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1 Introduction

1

1.1.1 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 Control the Frequency Converter
- Parameters
- Troubleshooting

1.1.2 Technical Overview

BACnet (Building Automation and Control Network) is an open data communications protocol, American National Standard (ANSI/ASHRAE 135-1995). BACnet provides a means by which computer-based control equipment from different manufacturers can work together. BACnet is designed to handle many types of building controls, including HVAC, lighting, security, fire, access control, maintenance and waste management. BACnet permits flexibility for expansion and different equipment combinations.

Conformance Classes, Function Groups and the PICS: Evaluating the capabilities of a BACnet device is potentially a formidable task, given the great choice of Objects, Properties and Services, which can be implemented, as well as the fact that it is not necessary for every BACnet device to have a full BACnet implementation in order to carry out its task. ASHRAE's BACnet Committee recognized this problem and responded with aids to evaluation in the form of "Conformance Classes," "Function Groups" and the "Protocol Implementation Conformance Statement" (PICS).

The BACnet protocol defines six levels of Conformance Classes, each of which specifies the minimum subset of Services implemented on the device. The lowest level, Conformance Class 1, requires only that the BACnet device contain a Device Object and that it be able to execute (respond to) a ReadProperty Service request. Each successive Conformance Class level adds Service Requests that must be executable by the device, as well as the Service Requests it must be able to initiate. Conformance Class 6 requires 21 types of Service Requests (of the 32 overall) to be implemented, of which 20 must be initi able and 17 executable. Conformance Class thus provides a measure of the device's ability to communicate.

Function Groups specify a combination of Objects and Services necessary to carry out certain building automation functions. They are specified independently of Conformance Class, though the implementation of some of the Function Groups automatically confers some Conformance Class higher than 1.

Background information

Protocol name:	BACnet
Technology developer:	ASHRAE
Year introduced:	1995
Governing standards:	ANSI/ASHRAE Standard 135-2004 version 4, ISO 16484-5
Openness:	Open specification

Physical characteristics

Network topology:	Bus
Physical media:	Shielded twisted pair
Max. Distance at low speed:	1200 meters

Transport mechanism

Communication methods:	Master/slave
Baud Rates Supported:	9600, 19200, 38400, 76800
Termination:	120 ohm

1.1.3 Assumptions

This manual assumes you are using a BACnet Option Card in conjunction with a series FC102 series frequency converter. It is also assumed that your system is equipped with a serial communication card supporting the BACnet communication services required by your application and that all requirements stipulated in the BACnet standard, as well as those pertaining to the VLT Variable Speed Drive are strictly observed as well as all limitations therein fully respected.

1.1.4 Background Knowledge

The Danfoss BACnet Option Card is designed to communicate with any system complying with the BACnet MS/TP standard. Familiarity with the PC, BMS or PLC used as a master in the system is assumed. Issues regarding hardware or software produced by other manufacturers are beyond the scope of this manual and are not the responsibility of Danfoss Drives.

If you have questions regarding set-up of master-to-master communication or communication to a non-Danfoss slave, please consult the appropriate manuals.

1.1.5 Available Literature for VLT HVAC Drive

- Operating Instructions MG.11.Ax.yy provide the necessary information for getting the frequency converter up and running.
- Operating Instructions VLT HVAC Drive High Power, MG.11.Fx.yy
- Design Guide MG.11.Bx.yy entails all technical information about the frequency converter and customer design and applications.
- Programming Guide MG.11.Cx.yy provides information on how to programme and includes complete parameter descriptions.
- Mounting Instruction, Analog I/O Option MCB109, MI.38.Bx.yy
- Application Note, Temperature Derating Guide, MN.11.Ax.yy
- PC-based Configuration Tool MCT 10, MG.10.Ax.yy enables the user to configure the frequency converter from a Windows™ based PC environment.
- Danfoss VLT® Energy Box software at www.danfoss.com/BusinessAreas/DrivesSolutions then choose PC Software Download
- VLT HVAC Drive Drive Applications, MG.11.Tx.yy
- Operating Instructions VLT HVAC Drive Profibus, MG.33.Cx.yy
- Operating Instructions VLT HVAC Drive Device Net, MG.33.Dx.yy
- Operating Instructions VLT HVAC Drive BACnet, MG.11.Dx.yy
- Operating Instructions VLT HVAC Drive LonWorks, MG.11.Ex.yy
- Operating Instructions VLT HVAC Drive Metasys, MG.11.Gx.yy
- Operating Instructions VLT HVAC Drive FLN, MG.11.Zx.yy
- Output Filter Design Guide, MG.90.Nx.yy
- Brake Resistor Design Guide, MG.90.Ox.yy

x = Revision number

yy = Language code

Danfoss technical literature is available in print from your local Danfoss Sales Office or online at:
www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm

1.1.6 Software Compatibility

This manual is written for firmware version 2.0x. If the installed BACnet option has a firmware lower than 2.00 this manual does not apply. The BACnet Firmware version 2.0x does require that the firmware of the FC 102 if equal to or higher than version 3.22

1.1.7 Abbreviations

ACI	Acyclical Control Interval
AOC	Application Orientated Controller
AV	Analog Variable
BMS	Building Management System
BV	Binary Variable
CAN	Controller Area Network
CTW	Control Word
EEPROM	Electrical Erasable Programmable Read Only Memory
EIA	Electronic Industries Association: Specifies of the EIA Standard RS 485-A
EMC	Electromagnetic Compatibility
IND	Sub index
I/O	Input/Output
ISO	International Standards Organization
LCD	Liquid Crystal Display
LCP	Local Control Panel
LED	Light Emitting Diode
MAV	Main Actual Value
MRV	Main Reference Value
PC	Personal Computer
PCD	Process Data
PDU	Protocol Data Unit
PELV	Protected Extra Low Voltage
PLC	Programmable Logic Control
PNU	Parameter Number
PVA	Parameter Value
RC	Request/Response Characteristics
STW	Status Word

2 Safety

2.1.1 Copyright, Limitation of Liability and Revision Rights

This publication contains information proprietary to Danfoss. By accepting and using this manual the user agrees that the information contained herein will be used solely for operating equipment from Danfoss or equipment from other vendors provided that such equipment is intended for communication with Danfoss equipment over a serial communication link. This publication is protected under the Copyright laws of Denmark and most other countries.

Danfoss does not warrant that a software program produced according to the guidelines provided in this manual will function properly in every physical, hardware or software environment.

Although Danfoss has tested and reviewed the documentation within this manual, Danfoss makes no warranty or representation, neither expressed nor implied, with respect to this documentation, including its quality, performance, or fitness for a particular purpose.

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

Safety Regulations

1. The mains supply to the frequency converter must be disconnected whenever repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains supply plugs.
2. The [OFF] button on the control panel of the frequency converter does not disconnect the mains supply and consequently it must not be used as a safety switch.
3. The equipment must be properly earthed, the user must be protected against supply voltage and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage current exceeds 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set par. 1-90 *Motor Thermal Protection* to data value ETR trip 1 [4] or data value ETR warning 1 [3].
6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains plugs.
7. Please note that the frequency converter has more voltage sources than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) or external 24 V DC are installed. Check that all voltage sources have been disconnected and that the necessary time has elapsed before commencing repair work.

Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations (e.g. risk of personal injury caused by contact with moving machine parts following an unintentional start) make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient. In such cases the mains supply must be disconnected or the *Safe Stop* function must be activated.
2. The motor may start while setting the parameters. If this means that personal safety may be compromised (e.g. personal injury caused by contact with moving machine parts), motor starting must be prevented, for instance by use of the *Safe Stop* function or secure disconnection of the motor connection.
3. A motor that has been stopped with the mains supply connected, may start if faults occur in the electronics of the frequency converter, through temporary overload or if a fault in the power supply grid or motor connection is remedied. If unintended start must be prevented for personal safety reasons (e.g. risk of injury caused by contact with moving machine parts), the normal stop functions of the frequency converter are not sufficient. In such cases the mains supply must be disconnected or the *Safe Stop* function must be activated.

**NB!**

When using the *Safe Stop* function, always follow the instructions in the *Safe Stop* section of the VLT AutomationDrive Design Guide.

4. Control signals from, or internally within, the frequency converter may in rare cases be activated in error, be delayed or fail to occur entirely. When used in situations where safety is critical, e.g. when controlling the electromagnetic brake function of a hoist application, these control signals must not be relied on exclusively.



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

Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back up.

Systems where frequency converters are installed must, if necessary, be equipped with additional monitoring and protective devices according to the valid safety regulations, e.g. law on mechanical tools, regulations for the prevention of accidents etc. Modifications on the frequency converters by means of the operating software are allowed.

Hoisting applications:

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

Protection Mode

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

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

The "Protection mode" can be disabled by setting par. 14-26 *Trip Delay at Inverter Fault* to zero which means that the drive will trip immediately if one of the hardware limits is exceeded.

**NB!**

It is recommended to disable protection mode in hoisting applications (par. 14-26 *Trip Delay at Inverter Fault* = 0)

