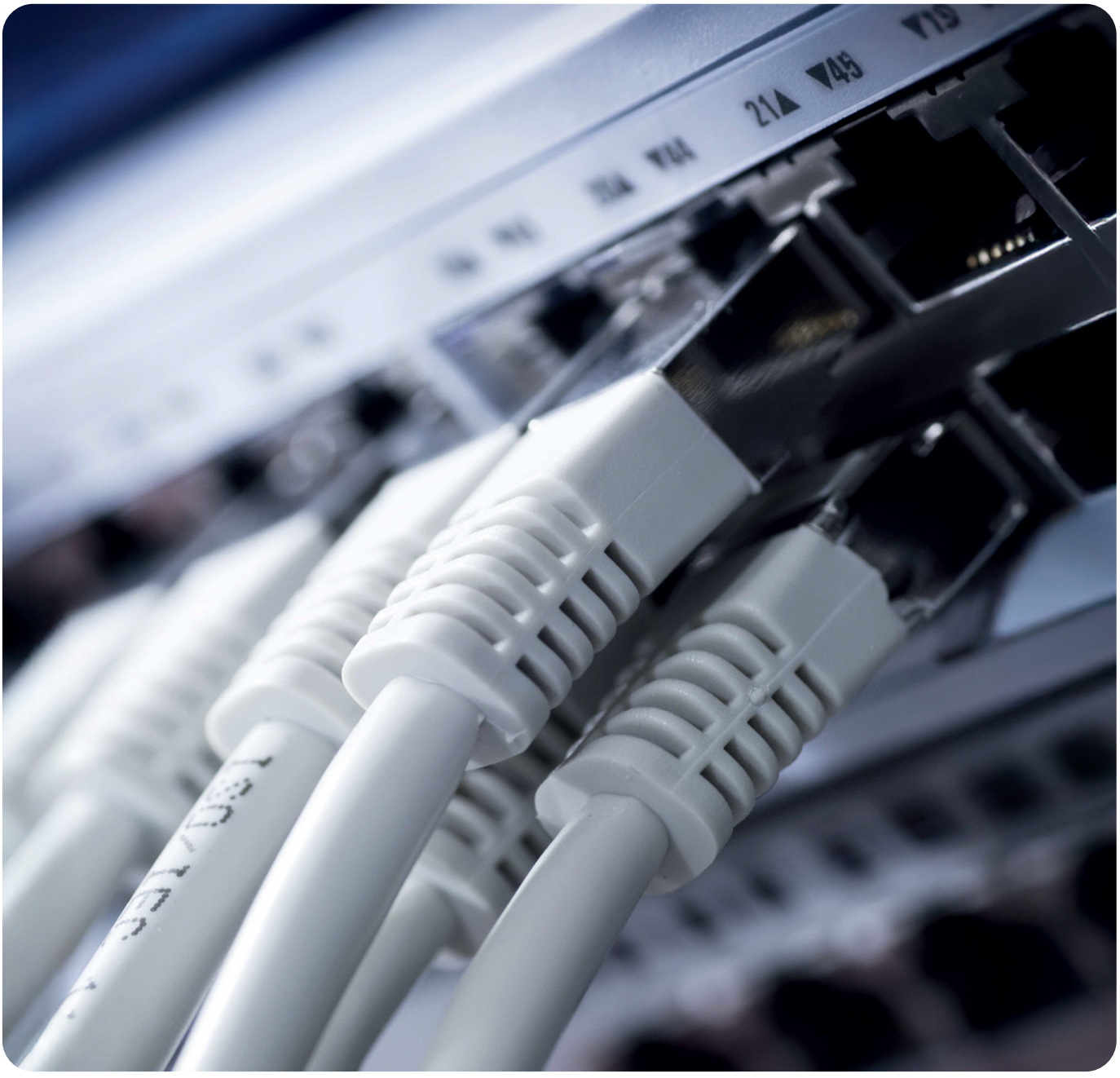
Programming Guide

VLT® BACnet/IP MCA 125

VLT® HVAC Drive FC 102, VLT® AQUA Drive FC 202



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1 Introduction

1.1 Purpose of the Programming Guide

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

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

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

1.2 Additional Resources

Resources available for the drives and for optional equipment:

- The operating guide of the relevant drive provides the necessary information for getting the drive up and running.
- The design guide of the relevant drive provides detailed information about capabilities and functionality to design motor control systems.
- The programming guide of the relevant drive provides greater details on working with parameters.
- The *VLT® Ethernet Fieldbuses MCA 12X Installation Guide* provides information about installing and troubleshooting the BACnet/IP interface.
- The *VLT® BACnet/IP MCA 125 Programming Guide* provides information about configuring the system, programming, and troubleshooting.
- The *VLT® Motion Control Tool MCT 10 Operating Guide* provides information for installation and use of the software on a PC.

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

1.2.1 Document and Software Version

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

The original language of this guide is in English.

Version	Remarks	Software Version	
		Drive	BACnet/IP MCA 125
AU361182716349, version 0201	Update to new software versions	FC 102: 9.7x FC 202: 5.8x	3.05

1.3 Intended Use

This installation guide relates to the BACnet/IP interface.

Code number:

- 134B1586 (conformal coated).

The BACnet/IP interface is designed to communicate with any system complying with the BACnet over Ethernet or BACnet/IP standard. BACnet/IP provides users with the network protocols to deploy standard Ethernet technology for manufacturing and building automation applications while enabling internet and enterprise connectivity.

VLT® BACnet/IP MCA 125 is intended for use with:

- VLT® HVAC Drive FC 102.

- VLT® AQUA Drive FC 202.

1.4 Approvals and Certifications

More approvals and certifications are available. For more information, contact a local Danfoss partner.

1.5 Disposal

Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

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

2.2 Qualified Personnel

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

Persons with proven skills:

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

2.3 Safety Precautions

⚠ WARNING

LACK OF SAFETY AWARENESS

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

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

⚠ WARNING

HAZARDOUS VOLTAGE

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

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

⚠ WARNING

UNINTENDED START

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

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

⚠ WARNING

DISCHARGE TIME

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

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

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

⚠ WARNING

ELECTRICAL SHOCK HAZARD - HIGH LEAKAGE CURRENT

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

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

⚠ WARNING

INTERNAL FAILURE HAZARD

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

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

3 Configuration

3.1 IP Settings

The VLT® BACnet/IP MCA 125 offers several ways of IP address assignment. All parameters related to IP assignment are in parameter group ***12-** IP Settings*** and are as follows:

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

Setting up the drive with a manually assigned IP address

Table 1: Parameter Settings for Manually Assigned IP Addresses

Parameter	Value
Parameter ***12-00 IP Address Assignment***	***[0] Manual***
Parameter ***12-01 IP Address***	192.168.0.xxx(1)
Parameter ***12-02 Subnet Mask***	255.255.255.0(1)
Parameter ***12-03 Default Gateway***	Optional

1) Class C IP address example. Any valid IP address can be entered.

NOTE: A power cycle is required after setting the IP parameters manually.

Setting up the drive with automatically (BOOTP/DHCP) assigned IP address or via the hardware switches

The interface supports IP address assignment through DHCP, BOOTP, and manual configuration.

DHCP:

When a valid IP address is received from the DHCP server, the assigned IP parameters are stored in parameters ***12-01 IP Address***, ***12-02 Subnet Mask***, and ***12-03 Default Gateway***. All these parameters are saved in EEPROM and retained after power-off.

BOOTP:

When a valid IP address is received from the BOOTP server, the assigned IP parameters are stored in parameters ***12-01 IP Address***, ***12-02 Subnet Mask***, and ***12-03 Default Gateway***. All these parameters are saved in EEPROM and retained after power-off.

Manual configuration:

The IP address, subnet mask, and gateway can be configured manually via VLT® Motion Control Tool MCT 10 or LCP in parameters ***12-01 IP Address***, ***12-02 Subnet Mask***, and ***12-03 Default Gateway***. The manually set parameters are saved in EEPROM and retained after power-off.

Table 2: Parameter Settings for Automatically Assigned IP Addresses

Parameter	Value
Parameter ***12-00 IP Address Assignment***	***[0] Manual*** ***[1] DHCP*** ***[2] BOOTP*** ***[3] Disable***
Parameter ***12-01 IP Address***	If ***[1] DHCP*** or ***[2] BOOTP*** is selected in parameter ***12-00 IP Address Assignment***, the parameter is read-only.
Parameter ***12-02 Subnet Mask***	If ***[1] DHCP*** or ***[2] BOOTP*** is selected in parameter ***12-00 IP Address Assignment***, the parameter is read-only.
Parameter ***12-03 Default Gateway***	If ***[1] DHCP*** or ***[2] BOOTP*** is selected in parameter ***12-00 IP Address Assignment***, the parameter is read-only.

When assigning the IP address by DHCP/BOOTP server or hardware switches, the assigned IP address and subnet mask can be read out in parameter ***12-01 IP Address*** and parameter ***12-02 Subnet Mask***. In parameter ***12-04 DHCP Server***, the IP address of the DHCP or BOOTP server found is shown.

For DHCP only: The remaining lease-time can be read out in parameter ***12-05 Lease Expires***.

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

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

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

Optional parameters used with domain name server systems:

- Parameter ***12-06 Name Servers***
- Parameter ***12-07 Domain Name***
- Parameter ***12-08 Host Name***

If DHCP or BOOTP is selected as IP address assignment, these parameters are read-only.

3.2 Ethernet Link Parameters

The following parameters provide Ethernet link information:

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

NOTE: The Ethernet link parameters are unique per port.

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

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

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

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

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

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

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

3.3 IP Traffic

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

3.4 BACnet Settings

All BACnet-related parameters are available in parameter groups ***8-7* BACnet*** and ***12-7* BACnet***.

Relevant parameters for parameter group ***8-7* BACnet***

- Parameter ***8-70 BACnet Device Instance***.
- Parameter ***8-74 "I-AM" Service***.
- Parameter ***8-75 Initialization Password***.
- Parameter ***8-76 VFD Fault Code Mapping New***.
- Parameter ***8-77 Custom Object List***.

The VLT® BACnet/IP MCA 125 shares these parameters with the built-in BACnet MS/TP interface. This means that if the BACnet MS/TP and the MCA 125 interfaces are connected at the same time, the settings affect both interfaces. It is not possible to assign a unique device instance to each interface. Therefore, the drive should only be connected to 1 network at a time for proper function of the BACnet.

Parameter ***8-70 BACnet Device Instance*** sets the device instance of the drive. Each device connected to the BACnet network must have a unique device instance. If 2 devices have the same device instance, the BACnet network goes into failure mode. When the DIP switches on the MCA 125 are set to On or Off, the option uses the value set in parameter ***8-70 BACnet Device Instance***. In all other cases, the option uses the values set by the DIP switches as device instance. If BACnet MS/TP is enabled on the RS-485 port of the control card, the BACnet MS/TP protocol uses parameter ***8-70 BACnet Device Instance***. By doing so, the drive can have 2 device instances.

Parameter ***8-74 "I-AM" Service*** sets the time interval for sending the "I-AM" telegram to the BACnet network. Select whether the device should send the "I-AM" message only at power-up, or continuously with an interval of approximately 1 minute.

In parameter ***8-75 Initialization Password***, enter the password needed for execution of drive reinitialization from BACnet. The default password is *admin*.

If parameter ***8-76 VFD Fault Code Mapping New*** is enabled, a new mapping method of the p-VFD fault codes according to the ASHRAE BACnet standard is used.

Parameter ***8-77 Custom Object List*** is used for configuring custom analog value objects. Custom objects are drive parameters which have been made accessible over BACnet. Custom objects are configured by entering parameter number into parameter ***8-77 Custom Object List***. This is an array parameter with 30 indices. Each array index corresponds to 1 BACnet object. Both standard drive parameters and user-defined parameters (parameter group ***19-**** are supported. Custom objects may use drive parameters which data type is integer. Parameters with complex data types such as strings, dates, and other non-integer data types are not supported. Parameter ***8-77 Custom Object List*** consists of 8 digits. The first 4 digits indicate the parameter number, and the last 4 digits indicate the array index. In cases

where an array index should not be indicated, enter 0000 in the first 4 digits followed by the parameter number in the last 4 digits. The user-defined objects are located in the analog value map of BACnet from address 0x66 to address 0x83. If an object is undefined (corresponding index in parameter ***8-77 Custom Object List*** is 0), then it is either not visible in BACnet or it is named "Not Configured", and the object is out of service. An object's name is “parameter XXXX.YY NNNN” where XXXX is the parameter number, YY is the array index, and NNNN is the parameter name in the LCP. The array index is shown for array parameters only. Long names may be cut off from the end. The properties of an object are the same as parameter properties in the drive. This means that data type, scaling, unit, and so on are the same as in the drive. If a parameter is editable in the drive, it is also possible to change its value in BACnet.

Relevant parameters for parameter group 12-7* BACnet

- Parameter ***12-70 BACnet Status***.
- Parameter ***12-71 BACnet Datalink***.
- Parameter ***12-72 BACnet UDP Port***.
- Parameter ***12-75 BBMD IP Address***.
- Parameter ***12-76 BBMD Port***.
- Parameter ***12-77 BBMD Reg. Interval***.
- Parameter ***12-78 Device ID Conflict***.
- Parameter ***12-79 Message Counter***.

Parameter group ***12-7* BACnet*** is only available if the drive has a BACnet/IP interface installed. Setting up this parameter group is only possible in the BACnet/IP MCA 125 interface. If the BACnet/IP has to run via IP network (UDP), this parameter group has a default setting which usually allows it to be omitted.

Parameter ***12-70 BACnet Status*** shows the status of the BACnet/IP MCA 125 interface. For detailed information, see 6.2.4 12-7* BACnet.

Parameter ***12-71 BACnet Datalink*** selects if the BACnet/IP MCA 125 interface uses the BACnet Ethernet, BACnet/IP, or all datalink layers. If all datalinks are selected, the BACnet/IP autodetects which BACnet layer to use.

