MAKING MODERN LIVING POSSIBLE

Operating Instructions
Native BACnet

VLT® HVAC Basic Drive

THE REAL DRIVE

Contents

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1 Safety

1.1.1 Legal Information

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1.1.2 Safety Note

Safety Regulations

1. The frequency converter 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/Reset] key on the LCP of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing 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. Protection against motor overload is set by *1-90 Motor Thermal Protection*. If this function is desired, set *1-90 Motor Thermal Protection* to data value [WR] *ETR Trip* (default value) or data value [ETR warning].

NOTE

The function is initialized at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

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 passed before removing motor and mains plugs.
7. The frequency converter has more voltage inputs than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

⚠WARNING

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 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. Consequently, the stop key [Off/Reset] must always be activated; following which data can be modified.**
3. **A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.**

1.1.3 Symbols

Symbols used in this manual

CAUTION

Indicates a situation that may result in equipment or property-damage-only accidents.

⚠CAUTION

Indicates a general warning.

⚠WARNING

Indicates a high-voltage warning.

NOTE

Indicates something to be noted by the reader.

1.1.4 Before Commencing Repair Work

1. Disconnect the frequency converter from mains
2. Disconnect DC bus terminals 68 and 69
3. Wait at least the time mentioned in section General Warning above
4. Remove motor cable

1.1.5 Special Conditions

Electrical ratings

The rating indicated on the nameplate of the frequency converter is based on a typical 3-phase mains power supply, within the specified voltage, current and temperature range, which is expected to be used in most applications.

The frequency converters also support other special applications, which affect the electrical ratings of the frequency converter.
Special conditions which affect the electrical ratings might be:

- Single phase applications
- High temperature applications which require de-rating of the electrical ratings
- Marine applications with more severe environmental conditions.

Other applications might also affect the electrical ratings.

Consult the relevant sections in this manual and in the *VLT® HVAC Drive Design Guide, MG11B* for information about the electrical ratings.

Installation requirements

The overall electrical safety of the frequency converter requires special installation considerations regarding:

- Fuses and circuit breakers for over-current and short-circuit protection
- Selection of power cables (mains, motor, brake, loadsharing and relay)
- Grid configuration (grounded delta transformer leg, IT,TN, etc.)
- Safety of low-voltage ports (PELV conditions)

Consult the relevant clauses in these instructions and in the *VLT® HVAC Drive Design Guide MG11B* for information about the installation requirements.

1.1.6 Installation at High Altitudes (PELV)

⚠WARNING

Hazardous Voltage!
By altitudes above 2 km, contact Danfoss regarding PELV.
Avoid un-intended start
While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the LCP.

- **Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start.**
- **To avoid unintended start, always press [Off] before changing parameters.**
- **An electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start.**

Failure to follow recommendations could result in death or serious injury.

2 Introduction

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2.1.1 About this Manual

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

2 Introduction

3 How to Install

4 How to Configure the System

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

6 Parameters

7 Troubleshooting

2.1.2 Technical Overview

BACnet (Building Automation and Control Network) is an open data communications protocol, American National Standard (ANSI/ASHRAE 135-1995). BACnet enables computer-based control equipment from different manufacturers to 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 initiable 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 135-2008 version 4, ISO 16484-5
Openness	Open specification
Physical characteristics	
Network topology	Bus
Physical media	Shielded twisted pair
Max. Distance at low speed	1200 m
Transport mechanism	
Communication methods	MS/TP
Baud Rates Supported	9600, 19200, 38400, 76800
Termination	120 Ω

Table 2.1

2.1.3 Assumptions

This manual assumes that the BACnet Protocol is used with a FC 101 series frequency converter. It is also assumed that the system is equipped with a firmware supporting the BACnet communication services required by the application and that all requirements stipulated in the BACnet standard, as well as those pertaining to the frequency converter are strictly observed as well as all limitations therein fully respected.

2.1.4 Background Knowledge

The Danfoss BACnet Protocol 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.

In case of questions regarding set-up of master-to-master communication or communication to a non-Danfoss slave, consult the appropriate manuals.

