BACnet MS/TP communication with X2 devices

Features

- BACnet MS/TP communication over RS485
- B-ASC Device Profile
- Supports up to 5 Change Of Value (COV) subscriptions
- Slave type of communication
- Supports up to 128 nodes on one network
- Galvanic isolated bus connection
- Baud rates: Auto / 9600 / 19200 / 38400 / 57600 / 76800 / 115200
- LED indicators

X2-BAC Protocol Implementation Conformance Statement (PICS)

Vendor Name: Vector Controls
Product Name: X2 Controls series
X2 product description:
The X2 communicating BACnet controllers are designed as universal controls equipment suitable for a large number of applications. They may be used in zoning and other applications which are monitored by a BACnet MS/TP network.

Supported BACnet® Interoperability Blocks (BIBB)

The BACnet® interface conforms to the B-ASC device profile (BACnet® Application Specific Controller).
The following BACnet® Interoperability Building Blocks (BIBB) are supported.

BIBB	Type	Name
DS-RP-B	Data sharing	Read property - B
DS-RPM-B	Data sharing	Read property multiple - B
DS-WP-B	Data sharing	Write property - B
DS-COV-B	Data sharing	Change of value - B
DM-DCC-B	Device management	Device communication Control - B
DM-DDB-B	Device management	Dynamic device binding - B
DM-DOB-B	Device management	Dynamic object binding - B
DM-TS-B	Device management	Time synchronization - B
DM-UTC-B	Device management	UTC Time synchronization - B
DM-RD-B	Device management	Reinitialize device - B

Supported standard BACnet® application services

- ReadProperty
- ReadPropertyMultiple
- WriteProperty
- ChangeOfValue (max. 5 COV subscriptions supported)
- DeviceCommunication. Needs a password which is “Vector” (case sensitive and without the quotes).
- I-Am
- I-Have
- TimeSynchronisation
- UTCTimeSynchronisation
- ReinitializeDevice (“cold” or “warm”). Needs a password which is “Vector” (case sensitive and without the quotes).

Supported standard Object types

- Device
- Analog input
- Analog value
- Binary value
- Multi-state Value
- Network Port

LED indicators

The BACnet® interface features a green LED and a red LED for indication of traffic on the RS-485 bus. The green LED is lit when an incoming packet is received, and the red LED is lit when an outgoing packet is transmitted to the bus. At power-up, both LED blink twice simultaneously as a sign of the boot process being completed. A constantly lit LED serves as an indication of a fault condition in the reception or sending process.

Configuration of X2-BAC devices

The communication parameters may be set via operation terminals. Login to the controller as follows:

1. Press UP/DOWN buttons simultaneously for three seconds. The display will show firmware version and revision number. Press the OPTION button to start login.
2. CODE is shown in small display.
3. Select 241 using UP/DOWN buttons.
4. Press OPTION after selecting the correct code.
5. Once logged in with 241 control modules are displayed (Lp1, Lp2, 1u, 2u, etc.) – select with UP/DOWN the communication parameters **CO** and open with OPTION. As soon as the module is open its parameters are displayed.
6. Select the parameters with the UP/DOWN buttons. Change a parameter by pressing the OPTION button. Three arrows are displayed to indicate that the parameter may be modified. Use UP/DOWN buttons to adjust the value.
7. After you are done, press OPTION to save the new value and return to the selection level (arrows disappear when selection is saved). Pressing left hand POWER button without pressing OPTION will discard the value and return without saving. For control parameters press POWER again to leave parameter selection and return to control module selection.

Press the POWER to leave the menu. The unit will return to normal operation if no button is pressed for more than 5 minutes.

COM parameters

Parameter	Description	Range	Default
CO 00	Bus plug-in hardware id (read only)	-	3
CO 01	Bus plug-in software version (read only)	-	-
CO 02	Bus plug-in software revision (read only)	-	-
CO 03	Communication address (must be unique in network)	1-127	1
CO 04	Baud rate: 0 = Auto-detect[1] 1 = 9600 2 = 19200 **3 = 38400** 4 = 57600 5 = 76800 6 = 115200	0-6	3
CO 05	Highest master	1-127	127
CO 06	Device object ID1 (aabbcc**dd**)	0-99	00
CO 07	Device object ID2 (aabb**cc**dd)	0-99	00
CO 08	Device object ID3 (aa**bb**ccdd)	0-99	01
CO 09	Device object ID4 (**aa**bbccdd)	0-4	0
CO 10	Send I-am at boot 0 = OFF, **1 = ON**	0-1	1
CO 11	Not used.	-	-
CO 12	Not used.	-	-
CO 13	Not used.	-	-
CO 14	Not used.	-	-
CO 15	[2,3] Automatic address / ID increment and auto-build of "device object name": 0 = Auto increment and auto-build of device object name disabled 1 = Auto increment is enabled, auto-build of device object name disabled 2 = Auto increment disabled; auto-build of device object name enabled 3 = Auto increment and auto-build of device object name enabled	0-3	2

[1] ***"Auto-detect baud rate"-mode***
When this option is selected, the AEC-BAC will detect the baud rate of the RS485 network. The AEX-BAC will stay in baud rate detection mode until it successfully decodes a package sent from device with **address = 0** with a baud rate which is supported by the AEX-BAC. The baud rate detection mode will be entered once at hardware start-up and after a prolonged communication failure.