Parameter ***12-72 BACnet UDP Port*** sets the port number used for UDP connection. It is recommended to use a port number within the ranges of 47808–47826 and 49752–65535.

Parameter ***12-75 BBMD IP Address*** sets the IP address of the remote BBMD management device. If set to 0.0.0.0, the foreign device function is disabled.

Parameter ***12-76 BBMD Port*** set the port number in the BBMD management device that handles the broadcast messages.

Parameter ***12-77 BBMD Reg. Interval*** sets the registration interval in seconds at which the drive re-registers itself in the remote BBMD managing device.

Parameter ***12-78 Device ID Conflict Detection*** specifies the time interval in minutes where the MCA 125 sends a "Who has" with its own device instance. This detects if a device has been programmed to use the same device instance (faulty configuration). *Warning 34, Fieldbus Fault* is issued until next detection.

Parameter ***12-79 Message Counter*** contains an array of 6 indices. They can be used to verify that the BMS controller sends data to the drive. Table 3 explains the indices.

Table 3: Index Descriptions

Index	Name	Description
[0]	Total bus messages	Total number of received and sent messages
[1]	Received messages	Total number of received bus messages
[2]	Sent messages	Total number of sent messages
[3]	Error messages	Total number of error messages

Table 3: Index Descriptions - (continued)

Index	Name	Description
[4]	Retried messages	Total number of retried (timed out) messages
[5]	Control word timeout messages	Total number of control word timeout error messages on an object.

For information about the BACnet broadcast management device (BBMD), see 5.5 Foreign Device.

3.5 Network Monitoring

In control systems, it is of the highest priority that the controller and the network work correctly. The VLT® BACnet/IP MCA 125 is designed to monitor that controller and network are available to the system.

Typical faults detected by the MCA 125

- Power loss (controller or network components).
- Cable faults (broken cable).
- Malfunction of network components (partly).
- Controller program stopped execution.

For indication of fieldbus faults detected by the fieldbus option directly, the option can activate *warning 34, Fieldbus fault* (W34). *Warning 34, Fieldbus fault* is suppressed for 60 s after power-up to allow the controller to establish connection to the MCA 125.

For monitoring the communication to the controller, the drive has a timer which can be set to a value from 0.5–18.000 s (5 hrs). The timer starts the countdown when it receives a valid write command to 1 of the objects listed in Table 4.

Table 4: Objects to Trigger Countdown

Object type	Short name	Object number
Analog output	AO	All
Analog value	AV	1, 2, 31, 36, 41
Binary value	BV	1, 2, 25, 26, 27
Multistage value	MS	1

The controller has to re-trigger the timer within the time set in parameter ***8-03 Control Timeout Time***. If the controller fails to re-trigger the timer within the time frame, the drive issues *alarm 17, Ctrl.word TO*, and executes 1 or more of the following commands:

- Sets the motor into a well-defined state, for example, parameter ***8-04 Control Timeout Function[5] Stop and trip***.
- Sets digital outputs to a well-defined state, for example, On, Off, No change.
- Sets analog outputs to a well-defined state, for example, 0–100%, No change.

By this, the drive reacts in a known way when communication faults occur. When communication is re-established, the function selected in parameter ***8-05 End-of-Timeout Function*** defines how the drive acts when communication is restored.

Table 5: Parameters for Monitoring Communication

ID	Name	Factory setup	Note
8-03	Control Timeout Time	60.0 s	Application dependent.
8-04	Control Timeout Function	Off	Application dependent.
8-05	End-of-Timeout Function	Resume setup	If the setup changes in parameter ***8-04 Control Timeout Function***.
8-06	Reset Control Timeout	Do not reset	No BACnet access.

Table 5: Parameters for Monitoring Communication - (continued)

ID	Name	Factory setup	Note
5-30	Terminal 27, D Output	No operation	Application dependent.
5-31	Terminal 29, D Output	No operation	Application dependent.
5-40	Function Relay 1 & 2	Alarm; running	Application dependent.
6-51	Terminal 42 Output	No operation	Application dependent.

The monitoring feature

The monitoring feature works from the simple state machine as shown in Figure 1.

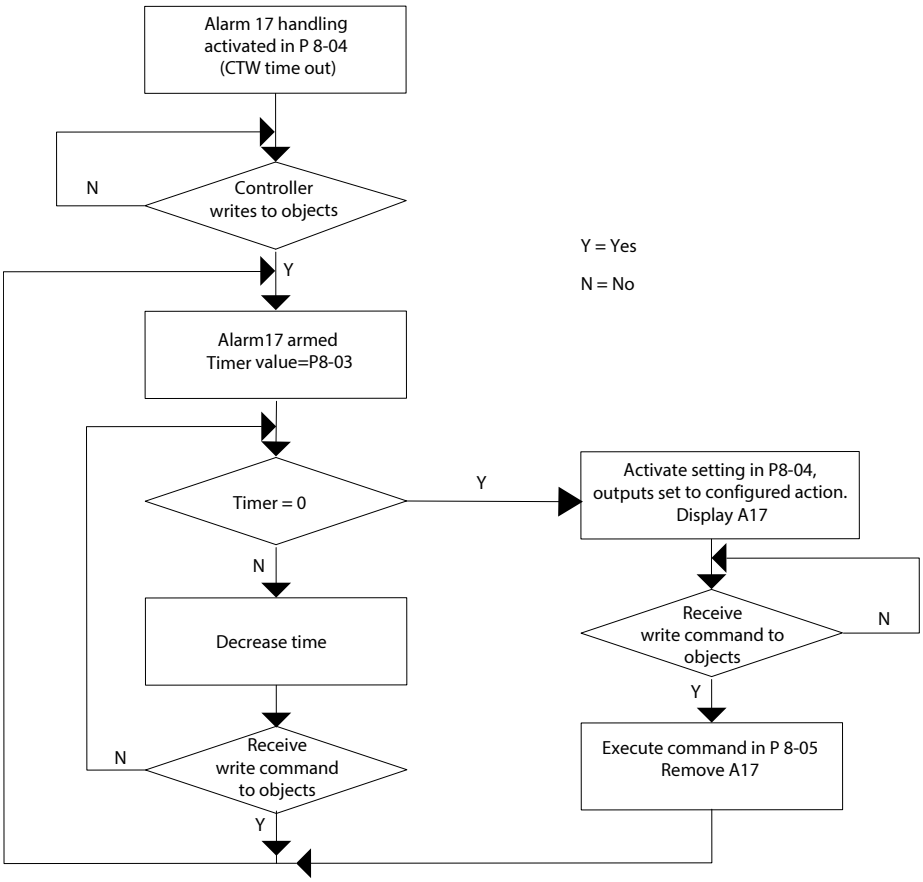


Figure 1: Simple State Machine

Parameter ***8-03 Control Timeout Time***defines the maximum time frame between writing to the present value of 1 of the objects that keeps *alarm 17, Ctrl.word TO* suppressed. The value set in parameter ***8-03 Control Timeout Time*** should not exceed the time frame which the application tolerates without failing or leading to faults. It has been proven that sending 3 write commands within the time set in parameter ***8-03 Control Timeout Time*** gives a stable system. In noisy environments, the numbers can be set higher, but as a 1st step, improve the installation.

Example

A cooling tower can accept loss of communication for up to 3 minutes. Parameter ***8-03 Control Timeout Time*** is therefore set to 180 s. The controller is programmed to send a write command every 60 s and allows 2 commands to be lost before issuing *alarm 17, Ctrl.word TO*. When the fault occurs, the drive is set to ***[4] Max. speed*** in parameter ***8-04 Control Timeout Function***. This setting generates maximum cooling, which is the best action for the application. The default value of parameter ***8-05 End-of-Timeout Function*** is ***[1] Resume setup***, since no setup change is selected in parameter ***8-04 Control Timeout Function***.

4 BACnet Objects

The following objects are supported by VLT® BACnet/IP MCA 125:

- Device
- Binary input
- Binary output
- Binary value
- Analog input
- Analog output
- Analog value
- Multistate value
- Loop
- Notification class
- Calendar
- Schedule
- Trend log
- Event enrollment
- CharacterString value
- Exception calendar

4.1 Object Specifications

4.1.1 BACnet AI Objects

Table 6: AI Objects

ID	Object name	R/W	Command-able	COV	Parameter	Unit	Unit change-able	Available from	Drive series
AI:0	Analog input 53	R	Yes	Yes	1662	%	No	Control card	FC 102/FC 202
AI:1	Analog input 54	R	Yes	Yes	1664	%	No	Control card	FC 102/FC 202
AI:2	Analog in X30/11	R	Yes	No	1675	%	No	MCB 101	FC 102/FC 202
AI:3	Analog in X30/12	R	Yes	No	1676	%	No	MCB 101	FC 102/FC 202
AI:4	Analog in X42/1	R	Yes	No	1830	V(1)	No	MCB 109	FC 102/FC 202
AI:5	Analog in X42/3	R	Yes	No	1831	V(1)	No	MCB 109	FC 102/FC 202
AI:6	Analog in X42/5	R	Yes	No	1832	V(1)	No	MCB 109	FC 102/FC 202
AI:7	Analog input X48/2	R	Yes	No	1836	%	No	MCB 114	FC 102/FC 202

Table 6: AI Objects - (continued)

ID	Object name	R/W	Command-able	COV	Parameter	Unit	Unit change-able	Available from	Drive series
AI:8	Analog input X48/4	R	Yes	No	1837	°C	Yes	MCB 114	FC 102/FC 202
AI:9	Analog input X48/7	R	Yes	No	1838	°C	Yes	MCB 114	FC 102/FC 202
AI:10	Analog input X48/10	R	Yes	No	1839	°C	Yes	MCB 114	FC 102/FC 202
AI:11	Analog input X49/1	R	Yes	Yes	1840	V/A/T	Yes	MCB 115	FC 102/FC 202
AI:12	Analog input X49/3	R	Yes	Yes	1841	V/A/T	Yes	MCB 115	FC 102/FC 202
AI:13	Analog input X49/5	R	Yes	Yes	1842	V/A/T	Yes	MCB 115	FC 102/FC 202
AI:14	Pressure sensor 1	R	–	No	3126	Pascal	No	Control card	FC 102
AI:15	Pressure sensor 2	R	–	No	3127	Pascal	No	Control card	FC 102
AI:16	Pressure sensor 3	R	–	No	3128	Pascal	No	Control card	FC 102
AI:17	Pressure sensor 4	R	–	No	3129	Pascal	No	Control card	FC 102

*1) This unit is defined in parameters **26-00 Terminal X42/1 Mode**, **26-01 Terminal X42/3 Mode**, and **26-02 Terminal X42/5 Mode**. The unit cannot be changed from the BACnet.*

4.1.2 BACnet AO Objects

Table 7: AO Objects

ID	Object name	Unit	Changeable units	R/W	COV	Command-able	Parameter	Available from
AO:0	Terminal 42 output bus control	%	No	R/W	No	Yes	653	Control card
AO:1	Pulse out #27 bus control	%	No	R/W	No	Yes	593	Control card
AO:2	Pulse out #29 bus control	%	No	R/W	No	Yes	595	Control card
AO:3	Terminal X30/8 output bus control	%	No	R/W	No	Yes	663	MCB 101
AO:4	Analog output X42/7	V	Yes	R/W	No	Yes	2643	MCB 109

Table 7: AO Objects - (continued)

ID	Object name	Unit	Changeable units	R/W	COV	Command-able	Parameter	Available from
AO:5	Analog output X42/9	V	Yes	R/W	No	Yes	2653	MCB 109
AO:6	Analog output X42/11	V	Yes	R/W	No	Yes	2663	MCB 109
AO:7	Analog output X49/7	V	Yes	R/W	No	Yes	3644	MCB 115
AO:8	Analog output X49/9	V	Yes	R/W	No	Yes	3654	MCB 115
AO:9	Analog output X49/11	V	Yes	R/W	No	Yes	3664	MCB 115
AO:10	Analog output X45/1	V	Yes	R	No	Yes	1678	MCB 113
AO:11	Analog output X45/3	V	Yes	R	No	Yes	1679	MCB 113

