BACnet/IP communication with X2 devices

Features

- BACnet/IP communication over Wi-Fi or Ethernet
- B-ASC Device Profile
- Slave (server) type of communication
- Embedded webserver for IP and network configuration
- Communication parameters (CO) of controller for IP and network configuration

X2-BAC Protocol Implementation Conformance Statement (PICS)

Vendor Name: Vector Controls
Product Name: X2 Controls series
X2 product description:
The X2 communicating BACnet/IP 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/IP 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
- 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

Configuration of BACnet/IP X2 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.

> More detailed information on the X2 TCP/IP configuration and operation can be found in the 70-00-0900 "X2 Wi-Fi and Ethernet Communication Manual".
> The manual can be found on our website www.vectorcontrols.com.

COM parameters (CO)

Parameter	BACnet/IP		Range	Default
CO 00	Bus plug-in hardware id	(read only)	-	7
CO 01	Bus plug-in software version	(read only)	-	-
CO 02	Bus plug-in software revision	(read only)	-	-
CO 03	IPv4 address octet IP0 (192.168.xxx.**yyy**)		1…254	101
CO 04	IPv4 address octet IP1 (192.168.**xxx**.yyy)		0…255	0
CO 05	IPv4 address octet IP2 (192.**168**.xxx.yyy)		0…255	168
CO 06	IPv4 address octet IP3 (**192**.168.xxx.yyy)		0…255	192
CO 07	Enable DHCP 0 = Static IP 1 = DHCP enabled		0…1	0
CO 08	Enable access point 0 = Access point disabled 1 = Access point enabled		0…1	0
CO 09	[1] Restore default configuration 0 = Normal Mode 1 = Reset to defaults immediately 7 = Reset to defaults on power up		0…7	0
CO 10	Not used		0…1	00
CO 11	Device Object ID1 (aabbcc**dd**)		0…99	00
CO 12	Device Object ID2 (aabb**cc**dd)		0…99	00
CO 13	Device Object ID3 (aa**bb**ccdd)		0…99	01
CO 14	Device Object ID4 (**aa**bbccdd)		0…4	00
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] **"*Restore default configuration*" function**
If this parameter is set to 1 during run time, the default configuration gets restored from its internal memory (Webserver names, host name, etc.). Any stored SSID / password information will be lost. The Wi-Fi module's Wi-Fi access point ("VectorAP-xxx") will be re-activated to make the webserver accessible. If CO 09 = 7 or the reset button is pressed during power up, the default configuration is pre-loaded to avoid any problems due to invalid configurations in the runtime memory.

[2] **"*Auto increment*" function**
When this function is enabled and an automatic AEC-PM parameter load is executed at power up of the controller, the following variables will be incremented and written back to the AEC-PM unit:
- **CO03**: Part of IPv4 address CO06.CO05.CO04.**CO03**
- CO11 … CO14 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 the each BACnet endpoint has a unique name on the network (device object name). The initial name of the AEX-BAC module is "AEX-BAC-IP" 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-IP" followed by the contents of CO11 – CO14 (The device object ID). For example, "AEX-BAC-IP_01050001".
Writing via BACnet to the device property "Object Name" (in the device object, see page 4) 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/IP 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	TCI2-204.202	SxC2-201.102	SxC2-200.101	TRI2-221.202
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							

(S) = Sensor inputs

Available output modules

	TCX2-40863	TCX2-23343	TCX2-24273	TCX2-14050	TCI2-204.202	SxC2-201.102	SxC2-200.101	TRI2-221.202
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/W
Description	Description of controller or location (max 32 characters)	String	R/W
Device Address Binding	Address binds	List	R
Firmware Revision	Open source BACnet stack 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 1476.	Integer	R
Model Name	Controller product name "X2-abcde-XYZ" (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 XYZ = WEB (**W**i-Fi **E**xternal antenna **B**ACnet/IP) XYZ = WIB (**W**i-Fi **I**nternal antenna **B**ACnet/IP) XYZ = ETB (**Et**hernet **B**ACnet/IP) Example: "TCX2-40863-WEB"	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 (CO11…CO14): 0-4194303	Integer	R/W
Object List	List of all objects currently implemented in the device	List	R
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 Object Types 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) - 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

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
Out Of Service	Setting out of service decouples the object from the physical input.	Boolean	R/W
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

