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1. Introduction

1.1. Introduction

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
>
> Application Example

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

> How to Control the FC 100
>
> How to Access FC 100 Parameters
>
> 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.
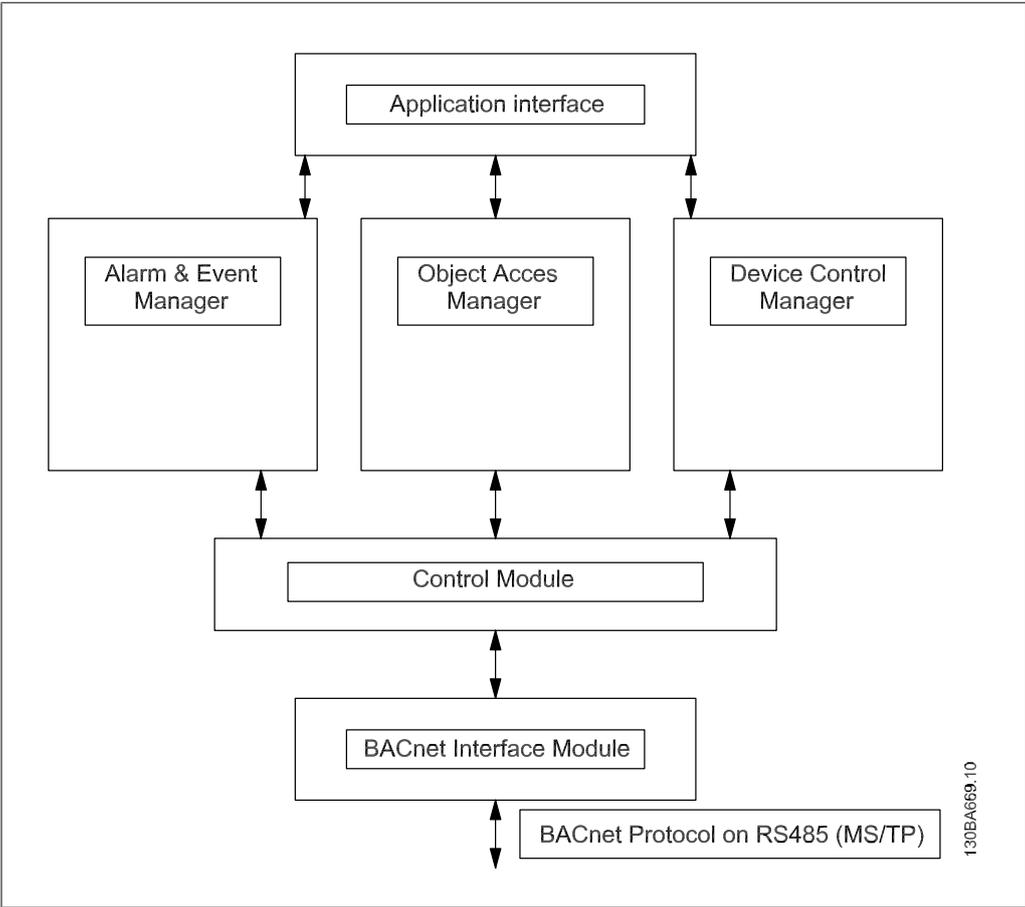
Conformance Classes, Function Groups and the PICS: Evaluating the capabilities of a BACnet device is potentially a formidable task, given the great choice of Objects, Properties and Services, which can be implemented, as well as the fact that it is not necessary for every BACnet device to have a full 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.

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Background information	
Protocol name:	BACnet
Technology developer:	ASHRAE
Year introduced:	1995
Governing standards:	ANSI/ASHRAE Standard 135-2004, 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

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1.1.3. Assumptions

This manual assumes you are using a Danfoss BACnet Option Card in conjunction with a Danfoss FC 100 series frequency converter. It is also assumed that your master is a BMS or PC equipped with a serial communication card supporting all 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 master complying with the BACnet standard. Familiarity with the PC 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.

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

- Operating Instructions MG.11.Ax.yy provide the neccessary information for getting the drive up and running.

- Design Guide MG.11.Bx.yy entails all technical information about the drive 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

- VLT® 6000 HVAC Application Booklet, MN.60.Ix.yy

- Operating Instructions VLT®HVAC Drive BACnet, MG.11.Dx.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 LonWorks, MG.11.Ex.yy

- Operating Instructions VLT® HVAC Drive High Power, MG.11.Fx.yy

- Operating Instructions VLT® HVAC Drive Metasys, MG.11.Gx.yy

x = Revision number
yy = Language code

Danfoss Drives technical literature is also available online at *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm*.

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1.1.6. Abbreviations

ACI	Acyclical Control Interval	PCD	Process Data
AOC	Application Orientated Controller	PCA	Parameter Characteristics
BMS	Building Management System	PCV	Parameter-Characteristics-Value
CAN	Controller Area Network	PDU	Protocol Data Unit
CTW	Control Word	PLC	Programmable Logic Control
EE-PROM	Electrical Erasable Programmable Read Only Memory	PNU	Parameter Number
EIA	Electronic Industries Association: Specifies of the EIA Standard RS 485-A	PVA	Parameter Value
EMC	Electromagnetic Compatibility	RC	Request/Response Characteristics
FDL	Fieldbus Data link Layer	STW	Status Word
FDT	Field Device Tool		
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		
MOC	Motion Orientated Controller		
MRV	Main Reference Value		
PC	Personal Computer		

2. Safety

2.1. Safety

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2.1.2. Safety Precautions

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

Safety Regulations

1. The mains supply to the frequency converter must be disconnected whenever repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains supply plugs.

