



9

BACnet MS/TP control through the embedded fieldbus interface (EFB)

Contents of this chapter

The chapter describes BACnet MS/TP control through the embedded fieldbus interface (EFB): supported functionality, services and objects as well as how to configure the BACnet through the **Primary settings** menu and with parameters.

BACnet overview

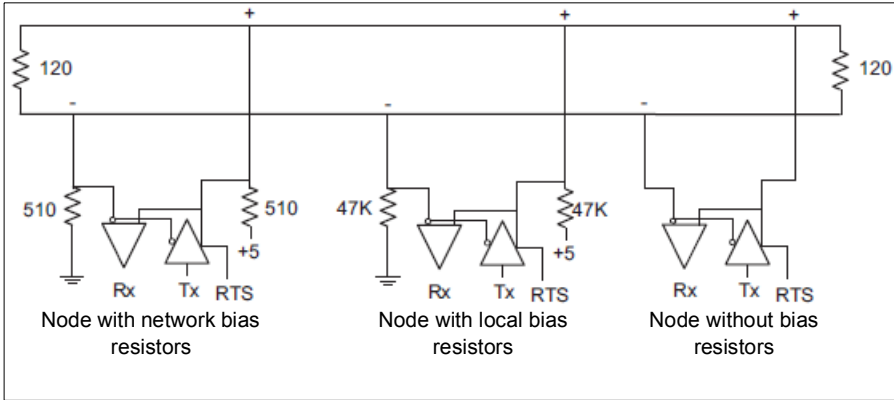
BACnet is an open standard for data communication that enables interoperability between different building systems (eg fire, security, lighting, HVAC, elevator, etc.) and devices in building automation and control applications. It enables data sharing among different types of devices from a broad set of suppliers.

You will find BACnet Protocol Implementation Conformance Statement (PICS) (3AXD10000387059 [English]) for the ACH580 in the ABB Document library on the Internet.

Hardware installation

■ Connecting devices to a BACnet MS/TP EIA-485 network

The figure shows three types of nodes connected on the EIA-485 network.



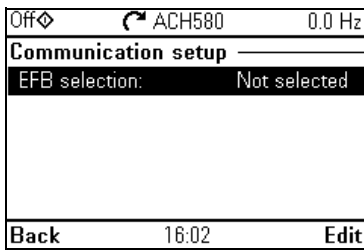
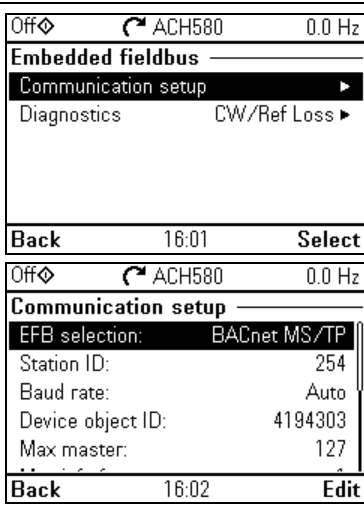
■ Connecting the drive to the building automation controller

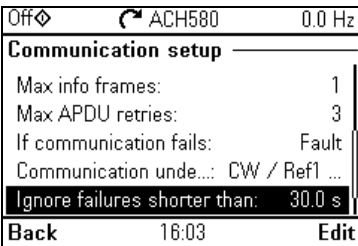
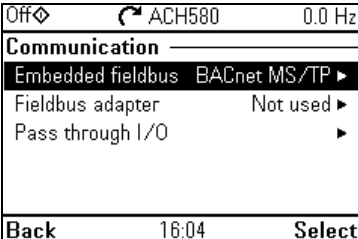
For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section [Connecting the drive to the fieldbus](#) on page 214.

Starting up BACnet communication through the Primary settings menu

The **Primary settings** menu enables easy programming of the most common settings for the drive including BACnet communication settings.

Commissioning	
<input type="checkbox"/> To start up fieldbus communication select Menu > Primary settings > Communication.	
<input type="checkbox"/> Select Embedded fieldbus > Communication setup.	

<input type="checkbox"/>	<p>Select EFB selection and then select BACnet MS/TP and press Save.</p>	
<input type="checkbox"/>	<p>To set up BACnet MS/TP parameters select Embedded fieldbus > Communication setup > Roll the screen down to see all rows.</p>	

<input type="checkbox"/>	<p>After setting all necessary parameters, select Apply settings to embedded fieldbus to validate your settings.</p>	
<input type="checkbox"/>	<p>After validating the settings, press Back twice until you see Pass through I/O on the Communication menu. Select Pass through I/O and then Drive control setup.</p>	

For relay output control through BACnet MS/TP, select **Relay outputs** and set the source of appropriate relays to EFB.