4.1.3 BACnet AV Objects

Table 8: AV Objects

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:0	Speed act value	%	No	R	Yes	No	1682	Control card	FC 102/FC 202
AV:1	Input reference 1	%	No	R/W	No	Yes	1682	Control card	FC 102/FC 202
AV:2	Input reference 2	%	No	R/W	No	Yes	1682	Control card	FC 102/FC 202
AV:3	Output speed	%	Yes	R	No	No	–	Control card	FC 102/FC 202
AV:4	PID feedback	%	No	R	No	No	–	Control card	FC 102/FC 202
AV:5	Motor current	Amps	Yes	R	Yes	No	1614	Control card	FC 102/FC 202
AV:6	Power	KW	Yes	R	Yes	No	1610	Control card	FC 102/FC 202
AV:15	Motor thermal	%	No	R	Yes	No	1618	Control card	FC 102/FC 202
AV:21	Operating hours	Hours	No	R	No	No	1500	Control card	FC 102/FC 202
AV:22	Running hours	Hours	No	R	No	No	1501	Control card	FC 102/FC 202
AV:23	kWh counter	kWh	Yes	R	No	No	1502	Control card	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:24	Motor voltage	V	Yes	R	No	No	1612	Control card	FC 102/FC 202
AV:25	Frequency	Hz	No	R	Yes	No	1613	Control card	FC 102/FC 202
AV:26	Torque	%	No	R	Yes	No	1622	Control card	FC 102/FC 202
AV:27	DC link voltage	V	Yes	R	No	No	1630	Control card	FC 102/FC 202
AV:28	Heatsink temp.	°Deg	Yes	R	No	No	1634	Control card	FC 102/FC 202
AV:29	Inverter thermal	%	No	R	No	No	1635	Control card	FC 102/FC 202
AV:30	Setpoint 1	%	No	R/W	No	No	2021	Control card	FC 102/FC 202
AV:31	Bus feedback 1	%	No	R/W	No	No	894	Control card	FC 102/FC 202
AV:58	Sensorless readout	None	No	R	Yes	No	1850	Control card	FC 102/FC 202
AV:59	PID output	%	No	R	No	No	1658	Control card	FC 102/FC 202
AV:60	PID set-point	Same as feedback unit	No	R	No	No	1659	Control card	FC 102/FC 202
AV:61	Alarm word 1	None	No	R	No	No	1690	Control card	FC 102/FC 202
AV:62	Alarm word 2	None	No	R	No	No	1691	Control card	FC 102/FC 202
AV:63	Alarm word 3	None	No	R	No	No	1697	Control card	FC 102/FC 202
AV:65	External reference	None	No	R	No	No	1650	Control card	FC 102/FC 202
AV:66	Warning word 1	None	No	R	No	No	1692	Control card	FC 102/FC 202
AV:67	Warning word 2	None	No	R	No	No	1693	Control card	FC 102/FC 202
AV:68	Warning word 3	None	No	R	No	No	1698	Control card	FC 102/FC 202
AV:70	Feedback [unit]	Same as feedback unit	No	R	Yes	No	1652	Control card	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:71	AirPressure To Air Flow 2	M^2/H	–	–	–	–	1857	Control card	FC 102
AV:72	Flow	M^2/H	–	–	–	–	2969	–	FC 202
AV:73	Cascade % of total ca-pacity	%	–	–	–	–	2792	MCO 102	FC 202
AV:74	Ext. status word	None	–	–	–	–	1694	–	FC 102/FC 202
AV:75	Ext. status word 2	None	–	–	–	–	1695	–	FC 102/FC 202
AV:80	Below level threshold [0]	Pascal	–	R/W	–	–	3121[0]	Control card	FC 102
AV:81	Below level threshold [1]	Pascal	–	R/W	–	–	3121[1]	Control card	FC 102
AV:82	Below level threshold [2]	Pascal	–	R/W	–	–	3121[2]	Control card	FC 102
AV:83	Below level threshold [3]	Pascal	–	R/W	–	–	3121[3]	Control card	FC 102
AV:84	Above level threshold [0]	Pascal	–	R/W	–	–	3122[0]	Control card	FC 102
AV:85	Above level threshold [1]	Pascal	–	R/W	–	–	3122[1]	Control card	FC 102
AV:86	Above level threshold [2]	Pascal	–	R/W	–	–	3122[2]	Control card	FC 102
AV:87	Above level threshold [3]	Pascal	–	R/W	–	–	3122[3]	Control card	FC 102
AV:88	On delay time [0]	Sec.	–	R/W	–	–	3123[0]	Control card	FC 102
AV:89	On delay time [1]	Sec.	–	R/W	–	–	3123[1]	Control card	FC 102
AV:90	On delay time [2]	Sec.	–	R/W	–	–	3123[2]	Control card	FC 102
AV:91	On delay time [3]	Sec.	–	R/W	–	–	3123[3]	Control card	FC 102

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:92	Reset delay time [0]	Sec.	–	R/W	–	–	3124[0]	Control card	FC 102
AV:93	Reset delay time [1]	Sec.	–	R/W	–	–	3124[1]	Control card	FC 102
AV:94	Reset delay Time [2]	Sec.	–	R/W	–	–	3124[2]	Control card	FC 102
AV:95	Reset delay time [3]	Sec.	–	R/W	–	–	3124[3]	Control card	FC 102
AV:96	CBM Stator [%]	%	No	R	Yes	No	4590	CBM li-cense re-quired	FC 102/FC 202
AV:97	CBM Load [%]	%	No	R	Yes	No	4591	CBM li-cense re-quired	FC 102/FC 202
AV:98	CBM Sen-sor 1 [%]	%	No	R	Yes	No	4592	CBM li-cense re-quired	FC 102/FC 202
AV:99	CBM Sen-sor 2 [%]	%	No	R	Yes	No	4594	CBM li-cense re-quired	FC 102/FC 202
AV:100	CBM Sen-sor 3 [%]	%	No	R	Yes	No	4596	CBM li-cense re-quired	FC 102/FC 202
AV:101	CBM Sen-sor 4 [%]	%	No	R	Yes	No	4598	CBM li-cense re-quired	FC 102/FC 202
AV:102	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[0]	Soft-ware for MCA125	FC 102/FC 202
AV:103	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[1]	Soft-ware for MCA125	FC 102/FC 202
AV:104	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[2]	Soft-ware for MCA125	FC 102/FC 202
AV:105	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[3]	Soft-ware for MCA125	FC 102/FC 202
AV:106	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[4]	Soft-ware for MCA125	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:107	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[5]	Soft-ware for MCA125	FC 102/FC 202
AV:108	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[6]	Soft-ware for MCA125	FC 102/FC 202
AV:109	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[7]	Soft-ware for MCA125	FC 102/FC 202
AV:110	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[8]	Soft-ware for MCA125	FC 102/FC 202
AV:111	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[9]	Soft-ware for MCA125	FC 102/FC 202
AV:112	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[10]	Soft-ware for MCA125	FC 102/FC 202
AV:113	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[11]	Soft-ware for MCA125	FC 102/FC 202
AV:114	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[12]	Soft-ware for MCA125	FC 102/FC 202
AV:115	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[13]	Soft-ware for MCA125	FC 102/FC 202
AV:116	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[14]	Soft-ware for MCA125	FC 102/FC 202
AV:117	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[15]	Soft-ware for MCA125	FC 102/FC 202
AV:118	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[16]	Soft-ware for MCA125	FC 102/FC 202
AV:119	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[17]	Soft-ware for MCA125	FC 102/FC 202
AV:120	Custom ob-ject	User de-fined	Yes	R/W	No	No	877[18]	Soft-ware for MCA125	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:121	Custom object	User defined	Yes	R/W	No	No	877[19]	Software for MCA125	FC 102/FC 202
AV:122	Custom object	User defined	Yes	R/W	No	No	877[20]	Software for MCA125	FC 102/FC 202
AV:123	Custom object	User defined	Yes	R/W	No	No	877[21]	Software for MCA125	FC 102/FC 202
AV:124	Custom object	User defined	Yes	R/W	No	No	877[22]	Software for MCA125	FC 102/FC 202
AV:125	Custom object	User defined	Yes	R/W	No	No	877[23]	Software for MCA125	FC 102/FC 202
AV:126	Custom object	User defined	Yes	R/W	No	No	877[24]	Software for MCA125	FC 102/FC 202
AV:127	Custom object	User defined	Yes	R/W	No	No	877[25]	Software for MCA125	FC 102/FC 202
AV:128	Custom object	User defined	Yes	R/W	No	No	877[26]	Software for MCA125	FC 102/FC 202
AV:129	Custom object	User defined	Yes	R/W	No	No	877[27]	Software for MCA125	FC 102/FC 202
AV:130	Custom object	User defined	Yes	R/W	No	No	877[28]	Software for MCA125	FC 102/FC 202
AV:131	Custom object	User defined	Yes	R/W	No	No	877[29]	Software for MCA125	FC 102/FC 202
AV:132	Freeze fault log for download	–	Yes	R/W	No	No	–	Software for MCA125	FC 102/FC 202
AV:133	Amount of faults	–	No	R	No	No	–	Software for MCA125	FC 102/FC 202
AV:134	Fault index	–	Yes	R/W	No	No	–	Software for MCA125	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:135	Fault num-ber	–	No	R	No	No	4330/1530	Soft-ware for MCA125	FC 102/FC 202
AV:136	Fault sub-code	–	No	R	No	No	4331/1531	Soft-ware for MCA125	FC 102/FC 202
AV:137	Fault time	–	No	R	No	No	4332/1532	Soft-ware for MCA125	FC 102/FC 202
AV:138	Fault date	–	No	R	No	No	4333/1533	Soft-ware for MCA125	FC 102/FC 202
AV:139	Fault set-point	–	No	R	No	No	4334/1534	Soft-ware for MCA125	FC202
AV:140	Fault feed-back	–	No	R	No	No	4335/1535	Soft-ware for MCA125	FC202
AV:141	Fault de-mand	–	No	R	No	No	4336/1536	Soft-ware for MCA125	FC202
AV:142	Fault speed	–	No	R	No	No	4338/1538	Soft-ware for MCA125	FC 102/FC 202
AV:143	Fault dura-tion	–	No	R	No	No	4339	Soft-ware for MCA125	FC 102/FC 202
AV:144	Fault ext. ref	–	No	R	No	No	4340/4040	Soft-ware for MCA125	FC 102/FC 202
AV:145	Fault fre-quency	–	No	R	No	No	4341/4041	Soft-ware for MCA125	FC 102/FC 202
AV:146	Fault cur-rent	–	No	R	No	No	4342/4042	Soft-ware for MCA125	FC 102/ FC 202
AV:147	Fault volt-age	–	No	R	No	No	4343/4043	Soft-ware for MCA125	FC 102/FC 202
AV:148	Fault DC link voltage	–	No	R	No	No	4344/4044	Soft-ware for MCA125	FC 102/FC 202

Table 8: AV Objects - (continued)

ID	Object name	Unit	Change-able Unit	R/W	COV	Command-able	Parameter	Available from	Drive series
AV:149	Fault con-trol word	–	No	R	No	No	4345/4045	Soft-ware for MCA125	FC 102/FC 202
AV:150	Fault status word	–	No	R	No	No	4346/4046	Soft-ware for MCA125	FC 102/FC 202
AV:151	Fault torque	–	No	R	No	No	4347/4047	Soft-ware for MCA125	FC 102/FC 202
AV:152	Fault CBM value	–	No	R	No	No	4348/4048	Software AND CBM license for MCA125	FC 102/FC 202
AV:153	Fault CBM threshold	–	No	R	No	No	4349/4049	Software AND CBM license for MCA125	FC 102/FC 202

4.1.4 BACnet BI Objects

Table 9: BI Objects

ID	Object name	Unit	R/W	Commandable	Parameter	Available from
BI:0	Digital input term 33	On/Off	R	Yes	1660, bit 0	Control card
BI:1	Digital input term 32	On/Off	R	Yes	1660, bit 1	Control card
BI:2	Digital input term 29	On/Off	R	Yes	1660, bit 2	Control card
BI:3	Digital input term 27	On/Off	R	Yes	1660, bit 3	Control card
BI:4	Digital input term 19	On/Off	R	Yes	1660, bit 4	Control card
BI:5	Digital input term 18	On/Off	R	Yes	1660, bit 5	Control card
BI:6	Digital input term 37	On/Off	R	Yes	1660, bit 6	Control card
BI:7	Digital input GPIO term X30/4	On/Off	R	Yes	1660, bit 7	MCB 101
BI:8	Digital input GPIO term X30/3	On/Off	R	Yes	1660, bit 8	MCB 101
BI:9	Digital input GPIO term X30/2	On/Off	R	Yes	1660, bit 9	MCB 101

Table 9: BI Objects - (continued)

ID	Object name	Unit	R/W	Commandable	Parameter	Available from
BI:10	Digital input ext. relay card X46/13	On/Off	R	Yes	1660, bit 10	MCB 113
BI:11	Digital input ext. relay card X46/11	On/Off	R	Yes	1660, bit 11	MCB 113
BI:12	Digital input ext. relay card X46/09	On/Off	R	Yes	1660, bit 12	MCB 113
BI:13	Digital input ext. relay card X46/07	On/Off	R	Yes	1660, bit 13	MCB 113
BI:14	Digital input ext. relay card X46/05	On/Off	R	Yes	1660, bit 14	MCB 113
BI:15	Digital input ext. relay card X46/03	On/Off	R	Yes	1660, bit 15	MCB 113
BI:16	Digital input ext. relay card X46/01	On/Off	R	Yes	1660, bit 16	MCB 113

4.1.5 BACnet BO Objects

Table 10: BO Objects

ID	Object name	Unit	R/W	Commandable	Parameter	Available from
BO:0	Digital output term 27	On/Off	R/W	Yes	5-90, bit 0	Control card
BO:1	Digital output term 29	On/Off	R/W	Yes	5-90, bit 1	Control card
BO:2	GPIO output term X30/6	On/Off	R/W	Yes	5-90, bit 2	MCB 101
BO:3	GPIO output term X30/7	On/Off	R/W	Yes	5-90, bit 3	MCB 101
BO:4	Relay 1	On/Off	R/W	Yes	5-90, bit 4	Control card
BO:5	Relay 2	On/Off	R/W	Yes	5-90, bit 5	Control card
BO:6	Option B relay 1 output	On/Off	R/W	Yes	5-90, bit 6	MCB 105
BO:7	Option B relay 2 output	On/Off	R/W	Yes	5-90, bit 7	MCB 105
BO:8	Option B relay 3 output	On/Off	R/W	Yes	5-90, bit 8	MCB 105
BO:9	Digital input programmable op. term X49/7	On/Off	R/W[(1)]	Yes	5-90, bit 24	MCB 115
BO:10	Digital input programmable op. term X49/9	On/Off	R/W[(1)]	Yes	5-90, bit 25	MCB 115

Table 10: BO Objects - (continued)

ID	Object name	Unit	R/W	Commandable	Parameter	Available from
BO:11	Digital input programmable op. term X49/11	On/Off	R/W(1)	Yes	5-90, bit 26	MCB 115
BO:12	Extended relay card 1 output	On/Off	R/W(1)	Yes	16-71, bit 4	MCB 113
BO:13	Extended relay card 2 output	On/Off	R/W(1)	Yes	16-71, bit 3	MCB 113
BO:14	Extended relay card 3 output	On/Off	R/W(1)	Yes	16-71, bit 2	MCB 113
BO:15	Extended relay card 4 output	On/Off	R/W(1)	Yes	16-71, bit 7	MCB 113