[2] ***"Auto increment"-function***
When this function is enabled and an automatic AEC-PM1 parameter load is executed at power up of the controller, the following variables will be incremented and written back to the AEC-PM1 unit:
- CO03 Communication address. This is incremented only if the value is not already 127 with respect to CO05 – the address of the highest master. If CO05 is equal or less than the newly incremented value of CO03, then CO05 is written to be 127 (the maximum value of CO05 possible).
- CO06 … CO09 Device object ID. This is incremented only if the value is not already "4194303".

[3] ***"Auto-build of device object name"-function***
The BACnet standard requires that each BACnet endpoint has a unique name on the network (device object name). The initial name of the AEX-BAC module is "AEX-BAC" equal for all devices.
If the auto-build of the device object name is disabled, this means that it needs to be edited manually in the BACnet client.
Using the auto-build-function the device object name can be automatically assembled using the label "AEX-BAC" followed by the contents of CO06 – CO09 (The device object ID). For example, AEX-BAC-01050001.
Writing via BACnet to the device property "Object Name" (in the device object, see page 5) will reset the auto-build option and sets the parameter CO15 parameter to 0 or 1 depending on the previous setting.

X2 object overview

The same module for BACnet communication is used over the entire X2 product range. When the module initializes, it reads the properties from the X2 device, such as in and outputs, control loops, alarms, time schedules and so forth. It then activates and assigns its objects to the available physical points.
If an output or an input is not physical present in the scope of the product, its object will not be generated.
The available physical properties for each device may be found in its product datasheet under the scope table.
Here is a brief overview.

Available inputs

	TCX2-40863	TCX2-23343	TCX2-24273	TCX2-14050	TCI2	SxC2-210	SxC2-200	TRI2
UI1	UI-01	UI-01	UI-01	UI-01	UI-01	UI-01 (S)	UI-01 (S)	UI-01 (S)
UI2	UI-02	UI-02	UI-02	UI-02	UI-02	UI-02 (S)	UI-02 (S)	UI-02 (S)
UI3	UI-03	UI-03	UI-03	UI-03	UI-03	UI-03 (S)	UI-03 (S)	UI-03 (S)
UI4	UI-04	UI-04	UI-04	UI-04	UI-04	UI-04 (S)	UI-04 (S)	UI-04
UI5	UI-05	UI-05	UI-05	VI-01	VI-01	UI-05 (S)	UI-05 (S)	UI-05
UI6	UI-06	UI-06	UI-06	VI-02	VI-02	UI-06	VI-01	UI-06
UI7	UI-07	VI-01	VI-01	VI-03	VI-03	VI-01	VI-02	VI-01
UI8	UI-08	VI-02	VI-02	VI-04	VI-04	VI-02	VI-03	VI-02
UI9	VI-01	VI-03	VI-03			VI-03	VI-04	VI-03
UI10	VI-02	VI-04	VI-04			VI-04		VI-04
UI11	VI-03							
UI12	VI-04							

UI = Universal inputs, VI = Virtual inputs, (S) = Sensor inputs

Available output modules

	TCX2-40863	TCX2-23343	TCX2-24273	TCX2-14050	TCI2	SxC2-210	SxC2-200	TRI2
AO1	AO1	AO1	AO1		AO1	AO1	AO1	AO1
AO2	AO2	AO2	AO2		AO2	AO2		AO2
AO3	AO3	AO3	AO3					
DO1	DO1	DO1	DO1	DO1	DO1	DO1	DO1	DO1
DO2	DO2	DO2	DO2	DO2	DO2			DO2
DO3	DO3	DO3	DO3	DO3				
DO4	DO4	DO4	DO4	DO4				
DO5	DO5		DO5	DO5				
DO6	DO6		DO6					
DO7			DO7					

Objects for digital outputs.

The available objects for digital outputs depend on their configuration. The reason is that an output assigned to a fan module will have different objects than if assigned to a floating or binary output.
There are 4 different object tables for digital objects:

- Digital output in fan configuration (applies to all binary outputs that are part of the fan module)
- Digital output in 3-point floating configuration (always two binary outputs)
- Digital output in PWM configuration
- Digital output in binary configuration

Available loops

TCX2-40863	TCX2-23343	TCX2-24273	TCX2-14050	TCI2	SxC2	TRI2
LP1	LP1	LP1	LP1	LP1	LP1	LP1
LP2	LP2	LP2		LP2	LP2	LP2
LP3						
LP4						

Available alarms

All devices have 8 alarms.