Off	ACH580	0.0 Hz
Drive control setup		
Relay outputs		▶
Analog outputs		▶
Back	16:04	Select
Off	ACH580	0.0 Hz
Relay outputs		
R01	Not energized	▶
R02	Custom	▶
R03	Custom	▶
Back	16:04	Select
Off	ACH580	0.0 Hz
R01		
Actual command:		0
Source:		EFB/FBA
Off delay:		0.0 s
On delay:		0.0 s
Back	16:04	Edit

<input type="checkbox"/>	<p>For analog output control through BACnet MS/TP, select Analog outputs and configure the appropriate analog outputs.</p>	<p>Off ◊ ACH580 0.0 Hz</p> <p>Drive control setup</p> <p>Relay outputs ▶</p> <p>Analog outputs ▶</p>
	<p>Back 16:04 Select</p> <p>Off ◊ ACH580 0.0 Hz</p> <p>Analog outputs</p> <p>A01: 0.000 V Custom ▶</p> <p>A02: 0.000 mA Custom ▶</p>	
	<p>Back 16:05 Select</p>	
	<p>Off ◊ ACH580 0.0 Hz</p> <p>A01:</p> <p>Output value: 0.000 V</p> <p>EFB/FBA Source value: 0.00 %</p> <p>Source: Custom</p> <p>Source min: 0.0 %</p> <p>Source max: 50.0 %</p> <p>Back 16:05 View</p>	

Starting up fieldbus communication with parameters

Follow these steps to setup fieldbus communication with parameters in the **Parameters** menu. For example of appropriate values, see section [Activating drive control functions](#) on page 250.

1. Power up the drive.
2. Enable BACnet communication by setting parameter [58.01 Protocol enable](#) to [BACnet MSTP](#).
3. Configure network settings with parameters [58.03 Node address](#) and [58.04 Baud rate](#).
4. Define the device object instance value with parameter [58.40 Device object ID](#).

Note: The object instance value should be unique and in the range 1...4194303.

5. Define communication loss function to detect communication loss between EFB and the drive:
 - Set the communication loss mode and communication loss time with parameters [58.15 Communication loss mode](#) and [58.16 Communication loss time](#).
 - Select how the drive reacts to an EFB communication break with parameter [58.14 Communication loss action](#).
6. Save the valid parameter values to permanent memory by setting parameter [96.07 Parameter save manually](#) to *Save*.
7. Validate the settings made in parameter group [58 Embedded fieldbus](#) by setting parameter [58.06 Communication control](#) to *Refresh settings*.
8. You can use parameters [58.07...58.13](#) for diagnostics. You can reset counters [58.08...58.12](#) by setting the parameter value to 0.
9. Set the relevant drive control parameters to control the drive according to the application.

Note: You find all embedded fieldbus parameters in group [58 Embedded fieldbus](#) on page [511](#).

Activating drive control functions

■ Drive control

To enable fieldbus control of various drive functions through BACnet MS/TP, do the following:

- Configure the drive to accept embedded fieldbus communication by enabling BACnet communication and defining the node address and device id for the drive.
- Select the individual control functions to use the embedded fieldbus as a source. This makes the input source come from the corresponding BACnet object.

Note: Change those parameter of the functions that you want to control through BACnet MS/TP. All other parameters can remain as factory default values.

Start/stop direction control

For Start/stop direction control through fieldbus, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.01 Ext1 commands	Embedded fieldbus	Start/stop by fieldbus with Ext1 selected	BV10
20.07 Ext2 commands	Embedded fieldbus	Start/stop by fieldbus with Ext2 selected	BV10

Drive parameter	Value	Description	BACnet object
20.21 Direction	Request	Direction by fieldbus, if required	BV11

Input reference select

The tables below show how to use the BACnet embedded fieldbus to select the drive input references for frequency and speed control modes

- For frequency control, set parameter [99.04 Motor control mode](#) = *Scalar* (default value for ACH580). See section [Frequency reference](#) on page 251 and parameter group [28 Frequency reference chain](#) on page 413.
- For speed control, set parameter [99.04 Motor control mode](#) = *Vector*. See section [Speed reference](#) on page 251 and parameter group [22 Speed reference selection](#) on page 395.

Vector control has better accuracy than scalar control, but vector control cannot be used in all situations. See parameter [99.04 Motor control mode](#).

