | TRUE | -4 | Uint32 |
| 2-31 | Speed PID Start Proportional Gain | 0.0150 N/A | All set-ups | | TRUE | -4 | Uint32 |
| 2-32 | Speed PID Start Integral Time | 200.0 ms | All set-ups | | TRUE | -4 | Uint32 |
| 2-33 | Speed PID Start Low-pass Filter Time | 10.0 ms | All set-ups | | TRUE | -4 | Uint16 |

## 4.1.7 3-** Reference/Ramps

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **3-0* Reference Limits** | | | | | | | |
| 3-00 | Reference Range | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 3-01 | Reference/Feedback Unit | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 3-02 | Minimum Reference | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 3-03 | Maximum Reference | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 3-04 | Reference Function | [0] Sum | All set-ups | | TRUE | - | Uint8 |
| **3-1* References** | | | | | | | |
| 3-10 | Preset Reference | 0% | All set-ups | | TRUE | -2 | Int16 |
| 3-11 | Jog Speed [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 3-12 | Catch up/Slow Down Value | 0% | All set-ups | | TRUE | -2 | Int16 |
| 3-13 | Reference Site | [0] Linked to Hand/Auto | All set-ups | | TRUE | - | Uint8 |
| 3-14 | Preset Relative Reference | 0% | All set-ups | | TRUE | -2 | Int32 |
| 3-15 | Reference Resource 1 | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 3-16 | Reference Resource 2 | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 3-17 | Reference Resource 3 | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 3-18 | Relative Scaling Reference Resource | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 3-19 | Jog Speed [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| **3-4* Ramp 1** | | | | | | | |
| 3-40 | Ramp 1 Type | [0] Linear | All set-ups | | TRUE | - | Uint8 |
| 3-41 | Ramp 1 Ramp Up Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-42 | Ramp 1 Ramp Down Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-45 | Ramp 1 S-ramp Ratio at Accel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-46 | Ramp 1 S-ramp Ratio at Accel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-47 | Ramp 1 S-ramp Ratio at Decel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-48 | Ramp 1 S-ramp Ratio at Decel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| **3-5* Ramp 2** | | | | | | | |
| 3-50 | Ramp 2 Type | [0] Linear | All set-ups | | TRUE | - | Uint8 |
| 3-51 | Ramp 2 Ramp Up Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-52 | Ramp 2 Ramp Down Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-55 | Ramp 2 S-ramp Ratio at Accel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-56 | Ramp 2 S-ramp Ratio at Accel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-57 | Ramp 2 S-ramp Ratio at Decel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-58 | Ramp 2 S-ramp Ratio at Decel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| **3-6* Ramp 3** | | | | | | | |
| 3-60 | Ramp 3 Type | [0] Linear | All set-ups | | TRUE | - | Uint8 |
| 3-61 | Ramp 3 Ramp up Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-62 | Ramp 3 Ramp down Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-65 | Ramp 3 S-ramp Ratio at Accel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-66 | Ramp 3 S-ramp Ratio at Accel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-67 | Ramp 3 S-ramp Ratio at Decel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 3-68 | Ramp 3 S-ramp Ratio at Decel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| **3-7* Ramp 4** | | | | | | | |
| 3-70 | Ramp 4 Type | [0] Linear | All set-ups | | TRUE | - | Uint8 |
| 3-71 | Ramp 4 Ramp up Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-72 | Ramp 4 Ramp Down Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-75 | Ramp 4 S-ramp Ratio at Accel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-76 | Ramp 4 S-ramp Ratio at Accel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-77 | Ramp 4 S-ramp Ratio at Decel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-78 | Ramp 4 S-ramp Ratio at Decel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| **3-8* Other Ramps** | | | | | | | |
| 3-80 | Jog Ramp Time | ExpressionLimit | All set-ups | | TRUE | -2 | Uint32 |
| 3-81 | Quick Stop Ramp Time | ExpressionLimit | 2 set-ups | | TRUE | -2 | Uint32 |
| 3-82 | Quick Stop Ramp Type | [0] Linear | All set-ups | | TRUE | - | Uint8 |
| 3-83 | Quick Stop S-ramp Ratio at Decel. Start | 50% | All set-ups | | TRUE | 0 | Uint8 |
| 3-84 | Quick Stop S-ramp Ratio at Decel. End | 50% | All set-ups | | TRUE | 0 | Uint8 |
| **3-9* Digital Pot.Meter** | | | | | | | |
| 3-90 | Step Size | 0.10% | All set-ups | | TRUE | -2 | Uint16 |
| 3-91 | Ramp Time | 1 s | All set-ups | | TRUE | -2 | Uint32 |
| 3-92 | Power Restore | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 3-93 | Maximum Limit | 100% | All set-ups | | TRUE | 0 | Int16 |
| 3-94 | Minimum Limit | -100% | All set-ups | | TRUE | 0 | Int16 |
| 3-95 | Ramp Delay | ExpressionLimit | All set-ups | | TRUE | -3 | TimD |

## 4.1.8 4-** Limits/Warnings

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **4-1* Motor Limits** | | | | | | | |
| 4-10 | Motor Speed Direction | ExpressionLimit | All set-ups | | FALSE | - | Uint8 |
| 4-11 | Motor Speed Low Limit [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 4-12 | Motor Speed Low Limit [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 4-13 | Motor Speed High Limit [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 4-14 | Motor Speed High Limit [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 4-16 | Torque Limit Motor Mode | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 4-17 | Torque Limit Generator Mode | 100% | All set-ups | | TRUE | -1 | Uint16 |
| 4-18 | Current Limit | ExpressionLimit | All set-ups | | TRUE | -1 | Uint32 |
| 4-19 | Max. Output Frequency | ExpressionLimit | All set-ups | | FALSE | -1 | Uint16 |
| **4-2* Limit Factors** | | | | | | | |
| 4-20 | Torque Limit Factor Source | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 4-21 | Speed Limit Factor Source | [0] No function | All set-ups | | TRUE | - | Uint8 |
| **4-3* Motor Speed Mon.** | | | | | | | |
| 4-30 | Motor Feedback Loss Function | [2] Trip | All set-ups | | TRUE | - | Uint8 |
| 4-31 | Motor Feedback Speed Error | 300 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 4-32 | Motor Feedback Loss Timeout | 0.05 s | All set-ups | | TRUE | -2 | Uint16 |
| 4-34 | Tracking Error Function | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 4-35 | Tracking Error | 10 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 4-36 | Tracking Error Timeout | 1 s | All set-ups | | TRUE | -2 | Uint16 |
| 4-37 | Tracking Error Ramping | 100 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 4-38 | Tracking Error Ramping Timeout | 1 s | All set-ups | | TRUE | -2 | Uint16 |
| 4-39 | Tracking Error After Ramping Timeout | 5 s | All set-ups | | TRUE | -2 | Uint16 |
| **4-5* Adj. Warnings** | | | | | | | |
| 4-50 | Warning Current Low | 0 A | All set-ups | | TRUE | -2 | Uint32 |
| 4-51 | Warning Current High | $I_{maxVLT}$ (P1637) | All set-ups | | TRUE | -2 | Uint32 |
| 4-52 | Warning Speed Low | 0 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 4-53 | Warning Speed High | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 4-54 | Warning Reference Low | -999999.999 N/A | All set-ups | | TRUE | -3 | Int32 |
| 4-55 | Warning Reference High | 999999.999 N/A | All set-ups | | TRUE | -3 | Int32 |
| 4-56 | Warning Feedback Low | -999999.999 Reference-FeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 4-57 | Warning Feedback High | 999999.999 Reference-FeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 4-58 | Missing Motor Phase Function | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| **4-6* Speed Bypass** | | | | | | | |
| 4-60 | Bypass Speed From [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 4-61 | Bypass Speed From [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |
| 4-62 | Bypass Speed To [RPM] | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |
| 4-63 | Bypass Speed To [Hz] | ExpressionLimit | All set-ups | | TRUE | -1 | Uint16 |

## 4.1.9 5-** Digital In/Out

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **5-0* Digital I/O mode** | | | | | | | |
| 5-00 | Digital I/O Mode | [0] PNP | All set-ups | | FALSE | - | Uint8 |
| 5-01 | Terminal 27 Mode | [0] Input | All set-ups | | TRUE | - | Uint8 |
| 5-02 | Terminal 29 Mode | [0] Input | All set-ups | x | TRUE | - | Uint8 |
| **5-1* Digital Inputs** | | | | | | | |
| 5-10 | Terminal 18 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-11 | Terminal 19 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-12 | Terminal 27 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-13 | Terminal 29 Digital Input | ExpressionLimit | All set-ups | x | TRUE | - | Uint8 |
| 5-14 | Terminal 32 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-15 | Terminal 33 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-16 | Terminal X30/2 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-17 | Terminal X30/3 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-18 | Terminal X30/4 Digital Input | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-19 | Terminal 37 Safe Stop | ExpressionLimit | 1 set-up | | TRUE | - | Uint8 |
| 5-20 | Terminal X46/1 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-21 | Terminal X46/3 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-22 | Terminal X46/5 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-23 | Terminal X46/7 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-24 | Terminal X46/9 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-25 | Terminal X46/11 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| 5-26 | Terminal X46/13 Digital Input | [0] No operation | All set-ups | | TRUE | - | Uint8 |
| **5-3* Digital Outputs** | | | | | | | |
| 5-30 | Terminal 27 Digital Output | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-31 | Terminal 29 Digital Output | ExpressionLimit | All set-ups | x | TRUE | - | Uint8 |
| 5-32 | Term X30/6 Digi Out (MCB 101) | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-33 | Term X30/7 Digi Out (MCB 101) | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| **5-4* Relays** | | | | | | | |
| 5-40 | Function Relay | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-41 | On Delay, Relay | 0.01 s | All set-ups | | TRUE | -2 | Uint16 |
| 5-42 | Off Delay, Relay | 0.01 s | All set-ups | | TRUE | -2 | Uint16 |
| **5-5* Pulse Input** | | | | | | | |
| 5-50 | Term. 29 Low Frequency | 100 Hz | All set-ups | x | TRUE | 0 | Uint32 |
| 5-51 | Term. 29 High Frequency | 100 Hz | All set-ups | x | TRUE | 0 | Uint32 |
| 5-52 | Term. 29 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | x | TRUE | -3 | Int32 |
| 5-53 | Term. 29 High Ref./Feedb. Value | ExpressionLimit | All set-ups | x | TRUE | -3 | Int32 |
| 5-54 | Pulse Filter Time Constant #29 | 100 ms | All set-ups | x | FALSE | -3 | Uint16 |
| 5-55 | Term. 33 Low Frequency | 100 Hz | All set-ups | | TRUE | 0 | Uint32 |
| 5-56 | Term. 33 High Frequency | 100 Hz | All set-ups | | TRUE | 0 | Uint32 |
| 5-57 | Term. 33 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 5-58 | Term. 33 High Ref./Feedb. Value | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 5-59 | Pulse Filter Time Constant #33 | 100 ms | All set-ups | | FALSE | -3 | Uint16 |
| **5-6* Pulse Output** | | | | | | | |
| 5-60 | Terminal 27 Pulse Output Variable | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-62 | Pulse Output Max. Freq #27 | ExpressionLimit | All set-ups | | TRUE | 0 | Uint32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 5-63 | Terminal 29 Pulse Output Variable | ExpressionLimit | All set-ups | x | TRUE | - | Uint8 |
| 5-65 | Pulse Output Max Freq #29 | ExpressionLimit | All set-ups | x | TRUE | 0 | Uint32 |
| 5-66 | Terminal X30/6 Pulse Output Variable | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 5-68 | Pulse Output Max. Freq #X30/6 | ExpressionLimit | All set-ups | | TRUE | 0 | Uint32 |
| **5-7* 24V Encoder Input** | | | | | | | |
| 5-70 | Term 32/33 Pulses Per Revolution | 1024 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 5-71 | Term 32/33 Encoder Direction | [0] Clockwise | All set-ups | | FALSE | - | Uint8 |
| **5-8* I/O Options** | | | | | | | |
| 5-80 | AHF Cap Reconnect Delay | 25 s | 2 set-ups | x | TRUE | 0 | Uint16 |
| **5-9* Bus Controlled** | | | | | | | |
| 5-90 | Digital & Relay Bus Control | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 5-93 | Pulse Out #27 Bus Control | 0% | All set-ups | | TRUE | -2 | N2 |
| 5-94 | Pulse Out #27 Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |
| 5-95 | Pulse Out #29 Bus Control | 0% | All set-ups | x | TRUE | -2 | N2 |
| 5-96 | Pulse Out #29 Timeout Preset | 0% | 1 set-up | x | TRUE | -2 | Uint16 |
| 5-97 | Pulse Out #X30/6 Bus Control | 0% | All set-ups | | TRUE | -2 | N2 |
| 5-98 | Pulse Out #X30/6 Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |

## 4.1.10 6-** Analog In/Out

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **6-0* Analog I/O Mode** | | | | | | | |
| 6-00 | Live Zero Timeout Time | 10 s | All set-ups | | TRUE | 0 | Uint8 |
| 6-01 | Live Zero Timeout Function | [0] Off | All set-ups | | TRUE | - | Uint8 |
| **6-1* Analog Input 1** | | | | | | | |
| 6-10 | Terminal 53 Low Voltage | 0.07 V | All set-ups | | TRUE | -2 | Int16 |
| 6-11 | Terminal 53 High Voltage | 10 V | All set-ups | | TRUE | -2 | Int16 |
| 6-12 | Terminal 53 Low Current | 0.14 mA | All set-ups | | TRUE | -5 | Int16 |
| 6-13 | Terminal 53 High Current | 20 mA | All set-ups | | TRUE | -5 | Int16 |
| 6-14 | Terminal 53 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 6-15 | Terminal 53 High Ref./Feedb. Value | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 6-16 | Terminal 53 Filter Time Constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| **6-2* Analog Input 2** | | | | | | | |
| 6-20 | Terminal 54 Low Voltage | 0.07 V | All set-ups | | TRUE | -2 | Int16 |
| 6-21 | Terminal 54 High Voltage | 10 V | All set-ups | | TRUE | -2 | Int16 |
| 6-22 | Terminal 54 Low Current | 0.14 mA | All set-ups | | TRUE | -5 | Int16 |
| 6-23 | Terminal 54 High Current | 20 mA | All set-ups | | TRUE | -5 | Int16 |
| 6-24 | Terminal 54 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 6-25 | Terminal 54 High Ref./Feedb. Value | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 6-26 | Terminal 54 Filter Time Constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| **6-3* Analog Input 3** | | | | | | | |
| 6-30 | Terminal X30/11 Low Voltage | 0.07 V | All set-ups | | TRUE | -2 | Int16 |
| 6-31 | Terminal X30/11 High Voltage | 10 V | All set-ups | | TRUE | -2 | Int16 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 6-34 | Term. X30/11 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 6-35 | Term. X30/11 High Ref./Feedb. Value | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 6-36 | Term. X30/11 Filter Time Constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| **6-4* Analog Input 4** | | | | | | | |
| 6-40 | Terminal X30/12 Low Voltage | 0.07 V | All set-ups | | TRUE | -2 | Int16 |
| 6-41 | Terminal X30/12 High Voltage | 10 V | All set-ups | | TRUE | -2 | Int16 |
| 6-44 | Term. X30/12 Low Ref./Feedb. Value | 0 ReferenceFeedbackUnit | All set-ups | | TRUE | -3 | Int32 |
| 6-45 | Term. X30/12 High Ref./Feedb. Value | ExpressionLimit | All set-ups | | TRUE | -3 | Int32 |
| 6-46 | Term. X30/12 Filter Time Constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| **6-5* Analog Output 1** | | | | | | | |
| 6-50 | Terminal 42 Output | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 6-51 | Terminal 42 Output Min. Scale | 0% | All set-ups | | TRUE | -2 | Int16 |
| 6-52 | Terminal 42 Output Max. Scale | 100% | All set-ups | | TRUE | -2 | Int16 |
| 6-53 | Term 42 Output Bus Ctrl | 0% | All set-ups | | TRUE | -2 | N2 |
| 6-54 | Terminal 42 Output Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |
| 6-55 | Analog Output Filter | [0] Off | 1 set-up | | TRUE | - | Uint8 |
| **6-6* Analog Output 2** | | | | | | | |
| 6-60 | Terminal X30/8 Output | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 6-61 | Terminal X30/8 Min. Scale | 0% | All set-ups | | TRUE | -2 | Int16 |
| 6-62 | Terminal X30/8 Max. Scale | 100% | All set-ups | | TRUE | -2 | Int16 |
| 6-63 | Terminal X30/8 Bus Control | 0% | All set-ups | | TRUE | -2 | N2 |
| 6-64 | Terminal X30/8 Output Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |
| **6-7* Analog Output 3** | | | | | | | |
| 6-70 | Terminal X45/1 Output | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 6-71 | Terminal X45/1 Min. Scale | 0% | All set-ups | | TRUE | -2 | Int16 |
| 6-72 | Terminal X45/1 Max. Scale | 100% | All set-ups | | TRUE | -2 | Int16 |
| 6-73 | Terminal X45/1 Bus Control | 0% | All set-ups | | TRUE | -2 | N2 |
| 6-74 | Terminal X45/1 Output Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |
| **6-8* Analog Output 4** | | | | | | | |
| 6-80 | Terminal X45/3 Output | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 6-81 | Terminal X45/3 Min. Scale | 0% | All set-ups | | TRUE | -2 | Int16 |
| 6-82 | Terminal X45/3 Max. Scale | 100% | All set-ups | | TRUE | -2 | Int16 |
| 6-83 | Terminal X45/3 Bus Control | 0% | All set-ups | | TRUE | -2 | N2 |
| 6-84 | Terminal X45/3 Output Timeout Preset | 0% | 1 set-up | | TRUE | -2 | Uint16 |

## 4.1.11 7-** Controllers

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **7-0* Speed PID Ctrl.** | | | | | | | |
| 7-00 | Speed PID Feedback Source | ExpressionLimit | All set-ups | | FALSE | - | Uint8 |
| 7-02 | Speed PID Proportional Gain | ExpressionLimit | All set-ups | | TRUE | -3 | Uint16 |
| 7-03 | Speed PID Integral Time | ExpressionLimit | All set-ups | | TRUE | -4 | Uint32 |
| 7-04 | Speed PID Differentiation Time | ExpressionLimit | All set-ups | | TRUE | -4 | Uint16 |
| 7-05 | Speed PID Diff. Gain Limit | 5 N/A | All set-ups | | TRUE | -1 | Uint16 |
| 7-06 | Speed PID Low-pass Filter Time | ExpressionLimit | All set-ups | | TRUE | -4 | Uint16 |
| 7-07 | Speed PID Feedback Gear Ratio | 1 N/A | All set-ups | | FALSE | -4 | Uint32 |
| 7-08 | Speed PID Feed Forward Factor | 0% | All set-ups | | FALSE | 0 | Uint16 |
| 7-09 | Speed PID Error Correction w/ Ramp | 300 RPM | All set-ups | | TRUE | 67 | Uint32 |
| **7-1* Torque PI Ctrl.** | | | | | | | |
| 7-12 | Torque PI Proportional Gain | 100% | All set-ups | | TRUE | 0 | Uint16 |
| 7-13 | Torque PI Integration Time | 0.020 s | All set-ups | | TRUE | -3 | Uint16 |
| 7-19 | Current Controller Rise Time | 100% | All set-ups | | TRUE | 0 | Uint16 |
| **7-2* Process Ctrl. Feedb** | | | | | | | |
| 7-20 | Process CL Feedback 1 Resource | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 7-22 | Process CL Feedback 2 Resource | [0] No function | All set-ups | | TRUE | - | Uint8 |
| **7-3* Process PID Ctrl.** | | | | | | | |
| 7-30 | Process PID Normal/Inverse Control | [0] Normal | All set-ups | | TRUE | - | Uint8 |
| 7-31 | Process PID Anti Windup | [1] On | All set-ups | | TRUE | - | Uint8 |
| 7-32 | Process PID Start Speed | 0 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 7-33 | Process PID Proportional Gain | 0.01 N/A | All set-ups | | TRUE | -2 | Uint16 |
| 7-34 | Process PID Integral Time | 10000 s | All set-ups | | TRUE | -2 | Uint32 |
| 7-35 | Process PID Differentiation Time | 0 s | All set-ups | | TRUE | -2 | Uint16 |
| 7-36 | Process PID Diff. Gain Limit | 5 N/A | All set-ups | | TRUE | -1 | Uint16 |
| 7-38 | Process PID Feed Forward Factor | 0% | All set-ups | | TRUE | 0 | Uint16 |
| 7-39 | On Reference Bandwidth | 5% | All set-ups | | TRUE | 0 | Uint8 |
| **7-4* Adv. Process PID I** | | | | | | | |
| 7-40 | Process PID I-part Reset | [0] No | All set-ups | | TRUE | - | Uint8 |
| 7-41 | Process PID Output Neg. Clamp | -100% | All set-ups | | TRUE | 0 | Int16 |
| 7-42 | Process PID Output Pos. Clamp | 100% | All set-ups | | TRUE | 0 | Int16 |
| 7-43 | Process PID Gain Scale at Min. Ref. | 100% | All set-ups | | TRUE | 0 | Int16 |
| 7-44 | Process PID Gain Scale at Max. Ref. | 100% | All set-ups | | TRUE | 0 | Int16 |
| 7-45 | Process PID Feed Fwd Resource | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 7-46 | Process PID Feed Fwd Normal/ Inv. Ctrl. | [0] Normal | All set-ups | | TRUE | - | Uint8 |
| 7-48 | PCD Feed Forward | 0 N/A | All set-ups | x | TRUE | 0 | Uint16 |
| 7-49 | Process PID Output Normal/Inv. Ctrl. | [0] Normal | All set-ups | | TRUE | - | Uint8 |
| **7-5* Adv. Process PID II** | | | | | | | |
| 7-50 | Process PID Extended PID | [1] Enabled | All set-ups | | TRUE | - | Uint8 |
| 7-51 | Process PID Feed Fwd Gain | 1 N/A | All set-ups | | TRUE | -2 | Uint16 |
| 7-52 | Process PID Feed Fwd Ramp up | 0.01 s | All set-ups | | TRUE | -2 | Uint32 |
| 7-53 | Process PID Feed Fwd Ramp down | 0.01 s | All set-ups | | TRUE | -2 | Uint32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 7-56 | Process PID Ref. Filter Time | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| 7-57 | Process PID Fb. Filter Time | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |

## 4.1.12 8-** Comm. and Options



| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **8-0* General Settings** | | | | | | | |
| 8-01 | Control Site | [0] Digital and ctrl.word | All set-ups | | TRUE | - | Uint8 |
| 8-02 | Control Word Source | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 8-03 | Control Word Timeout Time | 1 s | 1 set-up | | TRUE | -1 | Uint32 |
| 8-04 | Control Word Timeout Function | ExpressionLimit | 1 set-up | | TRUE | - | Uint8 |
| 8-05 | End-of-Timeout Function | [1] Resume set-up | 1 set-up | | TRUE | - | Uint8 |
| 8-06 | Reset Control Word Timeout | [0] Do not reset | All set-ups | | TRUE | - | Uint8 |
| 8-07 | Diagnosis Trigger | [0] Disable | 2 set-ups | | TRUE | - | Uint8 |
| 8-08 | Readout Filtering | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| **8-1* Ctrl. Word Settings** | | | | | | | |
| 8-10 | Control Word Profile | [0] FC profile | All set-ups | | TRUE | - | Uint8 |
| 8-13 | Configurable Status Word STW | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 8-14 | Configurable Control Word CTW | [1] Profile default | All set-ups | | TRUE | - | Uint8 |
| 8-19 | Product Code | ExpressionLimit | 1 set-up | | TRUE | 0 | Uint32 |
| **8-3* FC Port Settings** | | | | | | | |
| 8-30 | Protocol | [0] FC | 1 set-up | | TRUE | - | Uint8 |
| 8-31 | Address | 1 N/A | 1 set-up | | TRUE | 0 | Uint8 |
| 8-32 | FC Port Baud Rate | ExpressionLimit | 1 set-up | | TRUE | - | Uint8 |
| 8-33 | Parity/Stop bits | [0] Even Parity, 1 Stop bit | 1 set-up | | TRUE | - | Uint8 |
| 8-34 | Estimated cycle time | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| 8-35 | Minimum Response Delay | 10 ms | 1 set-up | | TRUE | -3 | Uint16 |
| 8-36 | Max. Response Delay | ExpressionLimit | 1 set-up | | TRUE | -3 | Uint16 |
| 8-37 | Max. Inter-Char Delay | ExpressionLimit | 1 set-up | | TRUE | -5 | Uint16 |
| **8-4* FC MC protocol set** | | | | | | | |
| 8-40 | Telegram Selection | [1] Standard telegram 1 | 2 set-ups | | TRUE | - | Uint8 |
| 8-41 | Parameters for Signals | 0 | All set-ups | | FALSE | - | Uint16 |
| 8-42 | PCD Write Configuration | ExpressionLimit | 2 set-ups | | TRUE | 0 | Uint16 |
| 8-43 | PCD Read Configuration | ExpressionLimit | 2 set-ups | | TRUE | 0 | Uint16 |
| 8-45 | BTM Transaction Command | [0] Off | All set-ups | | FALSE | - | Uint8 |
| 8-46 | BTM Transaction Status | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 8-47 | BTM Timeout | 60 s | 1 set-up | | FALSE | 0 | Uint16 |
| 8-48 | BTM Maximum Errors | 21 N/A | 1 set-up | | TRUE | 0 | Uint8 |
| 8-49 | BTM Error Log | 0.255 N/A | All set-ups | | TRUE | -3 | Uint32 |
| **8-5* Digital/Bus** | | | | | | | |
| 8-50 | Coasting Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-51 | Quick Stop Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-52 | DC Brake Select | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 8-53 | Start Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-54 | Reversing Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-55 | Set-up Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-56 | Preset Reference Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| 8-57 | Profidrive OFF2 Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 8-58 | Profidrive OFF3 Select | [3] Logic OR | All set-ups | | TRUE | - | Uint8 |
| **8-8* FC Port Diagnostics** | | | | | | | |
| 8-80 | Bus Message Count | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 8-81 | Bus Error Count | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 8-82 | Slave Messages Rcvd | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 8-83 | Slave Error Count | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| **8-9* Bus Jog** | | | | | | | |
| 8-90 | Bus Jog 1 Speed | 100 RPM | All set-ups | | TRUE | 67 | Uint16 |
| 8-91 | Bus Jog 2 Speed | ExpressionLimit | All set-ups | | TRUE | 67 | Uint16 |