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

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

4. The earth leakage current exceeds 3.5 mA.

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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 per-
     sonal 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 un-
     intended start occurs, these stop functions are not sufficient. In such cases the mains
     supply must be disconnected or the *Safe Stop* function must be activated.

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

3.   A motor that has been stopped with the mains supply connected, may start if faults occur
     in the electronics of the frequency converter, through temporary overload or if a fault in
     the power supply grid or motor connection is remedied. If unintended start must be
     prevented for personal safety reasons (e.g. risk of injury caused by contact with moving
     machine parts), the normal stop functions of the frequency converter are not sufficient.
     In such cases the mains supply must be disconnected or the *Safe Stop* function must be
     activated.

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

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

Touching the electrical parts may be fatal - even after the equipment has been dis-
connected 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.

Protection Mode
Once a hardware limit on motor current or dc-link voltage is exceeded the drive will enter "Pro-
tection 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 parameter 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.

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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

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Instructions:

- – - Remove the LCD 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.

- – - Remove the Plug for the FC Port and connect the Plug that is connected to the BACnet Option

- – - Replace the LCD 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.

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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 if a T-connection is used instead of permissible cable length and maximum number of nodes/Drivess with 1, 2, 3 and 4 bus segments.

Drop cable connection (i.e. T-connection) beyond the cable lengths indicated 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 masters (e.g. PC tools, Routers), the number of frequency converters must be reduced correspondingly.

Network topology	Maximum cable length
Free topology without repeater	500 m
Free topology with one repeater	1000 m
Free topology maximum device-to-device	500 m
Bus topology single terminated	500 m
Bus topology double terminated without repeater	2700 m
Bus topology double terminated with one repeater	5400 m
Bus topology maximum stub length	3 m

The length statements in the tables above are valid for bus cable with the following properties:

- Impedance: 135 to 165 Ohm at a measuring frequency from 3 to 20 MHz

- Resistance: <110 Ohm/km

- Capacitance: <30 pF/m

- Damping: max. 9 dB over the whole wire length

- Cross section: max. 0.34 mm^2, corresponding to AWG 22

- Cable type: twisted in pairs, 1 x 2, or 2 x 2, or 1 x 4 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.

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 62 is marked Green. These two are the RS485 lines. Terminal 66 the signal Ground for the RS485 Transmitter. In large systems it is recommended to use

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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.

3.2. System Specifications

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. Connection of the Cable Screen

It is recommended to connect the screen to ground in both end of the Bus Cable. This ensures the optimum resistance towards EMC noise. screen of the BACnet cable must always be connected to ground at both ends, meaning the screen must be connected to ground in all stations connected to the BACnet network. It is very important to have a low impedance ground connection of the screen, also at high frequencies. This can be obtained by connecting the surface of the screen to ground, for example by means of a cable clamp or a conductive cable gland. The FC 100 Series has various clamps and brackets to enable a proper ground connection of the BACnet cable screen.

3.2.3. Earth Connection

It is important that all stations connected to the BACnet network are connected to the same earth potential. The earth connection must have low HF (high frequency) impedance. This can be achieved by connecting a large surface area of the cabinet to earth, for example by mounting the FC 100 series on a conductive rear plate. Particularly when there are long distances between the stations in a BACnet network, it can be necessary to use additional potential equalizing cables, connecting the individual stations to the same earth potential. The use of Repeaters with galvanic isolation or Fibre optic can improve

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the EMC performance and reduce Ground loop
Current.

4. How to Configure the System

4.1. Configuring BACnet

4.1.1. Initialization Procedure

The Initialization Procedure is explained by the flow chart given below:

Initialization Parameter

General Settings

Name	Parameter Number	Default Value	Setting for BACnet
Control Site	8-01	Digital and control word	Digital and control word
Control word source	8-02	FC RS-485	FC RS-485
ControlWord Timeout time	8-03	1.0 sec	1.0 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	Set up	Don't care
ControlWord Profile	8-10	FC Profile	FC Profile

FC Port Settings

Name	Parameter Number	Default Value	Setting for BACnet
Protocol	8-30	FC	FC Option
Address	8-31	1	1
Baud Rate	8-32	9600 baud	9600 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	Parameter 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	Parameter 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 transmit time	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 Word Timeout Time and *par. 8-04 Control Word Timeout Function* are not enabled in this version of the BACnet option.

4.2. BIBBs

4.2.1. Bibb's

ReadProperty Service

ReadPropertyMultiple Service

WriteProperty Service

WritePropertyMultiple Service

ConfirmedEventNotification Service

UnconfirmedEventNotification Service

GetEventInformation Service

AcknowledgeAlarm Service

ReinitializeDevice Service

DeviceCommunicationControl Service

I-Have Service

Who-Has Service

Who-Is Service

I-am Service

TimeSynchronization

4.3. Example of a simple setup of BACnet

This example shows the necessary steps to set up the FC102 BACnet interface with the following system requirements:

- • MS/TP running at 38.400 Baud

- • MAC address 20 for the FC102

- • BACnet Device Instance 0 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	Parameter 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.

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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:

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* must be set to 0 Hz. Set the *par. 4-14 Motor Speed High Limit* 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.

