GE Consumer & Industrial
Electrical Distribution

AF-650 GP™ & AF-600 FP™

OPCMBTCP Modbus TCP Option

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Contents

1 Safety

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

1.1.2 Safety Note

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

1.1.3 Safety Regulations

1. The variable speed drive must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The off-command on the serial bus does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing or grounding of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Do not remove the plugs for the motor and mains supply while the variable speed drive is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

1.1.4 Warning against Unintended Start

1. The motor can be brought to a stop by means of bus commands while the variable speed drive is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start.
3. A motor that has been stopped may start if faults occur in the electronics of the variable speed drive, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

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

2 Introduction

2.1 Introduction

2.1.1 About this Manual

First time users can obtain the most essential information for quick installation and set-up in these chapters:

Introduction

How to Install

How to Configure the System

For more detailed information including the full range of set-up options and diagnosis tools please refer to the chapters:

How to Configure the System

How to Control the AF-650 GP/AF-600 FP

How to Access AF-650 GP/AF-600 FP Parameters

Parameters

Troubleshooting

Terminology:
In this manual several terms for Ethernet is used.

- **Ethernet**, is a common term used to describe the physical layer of the network and does not relate to the application protocol.

2.1.2 Assumptions

These operating instructions are under the conditions that the GE Modbus TCP option is used in conjunction with a GE AF-650 GP or AF-600 FP frequency converter, inclusive that the installed controller supports the interfaces described in this document and that all the requirements stipulated in the controller, as well as the frequency converter, are strictly observed along with all limitations herein.

2.1.3 Background Knowledge

The GE Modbus Option Card is designed to communicate with any system complying with the XXXX standard. Familiarity with this technology is assumed. Issues regarding hardware or software produced by other manufacturers, including commissioning tools, are beyond the scope of this manual, and are not the responsibility of GE.

For information regarding commissioning tools, or communication to a non-GE node, please consult the appropriate manuals.

2.1.4 Modbus Conformance

The Modbus option is tested to conform to the Modbus standards, and is certified, towards conformance test level version 3.

2.1.5 Abbreviations

Abbreviation	Definition
API	Actual Packet Interval
CC	Control Card
CIP	Common Industrial Protocol
CTW	Control Word
DHCP	Dynamic Host Configuration Protocol
EMC	Electromagnetic Compatibility
I/O	Input/Output
IP	Internet Protocol
LED	Light Emitting Diode
LSB	Least Significant Bit
MAR	Major Recoverable fail
MAU	Major Unrecoverable fail
MAV	Main Actual Value (actual output)
MSB	Most Significant Bit
MRV	Main Reference Value
N/A	Not applicable
PC	Personal Computer
PLC	Programmable Logic Controller
PNU	Parameter Number
REF	Reference (= MRV)
RTC	Real Time Clock
STP	Spanning tree Protocol
STW	Status Word

3 How to Install

3.1.1 The Modbus TCP Option

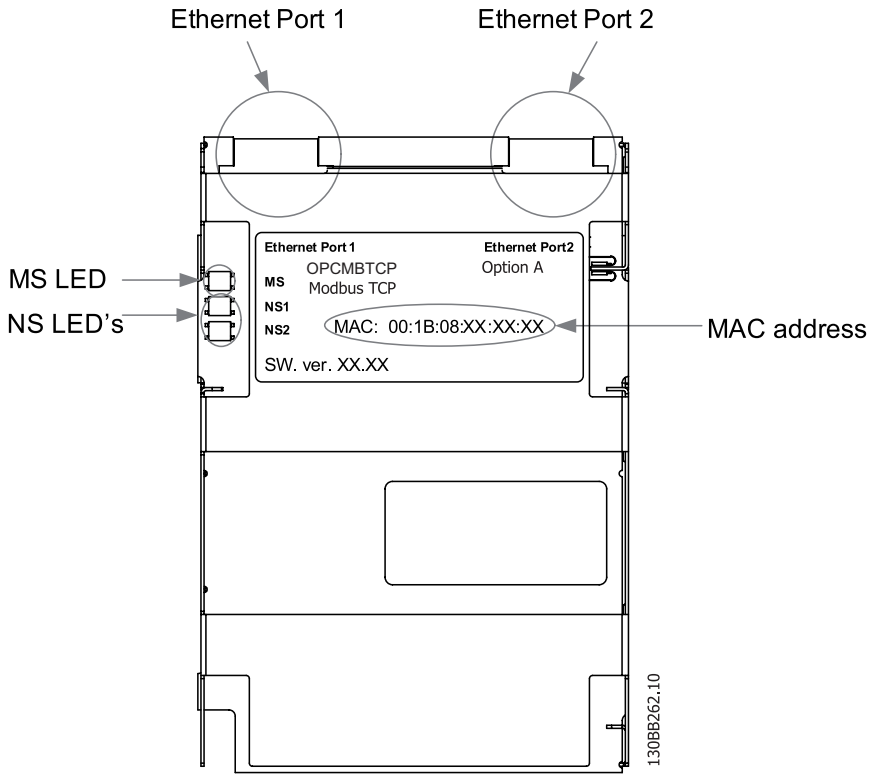
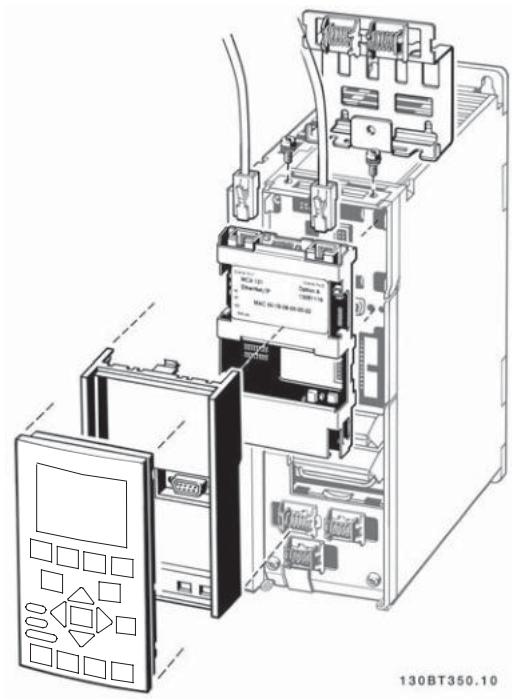


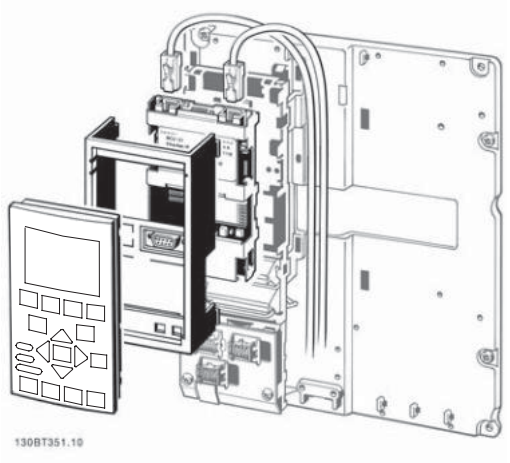
Illustration 3.1: Overview of the option

3.1.2 How to Install Option in Frequency Converter

Items required for installing a network option in the frequency converter:

- The network option
- Network option adaptor frame for the AF-650 GP/AF-600 FP. This frame is deeper than the standard frame, to allow space for the network option beneath
- Strain relief (only for unit size 12)





Instructions:

- Remove Keypad panel from the AF-650 GP/AF-600 FP.
- Remove the frame located beneath and discard it.
- Push the option into place. The Ethernet connectors must be facing upwards.
- Remove both knock-outs on the network option adaptor frame.
- Push the network option adaptor frame for the AF-650 GP/AF-600 FP into place.
- Replace the Keypad and attach cable

NB!
Do not strip the Ethernet cable and ground it via the strain relief-plate! The grounding of screened Ethernet cable is done through the RJ-45 connector on the option.

NB!
After installing the OPCMBTCP option, be aware of the following parameter settings:
par. O-01 *Control Site*: [2] *Controlword only* or [0] *Digital and ctrl. word*
par. O-02 *Control Word Source*: [3] *Option A*

3.1.3 LED Behaviour

The option has 3 bi-coloured LEDs according to ODVA specifications:

LED Label	Description
MS	Module Status
NS1	Network Status Ethernet Port 1
NS2	Network Status Ethernet Port 2

The option LED's operates according to ODVA specifications.

State	LED		Description
No power		Off	The device is un-powered
Device operational	Green:	Solid green	The device is operational
Standby	Green:	Flashing green	The device needs commissioning
Minor fault	Red:	Flashing red	The device has detected a recoverable fault
Major fault	Red:	Solid red	The device has detected an un-recoverable fault
Self test	Red: Green:	Flashing red/green	The Modbus TCP option is in self-test mode
No IP address	Yellow	Steady yellow	No IP address configured or obtained
Wink	Yellow	Flashing yellow	Flash for 20 seconds

Table 3.1: MS: Module Status

State	LED		Description
No IP-address (no power)		Off	No link present (or is un-powered)
Connected	Green:	Solid green	There is established (at least) one CIP connection to the device
Duplicate IP	Red:	Solid red	The IP-address assigned to the device is already in use
Self test	Red: Green	Flashing red/green	The Modbus TCP is in self-test mode
Device has been winked	Yellow	Flashing yellow	Flash for 20 seconds
Link present at 10 Mbps	Yellow	Steady yellow	Link present; but nor winked and no ACD

Table 3.2: NS1 + NS2: Network Status (one per port)

3.1.4 Topology

The OPCMBTCP features a build-in Ethernet-switch, thus having two Ethernet RJ-45 connectors. This enables the possibility for connecting several Modbus TCP options in a line topology as an alternative to the typical star-topology.

The two ports are equal, in the sense that they are transparent for the option. If only one connector is used, either port can be used.