## 4.1.13 9-** Profibus

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 9-00 | Set-point | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-07 | Actual Value | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-15 | PCD Write Configuration | ExpressionLimit | 1 set-up | | TRUE | - | Uint16 |
| 9-16 | PCD Read Configuration | ExpressionLimit | 2 set-ups | | TRUE | - | Uint16 |
| 9-18 | Node Address | 126 N/A | 1 set-up | | TRUE | 0 | Uint8 |
| 9-19 | Drive Unit System Number | 1034 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-22 | Telegram Selection | [100] None | 1 set-up | | TRUE | - | Uint8 |
| 9-23 | Parameters for Signals | 0 | All set-ups | | TRUE | - | Uint16 |
| 9-27 | Parameter Edit | [1] Enabled | 2 set-ups | | FALSE | - | Uint16 |
| 9-28 | Process Control | [1] Enable cyclic master | 2 set-ups | | FALSE | - | Uint8 |
| 9-44 | Fault Message Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-45 | Fault Code | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-47 | Fault Number | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-52 | Fault Situation Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-53 | Profibus Warning Word | 0 N/A | All set-ups | | TRUE | 0 | V2 |
| 9-63 | Actual Baud Rate | [255] No baudrate found | All set-ups | | TRUE | - | Uint8 |
| 9-64 | Device Identification | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-65 | Profile Number | 0 N/A | All set-ups | | TRUE | 0 | OctStr[2] |
| 9-67 | Control Word 1 | 0 N/A | All set-ups | | TRUE | 0 | V2 |
| 9-68 | Status Word 1 | 0 N/A | All set-ups | | TRUE | 0 | V2 |
| 9-70 | Edit Set-up | [1] Set-up 1 | All set-ups | | TRUE | - | Uint8 |
| 9-71 | Profibus Save Data Values | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 9-72 | ProfibusDriveReset | [0] No action | 1 set-up | | FALSE | - | Uint8 |
| 9-75 | DO Identification | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 9-80 | Defined Parameters (1) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-81 | Defined Parameters (2) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-82 | Defined Parameters (3) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-83 | Defined Parameters (4) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-84 | Defined Parameters (5) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-85 | Defined Parameters (6) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-90 | Changed Parameters (1) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-91 | Changed Parameters (2) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-92 | Changed Parameters (3) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-93 | Changed Parameters (4) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-94 | Changed Parameters (5) | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 9-99 | Profibus Revision Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |

## 4.1.14 10-** CAN Fieldbus

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **10-0* Common Settings** | | | | | | | |
| 10-00 | CAN Protocol | ExpressionLimit | 2 set-ups | | FALSE | - | Uint8 |
| 10-01 | Baud Rate Select | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 10-02 | MAC ID | ExpressionLimit | 2 set-ups | | TRUE | 0 | Uint8 |
| 10-05 | Readout Transmit Error Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint8 |
| 10-06 | Readout Receive Error Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint8 |
| 10-07 | Readout Bus Off Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint8 |
| **10-1* DeviceNet** | | | | | | | |
| 10-10 | Process Data Type Selection | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 10-11 | Process Data Config Write | ExpressionLimit | All set-ups | | TRUE | - | Uint16 |
| 10-12 | Process Data Config Read | ExpressionLimit | All set-ups | | TRUE | - | Uint16 |
| 10-13 | Warning Parameter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 10-14 | Net Reference | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 10-15 | Net Control | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| **10-2* COS Filters** | | | | | | | |
| 10-20 | COS Filter 1 | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 10-21 | COS Filter 2 | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 10-22 | COS Filter 3 | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 10-23 | COS Filter 4 | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| **10-3* Parameter Access** | | | | | | | |
| 10-30 | Array Index | 0 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 10-31 | Store Data Values | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 10-32 | DeviceNet Revision | ExpressionLimit | All set-ups | | TRUE | 0 | Uint16 |
| 10-33 | Store Always | [0] Off | 1 set-up | | TRUE | - | Uint8 |
| 10-34 | DeviceNet Product Code | ExpressionLimit | 1 set-up | | TRUE | 0 | Uint16 |
| 10-39 | Devicenet F Parameters | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| **10-5* CANopen** | | | | | | | |
| 10-50 | Process Data Config Write | ExpressionLimit | 2 set-ups | | TRUE | - | Uint16 |
| 10-51 | Process Data Config Read | ExpressionLimit | 2 set-ups | | TRUE | - | Uint16 |

## 4.1.15 12-** Ethernet

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **12-0* IP Settings** | | | | | | | |
| 12-00 | IP Address Assignment | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 12-01 | IP Address | 0 N/A | 1 set-up | | TRUE | 0 | OctStr[4] |
| 12-02 | Subnet Mask | 0 N/A | 1 set-up | | TRUE | 0 | OctStr[4] |
| 12-03 | Default Gateway | 0 N/A | 1 set-up | | TRUE | 0 | OctStr[4] |
| 12-04 | DHCP Server | 0 N/A | 2 set-ups | | TRUE | 0 | OctStr[4] |
| 12-05 | Lease Expires | ExpressionLimit | All set-ups | | TRUE | 0 | TimD |
| 12-06 | Name Servers | 0 N/A | 1 set-up | | TRUE | 0 | OctStr[4] |
| 12-07 | Domain Name | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[48] |
| 12-08 | Host Name | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[48] |
| 12-09 | Physical Address | 0 N/A | 1 set-up | | TRUE | 0 | VisStr[17] |
| **12-1* Ethernet Link Parameters** | | | | | | | |
| 12-10 | Link Status | [0] No Link | All set-ups | | TRUE | - | Uint8 |
| 12-11 | Link Duration | ExpressionLimit | All set-ups | | TRUE | 0 | TimD |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 12-12 | Auto Negotiation | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 12-13 | Link Speed | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 12-14 | Link Duplex | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| **12-2* Process Data** | | | | | | | |
| 12-20 | Control Instance | ExpressionLimit | 1 set-up | | TRUE | 0 | Uint8 |
| 12-21 | Process Data Config Write | ExpressionLimit | All set-ups | | TRUE | - | Uint16 |
| 12-22 | Process Data Config Read | ExpressionLimit | All set-ups | | TRUE | - | Uint16 |
| 12-23 | Process Data Config Write Size | 16 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-24 | Process Data Config Read Size | 16 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-27 | Master Address | 0 N/A | 2 set-ups | | FALSE | 0 | OctStr[4] |
| 12-28 | Store Data Values | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 12-29 | Store Always | [0] Off | 1 set-up | | TRUE | - | Uint8 |
| **12-3* EtherNet/IP** | | | | | | | |
| 12-30 | Warning Parameter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 12-31 | Net Reference | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 12-32 | Net Control | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 12-33 | CIP Revision | ExpressionLimit | All set-ups | | TRUE | 0 | Uint16 |
| 12-34 | CIP Product Code | ExpressionLimit | 1 set-up | | TRUE | 0 | Uint16 |
| 12-35 | EDS Parameter | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-37 | COS Inhibit Timer | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 12-38 | COS Filter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| **12-4* Modbus TCP** | | | | | | | |
| 12-40 | Status Parameter | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 12-41 | Slave Message Count | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-42 | Slave Exception Message Count | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| **12-5* EtherCAT** | | | | | | | |
| 12-50 | Configured Station Alias | 0 N/A | 1 set-up | | FALSE | 0 | Uint16 |
| 12-51 | Configured Station Address | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 12-59 | EtherCAT Status | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| **12-6* Ethernet PowerLink** | | | | | | | |
| 12-60 | Node ID | 1 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 12-62 | SDO Timeout | 30000 ms | All set-ups | | TRUE | -3 | Uint32 |
| 12-63 | Basic Ethernet Timeout | 5000.000 ms | All set-ups | | TRUE | -6 | Uint32 |
| 12-66 | Threshold | 15 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-67 | Threshold Counters | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-68 | Cumulative Counters | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-69 | Ethernet PowerLink Status | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| **12-8* Other Ethernet Services** | | | | | | | |
| 12-80 | FTP Server | [0] Disabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-81 | HTTP Server | [0] Disabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-82 | SMTP Service | [0] Disabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-89 | Transparent Socket Channel Port | ExpressionLimit | 2 set-ups | | TRUE | 0 | Uint16 |
| **12-9* Advanced Ethernet Services** | | | | | | | |
| 12-90 | Cable Diagnostic | [0] Disabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-91 | Auto Crossover | [1] Enabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-92 | IGMP Snooping | [1] Enabled | 2 set-ups | | TRUE | - | Uint8 |
| 12-93 | Cable Error Length | 0 N/A | 1 set-up | | TRUE | 0 | Uint16 |
| 12-94 | Broadcast Storm Protection | -1% | 2 set-ups | | TRUE | 0 | Int8 |
| 12-95 | Broadcast Storm Filter | [0] Broadcast only | 2 set-ups | | TRUE | - | Uint8 |
| 12-96 | Port Config | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 12-98 | Interface Counters | 4000 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 12-99 | Media Counters | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |

## 4.1.16 13-** Smart Logic



| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **13-0* SLC Settings** | | | | | | | |
| 13-00 | SL Controller Mode | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-01 | Start Event | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-02 | Stop Event | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-03 | Reset SLC | [0] Do not reset SLC | All set-ups | | TRUE | - | Uint8 |
| **13-1* Comparators** | | | | | | | |
| 13-10 | Comparator Operand | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-11 | Comparator Operator | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-12 | Comparator Value | ExpressionLimit | 2 set-ups | | TRUE | -3 | Int32 |
| **13-1* RS Flip Flops** | | | | | | | |
| 13-15 | RS-FF Operand S | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-16 | RS-FF Operand R | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| **13-2* Timers** | | | | | | | |
| 13-20 | SL Controller Timer | ExpressionLimit | 1 set-up | | TRUE | -3 | TimD |
| **13-4* Logic Rules** | | | | | | | |
| 13-40 | Logic Rule Boolean 1 | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-41 | Logic Rule Operator 1 | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-42 | Logic Rule Boolean 2 | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-43 | Logic Rule Operator 2 | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-44 | Logic Rule Boolean 3 | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| **13-5* States** | | | | | | | |
| 13-51 | SL Controller Event | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |
| 13-52 | SL Controller Action | ExpressionLimit | 2 set-ups | | TRUE | - | Uint8 |

## 4.1.17 14-** Special Functions

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **14-0* Inverter Switching** | | | | | | | |
| 14-00 | Switching Pattern | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 14-01 | Switching Frequency | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 14-03 | Overmodulation | [1] On | All set-ups | | FALSE | - | Uint8 |
| 14-04 | PWM Random | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 14-06 | Dead Time Compensation | [1] On | All set-ups | | TRUE | - | Uint8 |
| **14-1* Mains On/Off** | | | | | | | |
| 14-10 | Mains Failure | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 14-11 | Mains Voltage at Mains Fault | ExpressionLimit | All set-ups | | TRUE | 0 | Uint16 |
| 14-12 | Function at Mains Imbalance | [0] Trip | All set-ups | | TRUE | - | Uint8 |
| 14-13 | Mains Failure Step Factor | 1 N/A | All set-ups | | TRUE | -1 | Uint8 |
| 14-14 | Kin. back-up Timeout | 60 s | All set-ups | | TRUE | 0 | Uint8 |
| 14-15 | Kin. back-up Trip Recovery Level | ExpressionLimit | All set-ups | | TRUE | -3 | Uint32 |
| 14-16 | Kin. back-up Gain | 100% | All set-ups | x | TRUE | 0 | Uint32 |

  

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **14-2* Trip Reset** | | | | | | | |
| 14-20 | Reset Mode | [0] Manual reset | All set-ups | | TRUE | - | Uint8 |
| 14-21 | Automatic Restart Time | ExpressionLimit | All set-ups | | TRUE | 0 | Uint16 |
| 14-22 | Operation Mode | [0] Normal operation | All set-ups | | TRUE | - | Uint8 |
| 14-24 | Trip Delay at Current Limit | 60 s | All set-ups | | TRUE | 0 | Uint8 |
| 14-25 | Trip Delay at Torque Limit | 60 s | All set-ups | | TRUE | 0 | Uint8 |
| 14-26 | Trip Delay at Inverter Fault | ExpressionLimit | All set-ups | | TRUE | 0 | Uint8 |
| 14-28 | Production Settings | [0] No action | All set-ups | | TRUE | - | Uint8 |
| 14-29 | Service Code | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| **14-3* Current Limit Ctrl.** | | | | | | | |
| 14-30 | Current Lim Ctrl, Proportional Gain | 100% | All set-ups | | FALSE | 0 | Uint16 |
| 14-31 | Current Lim Ctrl, Integration Time | ExpressionLimit | All set-ups | | FALSE | -3 | Uint16 |
| 14-32 | Current Lim Ctrl, Filter Time | ExpressionLimit | All set-ups | | TRUE | -4 | Uint16 |
| 14-35 | Stall Protection | [1] Enabled | All set-ups | | FALSE | - | Uint8 |
| 14-36 | Fieldweakening Function | [0] Auto | All set-ups | x | TRUE | - | Uint8 |
| **14-4* Energy Optimising** | | | | | | | |
| 14-40 | VT Level | 66% | All set-ups | | FALSE | 0 | Uint8 |
| 14-41 | AEO Minimum Magnetisation | ExpressionLimit | All set-ups | | TRUE | 0 | Uint8 |
| 14-42 | Minimum AEO Frequency | ExpressionLimit | All set-ups | | TRUE | 0 | Uint8 |
| 14-43 | Motor Cosphi | ExpressionLimit | All set-ups | | TRUE | -2 | Uint16 |
| **14-5* Environment** | | | | | | | |
| 14-50 | RFI Filter | [1] On | 1 set-up | | FALSE | - | Uint8 |
| 14-51 | DC Link Compensation | ExpressionLimit | All set-ups | | TRUE | - | Uint8 |
| 14-52 | Fan Control | [0] Auto | All set-ups | | TRUE | - | Uint8 |
| 14-53 | Fan Monitor | [1] Warning | All set-ups | | TRUE | - | Uint8 |
| 14-55 | Output Filter | [0] No Filter | All set-ups | | FALSE | - | Uint8 |
| 14-56 | Capacitance Output Filter | ExpressionLimit | All set-ups | | FALSE | -7 | Uint16 |
| 14-57 | Inductance Output Filter | ExpressionLimit | All set-ups | | FALSE | -6 | Uint16 |
| 14-59 | Actual Number of Inverter Units | ExpressionLimit | 1 set-up | x | FALSE | 0 | Uint8 |
| **14-7* Compatibility** | | | | | | | |
| 14-72 | Legacy Alarm Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 14-73 | Legacy Warning Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 14-74 | Leg. Ext. Status Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| **14-8* Options** | | | | | | | |
| 14-80 | Option Supplied by External 24VDC | [1] Yes | 2 set-ups | | FALSE | - | Uint8 |
| 14-88 | Option Data Storage | 0 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 14-89 | Option Detection | [0] Protect Option Config. | 1 set-up | | TRUE | - | Uint8 |
| **14-9* Fault Settings** | | | | | | | |
| 14-90 | Fault Level | ExpressionLimit | 1 set-up | | TRUE | - | Uint8 |