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Object ID	Object Name	Read/ Write	Change able De-scrip-tion	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus time-out
AI:0	Analog Input 53	R	Yes	No	P 1662	Yes	NO
AI:1	Analog Input 54	R	Yes	No	P 1664	Yes	NO
AI:2	Analog In X30/11	R	Yes	No	P 1675	Yes	NO
AI:3	Analog In X30/12	R	Yes	No	P 1676	Yes	NO
AI:4	Analog Input X42/1	R	Yes	No	P 1830	Yes	NO
AI:5	Analog Input X42/3	R	Yes	No	P 1831	Yes	NO
AI:6	Analog Input X42/5	R	Yes	No	P 1832	Yes	NO

Table 5.1: Analog inputs

Object ID	Object Name	Read/ Write	Change able De-scrip-tion	Non vol-atile ram Store	Linked to FC100 Parame-ter	Alarm notifi-cation	Triggers Bus Time-out
AO:0	Terminal 42 Output Bus Control	W/R	Yes	No	P 653	No	Yes
AO:1	Pulse out #27 Bus Control	W/R	Yes	No	P 593	No	Yes
AO:2	Pulse out #29 Bus Control	W/R	Yes	No	P 595	No	Yes
AO:3	Analogue Out X30/8 [mA]	W/R	Yes	No	P 663	No	Yes
AO:4	Analogue output X42/7[V]	W/R	Yes	No	P 2643	No	Yes
AO:5	Analogue output X42/9[V]	W/R	Yes	No	P 2653	No	Yes
AO:6	Analogue output X42/11[V]	W/R	Yes	No	P 2663	No	Yes

Table 5.2: Analog outputs

Object ID	Object Name	Read/ Write	Changeable Description	Non volatile ram Store	FC100 Parameter	Alarm notification	Triggers Bus Time-out
AV:0	Reference	W/R	Yes	No	MRV	No	Yes
AV:1	Speed Act. Value	W/R	Yes	No	MAV	Yes	Yes
AV:2	Bus Feedback1	W/R	Yes	No	P 894	No	Yes
AV:3	Bus Feedback2	W/R	Yes	No	P 895	No	Yes
AV:4	Bus Feedback3	W/R	Yes	No	P 896	No	Yes
AV:5	Motor Voltage	Read	Yes	No	P 1612	Yes	No
AV:6	Motor Current	Read	Yes	No	P 1614	Yes	No
AV:7	Motor Torque %	Read	Yes	No	P 1622	Yes	No
AV:8	DC Link Voltage	Read	Yes	No	P 1630	Yes	No
AV:9	Motor thermal	Read	Yes	No	P 1618	Yes	No
AV:10	Heat sink Temperature	Read	Yes	No	P 1634	Yes	No
AV:11	Inverter Thermal	Read	Yes	No	P 1635	Yes	No
AV:12	Operating Hours	Read	No	No	P 1500	No	No
AV:13	Running Hours	Read	No	No	P 1501	No	No
AV:14	KWh Counter	Read	No	No	P 1502	No	No
AV:15	Power [KW]	Read	No	No	P 1610	No	No
AV:16	PID Start Speed [Hz]	W/R	No	FC 100	P 2083	No	No
AV:17	PID Proportional Gain	W/R	No	FC 100	P 2093	No	No
AV:18	PID Integral Time (Sec)	W/R	No	FC 100	P 20-94	No	No
AV:19	PID Differential Time (Sec)	W/R	No	FC 100	P 20-95	No	No
AV:20	PID Dif. Gain Limit	W/R	No	FC 100	P 20-96	No	No
AV:21	On Reference Bandwith	W/R	No	FC 100	P 20-84	No	No
AV:22	Ext. 1 Setpoint	W/R	No	FC 100	P 2115	No	No
AV:23	Ext. 1 Reference [Unit]	W/R	No	FC 100	P 2117	No	No
AV:24	Ext. 1 Feedback [Unit]	W/R	No	FC 100	P 2118	No	No
AV:25	Ext. 1 Propotional Gain	W/R	No	FC 100	P 2121	No	No
AV:26	Reserved	W/R	No	Na			
AV:27	Ext. 1 Integral Time (Sec)	W/R	No	FC 100	P 2122	No	No
AV:28	Ext. 1 Differential Time (Sec)	W/R	No	FC 100	P 2123	No	No
AV:29	Ext. 1 Dif. Gain Limit	W/R	No	FC 100	P 2124	No	No
AV:30	Reserved	W/R	No	Na			

Table 5.3: Analog values

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Object ID	Object Name	Read/ Write	Change able De-scrip-tion	Non vol-atile ram Store	FC100 Parame-ter	Alarm notifi-cation	Triggers Bus Time-out
AV:31	Ext. 2 Setpoint	W/R	No	FC 100	P 2135	No	No
AV:32	Ext. 2 refer-ence [Unit]	W/R	No	FC 100	P 2137	No	No
AV:33	Ext. 2 Feed-back [Unit]	W/R	No	FC 100	P 2138	No	No
AV:34	Ext. 2 Propor-tional Gain	W/R	No	FC 100	P 2141	No	No
AV:35	Ext. 2 Integral Time (Sec)	W/R	No	FC 100	P 2142	No	No
AV:36	Ext. 2 Differen-tial Time	W/R	No	FC 100	P 2143	No	No
AV:37	Ext. 2 Dif. Gain	W/R	No	FC 100	P 2144	No	No
AV:38	Ext. 3 Setpoint	W/R	No	FC 100	P 2155	No	No
AV:39	Ext. 3 Refer-ence [Unit]	W/R	No	FC 100	P 2157	No	No
AV:40	Ext. 3 Feed-back [Unit]	W/R	No	FC 100	P 2158	No	No
AV:41	Ext. 3 Propor-tional Gain	W/R	No	FC 100	P 2161	No	No
AV:42	Ext. 3 Integral Time (Sec)	W/R	No	FC 100	P 2162	No	No
AV:43	Ext. 3 Differen-tial Time (Sec)	W/R	No	FC 100	P 2163	No	No
AV:44	Ext. 3 Dif. Gain Limit	W/R	No	FC 100	P 2164	No	No
AV:45	Running By-pass	Read	No	No	P 3111	No	No