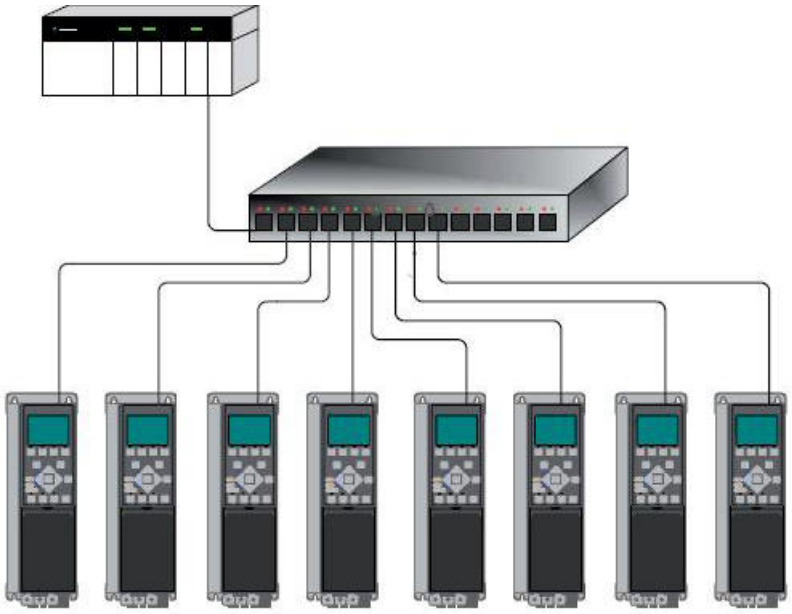


Illustration 3.2: Star topology

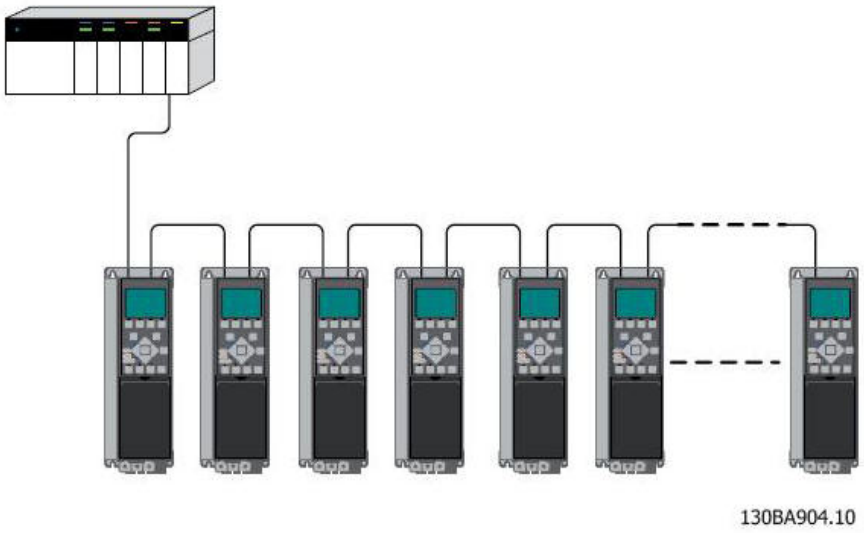


Illustration 3.3: Line topology

NB!
For line topology please refer to section: "Recommended design rules" In a line topology all drives must be powered, either by mains or by their 24 V DC option cards, for the build-in switch to work.

NB!

Please observe that mounting drives of different power-sizes in a line topology may result in unwanted power-off behaviour.

Smaller drives discharge faster than bigger drives. This can result in loss of link in the line topology, which may lead to control word timeout.

To avoid this, mount the drives with the longest discharge time first in the line topology.

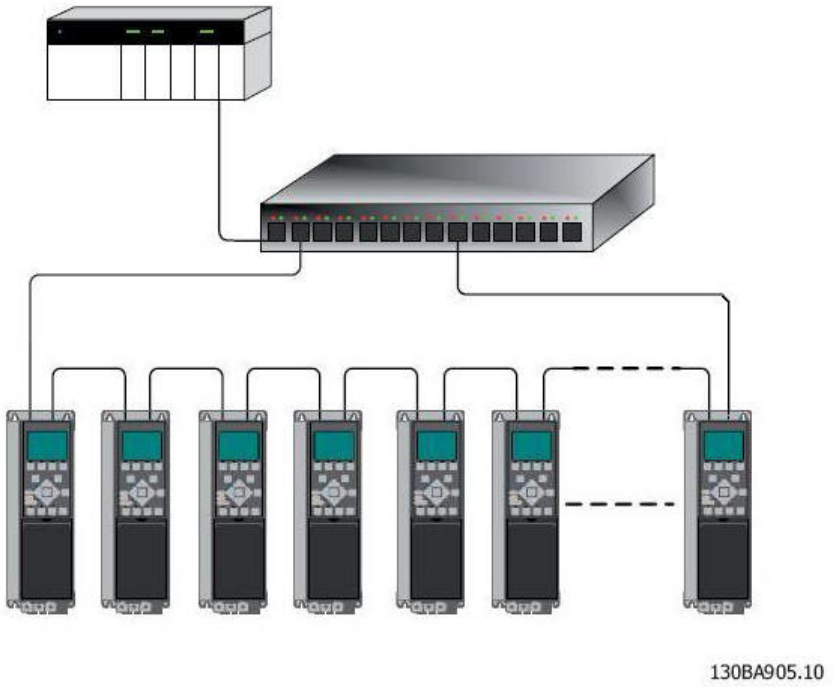


Illustration 3.4: Ring/redundant line topology

3.1.5 Network

It is of high importance that the media chosen for Ethernet data transmission are suitable. Usually CAT 5e and 6 cables are recommended for industrial applications. Both types of cable are available as Unshielded Twisted Pair and Shielded Twisted Pair. Generally shielded cables are recommended for use in industrial environments and with frequency converters.

A maximum cable-length of 100 m is allowed between switches.

Optical fibres can be used for gapping longer distances and providing galvanic isolation.

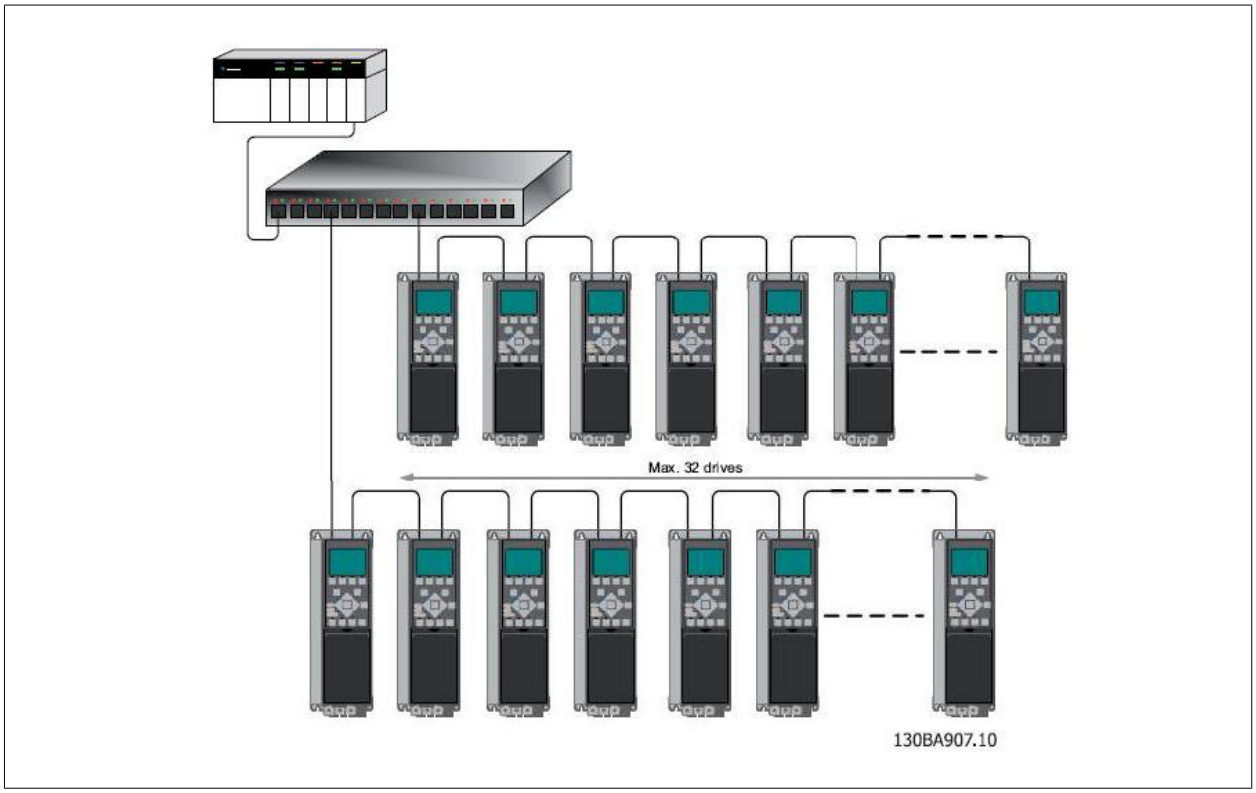
For connecting Modbus TCP devices both hubs and switches can be used. It is, however, recommended always to use suitable industrial graded Ethernet switches.

For more information regarding IP-switching, please refer to section: *IP Traffic* in this manual.

3.1.6 Recommended Design Rules

While designing Ethernet networks special attention and caution must be taken regarding active network components.
While designing a network for line topology it is important to notice that a small delay is added with each every switch in the line.

It is not recommended to connect more than 32 drives in a line at any API. Exceeding the recommended design rules, may result in failing communication.