*1) Write can only be done if parameters **36-41 Terminal X49/7 Digital Output**, **36-51 Terminal X49/9 Digital Output**, **36-61 Terminal X49/11 Digital Output** are set to **[45] Bus ctrl**, **[46] Bus ctrl, 1 if timeout**, **[47] Bus ctrl, 0 if timeout**.*

4.1.6 BACnet BV Objects

Table 11: BV Objects

ID	Object name	R/W	COV	Commandable	Parameter + Bit #	Available from	Drive series
BV:1	RUN/STOP command	R/W	No	Yes	CTW=047c + bit 15	Control card	–
BV:2	REF 1/REF 2 select	R/W	No	Yes	Note 1	Control card	–
BV:3	Fault reset command	R/W	No	No	CTW bit 7	Control card	–
BV:4	RUN/STOP monitor	R	No	No	STW bit 1	Control card	–
BV:5	OK/FAULT monitor	R	No	No	STW bits 3, 6, and 7	Control card	–
BV:6	HAND/AUTO reference	R	No	No	16-95 bit 1	Control card	–
BV:21	Warning	R	No	No	STW bit 7	Control card	–
BV:22	Trip	R	No	No	STW bit 3	Control card	–
BV:23	Triplock	R	No	No	STW bit 6	Control card	–
BV:24	Coasting	R/W	No	Yes	CTW bit 3	Control card	–
BV:25	CW/CCW	R/W	No	Yes	CTW bit 15	Control card	–
BV:26	Jog	R/W	No	Yes	CTW bit 8	Control card	–
BV:27	Reset	R/W	No	Yes	CTW bit 7	Control card	–
BV:28	Reset KWh counter	R/W	No	Yes	1506	Control card	–
BV:29	Reset running hours counter	R/W	No	No	1507	Control card	–

Table 11: BV Objects - (continued)

ID	Object name	R/W	COV	Command-able	Parameter + Bit #	Available from	Drive series
BV:30	Reverse	R/W	No	No	CTW bit 15	Control card	–
BV:31	Speed = reference	R	No	No	STW bit 8	Control card	–
BV:32	Bus control	R	No	No	STW bit 9	Control card	–
BV:33	Running	R	No	No	STW bit 11	Control card	–
BV:34	Ramp 1/Ramp 2	R/W	No	Yes	CTW bit 9	Control card	–
BV:35	ECB test mode	R	No	No	3110 bit 0	MCO 104	–
BV:36	ECB drive mode	R	No	No	3110 bit 1	MCO 104	–
BV:37	ECB auto. bypass enable	R	No	No	3110 bit 2	MCO 104	–
BV:38	ECB bypass mode	R	No	No	3110 bit 3	MCO 104	–
BV:39	Deragging status	–	No	–	1694 bit 23	–	FC 202
BV:40	Pre/post lube	–	No	–	1699 bit 3	–	FC 202
BV:41	Sleep mode status	–	No	–	1695 bit 21	–	FC 202
BV:42	Sleep mode command	R/W	No	–	592 bit 0	–	FC 202
BV:43	Pipe filling	–	No	–	1695 bit 23	–	FC 202
BV:44	External interlock	–	No	–	0592 bit 1	–	FC 202
BV:45	Latched pump derag	–	No	–	0592 bit 2	–	FC 202
BV:46	Flow confirmation	–	No	–	0592 bit 3	–	FC 202
BV:47	End of curve	–	No	–	1691 bit7 || 1693 bit 7	–	FC 202
BV:48	Broken belt	–	No	–	1691 bit 8 || 1693 bit 8	–	FC 202
BV:49	No flow	–	No	–	1691 bit 5 || 1693 bit 5	–	FC 202
BV:50	Dry pump	–	No	–	1691 bit 6 || 1693 bit 6	–	FC 202
BV:51	User defined alerts	–	No	–	1699 bit 4	–	FC 202
BV:52	Emergency mode (fire mode) active	–	No	–	1695 bit 25	–	FC 202

Table 11: BV Objects - (continued)

ID	Object name	R/W	COV	Command-able	Parameter + Bit #	Available from	Drive series
BV:53	Emergency mode (fire mode) was active	–	No	–	1693 bit 3	–	FC 202
BV:54	CBM motor overload warning	–	No	–	1698 bits 18, 19, 28, 29, 30, or 31	CBM license required	FC 102/FC 202
BV:55	CBM motor overload alarm	–	No	–	1697 bits 25, 30, or 31	CBM license required	FC 102/FC 202
BV:56	CBM sensor warning	–	No	–	1698 bits 20 to 27	CBM license required	FC 102/FC 202
BV:57	CBM sensor alarm	–	No	–	1697 bits 26 to 29	CBM license required	FC 102/FC 202

4.1.7 BACnet Multistate

Table 12: Multistate

ID	Object name	R/W	COV	Commandable	Parameter + Bit #	Available from
MSV:0	Smart logic controller state	R	No	No	1638	Control card
MSV:1	Active setup	R/W	No	Yes	CTW bit 13 and 14	Control card
MSV:3	Configuration mode	R/W	No	No	100	Control card
MSV:4	Pressure sensor 1 cmp states	R	Yes	–	3130	Control card
MSV:5	Pressure sensor 2 cmp states	R	Yes	–	3130	Control card
MSV:6	Pressure sensor 3 cmp states	R	Yes	–	3130	Control card
MSV:7	Pressure sensor 4 cmp states	R	Yes	–	3130	Control card
MSV:8	CBM stator winding	R	Yes	–	45-01 [0]	CBM license required
MSV:9	CBM load envelope	R	Yes	–	45-01 [1]	CBM license required
MSV:10	CBM sensor 1	R	Yes	–	45-01 [2]	CBM license required
MSV:11	CBM sensor 2	R	Yes	–	45-01 [3]	CBM license required

Table 12: Multistate - (continued)

ID	Object name	R/W	COV	Commandable	Parameter + Bit #	Available from
MSV:12	CBM sensor 3	R	Yes	–	45-01 [4]	CBM license required
MSV:13	CBM sensor 4	R	Yes	–	45-01 [5]	CBM license required

4.1.8 BACnet Notification Class

Table 13: Notification Class

ID	Object name	R/W	Parameter	Available from
NC:0	Warning notifier	R/W	None, MCA 125	MCA 125
NC:1	Trip notifier	R/W	None, MCA 125	MCA 125
NC:3	Triplock notifier	R/W	None, MCA 125	MCA 125
NC:100	NC 100	R/W	None, MCA 125	MCA 125
NC:200	NC 200	R/W	None, MCA 125	MCA 125
NC:300	NC 300	R/W	None, MCA 125	MCA 125
NC:400	NC 400	R/W	None, MCA 125	MCA 125

4.1.9 BACnet Trend Log

Table 14: Trend Log

ID	Object name	R/W	Parameter	Available from
TL:0	Trend log 0	R/W	–	MCA 125
TL:1	Trend log 1	R/W	–	MCA 125
TL:2	Trend log 2	R/W	–	MCA 125
TL:3	Trend log 3	R/W	–	MCA 125
TL:4	Trend log 4	R/W	–	MCA 125
TL:5	Trend log 5	R/W	–	MCA 125
TL:6	Trend log 6	R/W	–	MCA 125

4.1.10 BACnet Loop Object

Table 15: Loop Object

ID	Object name	R/W	Parameter	Available from
Loop:0	Drive close loop	R/W	2093, 2094, 2095	MCA 125

4.1.11 BACnet Event Enrollment

Table 16: Event Enrollment

ID	Object name	R/W	Parameter	Available from
EE:0	Event enrollment 0	R/W	None, MCA 125	MCA 125
EE:1	Event enrollment 1	R/W	None, MCA 125	MCA 125

Table 16: Event Enrollment - (continued)

ID	Object name	R/W	Parameter	Available from
EE:2	Event enrollment 2	R/W	None, MCA 125	MCA 125
EE:3	Event enrollment 3	R/W	None, MCA 125	MCA 125
EE:4	Event enrollment 4	R/W	None, MCA 125	MCA 125
EE:5	Event enrollment 5	R/W	None, MCA 125	MCA 125
EE:6	Event enrollment 6	R/W	None, MCA 125	MCA 125
EE:7	Event enrollment 7	R/W	None, MCA 125	MCA 125
EE:8	Event enrollment 8	R/W	None, MCA 125	MCA 125
EE:9	Event enrollment 9	R/W	None, MCA 125	MCA 125
EE:10	Event enrollment 10	R/W	None, MCA 125	MCA 125
EE:11	Event enrollment 11	R/W	None, MCA 125	MCA 125
EE:12	Event enrollment 12	R/W	None, MCA 125	MCA 125
EE:13	Event enrollment 13	R/W	None, MCA 125	MCA 125

4.1.12 BACnet CharacterString Value

Table 17: CharacterString Value

ID	Object name	R/W	Parameter	Available from	Drive
CSV:1	Pump status	R	None, MCA 125	MCA 125	FC 202

4.1.13 BACnet Schedule Object

Table 18: Schedule Object

ID	Object name	R/W	Parameter	Available from
SO:0	Drive schedule 0	R/W	None, MCA 125	MCA 125
SO:1	Drive schedule 1	R/W	None, MCA 125	MCA 125
SO:2	Drive schedule 2	R/W	None, MCA 125	MCA 125
SO:3	Drive schedule 3	R/W	None, MCA 125	MCA 125
SO:4	Drive schedule 4	R/W	None, MCA 125	MCA 125
SO:5	Drive schedule 5	R/W	None, MCA 125	MCA 125

4.1.14 BACnet Exception Calendar

Table 19: Exception Calendar

ID	Object name	R/W	Parameter	Available from
CO:0	Exception calendar	R/W	None, MCA 125	MCA 125
CO:1	Exception calendar	R/W	None, MCA 125	MCA 125
CO:2	Exception calendar	R/W	None, MCA 125	MCA 125
CO:3	Exception calendar	R/W	None, MCA 125	MCA 125
CO:4	Exception calendar	R/W	None, MCA 125	MCA 125
CO:5	Exception calendar	R/W	None, MCA 125	MCA 125

4.1.15 BACnet Event Log

Table 20: Event Log

ID	Object name	R/W	Parameter	Available from
EO:0	Event log	R	None, MCA125	MCA125

5 BACnet Product Features

5.1 Custom Objects

5.1.1 Introduction to Custom Objects

Custom objects are drive parameters that are made accessible via BACnet. The parameters are configured by assigning parameter numbers to array parameter ***8-77 Custom Object List***. This parameter is an array with 30 indices where each index represents a BACnet object. Custom objects support both standard drive parameters and user-defined parameters from parameter group ***19-** Application Params***.

Use the VLT® Programmable Controller MCB 301 to create user-defined parameters in parameter group ***19-** Application Params***. Use all available/supported fieldbus networks to make the user-defined parameters available to the upper-level systems, such as BMS.

5.1.2 Key Features

- Parameter presentation:

  All values are presented to the BACnet interface as 32-bit signed integers (S32) and are defined as read/write (R/W) at the fieldbus level. If a parameter in parameter group ***19-** Application Params*** is read-only, attempts to write to that parameter will be handled internally.

- Flexible mapping:

  Custom object mapping is not limited to parameter group ***19-** Application Params***. It is possible to map any drive parameter by entering the parameter number and linking it to a specific AV instance, for example, 341 for parameter ***3-41 Ramp 1 Ramp Up Time*** or 1905 for parameter ***User Parameter 19-05***.

- Consistency across fieldbus type:

  This mapping approach aligns with other fieldbus protocols like Modbus TCP. The approach has user-defined mappings for a Process Data Area. BACnet does not support continuous polling as this is a control system capability.

5.1.3 BACnet Custom Object Functionality

The BACnet Custom Object Function enables the configuration of dynamic parameters in parameter ***8-77 Custom Object List***, indices [0]–[29]. AV102–131 reflect the custom objects. For parameter group ***19-** Application Params***, use the custom objects as there are no dedicated BACnet objects.

Table 21: Example of Mapping of Drive Parameter via BACnet/IP

Parameter group - MCT 10	BACnet object instance	Value (MCT 10 Setup 1)
877.0	AV102	1900
877.1	AV103	1908
877.2	AV104	1945
877.3	AV105	1946
877.4	AV106	341
...	...	...
877.29	AV131	1634

5.1.4 Access from Other Fieldbus Networks

To ensure compatibility and flexibility when accessing individual parameters in parameter group ***19-** Application Params*** across various protocols, access from other fieldbus networks remains unaffected.

Example with Modbus TCP:

- Parameter: 19-00
- Holding register address (base 0): Offset 19899

5.1.5 Configuration of Custom Object Mapping

- Navigate to parameter ***8-77.[x] Custom Object List*** where x indicates the index number for mapping.
- Enter the parameter number to be mapped to a BACnet Analog Value (AV) instance from 102–131.
- Ensure that the parameter exists. If the drive parameter is available, parameter ***8-77.[x] Custom Object List*** accepts the value.

Parameter ***8-77.[x] Custom Object List*** supports 8 digits. The 4 leftmost digits are used for the parameter number, and the 4 rightmost digits for the array index.

Example:

- Parameter ***877.0 Custom Object List*** has a value of 13100008 as shown in Table 22.

Table 22: Configuring Array Type Parameter in Parameter 877.0 Custom Object List

Parameter number	Array index
1310	0008

If there is no need for specifying an array index, enter parameter numbers into the 4 rightmost digits as well. Table 23 shows an example where parameter ***877.0 Custom Object List*** has a value of 1310 or 13100000.