Properties of supported BACnet objects

Device Object

Property	Description	Format	R/W
APDU Timeout	Time between retransmissions in milliseconds. This device does not support retransmissions, so this always reads as "0".	Integer	R
App Software Version	Controller Firmware Version (assembled by firmware) VXXrY ("X" = version, "Y" = revision)	String	R
Database Revision	Increases if the settings change	Integer	R
Daylight Savings Status	Daylight savings status of host controller	Boolean	R
Description	Description of controller or location (max. 32 characters)	String	R/W
Device Address Binding	Address binds	List	R
Firmware Revision	BACnet Firmware Revision	String	R
Local Date	Date of host controller	DD-MM-YYYY	R
Local Time	Time of host controller	HH:MM:SS	R
Max APDU Length Accepted	The maximum APDU length supported by this device is 480.	Integer	R
Max Info Frames	The value specifies the maximum number of information frames the node may send before it must pass the token.	Integer	R/W
Max Master	Number of the highest addressed node: 1-127	Integer	R/W
Model Name	Controller product name "X2-abcde-BAC" (assembled by firmware) a = number of loops b = number of passive inputs c = number of universal inputs d = number of binary outputs e = number of analog outputs Example: "TCX2-40863-BAC"	String	R
Number of APDU Retries	Number of retransmissions. This device does not support retransmissions, so this always reads as "0".	Integer	R
Object Identifier	Device object identifier (CO06…CO09): 0-4194303	Integer	R/W
Object Name	Name of device (max. 32 characters)	String	R/W*
Object Type	The value is always "8: Object Device" for the device object	List	R
Protocol Objects Supported	The enumeration of the supported object types	List	R
Protocol Revision	BACnet protocol revision number	Integer	R
Protocol Services Supported	The enumeration of the supported services	List	R
Protocol Version	BACnet protocol version number	Integer	R
Segmentation Supported	This device does not support segmentation, so this always reads as "NO SEGMENTATION (3)".	List	R
System Status	Current physical and logical status supported: - OPERATIONAL (0) - DOWNLOAD REQUIRED (2) (IF INT. EEPROM CONF. ERRORS) - NON OPERATIONAL (4) (IF INT. I2C BUS ERRORS)	List	R
UTC Offset	Offset to UTC time in case UTC time synchronization is enabled: -780…780 in minutes	Integer	R/W
Vendor Identifier	561	Integer	R
Vendor Name	Vector Controls GmbH	String	R

* Only writable if CO15 < 2

Analog Input Object (AI)

Property	Description / Property description	Format	R/W
Object Identifier	AI number	Integer	R
Object Name	Name of the input, Assembled from template plus number	String	R
Description	Description of the input (max 32 characters)	String	R/W
Present Value	Current value of input	Floating Point	R
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Reliability	NO FAULT DETECTED, NO SENSOR, OVER RANGE, UNDER RANGE, OPEN LOOP, SHORTED LOOP, COMMUNICATION FAILURE, UNRELIABLE OTHER	List	R
Out Of Service	Writing to Out Of Service property is not supported	Boolean	R
Units	Describes the units used. Degree Celsius or Fahrenheit has to be set by MV02.	List	R
COV Increment	Minimum change in present value that will cause a COV notification.	Floating point	R/W

Analog Value Object (AV)

Property	Description / Property description	Format	R/W
Object Identifier	AV number	Integer	R
Object Name	1 Name of the value, Assembled from template plus number	String	R
Description	Description of the input (max 32 characters)	String	R/W(1)
Present Value	Current value of input	Floating Point	R/W(2)
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
Units	Describes the units used. Degree Celsius or Fahrenheit has to be set by MV02.	List	R
COV Increment	Minimum change in present value that will cause a COV notification.	Floating point	R/W

(1) Writable for objects with writable Present Value property only. (AVxx > AV11)
(2) Writable only for certain objects

Binary Value Object (BV)

Property	Description / Property description	Format	R/W
Object Identifier	BV number	Integer	R
Object Name	Name of the input, Assembled from template plus number	String	R
Description	Description of the input (max 32 characters)	String	R/W(1)
Present Value	Current value of the object 0 = OFF / Disabled / Inactive 1 = ON / Enabled / Active	Boolean 0/1	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R

(1) Writable for objects with Instance Number greater than 100.

Multi State Value Object (MV)

Property	Description / Property description	Format	R/W
Object Identifier	MV number	Integer	R
Object Name	Name of the input, Assembled from template plus number	String	R
Description	Description of the input (max 32 characters)	String	R/W(1)
Present Value	Current value of the object; see "state text" for explanation	Integer	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
Number Of States	Number of states of this object	Integer	R
State Text	Description of state	String	R

(1) Writable for objects with Instance Number greater than 100.