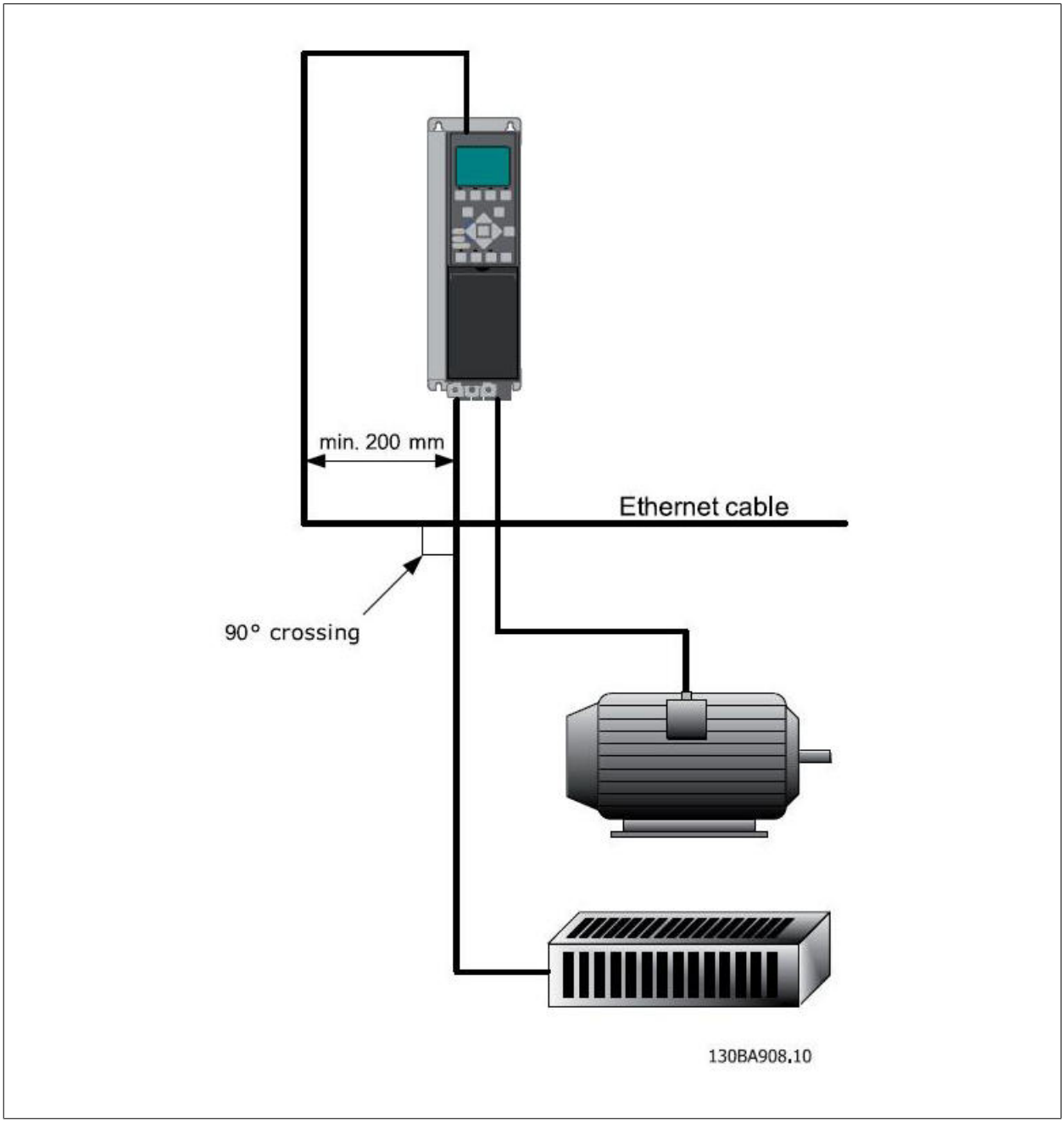


3.1.7 EMC Precautions

The following EMC precautions are recommended in order to achieve interference-free operation of the Ethernet network. Additional EMC information is available in the AF-650 GP/AF-600 FP series Design Guide.

NB!
Relevant national and local regulations, for example regarding protective earth connection, must be observed.

The Ethernet communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to the other. Normally a distance of 200 mm (8 inches) is sufficient, but maintaining the greatest possible distance between the cables is recommended, especially where cables run in parallel over long distances. When crossing is unavoidable, the Ethernet cable must cross motor and brake resistor cables at an angle of 90 degrees.



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4 How to Configure

4.1.1 IP Settings

All IP-related parameters are located in parameter group EN-##:

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

The OPCMBTCP option offers several ways of IP address assignment.

Setting up drive with manual assigned IP address:

Par.	Name	Value
EN-00	*IP Address Assignment*	[0] MANUAL
EN-01	*IP Address*	192.168.0.xxx*
EN-02	*Subnet Mask*	255.255.255.0*
EN-03	*Default Gateway*	optional

*= Class C IP address example. Any valid IP address can be entered.

NB!
A power-cycle is necessary after setting the IP parameters manually.

Setting up drive with automatic (BOOTP/DHCP) assigned IP address:

Par.	Name	Value
EN-00	*IP Address Assignment*	[1] DHCP/[2] BOOTP
EN-01	*IP Address*	Read only
EN-02	*Subnet Mask*	Read only
EN-03	*Default Gateway*	Read only

By IP address assigned by DHCP/BOOTP server, the assigned *IP Address* and *Subnet Mask* can be read out in par. EN-01 and EN-02. In par. EN-04 *DHCP Server*, the IP address of the found DHCP or BOOTP server is displayed. For DHCP only: The remaining lease-time can be read-out in par. EN-05 *Lease Expires*.

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

NB!
If no DHCP or BOOTP reply has been received after 4 attempts (e.g. if the DHCP/BOOTP server has been powered off), the option will fallback to the last good known IP address.

Par. EN-03, *Default Gateway* is optional and only used in routed networks.

Par. EN-06, *Name Servers*
Par. EN-07, *Domain Name*
Par. EN-08, *Host Name*
Are used with Domain Name Server systems and are all optional. If DHCP or BOOTP is selected as IP address assignment, these parameters are read only.

NB!
It is only possible to assign valid class A, B and C IP address to the option. The valid ranges are shown in the below table:

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Class A	1.0.0.1 - 126.255.255.254
Class B	128.1.0.1 - 191.255.255.254
Class C	192.0.1.1 - 223.255.254.254

4.1.2 Ethernet Link Parameters

Parameter group EN-1# holds information Ethernet Link information:

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

Please note the Ethernet Link Parameters are unique per port.

Par. EN-10, *Link Status* and par. EN-11, *Link Duration* displays information on the link status, per port.
Par. EN-10, *Link Status* will display Link or No Link according to the status of the present port.
Par. EN-11, *Link Duration* will display the duration of the link on the present port. If the link is broken the counter will be reset.

Par. EN-12, *Auto Negotiation* – is a feature that enables two connected Ethernet devices to choose common transmission parameters, such as speed and duplex mode. In this process, the connected devices first share their capabilities as for these parameters and then choose the fastest transmission mode they both support.
By default this function is enabled.
Incapability between the connected devices, may lead to decreased communication performance.
To prevent this, Auto Negotiation can be disabled.
If par. EN-12 is set to OFF, link speed and duplex mode can be configured manually in par. EN-13 and EN-14.

Par. EN-12, *Link Speed* – displays/sets the link speed per port. "None" is displayed if no link is present.

Par. EN-14, *Link Duplex* – displays/sets the duplex mode per port.
Half-duplex provides communication in both directions, but only in one direction at a time (not simultaneously).
Full-duplex allows communication in both directions, and unlike half-duplex, allows for this to happen simultaneously.

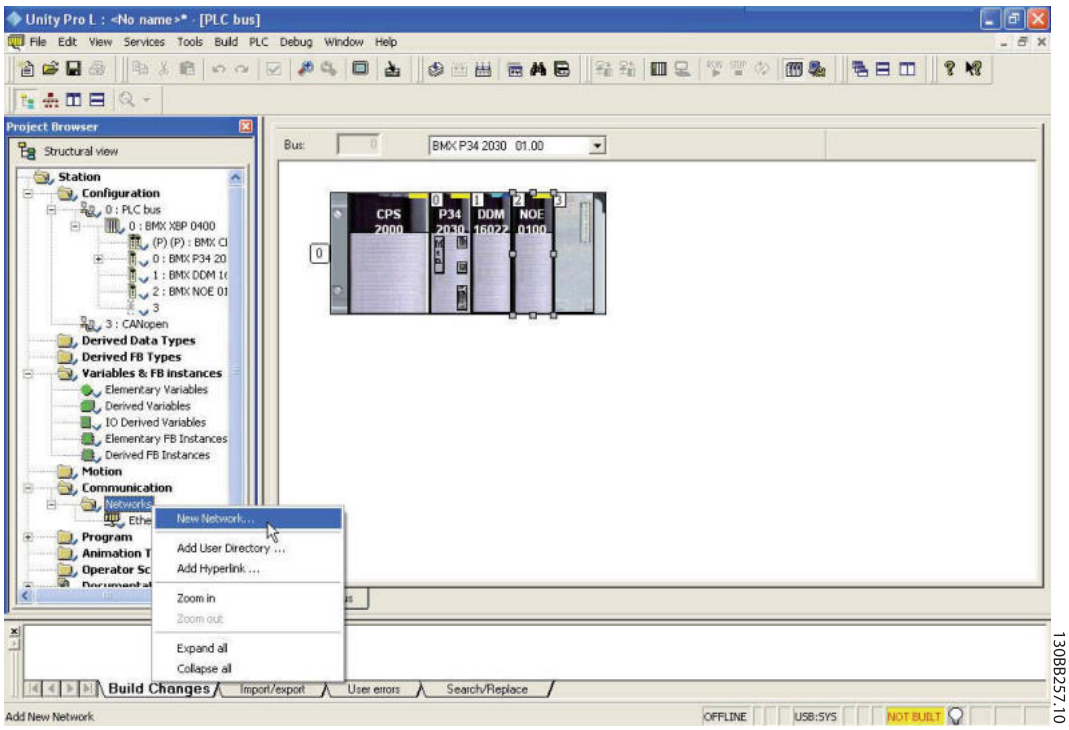
4.1.3 Configuring the Scanner

For configuring the scanner to communicate to the drive, no system (e.g. EDS, GSD file) file is needed. The AF-600 FP/AF-650 GP is handled as a generic device an as such, it has to be configured directly in the scanner. The following example setup the scanner to IP addresses 192.168.1.20 and the AF-650 GP to address 192.168.1.20.

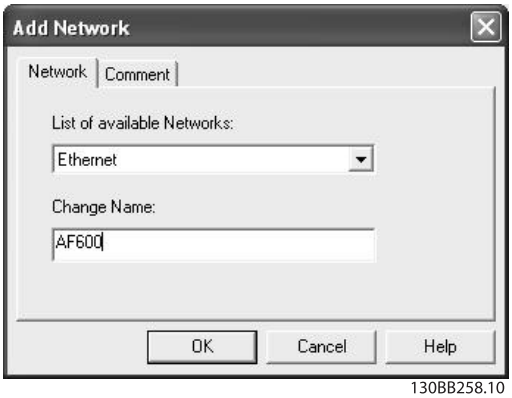
Configuring a Modicon scanner.

The following example uses the Unity Pro tool from Group Schneider to configure the PLC. The example only shows the setting up of the Protocol and assigning I/O mapping to internal memory of the PLC.