2.1.5 Available Literature for VLT® HVAC Drive

- *Design Guide MG11B* entails all technical information about the frequency converter and customer design and applications.
- *Programming Guide MG11C* provides information on how to programme and includes complete parameter descriptions.
- *Application Note, Temperature Derating Guide, MN11A*
- *PC-based Configuration Tool MCT 10, MG10R* 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 BACnet, Operating Instructions MG11D*
- *VLT® HVAC Drive Metasys, Operating Instructions MG11G*
- *VLT® HVAC Drive FLN, Operating Instructions MG11Z*

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

2.1.6 Abbreviations

ACI	Acyclical Control Interval
AOC	Application Orientated Controller
AV	Analog Values
BMS	Building Management System
BV	Binary Values
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
I/O	Input/Output
ISO	International Standards Organization
LCP	Local Control Panel
LED	Light Emitting Diode
MAV	Main Actual Value
MRV	Main Reference Value
PC	Personal Computer
PDU	Protocol Data Unit
PELV	Protected Extra Low Voltage
PLC	Programmable Logic Control
PNU	Parameter Number
STW	Status Word

Table 2.2

3 How to Install

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3.1 The BACnet Interface

3.1.1 Cabling

Cable lengths and number of nodes
For the correct function of a BACnet MS/TP system, it is mandatory to fulfill installation of the communication cables given in this manual. Under correct installation it is possible to have up to 250 nodes (125 masters and 125 slaves) on 1200 m (4000 ft) cable.

The use of drop cable connection (i.e. T-connection) is not allowed in a BACnet MS/TP system. Drop cables leads to reflection and malfunction of the system. In location where the cabling demands a T-connection the use of repeaters is recommended.

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 m (4000 ft)
- Characteristic impedance: 100 to 130 Ω
- Resistance: <110 Ω/km
- Distributed capacitance: <100 pF/m, between conductors
- Cross section: 0.82 mm^2 conductor area, corresponding to AWG 18
- Cable type: twisted in pairs, 1 x 2, or 2 x 2 wires
- Screening: 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.

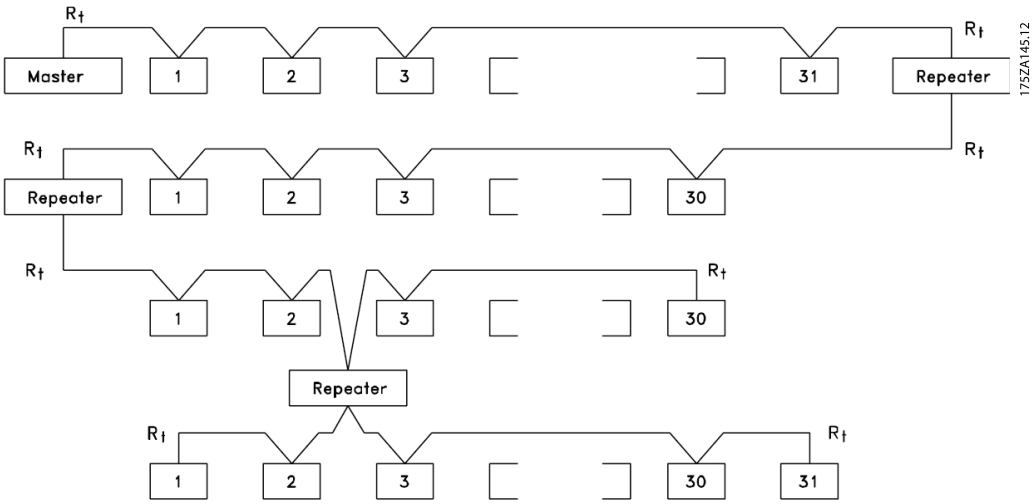

Illustration 3.1

3.1.2 Network Connection

Connect the frequency converter to the RS-485 network as follows (see *Illustration 3.2*):

1. Connect signal wires to terminal 68 (P+) and terminal 69 (N-) on the main control board of the frequency converter.
2. Connect the cable screen as described in *3.2 Bus Cabling*.

NOTE

Screened, twisted-pair cables are recommended to reduce noise between conductors.

