Programming Guide

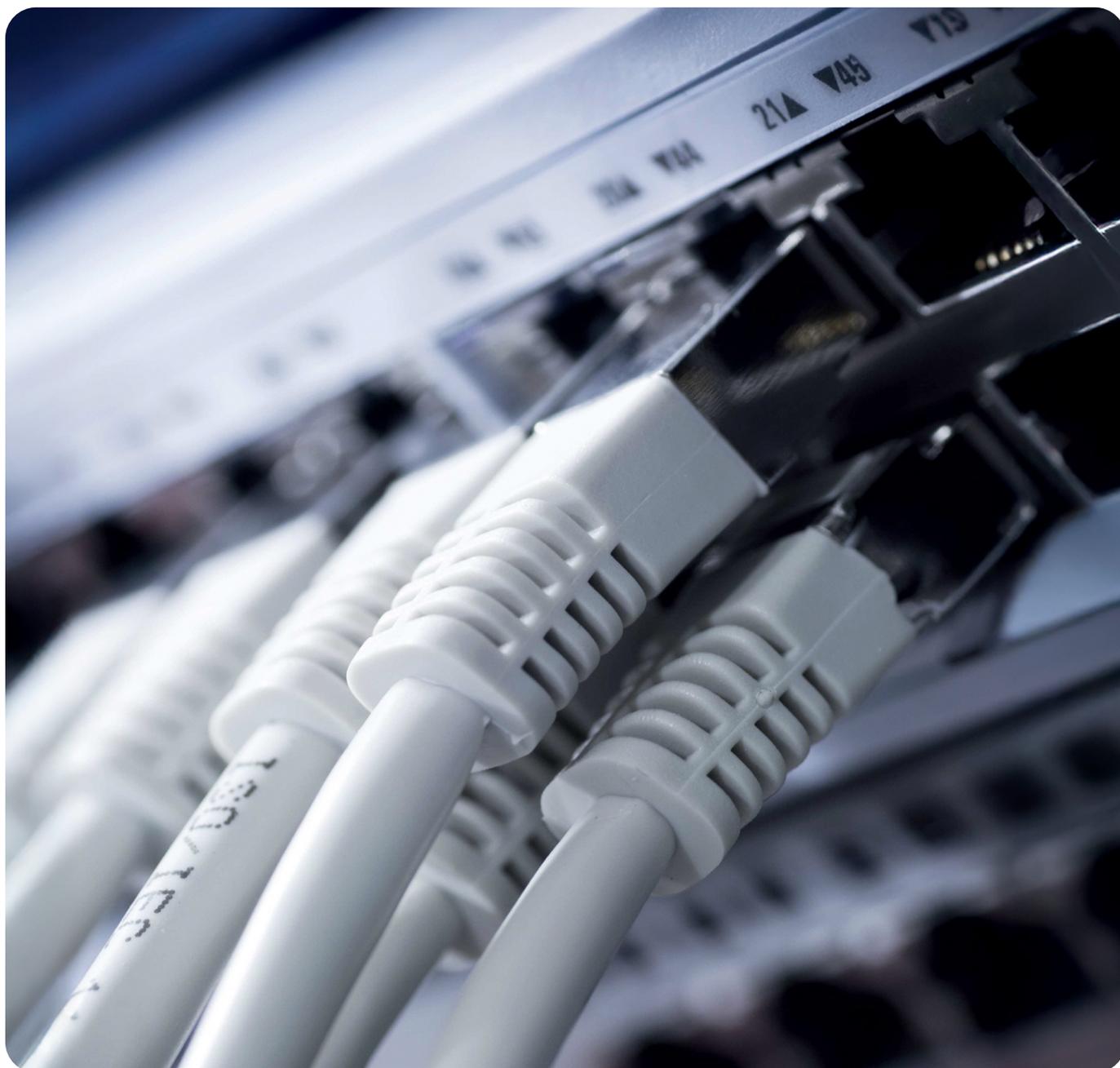# VLT® Modbus TCP MCA 122

VLT® HVAC Drive FC 102, VLT® Refrigeration Drive FC 103, VLT® AQUA Drive FC 202, VLT® AutomationDrive FC 301/FC 302

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1 Introduction

1.1 Purpose of the Programming Guide

This programming guide provides information about configuring the system, controlling the drive, accessing parameters, programming, and troubleshooting.

The programming guide is intended for use by qualified personnel familiar with VLT® drives, with Modbus TCP technology, and with the PC or PLC used as a master in the system.

Read the instructions before programming and follow the procedures in this guide.

1.2 Trademarks

VLT® is a registered trademark for Danfoss A/S.

Ethernet® is a registered trademark of Xerox Corporation.

MODBUS® is a registered trademark of Schneider Electric USA, Inc.

1.3 Additional Resources

Resources available for the drives and for optional equipment:

- The drive-specific operating guide of the relevant drive provides the necessary information for getting the drive ready for operation.

- The drive-specific design guide of the relevant drive provides detailed information about capabilities and functionality to design motor control systems.

- The drive-specific programming guide of the relevant drive provides greater details on working with parameters.

- The *VLT® Ethernet Fieldbuses MCA 12X Installation Guide* provides information about installing and troubleshooting the Modbus TCP interface.

- The *VLT® Modbus TCP Programming Guide* provides information about configuring the system, programming, and troubleshooting.

- The *VLT® Motion Control Tool MCT 10 Operating Guide* provides information for installation and use of the software on a PC.

Supplementary publications and guides are available from Danfoss. See www.danfoss.com for listings.

1.4 Document and Software Versions

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

The original language of this guide is English.

Table 1: Document and Software Versions

Edition	Remarks	Software version
AU538129377712, version 0101	New programming guide based on the VLT® Modbus TCP Operating Guide.	7.00

1.5 Intended Use

This installation guide relates to the Modbus TCP interface.

Code number:

- 130B1196 (uncoated)

- 130B1296 (conformal coated)

The VLT® Modbus TCP MCA 122 interface is designed to communicate with any system complying with the Modbus Messaging on TCP/IP Implementation Guide V1.0b and Modbus Application Protocol Specification V1.1b standard. The MCA 122 option is tested to conform to the Modbus standards and is certified towards conformance test level version 3.

VLT® Modbus TCP MCA 122 is intended for use with:

- VLT® HVAC Drive FC 102.

- VLT® Refrigeration Drive FC 103.

- VLT® AQUA Drive FC 202.

- VLT® AutomationDrive FC 301/FC 302.

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

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

⚠	ISO warning symbol for general warnings
⚠	ISO warning symbol for hot surfaces and burn hazard
⚠	ISO warning symbol for high voltage and electric shock
⟳	Symbol for indicating the required discharge time of the capacitors in the product.
📖	ISO action symbol for referring to the instructions

2.2 Qualified Personnel

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

Persons with proven skills:

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

2.3 Safety Precautions

⚠ **WARNING**

LACK OF SAFETY AWARENESS

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

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

⚠ **WARNING**

HAZARDOUS VOLTAGE

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

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

⚠ **WARNING**

UNINTENDED START

When the drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage.

- Disconnect the drive from the mains.
- Press *[Off/Reset]* on the LCP before programming parameters.
- Ensure that the drive is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.

⚠ **WARNING**

DISCHARGE TIME

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

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The discharge time is specified on the drive product label.
- Use a measuring device to make sure that there is no voltage before opening the drive or performing any work on the cables.

⚠ **WARNING**

ELECTRICAL SHOCK HAZARD - HIGH LEAKAGE CURRENT

Leakage currents exceed 3.5 mA. Failure to connect the system properly to protective earth may result in death or serious injury.

- Ensure reinforced protective earthing conductor according to IEC 60364-5-54 cl. 543.7 or according to local safety regulations for high touch current equipment. The reinforced protective earthing of the converter can be done with:
- PE conductor with a cross-section of at least 10 mm^2 Cu or 16 mm^2 Al.
- PE conductor completely enclosed within an enclosure or otherwise protected throughout its length against mechanical damage.

⚠ **WARNING**

INTERNAL FAILURE HAZARD

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

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

3 Configuration

3.1 IP Addresses

3.1.1 IP Settings

All IP-related parameters are in parameter group *12-0* IP Settings*:

- Parameter *12-00 IP Address Assignment*
- Parameter *12-01 IP Address*
- Parameter *12-02 Subnet Mask*
- Parameter *12-03 Default Gateway*
- Parameter *12-04 DHCP Server*
- Parameter *12-05 Lease Expires*
- Parameter *12-06 Name Servers*
- Parameter *12-07 Domain Name*
- Parameter *12-08 Host Name*
- Parameter *12-09 Physical Address*

There are 2 ways of assigning IP addresses, see and .

It is only possible to assign valid class A, B, and C IP addresses to the option.

Table 2: Valid Ranges of IP Addresses

Class	Range
A	1.0.0.1–126.255.255.254
B	128.1.0.1–191.255.255.254
C	192.0.1.1–223.255.254.254

3.1.2 Assigning IP Addresses Manually

1. Set parameter *12-00 IP Address Assignment* to *[0] Manual*.
2. Set parameter *12-01 IP Address* to 192-168-0.xxx.[1]
3. Set parameter *12-02 Subnet Mask* to 255.255.255.0
4. Optionally, set parameter *12-03 Default Gateway*.
5. Power cycle the drive.

3.1.3 Assigning IP Address Automatically

When assigning IP addresses automatically, parameters *12-01 IP Address* to *12-03 Default Gateway* become read-only parameters.

1. Set parameter *12-00 IP Address Assignment* to *[1] DHCP* or *[2] BOOTP*.

3.1.4 DHCP/BOOTP Servers

When the IP address is assigned via DHCP/BOOTP server, the assigned IP address and subnet mask can be read out in parameter *12-01 IP Address* and parameter *12-02 Subnet Mask*.

Parameter *12-04 DHCP Server* shows the IP address of the DHCP or BOOTP server found.

For DHCP only: Read out the remaining lease time in parameter *12-05 Lease Expires*.

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1) *Class C IP addresses are just examples. Any valid IP address can be entered.*

Parameter *12-09 Physical Address* reads out the MAC address of the option, which is also printed on the label of the option. If using fixed leases with DHCP or BOOTP, the physical MAC address is linked with a fixed IP address.

> 📄 NOTE: If no DHCP or BOOTP reply has been received after 4 attempts, for example, if the DHCP/BOOTP server has been powered off, the option falls back to the last good known IP address.

Parameter *12-03 Default Gateway* is optional and only used in routed networks.

Parameters *12-06 Name Servers* to parameter *12-08 Host Name* are used with Domain Name Server systems and are all optional. If DHCP or BOOTP is selected as IP address assignment, the parameters are read only.

3.2 Ethernet Link Parameters

The following parameters provide Ethernet link information:

- Parameter *12-10 Link Status*
- Parameter *12-11 Link Duration*
- Parameter *12-12 Auto Negotiation*
- Parameter *12-13 Link Speed*
- Parameter *12-14 Link Duplex*

> 📄 NOTE: The Ethernet link parameters are unique per port.

Parameter *12-10 Link Status* and parameter *12-11 Link Duration* show information on the link status per port. Parameter *12-10 Link Status* shows *[0] No Link* or *[1] Link* according to the status of the present port.

Parameter *12-11 Link Duration* shows the duration of the link on the present port. If the link is broken, the counter resets.

Parameter *12-12 Auto Negotiation* is a feature that enables 2 connected Ethernet devices to select a common transmission parameter, such as speed and duplex mode. In this process, the connected devices first share their capabilities for these parameters and then select the fastest transmission mode that they both support. By default, this function is enabled. Incapability between the connected devices may lead to decreased communication performance. To avoid decreased performance, disable auto negotiation.

If parameter *12-12 Auto Negotiation* is set to *[0] Off*, link speed and duplex mode can be configured manually in parameter *12-13 Link Speed* and parameter *12-14 Link Duplex*.

Parameter *12-13 Link Speed* shows/sets the link speed per port. If no link is present, none is shown.

Parameter *12-14 Link Duplex* shows/sets the duplex mode per port:

- Half duplex provides communication in both directions, but only in 1 direction at a time (not simultaneously).
- Full duplex allows communication in both directions, and unlike half duplex, it allows simultaneous communication in both directions.

3.3 Scanners

3.3.1 Scanner Configuration

A system file, for example, EDS or GSD, is not required for configuring a scanner to communicate with the drive. The drive is handled as a generic device and is configured directly in the scanner. 3.3.2 Configuring a Modicon Scanner shows an example of configuring a scanner.

3.3.2 Configuring a Modicon Scanner

This example uses the Unity Pro tool from Group Schneider to configure the PLC. The example shows how to set up the protocol and assign I/O mapping to the internal memory of the PLC.