## 4.1.18 15-** Drive Information

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **15-0* Operating Data** | | | | | | | |
| 15-00 | Operating hours | 0 h | All set-ups | | FALSE | 74 | Uint32 |
| 15-01 | Running Hours | 0 h | All set-ups | | FALSE | 74 | Uint32 |
| 15-02 | kWh Counter | 0 kWh | All set-ups | | FALSE | 75 | Uint32 |
| 15-03 | Power-up's | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 15-04 | Over Temp's | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 15-05 | Over Volt's | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 15-06 | Reset kWh Counter | [0] Do not reset | All set-ups | | TRUE | - | Uint8 |
| 15-07 | Reset Running Hours Counter | [0] Do not reset | All set-ups | | TRUE | - | Uint8 |
| **15-1* Data Log Settings** | | | | | | | |
| 15-10 | Logging Source | 0 | 2 set-ups | | TRUE | - | Uint16 |
| 15-11 | Logging Interval | ExpressionLimit | 2 set-ups | | TRUE | -3 | TimD |
| 15-12 | Trigger Event | [0] False | 1 set-up | | TRUE | - | Uint8 |
| 15-13 | Logging Mode | [0] Log always | 2 set-ups | | TRUE | - | Uint8 |
| 15-14 | Samples Before Trigger | 50 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| **15-2* Historic Log** | | | | | | | |
| 15-20 | Historic Log: Event | 0 N/A | All set-ups | | FALSE | 0 | Uint8 |
| 15-21 | Historic Log: Value | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 15-22 | Historic Log: Time | 0 ms | All set-ups | | FALSE | -3 | Uint32 |
| **15-3* Fault Log** | | | | | | | |
| 15-30 | Fault Log: Error Code | 0 N/A | All set-ups | | FALSE | 0 | Uint8 |
| 15-31 | Fault Log: Value | 0 N/A | All set-ups | | FALSE | 0 | Int16 |
| 15-32 | Fault Log: Time | 0 s | All set-ups | | FALSE | 0 | Uint32 |
| **15-4* Drive Identification** | | | | | | | |
| 15-40 | FC Type | 0 N/A | All set-ups | | FALSE | 0 | VisStr[6] |
| 15-41 | Power Section | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-42 | Voltage | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-43 | Software Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[5] |
| 15-44 | Ordered Typecode String | 0 N/A | All set-ups | | FALSE | 0 | VisStr[40] |
| 15-45 | Actual Typecode String | 0 N/A | All set-ups | | FALSE | 0 | VisStr[40] |
| 15-46 | Frequency Converter Ordering No. | 0 N/A | All set-ups | | FALSE | 0 | VisStr[8] |
| 15-47 | Power Card Ordering No. | 0 N/A | All set-ups | | FALSE | 0 | VisStr[8] |
| 15-48 | LCP Id No | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-49 | SW ID Control Card | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-50 | SW ID Power Card | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-51 | Frequency Converter Serial Number | 0 N/A | All set-ups | | FALSE | 0 | VisStr[10] |
| 15-53 | Power Card Serial Number | 0 N/A | All set-ups | | FALSE | 0 | VisStr[19] |
| 15-58 | Smart Setup Filename | ExpressionLimit | 1 set-up | | TRUE | 0 | VisStr[16] |
| 15-59 | CSIV Filename | ExpressionLimit | 1 set-up | | FALSE | 0 | VisStr[16] |
| **15-6* Option Ident** | | | | | | | |
| 15-60 | Option Mounted | 0 N/A | All set-ups | | FALSE | 0 | VisStr[30] |
| 15-61 | Option SW Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-62 | Option Ordering No | 0 N/A | All set-ups | | FALSE | 0 | VisStr[8] |
| 15-63 | Option Serial No | 0 N/A | All set-ups | | FALSE | 0 | VisStr[18] |
| 15-70 | Option in Slot A | 0 N/A | All set-ups | | FALSE | 0 | VisStr[30] |
| 15-71 | Slot A Option SW Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-72 | Option in Slot B | 0 N/A | All set-ups | | FALSE | 0 | VisStr[30] |
| 15-73 | Slot B Option SW Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-74 | Option in Slot C0/E0 | 0 N/A | All set-ups | | FALSE | 0 | VisStr[30] |
| 15-75 | Slot C0/E0 Option SW Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| 15-76 | Option in Slot C1/E1 | 0 N/A | All set-ups | | FALSE | 0 | VisStr[30] |
| 15-77 | Slot C1/E1 Option SW Version | 0 N/A | All set-ups | | FALSE | 0 | VisStr[20] |
| **15-8* Operating Data II** | | | | | | | |
| 15-80 | Fan Running Hours | 0 h | All set-ups | | TRUE | 74 | Uint32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 15-81 | Preset Fan Running Hours | 0 h | All set-ups | | TRUE | 74 | Uint32 |
| 15-89 | Configuration Change Counter | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| **15-9* Parameter Info** | | | | | | | |
| 15-92 | Defined Parameters | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 15-93 | Modified Parameters | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 15-98 | Drive Identification | 0 N/A | All set-ups | | FALSE | 0 | VisStr[40] |
| 15-99 | Parameter Metadata | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |



## 4.1.19 16-** Data Readouts

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **16-0* General Status** | | | | | | | |
| 16-00 | Control Word | 0 N/A | All set-ups | | FALSE | 0 | V2 |
| 16-01 | Reference [Unit] | 0 ReferenceFeedbackUnit | All set-ups | | FALSE | -3 | Int32 |
| 16-02 | Reference % | 0% | All set-ups | | FALSE | -1 | Int16 |
| 16-03 | Status Word | 0 N/A | All set-ups | | FALSE | 0 | V2 |
| 16-05 | Main Actual Value [%] | 0% | All set-ups | | FALSE | -2 | N2 |
| 16-09 | Custom Readout | 0 CustomReadoutUnit | All set-ups | | FALSE | -2 | Int32 |
| **16-1* Motor Status** | | | | | | | |
| 16-10 | Power [kW] | 0 kW | All set-ups | | FALSE | 1 | Int32 |
| 16-11 | Power [hp] | 0 hp | All set-ups | | FALSE | -2 | Int32 |
| 16-12 | Motor Voltage | 0 V | All set-ups | | FALSE | -1 | Uint16 |
| 16-13 | Frequency | 0 Hz | All set-ups | | FALSE | -1 | Uint16 |
| 16-14 | Motor current | 0 A | All set-ups | | FALSE | -2 | Int32 |
| 16-15 | Frequency [%] | 0% | All set-ups | | FALSE | -2 | N2 |
| 16-16 | Torque [Nm] | 0 Nm | All set-ups | | FALSE | -1 | Int16 |
| 16-17 | Speed [RPM] | 0 RPM | All set-ups | | FALSE | 67 | Int32 |
| 16-18 | Motor Thermal | 0% | All set-ups | | FALSE | 0 | Uint8 |
| 16-19 | KTY sensor temperature | 0 °C | All set-ups | | FALSE | 100 | Int16 |
| 16-20 | Motor Angle | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 16-21 | Torque [%] High Res. | 0% | All set-ups | | FALSE | -1 | Int16 |
| 16-22 | Torque [%] | 0% | All set-ups | | FALSE | 0 | Int16 |
| 16-23 | Motor Shaft Power [kW] | 0 kW | All set-ups | | TRUE | 1 | Int32 |
| 16-24 | Calibrated Stator Resistance | 0.0000 Ohm | All set-ups | x | TRUE | -4 | Uint32 |
| 16-25 | Torque [Nm] High | 0 Nm | All set-ups | | FALSE | -1 | Int32 |
| **16-3* Drive Status** | | | | | | | |
| 16-30 | DC Link Voltage | 0 V | All set-ups | | FALSE | 0 | Uint16 |
| 16-32 | Brake Energy /s | 0 kW | All set-ups | | FALSE | 0 | Uint32 |
| 16-33 | Brake Energy /2 min | 0 kW | All set-ups | | FALSE | 0 | Uint32 |
| 16-34 | Heat sink Temp. | 0 °C | All set-ups | | FALSE | 100 | Uint8 |
| 16-35 | Inverter Thermal | 0% | All set-ups | | FALSE | 0 | Uint8 |
| 16-36 | Inv. Nom. Current | ExpressionLimit | All set-ups | | FALSE | -2 | Uint32 |
| 16-37 | Inv. Max. Current | ExpressionLimit | All set-ups | | FALSE | -2 | Uint32 |
| 16-38 | SL Controller State | 0 N/A | All set-ups | | FALSE | 0 | Uint8 |
| 16-39 | Control Card Temp. | 0 °C | All set-ups | | FALSE | 100 | Uint8 |
| 16-40 | Logging Buffer Full | [0] No | All set-ups | | TRUE | - | Uint8 |
| 16-41 | LCP Bottom Status line | 0 N/A | All set-ups | | TRUE | 0 | VisStr[50] |
| 16-45 | Motor Phase U Current | 0 A | All set-ups | | TRUE | -2 | Int32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 16-46 | Motor Phase V Current | 0 A | All set-ups | | TRUE | -2 | Int32 |
| 16-47 | Motor Phase W Current | 0 A | All set-ups | | TRUE | -2 | Int32 |
| 16-48 | Speed Ref. After Ramp [RPM] | 0 RPM | All set-ups | | FALSE | 67 | Int32 |
| 16-49 | Current Fault Source | 0 N/A | All set-ups | x | TRUE | 0 | Uint8 |
| **16-5* Ref. & Feedb.** | | | | | | | |
| 16-50 | External Reference | 0 N/A | All set-ups | | FALSE | -1 | Int16 |
| 16-51 | Pulse Reference | 0 N/A | All set-ups | | FALSE | -1 | Int16 |
| 16-52 | Feedback [Unit] | 0 ReferenceFeedbackUnit | All set-ups | | FALSE | -3 | Int32 |
| 16-53 | Digi Pot Reference | 0 N/A | All set-ups | | FALSE | -2 | Int16 |
| 16-57 | Feedback [RPM] | 0 RPM | All set-ups | | FALSE | 67 | Int32 |
| **16-6* Inputs & Outputs** | | | | | | | |
| 16-60 | Digital Input | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| 16-61 | Terminal 53 Switch Setting | [0] Current | All set-ups | | FALSE | - | Uint8 |
| 16-62 | Analog Input 53 | 0 N/A | All set-ups | | FALSE | -3 | Int32 |
| 16-63 | Terminal 54 Switch Setting | [0] Current | All set-ups | | FALSE | - | Uint8 |
| 16-64 | Analog Input 54 | 0 N/A | All set-ups | | FALSE | -3 | Int32 |
| 16-65 | Analog Output 42 [mA] | 0 N/A | All set-ups | | FALSE | -3 | Int16 |
| 16-66 | Digital Output [bin] | 0 N/A | All set-ups | | FALSE | 0 | Int16 |
| 16-67 | Freq. Input #29 [Hz] | 0 N/A | All set-ups | x | FALSE | 0 | Int32 |
| 16-68 | Freq. Input #33 [Hz] | 0 N/A | All set-ups | | FALSE | 0 | Int32 |
| 16-69 | Pulse Output #27 [Hz] | 0 N/A | All set-ups | | FALSE | 0 | Int32 |
| 16-70 | Pulse Output #29 [Hz] | 0 N/A | All set-ups | x | FALSE | 0 | Int32 |
| 16-71 | Relay Output [bin] | 0 N/A | All set-ups | | FALSE | 0 | Int16 |
| 16-72 | Counter A | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 16-73 | Counter B | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 16-74 | Prec. Stop Counter | 0 N/A | All set-ups | | TRUE | 0 | Uint32 |
| 16-75 | Analog In X30/11 | 0 N/A | All set-ups | | FALSE | -3 | Int32 |
| 16-76 | Analog In X30/12 | 0 N/A | All set-ups | | FALSE | -3 | Int32 |
| 16-77 | Analog Out X30/8 [mA] | 0 N/A | All set-ups | | FALSE | -3 | Int16 |
| 16-78 | Analog Out X45/1 [mA] | 0 N/A | All set-ups | | FALSE | -3 | Int16 |
| 16-79 | Analog Out X45/3 [mA] | 0 N/A | All set-ups | | FALSE | -3 | Int16 |
| **16-8* Fieldbus & FC Port** | | | | | | | |
| 16-80 | Fieldbus CTW 1 | 0 N/A | All set-ups | | FALSE | 0 | V2 |
| 16-82 | Fieldbus REF 1 | 0 N/A | All set-ups | | FALSE | 0 | N2 |
| 16-84 | Comm. Option STW | 0 N/A | All set-ups | | FALSE | 0 | V2 |
| 16-85 | FC Port CTW 1 | 0 N/A | All set-ups | | FALSE | 0 | V2 |
| 16-86 | FC Port REF 1 | 0 N/A | All set-ups | | FALSE | 0 | N2 |
| 16-87 | Bus Readout Alarm/Warning | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| **16-9* Diagnosis Readouts** | | | | | | | |
| 16-90 | Alarm Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 16-91 | Alarm Word 2 | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 16-92 | Warning Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 16-93 | Warning Word 2 | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 16-94 | Ext. Status Word | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |

  

## 4.1.20 17-** Motor Feedb.Option

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **17-1* Inc. Enc. Interface** | | | | | | | |
| 17-10 | Signal Type | [1] RS422 (5V TTL) | All set-ups | | FALSE | - | Uint8 |
| 17-11 | Resolution (PPR) | 1024 N/A | All set-ups | | FALSE | 0 | Uint16 |
| **17-2* Abs. Enc. Interface** | | | | | | | |
| 17-20 | Protocol Selection | [0] None | All set-ups | | FALSE | - | Uint8 |
| 17-21 | Resolution (Positions/Rev) | ExpressionLimit | All set-ups | | FALSE | 0 | Uint32 |
| 17-24 | SSI Data Length | 13 N/A | All set-ups | | FALSE | 0 | Uint8 |
| 17-25 | Clock Rate | ExpressionLimit | All set-ups | | FALSE | 3 | Uint16 |
| 17-26 | SSI Data Format | [0] Gray code | All set-ups | | FALSE | - | Uint8 |
| 17-34 | HIPERFACE Baudrate | [4] 9600 | All set-ups | | FALSE | - | Uint8 |
| **17-5* Resolver Interface** | | | | | | | |
| 17-50 | Poles | 2 N/A | 1 set-up | | FALSE | 0 | Uint8 |
| 17-51 | Input Voltage | 7 V | 1 set-up | | FALSE | -1 | Uint8 |
| 17-52 | Input Frequency | 10 kHz | 1 set-up | | FALSE | 2 | Uint8 |
| 17-53 | Transformation Ratio | 0.5 N/A | 1 set-up | | FALSE | -1 | Uint8 |
| 17-56 | Encoder Sim. Resolution | [0] Disabled | 1 set-up | | FALSE | - | Uint8 |
| 17-59 | Resolver Interface | [0] Disabled | All set-ups | | FALSE | - | Uint8 |
| **17-6* Monitoring and App.** | | | | | | | |
| 17-60 | Feedback Direction | [0] Clockwise | All set-ups | | FALSE | - | Uint8 |
| 17-61 | Feedback Signal Monitoring | [1] Warning | All set-ups | | TRUE | - | Uint8 |

## 4.1.21 18-** Data Readouts 2

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **18-3* Analog Readouts** | | | | | | | |
| 18-36 | Analog Input X48/2 [mA] | 0 N/A | All set-ups | | TRUE | -3 | Int32 |
| 18-37 | Temp. Input X48/4 | 0 N/A | All set-ups | | TRUE | 0 | Int16 |
| 18-38 | Temp. Input X48/7 | 0 N/A | All set-ups | | TRUE | 0 | Int16 |
| 18-39 | Temp. Input X48/10 | 0 N/A | All set-ups | | TRUE | 0 | Int16 |
| **18-6* Inputs & Outputs 2** | | | | | | | |
| 18-60 | Digital Input 2 | 0 N/A | All set-ups | | FALSE | 0 | Uint16 |
| **18-9* PID Readouts** | | | | | | | |
| 18-90 | Process PID Error | 0% | All set-ups | | FALSE | -1 | Int16 |
| 18-91 | Process PID Output | 0% | All set-ups | | FALSE | -1 | Int16 |
| 18-92 | Process PID Clamped Output | 0% | All set-ups | | FALSE | -1 | Int16 |
| 18-93 | Process PID Gain Scaled Output | 0% | All set-ups | | FALSE | -1 | Int16 |

## 4.1.22 30-** Special Features

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **30-0* Wobbler** | | | | | | | |
| 30-00 | Wobble Mode | [0] Abs. Freq., Abs. Time | All set-ups | | FALSE | - | Uint8 |
| 30-01 | Wobble Delta Frequency [Hz] | 5 Hz | All set-ups | | TRUE | -1 | Uint8 |
| 30-02 | Wobble Delta Frequency [%] | 25% | All set-ups | | TRUE | 0 | Uint8 |
| 30-03 | Wobble Delta Freq. Scaling Resource | [0] No function | All set-ups | | TRUE | - | Uint8 |
| 30-04 | Wobble Jump Frequency [Hz] | 0 Hz | All set-ups | | TRUE | -1 | Uint8 |
| 30-05 | Wobble Jump Frequency [%] | 0% | All set-ups | | TRUE | 0 | Uint8 |
| 30-06 | Wobble Jump Time | ExpressionLimit | All set-ups | | TRUE | -3 | Uint16 |
| 30-07 | Wobble Sequence Time | 10 s | All set-ups | | TRUE | -1 | Uint16 |
| 30-08 | Wobble Up/Down Time | 5 s | All set-ups | | TRUE | -1 | Uint16 |
| 30-09 | Wobble Random Function | [0] Off | All set-ups | | TRUE | - | Uint8 |
| 30-10 | Wobble Ratio | 1 N/A | All set-ups | | TRUE | -1 | Uint8 |
| 30-11 | Wobble Random Ratio Max. | 10 N/A | All set-ups | | TRUE | -1 | Uint8 |
| 30-12 | Wobble Random Ratio Min. | 0.1 N/A | All set-ups | | TRUE | -1 | Uint8 |
| 30-19 | Wobble Delta Freq. Scaled | 0 Hz | All set-ups | | FALSE | -1 | Uint16 |
| **30-2* Adv. Start Adjust** | | | | | | | |
| 30-20 | High Starting Torque Time [s] | ExpressionLimit | All set-ups | x | TRUE | -2 | Uint16 |
| 30-21 | High Starting Torque Current [%] | ExpressionLimit | All set-ups | x | TRUE | -1 | Uint32 |
| 30-22 | Locked Rotor Protection | ExpressionLimit | All set-ups | x | TRUE | - | Uint8 |
| 30-23 | Locked Rotor Detection Time [s] | ExpressionLimit | All set-ups | x | TRUE | -2 | Uint8 |
| **30-8* Compatibility (I)** | | | | | | | |
| 30-80 | d-axis Inductance (Ld) | ExpressionLimit | All set-ups | x | FALSE | -6 | Int32 |
| 30-81 | Brake Resistor (ohm) | ExpressionLimit | 1 set-up | | TRUE | -2 | Uint32 |
| 30-83 | Speed PID Proportional Gain | ExpressionLimit | All set-ups | | TRUE | -4 | Uint32 |
| 30-84 | Process PID Proportional Gain | 0.100 N/A | All set-ups | | TRUE | -3 | Uint16 |

## 4.1.23 32-** MCO Basic Settings

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **32-0* Encoder 2** | | | | | | | |
| 32-00 | Incremental Signal Type | [1] RS422 (5V TTL) | 2 set-ups | | TRUE | - | Uint8 |
| 32-01 | Incremental Resolution | 1024 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-02 | Absolute Protocol | [0] None | 2 set-ups | | TRUE | - | Uint8 |
| 32-03 | Absolute Resolution | 8192 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-04 | Absolute Encoder Baudrate X55 | [4] 9600 | All set-ups | | FALSE | - | Uint8 |
| 32-05 | Absolute Encoder Data Length | 25 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 32-06 | Absolute Encoder Clock Frequency | 262 kHz | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-07 | Absolute Encoder Clock Generation | [1] On | 2 set-ups | | TRUE | - | Uint8 |

  

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 32-08 | Absolute Encoder Cable Length | 0 m | 2 set-ups | | TRUE | 0 | Uint16 |
| 32-09 | Encoder Monitoring | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 32-10 | Rotational Direction | [1] No action | 2 set-ups | | TRUE | - | Uint8 |
| 32-11 | User Unit Denominator | 1 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-12 | User Unit Numerator | 1 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-13 | Enc.2 Control | [0] No soft changing | 2 set-ups | | TRUE | - | Uint8 |
| 32-14 | Enc.2 node ID | 127 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 32-15 | Enc.2 CAN guard | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| **32-3* Encoder 1** | | | | | | | |
| 32-30 | Incremental Signal Type | [1] RS422 (5V TTL) | 2 set-ups | | TRUE | - | Uint8 |
| 32-31 | Incremental Resolution | 1024 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-32 | Absolute Protocol | [0] None | 2 set-ups | | TRUE | - | Uint8 |
| 32-33 | Absolute Resolution | 8192 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-35 | Absolute Encoder Data Length | 25 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 32-36 | Absolute Encoder Clock Frequency | 262 kHz | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-37 | Absolute Encoder Clock Generation | [1] On | 2 set-ups | | TRUE | - | Uint8 |
| 32-38 | Absolute Encoder Cable Length | 0 m | 2 set-ups | | TRUE | 0 | Uint16 |
| 32-39 | Encoder Monitoring | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 32-40 | Encoder Termination | [1] On | 2 set-ups | | TRUE | - | Uint8 |
| 32-43 | Enc.1 Control | [0] No soft changing | 2 set-ups | | TRUE | - | Uint8 |
| 32-44 | Enc.1 node ID | 127 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 32-45 | Enc.1 CAN guard | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| **32-5* Feedback Source** | | | | | | | |
| 32-50 | Source Slave | [2] Encoder 2 X55 | 2 set-ups | | TRUE | - | Uint8 |
| 32-51 | MCO 302 Last Will | [1] Trip | 2 set-ups | | TRUE | - | Uint8 |
| 32-52 | Source Master | [1] Encoder 1 X56 | 2 set-ups | | TRUE | - | Uint8 |
| **32-6* PID Controller** | | | | | | | |
| 32-60 | Proportional factor | 30 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-61 | Derivative factor | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-62 | Integral factor | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-63 | Limit Value for Integral Sum | 1000 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 32-64 | PID Bandwidth | 1000 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 32-65 | Velocity Feed Forward | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-66 | Acceleration Feed Forward | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-67 | Max. Tolerated Position Error | 20000 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-68 | Reverse Behaviour for Slave | [0] Reversing allowed | 2 set-ups | | TRUE | - | Uint8 |
| 32-69 | Sampling Time for PID Control | 1 ms | 2 set-ups | | TRUE | -3 | Uint16 |
| 32-70 | Scan Time for Profile Generator | 1 ms | 2 set-ups | | TRUE | -3 | Uint8 |
| 32-71 | Size of the Control Window (Activation) | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-72 | Size of the Control Window (Deactiv.) | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-73 | Integral limit filter time | 0 ms | 2 set-ups | | TRUE | -3 | Int16 |
| 32-74 | Position error filter time | 0 ms | 2 set-ups | | TRUE | -3 | Int16 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **32-8* Velocity & Accel.** | | | | | | | |
| 32-80 | Maximum Velocity (Encoder) | 1500 RPM | 2 set-ups | | TRUE | 67 | Uint32 |
| 32-81 | Shortest Ramp | 1 s | 2 set-ups | | TRUE | -3 | Uint32 |
| 32-82 | Ramp Type | [0] Linear | 2 set-ups | | TRUE | - | Uint8 |
| 32-83 | Velocity Resolution | 100 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-84 | Default Velocity | 50 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-85 | Default Acceleration | 50 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 32-86 | Acc. up for limited jerk | 100 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| 32-87 | Acc. down for limited jerk | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| 32-88 | Dec. up for limited jerk | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| 32-89 | Dec. down for limited jerk | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| **32-9* Development** | | | | | | | |
| 32-90 | Debug Source | [0] Control card | 2 set-ups | | TRUE | - | Uint8 |