3.1.3 Network Termination

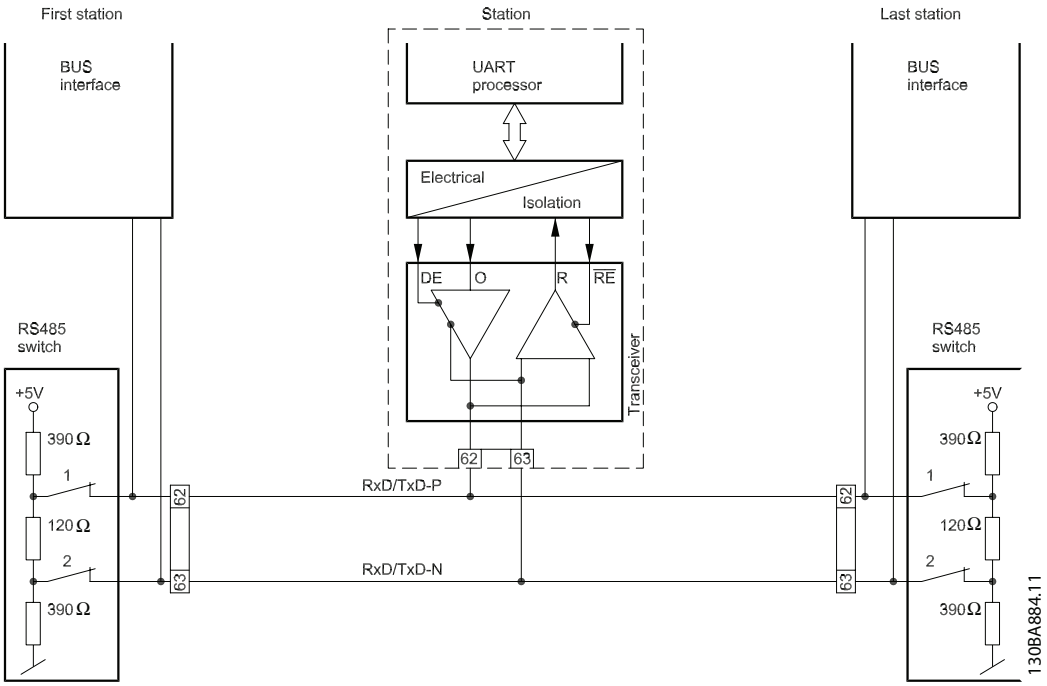

Illustration 3.2

Maximum Cable Lengths
Maximum total bus cable length: 4000 ft ~ 1200 m

3.1.4 S801

S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

Default setting:
S801 (Bus termination) = OFF

NOTE

When changing the function of S201, S202 or S801 be careful not to use force for the switch over. It is recommended to remove the fixture (cradle) when operating the switches. The switches must not be operated with power on the frequency converter.

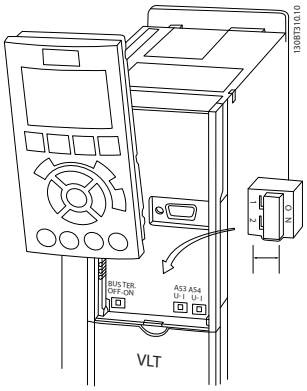

Illustration 3.3

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3.1.5 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°.

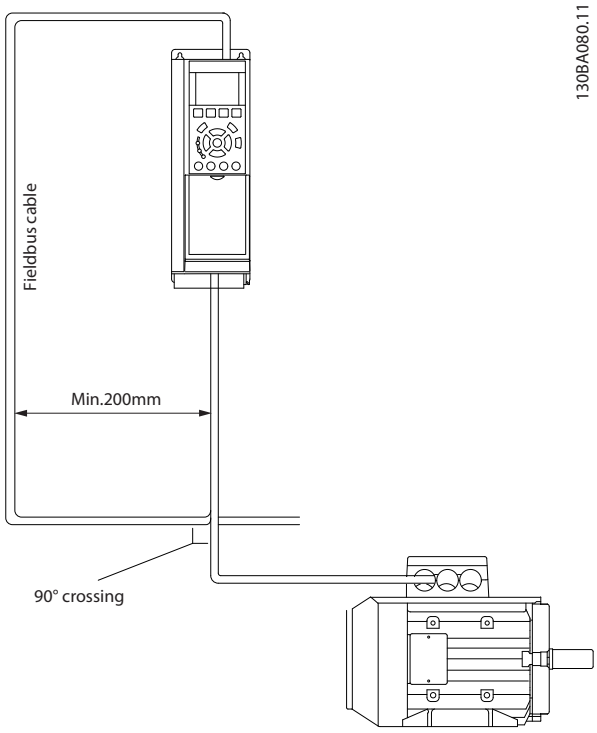

Illustration 3.4 Cable Routing

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, MG11B*.