1. In the *Project Browser* window, right-click *Networks* and select *New Network*.
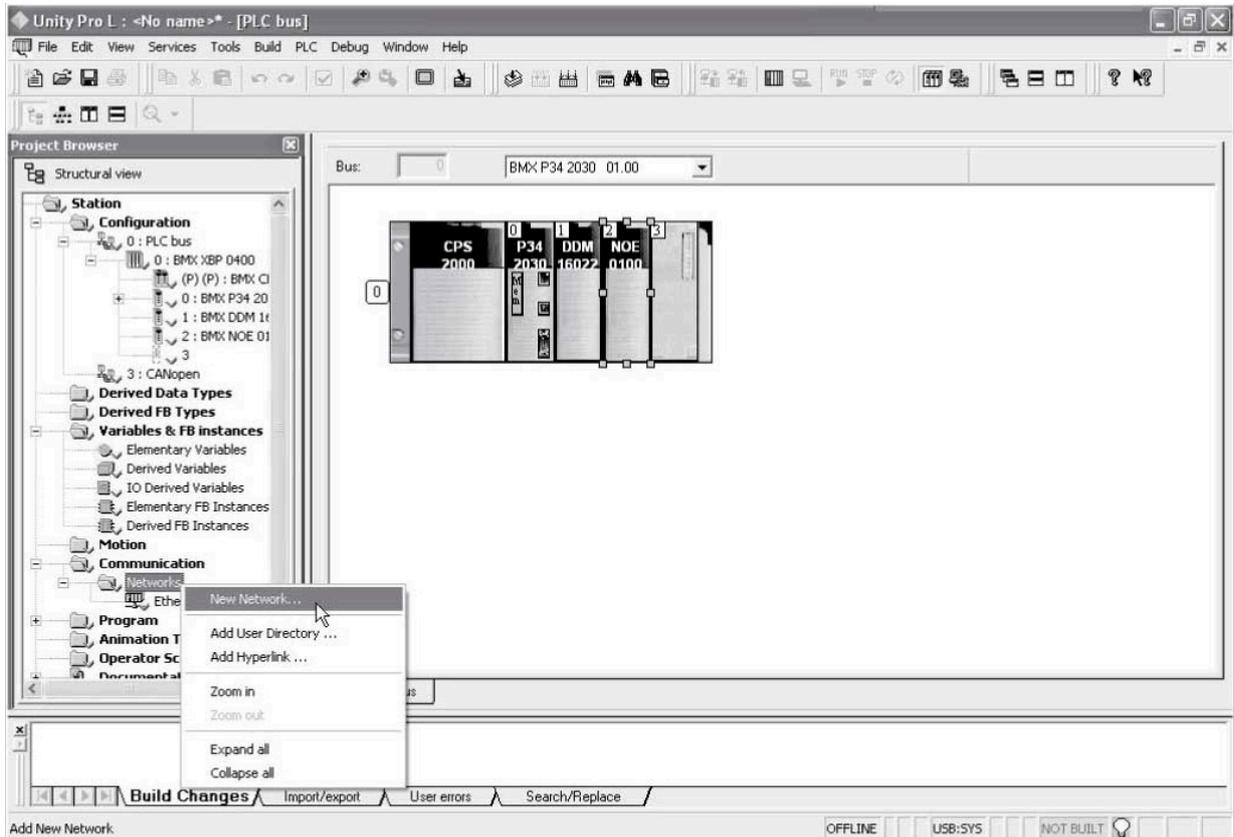
Figure 1: Adding a New Network

2. Assign a name to the new network in the field *Change Name*.
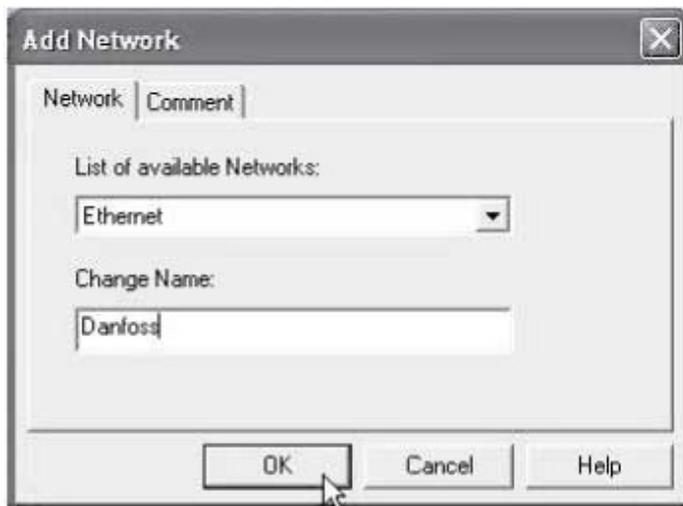
Figure 2: Adding a Name to the New Network

3. Click *OK*.

> The new network name shows up under *Networks*.

4. Click *Networks* in the *Project Browser* window to show the main configuration window.
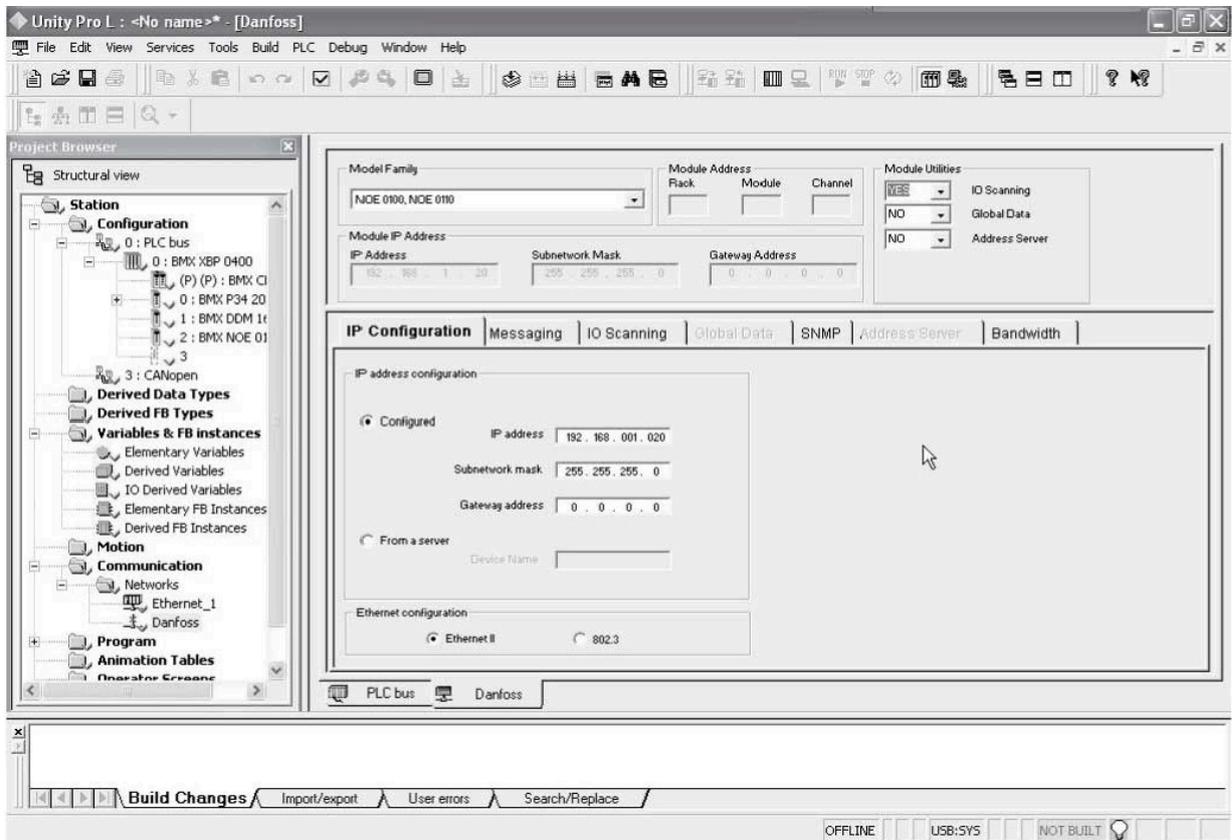
Figure 3: Main Configuration Window

Table 3: Menu Settings for the Configuration

Menu	Menu point	Settings
Model family	Model family	NOE 0100, NOE 0110
Model utilities	I/O scanning	Yes
	Global data	No
	Address server	No
IP address configuration	Configured/From a server	Configured
	IP address	192.168.001.020
	Subnet mask	255.255.255.0
	Gateway address	0.0.0.0
Ethernet configuration	Ethernet configuration	Ethernet II

5. In the *Configuration* tab, click *Configured*.

6. Enter the IP address and subnetwork mask in the respective fields.

> The protocol is assigned to the scanner.

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7.   Select the scanner and select the *Function* menu.

8.   Select *ETH TCP II* to enable the Ethernet.

↻   The *Net Link* menu appears.

9.   In the *Net Link* field, select Danfoss.
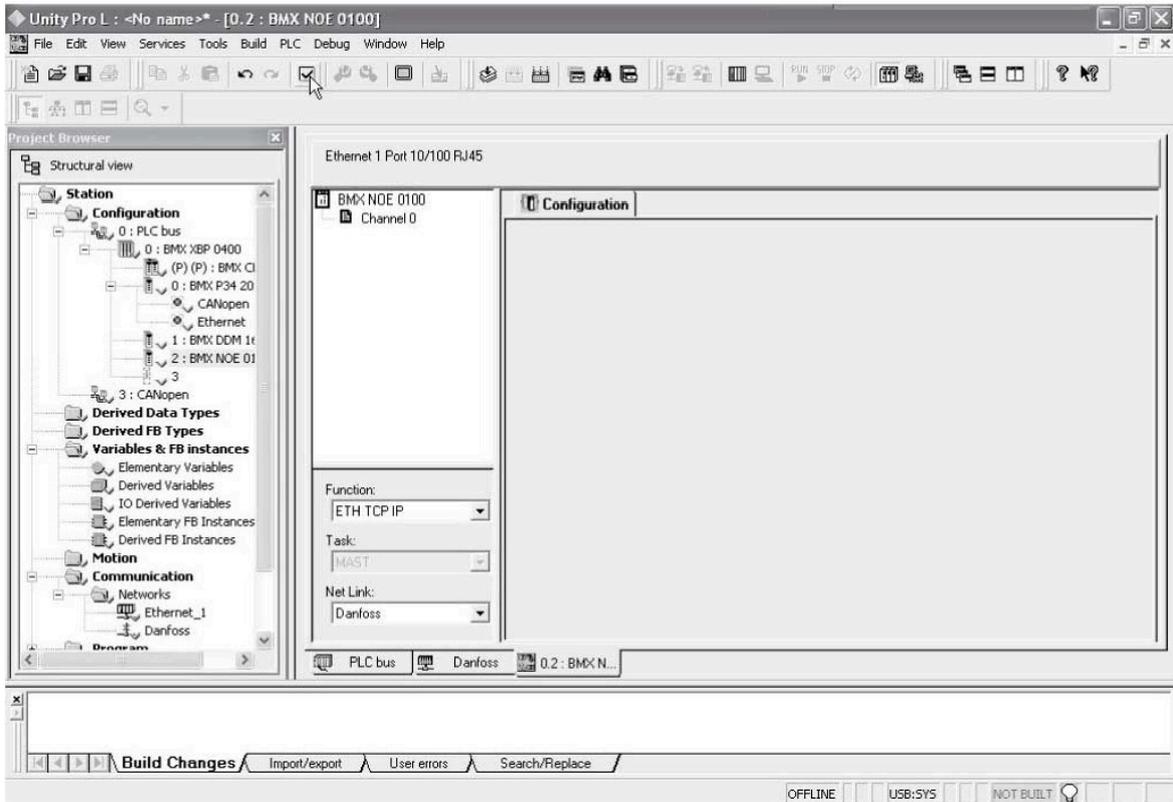
Figure 4: Net Link Field

Table 4: Menu Settings

Menu	Menu point	Setting
Function	Function	ETH TCP IP
Net link	Net link	Danfoss

↻   The Danfoss protocol is assigned to the scanner.

10.   To configure the scanner to read and write holding registers of the drive, select the Danfoss network.

11.   Select the *IO Scanning* tab.

↻   The scanning list appears.

12.   Fill out of the list as shown in Figure 5 and Figure 6. Use the information shown in Table 5.
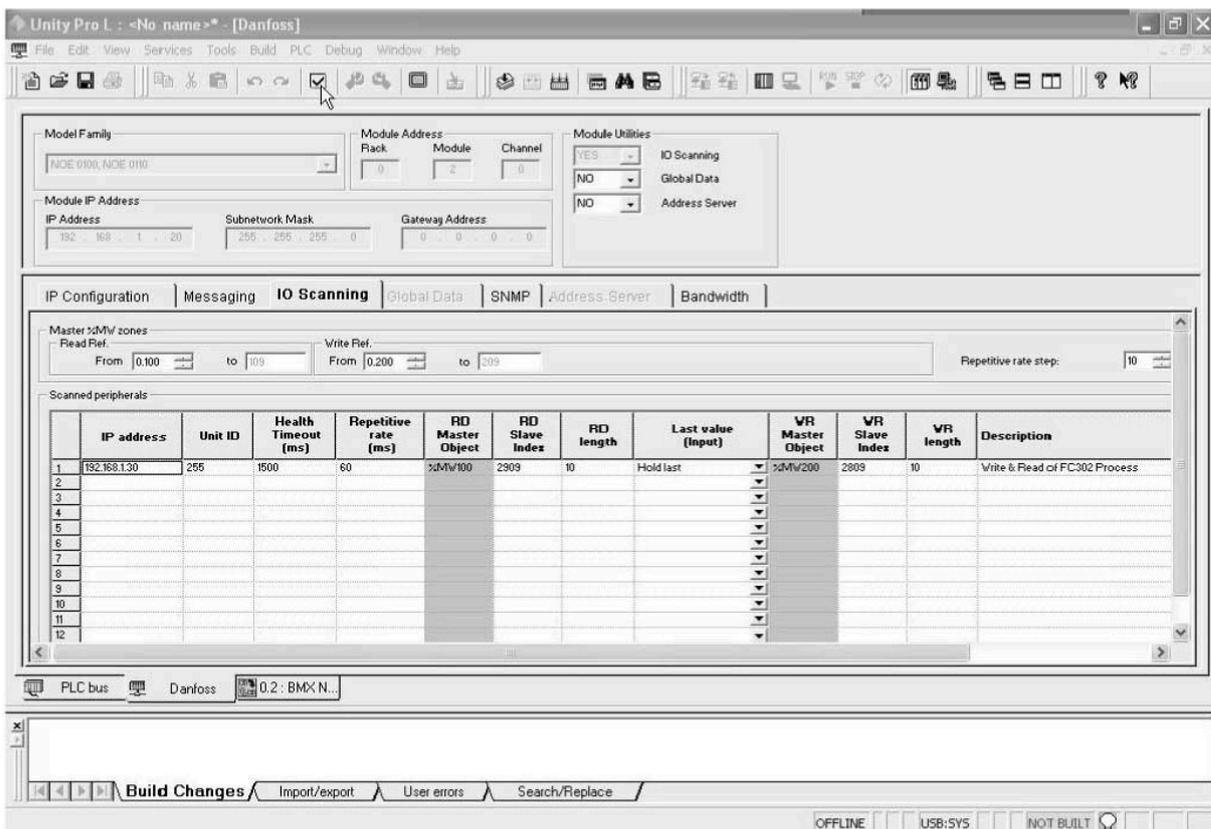
Figure 5: Scanning List
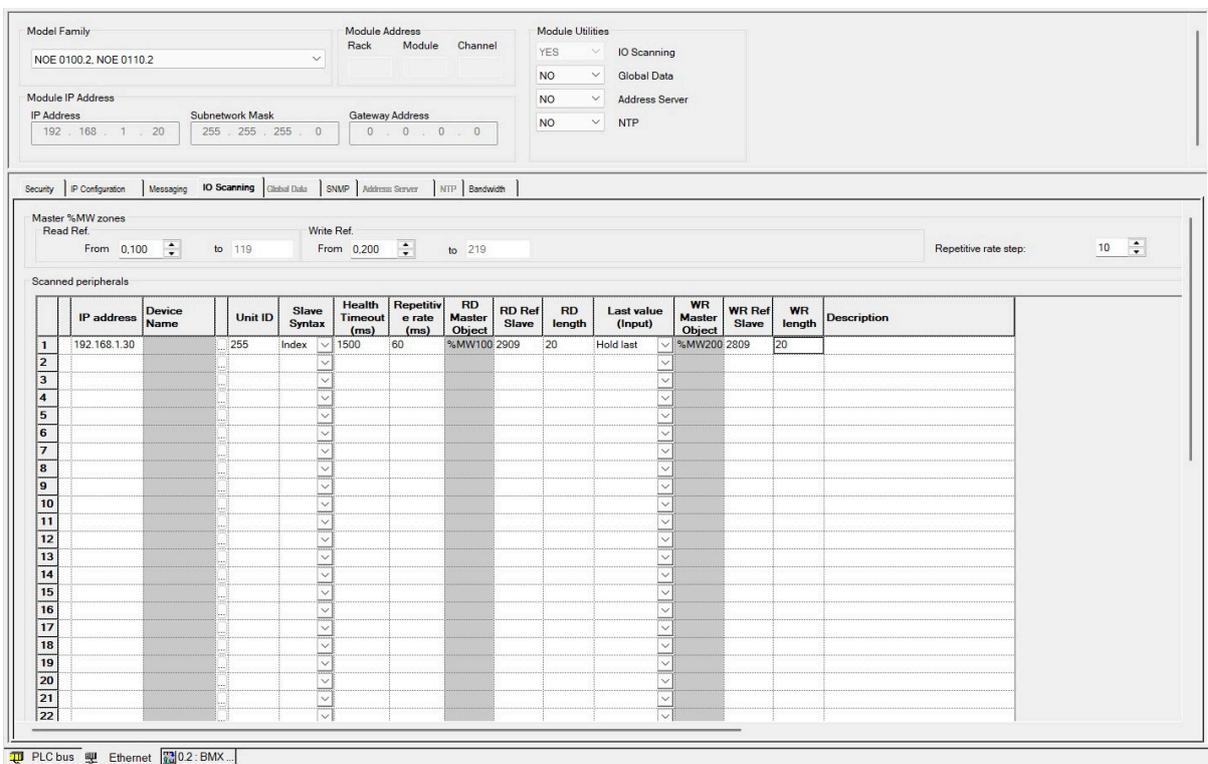
Figure 6: IO Scanning List

