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1. How to Read these Operating Instructions

These Operating Instructions will help you get started, install and program your VLT Extended Relay Card MCB 113.

Chapter 1, **How to Read these Operating Instructions**, introduces the manual and informs you about the approvals, symbols, and abbreviations used in this literature.

Chapter 2, **Safety and Conformity**, contains safety instructions for the option card and the VLT AutomationDrive FC 300.

Chapter 3, **Introduction to VLT Extended Relay Card MCB 113**, informs about the MCB 113 option card, the electrical connections and electrical data.

Chapter 4, **How to Install**, explains how to install the option card.

Chapter 5, **Parameter Set-up**, shows the parameter settings associated with the VLT Extended Relay Card MCB 113.

1.1.1. Approvals

1.1.2. Symbols

Symbols used in these Operating Instructions.

	NB! Indicates something to be noted by the reader.
	Indicates a general warning.
	Indicates a high-voltage warning.
*	Indicates default setting

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1.1.3. Abbreviations

SPDT	Single Pull Double Throw (Relay)
NAMUR NE37	German recommendations, commonly used within the Chemical Industry "Realisation of Frequency Converters Standard Terminal Strip for Variable-speed Drives"
Ampere/AMP	A
Alternating current	AC
Direct current	DC
Electromagnetic Compatibility	EMC
Hertz	Hz
Parameter	par.
Volts	V
Mili	m

2. Safety and Conformity

2.1. Safety Precautions

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

Safety Regulations

1. The mains supply to the frequency converter must be disconnected 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. The [OFF] button on the control panel of the frequency converter does not disconnect the mains supply and consequently it must not be used as a safety switch.

3. The equipment must be properly earthed, the user must be protected against supply voltage and the motor must be protected against overload in accordance with applicable national and local regulations.

4. The earth leakage current exceeds 3.5 mA.

5. Protection against motor overload is not included in the factory setting. If this function is desired, set par. F-10 Electronic *Overload* to data value ETR trip 1 [4] or data value ETR warning 1 [3].

6. 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.

7. Please note that 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 are 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 brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations (e.g. risk of personal injury caused by contact with moving machine parts following an unintentional start) make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient. In such cases the mains supply must be disconnected or the *Safe Stop* function must be activated.

2. The motor may start while setting the parameters. If this means that personal safety may be compromised (e.g. personal injury caused by contact with moving machine parts), motor starting must be prevented, for instance by use of the *Safe Stop* 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 the mains supply must be disconnected or the *Safe Stop* function must be activated.

NB!
When using the *Safe Stop* function, always follow the instructions in the *Safe Stop* section.

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.

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

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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.

Hoisting applications:

The frequency converter functions for controlling mechanical brakes cannot be considered as a primary safety circuit. There must always be a redundancy for controlling external brakes.

Protection Mode

Once a hardware limit on motor current or dc-link voltage is exceeded the drive will enter "Protection mode". "Protection mode" means a change of the PWM modulation strategy and a low switching frequency to minimize losses. This continues 10 sec after the last fault and increases the reliability and the robustness of the drive while re-establishing full control of the motor.

In hoist applications "Protection mode" is not usable because the drive will usually not be able to leave this mode again and therefore it will extend the time before activating the brake – which is not recommendable.

The "Protection mode" can be disabled by setting par. SP-26 Trip *Delay at Drive Fault* to zero which means that the drive will trip immediately if one of the hardware limits is exceeded.

> **NB!**
> It is recommended to disable protection mode in hoisting applications (par. SP-26 Trip *Delay at Drive Fault* = 0)

> The DC link capacitors remain charged after power has been disconnected. To avoid electrical shock hazard, disconnect the frequency converter from mains before carrying out maintenance. When using a PM-motor, make sure it is disconnected. Before doing service on the frequency converter wait at least the amount of time indicated below:

380 - 500 V	0.25 - 7.5 kW	4 minutes
	11 - 75 kW	15 minutes
	90 - 200 kW	20 minutes
	250 - 800 kW	40 minutes
525 - 690 V	37 - 315 kW	20 minutes
	355 - 1000 kW	30 minutes

For further information, please see the VLT Automation Drive FC 300 Operating Instructions, MG.33.AX.YY or the VLT Automation Drive FC 300 Design Guide, MG.33.BX.YY

x = version number

y = language

3. Introduction to Extended Relay Card MCB 113

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3.1. Introduction to Extended Relay Card MCB 113

The VLT Extended Relay Card MCB 113 is constructed as a standard C1 option for the Danfoss VLT AutomationDrive FC 300 and is automatically detected after mounting.

The MCB 113 adds 7 digital inputs, 2 analog outputs and 4 SPDT relays to the standard I/O of the frequency converter which makes it possible to comply with the German NAMUR NE37 recommendations.

3.1.1. Connection Schematic

Below the electrical connections for the Extended Relay Card MCB 113 are shown:

130BA687.10
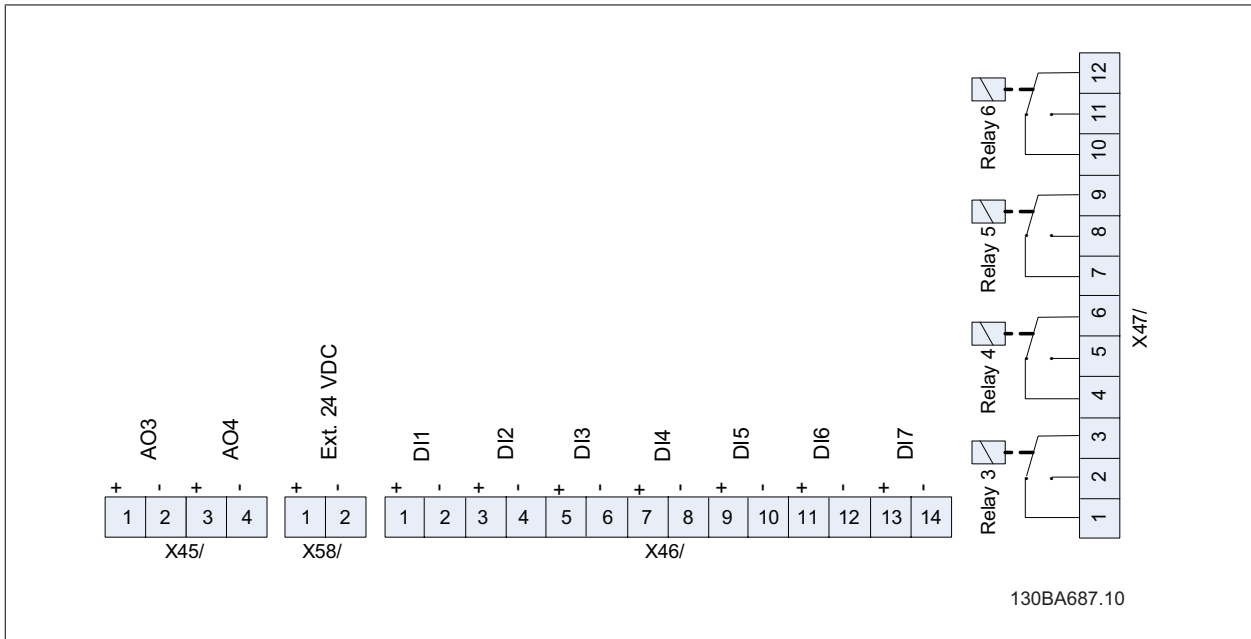
3.1.2. Galvanic Isolation

MCB 113 can be connected to an external 24 V on X58/ in order to ensure galvanic isolation between the VLT AutomationDrive and the option card. If galvanic isolation is not needed, the option card can be supplied through internal 24 V from the frequency converter - available on X58/ provided that internal supply is specified in par. 14-80 ([0] No).

3.1.3. Electrical Data

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Relays:

Number	4 SPDT
Load at 250 V AC / 30 V DC	8 A
Load at 250 V AC / 30 V DC with cos φ = 0.4	3.5 A
Overvoltage category (contact-earth)	III
Overvoltage category (contact-contact)	II
Combination of 250 V and 24 V signals	Possible with one unused relay in-between

Digital Inputs:

Number	7
Range	0/24 V
Mode	PNP/NPN
Input impedance	4 kΩ
Low trigger level	6.4 V
High trigger level	17 V

Analog Outputs:

Number	2
Range	0/4 -20 mA
Resolution	11 bit
Linearity	< 0.2%

EMC

EMC	IEC 61000-6-2 and IEC 61800-3 regarding Immunity of BURST, ESD, SURGE and Conducted Immunity

4. How to Install

4.1. How to Install

4.1.1. Installation of Option in the Frequency Converter

NB!
Before start, interrupt the power supply to the frequency converter. Never install an option card into the frequency converter during operation.

The VLT Extended Relay Card MCB 113 option is exclusively intended for use in option slot C1. The mounting position of C1 options is shown in the drawings below.

130BA945.10
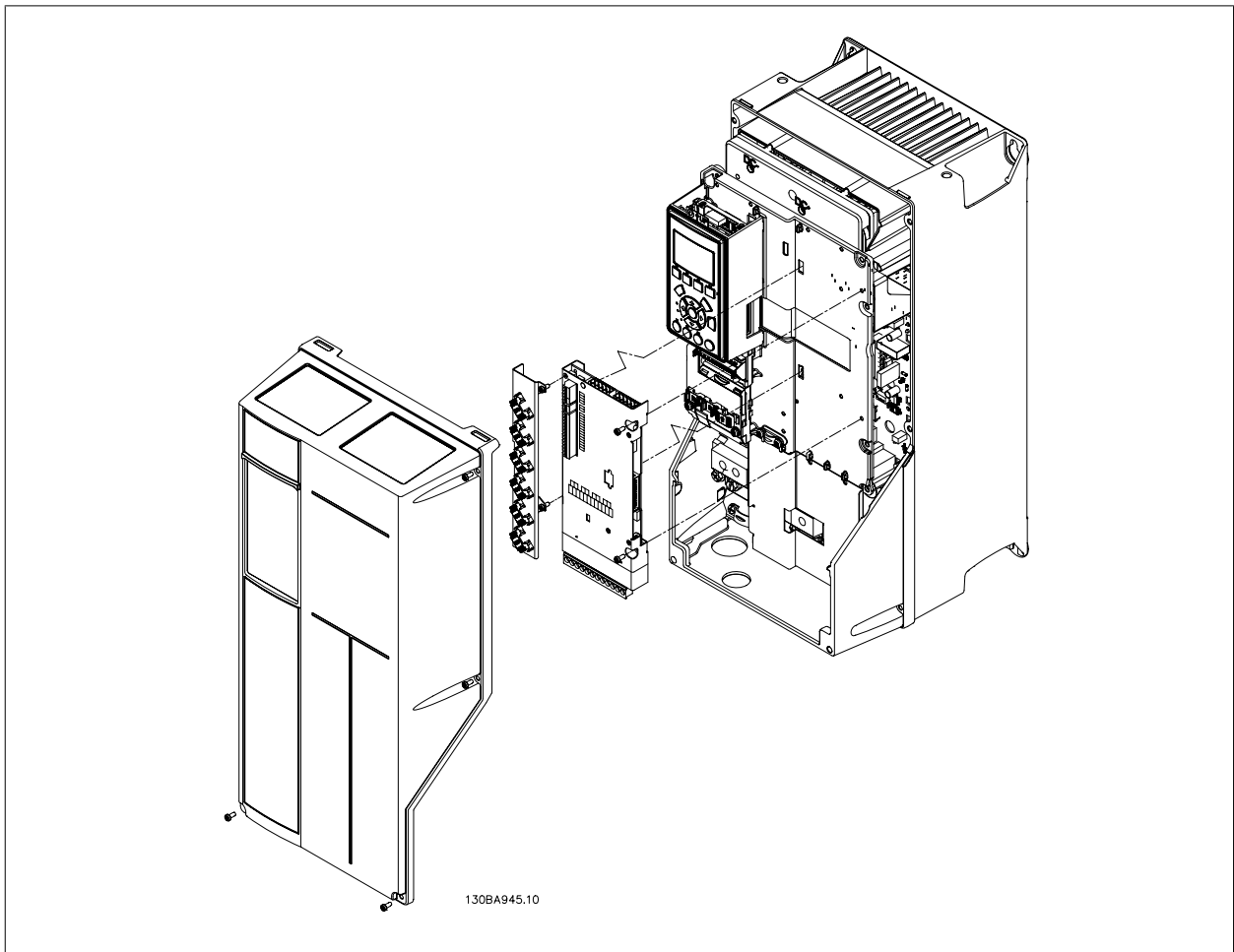
Enclosure A5 - C
The mounting kits for these enclosures include a fan. Note that this fan is not to be mounted!
For these enclosures only one C option can be installed at a time.