Network Port Object

Property	Description / Property description	Format	R/W
Object Identifier	Network port number	Integer	R
Object Name	Network port name	String	R
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
APDU length	BACnet maximum APDU length	Integer	R
Changes pending	Changes pending flag indicating parameter changes in Network port object	Boolean 0/1	R
Link speed	Baud rate of MS/TP communication	Integer	R/W
Mac Address	Mac Address used on this network	Octet string	R/W
Max Info Frames	Maximum info frames of MS/TP communication before the token must be passed	Integer	R/W
Max Master	Maximum master instance for MS/TP communication (0 to 127)	Integer	R/W
Network number	Network number of this device. 0 indicates that network number cannot be determined.	Integer	R
Network number quality	Current quality of network number property	List	R
Network type	Network type in use	List	R
Protocol level	Indication of protocol in use	Integer	R
Reliability	Indication whether the port connected to is reliable	List	R

Note: If any of the writable properties above is changed, the changes pending flag is set. To activate the changes, it is necessary for the client to initiate a ReinitializeDevice service request with "ACTIVATE_CHANGES" or "WARMSTART".

Available objects

Controller Information

Object	Name	Description	R/W
AV 00	#CtrLp	Number of control loops	R
AV 01	#BinIn	Number of binary inputs	R
AV 02	#uIn	Number of universal inputs	R
AV 03	#vIn	Number of virtual inputs	R
AV 04	#BinOut	Number of binary outputs	R
AV 05	#aOut	Number of analog outputs	R
AV 06	#Fan	Number of fan outputs	R
AV 07	#FlOut	Number of floating outputs	R
AV 08	#Alarm	Number of alarms	R
AV 09	#AuxFun	Number of auxiliary functions	R
AV 10	#Sched	Number of time schedules	R
AV 11	#PerSchd	Number of switching times / time schedule	R

Controller State

Object	Name	Description / Property description	R/W
BV 00	OpStOo	Operation state: 0 = Off, 1 = On	R/W
MV 00	OpStCoSt	Operation state Occupied/Unoccupied: 1 = Occupied, 2 = Unoccupied	R/W
MV 01	OpStHeCo	Operation state Cool/Heat: 1 = Cool, 2 = Heat	R/W
MV 02	Degree	Operation state Celsius/Fahrenheit: 1 = Celsius, 2 = Fahrenheit	R/W
BV 01	FanOnly	Operation state Fan Only 0: Inactive, 1: Active	R/W
BV 02	Schedule	Operation state Time Schedules: 0 = Inactive, 1 = Active	R/W
BV 03	AccOpMod	Enable access to operation modes: 0 = Disable, 1 = Enable	R/W
BV 04	AccSp	Enable access to set points: 0 = Disable, 1 = Enable	R/W
BV 05	AccMan	Enable manual control in cascade and for fan speeds: 0 = Disable, 1 = Enable	R/W
BV 06	AccHeCo	Enable change of heating/cooling mode for 2 pipe systems: 0 = Disable, 1 = Enable	R/W
BV 07	AccSchd	Enable access to time programs: 0 = Disable, 1 = Enable	R/W
MV 03	OpStOPMS	Operation State Master/Slave mode: 1 = Master, 2 = Slave	R/W
MV 04	OpStWink	Operation State “Wink” function: 1 = Wink OFF, 2 = Wink ON	R/W
MV 05	OpStSWM	Operation State Summer/Winter mode: 1 = Summer, 2 = Winter	R/W

X2-Inputs

The available input objects depend on the actual configuration of the X2 product. Sensor inputs will be treated as universal inputs in X2-BAC. Please observe the table on page 4 to see which are the available inputs for the product selected. At this stage all products have 4 virtual inputs with the objects listed below.

Universal inputs (UI)

Object	Name	Description	Access
AI 101	UI-01	Universal input 1 value	R
AV 101	UI-01-OS	Universal input 1 offset (calibration = 01u6)	R/W
AI 102	UI-02	Universal input 2 value	R
AV 102	UI-02-OS	Universal input 2 offset	R/W
AI 103	UI-03	Universal input 3 value	R
AV 103	UI-03-OS	Universal input 3 offset	R/W
AI 104	UI-04	Universal input 4 value	R
AV 104	UI-04-OS	Universal input 4 offset	R/W
AI 105	UI-05	Universal input 5 value	R
AV 105	UI-05-OS	Universal input 5 offset	R/W
AI 106	UI-06	Universal input 6 value	R
AV 106	UI-06-OS	Universal input 6 offset	R/W
AI 107	UI-07	Universal input 7 value	R
AV 107	UI-07-OS	Universal input 7 offset	R/W
AI 108	UI-08	Universal input 8 value	R
AV 108	UI-08-OS	Universal input 8 offset	R/W