3 How to Install

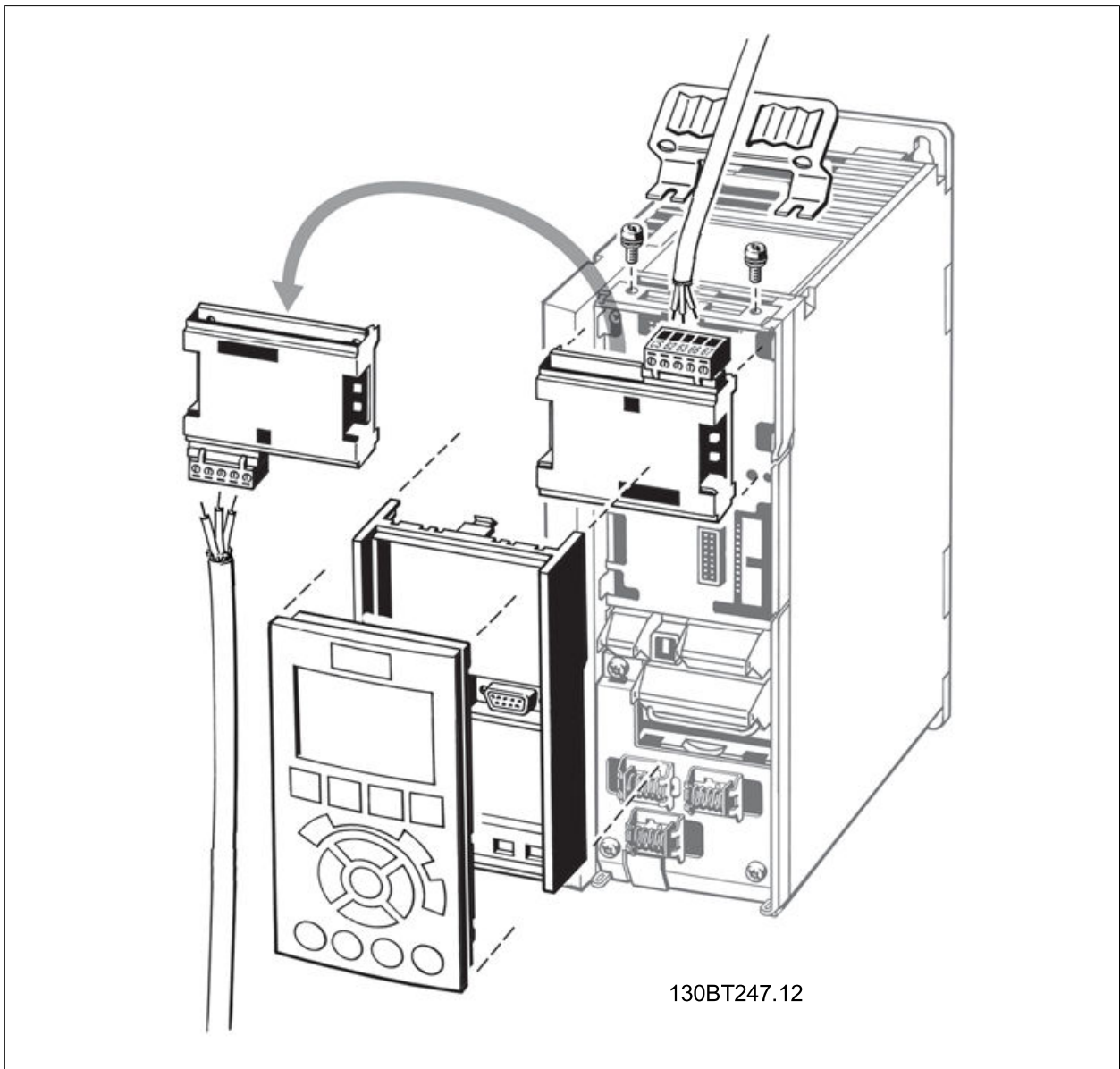
3.1 The BACnet Option

3.1.1 Installation of the Option

Items required to install a fieldbus option in the frequency converter:

- The fieldbus option
- Fieldbus option adaptor frame for the frequency converter. This frame is deeper than the standard frame, to allow space for the fieldbus option beneath.
- Cable holders

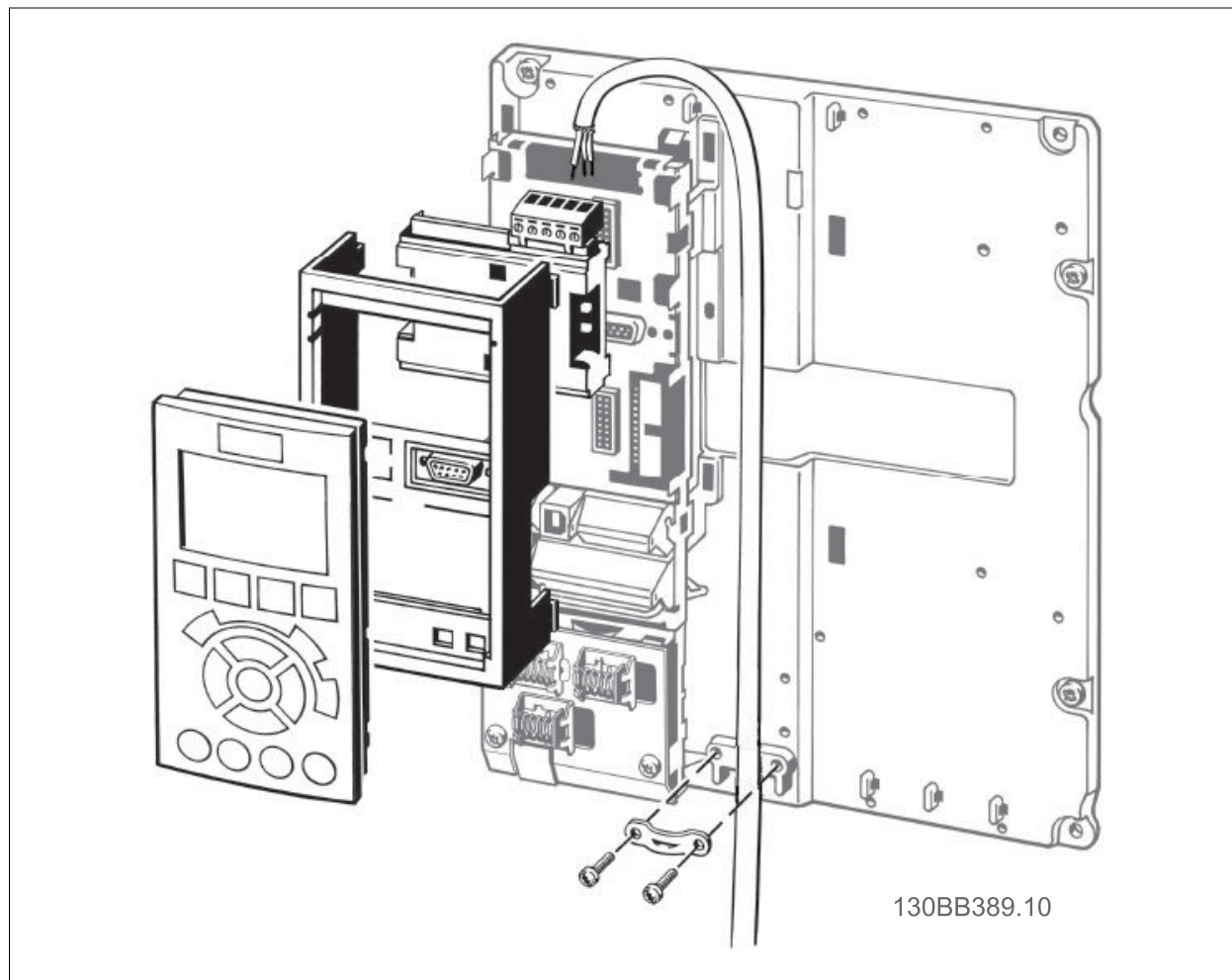
3



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Instructions:

- Remove the LCP panel from the frequency converter.
- Remove the frame located beneath and discard.
- Push the option into place. Two positions are possible, with cable terminal facing either up or down. The cable up position is often most suitable when several frequency converters are installed side by side in a rack, as this position permits shorter cable lengths.
- Push the fieldbus option adaptor frame for the frequency converter into place.
- Replace the LCP panel.
- Attach cable.
- Fasten the cable in place using cable holders. The frequency converter top surface has pre-drilled threaded holes for attaching the cable holders to the unit.



3.1.2 Cabling

Cable lengths and number of nodes

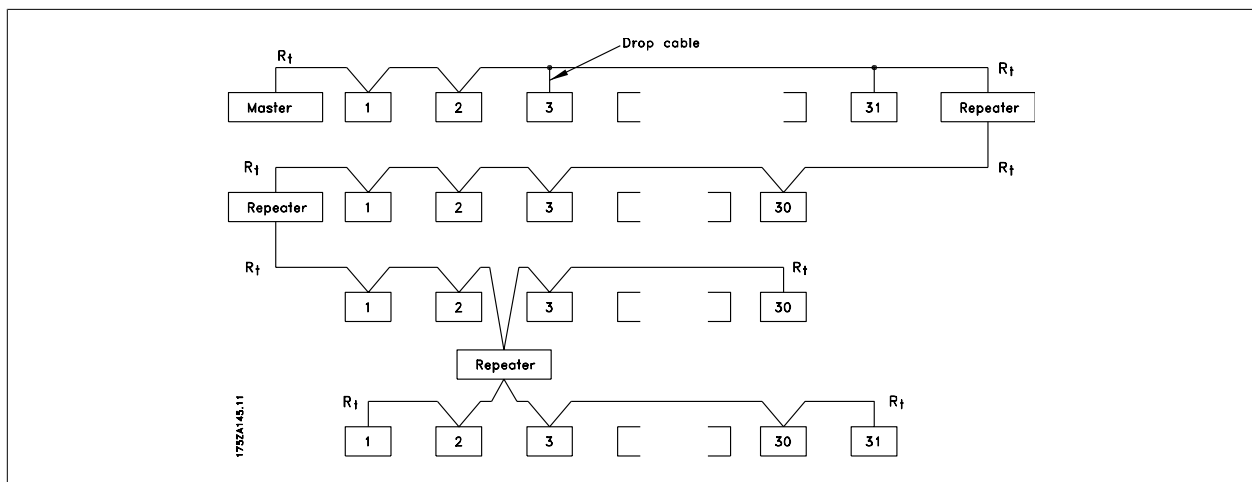
The maximum cable length allowable in one segment is dependent on the transmission speed. The total cable length includes drop cables if any. A drop cable is the connection from the main bus cable to each node.

Drop cable connection (i.e. T-connection) is not recommended, due to the increased risk of reflection occurring. Instead, Danfoss recommends direct connection of the frequency converter.

Note that a repeater is a node in both of the two segments it connects. The number of frequency converters is based on a single master system. If there are two or more devices (e.g. PC tools, Routers), the number of frequency converters must be reduced correspondingly.

- Maximum length of an MS/TP segment: 1200 meters (4000 feet)
- Impedance: 100 to 130 Ohm
- Resistance: <110 Ohm/km
- Capacitance: <100 pF/m
Distributed capacitance between conductors and shield shall be less than 200 pF per meter
- Cross section: 0.82 mm² conductor area, corresponding to AWG 18
- Cable type: twisted in pairs, 1 x 2, or 2 x 2 wires
- Shielding: Copper-braided screen or braided screen and foil screen

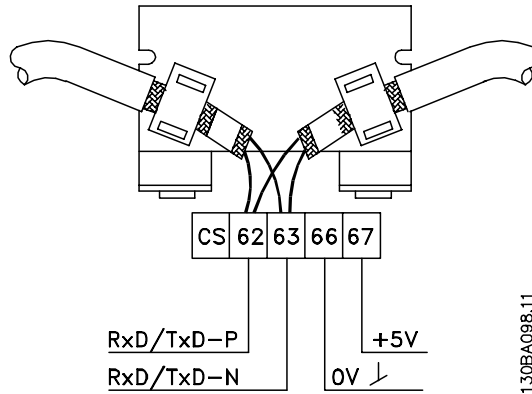
Use of the same cable type throughout the entire segment is recommended to avoid impedance mismatch.