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130BA946.10
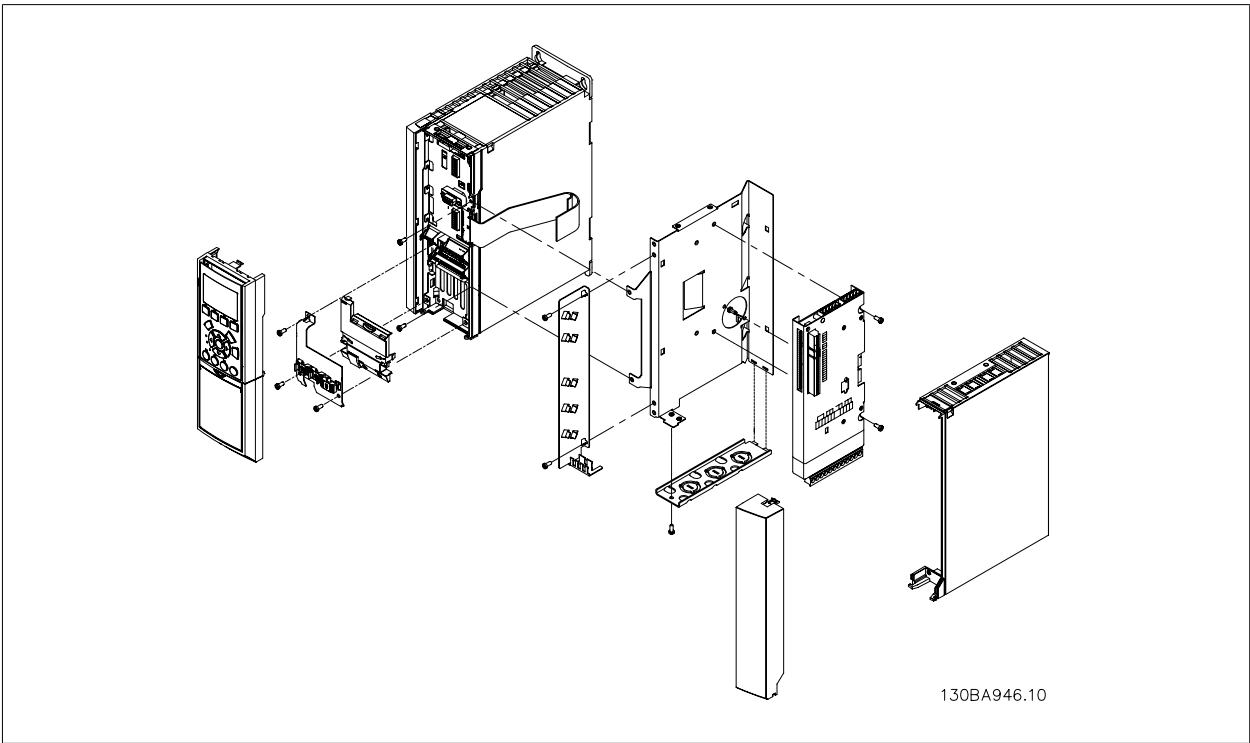
Enclosure A2, A3 (and B3)

40 mm (only one C option).