Table 5: Menu Settings

Menu	Menu point	Setting
I/O scanning	IP address	192.168.001.030
	Unit ID	255
	Health timeout	1500
	Repetitive rate	60
	RD master object	%MW100
	RD slave index	2910
	RD length	10 or 20
	Last value	Hold last
	VR master object	%MW200
	VR slave index	2810
	VR length	10 or 20
	Description	–

The configuration copies the information stored from %MW200 to %MW209 (10 PCD) or %MW219 (20 PCD) in the PLC to the holding register 2810–2910 (10 PCD) or 2810–2920 (20 PCD) of the drive. The configuration reads the holding registers 2910–2919 (10 PCD) or 2910–2920 (20 PCD) of the drive to the PLC memory %MW100 to %MW109 (10 PCD) or %MW119 (20 PCD).

4 Control

4.1 Modbus TCP Function Codes for Function and Data Fields

Modbus TCP supports the use of the following function codes in the function field of a message.

Table 6: Function Codes

Function	Function code
Read holding registers	3 hex
Write single register	6 hex
Write multiple registers	10 hex
Get comm. event counter	B hex
Report follower ID	11 hex
Read/write multiple registers	17 hex

Table 7: Sub-function Codes

Function	Function code	Sub-function code	Sub-function
Diagnostics	8	1	Restart communication.
		2	Return diagnostic register.
		10	Clear counters and diagnostic register.
		11	Return bus message count.
		12	Return bus communication error count.
		13	Return bus exception error count.
		14	Return slave message count.

4.2 Modbus TCP Message Framing Structure

4.2.1 Handling of Object Messages

Messaging is supported in both peer-to-peer and client/server configured networks. In both cases, object messages are communicated serially in the "data" portion of the Modbus protocol of each message transaction. A message consists of the MBAP header followed by the PDU (protocol data unit). The MBAP header consists of 7 bytes.

Table 8: MBAP Header

Field	Size (bytes)	Description
Transaction identifier	2	Used to match the response with the request.
Protocol identifier	2	Always 0x0000 for Modbus TCP.
Length	2	Number of remaining bytes in the message (unit identifier + PDU).
Unit identifier	1	Used for bridging to serial devices (like Modbus RTU). Usually, set to 0xFF or 0x01.

Table 9: PDU (Protocol Data Unit)

Field	Size (bytes)	Description
Function code	1	Defines the Modbus operation, for example, 0x03 for Read Holding Registers.
Data	Variable	Depends on the function, for example, register address, quantity, and values.

Example: Modbus TCP request frame

Reading Holding Registers (function code 0x03) request:

Table 10: Example, Modbus TCP Frame

Field	Value	Description
Transaction ID	0x0001	–
Protocol ID	0x0000	Always 0
Length	0x0006	6 bytes to follow (1 byte unit + 5 bytes PDU)
Unit ID	0x01	Follower address
Function code	0x03	Read holding registers
Starting address	0x000A	Start at register 10
Quantity	0x0002	Read 2 registers

The frame will be 00 01 00 00 00 06 01 03 00 0A 00 02.

4.2.2 Function Codes

The function code of a message frame contains 8 bits. Valid codes are in the range of 1–FF. Use function codes to send messages between client and server. When a message is sent from a client to a server device, the function code tells the server which action to perform. When the server responds to the client, it uses the function code to indicate either a normal (error-free) response, or that some error occurred (called an exception response). For a normal response, the server echoes the original function code. For an exception response, the server returns a code that is equivalent to the original function code with its most significant bit set to logic 1. Furthermore, the server places a unique code into the data field of the response message. It tells the client which error occurred, or the reason for the exception.

4.2.3 Data Field

The data field is constructed using sets of 2 hexadecimal digits in the range of 00–FF hexadecimal. These digits are made up of 1 TCP character. The data field of messages sent from a client to a server device contains extra information, which the server must use to act as defined by the function code. It can include items such as coil, or register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

4.2.4 Parameter Handling

The PNU (parameter number) is translated from the register address contained in the Modbus read or write message. The parameter number is translated to Modbus as (10 x parameter number) decimal.

Examples

- Reading parameter *3-12 Catch up/Slow Down Value* (16 bit): The holding register 3120 holds the values of the parameters. A value of 1352 (decimal) means that the parameter is set to 12.52%.

- Reading parameter *3-14 Preset Relative Reference* (32 bit): The holding registers 3410 and 3411 hold the parameters' values. A value of 11300 (decimal) means that the parameter is set to 1113.00.

For information on the parameters, size, and conversion index, see the programming guide of the drive.

4.2.5 Storage of Data

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

4.2.6 Parameter Index

Some parameters in the drive are array parameters, for example, parameter *12-21 Process Data Write*. Since Modbus does not support arrays in the holding registers, the drive has reserved the holding register 9 as a pointer to the array. Before reading or writing an array parameter, set the holding register 009 or 008. Setting the holding register to the value of 2 causes all following read/write to array parameters to be to the index 2.

Example: Set parameter *12-21 Process Data Write* index 2 to the value *[1613] Frequency*.

1. Write [2] to parameter index register 009 or 008.

2. Write [1613] to holding register 12210 or 12209.

3. Write [0] to parameter index register 009 to set it back to default 0.

📄 NOTE:

- The device uses a finite state machine. If index 009 is not reset, the device assumes that an indexed parameter is still being addressed. Any subsequent access to a non-indexed register is interpreted incorrectly and issues *Modbus Exception Code 4 Slave Device Failure*.

- After a power cycle, register 009 (parameter index) is reset to its default value of 0.

4.2.7 Text Blocks

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

4.2.8 Conversion Factor

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

4.2.9 Modbus Exception Codes

For a full explanation of the structure of an exception code response, refer to 4.2.1 Handling of Object Messages.

Table 11: Modbus Exception Codes

Code	Name	Meaning
1	Illegal function	The function code received in the query is not an allowable action for the server (or follower). This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the server (or follower) is in the wrong state to process a request of this type, for example, because it is not configured and is being asked to return register values.
2	Illegal data address	The data address received in the query is not an allowable address for the server (or follower). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 succeeds, while a request with offset 96 and length 5 generates exception 02.

Table 11: Modbus Exception Codes - (continued)

Code	Name	Meaning
3	Illegal data value	A value contained in the query data field is not an allowable value for server (or follower). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any value of any register.
4	Follower device failure	An unrecoverable error occurred while the server (or follower) was attempting to perform the requested action.

4.2.10 Register Addresses

Table 12: Register Addresses

Holding registers	
Modbus register number	**Description**
00001–00006	Reserved
00007	Last error code from an FC data object interface
00008	Reserved
00009	Parameter index
00010–00099	000 parameter group (parameters 001 through 099)
00100–00199	100 parameter group (parameters 100 through 199)
00200–00299	200 parameter group (parameters 200 through 299)
…	…
02810–02873	Write data block (PCD write via parameter *8-42 PCD Write Configuration*)
02910–02973	Read data block (PCD read via parameter *8-43 PCD Read Configuration*)
…	…
00300–00399	300 parameter group (parameters 300 through 399)
00400–00499	400 parameter group (parameters 400 through 499)
…	…
28000–28999	2800 parameter group (parameters 2800 through 2899)
…	…
50000	Control word (CTW)
50010	Bus reference (ref)
50200	Status word (STW)
50210	Main actual value (MAV)

4.3 PROFIdrive Control Profile

4.3.1 Overview of PROFIdrive Control Profile

This section describes the functionality of the control word and status word in the PROFIdrive profile. Select this profile by setting parameter *8-10 Control Word Profile*.

4.3.2 Control Word According to PROFIdrive Profile (CTW)

The control word is used to send commands from a master, for example, a PC, to a follower.

Table 13: Control Word Bits

Bit	Bit=0	Bit=1
00	OFF 1	ON 1
01	OFF 2	ON 2
02	OFF 3	ON 3
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold frequency output	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	Jog 1 OFF	Jog 1 ON
09	Jog 2 OFF	Jog 2 ON
10	Data invalid	Data valid
11	No function	Slow down
12	No function	Catch up
13	Parameter setup	Selection lsb
14	Parameter setup	Selection msb
15	No function	Reverse

4.3.3 Explanation of the Control Word Bits

Bit 00, OFF 1/ON 1

Normal ramp stops using the ramp times of the actual selected ramp.

- Bit 00 = 0 leads to stop and activation of the output relay 1 or 2 if the output frequency is 0 Hz and if [Relay 123] has been selected in parameter *5-40 Function Relay*.
- Bit 00 = 1 means that the drive is in State 1 *Switching on inhibited*.

Bit 01, OFF 2/ON 2

Coasting stop.

- Bit 01= 0 leads to a coasting stop and activation of the output relay 1 or 2 if the output frequency is 0 Hz and if [Relay 123] has been selected in parameter *5-40 Function Relay*.
- Bit 01 = 1 means that the drive is in State 1, *Switching on inhibited*.

Bit 02, OFF 3/ON 3

Quick stop using the ramp time of parameter *3-81 Quick Stop Ramp Time*.

- Bit 02 = 0 leads to a quick stop and activation of the output relay 1 or 2 if the output frequency is 0 Hz and if [Relay 123] has been selected in parameter *5-40 Function Relay*.
- Bit 02 = 1 means that the drive is in State 1, *Switching on inhibited*.

Bit 03, Coasting/No Coasting

- Bit 03 = 0 leads to a stop.
- Bit 03 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-50 Coasting Select* determines how bit 03 is linked with the corresponding function of the digital inputs.

Bit 04, Quick Stop/Ramp

Quick stop using the ramp time of parameter *3-81 Quick Stop Ramp Time*.

- Bit 04 = 0 leads to a quick stop.
- Bit 04 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-51 Quick Stop Select* determines how bit 04 is linked with the corresponding function of the digital inputs.

Bit 05, Hold Frequency Output/Use Ramp

- Bit 05 = 0 maintains the current output frequency even if the reference value is modified.
- Bit 05 = 1 means that the drive can perform its regulating function again. Operation occurs according to the respective reference values.

Bit 06, Ramp Stop/Start

Normal ramp stop using the ramp times of the actual ramp as selected. Additionally, activation of the output relay 1 and 4 if the output frequency is 50 Hz and if [Relay 123] has been selected in parameter *5-40 Function Relays*.

- Bit 06 = 0 leads to a stop in which the motor speed is ramped down to stop via the selected ramp-down parameter.
- Bit 06 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-53 Start Select* determines how bit 06 is linked with the corresponding functions of the digital inputs.

Bit 07, No Function/Reset

Reset after switching off. Acknowledges event in fault buffer.

- Bit 01 = 0 means that no reset occurs.
- Bit 07 = 1 means that a reset occurs after switching off.

Bit 08, Jog 1 OFF/ON

Activation of the preprogrammed speed in parameter *8-90 Bus Jog 1 Speed*. Jog 1 is only possible if bit 04=0 and bits 00–03 are set to 1.

Bit 09, Jog 2 OFF/ON

Activation of the preprogrammed speed in parameter *8-91 Bus Jog 2 Speed*. Jog 2 is only possible if bit 04=0 and bits 00–03 are set to 1.

Bit 10, Data Invalid/Valid

This bit tells the drive whether the control word should be used or ignored.

- Bit 10 = 0 ignores the control word giving the opportunity to turn off the control word when updating/reading parameters.
- Bit 10 = 1 uses the control word. This function is relevant because the control word is always contained in the telegram, regardless of the type of telegram.

Bit 11, No Function/Slow Down

This bit is used to reduce the speed reference value by the amount given in parameter *3-12 Catch Up/Slow Down Value*.

- Bit 11 = 0 means that no modification of the reference value occurs.
- Bit 11 = 1 means that the reference value is reduced.

Bit 12, No Function/Catch Up

This bit is used to increase the speed reference value by the amount given in parameter *3-12 Catch Up/Slow Down Value*.

- Bit 12 = 0 meas that no modification of the reference value occurs.
- Bit 12 = 1 means that the reference value is increased.

If both slowing down and accelerating are activated (bits 11 and 12 are set to 1), slowing down has priority, meaning that the speed reference value is reduced.