NOTE

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. The single ground shield is specified in the ANSI/ASRAHE 135-2004 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 stations, 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 prevents that a lightning stroke is 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 frequency converter 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 requires that each BACnet device has the same earth potential or an equalizing current flows 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, with 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 requires that each BACnet device has the same earth potential or else an equalizing current flows 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.

4 How to Configure the System

4.1 Configuring BACnet

4.1.1 Initialization Procedure

Parameter	Default Value	Setting for BACnet
8-01 Control Site	Digital and control word	Digital and control word
8-02 Control Source	FC RS485	FC RS-485
8-03 Control Timeout Time	1 s	1)
8-04 Control Timeout Function	Off	1)

Table 4.1 General Settings

Parameter	Default Value	Setting for BACnet
8-30 Protocol	FC	BACnet
8-31 Address	1	1[3)]
8-32 Baud Rate	9600	9600 baud
8-35 Minimum Response Delay	10 ms	10 ms
8-36 Maximum Response Delay	5000 ms	5000 ms

Table 4.2 FC Port Settings

[1)] Depending on the application.
[2)] Depending on the BMS system
[3)] The adress setting is depending on the system and each device connected to the BACnet MS/TP must have a unique adress on this MS/TP network. See also *6.1.1 Parameter List*.

Parameter	Default Value	Setting for BACnet
8-50 Coasting Select	Logic-or	Logic-or
8-52 DC Brake Select	Logic-or	Logic-or
8-53 Start Select	Logic-or	Logic-or
8-54 Reversing Select	Digital input	Digital input
8-55 Set-up Select	Logic-or	Logic-or
8-56 Preset Reference Select	Logic-or	Logic-or

Table 4.3 Digital/Bus Settings

Name	Default Value	Setting for BACnet
8-70 BACnet Device Instance	1	1[1]
8-72 MS/TP Max Masters	127	Dependent on the Number of Masters in the system
8-74 "I-Am" Service	At power up	At power up
8-75 Initialisation Password	“admin”	“admin”

Table 4.4 BACnet Settings

[1)] The device instance setting is depending on the system, and each device connected to the BACnet MS/TP must have a unique device instance in the complete system.

4.1.2 Control Word Time-out Function

8-03 Control Timeout Time and *8-04 Control Timeout Function* are not used.

4.2 Example of a Simple Setup of BACnet

This example shows the necessary steps to set up the VLT® HVAC Basic BACnet interface with the following system requirements:

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

Set the following parameters	
Parameter	**Value**
8-30 Protocol	[5] BACnet
8-31 Address	20
8-32 Baud Rate	[4] 38,400 Baud
8-50 Coasting Select	[1] Bus
8-70 BACnet Device Instance	1025
8-72 MS/TP Max Masters	35

Table 4.5

After the parameters have been set according to *Table 4.5*, the frequency converter has to be unpowered and repowered before the changes take effect. When the frequency converter is detected by the BMS, it can be controlled by BV:1, which starts the motor if set to [1]. Setting AV:1 sets the speed reference of the frequency converter. The actual speed can be monitored via AV:3. See also *5.1.1 Analog Input- and Output Objects*.

5 BACnet Objects

5.1.1 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. The availability of objects depends on the mounting of the B and/or C options.