130BA947.10
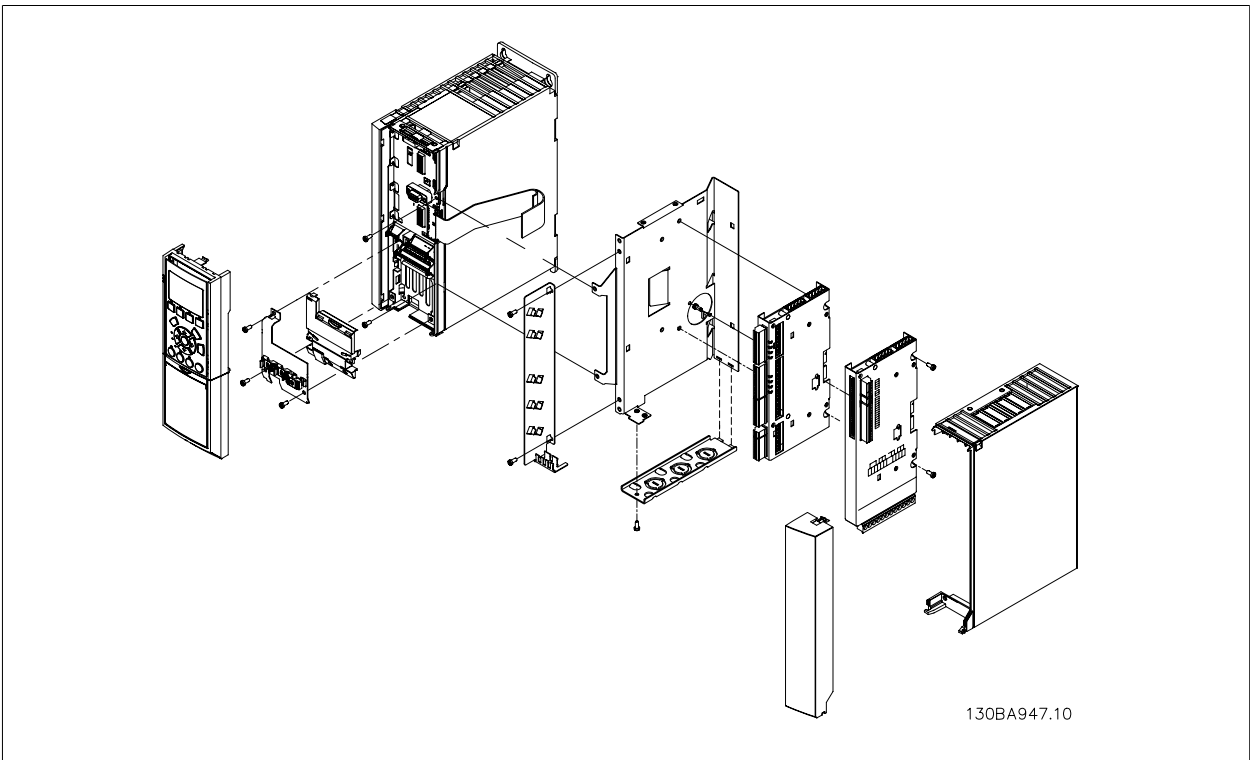
Enclosure A2, A3 (and B3)

60 mm (one C0 plus one C1 option, i.e. MCO 305 plus MCB 113).

5. Parameter Set-up

5.1. Parameter Set-up

The parameters included in these Operating Instructions are additional parameters for the FC 300 Programming Guide MG.33.MX.YY

5.2. 5-** Digital In/Out

5.2.1. 5-1* Digital Inputs

Parameters for configuring the input functions for the input terminals.

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

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| 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	[32]	29, 33
Ramp bit 0	[34]	All
Ramp bit 1	[35]	All
Mains failure inverse	[36]	All
Latched precise start	[40]	18, 19
Latched precise stop inverse	[41]	18, 19
DigiPot Increase	[55]	All
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	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
PTC Card 1	[80]	All

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 one 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 par. C-23 Quick *Stop Decel 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 energizing it with a DC current for a certain time period. See par. B-01 DC *Brake Current* to par. B-03 DC *Brake Cut In Speed [RPM]*. The function is only active when the value in par. B-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 (par. F-08 Decel *Time 1*, par. E-11 Decel *Time 2*, par. E-13 Decel *Time 3*, par. E-15 Decel *Time 4*).

> **NB!**
> When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *Torque limit & stop* [27] and connect this digital output to a digital input that is configured as coast.

[8]	Start	(Default Digital input 18): Select start for a start/stop command. Logic '1' = start, logic '0' = stop.
[9]	Latched start	The motor starts, if a pulse is applied for min. 2 ms. The motor stops when Stop inverse is activated.
[10]	Reversing	(Default Digital input 19). Change the direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in par. H-08 Reverse *Lock*. The function is not active in process closed loop.
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[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 par. C-20 Jog *Speed [Hz]*.
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that *External/preset* [1] has been selected in par. F-54 Reference *Function*. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Preset ref. bit 0,1, and 2 enables a choice between one of the eight preset references according to the table below.
[17]	Preset ref bit 1	Same as Preset ref bit 0 [16].
[18]	Preset ref bit 2	Same as Preset ref bit 0 [16].

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

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

> **NB!**
> When Freeze output is active, the frequency converter cannot be stopped via a low 'start [8]' signal. Stop the frequency converter via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse.

[21]	Speed up	Select Speed up and Speed down if digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up/ down is activated for less than 400 msec. the resulting reference will be increased/ decreased by 0.1 %. If Speed up/ down is activated for more than 400 msec. the resulting reference will follow the setting in 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