Frequency reference

For using the BACnet embedded fieldbus to provide input frequency references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 = <i>EFB MCW bit 11</i>	Reference set selection by fieldbus	BV13
28.11 Ext1 frequency ref1	8 = <i>EFB ref1</i> ¹⁾	Frequency reference source 1	AV16 Input Reference1
28.15 Ext2 frequency ref1	9 = <i>EFB ref2</i> ¹⁾	Frequency reference source 2	AV17 Input Reference 2
46.02 Frequency scaling	50.00 Hz ¹⁾	16-bit scaling of frequency-related parameters	No direct BACnet object

¹⁾ As an example

Speed reference

For using the BACnet embedded fieldbus to provide input speed references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 = <i>EFB MCW bit 11</i>	Reference set selection by fieldbus	BV13
22.11 Ext1 speed ref1	8 = <i>EFB ref1</i> ¹⁾	Speed reference source 1	AV16 Input Reference1
22.18 Ext2 speed ref1	9 = <i>EFB ref2</i> ¹⁾	Speed reference source 2	AV17 Input Reference 2
46.01 Speed scaling	1500 rpm ¹⁾	16-bit scaling of speed-related parameters	No direct BACnet object

¹⁾ As an example

■ Miscellaneous drive control

To use the BACnet embedded fieldbus for different drive control functions, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.40 Run permissive	15 = Embedded fieldbus	Run permission by fieldbus	BV12
No direct drive parameter. Via BACnet object the fault reset always goes through.	-	Fault reset via fieldbus	BV14
20.41 Start interlock 1	15 = Embedded fieldbus	Source for start interlock 1 is fieldbus	BV20
20.42 Start interlock 2	15 = Embedded fieldbus	Source for start interlock 2 is fieldbus	BV21

Relay output control

For relay output control through BACnet embedded fieldbus,

- set the following drive parameters to select the source for the ROs
- program the drive for control through BACnet.

Drive parameter	Value	Description	BACnet object
10.24 RO1 source	40 = RO/DIO control word bit0	Relay output 1 controlled by fieldbus	BO0
10.27 RO2 source	41 = RO/DIO control word bit1	Relay output 2 controlled by fieldbus	BO1
10.30 RO3 source	42 = RO/DIO control word bit2	Relay output 3 controlled by fieldbus	BO2
15.07 RO4 source	Other (10.99 RO/DIO control word , bit 3)	Relay output 4 controlled by fieldbus	BO3
15.10 RO5 source	Other (10.99 RO/DIO control word , bit 4)	Relay output 5 controlled by fieldbus	BO4
15.23 DO1 source	Other (10.99 RO/DIO control word , bit 8)	Digital output 1 controlled by fieldbus	BO5

Data point connections

The BACnet objects control parameter [10.99 RO/DIO control word](#) bit values. These bits need to be connected to the corresponding RO and DO sources as above.

BACnet object	Drive parameter	Description
BO0...BO5	10.99 RO/DIO control word	Storage parameter for relay outputs and digital output

Analog output control

For analog output control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied analog value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
13.12 AO1 source	37 = AO1 data storage	Analog output 1 controlled by fieldbus	AO0
13.22 AO2 source	38 = AO2 data storage	Analog output 2 controlled by fieldbus	AO1
13.17 AO1 source min	0.0 ¹⁾	Minimum value of signal selected by parameter 13.12 AO1 source	No direct BACnet object
13.18 AO1 source max	100.0 ¹⁾	Maximum value of signal selected by parameter 13.12 AO1 source	No direct BACnet object
13.27 AO2 source min	0.0 ¹⁾	Minimum value of signal selected by parameter 13.22 AO2 source	No direct BACnet object
13.28 AO2 source max	100.0 ¹⁾	Maximum value of signal selected by parameter 13.22 AO2 source	No direct BACnet object

¹⁾ As an example

Data point connections

The BACnet objects control parameters [13.91 AO1 data storage](#) and [13.92 AO2 data storage](#) values. These values need to be connected to the corresponding AO sources as above.

BACnet object	Drive parameter	Description
AO0	13.91 AO1 data storage	Storage parameter for AO1
AO1	13.92 AO2 data storage	Storage parameter for AO2

PID control

For PID control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied PID value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
40.08 Set 1 feedback 1 source	10 = Feedback data storage	Feedback 1 source data storage	AV43
40.09 Set 1 feedback 2 source	10 = Feedback data storage	Feedback 2 source data storage	AV43
40.16 Set 1 setpoint 1 source	24 = Setpoint data storage	Setpoint 1 source data storage	AV42
40.17 Set 1 setpoint 2 source	24 = Setpoint data storage	Setpoint 2 source data storage	AV42

Data point connections

The BACnet objects control parameters [40.91 Feedback data storage](#) and [40.92 Setpoint data storage](#). These values need to be connected to the corresponding PID setpoint and feedback values as above.

BACnet object	Drive parameter	Description
AV43	40.91 Feedback data storage	Storage parameter for process feedback value
AV42	40.92 Setpoint data storage	Storage parameter for process setpoint value

Communication fault

BACnet has no built-in feature to detect communication timeout, because it is not a synchronous protocol. If communication timeouts are needed, you can use the following parameters to detect timeouts based on different packets and specifying the drive action.