Bits 13/14, Setup Selection

Bits 13 and 14 are used for selecting between the 4 parameter setups according to the table below. The function is only possible if *[9] Multi set-up* has been selected in parameter *0-10 Active Set-up*. The selection in parameter *8-55 Set-up Select* determines how bits 13 and 14 are linked with the corresponding function of the digital inputs. Changing the setup while the drive is running is only possible if the setups have been linked in parameter *0-12 This Set-up Linked to*.

Table 14: Parameter Setups

Setup	Bit 13	Bit 13
1	0	0
2	1	0
3	0	1
4	1	1

Bit 15, No Function/Reverse

- Bit 15 = 0 means no reversing.
- Bit 15 = 1 means reversing is active.

> NOTE: In the factory setting, reversing is set to *[0] Digital input* in parameter *8-54 Reversing Select*.

> NOTE: Bit 15 only activates reversing when *[1] Bus*, *[2] Logic AND*, or *[3] Logic OR* is selected.

4.3.4 Status Word According to PROFIdrive Profile (STW)

The status word is used to notify a master, for example, a PC, about the status of a follower.

Table 15: Status Word Bits

Bit	Bit=0	Bit=1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	OFF 2	ON 2
05	OFF 3	ON 3
06	Start possible	Start not possible
07	No warning	Warning
08	Speed ≠ reference	Speed = reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit OK
11	No operation	In operation
12	Drive OK	Stopped, autostart
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

4.3.5 Explanation of the Status Word Bits

Bit 00, Control not Ready/Control Ready

- Bit 00 = 0 means that either bit 00, 01, or 02 of the control word is 0, or the drive is switched off (tripped).

- Bit 00 = 1 means that the drive control is ready, but there is not necessarily power supply to the unit present. For example, this situation could occur if 24 V external supply of the control system is used.

Bit 01, Drive not Ready/Drive Ready

Same meaning as bit 00, however, there is a supply of the power unit. The drive is ready when it receives the necessary start signals.

Bit 02, Coasting/Enable

- Bit 02 = 0 means that either bit 00, 01, or 02 of the control word is 0, or the drive is switched off (tripped).

- Bit 02 = 1 means that the drive can start the motor when a start command is given.

Bit 03, No Error/Trip

- Bit 03 = 0 means that there are no error conditions in the drive.

- Bit 03 = 1 means that the drive has tripped and requires a reset signal before it can start.

Bit 04, OFF 2/ON 2

- Bit 04 = 0 means that the control word bit 01 is 0.

- Bit 04 = 1 means that the control word bit 01 is 1.

Bit 05, OFF 3/ON 3

- Bit 05 = 0 means that control word bit 2 is 0.
- Bit 05 = 1 means that control word bit 2 is 1.

Bit 06, Start Possible/Start not Possible

If PROFIdrive has been selected in parameter *8-10 Control Word Profile*, bit 06 is 1 after a switch-off acknowledgment, after activation of OFF 2 or OFF 3, and after switching on the mains voltage. *Start not possible* is reset if control bit 00 is set to 0 and bits 01, 02, and 10 are set to 1.

Bit 07, No Warning/Warning

- Bit 07 = 0 means that there are no warnings.
- Bit 07 = 1 means that a warning has occurred.

Bit 08, Speed ≠ Reference/Speed = Reference

- Bit 08 = 0 means that the current motor speed deviates from the set speed reference value. This situation may occur, for example, when the speed is changed during start/stop through ramp up/ramp down.
- Bit 08 = 1 means that the current motor speed corresponds to the set speed reference value.

Bit 09, Local Operation/Bus Control

- Bit 09 = 0 indicates that the drive has been stopped via the [*Stop*] key on the LCP, or that *[0] Linked to hand/auto* or *[2] Local* has been selected in parameter *3-13 Reference Site*.
- Bit 09 = 1 means that the drive can be controlled via fieldbus/serial communication.

Bit 10, Out of Frequency Limit/Frequency Limit OK

- Bit 10 = 0 indicates that the output frequency is outside the limits set in parameter *4-52 Warning Speed Low* and parameter *4-53 Warning Speed High*.
- Bit 10 = 1 means that the output frequency is within the indicated limits.

Bit 11, No Operation/In Operation

- Bit 11 = 0 means that the motor does not run.
- Bit 11 = 1 means that the drive has a start signal, or the output frequency is > 0 Hz.

Bit 12, Drive OK/Stopped, Autostart

- Bit 12 = 0 means that there is no temporary overloading of the inverter.
- Bit 12 = 1 means that the inverter has stopped due to overloading. However, the drive has not switched off (trip) and will start again after the overloading has ended.

Bit 13, Voltage OK/Voltage Exceeded

- Bit 13 = 0 means that the voltage limits of the drive are not exceeded.
- Bit 13 = 1 means that the direct voltage in the DC link of the drive is too low or too high.

Bit 14, Torque OK/Torque Exceeded

- Bit 14 = 0 means that the motor torque is below the limits set in parameter *4-16 Torque Limit Motor Mode* or parameter *4-17 Torque Limit Generator Mode*.
- Bit 14 = 1 means that the limit selected in parameter *4-16 Torque Limit Motor Mode* or parameter *4-17 Torque Limit Generator Mode* is exceeded. The nominal torque can be read in parameter *16-16 Torque [Nm]*.

Bit 15, Timer OK/Timer Exceeded

- Bit 15 = 0 indicates that the timers for the motor thermal protection and thermal drive protection have not exceeded 100%.

- Bit 15 = 1 indicates that 1 of the timers has exceeded 100%.

4.3.6 PROFIdrive State/Transition Diagram

In the PROFIdrive control profile, the control bits 0–3 perform the basic start-up/power-down functions, whereas the control bits 4–15 perform application-oriented control.

Refer to Figure 7 to see the basic state/transition diagram where control bits 0–3 control the transitions and the corresponding status bit indicates the actual state. The black bullets indicate the priority of the control signals, where fewer bullets indicate lower priority, and more bullets indicate higter priority.
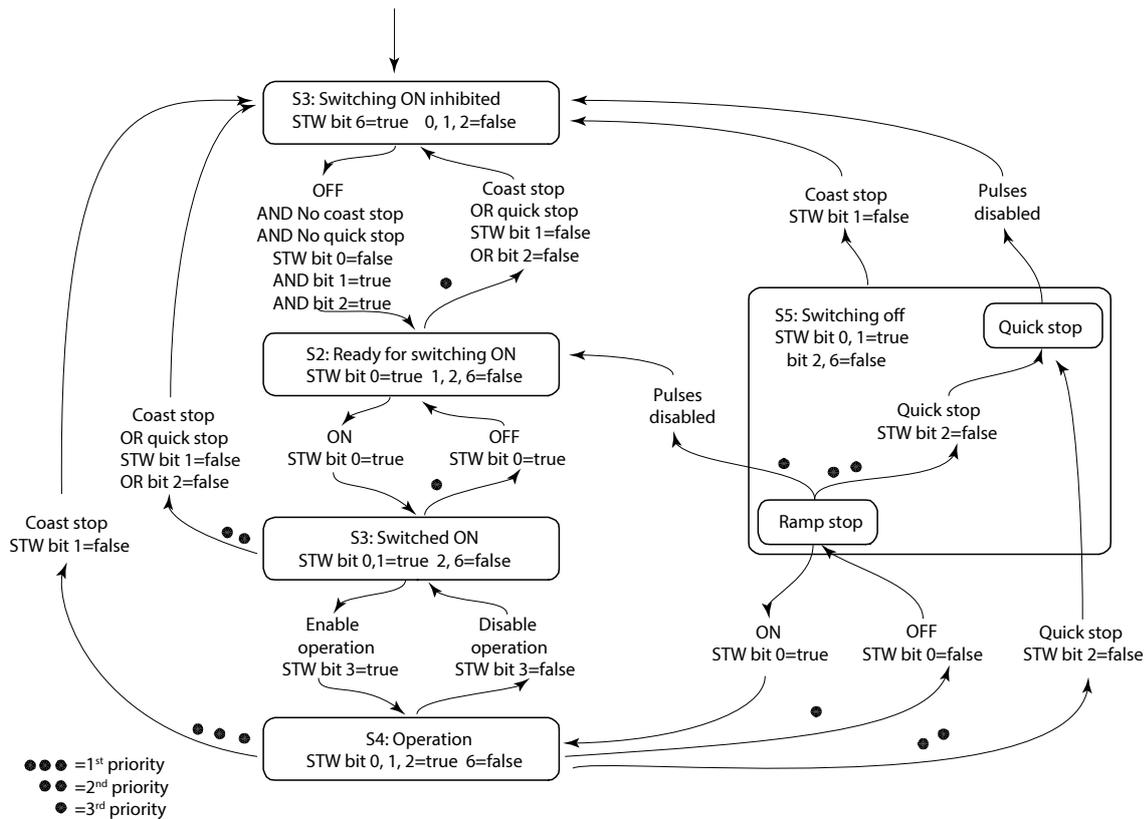
Figure 7: PROFIdrive State/Transition Diagram

4.4 Danfoss FC Control Profile

4.4.1 Control Word According to Danfoss FC Control Profile
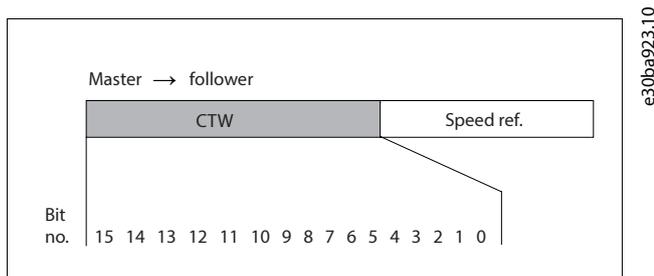
Figure 8: Parameter 8-10 Control Word Profile set to [1] FC Profile

Table 16: Control Word Bits

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

4.4.2 Explanation of the Control Word Bits

Bits 00/01, Reference Value

Bits 00 and 01 are used for selecting between the 4 reference values, which are pre-programmed in parameter *3-10 Preset Reference* according to the following table.

Table 17: Reference Values

Programmed reference value	Parameter number	Bit 01	Bit 02
1	3-10 [0]	0	0
2	3-10 [1]	0	1
3	3-10 [2]	1	0
4	3-10 [3]	1	1

> 📄 NOTE: In parameter *8-56 Preset Reference Select*, select to define how bits 00/01 are linked with the corresponding function on the digital inputs.

Bit 02, DC Brake/Ramp

- Bit 02 = 0 leads to DC braking and stop. The braking current and duration are set in parameter *2-01 DC Brake Current* and parameter *2-02 DC Braking Time*.
- Bit 02 = 1 leads to ramping according to parameter *3-41 Ramp 1 Ramp Up Time*.

Bit 03, Coasting/No Coasting

- Bit 03 = 0 leads to a stop.

- Bit 03 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-50 Coasting Select* determines how bit 03 is linked with the corresponding function of the digital inputs.

Bit 04, Quick Stop/Ramp

Quick stop using the ramp time of parameter *3-81 Quick Stop Ramp Time*.

- Bit 04 = 0 leads to a quick stop.

- Bit 04 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-51 Quick Stop Select* determines how bit 04 is linked with the corresponding function of the digital inputs.

Bit 05, Hold Output Frequency/Use Ramp

- Bit 05 = 0 causes the present output frequency (in Hz) to freeze. The frozen frequency can then be changed only with the digital inputs (parameter *5-10 Terminal 18 Digital Input* to parameter *5-15 Terminal 33 Digital Input*) programmed to *[21] Speed up* and *[22] Speed down*.

> 📄 NOTE: If freeze output is active, the drive can only be stopped in the following ways:
> - Bit 03 Coasting stop
> - Bit 02 DC brake
> - Digital input (parameter *5-10 Terminal 18 Digital Input* to parameter *5-15 Terminal 33 Digital Input*) programmed to *[5] DC brake inverse*, *[2] Coast inverse*, or *[3] Coast and reset inv*.

Bit 06, Ramp Stop/Start

Normal ramp stop using the ramp times of the actual ramp as selected. Additionally, activation of the output relay 1 and 4 if the output frequency is 50 Hz and if [Relay 123] has been selected in parameter *5-40 Function Relays*.

- Bit 06 = 0 leads to a stop in which the motor speed is ramped down to stop via the selected ramp-down parameter.

- Bit 06 = 1 means that the drive can start if the other start conditions are fulfilled.

> 📄 NOTE: The selection in parameter *8-53 Start Select* determines how bit 06 is linked with the corresponding functions of the digital inputs.

Bit 07, No Function/Reset

- Bit 07 = 0 means that there is no reset.

- Bit 07 = 1 resets a trip. Reset is activated when the signal changes from logic 0 to logic 1.

Bit 08, No Function/Jog

- Bit 08 = 1 means that the output frequency is as defined in parameter *3-19 Jog Speed [RPM]*.

Bit 09, Ramp 1/Ramp 2

- Bit 09 = 0 means that ramp 1 is active (parameter *3-40 Ramp 1 Type* to parameter *3-47 Ramp 1 S-ramp Ratio at Decel. Start*).
- Bit 09 = 1 means that ramp 2 is active (parameter *3-50 Ramp 2 Type* to parameter *3-57 Ramp 2 S-ramp Ratio at Decel. Start*).

Bit 10, Data Invalid/Valid

This bit tells the drive whether the control word should be used or ignored.

- Bit 10 = 0 ignores the control word giving the opportunity to turn off the control word when updating/reading parameters.
- Bit 10 = 1 uses the control word. This function is relevant because the control word is always contained in the telegram, regardless of the type of telegram.

Bit 11, No Function/Relay 01 Active

- Bit 11 = 0 means that the relay is not activated.
- Bit 11 = 1 means that relay 01 is activated if *[36] Control word bit 11* is selected in parameter *5-40 Function Relay*.

Bit 12, No Function/Relay 02

- Bit 12 = 0 means that the relay is not activated.
- Bit 12 = 1 means that relay 02 is activated if *[37] Control Word Bit 12* is selected in parameter *5-40 Function Relay*.

Bits 13/14, Setup Selection

Bits 13 and 14 are used for selecting between the 4 parameter setups according to the table below. The function is only possible if *[9] Multi set-up* has been selected in parameter *0-10 Active Set-up*. The selection in parameter *8-55 Set-up Select* determines how bits 13 and 14 are linked with the corresponding function of the digital inputs. Changing the setup while the drive is running is only possible if the setups have been linked in parameter *0-12 This Set-up Linked to*.

Table 18: Parameter Setups

Setup	Bit 13	Bit 13
1	0	0
2	1	0
3	0	1
4	1	1

Bit 15, No Function/Reverse

- Bit 15 = 0 means no reversing.
- Bit 15 = 1 means reversing is active.