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 Par.	Alarm notification	Triggers Bus Time-out
BI:0	Digital input 33	Read	No	No	P 1660/00	No	No
BI:1	Digital input 32	Read	No	No	P 1660/01	No	No
BI:2	Digital input 29	Read	No	No	P 1660/02	No	No
BI:3	Digital input 27	Read	No	No	P 1660/03	No	No
BI:4	Digital input 19	Read	No	No	P 1660/04	No	No
BI:5	Digital input 18	Read	No	No	P 1660/05	No	No
BI:6	Digital input 37	Read	No	No	P 1660/06	No	No
BI:7	Digital input X30/2	Read	No	No	P 1660/07	No	No
BI:8	Digital input X30/3	Read	No	No	P 1660/08	No	No
BI:9	Digital input X30/4	Read	No	No	P 1660/09	No	No
BI:10	Digital input P1660/10*	Read	No	No	P 1660/10	No	No
BI:11	Digital input P1660/11*	Read	No	No	P 1660/11	No	No
BI:12	Digital input P1660/12*	Read	No	No	P 1660/12	No	No
BI:13	Digital input P1660/13*	Read	No	No	P 1660/13	No	No
BI:14	Digital input P1660/14*	Read	No	No	P 1660/14	No	No
BI:15	Digital input P1660/15*	Read	No	No	P 1660/15	No	No

Table 5.5: Binary inputs

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

*) Reserved for future options!

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Object Id	Object Name	Read/Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
BO:0	Digital output 27	W/R	No	No	P 590/00	No	Yes
BO:1	Digital output 29	W/R	No	No	P 590/01	No	Yes
BO:2	GPIO Output Term X30/6	W/R	No	No	P 590/02	No	Yes
BO:3	GPIO Output Term X30/7	W/R	No	No	P 590/03	No	Yes
BO:4	Relay 1 output	W/R	No	No	P 590/04	No	Yes
BO:5	Relay 2 output	W/R	No	No	P 590/05	No	Yes
BO:6	Option B Relay 1 output	W/R	No	No	P 590/06	No	Yes
BO:7	Option B Relay 2 output	W/R	No	No	P 590/07	No	Yes
BO:8	Option B Relay 3 output	W/R	No	No	P 590/08	No	Yes
BO:9	Reserved out-put P590/9	W/R	No	No	P 590/09	No	Yes
BO:10	Reserved out-put P590/10*	W/R	No	No	P 590/10	No	Yes
BO:11	Reserved out-put P590/11*	W/R	No	No	P 590/11	No	Yes
BO:12	Reserved out-put P590/12*	W/R	No	No	P 590/12	No	Yes
BO:13	Reserved out-put P590/13*	W/R	No	No	P 590/13	No	Yes
BO:14	Reserved out-put P590/14*	W/R	No	No	P 590/14	No	Yes
BO:15	Reserved out-put P590/15*	W/R	No	No	P 590/15	No	Yes
BO:16	Option C Relay 1 output	W/R	No	No	P 590/16	No	Yes
BO:17	Option C Relay 2 output	W/R	No	No	P 590/17	No	Yes
BO:18	Option C Relay 3 output	W/R	No	No	P 590/18	No	Yes
BO:19	Option C Relay 4 output	W/R	No	No	P 590/19	No	Yes
BO:20	Option C Relay 5 output	W/R	No	No	P 590/20	No	Yes
BO:21	Option C Relay 6 output	W/R	No	No	P 590/21	No	Yes
BO:22	Option C Relay 7 output	W/R	No	No	P 590/22	No	Yes
BO:23	Option C Relay 8 output	W/R	No	No	P 590/23	No	Yes
BO:24	Reserved out-put P590/24*	W/R	No	No	P 590/24	No	Yes
BO:25	Reserved out-put P590/25*	W/R	No	No	P 590/25	No	Yes

Table 5.6: Binary outputs

*) Reserved for future options!

Object Id	Object Name	Read/ Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
BO:30	Reserved out-put P590/30*	W/R	No	No	P 590/30	No	Yes
BO:31	Reserved out-put P590/31*	W/R	No	No	P 590/31	No	Yes
BO:36	Reserved out-put P590/26*	W/R	No	No	P 590/26	No	Yes
BO:37	Reserved out-put P590/27*	W/R	No	No	P 590/27	No	Yes
BO:38	Reserved out-put P590/28*	W/R	No	No	P 590/28	No	Yes
BO:39	Reserved out-put P590/29*	W/R	No	No	P 590/29	No	Yes

Table 5.7: Binay outputs cont.

*) Reserved for future options!

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Object ID	Object Name	Read / Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
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	P15-06	No	NO
BV:7	Reset Running Hours Counter	W	No	No	P15-07	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 = refer-ence	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 -20	Reserved	R	No				
BV:21	ECB test mode	R	No	NA	P 3110/00	No	No
BV:22	ECB Drivemode	R	No	NA	P 3110/01	No	No
BV:23	ECB aut. by-pass enable	R	No	NA	P 3110/02	No	No
BV:24	ECB bypass mode	R	No	NA	P 3110/03	No	No
BV:25	ECB state	R	No	NA	P 3110/05	Yes	No
BV:26	ECB overload trip	R	No	NA	P 3110/06	Yes	No
BV:27	M2 fault	R	No	NA	P 3110/07	Yes	No
BV:28	M3 fault	R	No	NA	P 3110/08	Yes	No
BV:29	ECB external interlock	R	No	NA	P 3110/09	Yes	No
BV:30	ECB manual override	R	No	NA	P 3110/10	No	No
BV:31	Reserved	R	No				