Property	Description / Property description	Format	R/W
Object Identifier	AV number	Integer	R
Object Name	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 the object	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	Setting out of service decouples the objects present value from the physical input.	Boolean	R/W
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 only for objects with instance numbers <711

(2)   Writable only for certain objects

Binary Value Object

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
Present Value	Current value of the object 0/1 See "Active Text" and "Inactive Text" for value interpretation	Integer	R/W*
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Setting out of service decouples the objects present value from the physical input.	Boolean	R/W
Active Text	Description of active state (for present value = 1)	String	R
Inactive Text	Description of inactive state (for present value = 0)	String	R

* Writable only for certain objects

Multi State Value Object

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*
Present Value	Current value of the object; see "state text" for explanation	List	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Setting out of service decouples the objects present value from the physical input.	Boolean	R/W
Number Of States	Number of states of this object	Integer	R
State Text	Description of state	String	R

* Writable only for objects with instance numbers <711

Available objects

Controller State

Object	Name	Description	R/W
BV 00	OpStOo	Operation state: 0 = Off, 1 = On	R/W
MV 00	Occupation	Operation state Occupied/Unoccupied: 1 = Occupied, 2 = Unoccupied	R/W
MV 01	Ctrl-Mode	Operation state Cool/Heat: 1 = Cool, 2 = Heat	R/W
MV 02	Temp-Unit	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	OPA-Mode	Operation State Master/Slave mode: 1 = Master, 2 = Slave	R/W
MV 04	Wink	Operation State "Wink" function: 1 = Wink OFF, 2 = Wink ON	R/W
MV 05	Season	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 3 to see which inputs are the available for the selected product. At this stage all products have 4 virtual inputs with the objects listed below.

Universal inputs

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

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

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

*) Writable to "not active" only, if state is "not active, need confirmation".

Control Loops

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

Object	Name	Description	Access
MV 311	AO-01-ST	Analog output 1 state 1 = Disabled, 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	R
AV 322	AO-02-OV	Analog output 2 override value	R/W
MV 331	AO-03-ST	Analog output 3 state	R
AV 331	AO-03-VAL	Analog output 3 value	R
AV 332	AO-03-OV	Analog output 3 override value	R/W

Digital Outputs

Fan module

Object	Name	Description	Access
MV 412	FAN1	DO01-03 fan value 1 = OFF, 2 = Stage 1, 3 = Stage 2, 4 = Stage 3	R
MV 413	FAN1-OV	DO01-03 fan override value 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 override	R
MV 442	FAN2	DO04-06 fan value	R
MV 443	FAN2-OV	DO04-06 fan override value	R/W
MV 444	FAN2-ST	FAN2 state description	R

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	DO01-03 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 override	R
AV 415	FAN1-LL-TIME	FAN1 remaining time until next rotation in hours	R
MV 442	FAN2	DO04-06 fan value	R
MV 443	FAN2-OV	DO04-06 fan override	R/W
MV 444	FAN2-ST	FAN2 state description	R
AV 445	FAN2-LL-TIME	FAN2 remaining time until next rotation in hours	R

Digital Outputs in 3-point / floating configuration

Object	Name	Description	Access
AV 411	DO-01-FLT	Binary Output 1 value in 3-point floating configuration (DO1 and DO2 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 and DO4 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 in in 3-point floating configuration (DO5 and DO6 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	Access
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	Access
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

Time schedules

All devices support 12 individual time schedules (TS1 - TS12).