NOTE: In the factory setting, reversing is set to *[0] Digital input* in parameter *8-54 Reversing Select*.

NOTE: Bit 15 only activates reversing when *[1] Bus*, *[2] Logic AND*, or *[3] Logic OR* is selected.

4.4.3 Status Word According to Danfoss FC Profile (STW)

The status word is used to notify a master, for example, a PC, about the status of the drive.

Table 19: Status Word Bits

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

4.4.4 Explanation of the Status Word Bits

Bit 00, Control not Ready/Control Ready

- Bit 00 = 0 means that either bit 00, 01, or 02 of the control word is 0, or the drive is switched off (tripped).

- Bit 00 = 1 means that the drive control is ready, but there is not necessarily power supply to the unit present. For example, this situation could occur if 24 V external supply of the control system is used.

Bit 01, Drive not Ready/Drive Ready

Same meaning as bit 00, however, there is a supply of the power unit. The drive is ready when it receives the necessary start signals.

Bit 02, Coasting/Enable

- Bit 02 = 0 means that either bit 00, 01, or 02 of the control word is 0, or the drive is switched off (tripped).

- Bit 02 = 1 means that the drive can start the motor when a start command is given.

Bit 03, No Error/Trip

- Bit 03 = 0 means that there are no error conditions in the drive.

- Bit 03 = 1 means that the drive has tripped and requires a reset signal before it can start.

Bit 04, No Error/Error (no Trip)

- Bit 04 = 0 means that there is no fault in the drive.

- Bit 04 = 1 means that there is a fault in the drive, but it has not tripped.

Bit 05, Reserved

- Bit 05 is not used in the status word.

Bit 06, No Error/Trip Lock

- Bit 06 = 0 means that the drive is not in fault mode.
- Bit 06 = 1 means that the drive is tripped and locked.

Bit 07, No Warning/Warning

- Bit 07 = 0 means that there are no warnings.
- Bit 07 = 1 means that a warning has occurred.

Bit 08, Speed ≠ Reference/Speed = Reference

- Bit 08 = 0 means that the current motor speed deviates from the set speed reference value. This situation may occur, for example, when the speed is changed during start/stop through ramp up/ramp down.
- Bit 08 = 1 means that the current motor speed corresponds to the set speed reference value.

Bit 09, Local Operation/Bus Control

- Bit 09 = 0 indicates that the drive has been stopped via the [*Stop*] key on the LCP, or that *[0] Linked to hand/auto* or *[2] Local* has been selected in parameter *3-13 Reference Site*.
- Bit 09 = 1 means that the drive can be controlled via fieldbus/serial communication.

Bit 10, Out of Frequency Limit/Frequency Limit OK

- Bit 10 = 0 indicates that the output frequency is outside the limits set in parameter *4-52 Warning Speed Low* and parameter *4-53 Warning Speed High*.
- Bit 10 = 1 means that the output frequency is within the indicated limits.

Bit 11, No Operation/In Operation

- Bit 11 = 0 means that the motor does not run.
- Bit 11 = 1 means that the drive has a start signal, or the output frequency is > 0 Hz.

Bit 12, Drive OK/Stopped, Autostart

- Bit 12 = 0 means that there is no temporary overloading of the inverter.
- Bit 12 = 1 means that the inverter has stopped due to overloading. However, the drive has not switched off (trip) and will start again after the overloading has ended.

Bit 13, Voltage OK/Voltage Exceeded

- Bit 13 = 0 means that the voltage limits of the drive are not exceeded.
- Bit 13 = 1 means that the direct voltage in the DC link of the drive is too low or too high.

Bit 14, Torque OK/Torque Exceeded

- Bit 14 = 0 means that the motor torque is below the limits set in parameter *4-16 Torque Limit Motor Mode* or parameter *4-17 Torque Limit Generator Mode*.
- Bit 14 = 1 means that the limit selected in parameter *4-16 Torque Limit Motor Mode* or parameter *4-17 Torque Limit Generator Mode* is exceeded. The nominal torque can be read in parameter *16-16 Torque [Nm]*.

Bit 15, Thermal OK/Thermal Exceeded

- Bit 15 = 0 indicates that the timers for the motor thermal protection and thermal drive protection have not exceeded 100%.
- Bit 15 = 1 indicates that 1 of the timers has exceeded 100%.

4.5 Reference Handling

4.5.1 Bus Speed Reference Value

In FC profile (parameter *8-10 Control Word Profile* = *[0] FC profile*), the reference is scaled as a normalized relative value in percent. The value is transmitted in hexadecimal:

- 0% = 0 hex
- 100% = 4000 hex
- -100% = C000 hex

Depending on the setting of parameter *3-00 Reference Range*, the reference is scaled from -maximum to +maximum or from minimum to maximum.
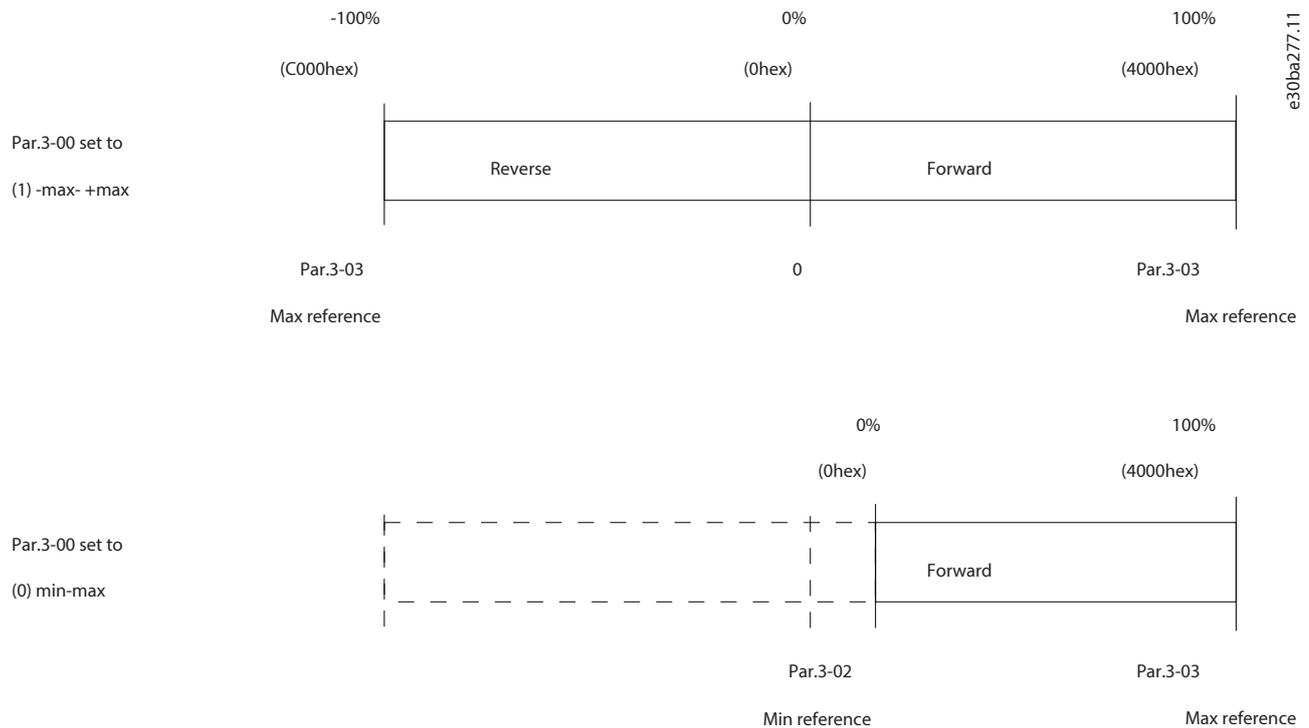
Figure 9: Scaling of Reference Values

The actual reference [Ref.%] in the drive depends on the settings in the following parameters:

- Parameter *1-23 Motor Frequency*
- Parameter *1-25 Motor Nominal Speed*
- Parameter *3-02 Minimum Reference*
- Parameter *3-03 Maximum Reference*

All reference provided to the drive are added to the total reference value. When the fieldbus controls a reference only, ensure that all other references in parameter *3-10 Preset Reference*.

> 📄 NOTE: If the bus speed reference is negative, and the control word contains a run reverse signal, the drive runs clockwise (- to - is +).

MAV is scaled in the same way as the reference.

4.6 Controlling the Drive via Modbus

Modbus enables drive control and speed control via the control word like start/stop and a bus reference, respectively.

Modbus enables control of the drive through the control word, such as start/stop, and speed adjustment via a bus reference. In the same way, Modbus also provides information of the drive status via the status word and the main actual value, that is, the actual running speed.

Use registers 2810–2873 and 2910–2973 to control the drive and ensure compatibility with all controllers.

4.7 Process Data Configuration Write/Read

The advantage of using the PCD write/read configuration is that the controller can write or read more data in 1 telegram. Up to 63 registers can be read or written to via the function code *Read holding register* or *Write multiple registers* in 1 telegram. The structure is also flexible so that only 2 registers can be written to, and 20 registers can be read from the controller. The PCD write list is data sent from the controller to the drive, such as control word, reference, and application-dependent data, for example, minimum reference and ramp times.

The PCD write list is set up in parameter *12-21 PCD Write Configuration*.

> 📄 NOTE: The control word and reference are always sent in the list from the controller to the drive.

The PCD read list is data sent from the drive to the controller, such as status word, main actual value, and application-dependent data, for example, running hours, motor current, and alarm word.

The PCD read list is set up in parameter *12-22 PCD Read Configuration*.

> 📄 NOTE: The status word and main actual value are always sent in the list from the drive to the controller.

4.8 Mapping Holding Registers to Drive Parameters

To make specific drive parameters accessible via standard holding registers, map the parameter number to parameter *12-21 PCD Write Configuration* or parameter *12-22 PCD Read Configuration*.

Example: The input and output data of the Modbus TCP has to be mapped to the drive parameter. Set up the following parameters in the drive.

ID	Name	Setup 1
1221.0	Process Data Config Write	[1680] Fieldbus CTW 1
1221.1	Process Data Config Write	[1682] Fieldbus REF 1
1221.2	Process Data Config Write	[311] Jog Speed [Hz]
1221.3	Process Data Config Write	[411] Motor Speed Low Limit [RPM]

ID	Name	Setup 1
1222.0	Process Data Config Re...	[1603] Status Word
1222.1	Process Data Config Re...	[1605] Main Actual Value [%]
1222.2	Process Data Config Re...	[1602] Reference [%]
1222.3	Process Data Config Re...	[1630] DC Link Voltage

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Figure 10: Parameters to be Set when Mapping

4.9 Mapping Holding Registers to 32-bit Parameters

Map 32-bit parameters inside the 32-bit boundaries (PCD 2 and PCD 3 or PCD 4 and PCD 5, and so on) where the parameter number is mapped twice to either parameter *12-21 PCD Write Configuration* or parameter *12-22 PCD Read Configuration*.

Example: Set the following parameters in the drive.

ID	Name	Setup 1
1221.0	Process Data Config Write	[1680] Fieldbus CTW 1
1221.1	Process Data Config Write	[1682] Fieldbus REF 1
1221.2	Process Data Config Write	[341] Ramp 1 Ramp Up Time
1221.3	Process Data Config Write	[341] Ramp 1 Ramp Up Time

ID	Name	Setup 1
1222.0	Process Data Config Re…	[1603] Status Word
1222.1	Process Data Config Re…	[1605] Main Actual Value [%]
1222.2	Process Data Config Re…	[1500] Operating hours
1222.3	Process Data Config Re…	[1500] Operating hours
1222.4	Process Data Config Re…	[1501] Running Hours
1222.5	Process Data Config Re…	[1501] Running Hours

e30bn315.10

Figure 11: Parameters to Set when Mapping to 32-bit Parameters

5 Parameter Descriptions

5.1 Conversion Index and Factor

The conversion index refers to a conversion figure, while the conversion factor is used when writing or reading parameters.

Table 20: Conversion

Conversion index	Conversion factor
67	1/60
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

5.2 Parameter Group 8-** Communication and Options

5.2.1 8-0* General Settings

8-01 Control Site

Default value:	_[1]	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

1) The default value for VLT® AQUA Drive FC 202 and VLT® AutomationDrive FC 301/FC 302 is [0] Digital and ctrl. word.

The setting in this parameter overrides the settings in parameter *8-50 Coasting Select* to parameter *8-56 Preset Reference Select*.

Option	Name	Description
[0]	Digital and ctrl.word	Use both digital input and control word.
[1]	Digital only	Use digital inputs only.
[2]	Controlword only	Use control word only.

8-02 Control Word Source

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–

Data type:	Uint8	Change during operation:	True

Select the source of the control word: 1 of 2 serial interfaces or 4 installed options. During initial power-up, the drive automatically sets this parameter to *[3] Option A* if it detects a valid fieldbus option installed in slot A. When the option is removed, the drive detects a configuration change, sets parameter *8-02 Control Word Source* to default setting *[1] FC RS485*, 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 drive trips and shows: *Alarm 67, Option Changed*. When retrofitting a bus option into a drive that did not have a bus option installed earlier, change the control to bus-based. This change is required for safety reasons to avoid an unintended change.

Option	Name	Description
[0]	None	Control via serial communication is disabled.
[1]	FC RS485	Control via RS-485 terminals 68/69 on the control card.
[2]	FC USB	Control via USB on the control card.
[3]	Option A	Control via option A.
[4]	Option B	Control via option B.
[5]	Option C0	Control via option C0.
[6]	Option C1	Control via option C1.
[30]	External Can	Internal
[35]	Option A fast	NOTE: This option is only available in FC 302. Same as option *[3] Option A*. The reference is transferred faster and without jitter, which ensures more stability and dynamic control. Moreover, all other references are ignored, which means that the drive is controlled by the A-option reference only.
[37]	Option C0 fast	NOTE: This option is only available in FC 302. Same as option *[5] Option C0*. The reference is transferred faster and without jitter, which ensures more stability and dynamic control. Moreover, all other references are ignored, which means that the drive is controlled by the C-option reference only.

8-03 Control Word Timeout Time

Default value:	Size related	Parameter type:	Range, 0.1 - 18000 s[1]
Setup:	1 setup	Conversion index:	-1
Data type:	Uint32	Change during operation:	True

1) For VLT® HVAC Drive FC 102, the range is 0.5–18000 s. For VLT® AQUA Drive FC 202 the range is 1–18000 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

Default value:	_[1]	Parameter type:	Option
Setup:	1 setup	Conversion index:	–

Data type:	Uint8		Change during operation:	True

1) For VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202, the default value is [0] Off.