## 4.1.24 33-** MCO Adv. Settings

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **33-0* Home Motion** | | | | | | | |
| 33-00 | Force HOME | [0] Home not forced | 2 set-ups | | TRUE | - | Uint8 |
| 33-01 | Zero Point Offset from Home Pos. | 0 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-02 | Ramp for Home Motion | 10 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-03 | Velocity of Home Motion | 10 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-04 | Behaviour during Home Motion | [0] Reverse and index | 2 set-ups | | TRUE | - | Uint8 |
| **33-1* Synchronisation** | | | | | | | |
| 33-10 | Sync Factor Master | 1 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-11 | Sync Factor Slave | 1 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-12 | Position Offset for Synchronization | 0 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-13 | Accuracy Window for Position Sync. | 1000 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-14 | Relative Slave Velocity Limit | 0% | 2 set-ups | | TRUE | 0 | Uint8 |
| 33-15 | Marker Number for Master | 1 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 33-16 | Marker Number for Slave | 1 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 33-17 | Master Marker Distance | 4096 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-18 | Slave Marker Distance | 4096 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-19 | Master Marker Type | [0] Encoder Z positive | 2 set-ups | | TRUE | - | Uint8 |
| 33-20 | Slave Marker Type | [0] Encoder Z positive | 2 set-ups | | TRUE | - | Uint8 |
| 33-21 | Master Marker Tolerance Window | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-22 | Slave Marker Tolerance Window | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-23 | Start Behaviour for Marker Sync | [0] Leading marker | 2 set-ups | | TRUE | - | Uint16 |
| 33-24 | Marker Number for Fault | 10 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 33-25 | Marker Number for Ready | 1 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 33-26 | Velocity Filter | 0 us | 2 set-ups | | TRUE | -6 | Int32 |
| 33-27 | Offset Filter Time | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 33-28 | Marker Filter Configuration | [0] Marker filter 1 | 2 set-ups | | TRUE | - | Uint8 |
| 33-29 | Filter Time for Marker Filter | 0 ms | 2 set-ups | | TRUE | -3 | Int32 |
| 33-30 | Maximum Marker Correction | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-31 | Synchronisation Type | [0] Standard | 2 set-ups | | TRUE | - | Uint8 |
| 33-32 | Feed Forward Velocity Adaptation | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-33 | Velocity Filter Window | 0 N/A | 2 set-ups | | TRUE | 0 | Uint32 |
| 33-34 | Slave Marker filter time | 0 ms | 2 set-ups | | TRUE | -3 | Uint32 |
| **33-4* Limit Handling** | | | | | | | |
| 33-40 | Behaviour atEnd Limit Switch | [0] Call error handler | 2 set-ups | | TRUE | - | Uint8 |
| 33-41 | Negative Software End Limit | -500000 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-42 | Positive Software End Limit | 500000 N/A | 2 set-ups | | TRUE | 0 | Int32 |
| 33-43 | Negative Software End Limit Active | [0] Inactive | 2 set-ups | | TRUE | - | Uint8 |
| 33-44 | Positive Software End Limit Active | [0] Inactive | 2 set-ups | | TRUE | - | Uint8 |
| 33-45 | Time in Target Window | 0 ms | 2 set-ups | | TRUE | -3 | Uint8 |
| 33-46 | Target Window Limit Value | 1 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| 33-47 | Size of Target Window | 0 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| **33-5* I/O Configuration** | | | | | | | |
| 33-50 | Terminal X57/1 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-51 | Terminal X57/2 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-52 | Terminal X57/3 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-53 | Terminal X57/4 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-54 | Terminal X57/5 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-55 | Terminal X57/6 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-56 | Terminal X57/7 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-57 | Terminal X57/8 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-58 | Terminal X57/9 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-59 | Terminal X57/10 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-60 | Terminal X59/1 and X59/2 Mode | [1] Output | 2 set-ups | | FALSE | - | Uint8 |
| 33-61 | Terminal X59/1 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-62 | Terminal X59/2 Digital Input | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-63 | Terminal X59/1 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-64 | Terminal X59/2 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-65 | Terminal X59/3 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-66 | Terminal X59/4 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-67 | Terminal X59/5 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-68 | Terminal X59/6 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-69 | Terminal X59/7 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| 33-70 | Terminal X59/8 Digital Output | [0] No function | 2 set-ups | | TRUE | - | Uint8 |
| **33-8* Global Parameters** | | | | | | | |
| 33-80 | Activated Program Number | -1 N/A | 2 set-ups | | TRUE | 0 | Int8 |
| 33-81 | Power-up State | [1] Motor on | 2 set-ups | | TRUE | - | Uint8 |
| 33-82 | Drive Status Monitoring | [1] On | 2 set-ups | | TRUE | - | Uint8 |
| 33-83 | Behaviour after Error | [0] Coast | 2 set-ups | | TRUE | - | Uint8 |
| 33-84 | Behaviour after Esc. | [0] Controlled stop | 2 set-ups | | TRUE | - | Uint8 |
| 33-85 | MCO Supplied by External 24 V DC | [0] No | 2 set-ups | | TRUE | - | Uint8 |
| 33-86 | Terminal at alarm | [0] Relay 1 | 2 set-ups | | TRUE | - | Uint8 |

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 33-87 | Terminal state at alarm | [0] Do nothing | 2 set-ups | | TRUE | - | Uint8 |
| 33-88 | Status word at alarm | 0 N/A | 2 set-ups | | TRUE | 0 | Uint16 |
| **33-9* MCO Port Settings** | | | | | | | |
| 33-90 | X62 MCO CAN node ID | 127 N/A | 2 set-ups | | TRUE | 0 | Uint8 |
| 33-91 | X62 MCO CAN baud rate | [20] 125 Kbps | 2 set-ups | | TRUE | - | Uint8 |
| 33-94 | X60 MCO RS 485 serial termination | [0] Off | 2 set-ups | | TRUE | - | Uint8 |
| 33-95 | X60 MCO RS 485 serial baud rate | [2] 9600 Baud | 2 set-ups | | TRUE | - | Uint8 |

## 4.1.25 34-** MCO Data Readouts

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **34-0* PCD Write Par.** | | | | | | | |
| 34-01 | PCD 1 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-02 | PCD 2 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-03 | PCD 3 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-04 | PCD 4 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-05 | PCD 5 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-06 | PCD 6 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-07 | PCD 7 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-08 | PCD 8 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-09 | PCD 9 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-10 | PCD 10 Write to MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| **34-2* PCD Read Par.** | | | | | | | |
| 34-21 | PCD 1 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-22 | PCD 2 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-23 | PCD 3 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-24 | PCD 4 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-25 | PCD 5 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-26 | PCD 6 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-27 | PCD 7 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-28 | PCD 8 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-29 | PCD 9 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-30 | PCD 10 Read from MCO | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| **34-4* Inputs & Outputs** | | | | | | | |
| 34-40 | Digital Inputs | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-41 | Digital Outputs | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| **34-5* Process Data** | | | | | | | |
| 34-50 | Actual Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-51 | Commanded Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-52 | Actual Master Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-53 | Slave Index Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-54 | Master Index Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-55 | Curve Position | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-56 | Track Error | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-57 | Synchronising Error | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-58 | Actual Velocity | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-59 | Actual Master Velocity | 0 N/A | All set-ups | | TRUE | 0 | Int32 |

  

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| 34-60 | Synchronising Status | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-61 | Axis Status | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-62 | Program Status | 0 N/A | All set-ups | | TRUE | 0 | Int32 |
| 34-64 | MCO 302 Status | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| 34-65 | MCO 302 Control | 0 N/A | All set-ups | | TRUE | 0 | Uint16 |
| **34-7* Diagnosis readouts** | | | | | | | |
| 34-70 | MCO Alarm Word 1 | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |
| 34-71 | MCO Alarm Word 2 | 0 N/A | All set-ups | | FALSE | 0 | Uint32 |



## 4.1.26 35-** Sensor Input Option

| Par. No. # | Parameter description | Default value | 4-set-up | FC 302 only | Change during operation | Conversion index | Type |
|---|---|---|---|---|---|---|---|
| **35-0* Temp. Input Mode** | | | | | | | |
| 35-00 | Term. X48/4 temp. unit | [60] °C | All set-ups | | TRUE | - | Uint8 |
| 35-01 | Term. X48/4 input type | [0] Not Connected | All set-ups | | TRUE | - | Uint8 |
| 35-02 | Term. X48/7 temp. unit | [60] °C | All set-ups | | TRUE | - | Uint8 |
| 35-03 | Term. X48/7 input type | [0] Not Connected | All set-ups | | TRUE | - | Uint8 |
| 35-04 | Term. X48/10 temp. unit | [60] °C | All set-ups | | TRUE | - | Uint8 |
| 35-05 | Term. X48/10 input type | [0] Not Connected | All set-ups | | TRUE | - | Uint8 |
| 35-06 | Temperature sensor alarm function | [5] Stop and trip | All set-ups | | TRUE | - | Uint8 |
| **35-1* Temp. Input X48/4** | | | | | | | |
| 35-14 | Term. X48/4 filter time constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| 35-15 | Term. X48/4 temp. monitor | [0] Disabled | All set-ups | | TRUE | - | Uint8 |
| 35-16 | Term. X48/4 low temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| 35-17 | Term. X48/4 high temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| **35-2* Temp. Input X48/7** | | | | | | | |
| 35-24 | Term. X48/7 filter time constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| 35-25 | Term. X48/7 temp. monitor | [0] Disabled | All set-ups | | TRUE | - | Uint8 |
| 35-26 | Term. X48/7 low temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| 35-27 | Term. X48/7 high temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| **35-3* Temp. Input X48/10** | | | | | | | |
| 35-34 | Term. X48/10 filter time constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |
| 35-35 | Term. X48/10 temp. monitor | [0] Disabled | All set-ups | | TRUE | - | Uint8 |
| 35-36 | Term. X48/10 low temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| 35-37 | Term. X48/10 high temp. limit | App.Dependent | All set-ups | | TRUE | 0 | Int16 |
| **35-4* Analog Input X48/2** | | | | | | | |
| 35-42 | Term. X48/2 low current | 4.00 mA | All set-ups | | TRUE | -5 | Int16 |
| 35-43 | Term. X48/2 high current | 20.00 mA | All set-ups | | TRUE | -5 | Int16 |
| 35-44 | Term. X48/2 low ref./feedb. value | 0.000 N/A | All set-ups | | TRUE | -3 | Int32 |
| 35-45 | Term. X48/2 high ref./feedb. value | 100.000 N/A | All set-ups | | TRUE | -3 | Int32 |
| 35-46 | Term. X48/2 filter time constant | 0.001 s | All set-ups | | TRUE | -3 | Uint16 |

# 5 Troubleshooting

## 5.1 Status Messages

### 5.1.1 Warnings/Alarm Messages

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.

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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 trips. Reset the alarm to resume operation once the cause has been rectified.

**3 ways to reset:**

- Press [Reset].
- Via a digital input with the "Reset" function.
- Via serial communication/optional fieldbus.

***NOTICE***

**After a manual reset pressing [Reset], press [Auto On] 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 5.1*).

Alarms that are trip-locked offer additional protection, meaning 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 can 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 *14-20 Reset Mode* (Warning: automatic wake-up is possible.)

If a warning or alarm is marked against a code in *Table 5.1*, this means that either a warning occurs before an alarm, or it is possible to specify whether a warning or an alarm should be displayed for a given fault.

This is possible, for instance, in *parameter 1-90 Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the frequency converter is reset.

***NOTICE***

**No missing motor phase detection (numbers 30-32) and no stall detection are active when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**

| Number | Description | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference |
|---|---|---|---|---|---|
| 1 | 10 volts low | X | | | |
| 2 | Live zero error | (X) | (X) | | *Parameter 6-01 Live Zero Timeout Function* |
| 3 | No motor | (X) | | | *Parameter 1-80 Function at Stop* |
| 4 | Mains phase Loss | (X) | (X) | (X) | *Parameter 14-12 Function at Mains Imbalance* |
| 5 | DC link voltage high | X | | | |
| 6 | DC link voltage low | X | | | |
| 7 | DC overvoltage | X | X | | |
| 8 | DC undervoltage | X | X | | |
| 9 | Inverter overloaded | X | X | | |
| 10 | Motor ETR overtemperature | (X) | (X) | | *Parameter 1-90 Motor Thermal Protection* |
| 11 | Motor thermistor overtemperature | (X) | (X) | | *Parameter 1-90 Motor Thermal Protection* |
| 12 | Torque limit | X | X | | |
| 13 | Over current | X | X | X | |
| 14 | Earth fault | X | X | | |

  

| Number | Description | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference |
|---|---|---|---|---|---|
| 15 | Hardware mismatch | | X | X | |
| 16 | Short circuit | | X | X | |
| 17 | Control word timeout | (X) | (X) | | *Parameter 8-04 Control Word Timeout Function* |
| 20 | Temp. input error | | X | | |
| 21 | Param error | | | X | |
| 22 | Hoist mech. brake | (X) | (X) | | Parameter group 2-2* |
| 23 | Internal fans | X | | | |
| 24 | External fans | X | | | |
| 25 | Brake resistor short-circuited | X | | | |
| 26 | Brake resistor power limit | (X) | (X) | | *Parameter 2-13 Brake Power Monitoring* |
| 27 | Brake chopper short-circuited | X | X | | |
| 28 | Brake check | (X) | (X) | | *Parameter 2-15 Brake Check* |
| 29 | Heat sink temp | X | X | X | |
| 30 | Motor phase U missing | (X) | (X) | (X) | *4-58 Missing Motor Phase Function* |
| 31 | Motor phase V missing | (X) | (X) | (X) | *4-58 Missing Motor Phase Function* |
| 32 | Motor phase W missing | (X) | (X) | (X) | *4-58 Missing Motor Phase Function* |
| 33 | Inrush fault | | X | X | |
| 34 | Fieldbus communication fault | X | X | | |
| 35 | Option fault | | | X | |
| 36 | Mains failure | X | X | | |
| 37 | Phase imbalance | | X | | |
| 38 | Internal fault | | X | X | |
| 39 | Heat sink sensor | | X | X | |
| 40 | Overload of digital output terminal 27 | (X) | | | *Parameter 5-00 Digital I/O Mode, parameter 5-01 Terminal 27 Mode* |
| 41 | Overload of digital output terminal 29 | (X) | | | *Parameter 5-00 Digital I/O Mode, parameter 5-02 Terminal 29 Mode* |
| 42 | Ovrld X30/6-7 | (X) | | | |
| 43 | Ext. supply (option) | X | | | |
| 45 | Earth fault 2 | X | X | | |
| 46 | Pwr. card supply | | X | X | |
| 47 | 24 V supply low | X | X | X | |
| 48 | 1.8 V supply low | | X | X | |
| 49 | Speed limit | | X | | *1-86 Trip Speed Low [RPM]* |
| 50 | AMA calibration failed | | X | | |
| 51 | AMA check $U_{nom}$ and $I_{nom}$ | | X | | |
| 52 | AMA low $I_{nom}$ | | X | | |
| 53 | AMA motor too big | | X | | |
| 54 | AMA motor too small | | X | | |
| 55 | AMA parameter out of range | | X | | |
| 56 | AMA interrupted by user | | X | | |
| 57 | AMA timeout | | X | | |
| 58 | AMA internal fault | X | X | | |
| 59 | Current limit | X | | | |
| 60 | External interlock | X | X | | |