Table 5.8: Binary values

Object ID	Object Name	Read / Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
BV:40	Brake check	R	No	NA	P 1690/00	Yes	
BV:41	Pwr. Card Temp	R	No	NA	P 1690/01	Yes	
BV:42	Earth Fault	R	No	NA	P 1690/02	Yes	
BV:43	Ctrl.Card Temp	R	No	NA	P 1690/03	Yes	
BV:44	Ctrl. Word TO	R	No	NA	P 1690/04	Yes	
BV:45	Over Current	R	No	NA	P 1690/05	Yes	
BV:46	Torque Limit	R	No	NA	P 1690/06	Yes	
BV:47	Motor TH Over	R	No	NA	P 1690/07	Yes	
BV:48	Motor TH Over	R	No	NA	P 1690/08	Yes	
BV:49	Inverter Overld.	R	No	NA	P 1690/09	Yes	
BV:50	DC under Volt	R	No	NA	P 1690/10	Yes	
BV:51	DC over Volt	R	No	NA	P 1690/11	Yes	
BV:52	Short Circuit	R	No	NA	P 1690/12	Yes	
BV:53	Inrush Fault	R	No	NA	P 1690/13	Yes	
BV:54	Mains Fault	R	No	NA	P 1690/14	Yes	
BV:55	AMA Not OK	R	No	NA	P 1690/15	Yes	
BV:56	Live Zero Error	R	No	NA	P 1690/16	Yes	
BV:57	Internal Fault	R	No	NA	P 1690/17	Yes	
BV:58	Brake Overload	R	No	NA	P 1690/18	Yes	
BV:59	U Phase Loss	R	No	NA	P 1690/19	Yes	
BV:60	V Phase Loss	R	No	NA	P 1690/20	Yes	
BV:61	W Phase Loss	R	No	NA	P 1690/21	Yes	
BV:62	Fieldbus Fault	R	No	NA	P 1690/22	Yes	
BV:63	24 V Supply Low	R	No	NA	P 1690/23	Yes	
BV:64	Mains fault	R	No	NA	P 1690/24	Yes	
BV:65	1.8V supply low	R	No	NA	P 1690/25	Yes	
BV:66	Brake Failure	R	No	NA	P 1690/26	Yes	
BV:67	Brake IGBT	R	No	NA	P 1690/27	Yes	
BV:68	Option Changed	R	No	NA	P 1690/28	Yes	
BV:69	Drive Initial-ized	R	No	NA	P 1690/29	Yes	
BV:70	Safe Stop	R	No	NA	P 1690/30	Yes	
BV:71	Brake low	R	No	NA	P 1690/31	Yes	
BV:72	Service trip 1691/0	R	No	NA	P 1691/00	Yes	
BV:73	Service trip 1691/1	R	No	NA	P 1691/01	Yes	
BV:74	Service trip 1691/2	R	No	NA	P 1691/02	Yes	
BV:75	Service trip 1691/3	R	No	NA	P 1691/03	Yes	
BV:76	Service trip 1691/4	R	No	NA	P 1691/04	Yes	
BV:77	No flow	R	No	NA	P 1691/05	Yes	
BV:78	Dry Pump	R	No	NA	P 1691/06	Yes	
BV:79	Curve end	R	No	NA	P 1691/07	Yes	

Table 5.9: Binary values cont.

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Object ID	Object Name	Read / Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
BV:80	Broken Belt	R	No	NA	P 1691/08	Yes	
BV:81	Discharge High	R	No	NA	P 1691/08	Yes	
BV:82	Start fault	R	No	NA	P 1691/10	Yes	
BV:83	Speed limit	R	No	NA	P 1691/11	Yes	
BV:84	State fault 1691/12	R	No	NA	P 1691/12	Yes	
BV:85	State fault 1691/13	R	No	NA	P 1691/13	Yes	
BV:86	State fault 1691/14	R	No	NA	P 1691/14	Yes	
BV:87	State fault 1691/15	R	No	NA	P 1691/15	Yes	
BV:88	KTY Tempera-ture error	R	No	NA	P 1691/16	Yes	
BV:89	Drive Fan error	R	No	NA	P 1691/17	Yes	
BV:90	ECB error	R	No	NA	P 1691/18	Yes	
BV:91	Alarm 1692/19	R	No	NA	P 1691/19	Yes	
BV:92	Alarm 1692/20	R	No	NA	P 1691/20	Yes	
BV:93	Alarm 1692/21	R	No	NA	P 1691/21	Yes	
BV:94	Alarm 1692/22	R	No	NA	P 1691/22	Yes	
BV:95	Alarm 1692/23	R	No	NA	P 1691/23	Yes	
BV:96	Alarm 1692/24	R	No	NA	P 1691/24	Yes	
BV:97	Alarm 1692/25	R	No	NA	P 1691/25	Yes	
BV:98	Alarm 1692/26	R	No	NA	P 1691/26	Yes	
BV:99	Alarm 1692/27	R	No	NA	P 1691/27	Yes	
BV:100	Alarm 1692/28	R	No	NA	P 1691/28	Yes	
BV:101	Alarm 1692/29	R	No	NA	P 1691/29	Yes	
BV:102	Alarm 1692/30	R	No	NA	P 1691/30	Yes	
BV:103	Alarm 1692/31	R	No	NA	P 1691/31	Yes	
BV:104	Brake Check	R	No	NA	P 1692/00	Yes	
BV:105	Pwr. Card Temp	R	No	NA	P 1692/01	Yes	
BV:106	Earth Fault	R	No	NA	P 1692/02	Yes	
BV:107	Ctrl. Card Temp	R	No	NA	P 1692/03	Yes	
BV:108	Crtl. Word TO	R	No	NA	P 1692/04	Yes	
BV:109	Over Current	R	No	NA	P 1692/05	Yes	
BV:110	Torque Limit	R	No	NA	P 1692/06	Yes	
BV:111	Motor Th Over	R	No	NA	P 1692/07	Yes	
BV:112	Motor ETR Over	R	No	NA	P 1692/08	Yes	
BV:113	Inverter overld.	R	No	NA	P 1692/09	Yes	
BV:114	DC under Volt	R	No	NA	P 1692/10	Yes	
BV:115	DC over Volt	R	No	NA	P 1692/11	Yes	
BV:116	DC Voltage Low	R	No	NA	P 1692/12	Yes	
BV:117	DC Voltage high	R	No	NA	P 1692/13	Yes	
BV:118	Mains Ph. Loss	R	No	NA	P 1692/14	Yes	
BV:119	No Motor	R	No	NA	P 1692/15	Yes	
BV:120	Live Zero Error	R	No	NA	P 1692/16	Yes	

Table 5.10: Binary values cont.