Under network, add a network by right clicking the Network menu and select "New Network"



By selecting this menu you will be asked to assign a name to the new network. In this example "AF-600" has been choosen.



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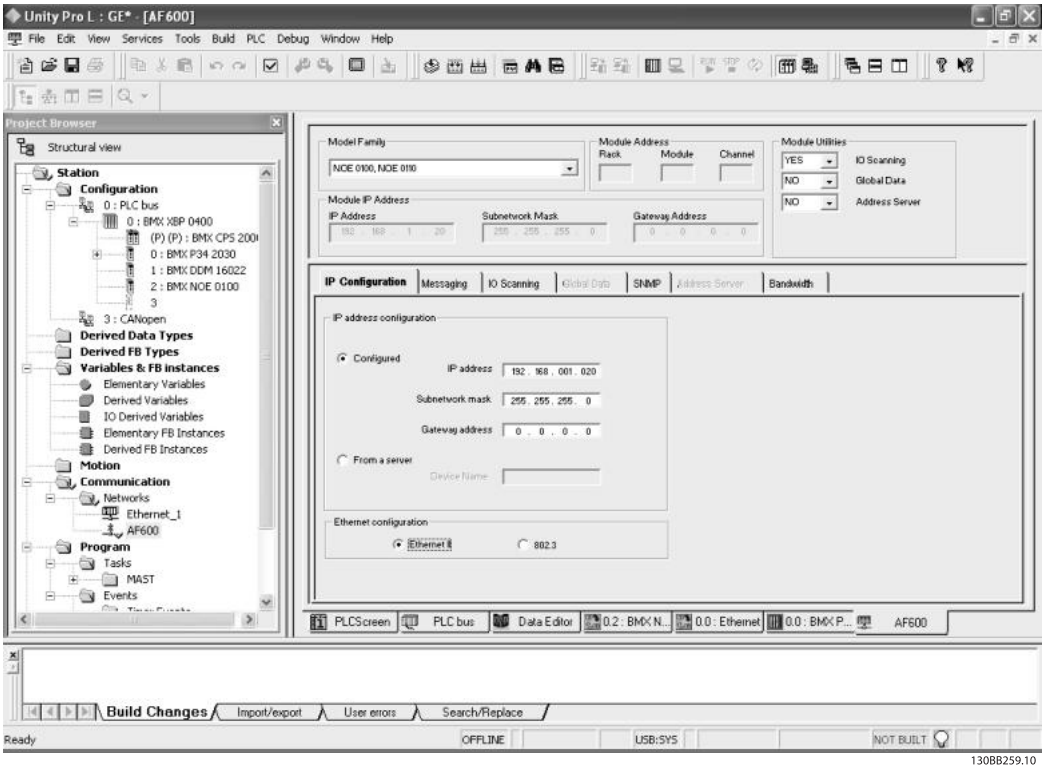
After selecting "OK" the network "GE" should show up under Networks and by selecting the Network, the main configuration page will be shown.

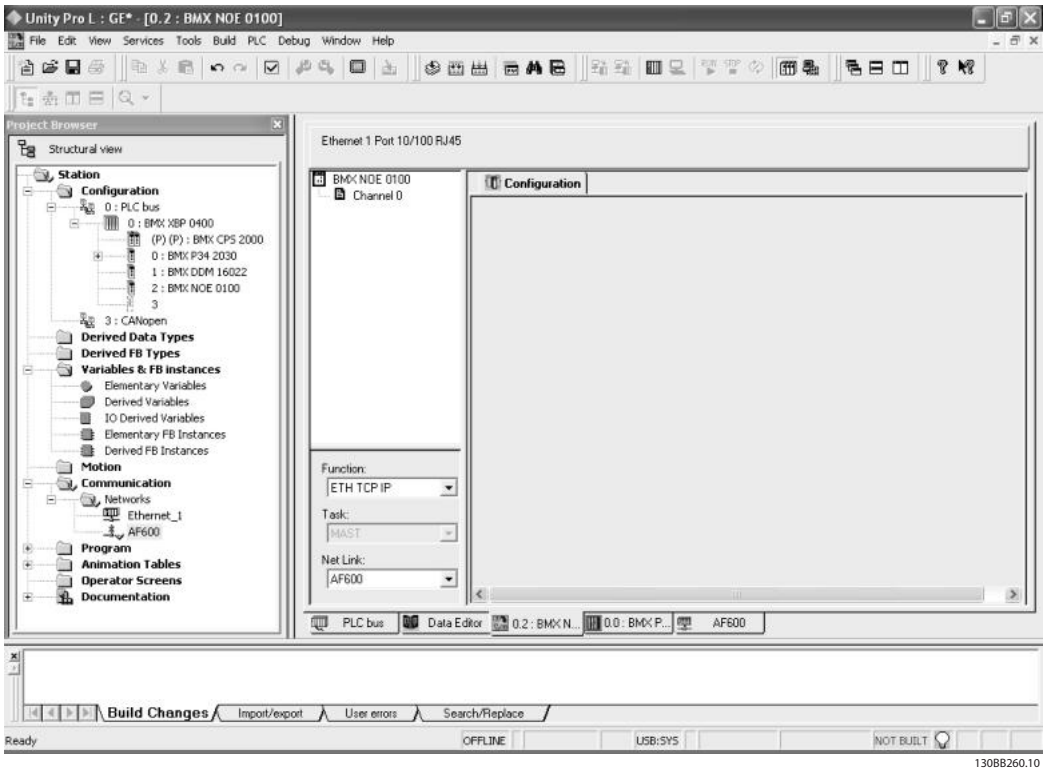


In this menu the following settings have to be made:

Menu	Menu point	Setting
Model Family	Model Family	NOE 0100, NOE 110
Model Utilities	IO Scanning	YES
	Global Data	NO
	Address Server	NO
IP address configuration	Configured/From a server	Configured
	IP address	192.168.001.020
	Subnetwork mask	255.255.255.0
	Gateway address	0.0.0.0
Ethernet Configuration	Ethernet Configuration	Ethernet II

In the IP Configuration tab, the "Configured" bottom has to be selected, and the IP address and Subnetwork mask has to be filed out. In this example the address 192.168.1.20 is used as the address for the master.

The step assigns the protocol to the scanner, *which is done by selecting the scanner and selecting the "Function" menu and enables the Ethernet by selecting "ETH TCP IP" This brings up the Net Link menu, where "GE" has to be selected. At this time the "GE" Protocol is assign to the Scanner and the last step is to configure the scanner to read and write holding registers of the AF-650 GP.*



In This menu following settings has to be made:

Menu	Menu point	Setting
Function	Function	ETH TCP IP
Net Link	Net Link	GE

At this time the "GE" Protocol is assign to the Scanner and the last step is to configure the scanner to read and write holding registers of the AF-650 GP.

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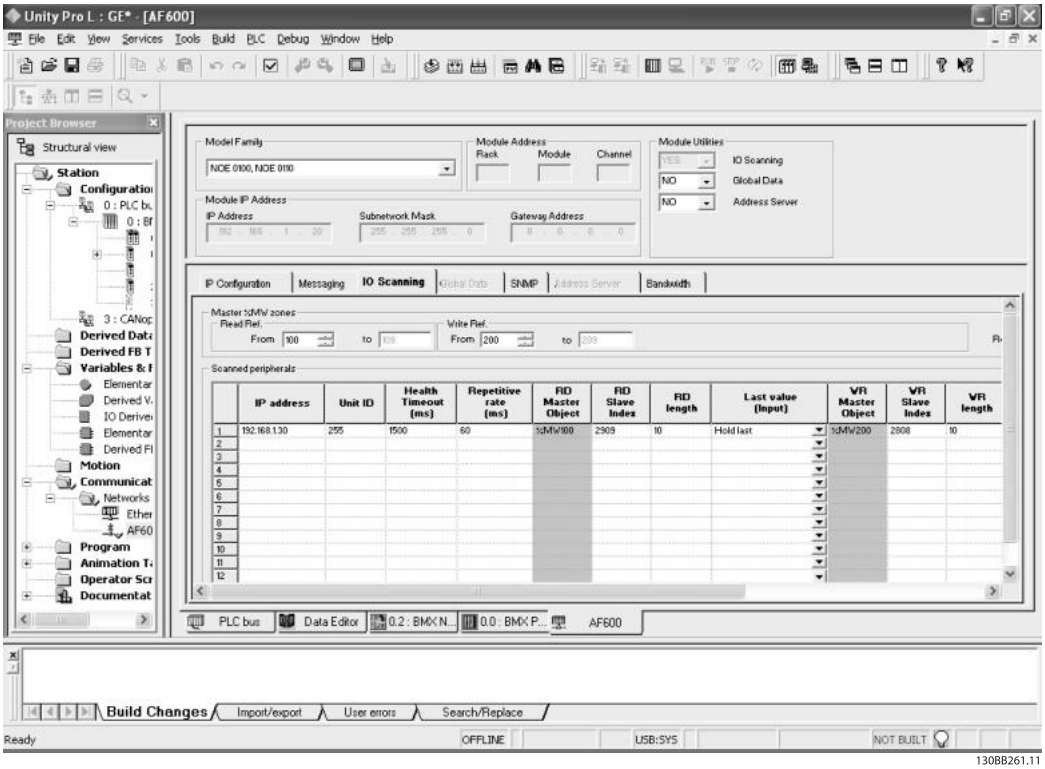
By first selecting the GE network and secondly selecting the IO Scanning tab, the scanning list appears. You will have to fill out the list as shown here



Menu	Menu point	Setting
IO Scanning	IP address	192.168.001.030
	Unit ID	255
	Health Timeout	1500
	Repetitive rate	60
	RD Master Object	%MW100
	RD Slave Index	50009
	RD Length	10
	Last Value	Hold Last
	VR Master Object	%MW200
	VR Slave Index	0
	VR Lenght	10
	Description	-

This configuration copies the information stored from %MW200 to %M209 in the PLC to the Holding register 50010 to 500019 of the AF-650 GP. It reads the holding registers 50000 to 50009 of the AF-650 GP to the PLC's memory %MW100 to %M109

4.1.4 IP traffic

The use of Ethernet based network for industrial automation purposes, calls for careful and thorough network design. Especially the use of active network components like switches and routers requires detailed know-how about the behaviour of IP traffic.