Drive parameter	Value	Description
58.15 Communication loss mode	1 = <i>Any message</i> 2 = <i>Cw / Ref1 / Ref2</i>	Defines which message types reset the timeout counter for detecting an EFB communication loss.
58.14 Communication loss action	0 = <i>No</i> 1 = <i>Fault</i> 2 = <i>Last speed</i> 3 = <i>Speed ref safe</i> 4 = <i>Fault always</i> 5 = <i>Warning</i>	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings are validated by parameter 58.06 Communication control (1 = <i>Refresh settings</i>).
58.16 Communication loss time	0.0...6000.0 s	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter 58.16 Communication loss time is taken.

Drive feedback

The inputs to the BMS controller (drive output signals) have pre-defined content. These drive feedback signals do not require any additional drive configuration. The following table lists a subset of the supported feedback data. For a complete listing, see the Protocol Implementation Conformance Statement (PICS) (3AXD10000387059 [English]), which you can find in the ABB Document library on the Internet.

Drive parameter	Description	BACnet object
01.01 Motor speed used	Estimated motor speed (rpm)	AV0
01.06 Output frequency	Estimated drive output frequency (Hz)	AV1
01.11 DC voltage	DC link voltage (V)	AV2
01.13 Output voltage	Calculated motor voltage (V AC)	AV3
01.07 Motor current	Measured (absolute) motor current (A)	AV4
01.10 Motor torque	Motor torque in percent of the nominal motor torque (%)	AV5

Drive parameter	Description	BACnet object
01.14 Output power	Drive output power (kW)	AV6
05.11 Inverter temperature	Estimated drive temperature in percent of fault limit (%)	AV7
01.20 Inverter kWh counter	Amount of energy that has passed through the drive (in either direction) in full kilowatthours. Whenever the counter rolls over, 01.19 Inverter MWh counter is incremented. The minimum value is zero.	AV9
35.01 Motor estimated temperature	Displays the motor temperature (°C or °F) as estimated by the internal motor thermal protection model. The unit is selected by parameter 96.16 Unit selection .	AV15
01.03 Motor speed %	Motor speed in percent of the synchronous motor speed.	AV31
40.01 Process PID output actual	PID controller output	AV44
40.04 Process PID deviation actual	PID deviation	AV49
01.50 Current hour kWh	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV130
01.51 Previous hour kWh	Previous hour energy consumption. The value 01.50 Current hour kWh is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV131
01.52 Current day kWh	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV132
01.53 Previous day kWh	Previous day energy consumption. The value 01.52 Current day kWh is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV133
04.01 Tripping fault	Fault that caused the current trip (active fault)	AV18
04.11 Latest fault	Previous fault (non-active)	AV19
04.12 2nd latest fault	Fault before the previous fault (non-active)	AV20

The actual output values of the drive can be read from AV0...AV6, AV31 and AV32:

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R

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Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV2	DC-Voltage	DC link voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R
AV4	Output-Current	Output current of drive	0, nominal current	A	R
AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R

Parameter setting example

■ Frequency control

The table below shows an example of how to configure a basic frequency control application. The rest of parameters can be left as default values.

Drive parameter	Settings	Description
58.06 Communication control	0 = <i>Enabled</i>	Normal operation
58.03 Node address	181 ¹⁾	Defines the node address of the drive on the fieldbus link.
58.40 Device object ID	51 ¹⁾	Configures device object ID.
58.16 Communication loss time	30 ¹⁾	Sets the communication timeout as 30 seconds.
58.15 Communication loss mode	1 = <i>Any message</i> ¹⁾	The timeout feature monitors any directed message received from the drive.
58.06 Communication control	0 = <i>Refresh settings</i>	Refreshes settings and takes changed EFB configuration settings in use.
20.01 Ext1 commands		Selects the embedded fieldbus interface as the source of start and stop commands for external control location 1.
28.11 Ext1 frequency ref1		Selects embedded fieldbus reference 1 as the source for frequency reference 1.

¹⁾ Example

BACnet protocol implementation conformance statement

Document: 3AXD10000387059, Rev 10

Date: May 18, 2018

Vendor name: ABB, Vendor ID 127

Product name: HVAC Drive

Product model number: ACH580

Applications software version: Drive FW: 2.x.x.x BACnet Appl: 2025

Firmware revision: 14.01

BACnet protocol revision: 14

■ Product description:

The ACH580 is a high-performance variable speed drive (VSD) designed for HVAC and refrigeration applications. Product supports native BACnet, connecting directly to the MS/TP LAN. MS/TP baud rates are supported up to 115.2 kbps, as well as master and slave mode functionalities. Over BACnet, the drive can be fully controlled and monitored as a standard variable speed drive. In addition, the drive's standard I/O is available over BACnet to the user application.