Virtual inputs (VI)

Object		Name (8 Bytes)	Description	Access
AV 109		VI-01	Virtual input 1 value	R/W
AV 110		VI-01-OS	Virtual input 1 offset	R/W
AV 111		VI-02	Virtual input 2 value	R/W
AV 112		VI-02-OS	Virtual input 2 offset	R/W
AV 113		VI-03	Virtual input 3 value	R/W
AV 114		VI-03-OS	Virtual input 3 offset	R/W
AV 115		VI-04	Virtual input 4 value	R/W
AV 116		VI-04-OS	Virtual input 4 offset	R/W

Writing to virtual inputs

Virtual inputs may be written to with BACnet if set to communication module in the X2 controller. If there is a time out period specified under the settings of the X2 controller, the input will have to be written to within the delay specified, else this input will be disabled. All the connected functions and control loops will then be disabled too and Err 4 will be displayed on the operation terminal.

Alarms (AL)

Object	Name	Description	Access
MV 601	AL-01	Alarm 1: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 602	AL-02	Alarm 2: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 603	AL-03	Alarm 3: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 604	AL-04	Alarm 4: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 605	AL-05	Alarm 5: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 606	AL-06	Alarm 6: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 607	AL-07	Alarm 7: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*
MV 608	AL-08	Alarm 8: 1 = Not Active, 2 = Active, 3 = Not Active. Needs confirmation	R/W*

*) Writable to "Not Active" only, if state is "Not Active, Needs Confirmation".

Control Loops (LP)

Object	Name	Description	Access
MV 211	LP-01-ST	Loop 1 state 1 = Disabled, 2 = Heating, 3 = Cooling	R
AV 211	LP-01-SSP	Loop 1 saved set point	R/W
AV 212	LP-01-CSP	Loop 1 calculated set point	R
AV 213	LP-01-PROP	Loop 1 proportional output 0-100%	R
MV 212	LP-01-DO	Loop 1 binary output: Activated binary stage 1 = SOFF, 2 = S01, 3 = S02, 4 = S03, …, 64 = S63	R
MV 221	LP-02-ST	Loop 2 state	R
AV 221	LP-02-SSP	Loop 2 saved set point	R/W
AV 222	LP-02-CSP	Loop 2 calculated set point	R
AV 223	LP-02-PROP	Loop 2 proportional output 0-100%	R
MV 222	LP-02-DO	Loop 2 binary output: Activated binary stage	R
MV 231	LP-03-ST	Loop 3 state	R
AV 231	LP-03-SSP	Loop 3 saved set point	R/W
AV 232	LP-03-CSP	Loop 3 calculated set point	R
AV 233	LP-03-PROP	Loop 3 proportional output 0-100%	R
MV 232	LP-03-DO	Loop 3 binary output: Activated binary stage	R
MV 241	LP-04-ST	Loop 4 state	R
AV 241	LP-04-SSP	Loop 4 saved set point	R/W
AV 242	LP-04-CSP	Loop 4 calculated set point	R
AV 243	LP-04-PROP	Loop 4 proportional output 0-100%	R
MV 242	LP-04-DO	Loop 4 binary output: Activated binary stage	R

Analog Outputs (AO)

Object	Name	Description	Access
MV 311	AO-01-ST	Analog output 1 state 1 = Off, 2 = Normal, 3 = Manual	R
AV 311	AO-01-VAL	Analog output 1 value 0-100%	R
AV 312	AO-01-OV	Analog output 1 override value 0-100%	R/W
MV 321	AO-02-ST	Analog output 2 state	R
AV 321	AO-02-VAL	Analog output 2 value 0-100%	R
AV 322	AO-02-OV	Analog output 2 override value 0-100%	R/W
MV 331	AO-03-ST	Analog output 3 state	R
AV 331	AO-03-VAL	Analog output 3 value 0-100%	R
AV 332	AO-03-OV	Analog output 3 override value 0-100%	R/W

Digital Outputs (DO)

Digital outputs in 3-point floating configuration

Object	Name	Description	R/W
AV 411	DO-01-FLT	Binary Output 1 value in 3-point floating configuration (DO1 (open) and DO2 (close) are used) Position = 0-100%	R
AV 412	DO-01-FLT-OV	Binary Output 1 override value in analog mode 3-point floating configuration Position = 0-100%	R/W
MV 411	DO-01-ST	Current State for Binary Output 1 1 = Off, 2 = Normal, 3 = Manual	R
AV 431	DO-03-FLT	Binary Output 3 value in 3-point floating configuration (DO3 (open) and DO4 (close) are used)	R
AV 432	DO-03-FLT-OV	Binary Output 3 override value in 3-point floating configuration	R/W
MV 431	DO-03-ST	Current State for Binary Output 3	R
AV 451	DO-05-FLT	Binary Output 5 value in 3-point floating configuration (DO5 (open) and DO6 (close) are used)	R
AV 452	DO-05-FLT-OV	Binary Output 5 override value in 3-point floating configuration	R/W
MV 451	DO-05-ST	Current State for Binary Output 5	R