Weekly time schedules

Object	Name	Description	Access
MV 711	TS1-TYPE	Type of time schedule object 1 = OFF 2 = OP (Operation mode) 3 = LP (Control loop set point) 4 = AO (Analog output set point) 5 = FAN (Fan output) 6 = DO (Digital output) 7 = HDAY (Holiday)	R/W
MV 712	TS1-NR	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: MV 711 = 4 (**AO**), MV 712 (group ID) = **1** Result: **AO1** (TS1 controls AO1) 8 = Invalid configuration or not used for this type.	R/W
MV 713	TS1-DAYS	Active days: 1 = No days 2 = Day 1 – Day 7 3 = Day 1 – Day 6 4 = Day 1 – Day 5 5 = Day 6 – Day 7 6 = Day 1 7 = Day 2 8 = Day 3 9 = Day 4 10 = Day 5 11 = Day 6 12 = Day 7 13 = other combination of active days (read-only)	R/W
AV 711	TS1-TIME	Time (rounded to 0.25 hours, e.g. 5.25h) 5.25 = 5h15 min 5.5 = 5h30 min 5.75 = 5h45min	R/W
AV 712	TS1-SP	Set point of time schedule TS1-TYPE: 1=OFF: No set point 2=OP: 0 = Off, 1 = Eco, 2 = On 3=LP: Set point 0-100% 4=AO: Value 0-100% 5=FAN: 0 = Fan Off, 1 = Fan stage 1, 2 = Fan stage 2, 3 = Fan stage 3, 4 = Auto 6=DO: 0 = Off, 1 = On	R/W
MV 721	TS2-TYPE	Type of time schedule object	R/W
MV 722	TS2-NR	Type group ID	R/W
MV 723	TS2-DAYS	Active days	R/W
AV 721	TS2-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 722	TS2-SP	Set point of time schedule	R/W
MV 731	TS3-TYPE	Type of time schedule object	R/W
MV 732	TS3-NR	Type group ID	R/W
MV 733	TS3-DAYS	Active days	R/W
AV 731	TS3-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 732	TS3-SP	Set point of time schedule	R/W
MV 741	TS4-TYPE	Type of time schedule object	R/W
MV 742	TS4-NR	Type group ID	R/W
MV 743	TS4-DAYS	Active days	R/W
AV 741	TS4-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 742	TS4-SP	Set point of time schedule	R/W
MV 751	TS5-TYPE	Type of time schedule object	R/W
MV 752	TS5-NR	Type group ID	R/W
MV 753	TS5-DAYS	Active days	R/W
AV 751	TS5-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 752	TS5-SP	Set point of time schedule	R/W
MV 761	TS6-TYPE	Type of time schedule object	R/W
MV 762	TS6-NR	Type group ID	R/W
MV 763	TS6-DAYS	Active days	R/W
AV 761	TS6-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 762	TS6-SP	Set point of time schedule	R/W
MV 771	TS7-TYPE	Type of time schedule object	R/W
MV 772	TS7-NR	Type group ID	R/W

Object	Name	Description	Access
MV 773	TS7-DAYS	Active days	R/W
AV 771	TS7-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 772	TS7-SP	Set point of time schedule	R/W
MV 781	TS8-TYPE	Type of time schedule object	R/W
MV 782	TS8-NR	Type group ID	R/W
MV 783	TS8-DAYS	Active days	R/W
AV 781	TS8-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 782	TS8-SP	Set point of time schedule	R/W
MV 791	TS9-TYPE	Type of time schedule object	R/W
MV 792	TS9-NR	Type group ID	R/W
MV 793	TS9-DAYS	Active days	R/W
AV 791	TS9-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 792	TS9-SP	Set point of time schedule	R/W
MV 801	TS10-TYPE	Type of time schedule object	R/W
MV 802	TS10-NR	Type group ID	R/W
MV 803	TS10-DAYS	Active days	R/W
AV 801	TS10-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 802	TS10-SP	Set point of time schedule	R/W
MV 811	TS11-TYPE	Type of time schedule object	R/W
MV 812	TS11-NR	Type group ID	R/W
MV 813	TS11-DAYS	Active days	R/W
AV 811	TS11-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 812	TS11-SP	Set point of time schedule	R/W
MV 821	TS12-TYPE	Type of time schedule object	R/W
MV 822	TS12-NR	Type group ID	R/W
MV 823	TS12-DAYS	Active days	R/W
AV 821	TS12-TIME	Time (rounded to 0.25 hours, e.g. 5.25h)	R/W
AV 822	TS12-SP	Set point of time schedule	R/W

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.