Select the timeout function. The timeout function activates when the control word is not updated within the time period specified in parameter **8-03 Control Word Timeout Time**.

> 📄 NOTE:
>
> To change the setup after a timeout, configure as follows:
>
> 1. Set parameter **0-10 Active Set-up** to **[9] Multi setup**.
> 2. Select the relevant link in parameter **0-12 This Set-up Linked to**.

Option	Name	Description
[0]	Off	Resumes control via fieldbus (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 drive to restart: • Via the fieldbus. • Via [Reset]. • Via a digital input.
[6]	Qstop and trip	Stops the motor with the quick stop ramp (parameter **3-81 Quick Stop Ramp Time**). Perform a reset to restart the drive. 📄 NOTE: This option is only available in FC 302 with IMC software version 48.1X or newer.
[7]	Select setup 1	Changes the setup after a control word timeout. If communication resumes after a timeout, parameter **8-05 End-of-Timeout Function** either resumes the setup used before the timeout, or retains the setup 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**.
[20]	N2 override release	📄 NOTE: This option is only available in FC 102 and FC 202.
[26]	Trip	Only available in FC 302 with VLT® Motion Controller Option MCO 302.

Option	Name	Description
[27]	Forced stop and trip	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬ 📄NOTE: This option is only available in FC 102 and FC 202.
[30]	Warning only	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬ 📄NOTE: This option is only available in FC 102 and FC 202.

8-05 End-of-Timeout Function

Default value:	[1] Resume set-up	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the action after receiving a valid control word following a timeout. This parameter is active only when parameter *8-04 Control Word Timeout Function* is set to:

- *[7] Setup 1*
- *[8] Setup 2*
- *[9] Setup 3*
- *[10] Setup 4*

Option	Name	Description
[0]	Hold set-up	Retains the setup selected in parameter *8-04 Control Word Timeout Function* and shows a warning until parameter *8-06 Reset Control Word Timeout* toggles. Then the drive resumes its original setup.
[1]*	Resume setup	Resumes the setup that was active before the timeout.

8-06 Reset Control Word Timeout

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is active only when *[0] Hold set-up* has been selected in parameter *8-05 End-of-Timeout Function*.

Option	Name	Description
[0]*	Do not reset	Retains the setup specified in parameter *8-04 Control Word Timeout Function*, following a control word timeout.
[1]	Do reset	Restores the drive to the original setup following a control word timeout. The drive resets and then immediately reverts to the *[0] Do not reset* setting.

5.2.2 8-1* Control Profile

8-10 Control Word Profile

Default value:	_(1)	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

1) For VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202, the default value is [0] FC 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 product-specific design guide. For more guidelines in the selection of *[1] PROFIdrive profile*, refer to the installation guide for the installed fieldbus.

Option	Name	Description
[0]	FC profile	
[1]	PROFIdrive profile	
[3]	FC motion profile	NOTE: This option is only available in FC 302 with IMC software version 48.0X. Assigns motion-specific functions to various control and status word bits. This option is available when *[9] Positioning* or *[10] Synchronization* is selected in parameter *1-00 Configuration Mode*.
[5]	ODVA	Available only with VLT® DeviceNet MCA 104 and VLT® EtherNet/IP MCA 121.
[7]	CANopen DSP 402	
[8]	MCO	NOTE: Only available in FC 302 with VLT® Motion Controller Option MCO 302.
[22]	PROFIdrive v4_2 profile	
[23]	Advanced MCO STW	NOTE: Only available in FC 302 with VLT® Motion Controller Option MCO 302.
[24]	VIK-NAMUR	NOTE: Only available in FC 202 and FC 302.

8-13 Configurable Status Word STW

Default value:	_ (1)	Parameter type:	Option, Array [16]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

1) For VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202, the default value is [1] Profile default.

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 more guidelines in the selection of *[1] PROFIdrive profile*, refer to the installation guide for the installed fieldbus.

Option	Name	Description
[0]	No function	The input is always low.
[1]	Profile default	Dependent on the profile set in parameter *8-10 Control Profile*.
[2]	Alarm 68 Only	The input goes high whenever *Alarm 68 Safe Stop Activated* is active and goes low whenever *Alarm 68 Safe Stop Activated* is not active.
[3]	Trip excl Alarm 68	
[4]	Position error	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. The position is outside its limits set in parameter *3-06 Minimum Position* and parameter *3-07 Maximum Position*.
[5]	Position limit	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. The position error exceeds the value in parameter *4-71 Maximum Position* for the time set in parameter *4-72 Position Error Timeout*.
[6]	Touch on target	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Target position is reached in touch probe position mode.
[7]	Touch activated	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Touch probe positioning is active. The drive monitors the touch probe sensor input.
[8]	Touch sensor found	NOTE: This option is only available in FC 302 with IMC software version 48.5X or newer. The touch sensor has been detected.
[9]	Vir. master on ref	NOTE: This option is only available in FC 302 with IMC software version 48.7X or newer. The virtual master is running on the set reference.
[10]	T18DI status	The bit indicates the status of terminal 18. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[11]	T19DI status	The bit indicates the status of terminal 19. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[12]	T27DI status	The bit indicates the status of terminal 27. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[13]	T29DI status	The bit indicates the status of terminal 29. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[14]	T32DI status	The bit indicates the status of terminal 32. 0 indicates that the terminal is low. 1 indicates that the terminal is high.

Option	Name	Description
[15]	T33DI status	The bit indicates the status of terminal 33. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[16]	T37DI status	The input goes high whenever T37 has 0 V and goes low whenever T37 has 24 V.
[17]	X30/2 DI status	
[18]	X30/3 DI status	
[19]	X30/4 DI status	
[20]	CTW timeout toggle inverse	NOTE: This option is only available in FC 202 and FC 302.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, drive, brake resistor, or thermistor.
[22]	Execution distance extended	NOTE: This option is only available in FC 302 with IMC software version 48.9X or newer. Indicates that the offset execution distance (set in parameter *17-95 Offset Execution Distance*) has been extended due to speed/ramp limitation.
[29]	Protection mode	NOTE: This option is only available in FC 302.
[30]	Brake fault (IGBT)	Output logic is 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the main voltage from the drive.
[40]	Out of ref range	
[49]	Derate active	NOTE: This option is only available in FC 102 and FC 301/FC 302.
[54]	Running	
[59]	On reference	
[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.

Option	Name	Description
[66]	Comparator 6	See parameter group *13-1* Comparators*. If comparator 6 is evaluated as true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See parameter group *13-1* Comparators*. If comparator 7 is evaluated as true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See parameter group *13-1* Comparators*. If comparator 8 is evaluated as true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See parameter group *13-1* Comparators*. If comparator 9 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.
[76]	Logic rule 6	See parameter group *13-4* Logic Rules*. If logic rule 6 is evaluated as true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See parameter group *13-4* Logic Rules*. If logic rule 7 is evaluated as true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See parameter group *13-4* Logic Rules*. If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See parameter group *13-4* Logic Rules*. If logic rule 9 is evaluated as true, the output goes high. Otherwise, it is low.
[80]	SL digital out A	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[38] Set digital out A high* is executed. The output goes low whenever the smart logic action *[32] Set digital out A low* is executed.
[81]	SL digital out B	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[39] Set digital out B high* is executed. The output goes low whenever the smart logic action *[33] Set digital out B low* is executed.
[82]	SL digital out C	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[40] Set digital out C high* is executed. The output goes low whenever the smart logic action *[34] Set digital out C low* is executed.
[83]	SL digital out D	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[41] Set digital out D high* is executed. The output goes low whenever the smart logic action *[35] Set digital out D low* is executed.

Option	Name	Description
[84]	SL digital out E	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[42] Set digital out E high* is executed. The output goes low whenever the smart logic action *[36] Set digital out E low* is executed.
[85]	SL digital out F	See parameter *13-52 SL Controller Action*. The output goes high whenever the smart logic action *[43] Set digital out F high* is executed. The output goes low whenever the smart logic action *[37] Set digital out F low* is executed.
[86]	ATEX ETR cur. alarm	
[87]	ATEX ETR freq. alarm	
[88]	ATEX ETR cur. warning	
[89]	ATEX ETR freq. warning	
[90]	Safe function active	NOTE: This option is only available in FC 302.
[91]	Safe opt. reset. req.	NOTE: This option is only available in FC 302.
[92]	IGBT-cooling	NOTE: This option is only available in FC 301/FC 302.
[96]	Reverse after ramp	NOTE: This option is only available in FC 302 with IMC software version 48.5X or newer. Indicates if the direction of rotation should be reversed. Depends on whether the speed reference is positive or negative after the ramp specified in parameter *16-48 Speed Ref. After Ramp [RPM]*.
[121]	Cavitation	
[122]	Cavitation S2	
[123]	Cavitation thld at max/min	
[181]	Prev. maintenance	
[190]	No-flow	NOTE: This option in only available in FC 102 and FC 202.
[191]	Dry pump	NOTE: This option in only available in FC 102 and FC 202.
[192]	End of curve	NOTE: This option in only available in FC 102 and FC 202.
[193]	Sleep mode	NOTE: This option in only available in FC 102 and FC 202.
[194]	Broken belt	NOTE: This option in only available in FC 102 and FC 202.

Option	Name	Description
[196]	Fire mode/Emcy mode is active	The drive is operating in emergency mode. See parameter group *24-0* Fire Mode*/*24-0* Emergency Mode*.
[197]	Fire mode/Emcy mode was active	The drive has been operating in fire mode/emergency mode.
[198]	Fire mode/Emcy mode limits	During fire mode/emergency mode operation, 1 of the critical alarms has been activated and suppressed by fire mode/ emergency mode. This may lead to reduced drive performance and expected operation lifetime before service is required.
[200]	User defined alerts	
[210]	Pos. set acknowledge	NOTE: This option is only available in FC 302 with IMC software version 48.9X or newer. Acknowledge activation of the set target position.
[231]	In power lim. mot.	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in motor mode only.
[232]	In power lim. gen.	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in generating mode only.
[233]	In power limit	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in both motor and generating modes.
[234]	Fire m./Emcy m. OPR unexpected	Fire mode/emergency mode is not operating as expected, for example, live zero monitoring on an analog input is activated.
[254]	Testing fire mode/emcy mode	Fire mode/emergency mode was activated in a special test mode where the drive stops on all alarms.

8-14 Configurable Control Word CTW

Default value:	[1] Profile default	**Parameter type:**	Option, Array [16]
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This is an array parameter with 16 elements, 1 element for each bit in range 0–15. Each of the bits can be configured to any of the following options.

Option	Name	Description
[0]	None	The drive ignores the information in this bit.
[1]*	Profile default	Dependent on the profile set in parameter *8-10 Control Profile*.
[2]	CTW valid, active low	If set to 1, the drive ignores the remaining bits of the control word.

Option	Name	Description
[3]	Safe option reset	NOTE: This option is only available in FC 302. This function is only available in bits 12–15 of the control word if a safety option is mounted in the drive. The reset is executed on a 0⇒1 transition and resets the safety option as set in parameter *42-24 Restart behavior*.
[4]	PID error inverse	NOTE: This option is only available in FC 301/FC 302. 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	NOTE: This option is only available in FC 301/FC 302. 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	NOTE: This option is only available in FC 301/FC 302. 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*.
[7]	External interlock	
[10]	Bit 10 = 0>CTW timeout	
[11]	Start homing	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Starts the homing function selected in parameter *17-80 Homing Function*. Must remain high until homing is done, otherwise homing is aborted.
[12]	Activate touch	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Activates monitoring of the touch sensor input.
[13]	Sync. to pos mode	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Select positioning in synchronization mode.
[14]	Ramp 2	NOTE: This option is only available in FC 302 with IMC software version 48.0X or newer. Select between ramp 1 (parameter group *3-4* Ramp 1*) and ramp 2 (parameter group *3-5* Ramp 2*).

Option	Name	Description
[15]	Relay 1	Control relay 1.
[16]	Relay 2	Control relay 2.
[17]	Speed mode	**NOTE:** This option is only available in FC 302 with IMC software version 48.1X or newer. Select the speed mode when *[9] Positioning* or *[10] Synchronization* is selected in parameter *1-00 Configuration Mode*. Speed reference is set by reference resource 1 or fieldbus REF1 relative to parameter *3-03 Maximum Reference*.
[18]	Enable vir. master	**NOTE:** This option is only available in FC 302 with IMC software version 48.1X or newer. Enable the signal for the virtual master function. The option is applicable when *[10] Synchronization* is selected in parameter *1-00 Configuration Mode*.
[19]	Enable mast. offset	**NOTE:** This option is only available in FC 302 with IMC software version 48.1X or newer. Activates the master offset selected in parameter *3-26 Master Offset* when parameter *17-93 Master Offset Selection* has a selection from *[1] Absolute* to *[5] Relative Touch Sensor*.
[20]	Control word toggle command	Changes the sign of the set target position. For example, if the set target is 1000, the activation of this option changes the value to -1000.
[21]	Target inverse	**NOTE:** This option is only available in FC 302 with IMC software version 48.3X or newer. Changes the sign of the set target position. For example, if the set target is 1000, the activation of this option changes the value to -1000.
[22]	Digital out 27	
[23]	Digital out 29	
[24]	Digital out X30/6	
[25]	Digital out X30/7	
[26]	Home sensor	**NOTE:** This option is only available in FC 302 with IMC software version 48.3X or newer. **NOTE:** Accuracy of the home position depends on the delay in transferring the signals. The home sensor is connected via fieldbus master.