  

| Number | Description | Warning | Alarm/Trip | Alarm/Trip Lock | Parameter Reference |
|---|---|---|---|---|---|
| 61 | Feedback error | (X) | (X) | | *Parameter 4-30 Motor Feedback Loss Function* |
| 62 | Output frequency at maximum limit | X | | | |
| 63 | Mechanical brake low | | (X) | | *Parameter 2-20 Release Brake Current* |
| 64 | Voltage limit | X | | | |
| 65 | Control board overtemperature | X | X | X | |
| 66 | Heat sink temperature low | X | | | |
| 67 | Option configuration has changed | | X | | |
| 68 | Safe stop | (X) | (X)[1)] | | *Parameter 5-19 Terminal 37 Safe Stop* |
| 69 | Pwr. card temp | | X | X | |
| 70 | Illegal FC configuration | | | X | |
| 71 | PTC 1 Safe Stop | | X | | |
| 72 | Dangerous failure | | | X | |
| 73 | Safe Stop Auto Restart | (X) | (X) | | *Parameter 5-19 Terminal 37 Safe Stop* |
| 74 | PTC Thermistor | | | X | |
| 75 | Illegal Profile Sel. | | X | | |
| 76 | Power Unit Set-up | X | | | |
| 77 | Reduced power mode | X | | | *Parameter 14-59 Actual Number of Inverter Units* |
| 78 | Tracking error | (X) | (X) | | *Parameter 4-34 Tracking Error Function* |
| 79 | Illegal PS config | | X | X | |
| 80 | Drive Initialised to default value | | X | | |
| 81 | CSIV corrupt | | X | | |
| 82 | CSIV parameter error | | X | | |
| 83 | Illegal option combination | | | X | |
| 84 | No safety option | | X | | |
| 88 | Option detection | | | X | |
| 89 | Mechanical brake sliding | X | | | |
| 90 | Feedback monitor | (X) | (X) | | *Parameter 17-61 Feedback Signal Monitoring* |
| 91 | Analog input 54 wrong settings | | | X | S202 |
| 99 | Locked rotor | | X | X | |
| 104 | Mixing fans | X | X | | |
| 122 | Mot. rotat. unexp. | | X | | |
| 123 | Motor mod. changed | | X | | |
| 163 | ATEX ETR cur.lim.warning | X | | | |
| 164 | ATEX ETR cur.lim.alarm | | X | | |
| 165 | ATEX ETR freq.lim.warning | X | | | |
| 166 | ATEX ETR freq.lim.alarm | | X | | |
| 220 | Configuration File Version not supported | X | | | |
| 246 | Pwr.card supply | | | X | |
| 250 | New spare part | | | X | |
| 251 | New type code | | X | X | |
| 430 | PWM Disabled | | X | | |

**Table 5.1 Alarm/Warning Code List**

*(X) Dependent on parameter*

*1) Cannot be Auto reset via 14-20 Reset Mode*

  

A trip is the action following an alarm. The trip coasts the motor and is reset by pressing [Reset] or by a digital input (parameter group *5-1* Digital Inputs* [1]). The original event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which could damage the frequency converter or connected parts. A trip lock situation can only be reset by a power cycling.

| | |
|---|---|
| Warning | yellow |
| Alarm | flashing red |
| Trip locked | yellow and red |

**Table 5.2 LED Indication**

| Bit | Hex | Dec | Alarm Word | Alarm Word 2 | Warning Word | Warning Word 2 | Extended Status Word | Extended Status Word 2 |
|---|---|---|---|---|---|---|---|---|
| **Alarm Word Extended Status Word** | | | | | | | | |
| 0 | 00000001 | 1 | Brake check (A28) | Servicetrip, read/write | Brake check (W28) | Start delayed | Ramping | Off |
| 1 | 00000002 | 2 | Pwr.card temp (A69) | Servicetrip, (reserved) | Pwr.card temp (A69) | Stop delayed | AMA running | Hand/auto |
| 2 | 00000004 | 4 | Earth fault (A14) | Servicetrip, typecode/ sparepart | Earth fault (W14) | reserved | Start CW/CCW start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the reference sign | Profibus OFF1 active |
| 3 | 00000008 | 8 | Ctrl.card temp (A65) | Servicetrip, (reserved) | Ctrl.card temp (W65) | reserved | Slow down slow down command active, e.g. via CTW bit 11 or DI | Profibus OFF2 active |
| 4 | 00000010 | 16 | Ctrl. word TO (A17) | Servicetrip, (reserved) | Ctrl. word TO (W17) | | Catch up catch up command active, e.g. via CTW bit 12 or DI | Profibus OFF3 active |
| 5 | 00000020 | 32 | Overcurrent (A13) | reserved | Overcurrent (W13) | reserved | Feedback high feedback > 4-57 | Relay 123 active |
| 6 | 00000040 | 64 | Torque limit (A12) | reserved | Torque limit (W12) | reserved | Feedback low feedback < 4-56 | Start prevented |
| 7 | 00000080 | 128 | Motor th over (A11) | reserved | Motor th over (W11) | reserved | Output current high current > 4-51 | Control ready |
| 8 | 00000100 | 256 | Motor ETR over (A10) | reserved | Motor ETR over (W10) | reserved | Output current low current < 4-50 | Drive ready |
| 9 | 00000200 | 512 | Inverter overld. (A9) | Discharge high | Inverter Overld (W9) | Discharge high | Output freq high speed > 4-53 | Quick stop |
| 10 | 00000400 | 1024 | DC under volt (A8) | Start failed | DC under volt (W8) | Multi-motor underload | Output freq low speed < 4-52 | DC brake |
| 11 | 00000800 | 2048 | DC over volt (A7) | Speed limit | DC over volt (W7) | Multi-motor overload | Brake check OK brake test NOT ok | Stop |
| 12 | 00001000 | 4096 | Short circuit (A16) | External interlock | DC voltage low (W6) | Compressor interlock | Braking max. BrakePower > Brakepo-werlimit (2-12) | Stand by |
| 13 | 00002000 | 8192 | Inrush fault (A33) | Illegal option combi. | DC voltage high (W5) | Mechanical brake sliding | Braking | Freeze output request |
| 14 | 00004000 | 16384 | Mains ph. loss (A4) | No safety option | Mains ph. loss (W4) | Safe option warning | Out of speed range | Freeze output |
| 15 | 00008000 | 32768 | AMA not OK | reserved | No motor (W3) | Auto DC braking | OVC active | Jog request |

| Bit | Hex | Dec | Alarm Word | Alarm Word 2 | Warning Word | Warning Word 2 | Extended Status Word | Extended Status Word 2 |
|---|---|---|---|---|---|---|---|---|
| 16 | 00010000 | 65536 | Live zero error (A2) | reserved | Live zero error (W2) | | AC brake | Jog |
| 17 | 00020000 | 131072 | Internal fault (A38) | KTY error | 10V low (W1) | KTY warn | Password timelock number of allowed password trials exceeded - timelock active | Start request |
| 18 | 00040000 | 262144 | Brake overload (A26) | Fans error | Brake overload (W26) | Fans warn | Password protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY | Start |
| 19 | 00080000 | 524288 | U phase loss (A30) | ECB error | Brake resistor (W25) | ECB warn | Reference high reference > 4-55 | Start applied |
| 20 | 00100000 | 1048576 | V phase loss (A31) | Hoist mechanical brake (A22) | Brake IGBT (W27) | Hoist mechanical brake (W22) | Reference low reference < 4-54 | Start delay |
| 21 | 00200000 | 2097152 | W phase Loss (A32) | reserved | Speed limit (W49) | reserved | Local reference reference site = REMOTE -> auto on pressed & active | Sleep |
| 22 | 00400000 | 4194304 | Fieldbus fault (A34) | reserved | Fieldbus fault (W34) | reserved | Protection mode notifi-cation | Sleep boost |
| 23 | 00800000 | 8388608 | 24 V supply low (A47) | reserved | 24V supply Low (W47) | reserved | Unused | Running |
| 24 | 01000000 | 16777216 | Mains failure (A36) | reserved | Mains failure (W36) | reserved | Unused | Drive bypass |
| 25 | 02000000 | 33554432 | 1.8 V supply low (A48) | Current limit (A59) | Current limit (W59) | reserved | Unused | Fire mode |
| 26 | 04000000 | 67108864 | Brake resistor (A25) | Motor rotating unexpectedly (A122) | Low temp (W66) | reserved | Unused | External interlock |
| 27 | 08000000 | 134217728 | Brake IGBT (A27) | reserved | Voltage limit (W64) | reserved | Unused | Firemode limit exceed |
| 28 | 10000000 | 268435456 | Option change (A67) | reserved | Encoder loss (W90) | reserved | Unused | Flying start active |
| 29 | 20000000 | 536870912 | Drive initialised (A80) | Encoder loss (A90) | Output freq. lim. (W62) | BackEMF too high | Unused | |
| 30 | 40000000 | 1073741824 | Safe stop (A68) | PTC thermi-stor (A74) | Safe stop (W68) | PTC thermi-stor (W74) | Unused | |
| 31 | 80000000 | 2147483648 | Mech. brake low (A63) | Dangerous failure (A72) | Extended status word | | Protection mode | |

**Table 5.3 Description of Alarm Word, Warning Word and Extended Status Word**

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnostics. See also *parameter 16-94 Ext. Status Word*.

**WARNING 1, 10 Volts low**

The control card voltage is <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 *6-01 Live Zero Timeout Function*. The signal on one 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 the connections on all the analog mains terminals.
  - Control card terminals 53 and 54 for signals, terminal 55 common.
  - MCB 101 terminals 11 and 12 for signals, terminal 10 common.
  - MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 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 has been 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 on the frequency converter. Options are programmed in *14-12 Function at Mains 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 is dependent 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 is dependent on the frequency converter voltage rating. The unit is still active.

**WARNING/ALARM 7, DC overvoltage**
If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

**Troubleshooting**

- Connect a brake resistor.
- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *2-10 Brake Function*.
- Increase *14-26 Trip Delay at Inverter Fault*.
- If the alarm/warning occurs during a power sag, use kinetic back-up (*parameter 14-10 Mains Failure*).

**WARNING/ALARM 8, DC under voltage**
If the DC link voltage drops below the undervoltage limit, the frequency converter checks if a 24 V DC back-up supply is connected. 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%, while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.

**Troubleshooting**

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Display the thermal drive load on the LCP 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 (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *parameter 1-24 Motor Current* is correct.
- Ensure that the motor data in *parameters 1–20* to *1–25* are set correctly.
- If an external fan is in use, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.



  

**WARNING/ALARM 11, Motor thermistor overtemp**
Check whether the thermistor is disconnected. Select whether the frequency converter issues a warning or an alarm in *1-90 Motor Thermal Protection*.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that *1-93 Thermistor Source* selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32 or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter 1-93 Thermistor Source*.

**WARNING/ALARM 12, Torque limit**
The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by an alarm.

**Troubleshooting**

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

**WARNING/ALARM 13, 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 1–20* to *1–25*.

**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.

**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.

**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 Danfoss:

- *Parameter 15-40 FC Type*
- *Parameter 15-41 Power Section*
- *Parameter 15-42 Voltage*
- *15-43 Software Version*
- *15-45 Actual Typecode String*
- *15-49 SW ID Control Card*
- *15-50 SW ID Power Card*
- *15-60 Option Mounted*
- *15-61 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/ALARM 17, Control word timeout**
There is no communication to the frequency converter. The warning is only active when *parameter 8-04 Control Word Timeout Function* is NOT set to *[0] Off*.
If *parameter 8-04 Control Word Timeout Function* is set to *[5] Stop and Trip*, a warning appears and the frequency converter ramps down until it stops, and then it displays an alarm.

**Troubleshooting**

- Check the connections on the serial communication cable.
- Increase *8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

**WARNING/ALARM 20, Temp. input error**
The temperature sensor is not connected.

  

**WARNING/ALARM 21, Parameter error**
The parameter is out of range. The parameter number is reported in the display.

**Troubleshooting**
- The affected parameter must be set to a valid value.

**WARNING/ALARM 22, Hoist mechanical brake**
Report value shows what kind it is.
0 = The torque reference was not reached before timeout (*parameter 2-27 Torque Ramp Up Time*).
1 = Expected brake feedback not received before timeout (*parameter 2-23 Activate Brake Delay*, *parameter 2-25 Brake Release Time*).