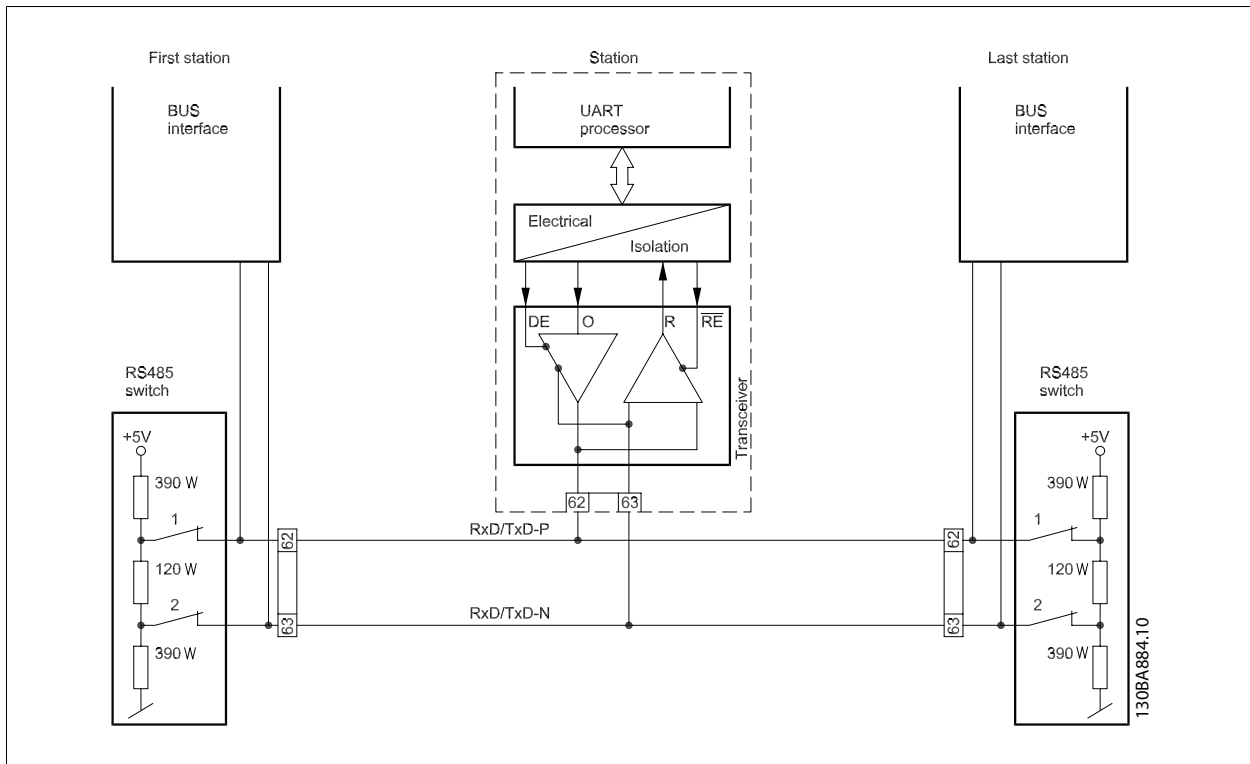
3.1.3 Network Termination

Connecting the bus line

Connect the BACnet Option Card to the bus line via terminals 62, 63 and 66. Terminal 62 is Marked Red and Terminal 63 is marked Green. These two are the RS485 lines. Terminal 66 the signal Ground for the RS485 Transmitter.



130BA098.11



130BA884.10

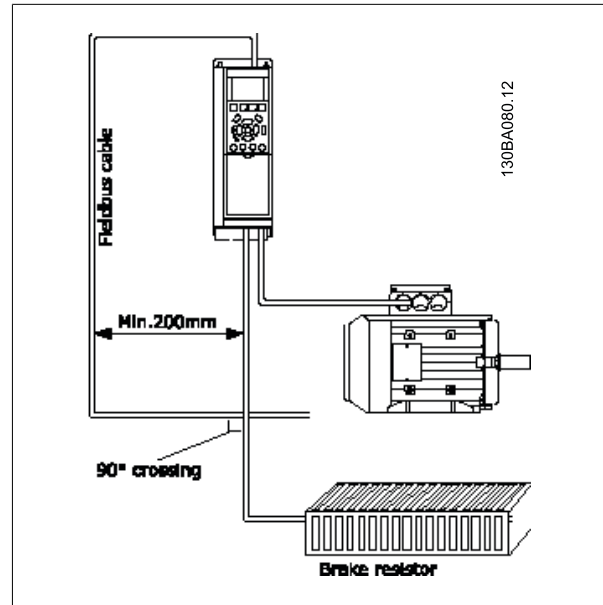
Maximum cable lengths

Maximum total bus cable length: 4000Feet ~ 1200Meter

3.1.4 Cable Routing

The BACnet 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 is sufficient, but maintaining the greatest possible distance between cables is generally recommended, especially where cables run in parallel over long distances.

When crossing is unavoidable, the BACnet cable must cross motor and brake resistor cables at an angle of 90 degrees.




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3.2 Bus Cabling

3.2.1 EMC Precautions

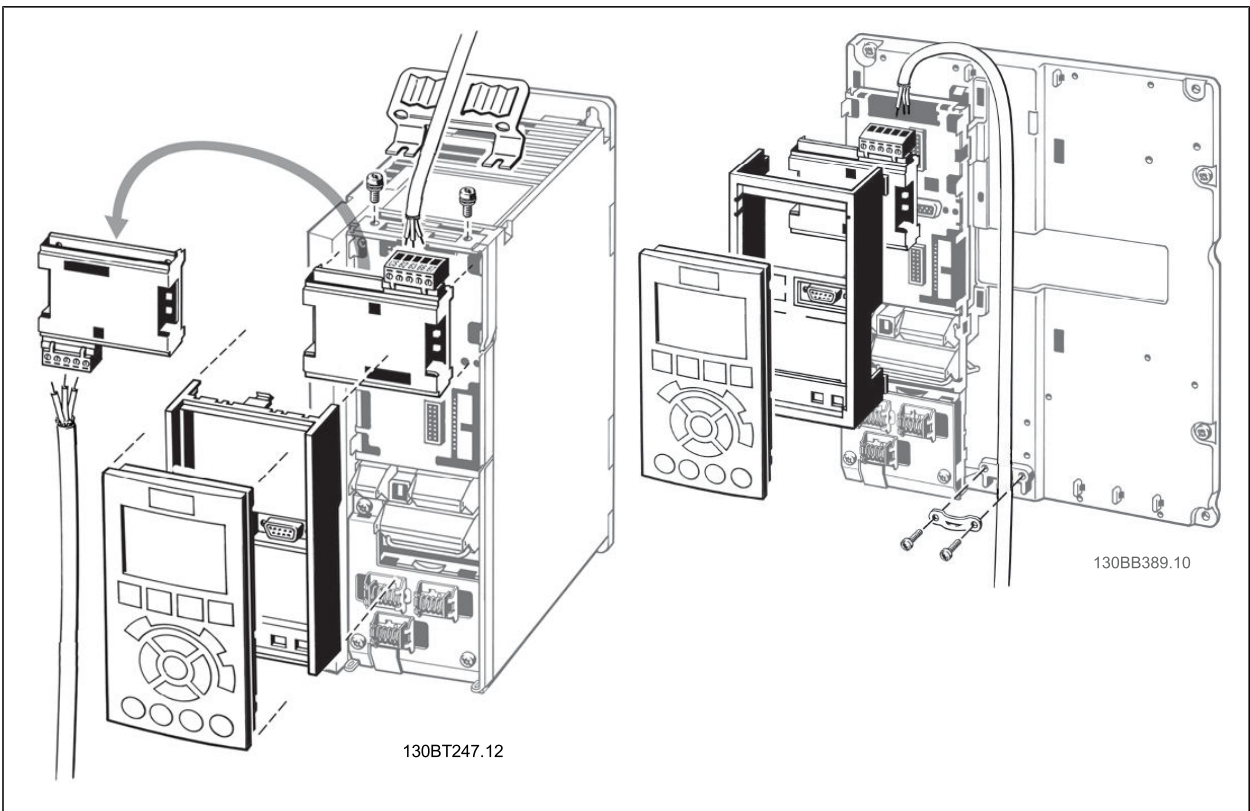
The following EMC precautions are recommended to achieve interference-free operation of the BACnet network. Additional EMC information is available in the *VLT HVAC Drive Design Guide, MG.11.Bx.yy*. Please also consult the BACnet master manual for further installation guidelines.



NB!
Ensure compliance with relevant national and local regulations, for example in protective earth connection.

3.2.2 Single Ground Shielding

For installing the bus cable on MS/TP, two different strategies can be followed, Single ground of shield and multiple ground of shield. Each strategy has both advantages and disadvantages. The following chapter explains the different between the two strategies. 3.2.1 The single ground shield is specified in the ANSI/ASRAHE 135-1995 standard. The solution benefits by having only one ground connection of the shield, by doing so the possibility for ground loop of equalizing current is heavily reduced. In these systems the shield of the MS/TP cables has to be isolated from ground at all station, except one. At each station the shield from the two cables has to be connected with each other, and isolated from ground. The best solution for this has been proven to be the use of shrink tubes. The single ground shielding is a good approach where the system uses long bus cables. If two buildings have to be connected over the same MS/TP bus cable, the use of fibre optic has to be considered. This will prevent that a lightning stroke will be carried from one building to another, and problem with difference in earth potential can be neglected.