	Object_Name	Present_Value		
ID	Default name	Parameter	Unit	Option
AI:0	Analog Input 53	1662	mA/Voltage	
AI:1	Analog Input 54	1664	mA/Voltage	

Table 5.1 Analog Inputs Object Map

	Object_Name	Present_Value					
ID	Default name	Parameter	Unit	Writeable	Cmd.able	Timeout	Option
AO:0	Terminal 42 Output Bus Control	696	N_2	x	x	x	

Table 5.2 Analog Outputs

	Object_Name			Present_Value					
ID	Default name	Writeable	EEPROM	Parameter	Unit	Writeable	Cmd.able	Timeout	Option
AV:0	Reserved for VFD profile								
AV:1	Input Reference 1	x	x	Note 1	%	x	x	x	
AV:2	Input Reference 2			Note 1	%	x	x	x	
AV:3	Output Speed	x	x	Note 2	%				
AV:4	PI Feedback			Note 3	%				
AV:5	Motor Current	x	x	1614	Amps				
AV:6	Power	x	x	1610	kW				
AV:7	Reserved for VFD profile								
AV:8									
AV:9									
AV:10									
AV:11									
AV:12									
AV:13									
AV:14									
AV:15	Motor Thermal			1618	%				
AV:16	Reserved for VFD profile								
AV:17									
AV:18									
AV:19									
AV:20									
AV:21	Operating Hours			1500	Hours				

ID	Object_Name			Present_Value					
	Default name	Writeable	EEPROM	Parameter	Unit	Writeable	Cmd.able	Timeout	Option
AV:22	Running Hours			1501	Hours				
AV:23	kWh Counter			1502	kWh				
AV:24	Motor Voltage			1612	V				
AV:25	Frequency			1613	Hz				
AV:27	DC Link Voltage			1630	V				
AV:28	Heatsink Temp.			1634	Deg				
AV:29	Inverter Thermal			1635	%				
AV:31	Bus Feedback 1			894	N_2	x			
AV:32	Reserved for P, I								
AV:33									
AV:37	Reserved for P, I								
AV:38									
AV:39									
AV:42	Reserved for P, I								
AV:43									
AV:44									
AV:46									
AV:47									
AV:48									
AV:49									
AV:50	Alarm Log: Error Code			1530	NONE				
AV:51	Fault Code			Note 4	NONE				
AV:52	PID Start Speed			2083	Hz	x			
AV:53	On Reference Bandwidth			2084	%	x			
AV:54	PID Proportional Gain			2093	NONE	x			
AV:55	PID Integral Time			2094	S	x			

Table 5.3 Analog Values

[1] Either AV:1 or AV:2 controls the drive reference. Only one of them can control the frequency converter at a time and BV:2 decides which one.

[2] This value is not directly available in the frequency converter. The value must be calculated as follows:

$$AV\#3 = \frac{Par.\ 16-13}{Par.\ 4-14} \times 100\,\%$$

[3] This value is not directly available in the frequency converter. The value must be calculated as follows:

$$AV\#4 = \frac{Par.\ 16-52}{Par.\ 3-303} \times 100\,\%$$

[4] VLT® HVAC Basic Drive fault codes are transmitted as an analog value in AV:51. The Fault codes are mapped as shown in *Table 5.4*. The VLT® HVAC Basic Drive alarm codes are shown as well for comparison.

Table 5.4 shows the mapping of the FC 101 alarm codes and their mapping to the BACnet's fault codes.