[22]	Speed down	Same as Speed up [21].
[23]	Set-up select bit 0	Select Set-up select bit 0 or Select Set-up select bit 1 to select one of the four set-ups. Set par. K-10 Active *Set-up* to Multi Set-up.
[24]	Set-up select bit 1	(Default Digital input 32): Same as Set-up select bit 0 [23].
[26]	Precise stop inv.	Prolongs stop signal to give a precise stop independent of speed. Sends an inverted stop signal when the precise stop function is activated in par. H-83 Precise *Stop Function*. Precise stop inverse function is available for terminals 18 or 19.
[27]	Precise start, stop	Use when Precise ramp stop [0] is selected in par 1-83.
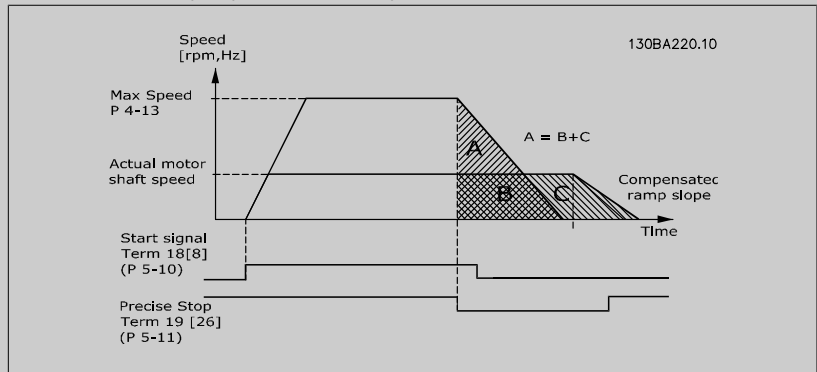
[28]	Catch up	Increases reference value by percentage (relative) set in par. F-62 Catch *up/slow Down Value*.
[29]	Slow down	Reduces reference value by percentage (relative) set in par. F-62 Catch *up/slow Down Value*.
[30]	Counter input	Precise stop function in par. H-83 Precise *Stop Function* acts as Counter stop or speed compensated counter stop with or without reset. The counter value must be set in par. H-84 Precise *Stop Counter Value*.
[32]	Pulse input	Use pulse sequence as either reference or feedback. Scaling is done in par. group 5-5*.
[34]	Ramp bit 0	Enables a choice between one of the 4 ramps available, according to the table below.
[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

[36]	Mains failure inverse	Activates par. SP-10 Line *failure*. Mains failure inverse is active in the Logic .0. situation.
[41]	Latched Precise Stop inverse	Sends a latched stop signal when the precise stop function is activated in par. H-83 Precise *Stop Function*. The Latched Precise stop inverse function is available for terminals 18 or 19.
[55]	DigiPot Increase	INCREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[56]	DigiPot Decrease	DECREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[57]	DigiPot Clear	Clears the Digital Potentiometer reference described in parameter group 3-9*
[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
[71]	Mech. Brake Feedback inv.	Inverted brake feedback for hoisting applications
[80]	PTC Card 1	All Digital Inputs can be set to PTC Card 1 [80]. However, only one Digital Input must be set to this choice.

5-20 Terminal X46/1 Digital Input (MCB 113)

Option: **Function:**

[0] *   No operation   This parameter is active when option module MCB 113 is installed in the frequency converter. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

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. Follow the function stated in 5-1*

5.2.2. 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals. The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in par. E-51 Terminal *27 Mode*, and set the I/O function for terminal 29 in par. E-52 Terminal *29 Mode*. 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 board receives supply voltage.
[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 is been given (start/disable). There are no warnings.
[5]	VLT running	Motor is running.
[6]	Running / no warning	Output speed is higher than the speed set in par. H-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 par. H-70 Warning *Current Low* to par. H-73 Warning *Speed High*. There are no warnings.
[8]	Run on reference / no warning	Motor runs at reference speed.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in par. F-40 Torque *Limiter (Driving)* or par. 1-17 has been exceeded.
[12]	Out of current range	The motor current is outside the range set in par. F-43 Current *Limit*.
[13]	Below current, low	Motor current is lower than set in par. H-70 Warning *Current Low*.
[14]	Above current, high	Motor current is higher than set in par. H-71 Warning *Current High*.
[15]	Out of range	Output frequency is outside the frequency range set in par. H-70 Warning *Current Low* and par. H-71 Warning *Current High*.
[16]	Below speed, low	Output speed is lower than the setting in par. H-72 Warning *Speed Low*.
[17]	Above speed, high	Output speed is higher than the setting in par. H-73 Warning *Speed High*.
[18]	Out of feedback range	Feedback is outside the range set in par. H-76 Warning *Feedback Low* and par. H-77 Warning *Feedback High*.
[19]	Below feedback low	Feedback is below the limit set in par. H-76 Warning *Feedback Low*.
[20]	Above feedback high	Feedback is above the limit set in par. H-77 Warning *Feedback High*.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
[22]	Ready, no thermal warning	Frequency converter is ready for operation and there is no over-temperature warning.
[23]	Remote, ready, no thermal warning	Frequency converter is ready for operation and is in Auto On mode. There is no over-temperature warning.
[24]	Ready, no over-/ under voltage	Frequency converter is ready for operation and the mains voltage is within the specified voltage range (see *General Specifications* section).
[25]	Reverse	*Reversing*. Logic '1' when CW rotation of the motor. Logic '0' when CCW rotation of the motor. If the motor is not rotating the output will follow the reference.
[26]	Bus OK	Active communication (no time-out) via the serial communication port.
[27]	Torque limit 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-**.
[32]	Mechanical brake control	Enables control of an external mechanical brake, see description in the section *Control of Mechanical Brake*, and par. group 2-2*
[33]	Safe stop activated (FC 302 only)	Indicates that the safe stop on terminal 37 has been activated.
[40]	Out of ref range	
[41]	Below reference low	
[42]	Above reference high	
[45]	Bus Ctrl	Controls output via bus. The state of the output is set in par. E-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 par. E-90 Digital *& Relay Bus Control*. In the event of bus time-out 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 par. E-90 Digital *& Relay Bus Control*. In the event of bus time-out the output state is set low (Off).
[51]	MCO controlled	
[55]	Pulse output	
[60]	Comparator 0	See par. group 13-1*. If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See par. group 13-1*. If Comparator 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[62]	Comparator 2	See par. group 13-1*. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[63]	Comparator 3	See par. group 13-1*. If Comparator 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[64]	Comparator 4	See par. group 13-1*. If Comparator 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[65]	Comparator 5	See par. group 13-1*. If Comparator 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[70]	Logic Rule 0	See par. group 13-4*. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic Rule 1	See par. group 13-4*. If Logic Rule 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[72]	Logic Rule 2	See par. group 13-4*. If Logic Rule 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[73]	Logic Rule 3	See par. group 13-4*. If Logic Rule 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[74]	Logic Rule 4	See par. group 13-4*. If Logic Rule 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[75]	Logic Rule 5	See par. group 13-4*. If Logic Rule 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[80]	SL Digital Output A	See par. LC-52 Logic *Controller Action*. The output will go high whenever the Smart Logic Action [38] *Set dig. out. A high* is executed. The output will go low whenever the Smart Logic Action [32] Set dig. out. A low is executed.
[81]	SL Digital Output B	See par. LC-52 Logic *Controller Action*. The input will go high whenever the Smart Logic Action [39] *Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action [33] *Set dig. out. A low* is executed.
[82]	SL Digital Output C	See par. LC-52 Logic *Controller Action*. The input will go high whenever the Smart Logic Action [40] *Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action [34] *Set dig. out. A low* is executed.

