

User Manual

BACnet **Option board**

SV-iP5A



- Be sure to read “Safety Instructions” before using for the proper use.
- Keep this manual within easy reach for quick reference.

Thank you for purchasing BACnet Option Board.

SAFETY PRECAUTIONS

- Always follow safety instructions to prevent accidents and potential hazards from occurring.
- Safety precautions are classified into “WARNING” and “CAUTION” and their meanings are as follows:



WARNING

Improper operation may result in serious personal injury or death.



CAUTION

Improper operation may result in slight to medium personal injury or property damage.

- The indicated illustrations on the product and in the manual have the following meanings.



Danger may be present. Read the message and follow the instructions carefully.



Particular attention should be paid because danger of an electric shock may be present.

- Keep operating instructions handy for quick reference.
- Read the operating instructions carefully to fully understand the functions of the SV-iP5A series and to use it properly.



CAUTION

- **Be cautious, when handling the CMOS components of the Option Board.**
Static may lead to malfunctioning of the product.
- **Turn off the inverter power, when changing the communication cable.**
Otherwise, you may damage the board or a communication error may occur.
- **Make sure to insert the Option Board connector to the inverter precisely.**
Otherwise, you may damage the board or a communication error may occur.
- **Check the parameter unit before setting up the parameter.**
Otherwise, a communication error may occur.

Introduction

BACnet stands for “Building Automation and Control network.” It is a communication protocol, which is often used in the area of Building Automation.

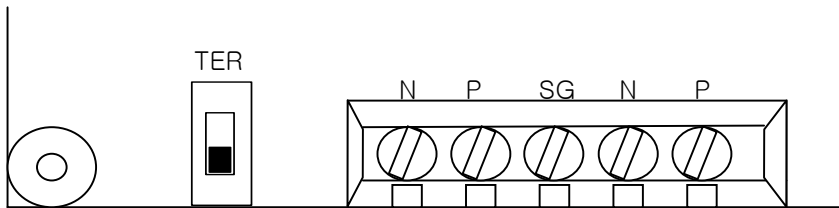
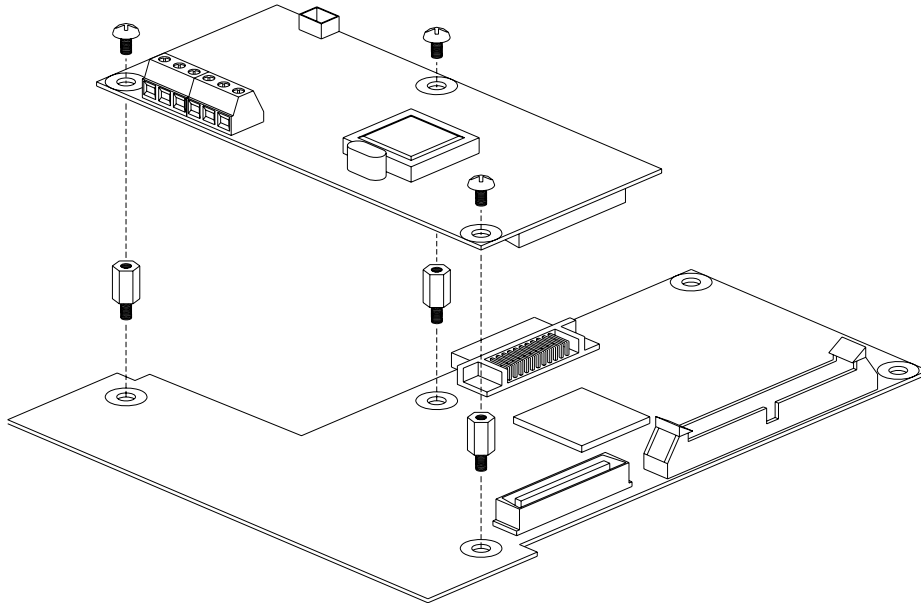
BACnet adopted the “Object-Oriented” concept for the flexibility of the system. It defines the standardized object, and all the data is expressed using the property of this object. It exchanges data by using this object and makes it possible to communicate with the products of other manufacturers.

Furthermore, it standardizes those systems that operate by accessing to the defined objects.