■ BACnet standardized device profile (Annex L):

- BACnet Operator Workstation (B-OWS)
- BACnet Advanced Operator Workstation (B-AWS)
- BACnet Operator Display (B-OD)
- BACnet Building Controller (B-BC)
- BACnet Advanced Application Controller (B-AAC)
- BACnet Application specific Controller (B-ASC)
- BACnet Smart Sensor (B-SS)
- BACnet Smart Actuator (B-SA)

■ List all BACnet interoperability building blocks supported (Annex K):

DS-RP-B	Data Sharing-ReadProperty
DS-RPM-B	Data Sharing-ReadProperty Multiple
DS-WP-B	Data Sharing-WriteProperty
DS-WPM-B	Data Sharing-WriteProperty Multiple
DS-COV-B	Data Sharing-Change of Value
DM-DDB-B	Device Management-DynamicDeviceBinding
DM-DOB-B	Device Management-DynamicObjectBinding
DM-DCC-B	Device Management-DeviceCommunicationControl
DM-RD-B	Device Management-ReinitializeDevice
DM-TS-B	Device Management-Time Synchronization

■ **Segmentation capability:**

- Able to transmit segmented messages Window size: -
- Able to receive segmented messages Window size: -

■ **Standard object types supported:**

Object instantiation is static, i.e. objects cannot be created or deleted. Refer to tables at end of this document for object details.

■ **Data link layer options:**

- BACnet IP, (Annex J)
- BACnet IP, (Annex J), foreign device
- ISO 8802-3, Ethernet (Clause 7)
- ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
- ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) _____
- MS/TP master (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
- MS/TP slave (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
- Point-to-point, EIA 232 (Clause 10), baud rate(s): _____
- Point-to-point, modem, (Clause 10), baud rate(s): _____
- LonTalk, (Clause 11), medium: _____
- BACnet/ZigBee (ANNEX O)
- Other: _____

■ **Device address binding:**

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) Yes No

■ **Networking options:**

- Router, Clause 6
 - BACnet/IP to MS/TP
 - BACnet/ ISO 8802-3, Ethernet to MS/TP
 - BACnet/IP to BACnet/ ISO 8802-3, Ethernet
 - BACnet/IP to BACnet/ ISO 8802-3, Ethernet to MS/TP
- Annex H, BACnet tunneling router over IP
- BACnet/IP broadcast management device (BBMD)
 - Does the BBMD support registrations by foreign devices? Yes No
 - Max BDT (Broadcast distribution table)-entries:
 - Does the BBMD support network address translation? Yes No

■ **Network security options:**

- Non-secure device - is capable of operating without BACnet network security
- Secure device - is capable of using BACnet network security (NS-SD BIBB)
 - Multiple application-specific keys:
 - Supports encryption (NS-ED BIBB)
 - Key server (NS-KS BIBB)

■ **Character sets supported:**

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

- ISO 10646 (UTF-8)
- IBM /Microsoft DBCS
- ISO 8859-1
- ISO 10646 (UCS-2)
- ISO 10646 (UCS-4)
- JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:

Object/Property support matrix

The following table summarizes the object types/properties supported and default values:

Property	Object type							Loop
	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistate value	
Object identifier	R	R	R	R	R	R	R	R
Object name	W, P	W, P	R	W, P	W, P	R ⁽¹⁾	R	W,P
Object type	R	R	R	R	R	R	R	R
Present value	R	C	C	R	C	C	R	R
Status flags	R	R	R	R	R	R	R	R
Event state	R	R	R	R	R	R	R	R
Out-of-service	W	W	W	W	W	W	W	W
Polarity	W, P	W, P						
Active text	R	R	R					
Inactive text	R	R	R					
Units				R	R	R		
Min present value				R	R	R		
Max present value				R	R	R		
Priority array		R	R		R	R		
Relinquish default		W, P	W,P		W, P	W, P		
COV increment				W,P	W,P	W,P		
Number of states							R	
State text							R	
Property list	R	R	R	R	R	R	R	R
	<ul style="list-style-type: none"> • R = Read only, W = Writable, C = Commandable, P = Persist • AV16, AV17, AV21, AV22, AV40- AV44, AV55, AV56, AV59, AV120-129 have W, P • Max length of writable object names is 25 characters 							

Device object instance summary

The following table summarizes the device object supported:

Device object			
Property	Flag	Type	Default value
Object identifier	W, P	OID	4194303
Object name	W, P	CharString, max length 25	AC Drive 4194303
Object type	R	Enum	DEV (8)
System status	R	Enum	
Vendor name	R	CharString	ABB
Vendor identifier	R	Unsigned	127
Model name	R	CharString	ACH580