Table 23: Configuring Non-array Type Parameter in Parameter 877.0 Custom Object List

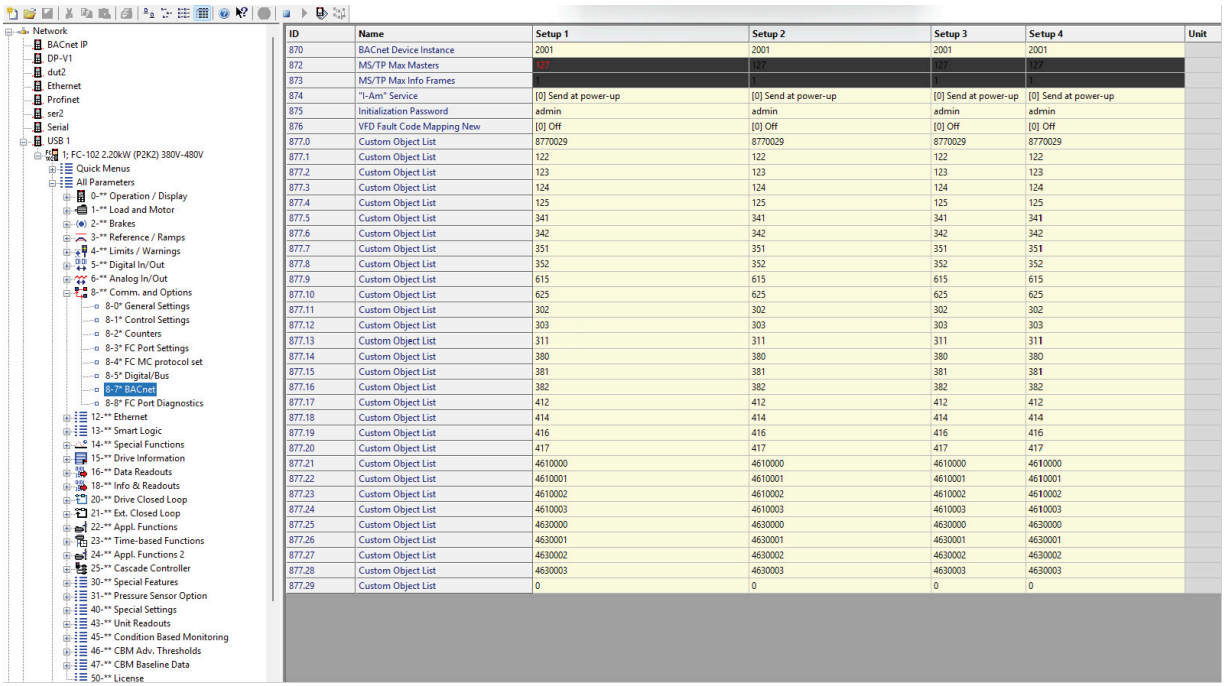
Parameter number	Array index
1310	0000
1310	{Empty}

NOTE:

- The data type of parameters ***8-77.[0] Custom Object List*** to ***8-77.[29] Custom Object List*** is Unsigned 32.
- The data type of AV102 to AV131 is Signed 32.
- Parameters with complex data types, such as strings, dates, or other non-integer types, are not supported.
- The Change of Value functionality is not supported for the custom objects AV102 to AV131.

5.1.6 How to Read/Write Other Parameter Groups via BACnet/IP

1. Configure the required parameters in parameter ***8-77 Custom Object List.[0]*** to ***8-77 Custom Object List.[29]***.



ID	Name	Setup 1	Setup 2	Setup 3	Setup 4	Unit
870	BACnet Device Instance	2001	2001	2001	2001	
872	MS/TP Max Masters	127	127	127	127	
873	MS/TP Max Info Frames	1	1	1	1	
874	"I-Am" Service	[0] Send at power-up	[0] Send at power-up	[0] Send at power-up	[0] Send at power-up	
875	Initialization Password	admin	admin	admin	admin	
876	VFD Fault Code Mapping New	[0] Off	[0] Off	[0] Off	[0] Off	
877.0	Custom Object List	8770029	8770029	8770029	8770029	
877.1	Custom Object List	122	122	122	122	
877.2	Custom Object List	123	123	123	123	
877.3	Custom Object List	124	124	124	124	
877.4	Custom Object List	125	125	125	125	
877.5	Custom Object List	341	341	341	341	
877.6	Custom Object List	342	342	342	342	
877.7	Custom Object List	351	351	351	351	
877.8	Custom Object List	352	352	352	352	
877.9	Custom Object List	615	615	615	615	
877.10	Custom Object List	625	625	625	625	
877.11	Custom Object List	302	302	302	302	
877.12	Custom Object List	303	303	303	303	
877.13	Custom Object List	311	311	311	311	
877.14	Custom Object List	380	380	380	380	
877.15	Custom Object List	381	381	381	381	
877.16	Custom Object List	382	382	382	382	
877.17	Custom Object List	412	412	412	412	
877.18	Custom Object List	414	414	414	414	
877.19	Custom Object List	416	416	416	416	
877.20	Custom Object List	417	417	417	417	
877.21	Custom Object List	4610000	4610000	4610000	4610000	
877.22	Custom Object List	4610001	4610001	4610001	4610001	
877.23	Custom Object List	4610002	4610002	4610002	4610002	
877.24	Custom Object List	4610003	4610003	4610003	4610003	
877.25	Custom Object List	4630000	4630000	4630000	4630000	
877.26	Custom Object List	4630001	4630001	4630001	4630001	
877.27	Custom Object List	4630002	4630002	4630002	4630002	
877.28	Custom Object List	4630003	4630003	4630003	4630003	
877.29	Custom Object List	0	0	0	0	

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Figure 2: Sample Configuration of Custom Object Parameters

2. Connect to the drive via a BACnet client tool such as YABE or VTS.

   Scan a drive, for example, an FC 102, using the YABE tool and navigate to *Devices⇒UDP:48080⇒FC-102-10001 [10001]*.

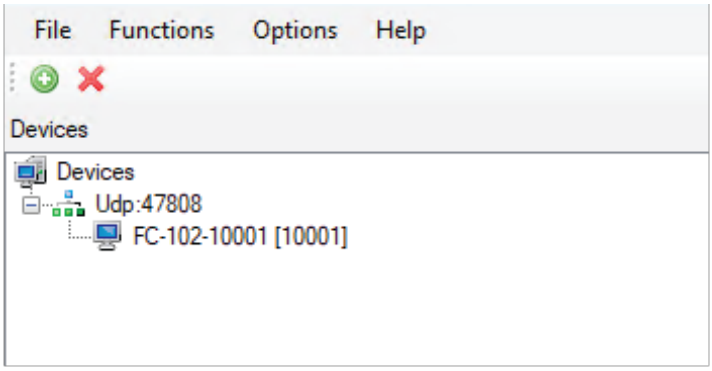

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Figure 3: Device Scanned via YABE Tool

Custom objects configured in parameter ***8-77 Custom Object List.[0]*** to ***8-77 Custom Object List.[29]*** are shown in AV102 to AV131.

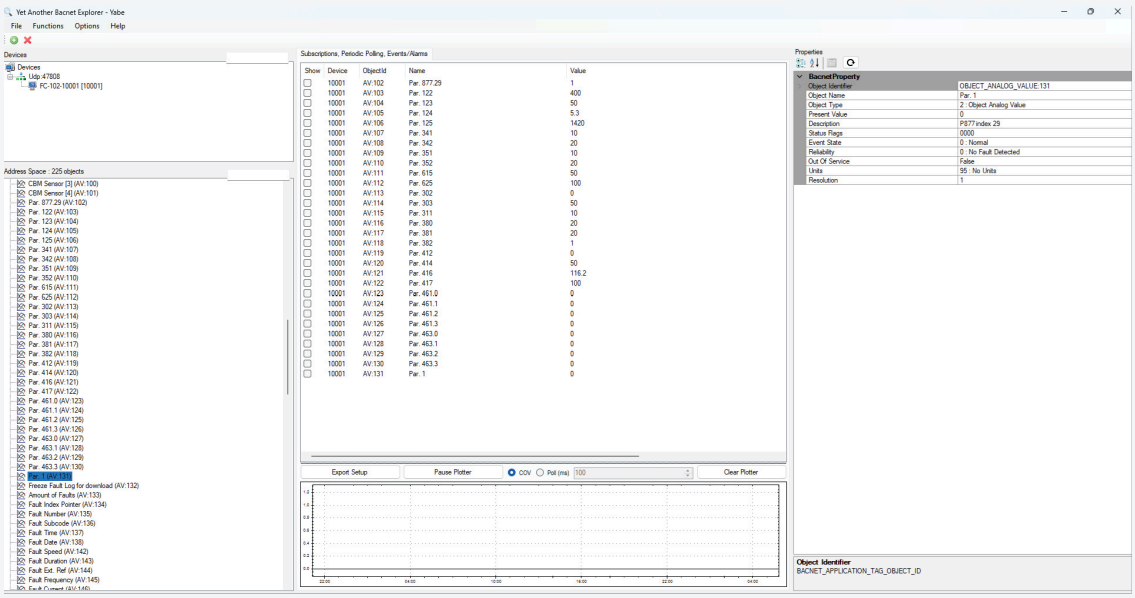

Figure 4: Custom Objects Shown in AV102 to AV131

3. To write to a given AV, select the AV and enter the wanted value in the *Present Value* field.

   In this example, AV103 is configured for parameter ***1-22 Motor Voltage***. The value of 420 is entered in the *Present Value* field.

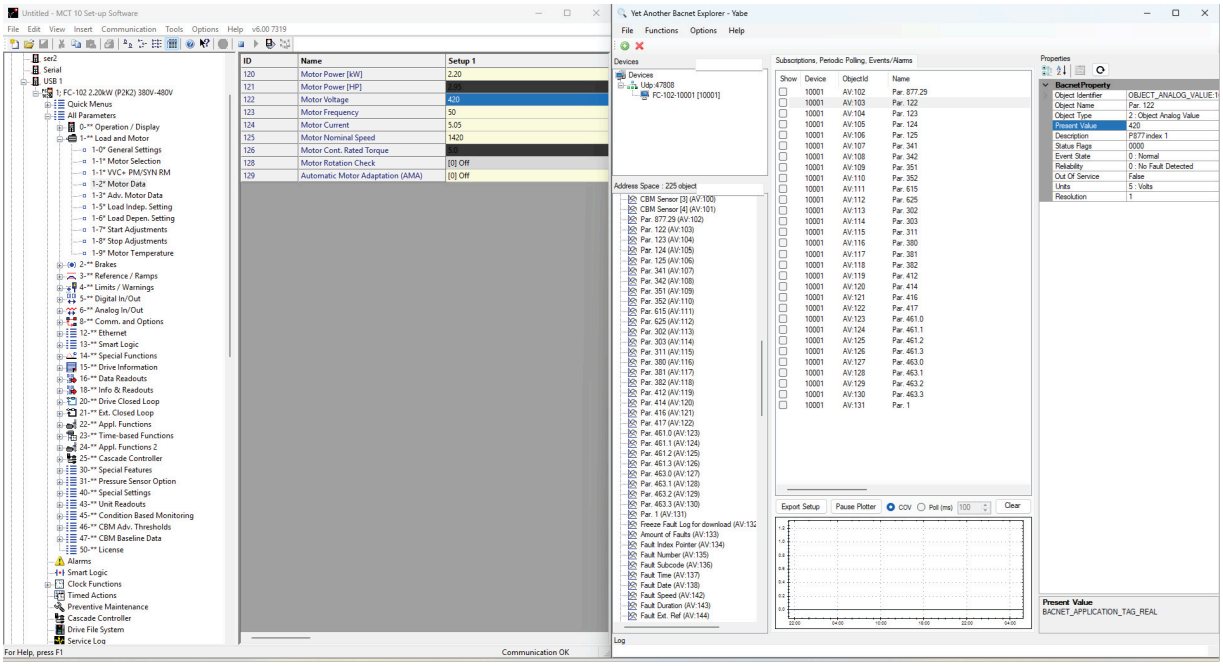

Figure 5: Writing to AV103

The properties of AV102 to AV103 are updated based on the configured parameters. For example, if parameter ***1-22 Motor Voltage*** is set to Volts, AV103 updates its unit accordingly. Similarly, all the custom object properties are updated based on their respective parameters.

NOTE: Custom objects are available in VLT® BACnet/IP MCA 125 from version 3.05.

5.2 Filter Monitoring

5.2.1 Introduction to Filter Monitoring

Pressure sensor with PTU 025

The pressure sensor option consists of 4 individual pressure sensors, which must be read separately from parameter ***31-35.[0] Pressure Source*** to ***31-35.[3] Pressure Source***. The measured pressure ranges are 500 Pa, 500 Pa, 1000 Pa, and 2500 Pa corresponding to the parameter ***31-34.[0] Pressure Range*** to ***31-34.[3] Pressure Range***. The update rate must be at least once per second.

Pressure sensor without PTU 025

Parameters for PTU 025 are available without PTU 025 options as well. It is possible to use pressure readings from analog inputs and fieldbus masters.

Table 24: Filter Monitoring Objects

S. No	ID	Object name	Parameter number	Unit	R/W
1	AI:14	Pressure Sensor 1	3126	Pascal	R
2	AI:15	Pressure Sensor 2	3127	Pascal	R
3	AI:16	Pressure Sensor 3	3128	Pascal	R
4	AI:17	Pressure Sensor 4	3129	Pascal	R
5	AV:80	Below level threshold [0]	3121[0]	Pascal	R/W
6	AV:81	Below level threshold [1]	3121[1]	Pascal	R/W
7	AV:82	Below level threshold [2]	3121[2]	Pascal	R/W
8	AV:83	Below level threshold [3]	3121[3]	Pascal	R/W
9	AV:84	Above level threshold [0]	3122[0]	Pascal	R/W
10	AV:85	Above level threshold [1]	3122[1]	Pascal	R/W
11	AV:86	Above level threshold [2]	3122[2]	Pascal	R/W
12	AV:87	Above level threshold [3]	3122[3]	Pascal	R/W
13	AV:88	On Delay Time [0]	P3123[0]	S	R/W
14	AV:89	On Delay Time [1]	P3123[1]	S	R/W
15	AV:90	On Delay Time [2]	P3123[2]	S	R/W
16	AV:91	On Delay Time [3]	P3123[3]	S	R/W
17	AV:92	Reset Delay Time [0]	P3124[0]	S	R/W
18	AV:93	Reset Delay Time [1]	P3124[1]	S	R/W
19	AV:94	Reset Delay Time [2]	P3124[2]	S	R/W
20	AV:95	Reset Delay Time [3]	P3124[3]	S	R/W

Table 24: Filter Monitoring Objects - (continued)

S. No	ID	Object name	Parameter number	Unit	R/W
21	MSV:4	Pressure Sensor 1 Cmp States	3130	No Unit	R
22	MSV:5	Pressure Sensor 2 Cmp States	3130	No Unit	R
23	MSV:6	Pressure Sensor 3 Cmp States	3130	No Unit	R
24	MSV:7	Pressure Sensor 4 Cmp States	3130	No Unit	R

5.2.2 Overview of Filter Monitoring

5.2.2.1 Purpose of Pressure Sensors

The pressure sensor PTU 025 option is intended for use in air-handling unit (AHU) applications where the sensors monitor pressure drops across inlet and outlet filters. This monitoring helps minimize energy loss by detecting dirty or defective filters. Also, some of the sensors will be used to monitor and control the AHU.