Digital outputs in PWM configuration

Object	Name	Description	R/W
AV 413	DO-01-PWM	Binary Output 1 in PWM configuration from 0-100%	R
AV 414	DO-01-PWM-OV	Binary Output 1 override value in PWM configuration from 0-100%	R/W
MV 411	DO-01-ST	Current State for Binary Output 1 1 = Off, 2 = Normal, 3 = Manual	R
AV 423	DO-02-PWM	Binary Output 2 in PWM configuration from 0-100%	R/W
AV 424	DO-02-PWM-OV	Binary Output 2 override value in PWM configuration from 0-100%	R/W
MV 421	DO-02-ST	Current State for Binary Output 2	R
AV 433	DO-03-PWM	Binary Output 3 in PWM configuration from 0-100%	R
AV 434	DO-03-PWM-OV	Binary Output 3 override value in PWM configuration from 0-100%	R/W
MV 431	DO-03-ST	Current State for Binary Output 3	R
AV 443	DO-04-PWM	Binary Output 4 in PWM configuration from 0-100%	R
AV 444	DO-04-PWM-OV	Binary Output 4 override value in PWM configuration from 0-100%	R/W
MV 441	DO-04-ST	Current State for Binary Output 4	R
AV 453	DO-05-PWM	Binary Output 5 in PWM configuration from 0-100%	R
AV 454	DO-05-PWM-OV	Binary Output 5 override value in PWM configuration from 0-100%	R/W
MV 451	DO-05-ST	Current State for Binary Output 5	R
AV 463	DO-06-PWM	Binary Output 6 in PWM configuration from 0-100%	R
AV 464	DO-06-PWM-OV	Binary Output 6 override value in PWM configuration from 0-100%	R/W
MV 461	DO-06-ST	Current State for Binary Output 6	R
AV 473	DO-07-PWM	Binary Output 7 in PWM configuration from 0-100%	R
AV 474	DO-07-PWM-OV	Binary Output 7 override value in PWM configuration from 0-100%	R/W
MV 471	DO-07-ST	Current State for Binary Output 7	R

Digital outputs in binary configuration

Object	Name	Description	R/W
BV 411	DO-01-BIN	Binary Output 1 in binary configuration 0 = Off, 1 = On	R
BV 412	DO-01-BIN-OV	Binary Output 1 override value in binary configuration 0 = Off, 1 = On	R/W
AV 511	DO-01-RT	Run time totalizer in hours	R
BV 511	DO-01-ALA	Run time limit exceeded 0 = No Error, 1 = RT Limit Reached	R
MV 411	DO-01-ST	Current State for Binary Output 1 1 = Off, 2 = Normal, 3 = Manual	R
BV 421	DO-02-BIN	Binary Output 2 in binary configuration	R
BV 422	DO-02-BIN-OV	Binary Output 2 override value in binary configuration	R/W
AV 521	DO-02-RT	Run time totalizer in hours	R
BV 521	DO-02-ALA	Run time limit exceeded	R
MV 421	DO-02-ST	Current State for Binary Output 2	R
BV 431	DO-03-BIN	Binary Output 3 in binary configuration	R
BV 432	DO-03-BIN-OV	Binary Output 3 override value in binary configuration	R/W
AV 531	DO-03-RT	Run time totalizer in hours	R
BV 531	DO-03-ALA	Run time limit exceeded	R
MV 431	DO-03-ST	Current State for Binary Output 3	R
BV 441	DO-04-BIN	Binary Output 4 in binary configuration	R
BV 442	DO-04-BIN-OV	Binary Output 4 override value in binary configuration	R/W
AV 541	DO-04-RT	Run time totalizer in hours	R
BV 541	DO-04-ALA	Run time limit exceeded	R
MV 441	DO-04-ST	Current State for Binary Output 4	R
BV 451	DO-05-BIN	Binary Output 5 in binary configuration	R
BV 452	DO-05-BIN-OV	Binary Output 5 override value in binary configuration	R/W
AV 551	DO-05-RT	Run time totalizer in hours	R
BV 551	DO-05-ALA	Run time limit exceeded	R
MV 451	DO-05-ST	Current State for Binary Output 5	R
BV 461	DO-06-BIN	Binary Output 6 in binary configuration	R
BV 462	DO-06-BIN-OV	Binary Output 6 override value in binary configuration	R/W
AV 561	DO-06-RT	Run time totalizer in hours	R
BV 561	DO-06-ALA	Run time limit exceeded	R
MV 461	DO-06-ST	Current State for Binary Output 6	R
BV 471	DO-07-BIN	Binary Output 7 in binary configuration	R
BV 472	DO-07-BIN-OV	Binary Output 7 override value in binary configuration	R/W
AV 571	DO-07-RT	Run time totalizer in hours	R
BV 571	DO-07-ALA	Run time limit exceeded	R
MV 471	DO-07-ST	Current State for Binary Output 7	R