Option	Name	Description
[27]	Touch sensor	📝NOTE: This option is only available in FC 302 with IMC software version 48.3X or newer. 📝NOTE: Accuracy of the home position depends on the delay in transferring the signals. The touch sensor is connected via fieldbus master.
[28]	Position vir. master	📝NOTE: This option is only available in FC 302 with IMC software version 48.4X or newer. Activates position-controlled virtual master when *[9] Positioning* or *[10] Synchronization* is selected in parameter *1-00 Configuration Mode*. When the option is selected, the following occurs: • Target position is set by Fieldbus Pos Ref or preset target is as defined in parameter *3-20 Preset Target*. • Speed is set relative to parameter *3-27 Virtual Master Max Ref* by the source selected in parameter *3-15 Reference Resource 1* or fieldbus REF1. • Acceleration and deceleration are set as defined in parameter group *3-6* Ramp 3*.
[29]	Set master home	📝NOTE: This option is only available in FC 302 with IMC software version 48.4X or newer. Sets the actual master position as defined in parameter *17-88 Master Home Position*.
[30]	Set vir. mas. pos. to actual	📝NOTE: This option is only available in FC 302 with IMC software version 48.7X or newer. Bit for setting the virtual master position = the actual follower position. This is needed for setting the correct starting position for position-controlled virtual master ensuring that the virtual master ensuring that the virtual master position is aligned with the physical position of the follower.
[31]	Activate CAM table	📝NOTE: This option is only available in FC 302 with IMC software version 48.7X or newer. Signal for activating a new CAM table while running with bumpless transfer.
[32]	Halt	📝NOTE: This option is only available in FC 302 with IMC software version 48.8X or newer.
[33]	Bit 10 = 0 > CTW TO always	

Option	Name	Description
[34]	Activate CAM cycles	NOTE: This option is only available with IMC software version 48.96 or newer. Activates the number of CAM cycles set in parameter *17-97 Number of CAM Cycles*.
[66]	Sleep mode	NOTE: This option is only available in FC 102 and FC 302.
[78]	Reset preventive maintenance word	
[85]	Latched pump derag	NOTE: This option is only available in FC 202.
[86]	Flow confirmation	NOTE: This option is only available in FC 202.
[94]	Light load detection	NOTE: This option is only available in FC 302. Use this option to ensure drive runs in the direction which requires least energy (UPS capacity), during an emergency.
[95]	Evacuation mode	NOTE: This option is only available in FC 302. Use this function to operate the drive at reduced DC voltage for evacuating people in case of power failure.
[189]	Fire mode/emergency mode	
[190]	Fire mode/emcy mode ref bit 0	Enables a choice between 1 of the 8 preset references.
[191]	Fire mode/emcy mode ref bit 1	Enables a choice between 1 of the 8 preset references.
[192]	Fire mode/emcy mode ref bit 2	Enables a choice between 1 of the 8 preset references.
[195]	Test fire mode/emcy mode	Fire mode/emergency mode is activated in a special test mode where the drive stops on all alarms.
[231]	Power limit mot.	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in the motor mode only.
[232]	Power limit gen.	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in the generating mode only.
[233]	Power limit both	NOTE: This option is only available in FC 302. See parameter group *4-8* Power Limit*. Use this option in both the motor and the generating modes.

Option	Name	Description
[234]	Light load+evacuation	 📝 NOTE: This option is only available in FC 302. Use this option to ensure that the drive runs in the direction which requires least energy (UPS capacity), during an emergency and to operate the drive at reduced DC-voltage for evacuating people in case of power failure.
[235]	Setup bit 0	
[236]	Setup bit 1	

8-19 Product Code

Default value:	Size related	**Parameter type:**	Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

Select 0 to read out the actual fieldbus product code according to the mounted fieldbus option. Select 1 to read out the actual vendor ID.

5.2.3 8-5* Digital/Bus

8-50 Coasting Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the coasting function.

Option	Name	Description
[0]	Digital input	A digital input triggers the coasting function.
[1]	Bus	A serial communication port or the fieldbus triggers the coasting function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the coasting function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the coasting function.

8-51 Quick Stop Select

Default value:	_[1]	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

1) For VLT® HVAC Drive FC 102 and VLT® AutomationDrive FC 301/FC 302, the default value is [3] Logic OR.

Select the control of the quick stop function via the terminals and/or via the bus.

Option	Name	Description
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3]	Logic OR	
[4]	Disabled	NOTE: This option is only available in FC 202. The quick stop function is disabled.

8-52 DC Brake Select

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.

> NOTE: When parameter *1-10 Motor Construction* is set to *[1] PM non-salient SPM*, only selection *[0] Digital input* is available.

Option	Name	Description
[0]	Digital input	Activate a start command via a digital input.
[1]	Bus	Activate a start command via a serial communication port or fieldbus option.
[2]	Logic AND	Activate a start command via the fieldbus/serial communication port and also via 1 of the digital inputs.
[3]	Logic OR	Activate a start command via the fieldbus/serial communication port or via 1 of the digital inputs.

8-53 Start Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the start function.

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

8-54 Reversing Select

Default value:	–	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the reversing function.

Option	Name	Description
[0]	Digital input	A digital input triggers the reversing function.
[1]	Bus	A serial communication port or the fieldbus triggers the reversing function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the reversing function.

8-55 Set-up Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the setup selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the setup selection.
[1]	Bus	A serial communication port or the fieldbus triggers the setup selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the setup selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the setup selection.

8-56 Preset Reference Select

Default value:	[3] Logic OR	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Select the trigger for the preset reference selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the fieldbus triggers the preset reference selection.

Option	Name	Description
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the preset reference selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the preset reference selection.

5.3 Parameter Group 12-** Ethernet

5.3.1 12-0* IP Settings

12-00 IP Address Assignment

Default value:	–	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type: Uint8	Change during operation: True		

Select the method for assigning the IP address.

Option	Name	Description
[0]	Manual	Set the IP address in parameter *12-01 IP Address*.
[1]	DHCP	Assign the IP address via DHCP server.
[2]	BOOTP	Assign the IP address via BOOTP server.
[3]	Disable	NOTE: This option is only available in FC 102 and FC 202.

12-01 IP Address

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Configure the IP address of the option. Read-only if parameter *12-00 IP Address Assignment* is set to *[1] DHCP*, *[2] BOOTP*, or via DIP switches.

12-02 Subnet Mask

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

Configure the IP subnet mask of the option. Read-only if parameter *12-00 IP Address Assignment* is set to *[1] DHCP* or *[2] BOOTP*.

12-03 Default Gateway

Default value:	0	**Parameter type:**	Range, 0 - 4294967295
Setup:	1 setup[1]	**Conversion index:**	0

Data type:	OctStr[4]	Change during operation:	True

1) VLT® AQUA Drive FC 202 has 2 setups.

Configure the IP default gateway of the option. Read-only if parameter *12-00 IP Address Assignment* set to *[1] DHCP* or *[2] BOOTP*. In a non-routed network, this address is set to the IP address of the I/O device.

12-04 DHCP Server

Default value:	0	Parameter type:	Range, 0 - 2147483647
Setup:	2 setups	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

> 📄 NOTE: This parameter is only available for VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202.

> 📄 NOTE: A power cycle is necessary after setting the IP parameters manually.

This parameter is read-only. It shows the IP address of the found DHCP or BOOTP server.

12-05 Lease Expires

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeDifferenceWithDateIndication	Change during operation:	True

> 📄 NOTE: This parameter is only available for VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202.

This parameter is read-only. It shows the lease time for the current DHCP-assigned IP address.

12-06 Name Servers

Default value:	0	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

IP addresses of the domain name servers. Can be automatically assigned when using DHCP.

12-07 Domain Name

Default value:	0	Parameter type:	Range, 0 - 48
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[48]	Change during operation:	True

Domain name of the attached network. Can be automatically assigned when using DHCP network.

12-08 Host Name

Default value:	0	Parameter type:	Range, 0 - 48

Setup:	1 setup	Conversion index:	0
Data type:	VisStr[48]	Change during operation:	True

📄 NOTE: The display of the drive only shows the 1st 19 characters, but the remaining characters are stored in the drive.

Logical (given) name of the option.

12-09 Physical Address

Default value:	0	Parameter type:	Range, 0 - 17
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[17]	Change during operation:	True

This parameter is read-only. It shows the physical (MAC) address of the option.

5.3.2 12-1* Ethernet Link Parameters

The following applies for the whole parameter group:

- Index [0] is used for port 1, and index [1] is used for port 2.
- For EtherCat, index [0] is for the in-port, and index [1] is for the out-port.

12-10 Link Status

Default value:	[0] No link	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is read-only. It shows the link status of the Ethernet ports. Index [0] is used for port 1, and index [1] is used for port 2. For EtherCAT, index [0] is for the in-port, and index [1] is for the out-port.

Index	Description
[0]*	No link
[1]	Link

12-11 Link Duration

Default value:	Size related	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	0
Data type:	TimeDifferenceWithDateIndication	Change during operation:	True

Shows the duration of the present link on each port in dd:hh:mm:ss.

12-12 Auto Negotiation

Default value:	[1] On[1]	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–

Data type:	Uint8	Change during operation:	True

1) VLT® AutomationDrive FC 301/FC 302 has no default value.

Configures auto negotiation of Ethernet link parameters, for each port: ON or OFF. Link Speed and Link Duplex can be configured in parameter *12-13 Link Speed* and parameter *12-14 Link Duplex*.

Option	Name	Description
[0]	Off	
[1]*	On	

12-13 Link Speed

Default value:	[0] None[1]	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

1) VLT® AutomationDrive F 301/FC 302 has not default value.

Forces the link speed for each port in 10 Mbps or 100 Mbps. If parameter *12-12 Auto Negotiation* is set to *[0] On*, this parameter is read-only and shows the actual link speed. If no link is present, *[0] None* is shown.

Option	Name	Description
[0]*	None	
[1]	10 Mbps	
[2]	100 Mbps	

12-14 Link Duplex

Default value:	[1] Full duplex[1]	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

1) VLT® AutomationDrive FC 301/FC 302 does not have a default value.

Forces the duplex for each port to full or half duplex. If parameter *12-12 Auto Negotiation* is set to *[1] On*, this parameter is read-only.

Option	Name	Description
[0]	Half duplex	
[1]*	Full duplex	

12-18 Supervisor MAC

Default value:	0	Parameter type:	Array [2]
Setup:	2 setups	Conversion index:	0
Data type:	OctStr[6]	Change during operation:	True

MAC addresses of currently active supervisors.

12-19 Supervisor IP Addr.

Default value:	0	**Parameter type:**	Array [2]
Setup:	2 setups	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True

IP addresses of currently active supervisors.

5.3.3 12-2* Process Data

12-21 Process Data Config Write

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Option	Name	Description
[0]	None	
[177]	Compressor start max speed [RPM]	NOTE: This option is only available in VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202.
[178]	Compressor start max speed [Hz]	NOTE: This option is only available in VLT® HVAC Drive FC 102 and VLT® AQUA Drive FC 202.
[302]	Minimum reference	
[303]	Maximum reference	
[311]	Jog speed [Hz]	
[319]	Jog speed [RPM]	
[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/homing ramp time 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	

Option	Name	Description
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 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	
[702]	Speed PID proportional gain	NOTE: This option is only available in FC 302.
[703]	Speed PID integral time	NOTE: This option is only available in FC 302.
[704]	Speed PID feed forward factor	NOTE: This option is only available in FC 302.
[748]	PCD feed forward	NOTE: This option is only available in FC 302.
[890]	Bus jog 1speed	
[891]	Bus jog 2 speed	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1444]	d-axis reference gain	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	
[1728]	SSI status bits	NOTE: This option is only available in FC 302.

12-22 Process Data Config Read

Default value:	–	**Parameter type:**	Option, Array [20]
Setup:	All setups	**Conversion index:**	–
Data type:	Uint16	**Change during operation:**	True

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[177]	Compressor start max speed [RPM]	NOTE: This option is only available in FC 102 and FC 202.
[178]	Compressor start max speed [Hz]	NOTE: This option is only available in FC 102 and FC 202.
[894]	Bus feedback 1	NOTE: This option is only available in FC 102 and FC 202.
[895]	Bus feedback 2	NOTE: This option is only available in FC 102 and FC 202.
[896]	Bus feedback 3	NOTE: This option is only available in FC 102 and FC 202.
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1444]	d-axis reference gain	
[1472]	Legacy alarm word	NOTE: This option is only available in FC 302.
[1473]	Legacy warning word	NOTE: This option is only available in FC 302.
[1474]	Leg. ext. status word	NOTE: This option is only available in FC 302.
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1583]	Motor U_d	NOTE: This option is only available in FC 302.
[1584]	Motor U_q	NOTE: This option is only available in FC 302.
[1585]	Motor I_d	NOTE: This option is only available in FC 302.
[1586]	Motor I_q	NOTE: This option is only available in FC 302.
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	

Option	Name	Description
[1603]	Status word	
[1605]	Main actual value [%]	
[1606]	Actual position	NOTE: This option is only available in FC 302.
[1608]	Position error	NOTE: This option is only available in FC 302.
[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]	Thermistor sensor temperature	
[1620]	Motor angle	
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1625]	Torque [Nm]	NOTE: This option is only available in FC 302.
[1626]	Power filtered [kW]	NOTE: This option is only available in FC 102 and FC 202.
[1627]	Power filtered [hp]	NOTE: This option is only available in FC 102 and FC 202.
[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.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	

Option	Name	Description
[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	NOTE: This option is only available in FC 302.
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	NOTE: This option is only available in FC 102 and FC 202.
[1655]	Feedback 2 [unit]	NOTE: This option is only available in FC 102 and FC 202.
[1656]	Feedback 3 [unit]	NOTE: This option is only available in FC 102 and FC 202.
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[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	NOTE: This option is only available in FC 302.
[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]	

Option	Name	Description
[1684]	Comm. option STW	
[1685]	FC port CTW 1	NOTE: This option is only available in FC 102.
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	NOTE: This option is only available in FC 202 and FC 302.
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	NOTE: This option is only available in FC 202 and FC 302.
[1728]	SSI status bits	NOTE: This option is only available in FC 302.
[1766]	SSI status	NOTE: This option is only available in FC 302.
[1767]	Raw inc. quad counter	NOTE: This option is only available in FC 302.
[1768]	Raw abs. pos. low	NOTE: This option is only available in FC 302.
[1769]	Raw abs. pos. high	NOTE: This option is only available in FC 302.
[1804]	Mech brake count	NOTE: This option is only available in FC 302.
[1827]	Safe opt. est. speed	NOTE: This option is only available in FC 302.
[1828]	Safe opt. meas. speed	NOTE: This option is only available in FC 302.
[1829]	Safe opt. speed error	NOTE: This option is only available in FC 302.