Object	Name	Description	Access
MV 711	TS1-TYPE	Type of time schedule object 1 = OFF 2 = OP (Operation mode) 3 = LP (Control loop set point) 4 = AO (Analog output set point) 5 = FAN (Fan output) 6 = DO (Digital output) **7 = HDAY (Holiday)**	R/W
AV 713	TS1-HDAY-START	Start day of holiday 1 = first day of the month	R/W
AV 714	TS1-HMONTH-START	Start month of holiday 1 = January, 12 = December	R/W
AV 715	TS1-HDAY-END	End day of holiday 1 = first day of the month	R/W
AV 716	TS1-HMONTH-END	End month of holiday 1 = January, 12 = December	R/W
MV 721	TS2-TYPE	Type of time schedule object	R/W
AV 723	TS2-HDAY-START	Start day of holiday	R/W
AV 724	TS2-HMONTH-START	Start month of holiday	R/W
AV 725	TS2-HDAY-END	End day of holiday	R/W
AV 726	TS2-HMONTH-END	End month of holiday	R/W
MV 731	TS3-TYPE	Type of time schedule object	R/W
AV 733	TS3-HDAY-START	Start day of holiday	R/W
AV 734	TS3-HMONTH-START	Start month of holiday	R/W
AV 735	TS3-HDAY-END	End day of holiday	R/W
AV 736	TS3-HMONTH-END	End month of holiday	R/W
MV 741	TS4-TYPE	Type of time schedule object	R/W
AV 743	TS4-HDAY-START	Start day of holiday	R/W
AV 744	TS4-HMONTH-START	Start month of holiday	R/W
AV 745	TS4-HDAY-END	End day of holiday	R/W
AV 746	TS4-HMONTH-END	End month of holiday	R/W
MV 751	TS5-TYPE	Type of time schedule object	R/W
AV 753	TS5-HDAY-START	Start day of holiday	R/W
AV 754	TS5-HMONTH-START	Start month of holiday	R/W
AV 755	TS5-HDAY-END	End day of holiday	R/W

Object	Name	Description	Access
AV 756	TS5-HMONTH-END	End month of holiday	R/W
MV 761	TS6-TYPE	Type of time schedule object	R/W
AV 763	TS6-HDAY-START	Start day of holiday	R/W
AV 764	TS6-HMONTH-START	Start month of holiday	R/W
AV 765	TS6-HDAY-END	End day of holiday	R/W
AV 766	TS6-HMONTH-END	End month of holiday	R/W
MV 771	TS7-TYPE	Type of time schedule object	R/W
AV 773	TS7-HDAY-START	Start day of holiday	R/W
AV 774	TS7-HMONTH-START	Start month of holiday	R/W
AV 775	TS7-HDAY-END	End day of holiday	R/W
AV 776	TS7-HMONTH-END	End month of holiday	R/W
MV 781	TS8-TYPE	Type of time schedule object	R/W
AV 783	TS8-HDAY-START	Start day of holiday	R/W
AV 784	TS8-HMONTH-START	Start month of holiday	R/W
AV 785	TS8-HDAY-END	End day of holiday	R/W
AV 786	TS8-HMONTH-END	End month of holiday	R/W
MV 791	TS9-TYPE	Type of time schedule object	R/W
AV 793	TS9-HDAY-START	Start day of holiday	R/W
AV 794	TS9-HMONTH-START	Start month of holiday	R/W
AV 795	TS9-HDAY-END	End day of holiday	R/W
AV 796	TS9-HMONTH-END	End month of holiday	R/W
MV 801	TS10-TYPE	Type of time schedule object	R/W
AV 803	TS10-HDAY-START	Start day of holiday	R/W
AV 804	TS10-HMONTH-START	Start month of holiday	R/W
AV 805	TS10-HDAY-END	End day of holiday	R/W
AV 806	TS10-HMONTH-END	End month of holiday	R/W
MV 811	TS11-TYPE	Type of time schedule object	R/W
AV 813	TS11-HDAY-START	Start day of holiday	R/W
AV 814	TS11-HMONTH-START	Start month of holiday	R/W
AV 815	TS11-HDAY-END	End day of holiday	R/W
AV 816	TS11-HMONTH-END	End month of holiday	R/W
MV 821	TS12-TYPE	Type of time schedule object	R/W
AV 823	TS12-HDAY-START	Start day of holiday	R/W
AV 824	TS12-HMONTH-START	Start month of holiday	R/W
AV 825	TS12-HDAY-END	End day of holiday	R/W
AV 826	TS12-HMONTH-END	End month of holiday	R/W

Parameter access through BACnet/IP

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 00) is the address of the parameter and ParValue (AV 01) 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 01.

Object	Name (8 Bytes)	Description / Property description	Format	R/W
AV 00	ParAdd	Address of parameter, see table below	AV	R/W
AV 01	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 TCX2 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				
Functions	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.

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