Fault codes	Fault Code	VLT® HVAC Drive Alarms	Fault Descriptions
Communication Error	1	17, 34	Loss of communication with the network
Over Current	2	59	Instantaneous Output Current has exceeded inverter rated or programmed value
Over Temperature	3	29, 65, 69, 143, 244, 245	Heat sink Temperature Limit has been reached
Over Speed Deviation	4	49, 62	Inverter has exceeded maximum or programmed limit
Over Voltage	5	5, 7, 64	DC Bus Voltage has exceeded inverter limit
Under Voltage	6	1, 6, 8	DC Bus Voltage is lower than required inverter limit
Short Circuit	7	16	Inverter Output has shorted Phase to Phase
Ground Fault	8	14	Inverter Output Grounding Current has exceeded manufacturer
Motor Overload	9	10, 50-58, 74, 222	Motor is overloaded
Inverter Overload	10	9	Timed over current fault
Over Torque Detection	11	12	Programmed limit for torque has been exceeded
External Fault	12	22, 24, 25, 26, 28, 43, 60, 63, 68, 71, 142, 150	External fault has been activated in the inverter. This is a hard fault that must be reset
Operator Interface Error	13	2, 50, 51, 52, 53, 54, 55, 56, 57, 58, 67	Inverter programming or operational interface malfunction
Load Loss	14	3, 92, 93, 94, 95, 229	Load on the Motor is less than programmed limit of system. An Example is a broken belt or coupling
Configuration Error	15	13, 40, 41, 42, 70, 72, 76, 79, 81, 82, 85, 86, 91, 96, 97, 98, 99, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 154	Errors exist in the programmed or operational configuration of the inverter
Feedback Failure	16	90, 192, 78, 108	Required system operational feedback (signal or sensor) is not responding as expected for correct system operation
Output Phase Loss	17	30, 31, 32	One or more of the output phases from the inverter to the motor are open
Motor Stall	18	11, 61, 204	Motor is operating in stall region and not able to accelerate
Power Unit Error	19	4, 23, 33, 36, 37, 46, 142, 220, 221, 222, 223, 224, 225, 226, 227, 228, 246	Error sensed on the power section of the inverter
Input Phase	20	-	Input single phase or low line voltage condition
Internal Drive Failure	21	4, 27, 36, 37, 38, 46, 76, 79, 81, 82, 91, 103, 105, 106, 107, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 125, 149, 151, 155, 162, 170, 171, 179, 180, 181, 182, 183, 184, 187, 190, 191, 230, 231, 232, 240, 241, 242, 246, 248	Manufacturer defined internal operations that have failed their-self checks.

Table 5.4 Mapping of Fault Codes

5.1.2 Binary Input- and Output Objects

	Object_Name	Present_Value		
ID	Default name	Parameter	Bit number	Option
BI:2	Digital input Term 29	1660	2	
BI:3	Digital input Term 27	1660	3	
BI:4	Digital input Term 19	1660	4	
BI:5	Digital input Term 18	1660	5	
BI:10..BI:15 are reserved for P1660/x				

Table 5.5 Binary Inputs

	Object_Name	Present_Value					
ID	Default name	Parameter	Bit number	Writeable	Cmd.able	Timeout	Option
BO:4	Relay 1	590	4	x	x	x	
BO:5	Relay 2	590	5	x	x	x	

Table 5.6 Binary Outputs

	Object_Name			Present_Value						
ID	Default name	Writeable	EEPROM	Parameter	Bit number	Writeable	Cmd.able	EEPROM	Timeout	Option
BV:0	Reserved for VFD profile									
BV:1	RUN/STOP Command	x	x	CTW=0x47C + Reversing bit 15	6 reverse 15	x	x		x	
BV:2	REF 1 / REF 2 Select	x	x	Note 1	n/a	x	x	x	x	
BV:3	Fault Reset Command	x	x	CTW	7	x				
BV:4	RUN / STOP Monitor	x	x	STW	1					
BV:5	OK / FAULT Monitor	x	x	STW	3, 6, 7					
BV:6	HAND / AUTO Reference	x	x	16-95	1					
BV:7	Reserved for VFD profile									
BV:8										
BV:9										
BV:10										
BV:11										
BV:12										
BV:13										
BV:14										
BV:15										
BV:16										
BV:17										
BV:18										
BV:19										
BV:20										

	Object_Name			Present_Value						
ID	Default name	Writeable	EEPROM	Parameter	Bit number	Writeable	Cmd.able	EEPROM	Timeout	Option
BV:21	Warning	x	x	STW	7					
BV:22	Trip	x	x	STW	3					
BV:23	Triplock			STW	6					
BV:24	Coasting			CTW	3	x	x		x	
BV:25	CW/CCW			CTW	15	x	x		x	
BV:26	Jog			CTW	8	x	x		x	
BV:27	Reset			CTW	7	x	x		x	
BV:28	Reset KWh Counter			1506	n/a	x				
BV:29	Reset Running Hours Counter			1507	n/a	x				
BV:30	Reverse			STW	1					
BV:31	Speed = reference			STW	8					
BV:32	Bus control			STW	9					
BV:33	Running	x	x	STW	11					
BV:34	Ramp 1/ Ramp 2			CTW	9	x	x			

Table 5.7

5.1.3 Multi-state Value Objects

	Object_Name	Present_Value				
ID	Default name	Parameter	Bit number	Writeable	Cmd.able	Timeout
MSV:0	Smart Logic Controller State	1638	n/a			
MSV:1	Active Setup	CTW	13	x	x	x

Table 5.8

5.2 Frequency Converter Feedback to Network

The BACnet option provides several output variables (nvo's) objects to the network, containing important frequency converter-, motor- and I/O feedback data. The BACnet option transmits bound network variables only and sends feedback data when there is a change in value.