[83]	SL Digital Output D	See par. LC-52 Logic *Controller Action*. The input will go high whenever the Smart Logic Action [41] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [35] *Set dig. out. A low* is executed.
[84]	SL Digital Output E	See par. LC-52 Logic *Controller Action*. The input will go high whenever the Smart Logic Action [42] *Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action [36] *Set dig. out. A low* is executed.
[85]	SL Digital Output F	See par. LC-52 Logic *Controller Action*. The input will go high whenever the Smart Logic Action [43] *Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action [37] *Set dig. out. A low* is executed.
[120]	Local reference active	Output is high when par. F-02 Operation *Method* = [2] Local or when par. F-02 Operation *Method* = [0] *Linked to hand auto* at the same time as the is in Hand on mode.
[121]	Remote reference active	Output is high when par. F-02 Operation *Method* = *Remote* [1] or *Linked to hand/auto* [0] while the is in [Auto on] mode.
[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 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 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]).

E-24 Function Relay

Array [9]

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

Option:	Function:
[0] *	No operation
[1]	Control ready
[2]	Drive ready
[3]	Drive rdy/rem ctrl
[4]	Enable / no warning
[5]	Drive 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
[36]	Control word bit 11
[37]	Control word bit 12
[40]	Out of ref range
[41]	Below reference, low
[42]	Above ref, high
[45]	Bus ctrl.
[46]	Bus ctrl, 1 if timeout
[47]	Bus ctrl, 0 if timeout
[51]	OPCMCO 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]	Logic Controller digital output A
[81]	Logic Controller digital output B
[82]	Logic Controller digital output C
[83]	Logic Controller digital output D
[84]	Logic Controller digital output E
[85]	Logic Controller digital output F
[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

5

5-41 On Delay, Relay

Enter the delay of the relay cut-in time. See par. 5-40.

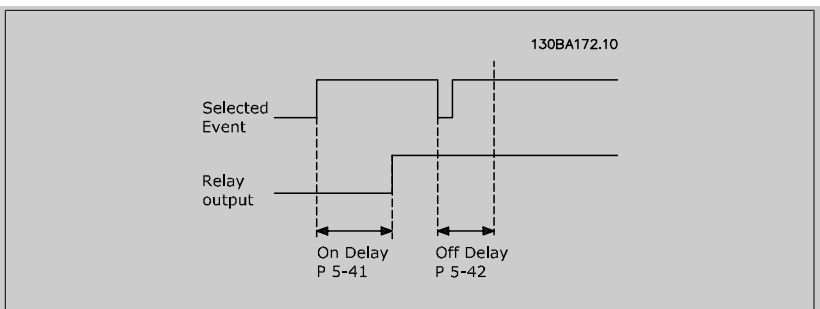| Array [9]	(Relay 1 [0], Relay 2 [1], Relay 3 [2], Relay 4 [3], Relay 5 [4], Relay 6 [5], Relay 6 [5], Relay 7 [6], Relay 8 [7], Relay 9 [8])
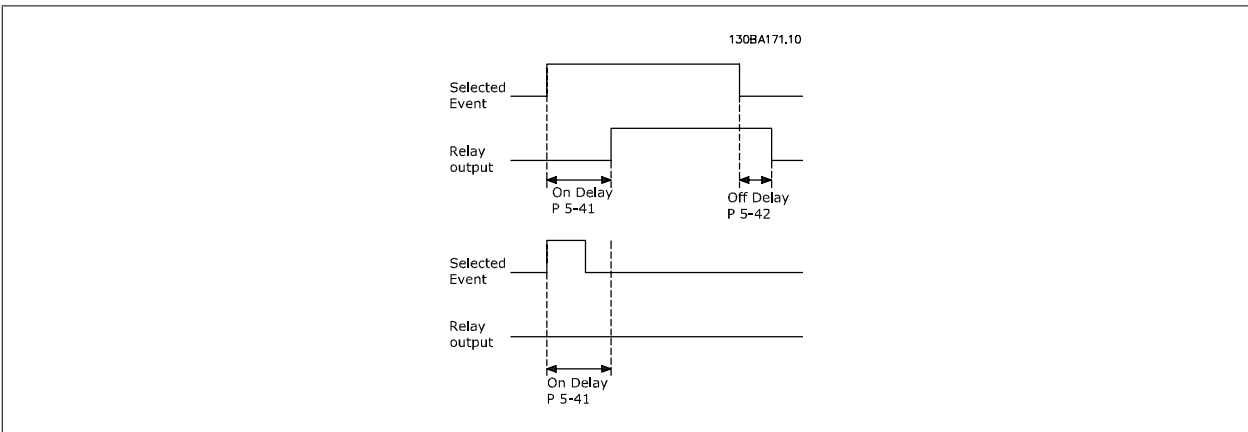
0.01s*	[0.01 - 600.00 s]

5-42 Off Delay, Relay

Enter the delay of the relay cut-out time. See par. 5-40.