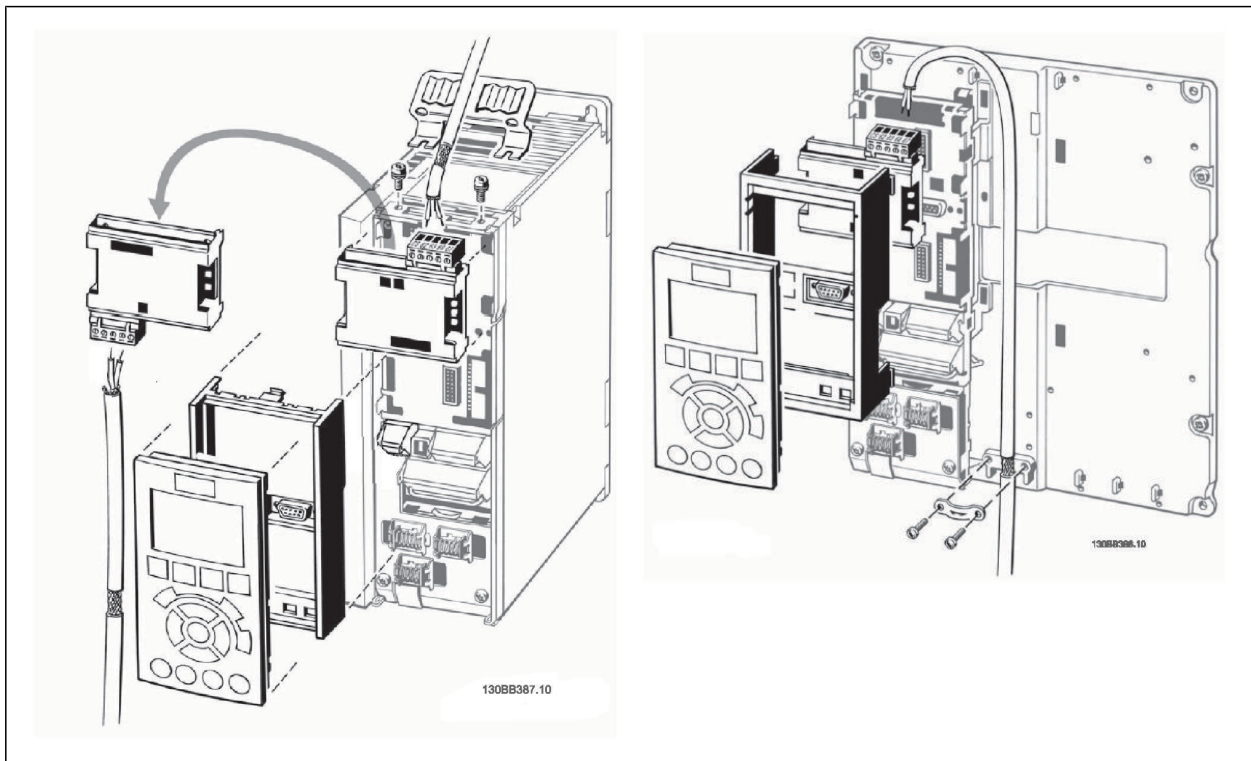


3.2.3 Multiple Ground Shielding

If the distance between the individual drives is limited (e.g. inside a cabinet or in one control room) Danfoss recommends connecting the screen to ground at both ends of the bus cable. This ensures the maximum protection from EMC noise. Connecting the screen at each end will require that each BACnet device has the same earth potential or an equalizing current will flow in the screen of the cable and cause disturbance and poor performance of the system. Low impedance to ground connection of the screen can be achieved by connecting the surface of the screen to ground, by means of a cable clamp or a conductive cable gland. The FC 100 Series supplies various clamps and brackets to enable a proper ground connection of the BACnet cable screen.

Danfoss recommends to connect the screen to ground at both ends of the bus cable. This ensures the maximum protection from EMC noise. Connecting the screen at each end will require that each BACnet device has the same earth potential or else an equalizing current will flow in the screen of the cable and cause disturbance and poor performance of the system. Where this is not possible, the screen can be isolated from the chassis of the drive by use of shrink-tubing. It must be pointed out that the routing of the BACnet cable must be established with a maximum distance to other cables such as mains, motor cable, etc..

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4 How to Configure the System

4.1 Configuring BACnet

4.1.1 Initialisation Procedure

General settings

Name	Par. Number	Default Value	Setting for BACnet
Control Site	8-01	Digital and control word	Digital and control word
Control word source	8-02	FC RS485	Option A
ControlWord Timeout time	8-03	60 sec	60 sec
ControlWord Timeout Function	8-04	Off	Off
End of Timeout Function	8-05	Resume setup	Resume setup
Reset ControlWord Timeout	8-06	Do not reset	Do not reset
Diagnosis	8-07	Disable	n.a.
ControlWord Profile	8-10	FC Profile	FC Profile

FC Port settings

Name	Par. Number	Default Value	Setting for BACnet
Protocol	8-30	FC	FC Option or FC
Address	8-31	1	1
Baud Rate	8-32	9600 baud	9600/19.200/38.400/76.800 baud
Minimum Response Delay	8-35	10 ms	10 ms
Max Response Delay	8-36	5000 ms	5000 ms

Table 4.1: 1) Please see also section: Parameter Overview >Parameter List.

Digital/Bus settings

Name	Par. Number	Default Value	Setting for BACnet
Coasting Select	8-50	Logic-or	Logic-or
Quick Stop Select	8-51	Logic-or	Logic-or
DC Brake Select	8-52	Logic-or	Logic-or
Start Select	8-53	Logic-or	Logic-or
Reversing Select	8-54	Logic-or	Logic-or
Set-up Select	8-55	Logic-or	Logic-or
Preset reference Select	8-56	Logic-or	Logic-or

BACnet settings

Name	Par. Number	Default Value	Setting for BACnet
BACnet device Instance	8-71	1	1
MS/TP Max Masters	8-73	127	Depent on the Number of Masters in the system
"I am" Service	8-74	At power up	At power up
Initialisation Password	8-75	"admin"	"admin"

4.1.2 Control Word Time-out Function

Par. 8-03 *Control Timeout Time* and Par. 8-04 *Control Timeout Function* are not enabled in this version of the BACnet option.

4.2 Example of a Simple Setup of BACnet

This example shows the necessary steps to set up the FC 102 BACnet interface with the following system requirements:

- MS/TP running at 38,400 Baud
- MAC address 20 for the FC 102 on the MS/TP network
- FC 102 has BACnet Device Instance number 1025
- Highest number of a Master stack is 35
- Start/stop of FC from BACnet only
- Reference from BACnet
- Read status of FC (Actual speed)

Set the following parameters:

Name	Par. number	Value
Protocol	8-30	FC option [9]
Address	8-31	20
FC Port Baud Rate	8-32	38,400 Baud [4]
Coasting Select	8-50	Bus [1]
BACnet device Instance	8-70	1025
MS/TP Max Masters	8-72	35

After the parameters have been set according the table above, the drive has to be unpowered and repowered before the changes take effect. When the frequency converter is detected by the BMS, the drive can be controlled by BV:1, which will start the motor if set to [1]. Setting AV:0 will set the speed reference of the drive. The actual speed can be monitored via AV:1. See also *Analog Input- and Output Objects* section.

5 How to Control the Frequency Converter

5.1.1 Reference Handling

Select the frequency converter configuration mode in par. 1-00 *Configuration Mode*.

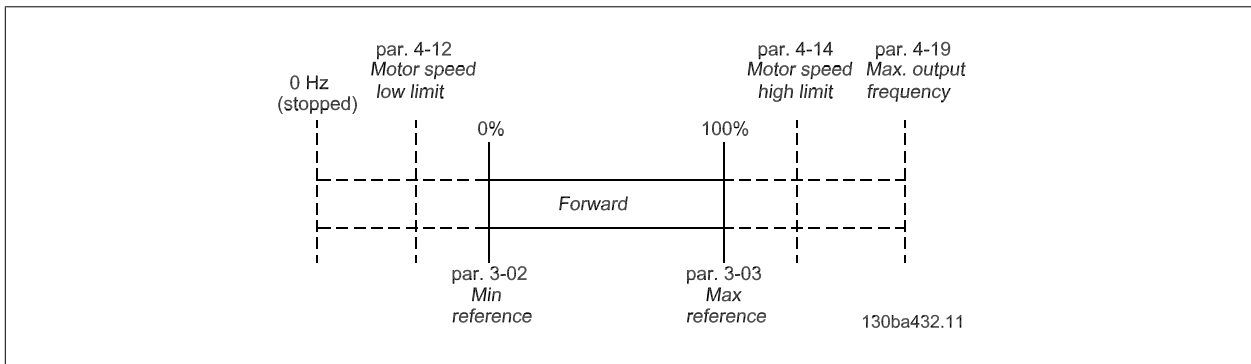
[0] Open Loop

[3] Closed Loop

Open loop

For open loop operation, the reference represents the desired output speed of the frequency converter.

The speed reference value:



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Closed loop

For closed loop operation, the reference represents the setpoint.



NB!

In closed loop operation, par. 3-02 *Minimum Reference* and par. 4-12 *Motor Speed Low Limit [Hz]* must be set to 0 Hz. Set the par. 4-14 *Motor Speed High Limit [Hz]* to a value greater than the setting in par. 3-03 *Maximum Reference*.

5.2 Network Frequency Converter Control Inputs and -Outputs

5.2.1 Analog Input- and Output Objects

Control the frequency converter from the BACnet network using 'objects'. The various types of 'objects' and their descriptions are shown in the following tables. In the following tables all available objects are shown. The availability of objects depends on the mounting of the B and/or C options.

Object ID	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC Par.	Alarm notification	Triggers Bus timeout	Remarks
AI:0	Analog Input 53	R	Yes	No	16-62	Yes	NO	Support COV
AI:1	Analog Input 54	R	Yes	No	16-64	Yes	NO	Support COV
AI:2	Analog In X30/11	R	Yes	No	16-75	Yes	NO	
AI:3	Analog In X30/12	R	Yes	No	16-76	Yes	NO	
AI:4	Analog Input X42/1	R	Yes	No	18-30	Yes	NO	
AI:5	Analog Input X42/3	R	Yes	No	18-31	Yes	NO	
AI:6	Analog Input X42/5	R	Yes	No	18-32	Yes	NO	

Table 5.1: Analog inputs

Object ID	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	Linked to FC 100Parameter	Alarm notification	Triggers Bus Timeout	Remarks
AO:0	Terminal 42 Output Bus Control	W/R	Yes	No	6-53	No	Yes	Commandable
AO:1	Pulse out #27 Bus Control	W/R	Yes	No	5-93	No	Yes	Commandable
AO:2	Pulse out #29 Bus Control	W/R	Yes	No	5-95	No	Yes	Commandable
AO:3	Analogue Out X30/8 [mA]	W/R	Yes	No	6-63	No	Yes	Commandable
AO:4	Analogue Output X42/7[V]	W/R	Yes	No	26-43	No	Yes	Commandable
AO:5	Analogue Output X42/9[V]	W/R	Yes	No	26-53	No	Yes	Commandable
AO:6	Analogue Output X42/11[V]	W/R	Yes	No	26-63	No	Yes	Commandable