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

NOTE

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

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.

⚠CAUTION

In order to control the frequency converter via BACnet, *8-50 Coasting Select* must be set to either *[1] Bus* or to *[2] Logic AND* and *8-01 Control Site* must be set to Digital and *[0] ctrl. word* or *[2] Controlword only*.

5.3 BIBBs

ReadProperty	Execute
WriteProperty	Execute
DeviceCommunicationControl	Execute
ReinitializeDevice	Execute
I-Am	Initiate
I-Have	Initiate
TimeSynchronization	Execute
Who-Has	Execute
Who-Is	Execute

Table 5.9

5.4.1 Object/Property Support Matrix

This table summarises the Object Types and Properties supported:								
Property	**Device**	**Binary input**	**Binary output**	**Binary value**	**Analog input**	**Analog output**	**Analog value**	**Multistage value**
Object identifier	X	X	X	X	X	X	X	X
Object Name	X	X	X	X	X	X	X	X
Object Type	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							
Protocol Version	X							
Protocol Revision	X							
Services 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	
Priority Array			X	X*		X	X*	X*
Relinquish Default			X	X*		X	X*	X*
Polarity		X	X					
Active Text		X	X	X				
Inactive Text		X	X	X				
*For commandable values only								

Table 5.10

6 Parameters

6.1 Parameter Overview

6.1.1 Parameter List

Parameter	Default value	Range	Conversion index	Data type
8-01 Control Site	[0] Dig. and ctrl. word	[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	[0] Off	[0-10]	-	5
8-30 Protocol	FC			
8-31 Address	1	[0-255]		
8-32 Baud Rate	9600	[0-7]		
8-33 Parity / Stop Bits	No Parity, 1 Stop Bit			
8-35 Minimum Response Delay	10 mS			
8-36 Maximum Response Delay	5000 mS			
8-37 Maximum Inter-Char Delay	25.00 mS			
8-50 Coasting Select	[3] Logic OR	[0-3]	-	5
8-52 DC Brake Select	[3] Logic OR	[0-3]	-	5
8-53 Start Select	[3] Logic OR	[0-3]	-	5
8-54 Reversing Select	Digital input	[0-3]	-	5
8-55 Set-up Select	[3] Logic OR	[0-3]	-	5
8-56 Preset Reference Select	[3] Logic OR	[0-3]	-	5
8-70 BACnet Device Instance	1	[0-4194302]	-	
8-72 MS/TP Max Masters	127	[0-127]	-	
8-73 MS/TP Max Info Frames				
8-74 "I-Am" Service	[0] Once at powerup	[0-1]	-	
8-75 Initialisation Password	“admin”	[19] String		

Table 6.1 BACnet Specific Parameter List

Refer to the *VLT® HVAC Drive Drive Operating Instructions, MG11A* for a comprehensive parameter list or to the *VLT® HVAC Drive Drive Programming Guide, MG11C* 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. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Table 6.2

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

Table 6.3

See the frequency converter *Design Guide* for further information about data types 33.

6

6.2 Parameter Description

6.2.1 8-** Comm. and Options

8-01 Control Site

Option:		Function:
		The setting in this parameter overrides the settings in *8-50 Coasting Select* to *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.
[0]	None	
[1]	FC Port	

8-30 Protocol

Option:		Function:
[5]	BACnet	Select BACnet protocol

8-31 Address

Range:		Function:
1. *	[1. - 127.]	Sets the drives MAC ID on the MS/TP network.