Object ID	Object Name	Read / Write	Change- able De- scription	Non vol- atile ram Store	FC Par.	Alarm notifi- cation	Triggers Bus Time- out
BV:121	10V low	R	No	NA	P 1692/17	Yes	
BV:122	Brake Overload	R	No	NA	P 1692/18	Yes	
BV:123	Brake Resistor	R	No	NA	P 1692/19	Yes	
BV:124	Brake IGBT	R	No	NA	P 1692/20	Yes	
BV:125	Speed Limit	R	No	NA	P 1692/21	Yes	
BV:126	Fieldbus Fault	R	No	NA	P 1692/22	Yes	
BV:127	24V Supply Low	R	No	NA	P 1692/23	Yes	
BV:128	Mains Failure	R	No	NA	P 1692/24	Yes	
BV:129	Current Limit	R	No	NA	P 1692/25	Yes	
BV:130	Low Temp	R	No	NA	P 1692/26	Yes	
BV:131	Voltage Limit	R	No	NA	P 1692/27	Yes	
BV:132	Encoder loss	R	No	NA	P 1692/28	Yes	
BV:133	Output Freq. limit	R	No	NA	P 1692/29	Yes	
BV:134	Safe stop	R	No	NA	P 1692/30	Yes	
BV:135	Ext. Status	R	No	NA	P 1692/31	Yes	
BV:136	Start delayed	R	No	NA	P 1693/00	Yes	
BV:137	Stop delayed	R	No	NA	P 1693/01	Yes	
BV:138	Clock failure	R	No	NA	P 1693/02	Yes	
BV:139	Fire mode was active	R	No	NA	P 1693/03	Yes	
BV:140	Reserved, P1693/04	R	No	NA	P 1693/04	Yes	
BV:141	No Flow	R	No	NA	P 1693/05	Yes	
BV:142	Dry Pump	R	No	NA	P 1693/06	Yes	
BV:143	End of Curve	R	No	NA	P 1693/07	Yes	
BV:144	Belt Broken	R	No	NA	P 1693/08	Yes	
BV:145	Discharge High	R	No	NA	P 1693/09	Yes	
BV:146	Reserved, P1693/10	R	No	NA	P 1693/10	Yes	
BV:147	Reserved, P1693/11	R	No	NA	P 1693/11	Yes	
BV:148	Reserved, P1693/12	R	No	NA	P 1693/12	Yes	
BV:149	Reserved, P1693/13	R	No	NA	P 1693/13	Yes	
BV:150	Reserved, P1693/14	R	No	NA	P 1693/14	Yes	
BV:151	Reserved, P1693/15	R	No	NA	P 1693/15	Yes	
BV:152	Reserved, P1693/16	R	No	NA	P 1693/16	Yes	
BV:153	KTY Tempera- ture	R	No	NA	P 1693/17	Yes	
BV:154	Drive Fan fail- ure	R	No	NA	P 1693/18	Yes	
BV:155	ECB failure	R	No	NA	P 1693/19	Yes	

Table 5.11: Binary values cont.

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Object ID	Object Name	Read / Write	Change-able De-scription	Non vol-atile ram Store	FC Par.	Alarm notifi-cation	Triggers Bus Time-out
BV:156	Reserved, P1693/20	R	No	NA	P 1693/20	Yes	
BV:157	Reserved, P1693/21	R	No	NA	P 1693/21	Yes	
BV:158	Reserved, P1693/22	R	No	NA	P 1693/22	Yes	
BV:159	Reserved, P1693/23	R	No	NA	P 1693/23	Yes	
BV:160	Reserved, P1693/24	R	No	NA	P 1693/24	Yes	
BV:161	Reserved, P1693/25	R	No	NA	P 1693/25	Yes	
BV:162	Reserved, P1693/26	R	No	NA	P 1693/26	Yes	
BV:163	Reserved, P1693/27	R	No	NA	P 1693/27	Yes	
BV:164	Reserved, P1693/28	R	No	NA	P 1693/28	Yes	
BV:165	Reserved, P1693/29	R	No	NA	P 1693/29	Yes	
BV:166	PTC Tempera-ture	R	No	NA	P 1693/30	Yes	
BV:167	Reserved, P1693/31	R	No	NA	P 1693/31	Yes	
BV:168	Ramping ac-tive	R	No	NA	P 1694/00	No	
BV:169	AMA Running	R	No	NA	P 1694/01	No	
BV:170	Start CW/CCW	R	No	NA	P 1694/02	No	
BV:171	Slowdown	R	No	NA	P 1694/03	No	
BV:172	Catch up	R	No	NA	P 1694/04	No	
BV:173	Feedback High	R	No	NA	P 1694/05	No	
BV:174	Feedback Low	R	No	NA	P 1694/06	No	
BV:175	Output Current High	R	No	NA	P 1694/07	No	
BV:176	Output Current Low	R	No	NA	P 1694/08	No	
BV:177	Output Freq High	R	No	NA	P 1694/09	No	
BV:178	Output Freq low	R	No	NA	P 1694/10	No	
BV:178	Brake Check OK	R	No	NA	P 1694/11	No	
BV:180	Brake Max	R	No	NA	P 1694/12	No	

Table 5.12: Binary values cont.