Some important issues:

Multicast

Multicast traffic; is traffic that is addressed to a number of recipients. Each host processes the received multicast packet to determine if it is the target for the packet. If not, the IP package is discarded. This causes an excessive network load of each node in the network since they are flooded with multicast packages. The nature of traffic is that all Originator-to-Target traffic is Unicast (point-to-point) but Target-to-Originator traffic is optional Multicast. This enables that several listen only -connections can be made to a single host.

In switched networks hosts also have the risk of becoming flooded with multicast traffic. A switch usually forwards traffic by MAC address tables build by looking into the source address field of all the frames it receives.
A multicast MAC address is never used as a source address for a packet. Such addresses do not appear in the MAC address table, and the switch has no method for learning them, so it will just forward all multicast traffic to all connected hosts.

IGMP

IGMP (Internet Group Management Protocol) is an integrated part of IP. It allows hosts to join or leave a multicast host group. Group membership information is exchanged between a specific host and the nearest multicast router.

Spanning Tree Protocol (STP)

For an Ethernet network to function properly, only one active path can exist between two nodes. Spanning-Tree Protocol is a link management protocol that provides path redundancy while preventing undesirable loops in the network.
When loops occur, some switches see stations appear on both sides of it self. This condition confuses the forwarding algorithm and allows for duplicate frames to be forwarded.

To provide path redundancy, Spanning-Tree Protocol defines a tree that spans all switches in an extended network. Spanning-Tree Protocol forces certain redundant data paths into a standby (blocked) state. If one network segment in the Spanning-Tree Protocol becomes unreachable, or if Spanning-Tree Protocol costs change, the spanning-tree algorithm reconfigures the spanning-tree topology and re-establishes the link by activating the standby path.

Spanning-Tree Protocol operation is necessary if the AF-650 GP or AF-600 FP's are running in a ring/redundant line topology.

5

5 How to Control

5.1.1 How to Control the Frequency Converter

This section describes codes which can be used in the function and data fields of a Modbus TCP message. For a complete description of all the message fields please refer to the section Modbus TCP Message Framing Structure.

5.1.2 Function Codes Supported by Modbus TCP

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

Function	Function Code
Read holding registers	3 hex
Write single register	6 hex
Write multiple registers	10 hex
Device identification	2B hex

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

5.2 Modbus TCP Message Framing Structure

5.2.1 Function Code

The function code of a message frame contains 8 bits. Valid codes are in the range of 1-FF. Function codes are used to send messages between master and slave. When a message is sent from a master to a slave device, the function code tells the slave what kind of action to perform. When the slave responds to the master, it uses the function code to indicate either a normal (error-free) response, or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to logic 1. In addition, the slave places a unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception. Please also refer to the section *Function Codes Supported by Modbus TCP and Exception Codes.*

5.2.2 Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. These are made up of one TCP character. The data field of messages sent from a master to slave device contains additional information which the slave must use to take the action defined by the function code. This 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.

5.2.3 CRC Check Field

Messages include an error-checking field, operating on the basis of a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC value is calculated by the transmitting device, which appends the CRC as the last field in the message. The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value received in the CRC field. If the two values are unequal, a bus time-out results. The error-checking field contains a 16-bit binary value implemented as two 8-bit bytes. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte sent in the message

5.2.4 Holding Register Addressing

	Holding registers
Register Number	**Description**
00001-00006	Reserved
00007	Last error code from an Drive data object interface
00008	Reserved
00009	Parameter index*
00100-00999	000 parameter group (parameters 001 through 099)
01000-01999	100 parameter group (parameters 100 through 199)
02000-02999	200 parameter group (parameters 200 through 299)
03000-03999	300 parameter group (parameters 300 through 399)
04000-04999	400 parameter group (parameters 400 through 499)
...	...
49000-49999	4900 parameter group (parameters 4900 through 4999)
2810	Input data: Frequency converter control word register (CTW).
2811	Input data: Bus reference register (REF).
...	...
2910	Output data: Frequency converter status word register (STW).
2911	Output data: Frequency converter main actual value register (MAV).

* Used to specify the index number to be used when accessing an indexed parameter.

5.2.5 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.

5.2.6 Storage of Data

The Coil 65 decimal determines whether data written to the frequency converter are stored in EEPROM and RAM (coil 65 = 1) or only in RAM (coil 65 = 0).

5.2.7 IND

The array index is set in Holding Register 9 and used when accessing array parameters.

5.2.8 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.

5.2.9 Conversion Factor

The different attributes for each parameter can be seen in the section on factory settings. Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals. Please refer to the *Parameters section*.

5.2.10 Parameter Values

Standard Data Types

Standard data types are int16, int32, uint8, uint16 and uint32. They are stored as 4x registers (40001 – 4FFFF). The parameters are read using function 03HEX "Read Holding Registers." Parameters are written using the function 6HEX "Preset Single Register" for 1 register (16 bits), and the function 10HEX "Preset Multiple Registers" for 2 registers (32 bits). Readable sizes range from 1 register (16 bits) up to 10 registers (20 characters).

Non standard Data Types

Non standard data types are text strings and are stored as 4x registers (40001 – 4FFFF). The parameters are read using function 03HEX "Read Holding Registers" and written using function 10HEX "Preset Multiple Registers." Readable sizes range from 1 register (2 characters) up to 10 registers (20 characters).

5.2.11 Cross Reference List

All parameters in the AF-650 GP and the AF-600 FP are named with one or two letters, a "-" and a number e.g. F-07. To access parameters the following table has to be used because letters cannot be addressed.
Example: F-07 = 7, E-01 = 101, DR-53 = 1253.

Letter	Number
F	0
E	1
C	2
P	3
H	4
K	5
AN	6
B	7
O	8
PB	9
SP	10
XC	11
DR	12
LG	13
CL	14
ID	15
AP	16
T	17
FB	18
PC	19
AO	20
BP	21
DN	22
PI	23
LC	24
EC	25
RS	26
BN	27
LN	28
EN	29
CB	30
CA	31
CD	32

5.2.12 Examples

The following examples illustrate various Modbus TCP commands. If an error occurs, please refer to the Exception Codes section.

5.2.13 Modbus Exception Codes

For a full explanation of the structure of an exception code response, please refer to the section *Modbus RTU Message Framing Structure, Function Field.*

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 slave). 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 slave) 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 slave). 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 would succeed, a request with offset 96 and length 5 will generate exception 02.
3	Illegal data value	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically 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 particular value of any particular register.
4	Slave device failure	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.

5.3 Control Profile

The frequency converter can be controlled according to the GE Drive protocol. Select the desired control profile in par. O-10 *Control Word Profile*. The choice of profile affects the control and status word only.

The *GE Drive control profile* sections provide a detailed description of control and status data.

5.4 GE Drive Control Profile

5.4.1 GE Drive Control Profile

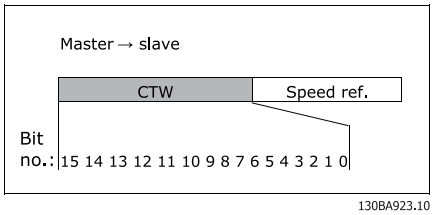


Illustration 5.1: (par. O-10 *Control Word Profile* = Drive profile)

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

Explanation of Control Bits

Bits 00/01

Bits 00 and 01 are used to choose between the four reference values, which are pre-programmed in par. C-05 *Multi-step Frequency 1 - 8* according to the following table:

Programmed ref. value	Parameter	Bit 01	Bit 00
1	C-05 [0]	0	0
2	C-05 [1]	0	1
3	C-05 [2]	1	0
4	C-05 [3]	1	1

NB!
In par. O-56 *Preset Reference Select* select a selection is made to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC brake:

Bit 02 = '0' leads to DC braking and stop. Braking current and duration are set in par. B-01 *DC Brake Current* and par. B-02 *DC Braking Time*. Bit 02 = '1' leads to ramping, par. F-07 *Accel Time 1*

Bit 03, Coasting:

Bit 03 = '0' causes the frequency converter to immediately "let go" of the motor (the output transistors are "shut off"), so that it coasts to a standstill.
Bit 03 = '1' enables the frequency converter to start the motor if the other starting conditions have been fulfilled.

NB!
In par. O-50 *Coasting Select* a selection is made to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop:

Bit 04 = '0' causes a stop, in which the motor speed is decelerated to stop via par. C-23 *Quick Stop Decel Time*.

Bit 05, Hold output frequency:

Bit 05 = '0' causes the present output frequency (in Hz) to freeze. The frozen output frequency can then be changed only by means of the digital inputs (par. E-01 *Terminal 18 Digital Input* to par. E-06 *Terminal 33 Digital Input*) programmed to *Speed up* and *Speed down*.

NB!
If Freeze output is active, the frequency converter can only be stopped by the following:

- Bit 03 Coasting stop
- Bit 02 DC braking
- Digital input (par. E-01 *Terminal 18 Digital Input* to par. E-06 *Terminal 33 Digital Input*) programmed to *DC braking*, *Coasting stop* or *Reset and coasting stop*

Bit 06, Ramp stop/start:
Bit 06 = '0' causes a stop, in which the motor speed is deceled to stop via the selected *decel* parameter. Bit 06 = '1' permits the frequency converter to start the motor, if the other starting conditions have been fulfilled.

NB!
In par. O-53 *Start Select* Start select a selection is made to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset:
Bit 07 = '0' no reset. Bit 07 = '1' resets a trip. Reset is activated on the leading edge of the signal, i.e. when changing from logic '0' to logic '1'.

Bit 08, Jog:
Bit 08 = '1' causes the output frequency to be determined by par. C-21 *Jog Speed [RPM]*.

Bit 09, Selection of ramp 1/2:
Bit 09 = '0' means that ramp 1 is active (par. H-07 *Accel/Decel Time 1 Type* to par. SP-73 *Decel Time 1 S-ramp Ratio at Decel. Start*). Bit 09 = '1' means that ramp 2 (par. SP-76 *Accel/Decel Time 2 Type* to par. SP-81 *Decel Time 2 S-ramp Ratio at Decel. Start*) is active.

Bit 10, Data not valid/Data valid:
This bit tells the frequency converter whether the control word is to be used or ignored. Bit 10 = '0' causes the control word to be ignored, Bit 10 = '1' causes the control word to be used. The control word is always contained in the telegram, regardless of which type of telegram is used, so this function is useful for 'turning off' the control word when not required for updating or reading parameters.