8-32 Baud Rate

Option:		Function:
		Baud rate selection depends on Protocol selection in *8-30 Protocol*.
[2]	9600 Baud	
[3]	19200 Baud	
[4] *	9600 Baud	
[6]	76800 Baud	

Default refers to the FC Protocol.

8-33 Parity / Stop Bits

Option:		Function:
		Parity and Stop Bits for the protocol *8-30 Protocol* using the FC Port. For some of the protocols, not all options are 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:		Function:
Size related*	[5. - 10000. ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-35 Minimum Response Delay

Range:		Function:
		transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Maximum Response Delay

Range:		Function:
Size related*	[11. - 10001. ms]	

8-37 Maximum Inter-Char Delay

Range:		Function:
Size related*	[0.00 - 35.00 ms]	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.

8-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus. **NOTE** **Only selection *[0] Digital input* is available when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-53 Start Select		
Option:		Function:
		Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-54 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.

NOTE

This parameter is active only when *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.

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.

8-70 BACnet Device Instance		
Range:		Function:
	0 - 4194302	The Device Instance number must be unique for the complete BACnet, not only for this MS/TP Branch.
1 *	[0 - 4194302]	Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters		
Option:		Function:
	0 - 127	Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

8-73 MS/TP Max Info Frames		
Range:		Function:
	1 - 65534	Define how many info/data frames the device is allowed to send while holding the token.
1*	[1 - 65534]	Define how many info/data frames the device is allowed to send while holding the token.

8-74 "I-Am" Service		
Option:		Function:
[0] *	Send at power-up	
[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.

8-75 Initialisation Password		
Range:		Function:
[Size related]	0 - 0	Enter the password needed for execution of Drive Re-initialisation from BACnet.
Admin*	[Str]	Enter the password needed for execution of Drive Re-initialisation from BACnet.

6

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 enters a fault condition. After the cause for the alarm has been cleared, the master must acknowledge the alarm message to restart operation of the frequency converter. 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 words 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 is shown. Warning words and alarm word are displayed in parameters *16-90 Alarm Word* to *16-95 Ext. Status Word 2*. For more information on the individual alarms and warnings, refer to: *VLT® HVAC Drive Design Guide, MG11B*.

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 *[0] FALSE* means no warning, while bit status *[1] TRUE* 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 enters 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 frequency converter resume operation. All alarms within the frequency converter are represented by a single bit within an alarm word. An alarm word is always an action parameter. Bit status *[0] FALSE* means no alarm, while bit status *[1] TRUE* means alarm.

7.1.2 Alarm Words

Bit (Hex)	Alarm Word (*16-90 Alarm Word*)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
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	
00004000	Mains phase loss
00008000	AMA not OK
00010000	Live zero error
00020000	Internal fault
00040000	
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00800000	Control Voltage Fault
01000000	
02000000	VDD, supply low
04000000	Brake resistor short circuit
08000000	Brake chopper fault
10000000	DESAT Earth fault
20000000	Drive initialised
40000000	Safe Stop [A68]
80000000	

Table 7.1 *16-90 Alarm Word*

Bit (Hex)	Alarm Word 2 (*16-91 Alarm Word 2*)
00000001	
00000002	Reserved
00000004	Service Trip, Typecode / Sparepart
00000008	Reserved
00000010	Reserved
00000020	
00000040	
00000080	
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	PTC 1 Safe Stop [A71]
80000000	Dangerous Failure [A72]

Table 7.2 *16-91 Alarm Word 2*

7.1.3 Warning Words

Bit (Hex)	Warning Word (*16-92 Warning Word*)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
00000080	Motor thermistor over temp.
00000100	Motor ETR over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	
00002000	
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	
00040000	
00080000	
00100000	
00200000	
00400000	
00800000	24V supply fault
01000000	
02000000	Current limit
04000000	
08000000	
10000000	
20000000	
40000000	Not used
80000000	Not used

Table 7.3 *16-92 Warning Word*

Bit (Hex)	Warning Word 2 (*16-93 Warning Word 2*)
00000001	
00000002	
00000004	
00000008	Reserved
00000010	Reserved
00000020	
00000040	
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	
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC 1 Safe Stop [W71]
80000000	Reserved

Table 7.4 *16-93 Warning Word 2*

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