Table 5.2: Analog outputs

Object ID	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC 100Parameter	Alarm notification	Triggers Bus Timeout	Remarks
AV:0	Reference	W/R	Yes	No	MRV	No	Yes	
AV:1	Speed Act. Value	W/R	Yes	No	MAV	Yes	Yes	Support COV
AV:2	Bus Feedback1	W/R	Yes	No	8-94	No	Yes	
AV:3	Bus Feedback2	W/R	Yes	No	8-95	No	Yes	
AV:4	Bus Feedback3	W/R	Yes	No	8-96	No	Yes	
AV:5	Motor Voltage	Read	Yes	No	16-12	Yes	No	
AV:6	Motor Current	Read	Yes	No	16-14	Yes	No	Support COV
AV:7	Motor Torque %	Read	Yes	No	16-22	Yes	No	Support COV
AV:8	DC Link Voltage	Read	Yes	No	16-30	Yes	No	
AV:9	Motor Thermal	Read	Yes	No	16-18	Yes	No	Support COV
AV:10	Heat Sink Temperature	Read	Yes	No	16-34	Yes	No	
AV:11	Inverter Thermal	Read	Yes	No	16-35	Yes	No	
AV:12	Operating Hours	Read	No	No	15-00	No	No	
AV:13	Running Hours	Read	No	No	15-01	No	No	
AV:14	KWh Counter	Read	No	No	15-02	No	No	
AV:15	Power [KW]	Read	No	No	16-10	No	No	Support COV
AV:16	PID Start Speed [Hz]	W/R	No	FC 100	20-83	No	No	Hz
AV:17	PID Proportional Gain	W/R	No	FC 100	20-93	No	No	
AV:18	PID Integral Time (Sec)	W/R	No	FC 100	20-94	No	No	Sec
AV:19	PID Differential Time (Sec)	W/R	No	FC 100	20-95	No	No	Sec
AV:20	PID Dif. Gain Limit	W/R	No	FC 100	20-96	No	No	
AV:21	On Reference Bandwidth	W/R	No	FC 100	20-84	No	No	
AV:22	Ext. 1 Setpoint	W/R	No	FC 100	21-15	No	No	
AV:23	Ext. 1 Reference [Unit]	W/R	No	FC 100	21-17	No	No	
AV:24	Ext. 1 Feedback [Unit]	W/R	No	FC 100	21-18	No	No	
AV:25	Ext. 1 Proportional Gain	W/R	No	FC 100	21-21	No	No	
AV:26	Reserved	W/R	No	Na				
AV:27	Ext. 1 Integral Time (Sec)	W/R	No	FC 100	21-22	No	No	Sec
AV:28	Ext. 1 Differential Time (Sec)	W/R	No	FC 100	21-23	No	No	Sec
AV:29	Ext. 1 Dif. Gain Limit	W/R	No	FC 100	21-24	No	No	
AV:30	Reserved	W/R	No	Na				

Table 5.3: Analog values

Object ID	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC 100 Parameter	Alarm notification	Triggers Bus Timeout	Remarks
AV:31	Ext. 2 Setpoint	W/R	No	FC 100	21-35	No	No	
AV:32	Ext. 2 Reference [Unit]	W/R	No	FC 100	21-37	No	No	
AV:33	Ext. 2 Feedback [Unit]	W/R	No	FC 100	21-38	No	No	
AV:34	Ext. 2 Proportional Gain	W/R	No	FC 100	21-41	No	No	
AV:35	Ext. 2 Integral Time (Sec)	W/R	No	FC 100	21-42	No	No	Sec
AV:36	Ext. 2 Differential Time	W/R	No	FC 100	21-43	No	No	
AV:37	Ext. 2 Dif. Gain	W/R	No	FC 100	21-44	No	No	
AV:38	Ext. 3 Setpoint	W/R	No	FC 100	21-55	No	No	
AV:39	Ext. 3 Reference [Unit]	W/R	No	FC 100	21-57	No	No	
AV:40	Ext. 3 Feedback [Unit]	W/R	No	FC 100	21-58	No	No	
AV:41	Ext. 3 Proportional Gain	W/R	No	FC 100	21-61	No	No	
AV:42	Ext. 3 Integral Time (Sec)	W/R	No	FC 100	21-62	No	No	Sec
AV:43	Ext. 3 Differential Time (Sec)	W/R	No	FC 100	21-63	No	No	Sec
AV:44	Ext. 3 Dif. Gain Limit	W/R	No	FC 100	21-64	No	No	
AV:45	Running Bypass	R	No	No	31-11	No	No	Hours
AV:46	Setpoint 1	W	No	No	20-21	No	No	From version 2.00
AV:47	Setpoint 2	W	No	No	20-22	No	No	From version 2.00
AV:48	Setpoint 3	W	No	No	20-23	No	No	From version 2.00
AV:49	reserved							
AV:50	Frequency	R	No	No	16-13	No	No	From version 2.00
AV:51	Feedback (Unit)	R	No	No	16-52	No	No	From version 2.00

Table 5.4: Analog values cont.

5.2.2 Binary Input- and Output Objects

Object Id	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BI:0	Digital Input 33	Read	No	No	16-60/00	No	No	
BI:1	Digital Input 32	Read	No	No	16-60/01	No	No	
BI:2	Digital Input 29	Read	No	No	16-60/02	No	No	
BI:3	Digital Input 27	Read	No	No	16-60/03	No	No	
BI:4	Digital Input 19	Read	No	No	16-60/04	No	No	
BI:5	Digital Input 18	Read	No	No	16-60/05	No	No	
BI:6	Digital Input 37	Read	No	No	16-60/06	No	No	
BI:7	Digital Input X30/2	Read	No	No	16-60/07	No	No	
BI:8	Digital Input X30/3	Read	No	No	16-60/08	No	No	
BI:9	Digital Input X30/4	Read	No	No	16-60/09	No	No	
BI:10	Digital Input 16-60/10	Read	No	No	16-60/10	No	No	Reserved for future options
BI:11	Digital Input 16-60/11	Read	No	No	16-60/11	No	No	Reserved for future options
BI:12	Digital Input 16-60/12	Read	No	No	16-60/12	No	No	Reserved for future options
BI:13	Digital Input 16-60/13	Read	No	No	16-60/13	No	No	Reserved for future options
BI:14	Digital Input 16-60/14	Read	No	No	16-60/14	No	No	Reserved for future options
BI:15	Digital Input 16-60/15	Read	No	No	16-60/15	No	No	Reserved for future options

Table 5.5: Binary inputs

BI:7 - BI:19 values are only available if the option is installed.

*) Reserved for future options

Object Id	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BO:0	Digital Output 27	W/R	No	No	5-90/00	No	Yes	Commandable
BO:1	Digital Output 29	W/R	No	No	5-90/01	No	Yes	Commandable
BO:2	GPIO Output Term X30/6	W/R	No	No	5-90/02	No	Yes	Commandable
BO:3	GPIO Output Term X30/7	W/R	No	No	5-90/03	No	Yes	Commandable
BO:4	Relay 1 Output	W/R	No	No	5-90/04	No	Yes	Commandable
BO:5	Relay 2 Output	W/R	No	No	5-90/05	No	Yes	Commandable
BO:6	Option B Relay 1 Output	W/R	No	No	5-90/06	No	Yes	Commandable
BO:7	Option B Relay 2 Output	W/R	No	No	5-90/07	No	Yes	Commandable
BO:8	Option B Relay 3 Output	W/R	No	No	5-90/08	No	Yes	Commandable
BO:9	Reserved Output 5-90/09	W/R	No	No	5-90/09	No	Yes	Commandable
BO:10	Reserved Output 5-90/10	W/R	No	No	5-90/10	No	Yes	Commandable (reserved)
BO:11	Reserved Output 5-90/11	W/R	No	No	5-90/11	No	Yes	Commandable (reserved)
BO:12	Reserved Output 5-90/12	W/R	No	No	5-90/12	No	Yes	Commandable (reserved)
BO:13	Reserved output 5-90/13	W/R	No	No	5-90/13	No	Yes	Commandable (reserved)
BO:14	Reserved Output 5-90/14	W/R	No	No	5-90/14	No	Yes	Commandable (reserved)
BO:15	Reserved Output 5-90/15	W/R	No	No	5-90/15	No	Yes	Commandable (reserved)
BO:16	Option C Relay 1 Output	W/R	No	No	5-90/16	No	Yes	Commandable
BO:17	Option C Relay 2 Output	W/R	No	No	5-90/17	No	Yes	Commandable
BO:18	Option C Relay 3 Output	W/R	No	No	5-90/18	No	Yes	Commandable
BO:19	Option C Relay 4 Output	W/R	No	No	5-90/19	No	Yes	Commandable
BO:20	Option C Relay 5 Output	W/R	No	No	5-90/20	No	Yes	Commandable
BO:21	Option C Relay 6 Output	W/R	No	No	5-90/21	No	Yes	Commandable
BO:22	Option C Relay 7 Output	W/R	No	No	5-90/22	No	Yes	Commandable
BO:23	Option C Relay 8 Output	W/R	No	No	5-90/23	No	Yes	Commandable
BO:24	Reserved Output 5-90/24	W/R	No	No	5-90/24	No	Yes	Commandable (reserved)
BO:25	Reserved Output 5-90/25	W/R	No	No	5-90/25	No	Yes	Commandable (reserved)

Table 5.6: Binary outputs

*) Reserved for future options

Object Id	Object Name	Read/Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BO:30	Reserved Output 5-90/30	W/R	No	No	5-90/30	No	Yes	Commandable (reserved)
BO:31	Reserved Output 5-90/31	W/R	No	No	5-90/31	No	Yes	Commandable (reserved)
BO:36	Reserved Output 5-90/26	W/R	No	No	5-90/26	No	Yes	Commandable (reserved)
BO:37	Reserved Output 5-90/27	W/R	No	No	5-90/27	No	Yes	Commandable (reserved)
BO:38	Reserved Output 5-90/28	W/R	No	No	5-90/28	No	Yes	Commandable (reserved)
BO:39	Reserved Output 5-90/29	W/R	No	No	5-90/29	No	Yes	Commandable (reserved)

Table 5.7: Binay outputs cont.