The drive detects if a pressure sensor option is connected.

Pressure monitoring is also possible without a PTU 025 option. The usage of pressure signals in digital outputs, analog outputs, SLC, and feedback handling is the same whether or not a PTU 025 option is mounted.

NOTE: The pressure signals *Pressure 1* and *Pressure 2* cannot be used as feedback source if a PTU 025 is mounted as these signals have a special functionality in the PTU 025.

If a PTU 025 option is not mounted, the pressure is taken from the source specified in parameter ***31-35 Pressure Source***. If the source is an analog input, the pressure is taken from that analog input by using the corresponding scaling for the analog input in question. If the selected pressure source is ***[24] Bus Fdb. Pres. [3136]*** to ***[27] Bus Fdb. Pres. [3139]***, the fieldbus master writes the pressure to the corresponding parameter, and the drive uses these pressures as a source for its calculations.

Input pressure is scaled according to the values in parameter ***31-34 Pressure Range***, which specifies the maximum pressure for the pressure sensor.

NOTE: Input pressure scaling is used for analog outputs only. The maximum pressure corresponds to 100% of the analog output.

5.2.2.2 Pressure Threshold

The measured pressure triggers a user-defined alarm if the pressure exceeds the defined thresholds. Each sensor has 2 triggers, 1 triggering if the level is above the threshold, and 1 triggering if the level is below. If the pressures are outside of the given threshold for 0–60 minutes, the alarm is triggered. If the pressure is within the valid range for a specified time, the alarm can be reset automatically or manually.

Parameter group ***31-** Pressure Sensor Option*** contains 5 parameters for each pressure type:

- Pressure/speed curve (None, linear, square root, square)
- Below threshold (-8000...8000 Pa. Default is -8000 Pa (disabled))
- Above threshold (-8000...8000 Pa. Default is 8000 Pa (disabled))
- On delay time (0–3600 s (9999 s = disabled))

- Reset delay time (0–9999 s (9999 s = disabled))

The pressure thresholds are only compared while running, and the delay times are the same for above and below level, respectively.

If a status bit is triggered, it remains triggered until it is reset in 1 of the following ways:

- At the next power cycle.
- Actively reset by a command while the pressure is valid, or if it is valid within the limits for the reset delay time.

The state of each of the level thresholds can be selected in the user-defined alarms or in the SLC.

For digital output and relay, there is a common selection indicating if 1 or more thresholds have been activated.

The below-level threshold is used on a system where vacuum is measured in the manifold for controlling the system and indicates a decrease in the flow in the entire system.

The above-level threshold is used to indicate that a dirty/blocked filter must be cleaned or replaced.

5.2.2.3 Pressure Readouts

The following pressure readouts are available:

- 1 readout per sensor - 4 in total.
- 1 readout of the pressure level threshold state indicating which level threshold that has been triggered.
- 1 common pressure readout that toggles through the analog value of the 4 pressure sensors.

The readouts are available in parameter group ***XX-XX Data Readout*** and can be read in the LCP or via fieldbus.

5.2.2.4 Multistate Value

The PTU 025 option has 4 pressure sensors numbered from 1–4. Each sensor has 2 bits assigned for indicating High and Low of the defined pressure.

Digital readouts of the bits are available in parameter ***31-30 Press Sense Cmp. State***.

Table 25: Overview of Bits Assigned to the Pressure Sensors

Bit	7	6	5	4	3	2	1	0
Pressure sensor number	4	3	2	1	4	3	2	1
Pressure (high/low)	H	H	H	H	L	L	L	L

5.2.2.5 How to Read/Write Filter Monitoring via BACnet/IP

1. Use a BACnet client tool such as YABE or VTS to connect to the drive.

   Scan a drive, for example, an FC 102, using the YABE tool and navigate to *Devices⇒UDP:48080⇒FC-102-10001 [10001]*.

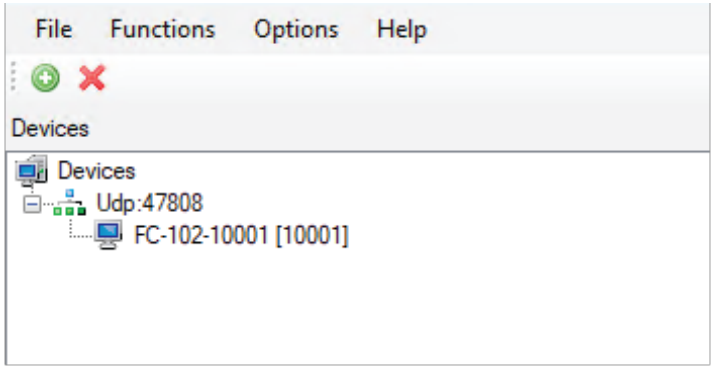

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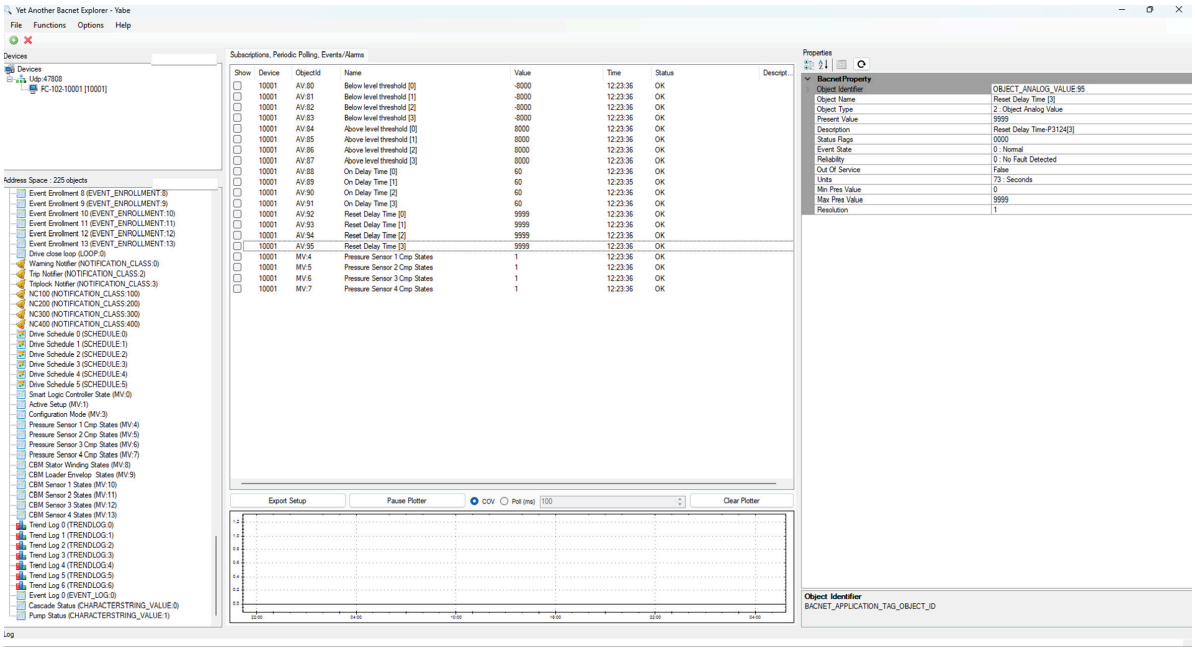
Figure 6: Device Scanned via YABE Tool

2. Read/write to AV80–AV95 which are objects assigned to filter monitoring.



e30bm941.10

Figure 7: Read/Write to AV80–AV95

3. Read the statuses of the pressure sensors in MSV4–MSV7, which are the multi-state value objects containing the status information.

5.3 Alarm and Warning Logs

5.3.1 Alarm Logs

The drive maintains a log of the 10 latest faults. 0 is the most recently logged data, and 9 is the oldest. Fault codes, values, and time stamps can be viewed for all logged data.

All alarm data is stored in the EEPROM of the drive, and is retained after restart to avoid loss of historical fault/alarm information.

The following list shows the parameters which contain alarm data that is available via VLT® BACnet/IP MCA 125:

- Parameter ***15-30 Alarm Log: Code***
- Parameter ***15-31 Alarm Log: Value***
- Parameter ***15-32 Alarm Log: Time***
- Parameter ***15-33 Alarm Log: Speed***
- Parameter ***40-40 Alarm Log: External Reference***
- Parameter ***40-41 Alarm Log: Frequency***
- Parameter ***40-42 Alarm Log: Current***
- Parameter ***40-43 Alarm Log: Voltage***
- Parameter ***40-44 Alarm Log: DC-link Voltage***
- Parameter ***40-45 Alarm Log: Control Word***
- Parameter ***40-46 Alarm Log: Status Word***

- Parameter ***40-47 Alarm Log: Torque***
- Parameter ***40-48 Alarm Log: CBM Value***(this parameter is only available if CBM is enabled in the drive).
- Parameter ***40-49 Alarm Log: CBM Threshold*** (this parameter is only available if CBM is enabled in the drive).

5.3.2 Warning Logs

Warnings are logged in a similar way to alarms and give an overview of the CBM behavior.

Warning log behavior:

- The warning log stores the 30 latest warnings.
- The log contains the dame information as the alarm log, but with the addition of the warning duration.
- When a warning is activated, the data from the drive and the motor at the start moment is saved to the log.

  Even if the warning stays active for a long time, data is only captured at the start.
- The warning log is stored in the control card EEPROM memory.
- The warning log is cleared either by service reset or 3-finger initialization.

The data in the warning log is available in parameter group ***43-3* Warning Log*** and can be accessed via:

- LCP
- VLT® Motion Control Tool MCT 10
- Fieldbus

The following list shows the parameters which contain warning log data:

- Parameter ***43-30 Warning Log: Number***
- Parameter ***43-31 Warning Log: Value***
- Parameter ***43-32 Warning Log: Time***
- Parameter ***43-33 Warning Log: Date and Time*** (only if supported by the alarm log)
- Parameter ***43-34 Warning Log: Setpoint*** (FC 202 only)
- Parameter ***43-35 Warning Log: Feedback*** (FC 202 only)
- Parameter ***43-36 Warning Log: Current Demand*** (FC 202 only)
- Parameter ***43-37 Warning Log: Process Control Unit*** (FC 202 only)
- Parameter ***43-38 Warning Log: Speed***
- Parameter ***43-39 Warning Log: Duration***
- Parameter ***43-40 Warning Log: External Reference***
- Parameter ***43-41 Warning Log: Frequency***
- Parameter ***43-42 Warning Log: Current***
- Parameter ***43-43 Warning Log: Voltage***
- Parameter ***43-44 Warning Log: DC-link Voltage***
- Parameter ***43-45 Warning Log: Control Word***
- Parameter ***43-46 Warning Log: Status Word***
- Parameter ***43-47 Warning Log: Torque***
- Parameter ***43-48 Warning Log: CBM Value*** (if CBM is enabled in the drive).
- Parameter ***43-49 Warning Log: CBM Treshold*** (if CBM is enabled in the drive).

5.3.3 Alarm and Warning BACnet Objects

Table 26: BACnet Objects that are Mapped with the Alarm and Warning Logs

AV object number	Register name	Comments	
		Alarm log	Warning log
AV132	Freeze fault log for download	Changing the object will start or stop log download.	
AV133	Amount of faults	The object shows the number of warnings/alarms in log.	
AV133	Amount of faults	Number of alarms in the log.	Number of warnings in the log.
AV134	Fault index pointer	Indices 100-109 select alarm log entries. Corresponding parameter ***15-30 Alarm Log: Error Code***, [0]–[9].	Indices 0-29 select warning log entries. Corresponding parameter ***43-30 Warning Log: Warning Number***, [0]–[29]
AV135	Fault number	Alarm code Corresponds to parameter ***15-30 Alarm Log: Error Code***, [0]–[9].	Warning code Corresponds to parameter ***43-30 Warning Log: Warning Number***, [0]–[29].
AV136	Fault subcode	Alarm subcode Corresponds to parameter ***15-31 Alarm Log: Value***, [0]–[9]	Warning subcode Corresponds to parameter ***43-31 Warning Log: Value***, [0]–[29].
AV137	Fault time	Alarm duration Corresponds to parameter ***15-32 Alarrm Log: Time***, [0]–[9].	Warning duration Corresponds to parameter ***43-32 Warning Log: Time***, [0]–[29].
AV138	Fault date	Alarm days Corresponds to parameter ***15-33 Alarm Log: Date and Time***, [0]–[9]	Warning days Corresponds to parameter ***43-33 Warning Log: Date and Time***, [0]–[29].
AV139	Fault setpoint (Only FC 202)	Setpoint if an alarm occurs. Corresponds to parameter ***15-34 Alarm Log: Setpoint***, [0]–[9].	Setpoint if a warning occurs. Corresponds to parameter ***43-34 Warning Log: Setpoint***, [0]–[29].
AV140	Fault feedback (Only FC 202)	Feedback if an alarm occurs. Corresponds to parameter ***15-35 Alarm Log: Feedback***, [0]–[9].	Feedback if a warning occurs. Corresponds to parameter ***43-35 Warning Log: Feedback***, [0]–[29].
AV141	Fault current demand (Only FC 202)	Current demand if an alarm occurs. Corresponds to parameter ***15-36 Alarm Log: Current Demand***, [0]–[9].	Current demand if a warning occurs. Corresponds to parameter ***43-36 Warning Log: Current Demand***, [0]–[29].
AV142	Fault speed	Speed if an alarm occurs. Corresponds to parameter ***15-38 Alarm Log: Speed***, [0]–[9].	Speed if a warning occurs. Corresponds to parameter ***43-38 Warning Log: Speed***, [0]–[29].