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

0.01s*	[0.01 - 600.00 s.]

If the Selected Event condition changes before the on- or off delay timer expires, the relay output is unaffected.

5.3. 6-** Analog Outputs

5.3.1. 6-7* Analog Output 3

Parameters for configuring the scaling and limits for analog output 3, Terminal 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.
[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	Par. 3-00 [Min - Max] 0% = 0 mA; 100% = 20 mA Par. 3-00 [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA
[102]	Feedback	
[103]	Motor current 0-20 mA	Value is taken from par. 16-37. 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 Read-out 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 par. 6-52 is: $$\frac{I_{VLT_{Max}} \ x \ 100}{I_{Motor_{Norm}}} = \frac{38.4 \ x \ 100}{22} = 175 \ \%$$
[104]	Torque rel to lim 0-20 mA	The torque setting is related to setting in par. 4-16
[105]	Torque rel to rated motor torque 0-20 mA	The torque is related to the motor torque setting.
[106]	Power 0-20 mA	Taken from par. 1-20.
[107]	Speed 0-20 mA	Taken from par. 3-03. 20 mA = value in par. 3-03
[108]	Torque ref. 0-20 mA	Torque reference related to 160% torque.
[109]	Max Out Freq 0-20 mA	In relation to par. 4-19.
[130]	Output freq. 4-20 mA	0 Hz = 4 mA, 100 Hz = 20 mA
[131]	Reference 4-20 mA	Par. 3-00 [Min-Max] 0% = 4 mA; 100% = 20 mA Par. 3-00 [-Max-Max] -100% = 4mA; 0% = 12 mA; +100% = 20 mA
[132]	Feedback 4-20 mA	
[133]	Motor cur. 4-20 mA	Value is taken from par. 16-37. 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 Read-out 11.46 mA. $$\frac{16 \ mA \ x \ 22 \ A}{38.4 \ A} = 9.17 \ mA$$ In case the norm motor current is equal to 20 mA, the output setting of par. 6-52 is: $$\frac{I_{VLT_{Max}} \ x \ 100}{I_{Motor_{Norm}}} = \frac{38.4 \ x \ 100}{22} = 175 \ \%$$
[134]	Torque % lim. 4-20 mA	The torque setting is related to setting in par. 4-16.
[135]	Torque % nom 4-20 mA	The torque setting is related to the motor torque setting.
[136]	Power 4-20 mA	Taken from par. 1-20
[137]	Speed 4-20 mA	Taken from par. 3-03. 20 mA = Value in par. 3-03.
[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 will work independently of internal functions in the frequency converter.
[140]	Bus ctrl. 4-20 mA	An output value set from fieldbus process data. The output will work independently of internal functions in the frequency converter.
[141]	Bus ctrl. 0-20 mA, timeout	Par. 4-54 defines the behaviour of the analog output in case of bus time-out.
[142]	Bus ctrl. 4-20 mA, timeout	Par. 4-54 defines the behaviour of the analog output in case of bus time-out.
[150]	Max Out Freq 4-20 mA	In relation to par. 4-19.

6-71 Terminal X45/1 Output Min Scale
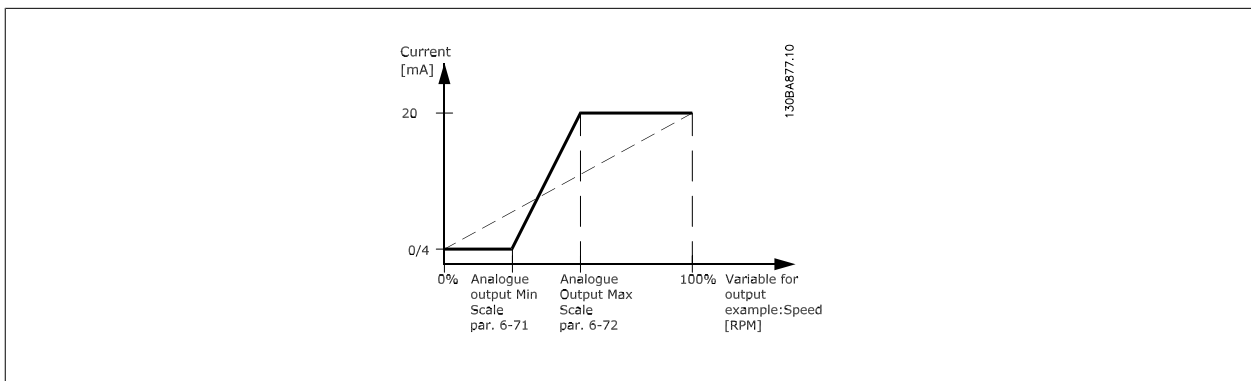
Range:

0.00%* [0.00 - 200.00%]

Function:

Scale the minimum output of the selected analog signal at terminal X45/1, as a percentage of the maximum signal value. E.g. if 0 mA (or 0 Hz) is desired at 25% of the maximum output value, then programme 25%. Scaling values up to 100% can never be higher than the corresponding setting in par. 6-72.

6-72 Terminal X45/1 Output Max Scale

Range:

100%* [0.00 - 200.00%]

Function:

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, programme 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):

$$\frac{I_{RANGE}\,[mA]}{I_{DESIRED\ MAX}\,[mA]} \; x \; 100\,\% \; = \; \frac{20 \; - \; 4 \; mA}{10 \; mA} \; x \; 100\,\% \; = \; 160\,\%$$

6-73 Terminal X45/1 Output Bus Control

Range:

0.00%* [0.00 - 100.00%]

Function:

Holds the level of Analog Output 3 (terminal X45/1) if controlled by bus.