Firmware revision	R	CharString	14.01
Application software revision	R	CharString	
Description	W, P	CharString, max length 100	"ACH580 is a high-performance variable speed drive designed for HVAC and refrigeration applications."
Location	W, P	CharString, max length 50	"(not set)"
Protocol version	R	Unsigned	1
Protocol revision	R	Unsigned	14
Protocol services supported	R	BitString	
Protocol object types supported	R	BitString	
Object list	R	Array of OID	
Max APDU length accepted	R	Unsigned	480
Segmentation supported	R	Enum	No segmentation (3)
Local time	R	BACnetTime	
Local date	R	BACnetDate	
APDU timeout	W, P	Unsigned	10000 ms
Number of APDU retries	W, P	Unsigned	3
Max master	W, P	Unsigned	127
Max info frames	W, P	Unsigned	1
Device address binding	R	List of Struct	
Database revision	R, P	Unsigned	
Active COV subscriptions	R	Array of BACnetCOVSubscription	
Serial number	R	CharString	
Property list	R	Array of Unsigned	
Flags: R = Read only, W = Writable, C = Commandable, P = Persist			

Binary input object instance summary

The following table summarizes the binary input objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
B10	RO1-Monitor	Status of relay output 1	On / Off	R
B11	RO2-Monitor	Status of relay output 2	On / Off	R
B12	RO3-Monitor	Status of relay output 3	On / Off	R
B13	RO4-Monitor	Status of relay output 4	On / Off	R
B14	RO5-Monitor	Status of relay output 5	On / Off	R
B15	DO1-Monitor	Status of digital output 1	On / Off	R
B16	DI1-Monitor	Status of digital input 1	On / Off	R
B17	DI2-Monitor	Status of digital input 2	On / Off	R
B18	DI3-Monitor	Status of digital input 3	On / Off	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BI9	DI4-Monitor	Status of digital input 4	On / Off	R
BI10	DI5-Monitor	Status of digital input 5	On / Off	R
BI11	DI6-Monitor	Status of digital input 6	On / Off	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary output object instance summary

The following table summarizes the binary output objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BO0	RO1-Command	Output state of relay 1	On / Off	C
BO1	RO2-Command	Output state of relay 2	On / Off	C
BO2	RO3-Command	Output state of relay 3	On / Off	C
BO3	RO4-Command	Output state of relay 4	On / Off	C
BO4	RO5-Command	Output state of relay 5	On / Off	C
BO5	DO1-Command	Output state of digital output 1	On / Off	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary value object instance summary

The following table summarizes the binary value objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV0	RUN-STOP-Monitor	Drive's run status	Run / Stop	R
BV1	Direction-Monitor	Rotational direction of the motor	Reverse / Forward	R
BV2	OK-FAULT-Monitor	Actual fault status of drive	Fault / OK	R
BV3	EXT1-EXT2-Monitor	Actual control source	Ext2 / Ext1	R
BV4	HAND-AUTO-Monitor	Actual operating mode.	Hand / Auto	R
BV5	Warning-Monitor	Actual warning status	Warning / OK	R
BV7	Ready-Monitor	Actual ready status	Ready / Not-Ready	R
BV8	At-Setpoint-Monitor	Actual at setpoint status	Yes / No	R
BV9	Enabled-Monitor	Actual run enabled status	Enable / Disable	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV10	RUN-STOP-Command	Command to start drive	Run / Stop	C
BV11	Direction-Command	Command to rotational direction	Reverse / Forward	C
BV12	Run-Permissive-Command	Command to run permissive command	Enable / Disable	C
BV13	EXT1-EXT2-Command	Commanded to external 1 or external 2 selection	Ext2 / Ext1	C
BV14	Fault-Reset-Command	Commanded to fault reset	Reset / No	W
BV15-BV16	<Reserved>			
BV17	Lock-Parameters	Actual status of parameter lock.	Lock / Unlock	R
BV18	Control-Override-Command	Command the drive into BACnet control override. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet Control Override.	On / Off	C
BV19	Control-Override-Monitor	Indicates if drive has been placed in BACnet control override by commanding BV18. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet control override.	On / Off	R
BV20	Start-Interlock-1-Command	Command to start enable 1	Enable / Disable	C
BV21	Start-Interlock-2-Command	Command to start enable 2	Enable / Disable	C
BV24	Started-Monitor	Actual start status	Started / Not-Started	R
BV25	Safe-Torque-Off-Monitor	Actual status of Safe Torque Off	Active / OK	R
BV26	Underload-Monitor	Indicates if ULC signal is lower than the Underload curve	Underload / OK	R
BV27	Overload-Monitor	Indicates if ULC signal is higher than the overload curve	Overload / OK	R
BV28	Motor-Heating-Command	Command to motor heating mode	On / Off	W
BV29	Motor-Heating-Monitor	Actual status of motor heating mode	On / Off	R
BV30	User0-Monitor	Actual status of "User bit0" in drive status word	On / Off	R
BV31	User1-Monitor	Actual status of "User bit1" in drive status word	On / Off	R
BV32	User2-Monitor	Actual status of "User bit2" in drive status word	On / Off	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV33	User3-Monitor	Actual status of "User bit3" in drive status word	On / Off	R
BV34	User0-Command	Commands "User bit0" in drive status word	On / Off	C
BV35	User1-Command	Commands "User bit1" in drive status word	On / Off	C
BV36	User2-Command	Commands "User bit2" in drive status word	On / Off	C
BV37	User3-Command	Commands "User bit3" in drive status word	On / Off	C
BV38	<Reserved>			
BV39	Parameter-Save-Command	Command to save drive parameters and BACnet property data (properties marked as 'P=Persist')	Save / No	W
BV40	PID-Set-Select	Command to Process PID set1 or Process PID set2 selection	Set1 / Set2	W