Table 26: BACnet Objects that are Mapped with the Alarm and Warning Logs - (continued)

AV object number	Register name	Comments	
		Alarm log	Warning log
AV143	Fault duration	Corresponds to parameter ***43-32 Warning Log: Time***. NOTE: This is not used in the alarm log.	
AV144	Fault ext. ref	EXT. reference if an alarm occurs. Corresponds to parameter ***40-40 Alarm Log: Ext. Reference***, [0]–[9].	EXT. reference if a warning occurs. Corresponds to parameter ***43-40 Warning Log: Ext. Reference***, [0]–[29].
AV145	Fault frequency	Frequency if an alarm occurs. Corresponds to parameter ***40-41 Alarm Log: Frequency***, [0]–[9].	Frequency if a warning occurs. Corresponds to parameter ***43-41 Warning Log: Frequency***, [0]–[29].
AV146	Fault current	Current if an alarm occurs. Corresponds to parameter ***40-42: Alarm Log: Current***, [0]–[9].	Current if a warning occurs. Corresponds to parameter ***43-42 Warning Log: Current***, [0]–[29].
AV147	Fault voltage	Motor voltage if an alarm occurs. Corresponds to parameter ***40-43 Alarm Log: Voltage***, [0]–[9].	Motor voltage if a warning occurs. Corresponds to parameter ***43-43 Warning Log: Voltage***, [0]–[29].
AV148	Fault DC-link voltage	DC-link voltage if an alarm occurs. Corresponds to parameter ***40-44 Alarm Log: DC Link Voltage***, [0]–[9].	DC-link voltage if a warning occurs. Corresponds to parameter ***43-44 Warning Log: DC Link Voltage***, [0]–[29].
AV149	Fault control word	Control word if an alarm occurs. Corresponds to parameter ***40-45 Alarm Log: Control Word***, [0]–[9].	Control word if a warning occurs. Corresponds to parameter ***43-45 Warning Log: Control Word***, [0]–[29].
AV150	Fault status word	Status word if an alarm occurs. Corresponds to parameter ***40-46 Alarm Log: Status Word***, [0]–[9].	Status word if a warning occurs. Corresponds to parameter ***43-46 Warning Log: Status Word***, [0]–[29].
AV151	Fault torque	Torque if an alarm occurs. Corresponds to parameter ***40-47 Torque***, [0]–[9].	Torque if a warning occurs. Corresponds to parameter ***43-47 Warning Log: Torque***, [0]–[29].

Table 26: BACnet Objects that are Mapped with the Alarm and Warning Logs - (continued)

AV object number	Register name	Comments	
		Alarm log	Warning log
AV152	Fault CBM value	CBM actual value if an alarm occurs. Corresponds to parameter ***40-48 Alarm Log: CBM Value***, [0]–[9].	CBM actual value if a warning occurs. Corresponds to parameter ***43-48: Warning Log: CBM Value***, [0]–[29].
AV153	Fault CBM threshold	CBM threshold if an alarm occurs. Corresponds to parameter ***40-49 Alarm Log: CBM Threshold***.	CBM Threshold if a warning occurs. Corresponds to parameter ***43-49 Warning Log: CBM Threshold***, [0–29].

5.3.4 How to Read/Write Alarm/Warning Log via BACnet

1. Use a BACnet client tool such as YABE or VTS to connect to the drive.

   Scan a drive, for example, an FC 102, using the YABE tool and navigate to *Devices⇒UDP:48080⇒FC-102-10001 [10001]*.

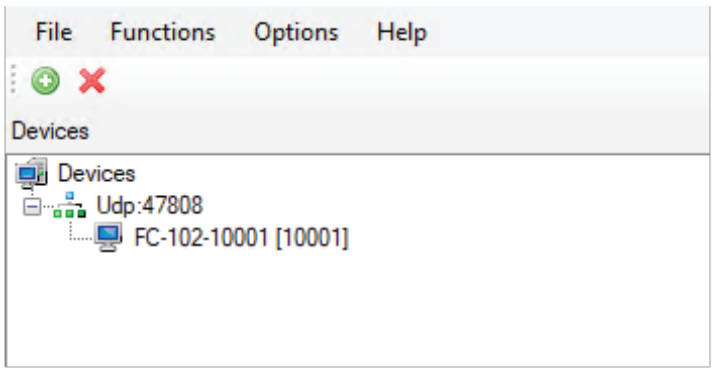


Figure 8: Scanned Device

2. Freeze or unfreeze the log updates in AV132.
   - Write *1* to AV132 to freeze the alarm/warning log updates.
   - Write *0* to AV132 to unfreeze the alarm/warning log updates.

   If reading any AV object from AV133 to AV153, AV132 is automatically set to *High* (1), which triggers a temporary freeze of the log updates. The freeze clears automatically after 3 minutes.

3. View the number of logs stored in AV133.
4. Select which log to read in AV134.
   - Use indices 100–109 to read alarms.
   - Use indices 0–29 to read warnings.
5. Read the selected log entry in AV135–AV153

   Reading the 1st alarm log:

   a. Write *100* to AV134.

   b. Read AV135–AV153 to see all details related to this alarm.

Reading the 1st warning log:

a. Write *0* to AV134.

b. Read AV135–AV153 to see all details related to this warning.

NOTE: AV139–AV141 are only applicable for FC 202.

5.4 Condition-based Monitoring (CBM)

5.4.1 Overview and Benefits of Condition-based Monitoring

Corrective and preventive maintenance are fault (event) or time-based. Therefore, maintenance is performed if faults occur (corrective) or after pre-established operation hours (preventive). These types of maintenance do not use any feedback from the actual application.

Condition-based and predictive maintenance use actual sensor data to determine the condition of the equipment in service (condition-based maintenance) or to predict future failures (predictive maintenance).

Condition-based maintenance is the easiest and most intuitive maintenance technique based on data from the actual application. The acquired data is used to monitor the health of the equipment in service. For this purpose, key parameters are selected as indicators to identify developing faults. As equipment degrades over time, there is a risk of functional failure, where the equipment fails to perform the intended function. Condition-based maintenance detects such potential failures before actual failures occur.

Planning maintenance actions has several benefits, such as:

- Downtime reduction
- Elimination of unexpected production stops
- Maintenance optimization
- Reduction in spare part stock inventory

5.4.2 CBM in 3 Steps

5.4.2.1 Condition Monitoring Functions for AC Drives

A part of condition-based maintenance involves monitoring of the condition of the equipment. In variable-speed applications, the condition of the application often depends on speed. For example, vibration levels tend to increase at higher speeds, although this relationship is not linear. Sometimes, resonances occur at certain speeds and then disappear when the speed is increased.

Using an independent system to monitor the condition of a variable-speed application is complicated by the need for knowing the speed and the related monitored value with speed. Using drives for condition monitoring is an advantage as the drive contains information about application speed. Furthermore, the drive also contains information about the load/motor torque and acceleration.

There are 3 steps in condition monitoring:

1. Establish a baseline.
2. Define thresholds.
3. Perform monitoring:

5.4.2.2 Establish a Baseline

To ensure an efficient condition monitoring system, first determine and define the normal operating conditions by establishing baselines. There are 3 different types of baseline:

- Manual baseline:

When the baseline values are defined by using previous experience, the known values are programmed into the drive.

- Baseline run:

  The baseline is determined during commissioning. When this method is used, a speed sweep is performed through the relevant speed range determining the condition in each speed point. However, in certain commissioning scenarios, it is possible that the application does not run at full capacity or a wear-in period is required. In such situations, perform the baseline run after the wear-in period to capture an operating state which is as close to normal operation as possible.

- Online baseline:

  This is an advanced method which captures baseline data during normal operation. This method is useful in situations when a baseline run cannot be performed because the application does not allow analyzing the entire speed range.

5.4.2.3 Define Thresholds for Warnings and Alarms

After establishing the baseline, generate thresholds for warnings and alarms. The thresholds indicate the condition of the application. The condition is indicated based on the "traffic-light status" where 4 colors signify the following:

- Green:

  Green indicates that the equipment is in good condition and performs efficiently.

- Yellow:

  Yellow indicates a Warning 1 stage and signifies that the 1st threshold is exceeded. The maintenance personnel should plan for a maintenance action.

- Orange:

  Orange indicates a Warning 2 stage or critical stage and signifies that the 2nd threshold level is exceeded. The maintenance personnel must carry out an immediate maintenance action.

- Red:

  Red indicates an alarm and signifies that the machine will stop and corrective maintenance is required.

There are 3 different ways of defining threshold values:

- Absolute:

  This is the common method when the equipment values are already known. The threshold has a fixed value with no regards to the measured baseline value. For example, when the operator knows the absolute limit for the equipment, an absolute value is set for the alarm threshold. For vibration monitoring, the limit values described in, for example, ISO 10816/20816 can be entered as an absolute value for the alarm threshold.

- Offset:

  This method of setting threshold values requires understanding of the application and baseline values. The threshold depends on the baseline value to which a user-defined offset is selected. The risk in this case is setting a very low or high value, which can lead to false positives. False settings can cause irresponsive monitoring, even if faults occur.

- Factor:

  This method is easier to use than the offset because it requires less application understanding. The threshold depends on the baseline value which is multiplied by a factor. For example, the threshold value may be 150% of the baseline. The risk in this case is setting a too high threshold.

Actual monitored values can be read from the drive via the LCP, fieldbus, or IoT communication. Moreover, digital outputs can be configured to react to specific warnings and alarms. Some drives have a built-in web server, which can also be used for reading the condition status.

5.4.2.4 Perform Monitoring

Monitoring is performed with continuous comparison to the thresholds. During normal operation, the actual values are compared with the threshold value. When the monitored parameters exceed a threshold for a predefined time, a warning or alarm is activated. The timer is configured to act as a filter so that short transients do not trigger warnings and alarms.

Table 27: CBM Objects

S. No	ID	Object name	Parameter number	Unit	R/W
1	AV:96	CBM Stator [%]	4590	%	R
2	AV:97	CBM Load [%]	4591	%	R
3	AV:98	CBM Sensor 1 [%]	4592	%	R
4	AV:99	CBM Sensor 2 [%]	4594	%	R
5	AV:100	CBM Sensor 3 [%]	4596	%	R
6	AV:101	CBM Sensor 4 [%]	4598	%	R
7	MSV:8	CBM Stator winding	45-01 [0]	NA	R
8	MSV:9	CBM Load envelope	45-01 [1]	NA	R
9	MSV:10	CBM Sensor 1	45-01 [2]	NA	R
10	MSV:11	CBM Sensor 2	45-01 [3]	NA	R
11	MSV:12	CBM Sensor 3	45-01 [4]	NA	R
12	MSV:13	CBM Sensor 4	45-01 [5]	NA	R

5.4.3 How to Read CBM Objects via BACnet

1. Use a BACnet client tool such as YABE or VTS to connect to the drive.

   Scan a drive, for example, an FC 102, using the YABE tool and navigate to *Devices⇒UDP:48080⇒FC-102-10001 [10001]*.

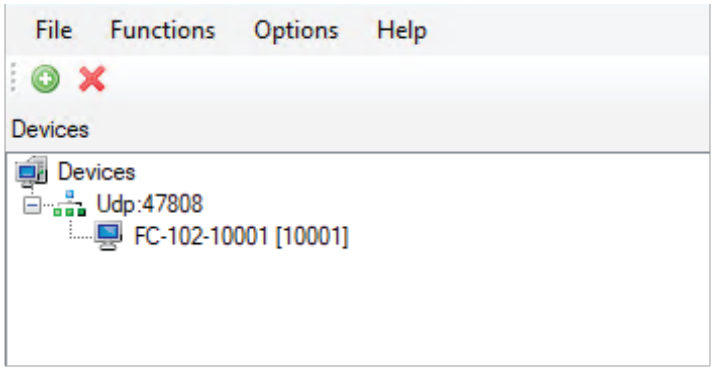


Figure 9: Scanned Device

2. Select which CBM information to read:
   - Select analog values AV96–AV101 to read the CBM measurement data, such as vibration, temperature, current.
   - Select multi-state values MSV10–MSV13 to read CBM status information, such as condition severity level, operational modes, or fault categories.

5.5 Foreign Device

The VLT® BACnet/IP MCA 125 uses services such as *Who Is* and *I-Am* which both are based on broadcasts. These services are required to find devices within a network.

When more then 1 IP network is used, routers are installed to join the networks. The routers do not forward broadcasts from 1 network to another. The BACnet handles this by providing a technology called BBMD - BACnet broadcast management device. The BBMD is easily made by adding 1 BBMD device in each network. The BBMDs are configured so that the broadcasts they receive on their local networks are packed in an IP frame and sent to the other BBMD. The 2nd BBMD now transmits the broadcast to its local network. This solution requires an extra device in each network, which increases the cost.

In installations where only a few devices are on the remote side, a foreign device registration (FD) is sometimes more efficient. The remote network does not require a BMD to be installed locally. Instead, each BACnet device with the foreign device feature establishes a direct connection to the BBMD in the remote network.

The FD holds at least 3 parameters for configuration:

- Parameter ***12-75 BBMD IP Address*** which holds the IP address of the BBMD.
- Parameter ***12-76 BBMD Port*** defines which port the BBMD uses.
- Parameter ***12-77 BBMD Reg. Interval*** defines the interval of how often the FD sends information to the BBMD.