**WARNING 23, Internal fan fault**
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 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 and control card.

**WARNING 24, External fan fault**
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 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 and control card.

**WARNING 25, Brake resistor short circuit**
The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational, but without the brake function.

**Troubleshooting**
- Remove the power to the frequency converter and replace the brake resistor (see *parameter 2-15 Brake Check*).

**WARNING/ALARM 26, Brake resistor power limit**
The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in *2-16 AC brake Max. Current*. The warning is active when the dissipated braking power is higher than 90% of the brake resistor power. If option *[2] Trip* is selected in *parameter 2-13 Brake Power Monitoring*, the frequency converter trips when the dissipated braking power reaches 100%.

**WARNING/ALARM 27, Brake chopper fault**
The brake transistor is monitored during operation, and if a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

**Troubleshooting**
- Remove power to the frequency converter and remove the brake resistor.

**WARNING/ALARM 28, Brake check failed**
The brake resistor is not connected or not working. Check *parameter 2-15 Brake Check*.

**ALARM 29, Heat Sink temp**
The maximum temperature of the heat sink has been exceeded. The temperature fault does 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.
- Ambient temperature too high.
- Motor cables 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.

**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.

**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.

**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.

5

**WARNING/ALARM 34, Fieldbus communication fault**
The fieldbus on the communication option card is not working.

**WARNING/ALARM 35, Option fault**
An option alarm is received. The alarm is option-specific. The most likely cause is a power-up or a communication fault.

**WARNING/ALARM 36, Mains failure**
This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is not set to option *[0] No Function*. 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 5.4* is displayed.

**Troubleshooting**

- Cycle power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

It may be necessary to contact the Danfoss supplier or service department. Note the code number for further troubleshooting directions.

| Number | Text |
|---|---|
| 0 | Serial port cannot be initialised. Contact the Danfoss supplier or Danfoss Service Department. |
| 256-258 | Power EEPROM data is defective or too old. Replace power card. |
| 512-519 | Internal fault. Contact the Danfoss supplier or Danfoss Service Department. |
| 783 | Parameter value outside of minimum/maximum limits. |
| 1024-1284 | Internal fault. Contact the Danfoss supplier or the Danfoss Service Department. |
| 1299 | The option SW in slot A is too old. |
| 1300 | The option SW in slot B is too old. |
| 1302 | The option SW in slot C1 is too old. |
| 1315 | The option SW in slot A is not supported (not allowed). |
| 1316 | The option SW in slot B is not supported (not allowed). |
| 1318 | The option SW in slot C1 is not supported (not allowed). |
| 1379-2819 | Internal fault. Contact the Danfoss supplier or Danfoss Service Department. |
| 1792 | HW reset of DSP. |
| 1793 | Motor derived parameters not transferred correctly to DSP. |
| 1794 | Power data not transferred correctly at power-up to DSP. |
| 1795 | The DSP has received too many unknown SPI telegrams. The frequency converter also uses this fault code if the MCO does not power up correctly, for example due to poor EMC protection or improper grounding. |
| 1796 | RAM copy error. |
| 2561 | Replace control card. |
| 2820 | LCP 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. |
| 5125 | Option in slot C0: Hardware incompatible with control board hardware. |
| 5126 | Option in slot C1: Hardware incompatible with control board hardware. |
| 5376-6231 | Internal fault. Contact the Danfoss supplier or Danfoss Service Department. |

**Table 5.4 Internal Fault Codes**

**ALARM 39, Heat sink 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 *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

**WARNING 41, Overload of digital output terminal 29**
Check the load connected to terminal 29 or remove the short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

**WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7**
For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check *parameter 5-32 Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check *parameter 5-33 Term X30/7 Digi Out (MCB 101)*.

**ALARM 43, Ext. supply**
MCB 113 Ext. Relay Option is mounted without external 24 V DC. Either connect an ext. 24 V DC supply or specify that no external supply is used via *parameter 14-80 Option Supplied by External 24VDC [0] No*. A change in *parameter 14-80 Option Supplied by External 24VDC* requires a power cycle.

**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.

**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 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. 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 24 V DC is measured on the control card. This alarm appears when the detected voltage of terminal 12 is <18 V.

**Troubleshooting**

- Check for a defective control 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. Check for a defective control card. If an option card is present, check for overvoltage.

**WARNING 49, Speed limit**
When the speed is outside of the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping), the frequency converter trips.

**ALARM 50, AMA calibration failed**
Contact the Danfoss supplier or Danfoss Service.

**ALARM 51, AMA check $U_{nom}$ and $I_{nom}$**
The settings for motor voltage, motor current, and motor power are wrong. Check the settings in *parameters 1–20* to *1–25*.

**ALARM 52, AMA low $I_{nom}$**
The motor current is too low. Check the settings in *4-18 Current Limit*.

**ALARM 53, AMA motor too big**
The motor is too big for the AMA to operate.

**ALARM 54, AMA motor too small**
The motor is too small for the AMA to operate.

**ALARM 55, AMA parameter out of range**
The parameter values of the motor are outside of the acceptable range. AMA cannot run.

**ALARM 56, AMA interrupted by user**
The user has interrupted AMA.

**ALARM 57, AMA internal fault**
Try to restart AMA again. Repeated restarts can over heat the motor.

**ALARM 58, AMA Internal fault**
Contact the Danfoss supplier.

**WARNING 59, Current limit**
The current is higher than the value in *4-18 Current Limit*. Ensure that motor data in *parameters 1–20* to *1–25* are 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 is indicating 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. Reset the frequency converter.

**WARNING/ALARM 61, Feedback error**
An error between calculated speed and speed measurement from feedback device. The function Warning/ Alarm/Disabling setting is in *parameter 4-30 Motor Feedback Loss Function*. The tolerable error is set in *parameter 4-31 Motor Feedback Speed Error*. The tolerable feedback loss time is set in *parameter 4-32 Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

**WARNING 62, Output frequency at maximum limit**
The output frequency has reached the value set in *4-19 Max Output Frequency*. 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.

**ALARM 63, Mechanical brake low**
The actual motor current has not exceeded the release brake current within the start delay time window.

**WARNING 64, Voltage limit**
The combination of load and speed demands a motor voltage higher than the actual DC link voltage.

**WARNING/ALARM 65, Control card over temperature**
The cut-out temperature of the control card is 80 °C.

**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, Heat sink 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 *2-00 DC Hold/Preheat Current* at 5% and *1-80 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 68, Safe Stop activated**
STO has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]).

**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 FC configuration**
The control card and power card are incompatible. To check compatibility, contact the Danfoss supplier with the type code of the unit from the nameplate and the part numbers of the cards.

**ALARM 71, PTC 1 safe stop**
STO has been activated from the VLT® PTC Thermistor Card MCB 112 (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to terminal 37 again (when the motor temperature reaches an acceptable level) and when the digital input from the MCB 112 is deactivated. When that happens, send a reset signal must be sent (via bus or digital I/O, or press [Reset]).

**ALARM 72, Dangerous failure**
STO with trip lock. An unexpected combination of STO commands has occurred:

- VLT® PTC Thermistor Card MCB 112 enables X44/10, but STO is not enabled.
- MCB 112 is the only device using STO (specified through selection *[4] PTC 1 Alarm* or *[5] PTC 1 Warning* in *parameter 5-19 Terminal 37 Safe Stop*), STO is activated, and X44/10 is not activated.

**WARNING 73, Safe Stop auto restart**
Safe Torque Off activated. With automatic restart enabled, the motor can start when the fault is cleared.

**ALARM 74, PTC Thermistor**
Alarm related to the ATEX option. The PTC is not working.

**ALARM 75, Illegal profile sel.**
Parameter value must not be written while motor is running. Stop motor before writing MCO profile to *parameter 8-10 Control Word Profile*.

**WARNING 76, Power unit setup**
The required number of power units does not match the detected number of active power units.

**WARNING 77, Reduced power mode**
The frequency converter is operating in reduced power mode (less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters and remains on.

**ALARM 78, Tracking error**
The difference between set-point value and actual value has exceeded the value in *parameter 4-35 Tracking Error*. Disable the function or select an alarm/warning in *parameter 4-34 Tracking Error Function*. Investigate the mechanics around the load and motor, check feedback connections from motor encoder to frequency converter. Select motor feedback function in *parameter 4-30 Motor Feedback Loss Function*. Adjust tracking error band in *parameter 4-35 Tracking Error* and *parameter 4-37 Tracking Error Ramping*.

**ALARM 79, Illegal power section configuration**
The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

**ALARM 80, Drive initialised to default value**
Parameter settings are initialised to default settings after a manual reset. To clear the alarm, reset the unit.

  

**ALARM 81, CSIV corrupt**
CSIV file has syntax errors.

**ALARM 82, CSIV parameter error**
CSIV failed to initialise a parameter.

**ALARM 83, Illegal option combination**
The mounted options are incompatible.

**ALARM 84, No safety option**
The safety option was removed without applying a general reset. Reconnect the safety option.

**ALARM 88, Option detection**
A change in the option layout was detected.
*Parameter 14-89 Option Detection* is set to *[0] Frozen configuration* and the option layout has been changed.

- To apply the change, enable option layout changes in *parameter 14-89 Option Detection*.
- Alternatively, restore the correct option configuration.

**WARNING 89, Mechanical brake sliding**
The hoist brake monitor has detected a motor speed > 10 RPM.

**ALARM 90, Feedback monitor**
Check the connection to encoder/resolver option and eventually replace the MCB 102 or MCB 103.

**ALARM 91, Analog input 54 wrong settings**
Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

**ALARM 99, Locked rotor**
Rotor is blocked.

**WARNING/ALARM 104, Mixing fan fault**
The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing-fan fault can be configured as a warning or an alarm trip in *parameter 14-53 Fan Monitor*.

**Troubleshooting**

- Cycle power to the frequency converter to determine if the warning/alarm returns.

**WARNING/ALARM 122, Mot. rotat. unexp.**
The frequency converter performs a function that requires the motor to be at standstill, e.g. DC hold for PM motors.

**WARNING 123, Motor Mod. Changed**
The motor selected in *parameter 1-11 Motor Model* is not correct and the selection has been corrected.

**WARNING 163, ATEX ETR cur.lim.warning**
The frequency converter has run above the characteristic curve for more than 50 s. The warning is activated at 83% and deactivated at 65% of the permitted thermal overload.

**ALARM 164, ATEX ETR cur.lim.alarm**
Operating above the characteristic curve for more than 60 s within a period of 600 s activates the alarm, and the frequency converter trips.

**WARNING 165, ATEX ETR freq.lim.warning**
The frequency converter is running more than 50 s below the permitted minimum frequency (*parameter 1-98 ATEX ETR interpol. points freq.*).

**ALARM 166, ATEX ETR freq.lim.alarm**
The frequency converter has operated more than 60 s (in a period of 600 s) below the permitted minimum frequency (*parameter 1-98 ATEX ETR interpol. points freq.*).

**WARNING 220, Configuration file version not supported**
The frequency converter does not support the current configuration file version. Customisation is aborted.

**ALARM 246, Power card supply**
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 46. The report value in the alarm log indicates which power module generated the alarm:

1 = inverter module to the far left.

2 = middle inverter module in F2 or F4 frequency converter.

2 = right inverter module in F1 or F3 frequency converter.

3 = right inverter module in F2 or F4 frequency converter.

5 = rectifier module.

**WARNING 250, New spare part**
A component in the frequency converter has been replaced.

**Troubleshooting**

- Reset the frequency converter for normal operation.

**WARNING 251, New typecode**
The power card or other components have been replaced and the type code has been changed.

**Troubleshooting**

- Reset to remove the warning and resume normal operation.

**ALARM 430, PWM Disabled**
The PWM on the power card is disabled.

# 6 Appendix

## 6.1 Symbols, Abbreviations and Conventions

| | |
|---|---|
| °C | Degrees celsius |
| AC | Alternating current |
| AEO | Automatic energy optimization |
| AWG | American wire gauge |
| AMA | Automatic motor adaptation |
| DC | Direct current |
| EMC | Electro magnetic compatibility |
| ETR | Electronic thermal relay |
| $f_{M,N}$ | Nominal motor frequency |
| FC | Frequency converter |
| $I_{INV}$ | Rated inverter output current |
| $I_{LIM}$ | Current limit |
| $I_{M,N}$ | Nominal motor current |
| $I_{VLT,MAX}$ | Maximum output current |
| $I_{VLT,N}$ | Rated output current supplied by the frequency converter |
| IP | Ingress protection |
| LCP | Local control panel |
| MCT | Motion control tool |
| $n_s$ | Synchronous motor speed |
| $P_{M,N}$ | Nominal motor power |
| PELV | Protective extra low voltage |
| PCB | Printed circuit board |
| PM Motor | Permanent magnet motor |
| PWM | Pulse width modulated |
| RPM | Revolutions per minute |
| Regen | Regenerative terminals |
| $T_{LIM}$ | Torque limit |
| $U_{M,N}$ | Nominal motor voltage |

**Table 6.1 Symbols and Abbreviations**

**Conventions**

Numbered lists indicate procedures.
Bullet lists indicate other information.
Italicised text indicates:

- Cross reference
- Link
- Parameter name

All dimensions are in [mm].

# Index



  

  

## R



## S



## T



## V



## W



  

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