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog input object instance summary

The following table summarizes the analog input objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AI0	AI1-Monitor	Indicates the input level of analog input 1.	0...100	Percent (%)	R
AI1	AI2-Monitor	Indicates the input level of analog input 2.	0...100	Percent (%)	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog output object instance summary

The following table summarizes the analog output objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AO0	AO1-Command	Controls analog output 1 (drive must be configured for BACnet control).	0...100	Percent	C
AO1	AO2-Command	Controls analog output 2 (drive must be configured for BACnet control).	0...100	Percent	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog value object instance summary

The following table summarizes the analog value objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R
AV2	DC-Voltage	DC bus voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R
AV4	Output-Current	Output current of drive	0, nominal current	A	R
AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV7	Operating-Temp-Range	Heatsink temperature	-40, 160	%	R
AV8	Kilowatt-Hour-Meter-R	Drive's cumulative energy usage. This value is resettable.	0,65535	kWh	W
AV9	Kilowatt-Hour-Meter-NR	Drive's cumulative energy usage. This value is not resettable.	0, 65535999999	kWh	R
AV10	Process-PID-Feedback	This object is the process PID feedback signal.	0, 100	%	R
AV11	Process-PID-Deviation	This object is the process PID output signal's deviation from its setpoint.	0, 100	%	R
AV12	External-PID-Feedback	This object is the external PID feedback signal.	0, 100	%	R
AV13	External-PID-Deviation	This object is the external PID output signal's deviation from its setpoint.	0, 100	%	R
AV14	Running-Hours	Drive's resettable run time (reset by writing 0).	0, 3.40282347e38	hours	R
AV15	Motor-Temp-Degrees-C	Motor temperature	-10, 200	°C	R
AV16	Input-Reference-1	Speed setpoint 1	-150, 150	%	C

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV17	Input-Reference-2	Speed setpoint 2.	-150, 150	%	C
AV18	Active-Fault	Displays most recent fault currently active.			R
AV19	Previous-Fault-1	Displays most recent stored (non-active) fault			R
AV20	Previous-Fault-2	Displays the second most recent stored (non-active) fault			R
AV21	AO1-Monitor	Output level of analog output 1	0, 100	%	R
AV22	AO2-Monitor	Output level of analog output 2	0, 100	%	R
AV23	Accel-1-Seconds	Ramp1 acceleration time	0, 1800	s	W
AV24	Decel-1-Seconds	Ramp 1 deceleration time	0, 1800	s	W
AV25	Mbox-Param	Parameter number to be used by mailbox function.		No Units	W
AV26	Mbox-Data	Set (W) or indicate (R) of the data value of mailbox function		No Units	W
AV27	External-PID-Setpoint	This object sets the external PID controller setpoint	0,100	%	C
AV27-AV28	<Reserved>				
AV29	Min-Speed	Defines the allowed minimum output frequency	-500, 500	Hz	W
AV30	Max-Speed	Defines the allowed maximum output frequency	-500, 500	Hz	W
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R
AV33	Max-Current	Max motor current	0, nominal current	A	W
AV34-AV39	<Reserved>				
AV40	LOOP-Feedback-Monitor	Loop controller feedback value after source selection, mathematical function and filtering (read-only)	0, 100	%	R
AV41	LOOP-Setpoint-Monitor	Loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only)	0,100	%	R