Figure 10 shows an example of a setup consisting of 2 networks:

- Network 1:

  This is where the remote drive is located. This network has no controller, and the drive uses the BBMD in the BMS controller in network 2.

- Network 2:

  This is where the BMS controller is connected. The IP address of the BMS controller is 192.168.1.10, and the BMS controller also has the BBMD feature. The BBMD uses port number 47808.

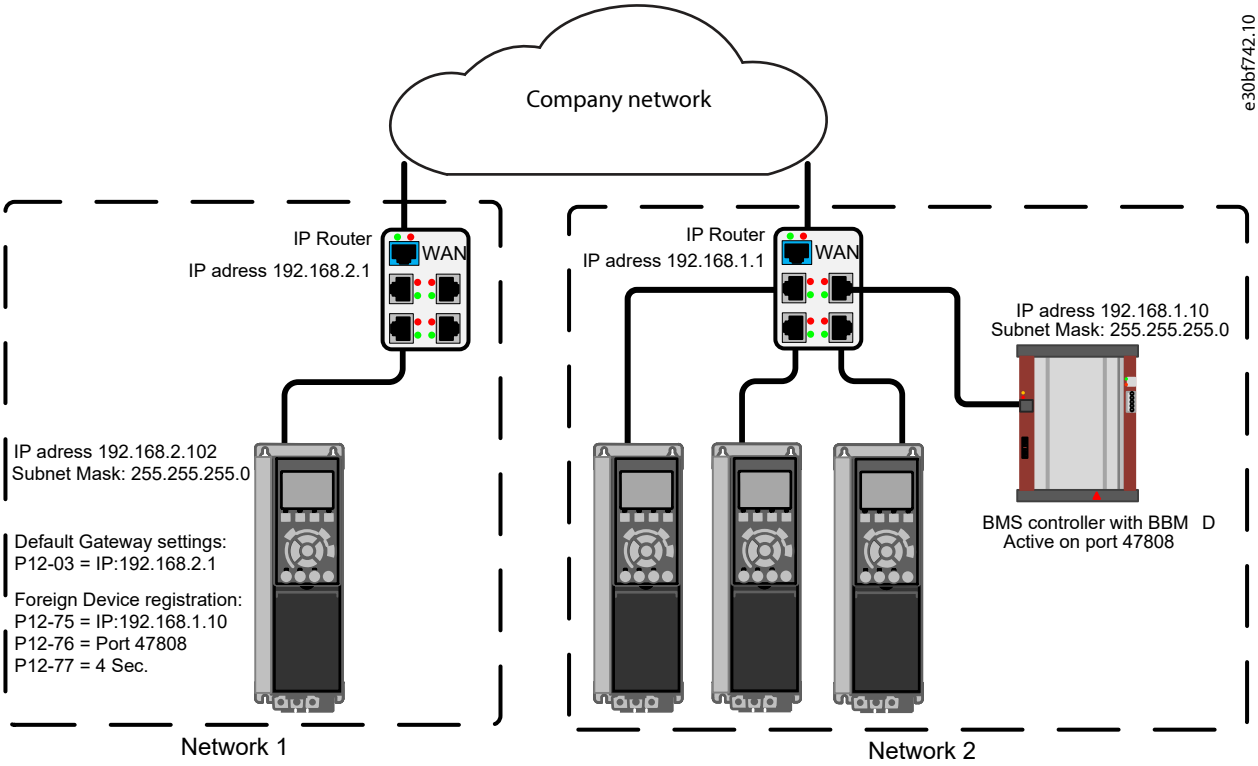


Figure 10: Example with 2 Networks

6 Parameter Description

6.1 8-7* BACnet

8-70 BACnet Device Instance

Default value:	1	Parameter type:	Range, 0 - 4194302
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters

Default value:	127	Parameter type:	Range, 1 - 127
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

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

8-73 MS/TP Max Info Frames

Default value:	1	Parameter type:	Range, 1 - 65534
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

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

8-74 I-AM Service

Default value:	[0] Send at power-up	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

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

Option	Name	Description
*[0]	Send at power-up	
[1]	Continuously	

8-75 Initialization Password

Default value:	Size related	Parameter type:	Range, 1 - 20
Setup:	1 setup	Conversion index:	0
Data type:	VisStr [20]	Change during operation:	True

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

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

8-76 VFD Fault Code Mapping New

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

NOTE: This parameter is active only when parameter ***8-30 Protocol*** is set to ***[5] BACnet*** or ***[9] FC Option***.

If enabled, a new mapping method of the p-VFD fault codes according to the ASHRAE BACnet standard is used.

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

8-77 Custom Object List

Default value:	0 N/A	Parameter type:	Array [30]
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Use this parameter for configuring custom analog value objects.

6.2 Parameter Group 12-** Ethernet

6.2.1 12-0* IP Settings

12-00 IP Address Assignment

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

Select the method for assigning the IP address.

Option	Name	Description
[0]	Manual	Set the IP address in parameter ***12-01 IP Address***.
[1]	DHCP	Assign the IP address via DHCP server.
[2]	BOOTP	Assign the IP address via BOOTP server.
[3]	Disable	

12-01 IP Address

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

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

12-02 Subnet Mask

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

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

12-03 Default Gateway

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

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

12-04 DHCP Server

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

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

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

12-05 Lease Expires

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	TimeDifferenceWithDateIndication	Change during operation:	True

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

12-06 Name Servers

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

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

12-07 Domain Name

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

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

12-08 Host Name

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

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

Logical (given) name of the option.

12-09 Physical Address

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

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

6.2.2 12-1* Ethernet Link Parameters

The following applies for the whole parameter group:

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

12-10 Link Status

Default value:	[0] No link	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	–

Data type:	Uint8	Change during operation:	True

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

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

12-11 Link Duration

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

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

12-12 Auto Negotiation

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

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

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

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

12-13 Link Speed

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

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

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

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

12-14 Link Duplex

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

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

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

12-18 Supervisor MAC

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

MAC addresses of currently active supervisors.

12-19 Supervisor IP Addr.

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

IP addresses of currently active supervisors.

6.2.3 12-4* Fieldbus Extension

12-49 Ethernet Extended Status

Default value:	0hex	Parameter type:	Array [13]
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter provides extra information from Ethernet-based communication.

Table 28: Parameter Index

ID	Description
[0]	Number of times the options have gone into Data exchange since power-up.
[1]	Fieldbus cyclic update time in µSec (0=not set).
[2]	Total number of lost cyclic frames since power-up.
[3]	Number of lost cyclic frames since power-up while the motor has been running.
[4]	Reserved.
[5]	Control word timeout in µSec (set by the PLC, hardware configuration).
[6]	CPU load %.

Table 28: Parameter Index - (continued)

ID	Description
[7]	Reserved for future enhancements.
[8]	SPI error counter, errors since power-up (received from CC).
[9]	SPI error counter, error since power-up (received from IRT).
[10]	S2 IO controller switch counter (number of switches between primary and secondary).
[11]	S2 running on PLC1 counter in minutes.
[12]	S" running on PLC2 counter in minutes.

6.2.4 12-7* BACnet

12-70 BACnet Status

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

This parameter shows the status of the BACnet IP option.

Table 29: Bit Descriptions

Bit number	Description	Value = 0	Value = 1	Comment
0	Reserved	–	–	Read as 0.
1	Duplicate device instance detection	Not detected	Detected	–
2	Invalid DIP switch setting	Not detected	Detected	Read as 0.
3	Reserve	–	–	Read as 0.
4	Link on port 1	No link	Link	–
5	Link on port 2	No link	Link	–
6	W34 source alarm	No error/alarm	Error or alarm	Mapped to alarm word and alarm word 2.
7	W34 IP conflict	No conflict	Conflict detected	–
8	Reserved	–	–	Read as 0.
9	Reserved	–	–	Read as 0.
10	Reserved	–	–	Read as 0.
11	Reserved	–	–	Read as 0.
12	Reserved	–	–	Read as 0.
13	Reserved	–	–	Read as 0.
14	Reserved	–	–	Read as 0.
15	Reserved	–	–	Read as 0.

12-71 BACnet Datalink

Default value:	[1] BACnet/IP	Parameter type:	Option

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

Select which interface BACnet/IP should use. If ***[0] All datalinks*** is selected, the BACnet/IP automatically detects which BACnet layer to use.

Option	Name	Description
[0]	All datalinks	Enables BACnet over IP and BACnet over Ethernet.
[1]*	BACnet/IP	Enables BACnet over IP and disables BACnet over Ethernet.
[2]	BACnet Ethernet	Enables BACnet over Ethernet and disables BACnet over IP.

12-72 BACnet UDP Port

Default value:	47808	Parameter type:	Range, 1 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Set the port number used for the UDP connection. The recommended port number is within the ranges 47808–47823 and 49152–65535.

12-75 BBMD IP Address

Default value:	0	Parameter type:	Range, 0 - 2147483647
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

Set the IP address if the remote BBMD management device. If set to 0.0.0.0, the Foreign Device function is disabled.

12-76 BBMD Port

Default value:	47808	Parameter type:	Range, 1 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the port number of the BBMD management device that handles the broadcast messages.

12-77 BBMD Reg. Interval

Default value:	10 s	Parameter type:	Range, 1 - 65535 s
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets the registration interval at which the drive re-registers itself in the remote BBMD. The interval is set in seconds.

12-78 Device ID Conflict Detection

Default value:	0 min	Parameter type:	Range, 0 - 525600 min
Setup:	2 setups	Conversion index:	70
Data type:	Uint32	Change during operation:	True

Set the time in minutes that should pass between a device ID conflict and the logging of the conflict. If the parameter is set to 0, logging is disabled.

12-79 Message Counter

Default value:	0	Parameter type:	Readout, Array [6]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Index	Description
[0]	Total number of received and sent messages
[1]	Total number of received bus messages
[2]	Total number of sent messages
[3]	Total number of error messages
[4]	Total number of retired (timed out) messages
[5]	Total number of control word timeout error messages on an object.

6.2.5 12-8* Other Ethernet Services

12-80 FTP Server

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

Enables/disables the built-in FTP server.

Option	Name	Description
[0]*	Disabled	Disable the built-in FTP server.
[1]	Enabled	Enable the built-in FTP server.
[2]	Enabled with TLS	

12-81 HTTP Server

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

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

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

12-82 SMTP Service

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

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

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

12-83 SNMP Agent

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

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

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

12-84 Address Conflict Detection

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

Use this parameter to detect and resolve IP address conflict.

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

12-85 ACD Last Conflict

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

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

12-86 NTP Host Server

Default value:	0	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0

Data type:	VisStr[48]	Change during operation:	True

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

12-87 SNTP Time Sync

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

Synchronize the clock via NTP at a defined interval.

12-89 Transparent Socket Channel Port

Default value:	4000	Parameter type:	Range, 0 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

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

6.2.6 12-9* Advanced Ethernet Services

12-90 Cable Diagnostics

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

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

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

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

12-91 Auto Cross Over

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

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

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

12-93 Cable Error Length

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

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

12-96 Port Config

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

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

Option	Name	Description
[0]	Normal/Disable	
[1]	Mirror port 1 to 2	
[2]	Mirror port 2 to 1	
[10]	Port 1 disabled	
[11]	Port 2 disabled	
[254]	Mirror int. port to 1	
[255]	Mirror int. port to 2	

12-97 QoS Priority

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

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

Table 30: Parameter Index

Index	Value
[0]	59
[1]	47
[2]	55

Table 30: Parameter Index - (continued)

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

12-98 Interface Counters

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

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

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

Table 31: Parameter Indices

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

12-99 Media Counters

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

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

Table 32: Parameter Indices

Index	Description
[0]	Alignment errors
[1]	FCS errors

Table 32: Parameter Indices - (continued)

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

7 Troubleshooting

7.1 Warnings and Alarms

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

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

7.2 LED Status

The VLT® BACnet/IP MCA 125 has 3 bicolored LEDs that allow a fast and detailed diagnosis. Each LED is linked to its unique part of the interface, see Table 33.

Table 33: LED Label

LED label	Description
MS	Module status, reflects the activity on the BACnet/IP stack.
NS1	Network status 1, reflects the activity on port 1.
NS2	Network status 2, reflects the activity on port 2.

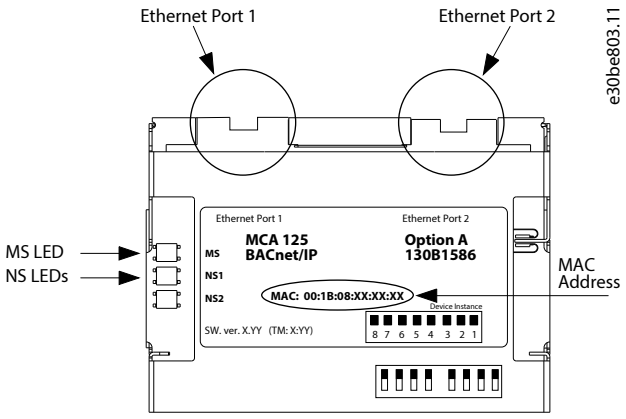


Figure 11: Overview of the VLT® BACnet/IP MCA 125 Option Module

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

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

Table 34: MS: Module Status

State	LED		Description
Power up	Red/green: 	Solid red/green	The device is powering up.
Running	Yellow: 	Solid yellow	No IP address is configured.
	Red: 	Flashing red	Fault: • IP address conflict • Device ID error
	Red: 	Solid red	Alarm

Table 35: NS1 + NS2: Network Status (1 per Port)

State	LED		Description
Power up	Red/green: 	Solid red/green	The device is powering up (after MS LED).
Running	Green: 	Solid green	The link is active.
	Red: 	Solid red	The IP address assigned to the device is already in use.
	Off	Off	There is no link or the link has been removed after a valid IP address has been entered.

7.3 No Communication with the Drive

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

Check the link status

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

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

Check the cabling

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

Check the IP address

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

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