Bit 11, Relay 01:
Bit 11 = '0' Relay not activated. Bit 11 = '1' Relay 01 activated, provided *Control word bit 11* has been chosen in par. E-24 *Function Relay*.

Bit 12, Relay 02:
Bit 12 = '0' Relay 02 has not been activated. Bit 12 = '1' Relay 02 has been activated, provided *Control word bit 12* has been chosen in par. E-24 *Function Relay*.

Bit 13/14, Selection of set-up:
Bits 13 and 14 are used to select one of four menu set-ups according to the following table:

Set-up	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

The function is only possible when *Multi-Set-ups* is selected in par. K-10 *Active Set-up*.

NB!
In par. O-55 *Set-up Select* a selection is made to define how Bit 13/14 gates with the corresponding function on the digital inputs.

Bit 15 Reverse:
Bit 15 = '0' causes no reversing. Bit 15 = '1' causes reversing. Note: In the factory setting reversing is set to *digital* in par. O-54 *Reversing Select*. Bit 15 causes reversing only when *Ser. communication*, *Logic AND* or *Logic OR* is selected.

5.4.2 Status Word according to Drive Profile (STW)

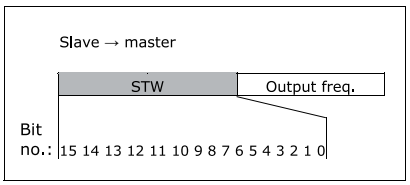


Illustration 5.2: (par. O-10 *Control Word Profile*)

Bit	Bit value = 0	Bit value = 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, auto start
13	Voltage ok	Voltage exceeded
14	Torque ok	Torque exceeded
15	Thermal ok	Thermal exceeded

Explanation of the Status Bits

Bit 00, Control ready:
Bit 00 = '0' means that the frequency converter has tripped. Bit 00 = '1' means that the frequency converter controls are ready, but that the power component is not necessarily receiving any power supply (in the event of external 24 V supply to controls).

Bit 01, Drive ready:
Bit 01 = '1'. The frequency converter is ready for operation.

Bit 02, Coasting stop:
Bit 02 = '0'. The frequency converter has released the motor. Bit 02 = '1'. The frequency converter can start the motor when a start command is given.

Bit 03, No error/Trip:
Bit 03 = '0' means that the frequency converter is not in fault mode. Bit 03 = '1' means that the frequency converter is tripped, and that a reset signal is required to re-establish operation.

Bit 04, No error/Error (no trip):
Bit 04 = '0' means that the frequency converter is not in fault mode. Bit 04 = '1' means that there is a frequency converter error but no trip.

Bit 05, Reserved:
Bit 05 is not used in the status word.

Bit 06, No error / Trip lock:
Bit 06 = '0' means that the frequency converter is not in fault mode. Bit 06 = '1' means that the frequency converter 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 motor is running, but that the present speed is different from the preset speed reference. For example, this might occur while the speed is being acceled/deceled during start/stop. Bit 08 = '1' means that the present motor speed matches the preset speed reference.

Bit 09, Local operation/Bus control:
Bit 09 = '0' means that [STOP/RESET] is activated on the control unit, or that Local control in par. F-02 *Operation Method* is selected. It is not possible to control the frequency converter via serial communication. Bit 09 = '1' means that it is possible to control the frequency converter via the network/ serial communication.

Bit 10, Out of frequency limit:
Bit 10 = '0', if the output frequency has reached the value in par. F-18 *Motor Speed Low Limit [RPM]* or par. F-17 *Motor Speed High Limit [RPM]*. Bit 10 = '1' means that the output frequency is within the defined limits.

Bit 11, No operation/In operation:
Bit 11 = '0' means that the motor is not running. Bit 11 = '1' means that the frequency converter has a start signal or that the output frequency is greater than 0 Hz.

Bit 12, Drive OK/Stopped, auto start:
Bit 12 = '0' means that there is no temporary over temperature on the inverter. Bit 12 = '1' means that the inverter has stopped because of over temperature, but that the unit has not tripped and will resume operation once the over temperature stops.

Bit 13, Voltage OK/Voltage exceeded:
Bit 13 = '0' means that there are no voltage warnings. Bit 13 = '1' means that the DC voltage in the frequency converter's intermediate circuit is too low or too high.

Bit 14, Torque OK/Torque limit exceeded:
Bit 14 = '0' means that the motor current is lower than the torque limit selected in par. F-40 and F-41 Torque limit. Bit 14 = '1' means that the torque limit in par. F-40 and F-41 Torque limit has been exceeded. The nominal torque can be read in par. DR-16 *Torque [Nm]*.

Bit 15, Thermal OK/limit exceeded:
Bit 15 = '0' means that the timers for both motor thermal protection and drive thermal protection, have not exceeded 100%. Bit 15 = '1' means that one of the limits has exceeded 100%.

5.5 Reference Handling

5.5.1 Bus Speed Reference Value

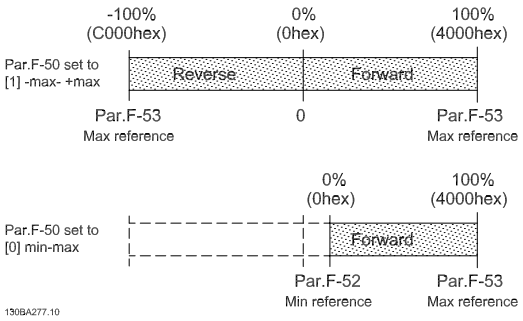
In Drive-Profile (par. O-10 = [0] Drive profile) the reference is scaled as a normalized relative value in percent. The value is transmitted in hexadecimal:

0% = 0hex

100% = 4000hex

-100% = C000hex

Depending of the setting of par. F-50 *Reference Range*, the reference is scaled from – Max. to + Max. or from Min. to Max.



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

Par. F-04 *Base Frequency*

Par. P-06 *Base Speed*

Par. F-52 *Minimum Reference*

Par. F-53 *Maximum Reference*

All references provided to the frequency converter are added to the total reference value. If a reference is to be controlled by the network only, ensure that all other reference inputs are zero.

This means that digital and analogue input terminals should not be used for reference signals. The default setting (0%) should be maintained for preset references in par. C-05 *Multi-step Frequency 1 - 8* .

NB!
If the bus speed reference is negative, and the control word contains a run reverse signal, the drive will run clockwise (- - is +).

MAV is scaled in the same way as the reference.

6

6 Parameters

6.1 Parameter Group O-##

O-01 Control Site

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

O-02 Control Word Source

Select the source of the control word: one of two serial interfaces or four installed options. During initial power-up, the frequency converter automatically sets this parameter to *Option A* [3] if it detects a valid network option module installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets par. O-02 *Control Word Source* back to default setting *Drive* RS485, and the frequency converter then trips. If an option is installed after initial power-up, the setting of par. O-02 *Control Word Source* will not change but the frequency converter will trip and display: Alarm 67 *Option Changed*.

This parameter cannot be adjusted while the motor is running.

Option:		Function:
[0]	None	
[1]	Drive RS485	
[2]	Drive USB	
[3] *	Option A	
[4]	Option B	
[5]	Option C0	
[6]	Option C1	

O-03 Control Word Timeout Time

Range:		Function:
1.0 s*	[0.1 - 18000.0 s]	Enter the maximum time expected to pass between the reception of two consecutive messages. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in par. O-04 *Control Word Timeout Function* will then be carried out. The time-out counter is triggered by a valid control word.

O-04 Control Word Timeout Function

Select the time-out function. The time-out function activates when the control word fails to be updated within the time period specified in par. O-03 *Control Word Timeout Time*.

Option:		Function:
[0] *	Off	Resumes control via serial bus (Network or standard) using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at JOG frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stops the motor, then resets the frequency converter in order to restart: via the network, via the reset button on the Keypad or via a digital input.
[7]	Select setup 1	Changes the set-up upon reestablishment of communication following a control word time-out. If communication resumes causing the time-out situation to disappear, par. O-05 *End-of-Timeout Function* defines whether to resume the set-up used before the time-out or to retain the set-up endorsed by the time-out function.
[8]	Select setup 2	See [7] *Select setup 1*
[9]	Select setup 3	See [7] *Select setup 1*
[10]	Select setup 4	See [7] *Select setup 1*

NB!
The following configuration is required in order to change the set-up after a time-out:
Set par. K-10 *Active Set-up* to [9] *Multi set-up* and select the relevant link in par. K-12 *This Set-up Linked to*.

O-05 End-of-Timeout Function

Option:		Function:
		Select the action after receiving a valid control word following a time-out. This parameter is active only when par. O-04 *Control Word Timeout Function* is set to [Set-up 1-4].
[0]	Hold set-up	Retains the set-up selected in par. O-04 *Control Word Timeout Function* and displays a warning, until par. O-06 *Reset Control Word Timeout* toggles. Then the drive resumes its original set-up.
[1] *	Resume set-up	Resumes the set-up active prior to the time-out.

O-06 Reset Control Word Timeout

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

Option:		Function:
[0] *	Do not reset	Retains the set-up specified in par. O-04 *Control Word Timeout Function*, following a control word time-out.
[1]	Do reset	Returns the frequency converter to the original set-up following a control word time-out. The frequency converter performs the reset and then immediately reverts to the *Do not reset* [0] setting

O-10 Control Word Profile

Select the interpretation of the control and status words corresponding to the installed network. Only the selections valid for the network installed in slot A will be visible in the Keypad display.

For guidelines in selection of *GE Drive profile* [0] please refer to the *Serial communication via RS 485 Interface* section.

Option:		Function:
[0] *	Drive Profile	

O-13 Configurable Status Word STW

Option:		Function:
		This parameter enables configuration of bits 12 – 15 in the status word.
[0]	No function	
[1] *	Profile Default	Function corresponds to the profile default selected in par. O-10 *Control Word Profile*.
[2]	Alarm 68 Only	Only set in case of an Alarm 68.
[3]	Trip excl Alarm 68	Set in case of a trip, except if the trip is executed by an Alarm 68.
[16]	T37 DI status	The bit indicates the status of terminal 37. "1" indicates T37 is high (normal) only available in AF-650 GP.