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV42	LOOP-Setpoint	Command to store loop controller setpoint value used as input for the process	0,100	%	C
AV43	LOOP-Feedback	Stores the feedback value for loop controller	0,100	%	W
AV44	LOOP-Output	Loop controller output	0,100	%	R
AV45	LOOP- Gain	Loop controller gain	0.1,100	No Units	W
AV46	LOOP-Integration-Time	Loop controller integration time	0,3600	s	W
AV47-AV48	<Reserved>				
AV49	LOOP-Deviation-Monitor	Loop controller deviation	0,100	%	R
AV50-AV52	<Reserved>				
AV53	LOOP-1-Gain	Loop controller gain (set 2)	0.1,100	No Units	W
AV54	LOOP-1-Integration-Time	Loop controller integration time (set 2)	0,3600	s	W
AV55	LOOP-2-Feedback-Monitor	External loop controller feedback value after source selection, mathematical function and filtering (read-only)	0,100	%	R
AV56	LOOP-2-Setpoint-Monitor	External loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only)	0,100	%	R
AV57-AV58	<Reserved>				
AV59	LOOP-2-Output	External loop controller output	0,100	%	R
AV60	LOOP-2-Gain	External loop controller gain	0.1,100	No Units	W
AV61	LOOP-2-Integration-Time	External loop controller integration time	0,3600	s	W
AV62-AV63	<Reserved>				
AV64	LOOP-2-Deviation-Monitor	External loop controller deviation	0,100	%	R
AV65-119	<Reserved>			No Units	W

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV120	Data-IO-1	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.101		No Units	W
AV121	Data-IO-2	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.102		No Units	W
AV122	Data-IO-3	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.103		No Units	W
AV123	Data-IO-4	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.104		No Units	W
AV124	Data-IO-5	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.105 (Read-only)		No Units	R
AV125	Data-IO-6	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.106 (Read-only)		No Units	R
AV126	Data-IO-7	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.107 (Read-only)		No Units	R
AV127	Data-IO-8	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.108 (Read-only)		No Units	R
AV128	Data-IO-9	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.109 (Read-only)		No Units	R
AV129	Data-IO-10	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.110 (Read-only)		No Units	R
AV130	Kilowatt-Hour-This-Hour	Current hour energy consumption	0, 3.40282347e38	kWh	R
AV131	Kilowatt-Hour-Last-Hour	Last hour energy consumption	0, 3.40282347e38	kWh	R
AV132	Kilowatt-Hour-This-Day	Current day energy consumption	0, 3.40282347e38	kWh	R

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV133	Kilowatt-Hour-Last-Day	Last day energy consumption	0, 3.40282347e38	kWh	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Multistate value object instance summary

The following table summarizes the multistate value objects supported:

Object ID	Object name	Description	State text	Present value access type
MSV0	HAND-AUTO-Reference	Indicates whether the drive is under Hand or Auto control, or if override mode is active.	Off, Hand, Auto, Override	R
MSV1	Active-Fault-1	Enumerated type of the most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

Object ID	Object name	Description	State text	Present value access type
MSV2	Active-Fault-2	Enumerated type of the 2nd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R
MSV3	Active-Fault-3	Enumerated type of the 3rd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

Object ID	Object name	Description	State text	Present value access type
MSV4	Active-Warning-1	Enumerated type of the most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R
MSV5	Active-Warning-2	Enumerated type of the 2nd most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R
MSV6	Active-Warning-3	Enumerated type of the 3rd most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Loop object instance summary

The following table summarizes the loop objects supported:

Object ID	Object name	Description	Manipulated variable reference	Controlled variable reference	Setpoint reference	Present value access type
LOOP0	LOOP-Set1	Loop object for process PID set 1	AV44 Present Value	AV43 Present Value	AV42 Present Value	R

Object ID	Object name	Description	Manipulated variable reference	Controlled variable reference	Setpoint reference	Present value access type
LOOP1	LOOP-Set2	Loop object for process PID set 2	AV44 Present Value	AV43 Present Value	AV42 Present Value	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Mailbox function

The drive provides a Mailbox function to access parameters that have not been pre-defined by the protocol. Using mailbox, any drive parameter can be identified and read. Mailbox can also be used to adjust parameter settings by writing a value to any parameter identified. The following table shows the mailbox objects.

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV25	Mbox-Param	Parameter number to be used by mailbox function.		No units	W
AV26	Mbox-Data	Set (W) or indicate (R) of the data value of mailbox function			W

To use the Mailbox function, write the parameter address to the Mbox-Param object as a floating point value. The three lowest digits in the integer part are used for the parameter index within the parameter group.

Example: For parameter 47.01, write the address as 47001.00 to the Mbox-Param object. For parameter 47.999, write the address as 47999.00 to the Mbox-Param object.

Read or write the value to the Mbox-Data object as a floating point value. If the parameter is a decimal type parameter it's value is shown as a decimal number. The value of an integer type parameter is shown as an integer number.

Example: If parameter 47.01 has value 12.554 it is shown just as it is. If parameter 47.21 has value 125, it is shown just like that, without a decimal part.