Fan module

Analog output in fan mode configuration

Object	Name	Description	R/W
MV 412	DO-01-FAN	Analog output 1 value FAN1 (AO1) 1 = Fan Off 2 = Fan Low 3 = Fan Medium 4 = Fan High	R
MV 413	DO-01-FAN-OV	Analog output 1 override value FAN1 1 = Fan Off 2 = Fan Low 3 = Fan Medium 4 = Fan High 5 = Fan Auto	R/W
MV 311	AO-01-ST	Analog output 1 state 1 = Off, 2 = Normal, 3 = Manual	R
MV 442	DO-04-FAN	Analog output 2 value FAN2 (AO2)	R
MV 443	DO-04-FAN-OV	Analog output 2 override value FAN2	R/W
MV 321	AO-02-ST	Analog output 2 state	R

Note: Not used FAN output is free to use as analog output.

Digital output in fan mode configuration

Object	Name	Description	R/W
MV 412	DO-01-FAN	Binary Output 1 (FAN1) in fan mode (DO1-DO3) 1 = Fan Off 2 = Fan Low (DO1) 3 = Fan Medium (DO2) 4 = Fan High (DO3)	R
MV 413	DO-01-FAN-OV	Binary Output 1 (FAN1) override value 1 = Fan Off 2 = Fan Low 3 = Fan Medium 4 = Fan High 5 = Fan Auto	R/W
MV 411	DO-01-ST	Current State for Binary Output 1 1 = Off, 2 = Normal, 3 = Manual	R
MV 442	DO-04-FAN	Binary Output 4 (FAN2) in fan mode (DO4-DO6) 1 = Fan Off 2 = Fan Low (DO4) 3 = Fan Medium (DO5) 4 = Fan High (DO6)	R
MV 443	DO-04-FAN-OV	Binary Output 4 (FAN2) override value 1 = Fan Off 2 = Fan Low 3 = Fan Medium 4 = Fan High 5 = Fan Auto	R/W
MV 441	DO-04-ST	Current State for Binary Output 4 1 = Off, 2 = Normal, 3 = Manual	R

Note: Not used FAN outputs are free to use as digital outputs.

Fan in lead-lag configuration (rotation mode)

Object	Name	Description	Access
MV 412	FAN1	DO-01-03 fan value 1 = OFF, 2 = Stage 1, 3 = Stage 2, 4 = Stage 3	R
MV 413	FAN1-OV	DO-01-03 fan override 1 = OFF, 2 = Stage 1, 3 = Stage 2, 4 = Stage 3, 5 = AUTO	R/W
MV 414	FAN1-ST	FAN1 state description 1 = Disabled, 2 = Normal, 3 = Manual	R
MV 442	FAN2	DO-04-06 fan value	R
MV 443	FAN2-OV	DO-04-06 fan override	R/W
MV 444	FAN2-ST	FAN2 state description	R

Parameter access through BACnet in X2

Generally, we do not encourage changing parameter value through external communications. It can however be done as a work around. This application note explains how access is given and how to interpret the associated values.
With two Analog Value objects each configuration parameter of the controller may be accessed. ParAdd (AV 12) is the address of the parameter and ParValue (AV 13) is the value. The correct address may be calculated with the static address table below. Once the address is set, the value of the parameter may be read or written using AV 13.

Object	Name (8 Bytes)	Description / Property description	Format	R/W
AV 12	ParAdd	Address of parameter, see table below	AV	R/W
AV 13	ParValue	Parameter value	AV	R/W

Parameter address overview

With the addresses listed in the table below the settings may be changed of the controller. They correspond with the parameter settings for the addressed X2 controller.

The address is calculated by adding the parameter number to the value from the table below. To use the table, choose the type of parameter by selecting the row of the table and then choose the item with the column. UI5 would result in 3400. Parameter 5U10 would thus be address 3410.

Description	Parameter Address											
	1	2	3	4	5	6	7	8	9	10	11	12
User settings	2000											
Universal input	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000	4100
Control Loop	5000	5100	5200	5300								
Analog Output	6000	6100	6200									
Binary Output	7000	7100	7200	7300	7400	7500	7600	7700				
Fan output	8000	8100										
Alarm	9000	9100	9200	9300	9400	9500	9600	9700				
Function	10000	10100	10200	10300	10400							
Time Schedules	11100	11200	11300	11400	11500	11600	11700	11800	11900	12000	12100	12200
Communication	13000											

Parameter interpretation

All parameters are converted into a readable format by the communication module:

1. Parameters with whole numbered integers are shown 1:1 without conversion:
    a. Selections of input, outputs indexes
    b. Selections of mode or type indexes
    c. Fan speed
    d. …
2. Parameters with values which can hold decimals, the parameter value is multiplied by 10
    a. Input depending values such as input offset, min/max values for inputs and loops
    b. 0-100% values. Example: 10.5% -> 105
    c. …
3. Time delays are shown in seconds
4. OFF/ON parameters are shown as 0/1

Note: With the "read-modify-write" method it helps to understand the correct parameters format which has to be used in order to modify a parameter value correctly.