6-74 Terminal X45/1 Output Timeout Preset

Range:

0.00%* [0.00 - 100.00%]

Function:

Holds the preset level of Analog Output 3 (terminal X45/1).

In case of a bus timeout and a timeout function is selected in par. 6-70 the output will preset to this level.

5.3.2. 6-8* Analog Output 4

Parameters for configuring the scaling and limits for analog output 4. Terminal X45/3 and X45/4. Analog outputs are current outputs: 0/4 – 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 par. 6-70

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 par. 6-82 if value is below 100%.
	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 ful-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):

$$\frac{I_{RANGE}\ [mA]}{I_{DESIRED\ MAX}\ [mA]}\ x\ 100\ \% \ =\ \frac{20\ -\ 4\ mA}{10\ mA}\ x\ 100\ \% \ =\ 160\ \%$$

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 par. 6-80 the output will preset to this level.

5.4. 14-** 24 V DC External Supply

5.4.1. 14-6* Options

14-80 MCB 113 Supplied by External 24 V DC		
Option:		**Function:**
[0]	No	Select No [0] to use the drive's 24 V DC supply.
[1] *	Yes	Select Yes [1] if an external 24 V DC supply will be used to power the option. I/O will be galvanically isolated from the drive when operated from an external supply.

5.5. 16-** Data readouts

5.5.1. 16-6* Inputs and Outputs

Parameters for reporting the digital and analog IO ports.

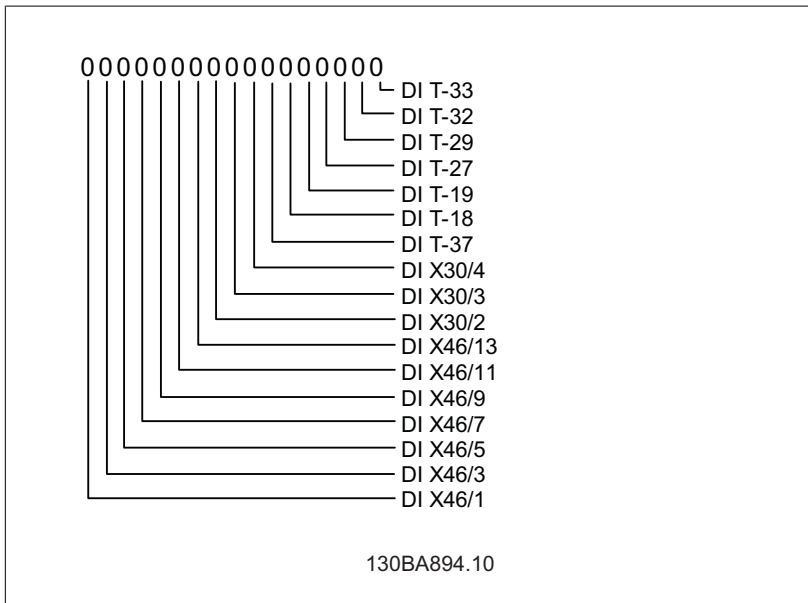| 16-60 Digital Input		
Range:		**Function:**

0   [0 - 63]

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

```
00000000000000000
                 └─ DI T-33
                ── DI T-32
                ── DI T-29
                ── DI T-27
                ── DI T-19
                ── DI T-18
                ── DI T-37
                ── DI X30/4
                ── DI X30/3
                ── DI X30/2
                ── DI X46/13
                ── DI X46/11
                ── DI X46/9
                ── DI X46/7
                ── DI X46/5
                ── DI X46/3
                ── DI X46/1
```

130BA894.10

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16-71 Relay Output [bin]

View the settings of all relays.

0.000 N/A* [0 - 511 N/A]

Bit 0	Relay 9
Bit 1	Relay 8
Bit 2	Relay 7
Bit 3	Relay 2
Bit 4	Relay 1
Bit 5	Relay 6
Bit 6	Relay 5
Bit 7	Relay 4
Bit 8	Relay 3
Bit 9-15	Reserved for future relays

```
000000000
        └─ Relay 9
          Relay 8
          Relay 7
          Relay 2
          Relay 1
          Relay 6
          Relay 5
          Relay 4
          Relay 3
```

130BA689.10
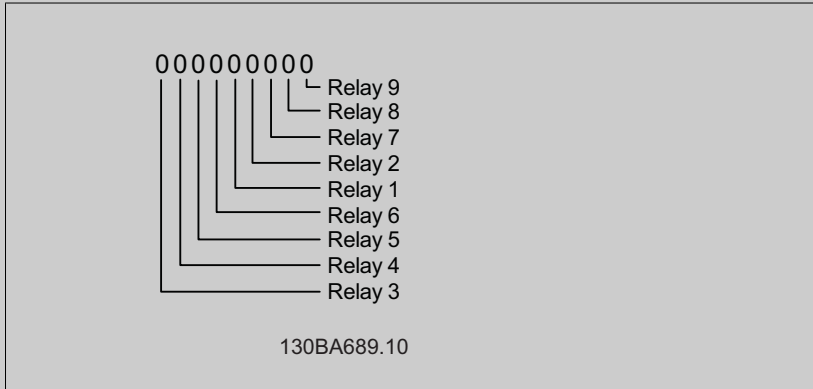
16-78 Analog Out X45/1 [mA]

Range:

0.000 N/A* [0.000 - 30.000 N/A]

Function:

View the actual value at output X45/1. The value shown reflects the selection in par. 6-70.

16-79 Analog Out X45/3 [mA]

Range:

0.000 N/A* [0.000 - 30.000 N/A]

Function:

View the actual value at output X45/3. The value shown reflects the selection in par. 6-80.