Object ID	Object Name	Read / Write	Change-able Description	Non volatile ram Store	FC Par.	Alarm notification	Triggers Bus Time-out
BV:181	Braking	R	No	NA	P 1694/13	No	
BV:182	Out of Speed range	R	No	NA	P 1694/14	No	
BV:183	OVC Active	R	No	NA	P 1694/15	No	
BV:184	AC Brake	R	No	NA	P 1694/16	No	
BV:185	Password Timelock	R	No	NA	P 1694/17	No	
BV:186	Password status	R	No	NA	P 1694/18	No	
BV:187	Reference high	R	No	NA	P 1694/19	No	
BV:188	Reference low	R	No	NA	P 1694/20	No	
BV:189	Reference site	R	No	NA	P 1694/21	No	
BV:190	Reserved, P1694/22	R	No	NA	P 1694/22	No	
BV:191	Reserved, P1694/23	R	No	NA	P 1694/23	No	
BV:192	Reserved, P1694/24	R	No	NA	P 1694/24	No	
BV:193	Reserved, P1694/25	R	No	NA	P 1694/25	No	
BV:194	Reserved, P1694/26	R	No	NA	P 1694/26	No	
BV:195	Reserved, P1694/27	R	No	NA	P 1694/27	No	
BV:196	Reserved, P1694/28	R	No	NA	P 1694/28	No	
BV:197	Reserved, P1694/29	R	No	NA	P 1694/29	No	
BV:198	Reserved, P1694/30	R	No	NA	P 1694/30	No	
BV:199	Reserved, P1694/31	R	No	NA	P 1694/31	No	

Table 5.13: Binary values cont.

5.2.3. Multi-state Input- and Output Objects

Multi-state Variable

Object Id	Object Name	Read/ Write	Change-able Description	Non volatile ram Store	FC Par.	Alarm notification	Triggers Bus Time-out
MSV:0	SL Controller State	R	No	Non	P16-38	No	No
MSV:1	Setup selection	W/R	No	Non	Bit13&14 in CTW	No	No

Mailbox variable

Object Id	Object Name	Read/ Write	Change-able Description	Non vol-atile ram Store	FC Par.	Alarm no-tification	Triggers Bus Time-out
MBV:0	Mailbox Write	W/R	No	Non	PCV part of the send FC telegram	No	No
MBV:1	Mailbox Read	R	No	Non	PCV part of the re-ceive FC telegram	No	No

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 back-up function, which will lead to a time stop if the FC is unpowered. Some BACnet Master's can be programmed to send out the date and time as a Broadcast Telegram on a regular basis. The BACnet will update the real-time clock of the FC if it receives this type of telegram: "Telegram".

5.3. Frequency Converter Feedback to Network

The BACnet option provides several output variables (nvo's) 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, *parameters 8-50 to 8-56.*
The influence of the digital input terminals upon control of the frequency converter can be pro-grammed in *parameters 8-50 to 8-56*.

NB!
Par. 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 Ether Fieldbus OR Digital input terminal.

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

More detailed information and examples of logical relationship options are provided in the *Trou-bleshooting* chapter.

5.4.1. Object / Property Support Matrix

The following table summarises the Object Types and Properties supported:

Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value	File	Event notification class
Object identifier	X	X	X	X	X	X	X	X	X	X
Object Name	X	X	X	X	X	X	X	X	X	X
Object Type	X	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	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			

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Object / Property Support Matrix, continued..

Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value	File	Event notification class
Status Flags		X	X	X	X	X	X			
Event State		X	X	X	X	X	X			
Reliability		X	X	X	X	X	X			
Out-of-Service		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			
Priority Array			X	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						
File type									X	
File size									X	
Modification Date									X	
Archive									X	
Read Only									X	
File Access Method									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	FC RS485 [0]	[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 profile [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® HVAC Drive Operating Instructions, MG.11.Ax.yy* for a comprehensive parameter list or to the *VLT® HVAC Drive Programming Guide, MG.11.Cx.yy* for detailed descriptions of parameters.

6.2. Parameter Description

6.2.1. 8-** Comm. and Options

Parameter group for configuring communications and options.

8-01 Control Site

The setting in this parameter overrides the settings in par. 8-50 to 8-56.

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

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8-02 Control Word Source

Select the source of the control word: one of two serial interfaces or four installed options. During initial power-up, the frequency converter automatically sets this parameter to *Option A* [3] if it detects a valid fieldbus option installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets par. 8-02 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 will not change but the frequency converter will trip and display: Alarm 67 *Option Changed*.

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

This parameter cannot be adjusted while the motor is running.

8-03 Control Timeout Time

Range:		Function:
0 s*	[0.1 - 18000 s]	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 Time-out Function* will then be carried out.

In LonWorks the following variables will trigger the Control Word Time parameter:

      nviStartStop

      nviReset Fault

      nviControlWord

      nviDrvSpeedStpt

      nviRefPcnt

      nviRefHz

8-04 Control Timeout 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 Time-out Time*. Choice [20] only appears after setting the N2 protocol.

[0] *	Off
[1]	Freeze output

[2]	Stop
[3]	Jogging
[4]	Max. Speed
[5]	Stop and trip
[7]	Select set-up 1
[8]	Select set-up 2
[9]	Select set-up 3
[10]	Select set-up 4
[20]	N2 Override Release

In LonWorks, the time-out function is also activated when the following SNVT's fail to be updated within the time period specified in *par. 8-03 Control Time-out Time*:

nviStartStop	nviRefPcnt
nviReset Fault	nviRefHz
nviControlWord	
nviDrvSpeedStpt	

8-05 End-of-Timeout Function

Select the action after receiving a valid control word following a time-out. This parameter is active only when par. 8-04 is set to [Set-up 1-4].

| [0] | Hold set-up | Retains the set-up selected in par. 8-04 and displays a warning, until par. 8-06 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

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

| [0] * | Do not reset | Retains the set-up specified in par. 8-04, [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

This parameter has no function for LonWorks.