Time Schedules

All devices support 12 individual time schedules.

Address	Module	Description	R/W
11000	General	Enable / disable all Time Schedules 0=Disabled, 1=Enabled	R/W

Weekly time schedules

Address	Module	Description	R/W
11100	SCHED1	Time of time schedule event in format **hhmm** 1000 = 10:00 1015 = 10:15 1030 = 10:30 1045 = 10:45	R/W
11101	SCHED1	Active days of time schedule event (Day 1 is Monday) -1 = invalid option (read only) 0 = No active days 1 = Day 1 – Day 7 (all) 2 = Day 1 – Day 6 3 = Day 1 – Day 5 4 = Day 6 – Day 7 5 = Day 1 6 = Day 2 7 = Day 3 8 = Day 4 9 = Day 5 10 = Day 6 11 = Day 7	R/W
11102	SCHED1	Type of time schedule 0 = Off 1 = OP (Operation mode) 2 = LP (Control loop set point) 3 = AO (Analog output set point) 4 = FAN (Fan output) 5 = DO (Digital output) 6 = Holiday	R/W
11103	SCHED1	Type group ID - Valid only for the following types LP: LP**1** … LP**x** AO: AO**1** … AO**x** FAN: FAN**1** … FAN**x** DO: DO**1** … DO**x** Example: 11102 = 3 (**AO**), 11103 (group ID) = **1** Result: **AO1** (SCHED1 controls AO1)	R/W
11104	SCHED1	Set point according Type (11102) OP: 0 = OFF (Protection), 1 = Economy (Unoccupied), 2 = ON (Occupied) LP: Value x10 AO: 0-1000 = 0-100% FAN: 0-3 = fan speed, 4 = fan auto mode DO: 0 = OFF, 1 = ON or 0-1000 = 0-100% for PWM, FLOAT	R/W
11200	SCHED2	Time of time schedule event in format (hhmm)	R/W
11201	SCHED2	Active days of time schedule event	R/W
11202	SCHED2	Type of time schedule	R/W
11203	SCHED2	Type group ID	R/W
11204	SCHED2	Set point of time schedule	R/W
11300	SCHED3	…	…
…	…	…	…
11400	SCHED4	…	…
…	…	…	…
11500	SCHED5	…	…
…	…	…	…
11600	SCHED6	…	…
…	…	…	…
11700	SCHED7	…	…
…	…	…	…
11800	SCHED8	…	…
…	…	…	…
11900	SCHED9	…	…
…	…	…	…
12000	SCHED10	…	…
…	…	…	…
12100	SCHED11	…	…
…	…	…	…
12200	SCHED12	…	…
…	…	…	…

Annual time schedules (holidays)

Annual time schedules used to define holidays have a different format than weekly time schedules. They share however the same address space. So, if a time schedule is changed to holiday mode, the format of the other settings associated with this time schedule change as well.

Address	Module	Description	R/W
11100	SCHED1	Start month of holiday -1 0 = January, 11 = December	R/W
11101	SCHED1	Start day of holiday -1 0 = first day of the month	R/W
11102	SCHED1	Type of time schedule 0 = Off 1 = Operation mode 2 = Control loop set point 3 = Analog output set point 4 = Fan output 5 = Digital output **6 = Holiday**	R/W
11103	SCHED1	End month of holiday -1 0 = January, 11 = December	R/W
11104	SCHED1	End day of holiday -1 0 = first day of the month	R/W
11200	SCHED2	Start month of holiday -1	R/W
11201	SCHED2	Start day of holiday -1	R/W
11202	SCHED2	Type of time schedule	R/W
11203	SCHED2	End month of holiday -1	R/W
11204	SCHED2	End day of holiday -1	R/W
11300	SCHED3	…	…
…	…	…	…
11400	SCHED4	…	…
…	…	…	…
11500	SCHED5	…	…
…	…	…	…
11600	SCHED6	…	…
…	…	…	…
11700	SCHED7	…	…
…	…	…	…
11800	SCHED8	…	…
…	…	…	…
11900	SCHED9	…	…
…	…	…	…
12000	SCHED10	…	…
…	…	…	…
12100	SCHED11	…	…
…	…	…	…
12200	SCHED12	…	…
…	…	…	…

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