*) Reserved for future options

Object ID	Object Name	Read / Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:0	Com. Fault	R	No	NA	BACnet option	Yes	No	
BV:1	Start	W/R	No	No	CTW	No	Yes	
BV:2	Coasting	W/R	No	No	CTW, Bit 3 =0	No	Yes	
BV:3	CW/CCW	W/R	No	No	CTW bit 15=1	No	Yes	
BV:4	Jog	W/R	No	No	CTW bit 0 =1	No	Yes	
BV:5	Reset	W	No	No	CTW bit 07 = 1	No	Yes	
BV:6	Reset Kwh Counter	W	No	No	15-06	No	NO	
BV:7	Reset Running Hours Counter	W	No	No	15-07	No	NO	
BV:10	Drive Ready	R	No	NA	STW Bit 01	No	No	
BV:11	Reverse	R	No	NA	STW Bit 15	No	No	
BV:12	Speed = Reference	R	No	NA	STW Bit 08	No	No	
BV:13	Bus Control	R	No	NA	STW Bit 09	No	No	
BV:14	Tripped	R	No	NA	STW Bit 03	Yes	No	
BV:15	Triplock	R	No	NA	STW Bit 06	Yes	No	
BV:16	Motor running	R	No	NA	STW Bit 11	No	No	From version 2.00
BV:17	Warning	R	No	NA	STW Bit 07	No	No	From version 2.00
BV:18 -20	Reserved	R	No					
BV:21	ECB Test Mode	R	No	NA	31-10/00	No	No	
BV:22	ECB Drivemode	R	No	NA	31-10/01	No	No	
BV:23	ECB Aut. Bypass Enable	R	No	NA	31-10/02	No	No	
BV:24	ECB Bypass Mode	R	No	NA	31-10/03	No	No	
BV:xx	Reserved	R	No	NA	31-10/04	No	No	
BV:25	ECB State	R	No	NA	31-10/05	Yes	No	
BV:26	ECB Overload Trip	R	No	NA	31-10/06	Yes	No	
BV:27	M2 Fault	R	No	NA	31-10/07	Yes	No	
BV:28	M3 Fault	R	No	NA	31-10/08	Yes	No	
BV:29	ECB External Interlock	R	No	NA	31-10/09	Yes	No	
BV:30	ECB Manual Override	R	No	NA	31-10/10	No	No	
BV:31	Reserved	R	No					

Table 5.8: Binary values

Object ID	Object Name	Read / Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:40	A: Brake Check	R	No	NA	16-90/00	Yes		
BV:41	A: Pwr. Card Temp	R	No	NA	16-90/01	Yes		
BV:42	A: Earth Fault	R	No	NA	16-90/02	Yes		
BV:43	A: Ctrl.Card Temp	R	No	NA	16-90/03	Yes		
BV:44	A: Ctrl. Word TO	R	No	NA	16-90/04	Yes		
BV:45	A: Over Current	R	No	NA	16-90/05	Yes		
BV:46	A: Torque Limit	R	No	NA	16-90/06	Yes		
BV:47	A: Motor TH Over	R	No	NA	16-/07	Yes		
BV:48	A: Motor TH Over	R	No	NA	16-90/08	Yes		
BV:49	A: Inverter Overld.	R	No	NA	16-90/09	Yes		
BV:50	A: DC under Volt	R	No	NA	16-90/10	Yes		
BV:51	A: DC over Volt	R	No	NA	16-90/11	Yes		
BV:52	A: Short Circuit	R	No	NA	16-90/12	Yes		
BV:53	A: Inrush Fault	R	No	NA	16-90/13	Yes		
BV:54	A: Mains Fault	R	No	NA	16-90/14	Yes		
BV:55	A: AMA Not OK	R	No	NA	16-90/15	Yes		
BV:56	A: Live Zero Error	R	No	NA	16-90/16	Yes		
BV:57	A: Internal Fault	R	No	NA	16-90/17	Yes		
BV:58	A: Brake Overload	R	No	NA	16-90/18	Yes		
BV:59	A: U Phase Loss	R	No	NA	16-90/19	Yes		
BV:60	A: V Phase Loss	R	No	NA	16-90/20	Yes		
BV:61	A: W Phase Loss	R	No	NA	16-90/21	Yes		
BV:62	A: Fieldbus Fault	R	No	NA	16-90/22	Yes		
BV:63	A: 24 V Supply Low	R	No	NA	16-90/23	Yes		
BV:64	A: Mains Fault	R	No	NA	16-90/24	Yes		
BV:65	A: 1.8V Supply Low	R	No	NA	16-90/25	Yes		
BV:66	A: Brake Failure	R	No	NA	16-90/26	Yes		
BV:67	A: Brake IGBT	R	No	NA	16-90/27	Yes		
BV:68	A: Option Changed	R	No	NA	16-90/28	Yes		
BV:69	A: Drive Initialized	R	No	NA	16-90/29	Yes		
BV:70	A: Safe Stop	R	No	NA	16-90/30	Yes		
BV:71	A: Brake Low	R	No	NA	16-90/31	Yes		
BV:72	A: Service Trip 16-91/00	R	No	NA	16-91/00	Yes		
BV:73	A: Service Trip 16-91/01	R	No	NA	16-91/01	Yes		
BV:74	A: Service Trip 16-91/02	R	No	NA	16-91/02	Yes		
BV:75	A: Service Trip 16-91/03	R	No	NA	16-91/03	Yes		
BV:76	A: Service Trip 16-91/04	R	No	NA	16-91/04	Yes		
BV:77	A: No Flow	R	No	NA	16-91/05	Yes		
BV:78	A: Dry Pump	R	No	NA	16-91/06	Yes		
BV:79	A: Curve End	R	No	NA	16-91/07	Yes		

Table 5.9: Binary values cont.

Object ID	Object Name	Read / Write	Change-able Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:80	A: Broken Belt	R	No	NA	16-91/08	Yes		
BV:81	A: Discharge High	R	No	NA	16-91/09	Yes		
BV:82	A: Start Fault	R	No	NA	16-91/10	Yes		
BV:83	A: Speed Limit	R	No	NA	16-91/11	Yes		
BV:84	A: State Fault 16-91/12	R	No	NA	16-91/12	Yes		
BV:85	A: State Fault 16-91/13	R	No	NA	16-91/13	Yes		
BV:86	A: State Fault 16-91/14	R	No	NA	16-91/14	Yes		
BV:87	A: State Fault 16-91/15	R	No	NA	16-91/15	Yes		
BV:88	A: KTY Temperature Error	R	No	NA	16-91/16	Yes		
BV:89	A: Drive Fan Error	R	No	NA	16-91/17	Yes		
BV:90	A: ECB Error	R	No	NA	16-91/18	Yes		
BV:91	A: Alarm 1691/19	R	No	NA	16-91/19	Yes		Reserved
BV:92	A: Alarm 1691/20	R	No	NA	16-91/20	Yes		Reserved
BV:93	A: Alarm 1691/21	R	No	NA	16-91/21	Yes		Reserved
BV:94	A: Alarm 1691/22	R	No	NA	16-91/22	Yes		Reserved
BV:95	A: Alarm 1691/23	R	No	NA	16-91/23	Yes		Reserved
BV:96	A: Alarm 1691/24	R	No	NA	16-91/24	Yes		Reserved
BV:97	A: Alarm 1691/25	R	No	NA	16-91/25	Yes		Reserved
BV:98	A: Alarm 1691/26	R	No	NA	16-91/26	Yes		Reserved
BV:99	A: Alarm 1691/27	R	No	NA	16-91/27	Yes		Reserved
BV:100	A: Alarm 1691/28	R	No	NA	16-91/28	Yes		Reserved
BV:101	A: Alarm 1691/29	R	No	NA	16-91/29	Yes		Reserved
BV:102	A: Alarm 1691/30	R	No	NA	16-91/30	Yes		Reserved
BV:103	A: Alarm 1691/31	R	No	NA	16-91/31	Yes		Reserved
BV:104	W: Brake Check	R	No	NA	16-92/00	Yes		
BV:105	W: Pwr. Card Temp	R	No	NA	16-92/01	Yes		
BV:106	W: Earth Fault	R	No	NA	16-92/02	Yes		
BV:107	W: Ctrl. Card Temp	R	No	NA	16-92/03	Yes		
BV:108	W: Ctrl. Word TO	R	No	NA	16-92/04	Yes		
BV:109	W: Over Current	R	No	NA	16-92/05	Yes		
BV:110	W: Torque Limit	R	No	NA	16-92/06	Yes		
BV:111	W: Motor Th Over	R	No	NA	16-92/07	Yes		
BV:112	W: Motor ETR Over	R	No	NA	16-92/08	Yes		
BV:113	W: Inverter Overld.	R	No	NA	16-92/09	Yes		
BV:114	W: DC under Volt	R	No	NA	16-92/10	Yes		
BV:115	W: DC over Volt	R	No	NA	16-92/11	Yes		
BV:116	W: DC Voltage Low	R	No	NA	16-92/12	Yes		
BV:117	W: DC Voltage high	R	No	NA	16-92/13	Yes		
BV:118	W: Mains Ph. Loss	R	No	NA	16-92/14	Yes		
BV:119	W: No Motor	R	No	NA	16-92/15	Yes		
BV:120	W: Live Zero Error	R	No	NA	16-92/16	Yes		

Table 5.10: Binary values cont.

Object ID	Object Name	Read / Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:121	W:10V Low	R	No	NA	16-92/17	Yes		
BV:122	W: Brake Overload	R	No	NA	16-92/18	Yes		
BV:123	W: Brake Resistor	R	No	NA	16-92/19	Yes		
BV:124	W: Brake IGBT	R	No	NA	16-92/20	Yes		
BV:125	W: Speed Limit	R	No	NA	16-92/21	Yes		
BV:126	W: Fieldbus Fault	R	No	NA	16-92/22	Yes		
BV:127	W: 24V Supply Low	R	No	NA	16-92/23	Yes		
BV:128	W: Mains Failure	R	No	NA	16-92/24	Yes		
BV:129	W: Current Limit	R	No	NA	16-92/25	Yes		
BV:130	W: Low Temp	R	No	NA	16-92/26	Yes		
BV:131	W: Voltage Limit	R	No	NA	16-92/27	Yes		
BV:132	W: Encoder loss	R	No	NA	16-92/28	Yes		
BV:133	W: Output Freq. Limit	R	No	NA	16-92/29	Yes		
BV:134	W: Safe Stop	R	No	NA	16-92/30	Yes		
BV:135	W: Ext. Status	R	No	NA	16-92/31	Yes		
BV:136	W: Start Delayed	R	No	NA	16-93/32	Yes		
BV:137	W: Stop Delayed	R	No	NA	16-93/01	Yes		
BV:138	W: Clock Failure	R	No	NA	16-93/02	Yes		
BV:139	W: Fire Mode was Active	R	No	NA	16-93/03	Yes		
BV:140	W: Reserved, 16-93/04	R	No	NA	16-93/04	Yes		
BV:141	W: No Flow	R	No	NA	16-93/05	Yes		
BV:142	W: Dry Pump	R	No	NA	16-93/06	Yes		
BV:143	W: End of Curve	R	No	NA	16-93/07	Yes		
BV:144	W: Belt Broken	R	No	NA	16-93/08	Yes		
BV:145	W: Discharge High	R	No	NA	16-93/09	Yes		
BV:146	W: Reserved, 16-93/10	R	No	NA	16-93/10	Yes		
BV:147	W: Reserved, 16-93/11	R	No	NA	16-93/11	Yes		
BV:148	W: Reserved, 16-93/12	R	No	NA	16-93/12	Yes		
BV:149	W: Reserved, 16-93/13	R	No	NA	16-93/13	Yes		
BV:150	W: Reserved, 16-93/14	R	No	NA	16-93/14	Yes		
BV:151	W: Reserved, 16-93/15	R	No	NA	16-93/15	Yes		
BV:152	W: Reserved, 16-93/16	R	No	NA	16-93/16	Yes		
BV:153	W: KTY Temperature	R	No	NA	16-93/17	Yes		
BV:154	W: Drive Fan Failure	R	No	NA	16-93/18	Yes		
BV:155	W: ECB Failure	R	No	NA	16-93/19	Yes		

Table 5.11: Binary values cont.