[0] *	Disable
[1]	Trigger on alarms
[2]	Trigger alarms/warn.

8-10 Control Profile

Select the interpretation of the control and status words corresponding to the installed fieldbus.

Only the selections valid for the fieldbus installed in slot A will be visible in the LCP display.

[0] *	FC profile

8-30 Protocol

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, Chapter 7, RS-485 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, Chapter 7, RS-485 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 RS-485 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.

NB!
Further details can be found in the BACnet and Metasys manuals.

8-31 Address

Range:		Function:
1*	[1 - 126]	Enter the address for the FC (standard) port. Valid range: 1 - 126.

8-32 FC Port Baud Rate

Option:		Function:
		Baud rate selection depends on Protocol selection in par. 8-30.
[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

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:	**Function:**
10 ms* [5 - 500 ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Max Response Delay

Range:	**Function:**
5000 ms* [5 - 10000 ms]	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 Max Inter-Char Delay

This parameter is active only when par. 8-30 is set to *FC MC* [1] protocol.

25 ms* [0 - 35 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

Select control of the coasting function via the terminals (digital input) and/or via the bus.

[0]	Digital input
[1]	Bus
[2]	Logic AND
[3] *	Logic OR

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

8-52 DC Brake Select

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

[0]	Digital input
[1]	Bus
[2]	Logic AND
[3] *	Logic OR

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

8-53 Start Select

Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.

[0]	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

'Select control of the frequency converter reverse function via the terminals (digital input) and/or via the fieldbus.

[0] *	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

Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.

[0]	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

Select control of the frequency converter Preset Reference selection via the terminals (digital input) and/or via the fieldbus.

[0]	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:		**Function:**
1*	[0 - 4194304]	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:	Function:
127* [0 - 127]	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:	Function:
1* [1 - 65534]	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:	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.

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

8-75 Initialisation Password

Range:	Function:
Size related* [0 - 0]	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.

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7.1.2. Alarm words

Alarm word, 16-90

Bit (Hex)	Alarm Word (Par. 16-90)
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Ctrl. card over temperature
00000010	Control word time-out
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 initialized
40000000	Safe Stop
80000000	Not used

Alarm word 2, 16-91

Bit (Hex)	Alarm Word 2 (Par. 16-91)
00000001	Service Trip, read / Write
00000002	Reserved
00000004	Service Trip, Typecode / Sparepart
00000008	Reserved
00000010	Reserved
00000020	No Flow
00000040	Dry Pump
00000080	End of Curve
00000100	Broken Belt
00000200	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

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7.1.3. Warning words

Warning word, 16-92

Bit (Hex)	Warning Word (Par. 16-92)
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Ctrl. card over temperature
00000010	Control word time-out
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, 16-93

Bit (Hex)	Warning Word 2 (Par. 16-93)
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

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7.1.4. Extended status words

Extended status word, Par. 16-94

Bit (Hex)	Extended Status Word (Par. 16-94)
00000001	Ramping
00000002	AMA tuning
00000004	Start CW/CCW
00000008	Not used
00000010	Not used
00000020	Feedback high
00000040	Feedback low
00000080	Output current high
00000100	Output current low
00000200	Output frequency high
00000400	Output frequency low
00000800	Brake check OK
00001000	Braking max
00002000	Braking
00004000	Out of speed range
00008000	OVC active
00010000	AC brake
00020000	Password Timelock
00040000	Password Protection
00080000	Reference high
00100000	Reference low
00200000	Local Ref./Remote Ref.
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

Extended status word 2, 16-95

Bit (Hex)	Extended Status Word 2 (Par. 16-95)
00000001	Off
00000002	Hand / Auto
00000004	Not used
00000008	Not used
00000010	Not used
00000020	Relay 123 active
00000040	Start Prevented
00000080	Control ready
00000100	Drive ready
00000200	Quick Stop
00000400	DC Brake
00000800	Stop
00001000	Standby
00002000	Freeze Output Request
00004000	Freeze Output
00008000	Jog Request
00010000	Jog
00020000	Start Request
00040000	Start
00080000	Start Applied
00100000	Start Delay
00200000	Sleep
00400000	Sleep Boost
00800000	Running
01000000	Bypass
02000000	Fire Mode
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

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7.2. LED Status

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

LED 1: Net Status

Phases	Bi-colour LED	Status
Power On	Red	The PROFIBUS card is defect. Contact Danfosss Drives
	Green	The PROFIBUS card is OK.
Search baud rate	Green	Searching for the baud rate. Check the connection to the master if it stays in this state.
Wait Parameterizing	Green	Baud rate found - waiting for parameters from the master.
	Red	Wrong parameters from the master.
Wait Configuration	Green	Parameters from master OK - waiting for configuration data.
	Red	Wrong Configuration data from the master.
Data Exchange	Green	Data Exchange between the master and the Frequency Converter is active.
	Red	Clear State. Warning 34 is active and a bus reaction in parameter 8-04 is executed.

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LED 2 : Module Status

Bi-colour LED	Status
No light	No PROFIBUS DPV1 communication is active.
Green	DP V1 communication from a Master Class 1 (PLC) is active.
Green	DP V1 communication from a Master Class 2 (MCT 10, FDT) is active.
Green	DP V1 communication from a Master Class 1 and 2 is active.
Red	Internal error.

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