O-14 Configurable Control Word CTW

Option:		Function:
		Selection of control word bit 10 if it is active low or active high
[0]	None	
[1] *	Profile default	
[2]	CTW Valid, active low	

O-50 Coasting Select

Option:		Function:
		Select control of the coasting function via the terminals (digital input) and/or via the network.
[0]	Digit Input	Activates command via a digital input.
[1]	Bus	Activates command via the serial communication port or network option module.
[2]	Logic AND	Activates command via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates command via the network/serial communication port OR via one of the digital inputs.

NB!

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

O-51 Quick Stop Select

Select control of the Quick Stop function via the terminals (digital input) and/or via the network.

Option:		Function:
[0]	Digital Input	
[1]	Bus	
[2]	Logic AND	
[3] *	Logic OR	

NB!

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

O-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input) and/or via the network.
[0]	Digit Input	Activates command via a digital input.
[1]	Bus	Activates command via the serial communication port or network option module.
[2]	Logic AND	Activates command via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates command via the network/serial communication port OR via one of the digital inputs.

NB!
This parameter is active only when par. O-01 *Control Site* is set to [0] *Digital and control word*.

O-53 Start Select

Option:		Function:
		Select control of the drive start function via the terminals (digital input) and/or via the network.
[0]	Digit Input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or network option module.
[2]	Logic AND	Activates Start command via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the network/serial communication port OR via one of the digital inputs.

NB!
This parameter is active only when par. O-01 *Control Site* is set to [0] *Digital and control word*.

O-54 Reversing Select

Option:		Function:
[0]	Digital Input	Select control of the frequency converter reverse function via the terminals (digital input) and/or via the network.
[1]	Bus	Activates the Reverse command via the serial communication port or network option module.
[2]	Logic AND	Activates the Reverse command via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Reverse command via the network/serial communication port OR via one of the digital inputs.

NB!
This parameter is only active when par. O-01 *Control Site* is set to [0] *Digital and control word*.

O-55 Set-up Select		
Option:		**Function:**
		Select control of the drive set-up selection via the terminals (digital input) and/or via the network.
[0]	Digit Input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or network option module.
[2]	Logic AND	Activates the set-up selection via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the network/serial communication port OR via one of the digital inputs.

NB!
This parameter is active only when par. O-01 *Control Site* is set to [0] *Digital and control word*.

O-56 Preset Reference Select		
Option:		**Function:**
		Select control of the drive Preset Reference selection via the terminals (digital input) and/or via the network.
[0]	Digit Input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port or network option module.
[2]	Logic AND	Activates Preset Reference selection via the network/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the network/serial communication port OR via one of the digital inputs.

NB!
This parameter is active only when par. O-01 *Control Site* is set to [0] *Digital and control word*.

6.2 Parameter Group EN-##

EN-00 IP Address Assignment		
Option:		**Function:**
		Selects the IP Address assignment method.
[0] *	Manual	IP-address can be set in par. EN-01 IP Address.
[1]	DHCP	IP-address is assigned via DHCP server.
[2]	BOOTP	IP-address is assigned via BOOTP server.

EN-01 IP Address		
Range:		**Function:**
	[000.000.000.000 - 255.255.255.255]	Configure the IP address of the option. Read-only if par. EN-00 set to DHCP or BOOTP.

EN-02 Subnet Mask		
Range:		**Function:**
	[000.000.000.000 - 255.255.255.255]	Configure the IP subnet mask of the option. Read-only if par. EN-00 set to DHCP or BOOTP.

EN-03 Default Gateway		
Range:		**Function:**
	[000.000.000.000 – 255.255.255.255]	Configure the IP default gateway of the option. Read-only if par. EN-00 set to DHCP or BOOTP.

EN-04 DHCP Server

Range:	Function:
[000.000.000.000 – 255.255.255.255]	Read only. Displays the IP address of the found DHCP or BOOTP server.

NB!
A power-cycle is necessary after setting the IP parameters manually.

EN-05 Lease Expires

Range:	Function:
[dd:hh:mm:ss]	Read only. Displays the lease-time left for the current DHCP-assigned IP address.

EN-06 Name Servers

Option:		Function:
		IP addresses of Domain Name Servers. Can be automatically assigned when using DHCP.
[0]	Primary DNS	
[1]	Secondary DNS	

EN-07 Domain Name

Range:		Function:
Blank	[0-19 characters]	Domain name of the attached network. Can be automatically assigned when using DHCP.

EN-08 Host Name

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

EN-09 Physical Address

Range:	Function:
[00:1B:08:00:00:00 – 00:1B:08:FF:FF:FF]	Read only Displays the Physical (MAC) address of the option.

EN-1# Ethernet Link Parameters

Option:		Function:
		Applies for whole parameter group.
[0]	Port 1	
[1]	Port 2	

EN-10 Link Status

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

EN-11 Link Duration

Option:		Function:
	Link Duration Port 1 (dd:hh:mm:ss)	Read only. Displays the duration of the present link on each port in dd:hh:mm:ss.

EN-12 Auto Negotiation

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

EN-13 Link Speed

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

EN-14 Link Duplex

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

EN-21 Process Data Config Write

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

NB!
For configuration of 2-word (32-bit) parameter read/write, use 2 consecutive arrays in par. EN-21 and EN-22.

EN-22 Process Data Config Read

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

EN-28 Store Data Values

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

EN-29 Store Always

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

6.2.1 Modbus TCP

EN-40 MODBUS TCP Status

Range:	Function:
[0]	
[1]	Read only. Displays the Modbus TCP- specific 16-bit Status word.

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 com-munication	No	Yes
5	UNUSED	-	-
6	Valid IP address	No	Yes
7	Modbus time-out (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 service	Disabled	Enabled
13	Cable diagnosis	Disabled	Enabled
14	Auto crossover	Disabled	Enabled
15	IGMP snooping	Disabled	Enabled

EN-41 Slave Message Count

Option:	Function:
	Read only. Displays the number of Modbus messages received and processed by the slave.

EN-42 Slave Exception

Option:	Function:
	Read only. Displays the number of Modbus messages for which the slave has sent an exception response.

EN-80 FTP Server

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

EN-81 HTTP Server

Option:		Function:
[0] *	Disable	Disables the build-in HTTP (web) server.
[1]	Enable	Enables the build-in HTTP (web) server.

EN-82 SMTP Service

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

EN-89 Transparent Socket Channel Port

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

EN-90 Cable Diagnostics

Option:		Function:
		Enables/disables advanced Cable diagnosis function. If enabled, the distance to cable errors can be read out in par. EN-93. The parameter resumes to the default setting of Disable after the diagnostics have finished.
[0] *	Disable	
[1]	Enable	

NB!
The cable diagnostics function will only be issued on ports where there is no link (see par. EN-10, *Link Status*)

EN-91 Auto Cross-Over

Option:		Function:
[0]	Disable	Disables the auto cross-over function.
[1] *	Enable	Enables the auto cross-over function.

NB!
Disabling of the auto cross-over function will require crossed Ethernet cables for daisy-chaining the options.

EN-92 IGMP Snooping

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

EN-93 Cable Error Length

Option:		Function:
		If Cable Diagnostics is enabled in par. EN-90, the built-in switch is able 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 displayed in meters with an accuracy of +/- 2m. The value 0 means no errors detected.
[0]	Error length Port 1 (0 – 200m)	
[1]	Error length Port 2 (0 – 200m)	

EN-94 Broadcast Storm Protection

Option:		Function:
		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: The "OFF" means that the filter is disabled –all broadcast messages will be passed through. The value "0%" means that no broadcast messages will be passed through. A value of "10%" means that 10% of the total bandwidth is allowed for broadcast messages, if the amount of broadcast messages increases above the 10% threshold, they will be blocked.
[0]	Protection Value Port 1 (*Off – 20%)	
[1]	Protection Value Port 2 (*Off – 20%)	

EN-95 Broadcast Storm Filter

Option:		Function:
		Applies to par. EN-94; if the Broadcast Storm Protection should also include Multicast messages.
[0]	Broadcast only	
[1]	Broadcast & Multicast	

EN-98 Interface Counters

Option:		Function:
		Read only. Advanced Interface counters, from build-in switch, can be used for low-level trouble-shooting, The parameter shows a sum of port 1 + port 2.
[0]	In Octets	
[1]	In Unicast Packets	
[2]	In Non-Unicast Packets	
[3]	In Discards	
[4]	In Errors	
[5]	In Unknown Protocols	
[6]	Out Octets	
[7]	Out Unicast Packets	
[8]	Out Non-Unicast Packets	
[9]	Out Discards	
[10]	Out Errors	

EN-99 Media Counters	
Option:	**Function:**
	Read only. Advanced Interface counters, from build-in switch, can be used for low-level trouble-shooting, The parameter shows a sum of port 1 + port 2.
[0]	Alignment Errors
[1]	FCS Errors
[2]	Single Collisions
[3]	Multiple Collisions
[4]	SQE Test Errors
[5]	Deferred Errors
[6]	Late Collisions
[7]	Excessive Collisions
[8]	MAC Transmit Errors
[9]	Carrier Sense Errors
[10]	Frame Too Long
[11]	MAC Receive Errors

6.3 Parameter List

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
O-0#						
O-01	Control Site	null	All set-ups	TRUE	-	Uint8
O-02	Control Word Source	null	All set-ups	TRUE	-	Uint8
O-03	Control Word Timeout Time	ExpressionLimit	1 set-up	TRUE	-1	Uint32
O-04	Control Word Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
O-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
O-06	Reset Control Word Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
O-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
O-1#						
O-10	Control Word Profile	[0] Drive Profile	All set-ups	TRUE	-	Uint8
O-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
O-14	Configurable Control Word CTW	[1] Profile Default	All set-ups	TRUE	-	Uint8
O-3#						
O-30	Protocol	null	1 set-up	TRUE	-	Uint8
O-31	Address	ExpressionLimit	1 set-up	TRUE	0	Uint8
O-32	Drive Port Baud Rate	null	1 set-up	TRUE	-	Uint8
O-33	Drive Port Parity	null	1 set-up	TRUE	-	Uint8
O-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-36	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
O-37	Maximum Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
O-4#						
O-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
O-5#						
O-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-54	Reversing Select	null	All set-ups	TRUE	-	Uint8
O-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
O-8#						
O-80	Bus Message Count	0	All set-ups	TRUE	0	Uint32
O-81	Bus Error Count	0	All set-ups	TRUE	0	Uint32
O-82	Slave Messages Rcvd	0	All set-ups	TRUE	0	Uint32
O-83	Slave Error Count	0	All set-ups	TRUE	0	Uint32
O-9#						
O-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
O-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
O-94	Bus Feedback 1	0	1 set-up	TRUE	0	N2
O-95	Bus Feedback 2	0	1 set-up	TRUE	0	N2
O-96	Bus Feedback 3	0	1 set-up	TRUE	0	N2