Object ID	Object Name	Read / Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:156	W: Reserved, 16-93/20	R	No	NA	16-93/20	Yes		
BV:157	W: Reserved, 16-93/21	R	No	NA	16-93/21	Yes		
BV:158	W: Reserved, 16-93/22	R	No	NA	16-93/22	Yes		
BV:159	W: Reserved, 16-93/23	R	No	NA	16-93/23	Yes		
BV:160	W: Reserved, 16-93/24	R	No	NA	16-93/24	Yes		
BV:161	W: Reserved, 16-93/25	R	No	NA	16-93/25	Yes		
BV:162	W: Reserved, 16-93/26	R	No	NA	16-93/26	Yes		
BV:163	W: Reserved, 16-93/27	R	No	NA	16-93/27	Yes		
BV:164	W: Reserved, 16-93/28	R	No	NA	16-93/28	Yes		
BV:165	W: Reserved, 16-93/29	R	No	NA	16-93/29	Yes		
BV:166	W: PTC Temperature	R	No	NA	16-93/30	Yes		
BV:167	W: Reserved, 16-93/31	R	No	NA	16-93/31	Yes		
BV:168	W: Ramping Active	R	No	NA	16-94/00	No		
BV:169	W: AMA Running	R	No	NA	16-94/01	No		
BV:170	W: Start CW/CCW	R	No	NA	16-94/02	No		
BV:171	W: Slowdown	R	No	NA	16-94/03	No		
BV:172	W: Catch Up	R	No	NA	16-94/04	No		
BV:173	W: Feedback High	R	No	NA	16-94/05	No		
BV:174	W: Feedback Low	R	No	NA	16-94/06	No		
BV:175	W: Output Current High	R	No	NA	16-94/07	No		
BV:176	W: Output Current Low	R	No	NA	16-94/08	No		
BV:177	W: Output Freq High	R	No	NA	16-94/09	No		
BV:178	W: Output Freq Low	R	No	NA	16-94/10	No		
BV:178	W: Brake Check OK	R	No	NA	16-/11	No		
BV:180	W: Brake Max	R	No	NA	16-94/12	No		

Table 5.12: Binary values cont.

Object ID	Object Name	Read / Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
BV:181	W: Braking	R	No	NA	16-94/13	No		
BV:182	W: Out of Speed range	R	No	NA	16-94/14	No		
BV:183	W: OVC Active	R	No	NA	16-94/15	No		
BV:184	W: AC Brake	R	No	NA	16-94/16	No		
BV:185	W: Password Time-lock	R	No	NA	16-94/17	No		
BV:186	W: Password Status	R	No	NA	16-94/18	No		
BV:187	W: Reference High	R	No	NA	16-94/19	No		
BV:188	W: Reference Low	R	No	NA	16-94/20	No		
BV:189	W: Reference Site	R	No	NA	16-94/21	No		
BV:190	W: Reserved, 16-94/22	R	No	NA	16-94/22	No		
BV:191	W: Reserved, 16-94/23	R	No	NA	16-94/23	No		
BV:192	W: Reserved, 16-94/24	R	No	NA	16-94/24	No		
BV:193	W: Reserved, 16-94/25	R	No	NA	16-94/25	No		
BV:194	W: Reserved, 16-94/26	R	No	NA	16-94/26	No		
BV:195	W: Reserved, 16-94/27	R	No	NA	16-94/27	No		
BV:196	W: Reserved, 16-94/28	R	No	NA	16-94/28	No		
BV:197	W: Reserved, 16-94/29	R	No	NA	16-94/29	No		
BV:198	W: Reserved, 16-94/30	R	No	NA	16-94/30	No		
BV:199	W: Reserved, 16-94/31	R	No	NA	16-94/31	No		

Table 5.13: Binary values cont.

5.2.3 Multi-state Output Objects

Multi-state Output

Object Id	Object Name	Read/ Write	Changeable Description	Non volatile RAM Store	FC Parameter	Alarm notification	Triggers Bus Timeout	Remarks
MSO:0	Setup selection	W/R	No	Non	Bit13&14 in CTW	No	Yes	

5.2.4 Real Time Clock Variable

The frequency converter has a built-in real-time clock. The standard real-time clock has no battery backup function, which will lead to a loss of time if the drive is un-powered. Some BACnet Master's can be programmed to send out the date and time as a Broadcast Telegram on a regular basis. The BACnet Interface will update the real-time clock of the drive if it receives the time synchronization telegram.

5.3 Frequency Converter Feedback to Network

The BACnet option provides several output variables to the network, containing important frequency converter-, motor- and I/O feedback data.

Influence of the digital input terminals upon the FC Control Mode, par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select*

The influence of the digital input terminals upon control of the frequency converter can be programmed in par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select*.



NB!

Par. 8-01 *Control Site* overrules the settings in *parameters 8-50 to 8-56* and Terminal 37, Safe Stop overrules any parameter.

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Each of the digital input signals can be programmed to logic AND, logic OR, or to have no relation to the corresponding bit in the control word. In this way a specific control command i.e. stop / coast, can be initiated by the fieldbus only, fieldbus AND Digital Input, or Fieldbus OR Digital input terminal.

5.4 BIBBs

AcknowledgeAlarm	Execute
ConfirmedEventNotification	Initiate
UnconfirmedEventNotification	Initiate
ReadProperty	Execute
ReadPropertyMultiple	Execute
WriteProperty	Execute
WritePropertyMultiple	Execute
DeviceCommunicationControl	Execute
ReinitializeDevice	Execute
I-Am	Initiate/Execute
I-Have	Initiate
TimeSynchronization	Execute
Who-Has	Execute
Who-Is	Initiate/Execute
GetEventInformation	Execute
AddListElement	Execute
RemoveListElement	Execute
SubscribeCOV	Execute
ConfirmedCOVNotification	Initiate
UnconfirmedCOVNotification	Initiate

5.5.1 Object / Property Support Matrix

Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value	Event notification class
Object identifier	X	X	X	X	X	X	X	X	X
Object Name	X	X	X	X	X	X	X	X	X
Object Type	X	X	X	X	X	X	X	X	X
System Status	X								
Vendor Name	X								
Vendor Identifier	X								
Model Name	X								
Firmware Revision	X								
Appl. Software Revision	X								
Location	X								
Description	X	X	X	X	X	X	X	X	X
Protocol Version	X								
Protocol Revision	X								
Services Supported	X								
Object Types Supported	X								
Object List	X								
Max. APDU Length	X								
Segmentation Support	X								
Local Time	X								
Local Date	X								
APDU Timeout	X								
Number APDU Retries	X								
Max Master	X								
Max Info Frames	X								
Device Address Binding	X								
Database Revision	X								
Present Value		X	X	X	X	X	X	X	
Status Flags		X	X	X	X	X	X	X	
Event State		X	X	X	X	X	X	X	
Reliability		X	X	X	X	X	X	X	
Out-of-Service		X	X	X	X	X	X	X	
Number of States								X	
State Text								X	
Units					X	X	X		
Time Delay					X		X		
Notification Class					X		X		
High Limit					X		X		
Low Limit					X		X		
Deadband					X		X		
Limit Enable					X		X		
Event Enable					X		X		
Acked Transitions					X		X		
Notify Type					X		X		
Event Time Stamp					X		X		
cov-increment					X		X		

*For commandable values only

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Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value	Event notification class
Priority Array			X			X		X	
Priority									X
ACk Required									X
Recipient List									X
# of Notification Class									X
Relinquish Default			X	X*		X	??	X	
Polarity		X	X						
Active Text		X	X	X					
Inactive Text		X	X	X					
Modification Date									
Archive									
Read Only									
cov-increment					X		X		

*For commandable values only

6 Parameters

6.1 Parameter Overview

6.1.1 Parameter List

Nr.	Title	Default value	Range	Conversion index	Data type
8-01	Control Site	Dig. and ctrl. word [0]	[0 - 2]	-	5
8-02	Control Source	Option A	[0 - 4]	-	5
8-03	Control Timeout Time	1 s	0.1 - 18000	- 1	7
8-04	Control Timeout Function	Off [0]	[0 - 10]	-	5
8-05	End-of-timeout Function	Hold set-up [0]	[0 - 1]	-	5
8-06	Reset Control Timeout	Do not reset [0]	[0 - 1]	-	5
8-07	Diagnosis Trigger	Disable [0]	[0 - 3]	-	5
8-10	Control Profile	FC [0]	[0 - x]	-	5
8-30	Protocol	FC			
8-31	Address	1	[0 - 255]		
8-32	Baudrate	9600	[0 - 7]		
8-33	Parity/Stop Bits	No Parity, 1 Stop Bit			
8-35	Minimum Response Delay	10mS			
8-36	Max Response Delay	5000mS			
8-37	Max Inter-Char Delay	25.00mS			
8-50	Coasting Select	Logic OR [3]	[0 - 3]	-	5
8-52	DC Brake Select	Logic OR [3]	[0 - 3]	-	5
8-53	Start Select	Logic OR [3]	[0 - 3]	-	5
8-54	Reversing Select	Logic OR [3]	[0 - 3]	-	5
8-55	Setup Select	Logic OR [3]	[0 - 3]	-	5
8-56	Preset Reference Select	Logic OR [3]	[0 - 3]	-	5
8-70	BACnet Device Instance	1	[1-4194304]	-	
8-72	MS/TP Max Masters	127	[1-127]	-	
8-73	MS/TP Max Info Frames				
8-74	"I am" Service	Once at powerup [0]	[0-1]	-	
8-75	Initialisation Password	"admin"	String[19]		

Table 6.1: BACnet specific parameter list

Please refer to the *VLT® VLT HVAC Drive Drive Operating Instructions, MG.11.Ax.yy* for a comprehensive parameter list or to the *VLT® VLT HVAC Drive Drive Programming Guide, MG.11.Cx.yy* for detailed descriptions of parameters.

Conversion index

This number refers to a conversion figure used when writing or reading to and from the frequency converter.

Conv.i ndex	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv.f actor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	UInt8
6	Unsigned 16	UInt16
7	Unsigned 32	UInt32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2
54	Time difference w/o date	TimD

See the frequency converter *Design Guide* for further information about data types 33, 35 and 54.

6.2 Parameter Description

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6.2.1 8-*** Comm. and Options

Parameter group for configuring communications and options.

8-01 Control Site

Option:

Function:

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

[0] *	Digital and ctrl.word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Controlword only	Control by using control word only.