Option	Name	Description
[1830]	Analog input X42/1	NOTE: This option is only available in FC 102 and FC 202.
[1831]	Analog input X42/3	NOTE: This option is only available in FC 102 and FC 202.
[1832]	Analog input X42/5	NOTE: This option is only available in FC 102 and FC 202.
[1833]	Analog out X42/7 [V]	NOTE: This option is only available in FC 102 and FC 202.
[1834]	Analog out X42/9 [V]	NOTE: This option is only available in FC 102 and FC 202.
[1835]	Analog out X42/11 [V]	NOTE: This option is only available in FC 102 and FC 202.
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	NOTE: This option is only available in FC 102 and FC 202.
[1860]	Digital input 2	
[1861]	Temp. input X48 max	NOTE: This option is only available in FC 302.
[1864]	Power based speed limit	NOTE: This option is only available in FC 302.
[1866]	Actual switching frequency	
[1867]	Alarm word 4	

Option	Name	Description
[1868]	Warning word 4	
[1899]	Speed PID torque FF [Nm]	NOTE: This option is only available in FC 302.

12-27 Primary Master

> NOTE: In VLT® AutomationDrive FC 301/FC 302, this parameter is called **Master Address**.

Default value:	0	**Parameter type:**	Range, Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	OctStr[4]	**Change during operation:**	True[1]

1) In VLT® Aqua Drive FC 202 and VLT® AutomationDrive FC 301/FC 302, change during operation=false.

Holds the valid ip addresses for masters that are allowed to control this slave. If both indexes are set to 0.0.0.0 all masters have access.

12-28 Store Data Values

Default value:	[0] Off	**Parameter type:**	Option
Setup:	All setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

This parameter activates a function that stores all parameter values in the non-volatile memory (EEPROM) thus retaining parameter values at power-down. The parameter returns to **[0] Off**.

Option	Name	Description
[0]*	Off	
[1]	Store all setups[1]	
[2]	Store all setups	

1) In VLT® AQUA Drive FC 202, this option is called Store edit setup.

12-29 Store Always

Default value:	[0] Off	**Parameter type:**	Option
Setup:	1 setup	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Activates a function that always stores received parameter data in the non-volatile memory (EEPROM).

Option	Name	Description
[0]*	Off	
[1]	On	

5.3.4 12-4* Modbus TCP

12-40 Status Parameter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter is read-only. It shows the Modbus TCP-specific 16-bit status word.

Table 21: 16-Bit Status Word, Modbus TCP

Bit	Description	Bit = [0]	Bit = [1]
0	Link status port 1	Disconnected	Connected
1	Link status port 2	Disconnected	Connected
2	Link speed	0/10 Mbps	100 Mbps
3	Link duplex	Half	Full
4	Port 502 communication	No	Yes
5	UNUSED	–	–
6	Valid IP address	No	Yes
7	Modbus timeout (30 s)	No	Yes
8	Duplicate IP	No	Yes
9	Register 7 error	No	Yes
10	FTP server	Disabled	Enabled
11	HTTP server	Disabled	Enabled
12	SMTP server	Disabled	Enabled
13	Cable diagnosis	Disabled	Enabled
14	Auto crossover	Disabled	Enabled
15	IPMG	Disabled	Enabled

12-41 Slave Message Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is read-only. It shows the number of Modbus messages received and processed by the follower drive.

12-42 Slave Exception Message Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is read-only. It shows the number of Modbus messages for which the follower has sent an exception response.

5.3.5 12-4* Fieldbus Extension

12-49 Ethernet Extended Status

Default value:	0hex	**Parameter type:**	Array [20]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter provides extra information from Ethernet-based communication.

Table 22: Parameter Index

ID	Description
[0]	Number of times the options have gone into Data exchange since power-up.
[1]	Fieldbus cyclic update time in μs (0=not set).
[2]	Total number of lost cyclic frames since power-up.
[3]	Number of lost cyclic frames since power-up while the motor has been running.
[4]	Reserved.
[5]	Control word timeout in μs (set by the PLC, hardware configuration).
[6]	CPU load %.
[7]	Reserved for future enhancements.
[8]	SPI error counter, errors since power-up (received from CC).
[9]	SPI error counter, error since power-up (received from IRT).
[10]	S2 IO controller switch counter (number of switches between primary and secondary).
[11]	S2 running on PLC1 counter in minutes.
[12]	S" running on PLC2 counter in minutes.

5.3.6 12-8* Other Ethernet Services

12-80 FTP Server

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables/disables the built-in FTP server.

Option	Name	Description
[0]*	Disabled	Disable the built-in FTP server.
[1]	Enabled	Enable the built-in FTP server.
[2]	Enabled with TLS	NOTE: This option is only available in FC 102 and FC 202.

12-81 HTTP Server

Default value:	[0] Disabled	**Parameter type:**	Option

Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables the built-in HTTP (web) server.

Option	Name	Description
[0]*	Disabled	Disable the built-in HTTP (web) server.
[1]	Enabled	Enable the built-in HTTP (web) server.

12-82 SMTP Service

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables the built-in SMTP (e-mail) service on the option.

Option	Name	Description
[0]*	Disabled	Disable the SMTP (e-mail) service on the option.
[1]	Enabled	Enable the SMTP (e-mail) service on the option.

12-83 SNMP Agent

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to either enable or disable the SNMP agent.

Option	Name	Description
[0]	Disabled	Disable the SNMP agent.
[1]*	Enabled	Enable the SNMP agent.

12-84 Address Conflict Detection

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to detect and resolve IP address conflict.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

12-85 ACD Last Conflict

Default value:	0	**Parameter type:**	Range, 0 - 2147483647
Setup:	2 setups	**Comversion index:**	0
Data type:	OctStr[35]	**Change during operation:**	True

The name of the IP address causing the most recent address conflict.

12-86 NTP Host Server

Default value:	0	**Parameter type:**	Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	VisStr[48]	**Change during operation:**	True

Enter the IPv4/IPv6 address, the FQDN, or the hostname of the NTP server.

12-87 SNTP Time Sync

Default value:	60 min	**Parameter type:**	Range, 1 - 65535 min
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Synchronize the clock via NTP at a defined interval.

12-89 Transparent Socket Channel Port

Default value:	Size related	**Parameter type:**	Range, 0 - 65535
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Configures the TCP port number for the transient socket channel. This enables FC telegrams to be sent transiently on Ethernet via TCP. 0 indicates that the function is disabled.

5.3.7 12-9* Advanced Ethernet Services

12-90 Cable Diagnostics

Default value:	[0] Disabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enables/disables the advanced cable diagnosis function. If enabled, the distance to cable errors can be read out in parameter *12-93 Cable Error Length*. The parameter resumes to the default setting *[0] Disable* after the diagnostics have finished.

> 📄 NOTE: The cable diagnostics function is only issued on ports where there is no link (see parameter *12-10 Link Status*).

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

12-91 Auto Cross Over

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

📄 NOTE: Disabling of the auto-crossover function requires crossed Ethernet cables for daisy-chaining the options.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

12-92 IGMP Snooping

Default value:	[1] Enabled	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

Enabling the IGMP snooping function prevents flooding of the Ethernet protocol stack. Multicast packets are only forwarded to ports that are a member of the multicast group.

Option	Name	Description
[0]	Disabled	The IGMP snooping function is disabled.
[1]*	Enabled	The IGMP snooping function is enabled.

12-93 Cable Error Length

Default value:	0	**Parameter type:**	Array [2]
Setup:	1 setup	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

If cable diagnostics is enabled in parameter *12-90 Cable Diagnostic*, the built-in switch is possible via time domain reflectometry (TDR). This is a measurement technique which detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is shown in meters with an accuracy of ±2 m (6.6 ft). The value 0 means no errors detected.

12-94 Broadcast Storm Protection

Default value:	-1%	**Parameter type:**	Range, -1 - 20%
Setup:	2 setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

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

12-95 Inactivity Timeout

Default value:	120	**Parameter type:**	Range, 0 - 3600
Setup:	2 setups	**Conversion index:**	0
Data type:	Uint16	**Change during operation:**	True

Applies to parameter *12-94 Broadcast Storm Protection*, if the broadcast storm protection also includes multicast telegrams.

12-96 Port Config

Default value:	_(1)	**Parameter type:**	Option
Setup:	2 setups	**Conversion index:**	–
Data type:	Uint8	**Change during operation:**	True

1) In VLT® HVAC Drive FC 102, the default value is [0] Normal.

Enable or disable the port-mirroring function. The function is used for troubleshooting with a network analyzer tool.

Option	Name	Description
[0]	Normal/Disable	
[1]	Mirror port 1 to 2	
[2]	Mirror port 2 to 1	
[10]	Port 1 disabled	
[11]	Port 2 disabled	
[254]	Mirror int. port to 1	NOTE: This option is only available in FC 202.
[255]	Mirror int. port to 2	NOTE: This option is only available in FC 202.

12-97 QoS Priority

Default value:	Size related	**Parameter type:**	Array [7]
Setup:	2 setups	**Conversion index:**	0
Data type:	Int8	**Change during operation:**	True

Each index sets the DSCP value of different types of QoS prioritized messages.

Table 23: Parameter Index

Index	Value
[0]	59
[1]	47

Table 23: Parameter Index - (continued)

Index	Value
[2]	55
[3]	47
[4]	43
[5]	31
[6]	27

12-98 Interface Counters

Default value:	4000[1]	**Parameter type:**	Readout, Array [20]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

1) For VLT® HVAC Drive FC 102, the default value is 0.

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

Table 24: Parameter Indices

Index	Description
[0]	Octet received on the interface.
[1]	Unicast packets received on the interface.
[2]	Non-unicast packets received on the interface
[3]	Inbound packets received on the interface, but discarded.
[4]	Inbound packets that contain errors.
[5]	Incound packets with unknown protocol.
[6]	Octet sent on the interface.
[7]	Unicast packets sent on the interface.
[8]	Non-unicast packets sent on the interface.
[9]	Outbound packets discarded.
[10]	Outbound packets that contain errors.

12-99 Media Counters

Default value:	0	**Parameter type:**	Readout, Array [10]
Setup:	All setups	**Conversion index:**	0
Data type:	Uint32	**Change during operation:**	True

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

Table 25: Parameter Indices

Index	Description
[0]	Alignment errors
[1]	FCS errors
[2]	Single collisions
[3]	Multiple collisions
[4]	SQE test errors
[5]	Deferred transmissions
[6]	Late collisions
[7]	Excessive collisions
[8]	MAC transmit errors
[9]	Carrier sense errors

6 Troubleshooting

6.1 LED Status

The VLT® Modbus TCP MCA 122 has 3 bicolored LEDs that allow a fast and detailed diagnosis. Each LED is linked to its unique part of the interface, see Table 26.

Table 26: LED Label

LED label	Description
MS	Module status, reflects the activity on the option module.
NS1	Network status 1, reflects the activity on port 1.
NS2	Network status 2, reflects the activity on port 2.
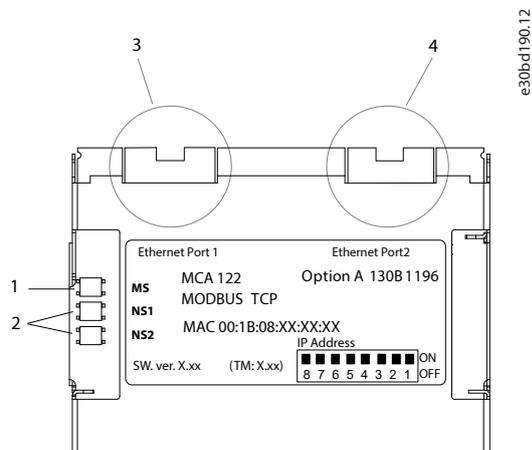
Figure 12: Overview of the VLT® Modbus TCP MCA 122 Option Module

1	MS LED	2	NS LEDs
3	Ethernet port 1	4	Ethernet port 2

> 📄 NOTE: In VLT® Motion Control Tool MCT 10, when the drive is scanned via Ethernet TSC, right-clicking the drive and selecting *Start Winking* causes the MS/NS LEDs to flash yellow (50% duty cycle at 1 Hz).

> 📄 NOTE: When link speed for port 1 or port 2 is 10 Mbps, the NS1 and NS2 LEDs go steady yellow.

Table 27: MS: Module Status

State	LED		Description
Off	Off	No power	No power is supplied to the device. The module status indicator is steady off.
Steady green	▬▬▬▬▬	Device operational	The device has at least 1 conncetion from a Modbus client at port 502.
Flashing green	▬_▬_▬_▬	Standby	There are no client connected to the Modbus server at port 502.

Table 27: MS: Module Status - (continued)

State	LED		Description
Flashing red		Minor fault	The device has detected a recoverable minor fault, which is the failure to read/write a parameter from the control card. An address conflict is detected.
Steady red		Major fault	The device has detected a non-recoverable major fault. A major fault is hardware failure on the option, such as ram test, flash/EEPROM access error.
Flashing red/green	Red: Green:	Self test	The device is performing its power-up testing.
Steady yellow		No IP address	An IP address has not been configured or obtained.
Flashing yellow		Wink	Flash for 20 s for identification.

Table 28: NS1 + NS2: Network Status (1 per Port)

State	LED		Description
Not powered, no link	Off	Off	The device is powered off, or no link is present.
Connected		Solid green	A link is present but not winked, and no address conflict is detected.
Address conflict		Solid red	The IP address assigned to the device is already in use.
Self test	Red: Green:	Flashing red/green	The device is performing its power-up testing.
Device has been winked		Flashing yellow	Flash for 20 s
Link present at 10 Mbps		Steady yellow	A link is present, but it is not winked, and there is no ACD.

6.2 Warnings and Alarms

> 📄 NOTE: Refer to the drive-specific operating guide for an overview of warning and alarm types, and for the full list of warnings and alarms.

Alarm words and warning words are shown in the display in hex format. When there is more than 1 warning or alarm, the sum of all warnings and alarms is shown. Warning words and alarm words are shown in parameter *16-90 Alarm Word* to parameter *16-99 Ext. Status Word 3* and in parameter *18-67 Alarm Word 4* to parameter *18-68 Warning Word 4*.

6.3 No Communication with the Drive

If there is no communication with the drive, proceed with the following checks:

Check the link status

The status of the Ethernet link can be directly identified using the LEDs when no BACnet connection is established. Verify presence of the link in parameter *12-10 Link Status*.

Verify that the link is steadily present in parameter *12-11 Link Duration*. The parameter shows the duration of the present link and is preset to 00:00:00:00 when the link is broken.

Check the cabling

In rare cases of cabling misconfiguration, the option may show the presence of a link even if no communication is running. Exchange the cable if in doubt.

Check the IP address

Verify that the option has a valid IP address in parameter *12-01 IP Address*. If the option has identified a duplicate IP address, the NS LEDs are solid red. If the option is set up for BOOTP or DHCP, verify that a BOOTP or DHCP server is connected in parameter *12-04 DHCP Server*. If no server is connected, the parameter shows 000.000.000.000.

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