Parameter Number	Parameter Description	Default Value	Range	Conversion Index	Data Type	Array
EN-0# IP Settings						
EN-00	IP Address Assignment	0.0.0.0	0 - 255	-	Unsigned 8	-
EN-01	IP Address	0.0.0.0	0 – 255	-	Oct. string 4	-
EN-02	Subnet Mask	0.0.0.0	0 – 255	-	Oct. string 4	-
EN-03	Default Gateway	0.0.0.0	0 - 255	-	Oct. string 4	-
EN-04	DHCP Server	0.0.0.0	0 - 255	-	Oct. string 4	-
EN-05	Lease Expires	00:00:00:00	-	-	Time diff. w/date	-
EN-06	Name Servers	0.0.0.0	0 - 255	-	Oct. string 4	-
EN-07	Domain Name	-	max. 19 ch.	-	Visible string 48	-
EN-08	Host Name	-	max. 19 ch.	-	Visible string 48	-
EN-09	Physical Address	00:1B:08:00:00:00	-	-	Visible string 17	-
EN-1# Ethernet Link Parameters						
EN-10	Link Status	No Link [0]	[0 - 1]	-	Unsigned 8	[0-1]
EN-11	Link Duration	00:00:00:00	-	-	Time diff. w/date	[0-1]
EN-12	Auto Negotiation	On [1]	[0 - 1]	-	Unsigned 8	[0-1]
EN-13	Link Speed	None [0]	[0 - 2]	-	Unsigned 8	[0-1]
EN-14	Link Duplex	Full Duplex [1]	[0 - 1]	-	Unsigned 8	[0-1]
EN-2# Process Data						
EN-21	Process Data Config Write	-	-	-	Unsigned 16	[0-9]
EN-22	Process Data Config Read	-	-	-	Unsigned 16	[0-9]
EN-28	Store Data Values	Off [0]	[0 – 1]	-	Unsigned 8	-
EN-29	Store Always	Off [0]	[0 - 1]	-	Unsigned 8	-
EN-4# Modbus TCP						
EN-40	Modbus TCP Status		[0 – 1]			
EN-41	Slave Message Count	0				
EN-42	Slave Exception	0				
EN-8# Other Ethernet Services						
EN-80	FTP Server	Disable [0]	[0 – 1]	-	Unsigned 8	-
EN-81	HTTP Server	Disable [0]	[0 – 1]	-	Unsigned 8	-
EN-82	SMTP Service	Disable [0]	[0 – 1]	-	Unsigned 8	-
EN-89	Transp. Socket Channel Port	Disable [0]	[0 – 1]	-	Unsigned 8	-
EN-9# Advanced Ethernet Settings						
EN-90	Cable Diagnostics	Disable [0]	[0 - 1]	-	Unsigned 8	-
EN-91	Auto Cross-Over	Enable [0]	[0 - 1]	-	Unsigned 8	-
EN-92	IGMP Snooping	Enable [0]	[0 - 1]	-	Unsigned 8	-
EN-93	Cable Error Length	0	0 - 200	0	Unsigned 16	[0-1]
EN-94	Broadcast Storm Protection	0	Off – 20%	-	Unsigned 16	[0-1]
EN-95	Broadcast Storm Filter	Enable [1]	[0 - 1]	-	Unsigned 8	[0-1]
EN-98	Interface Counters	0	0 - 65535	-	Unsigned 16	[0-10]
EN-99	Media Counters	0	0 - 65535	-	Unsigned 16	[0-11]

6.4 Data Types

6.4.1 Data Types Supported by AF-650 GP/AF-600 FP

Conversion Index

This number to the left refers to a conversion figure on the right to be used when writing or reading parameters.

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

7 Troubleshooting

7.1 Troubleshooting

7.1.1 Step-by-step Troubleshooting

Check: LEDs

The option contains two LEDs to indicate the state of the device and the network. During normal operation the MS and at least one NS LED will show a constant green light.

State	LED		Description
No power		Off	The device is un-powered
Device operational	Green:	Solid green	The device is operational
Standby	Green:	Flashing green	The device needs commissioning
Minor fault	Red:	Flashing red	The device has detected a recoverable fault
Major fault	Red:	Solid red	The device has detected an un-recoverable fault
Self test	Red: Green:	Flashing red/green	The Modbus TCP option is in self-test mode
No IP address	Yellow	Steady yellow	No IP address configured or obtained
Wink	Yellow	Flashing yellow	Flash for 20 seconds

Table 7.1: MS: Module Status

State	LED		Description
No IP-address (no power)		Off	No link present (or is un-powered)
Connected	Green:	Solid green	There is established (at least) one CIP connection to the device
Duplicate IP	Red:	Solid red	The IP-address assigned to the device is already in use
Self test	Red: Green	Flashing red/green	The Modbus TCP option is in self-test mode
Device has been winked	Yellow	Flashing yellow	Flash for 20 seconds
Link present at 10 Mbps	Yellow	Steady yellow	Link present; but nor winked and no ACD

Table 7.2: NS1 + NS2: Network Status (one per port)

Check: Link Status

The status of the Ethernet link cannot be directly identified by means of the LEDs.

Use par. EN-10, *Link Status* to verify presents of the link.

Use par. EN-11, *Link Duration* to verify that the link is steady present.

The parameter will show the duration of the present link, and preset to 00:00:00:00 if the link is broken.

Check: Cabling

In rare cases of cabling mis-configuration, the option might show the presents of a link, but no communication is running. Exchange the cable in doubt.

Check: IP Address

Verify that the option has a valid IP address (please refer to section: IP Settings) in par. EN-01, *IP Address*. If the option has identified a duplicate IP Address NS LEDs will light steady red. If the option is set up for BOOTP or DHCP, verify that a BOOTP or DHCP server is connected in par. EN-04, *DHCP Server*. If no server is connected, the parameter will show: 000.000.000.000.

7.1.2 Alarm Word and Warning Word

Alarm word and warning word are shown in the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms will be shown. Warning word and alarm word are displayed in par. DR-90 to DR-95. For more information on the individual alarms and warnings, please refer to: AF-650 GP/ AF-600 FP Design Guide.

NB!
Please note that the availability of the individual alarms and warnings are dependent on the drive type: AF-600 FP/AF-650 GP series.

Warning and Alarm Messages

There is a clear distinction between alarms and warnings. In the event of an alarm, the frequency converter will enter a fault condition. After the cause for the alarm has been cleared, the master must acknowledge the alarm message in order to start operation of the frequency converter again. A warning, on the other hand, may appear when a warning condition arises, then disappear when conditions return to normal without interfering with the process.

Warnings

All warnings within the frequency converter are represented by a single bit within a warning word. A warning word is always an action parameter. Bit status FALSE [0] means no warning, while bit status TRUE [1] means warning. Each bit status has a corresponding text string message. In addition to the warning word message the master will also be notified via a change in the status word.

Bit (Hex)	Alarm word 2 (Par DR-91)
00000001	Service Trip, Read/Write
00000002	Reserved
00000004	Service Trip, Typecode/Sparepart
00000008	Reserved
00000010	Reserved
00000020	No Flow
00000040	Dry Pump
00000080	End of Curve
00000100	Broken Belt
00000200	Discharge high
00000400	Start failed
00000800	Speed limit
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	KTY error
00040000	Fans error
00080000	ECB error
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC thermistor
80000000	Dangerous failure

Bit (Hex)	Warning word (Par. DR-92)
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Control card over temperature
00000010	Control word timeout
00000020	Over current
00000040	Torque limit
00000080	Motor thermistor over temp.
00000100	Motor Electronic Thermal Overload over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	DC link voltage low
00002000	DC link voltage high
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	10V low
00040000	Brake resistor power limit
00080000	Brake resistor short circuit
00100000	Brake chopper fault
00200000	Speed limit
00400000	Network comm. fault
00800000	24V supply fault
01000000	Mains failure
02000000	Current limit
04000000	Low temperature
08000000	Voltage limit
10000000	Encoder loss
20000000	Output frequency limit
40000000	Safe stop 1. Only available in AF-650 GP
80000000	Extended status word

1. Only available in AF-650 GP

Bit (Hex)	Warning word 2 (Par. DR-93)
00000001	Start Delayed
00000002	Stop Delayed
00000004	Clock Failure
00000008	Firemode was active
00000010	Reserved
00000020	No Flow
00000040	Dry Pump
00000080	End of Curve
00000100	Broken Belt
00000200	Discharge high
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	KTY warning
00040000	Fans warning
00080000	ECB warning
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC thermistor
80000000	Reserved

Bit (Hex)	Extended status word (Par. DR-94)
00000001	Ramping
00000002	Auto Tune Running
00000004	Start CW/CCW
00000008	Slow Down
00000010	Catch Up
00000020	Feedback high
00000040	Feedback low
00000080	Output current high
00000100	Output current low
00000200	Output frequency high
00000400	Output frequency low
00000800	Brake check OK
00001000	Braking max
00002000	Braking
00004000	Out of speed range
00008000	OVC active
00010000	AC brake
00020000	Password Timelock
00040000	Password Protection
00080000	Reference high
00100000	Reference low
00200000	Local Ref./Remote Ref.
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

Bit (Hex)	Extended status word 2 (Par. DR-95) AF-600 FP only !!
00000001	Off
00000002	Hand/Auto
00000004	PROFIbus OFF1 active
00000008	PROFIbus OFF2 active
00000010	PROFIbus OFF3 active
00000020	Relay 123 active
00000040	Start Prevented
00000080	Control ready
00000100	Drive ready
00000200	Quick Stop
00000400	DC Brake
00000800	Stop
00001000	Stand By
00002000	Freeze Output Request
00004000	Freeze Output
00008000	Jog Request
00010000	Jog
00020000	Start Request
00040000	Start
00080000	Start Applied
00100000	Start Delay
00200000	Sleep
00400000	Sleep Boost
00800000	Running
01000000	Bypass
02000000	Fire Mode
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

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The instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE company.

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