8-02 Control Source

Option:

Function:

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 fieldbus option installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets par. 8-02 *Control Source* back to default setting *FC Port*, and the frequency converter then trips. If an option is installed after initial power-up, the setting of par. 8-02 *Control Source* will not change but the frequency converter will trip and display: Alarm 67 *Option Changed*.

[0]	None
[1]	FC Port
[2]	USB Port
[3] *	Option A
[4]	Option B
[5]	Option C0
[6]	Option C1
[30]	External Can



NB!

This parameter cannot be adjusted while the motor is running.

8-03 Control Timeout Time

Range:

60.0 s* [1.0 - 18000.0 s]

Function:

Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in par. 8-04 *Control Timeout Function Control Time-out Function* will then be carried out.

In BACnet the control timeout is only triggered if some specific objects are written. The object list hold information on the objects that triggers the control timeout:

- Analog Outputs
- Binary Outputs
- AV0
- AV1
- AV2
- AV4
- BV1
- BV2
- BV3
- BV4
- BV5
- Multistate Outputs

8-04 Control Timeout Function

Option:

Function:

Select the time-out function. The time-out function is activated when the control word fails to be updated within the time period specified in par. 8-03 *Control Timeout Time*. Choice [20] only appears after setting the Metasys N2 protocol.

- [0] * Off
- [1] Freeze output
- [2] Stop
- [3] Jogging
- [4] Max. speed
- [5] Stop and trip
- [7] Select setup 1
- [8] Select setup 2
- [9] Select setup 3
- [10] Select setup 4
- [20] N2 Override Release

8-05 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. 8-04 *Control Timeout Function* is set to [Set-up 1-4].

- [0] Hold set-up
Retains the set-up selected in par. 8-04 *Control Timeout Function* and displays a warning, until par. 8-06 *Reset Control Timeout* toggles. Then the frequency converter resumes its original set-up.
- [1] * Resume set-up
Resumes the set-up active prior to the time-out.

8-06 Reset Control Timeout

Option:
Function:

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

[0] * Do not reset

Retains the set-up specified in par. 8-04 *Control Timeout Function*, [Select setup 1-4] following a control time-out.

[1] Do reset

Returns the frequency converter to the original set-up following a control word time-out. When the value is set to *Do reset* [1], the frequency converter performs the reset and then immediately reverts to the *Do not reset* [0] setting.

8-07 Diagnosis Trigger

Option:
Function:

This parameter has no function for BACnet.

[0] * Disable

[1] Trigger on alarms

[2] Trigger alarm/warn.

8-10 Control Profile

Option:
Function:

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 will be visible in the LCP display.

[0] * FC profile

[1] PROFIdrive profile

[5] ODVA

[7] CANopen DSP 402

8-30 Protocol

Option:
Function:

Protocol selection for the integrated FC (standard) Port (RS485) on the control card. Parameter group 8-7* is only visible when FC Option [9] is chosen.

[0] * FC

Communication according to the FC Protocol as described in the *VLT HVAC Drive Design Guide, RS485 Installation and Set-up*.

[1] FC MC

Same as *FC* [0] but to be used when downloading SW to the frequency converter or uploading dll file (covering information regarding parameters available in the frequency converter and their inter-dependencies) to Motion Control Tool MCT10.

[2] Modbus RTU

Communication according to the Modbus RTU protocol as described in the *VLT HVAC Drive Design Guide, RS485 Installation and Set-up*.

[3] Metasys N2

Communication protocol. The N2 software protocol is designed to be general in nature in order to accommodate the unique properties each device may have. Please see separate manual *VLT HVAC Drive Metasys MG.11.Gx.yy*.

[9] FC Option

To be used when a gateway is connected to the integrated RS485 port, e.g. the BACnet gateway. Following changes will take place:
 -Address for the FC port will be set to 1 and par. 8-31 *Address*, is now used to set the address for the gateway on the network, e.g. BACnet.
 Please see separate manual *VLT HVAC Drive BACnet, MG.11.Dx.yy*.
 -Baud rate for the FC port will be set to a fixed value (115.200 Baud) and par. 8-32 *Baud Rate*, is now used to set the baud rate for the network port (e.g. BACnet) on the gateway.

[20] LEN



NB!

Further details can be found in the Metasys manual.

8-31 Address

Range:

1. N/A* [1. - 126. N/A]

Function:

8-32 Baud Rate

Option:

Function:

Baud rates 9600, 19200, 38400 and 76800 baud are valid for BacNet only.

[0] 2400 Baud

[1] 4800 Baud

[2] * 9600 Baud

[3] 19200 Baud

[4] 38400 Baud

[5] 57600 Baud

[6] 76800 Baud

[7] 115200 Baud

Default refers to the FC Protocol.

8-33 Parity / Stop Bits

Option:

Function:

Parity and Stop Bits for the protocol par. 8-30 *Protocol* using the FC Port. For some of the protocols, not all options will be visible. Default depends on the protocol selected.

[0] * Even Parity, 1 Stop Bit

[1] Odd Parity, 1 Stop Bit

[2] No Parity, 1 Stop Bit

[3] No Parity, 2 Stop Bits

8-35 Minimum Response Delay

Range:

10. ms* [5. - 10000. ms]

Function:

Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Maximum Response Delay

Range:

10001. ms* [11. - 10001. ms]

Function:

Specify the maximum permissible delay time between transmitting a request and receiving a response. Exceeding this delay time will cause control word time-out.

8-37 Maximum Inter-Char Delay

Range:

25.00 ms* [0.00 - 35.00 ms]

Function:

Specify the maximum permissible time interval between receipt of two bytes. This parameter activates time-out if transmission is interrupted.

8-50 Coasting Select

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



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

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8-52 DC Brake Select

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



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-53 Start Select

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



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-54 Reversing Select

Option:

Function:

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



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-55 Set-up Select

Option:

Function:

		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the set-up selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the fieldbus/serial communication port OR via one of the digital inputs.



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-56 Preset Reference Select

Option:

Function:

		Select control of the frequency converter Preset Reference selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Preset Reference selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the fieldbus/serial communication port OR via one of the digital inputs.



NB!

This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-70 BACnet Device Instance**Range:**

1 N/A* [0 - 4194304 N/A]

Function:

Enter a unique ID number for the BACnet device.

**NB!**This parameter is active only when par. 8-30 *Protocol* is set to [9] *FC Option*.**8-72 MS/TP Max Masters****Range:**

127 N/A* [0 - 127 N/A]

Function:

Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

**NB!**This parameter is active only when par. 8-30 *Protocol* is set to [9] *FC Option*.**8-73 MS/TP Max Info Frames****Range:**

1 N/A* [1 - 65534 N/A]

Function:

Define how many info/data frames the device is allowed to send while holding the token.

**NB!**This parameter is active only when par. 8-30 *Protocol* is set to [9] *FC Option*.**8-74 "I-Am" Service****Option:**

[0] * Send at power-up

Function:

[1] Continuously

Choose whether the device should send the "I-Am" service message only at power-up or continuously with an interval of approx. 1 min.

**NB!**This parameter is active only when par. 8-30 *Protocol* is set to [9] *FC Option*.**8-75 Initialisation Password****Range:**

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

Function:

Enter the password needed for execution of Drive Re-initialisation from BACnet.

**NB!**This parameter is active only when par. 8-30 *Protocol* is set to [9] *FC Option*.

7 Troubleshooting

7.1 Alarm, Warning and Extended Status Word

7.1.1 Alarm and Warning Messages

General

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.

Alarm Word and Warning Word are shown on 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. 16-90 to 16-95. For more information on the individual alarms and warnings, please refer to: *VLT HVAC Drive Design Guide*.

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 to bit 7 in the status word.

Alarms

Following an alarm message the frequency converter will enter a fault condition. Only after the fault has been rectified and the master has acknowledged the alarm message by setting bit 3 in the Control Word, can the FC resume operation. All alarms within the FC are represented by a single bit within an Alarm Word. An Alarm Word is always an action parameter. Bit status FALSE [0] means no alarm, while bit status TRUE [1] means alarm.

7.1.2 Alarm Words

Alarm word, par. 16-90 *Alarm Word*

Bit (Hex)	Alarm Word (par. 16-90 <i>Alarm Word</i>)
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Ctrl. card over temperature
00000010	Control word timeout
00000020	Over current
00000040	Torque limit
00000080	Motor thermistor over temp.
00000100	Motor ETR over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	Short circuit
00002000	Inrush fault
00004000	Mains phase loss
00008000	AMA not OK
00010000	Live zero error
00020000	Internal fault
00040000	Brake overload
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00400000	Fieldbus fault
00800000	24V supply fault
01000000	Mains failure
02000000	1.8V supply fault
04000000	Brake resistor short circuit
08000000	Brake chopper fault
10000000	Option change
20000000	Drive initialised
40000000	Safe Stop
80000000	Not used

Alarm word 2, par. 16-91 *Alarm Word 2*

Bit (Hex)	Alarm Word 2 (par. 16-91 <i>Alarm Word 2</i>)
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	Not used
00000400	Not used
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
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	Reserved
80000000	Reserved

7.1.3 Warning Words

Warning word , par. 16-92 *Warning Word*

Bit (Hex)	Warning Word (par. 16-92 <i>Warning Word</i>)
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Ctrl. card over temperature
00000010	Control word timeout
00000020	Over current
00000040	Torque limit
00000080	Motor thermistor over temp.
00000100	Motor ETR 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	Fieldbus 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	Not used
80000000	Not used

Warning word 2, par. 16-93 *Warning Word 2*

Bit (Hex)	Warning Word 2 (par. 16-93 <i>Warning Word 2</i>)
00000001	Start Delayed
00000002	Stop Delayed
00000004	Clock Failure
00000008	Reserved
00000010	Reserved
00000020	No Flow
00000040	Dry Pump
00000080	End of Curve
00000100	Broken Belt
00000200	Not used
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans warning
00080000	ECB warning
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved



7.2 LED Status

Check the LEDs. The two bi-colour LEDs on the BACnet card indicate the status of BACnet communication.






Phases	Bi-colour LED	Status
Power On	Red 	The BACnet card is defect. Contact Danfoss Drives
	Green 	Self test/configuration takes place
Running	Green 	Module OK
	Red 	Recoverable fault, BACnet error
Communicating	Red 	Device communicating

Table 7.1: LED 1: Net Status




Bi-colour LED	Status
No light	Unrecoverable fault, Drive is not responding on internal bus
Green 	Self test/configuration takes place
Green 	Module OK
Red 	Recoverable fault <ul style="list-style-type: none"> - Configuration not OK. Check parameter 8-3* and 8-7* - Drive tripped

Table 7.2: LED 2: Module Status

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