1. BACnet Communication card Technical Data

| | | |
|----------------------|--------------------------|----------------------------------|
| Connection | Interface | 5Pin Pluggable connector |
| | Data transmission method | RS-485 MS/TP, Half-duplex |
| | Cable | Twisted pair (1 pair and shield) |
| Communication | BACnet MS/TP | ANSI/ASHRAE Standards 135-2004 |
| | Baud Rate | 9600, 19200, 38400, 76800 bps |
| | MAC Address | 1~127 |

BACnet Communication card Layout and Network connection



| Signal | Description |
|--------|--|
| TER | Terminal Resistance Selection Switch (120 Ohm) |

Terminal not in use



Terminal in use



| Signal | Connector Number | Description |
|--------|------------------|-------------------------|
| N | 1 | Transmit/Receive data - |
| P | 2 | Transmit/Receive data + |
| SG | 3 | Signal Ground |
| N | 4 | Transmit/Receive data - |
| P | 5 | Transmit/Receive data + |

※ Whether the right side 4 switches are On or Off, there is no effect to the BACnet communication card.

Hardware installation method

Warning! Connect to network after turning off the power of Inverter.

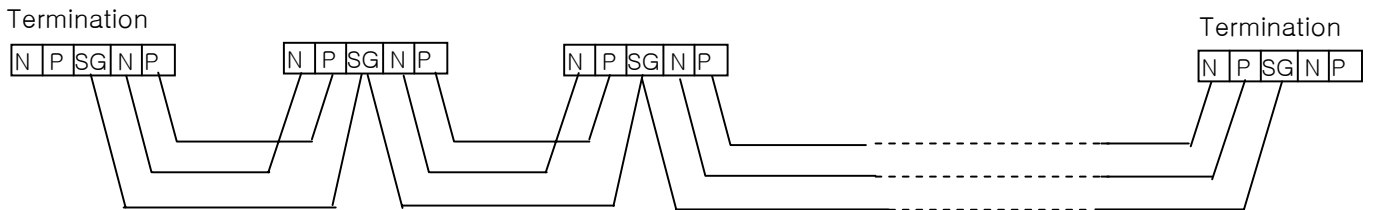
Use Belden 9842 or equivalent cable to it. Belden9842 is Dual Twisted Shielded pair cable, and its track impedance is 120 Ohm.

For communication, connect one out of 2 cables twisted to terminal N and the other one to terminal P.

Also, connect one out of the other 2 cables twisted to terminal SG, and the other is out of use.

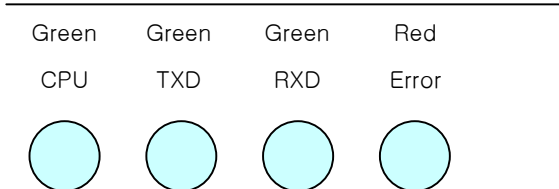
Connect to network with Daisy-Chained Bus. (Not with Dropout Line)

To reduce noise, it is required to terminate register 120Ohm on Device of Networks' both ends. And, terminate, using terminal Dip switch on communication card.



2. Status LED

There are 3 green LEDs and 1 red LED that indicate the present status of the BACnet Communication card and are lined up as follows on the BACnet Communication card.



| LED Name | Color | Status |
|----------|-------|---|
| CPU | Green | <p>Off – BACnet Communication card is getting no power supply or there is a problem with the card</p> <p>Blink – BACnet Communication card is getting power supply and it is at a normal state.</p> |
| ERROR | Red | <p>Blinks against the CPU cycle – Communication card is ready to communicate but not receiving or sending actual data.</p> <p>Blinks with the CPU cycle – There is a problem with the DPRam communication between the BACnet Communication card and inverter.</p> <p>Off – There is no error and BACnet Communication card is communicating.</p> |
| TXD | Green | <p>On – BACnet Communication card is sending communication frame.</p> <p>Off – BACnet Communication card is not sending data.</p> |
| RXD | Green | <p>ON – BACnet Communication card is receiving communication frame.</p> <p>Off – BACnet Communication card is not receiving data.</p> |

When power is first supplied to the BACnet communication card and if it is not communicating, the TX LED lights up and RX LED remains off.

3. Quick Communication Start

1. Install the BACnet Communication card with the inverter power turned off. Set the protocol switch of the card to BACnet and make sure that the COM-01 parameter is "RS-485" after turning it on.
2. Connect to the network by connecting the cable with the BACnet Communication card.
3. Set IO-91 baud rate.
4. Set COM-63, 64 Device Object Instance.
 - ✓ The modified Device Instance value gets written in the Communication card only when the COM-67 Comm Update is set to "Yes" after setting COM-63, 64.
 - ✓ Set value to COM-63, COM-64. Device Object Instance must be a peculiar value.
5. Set MAC ID that is to be used in COM-61
 - ✓ When the COM-61 MAC ID value gets modified, it gets written in the Communication card only when the COM-67 Comm Update is set to "Yes"
 - ✓ To execute MS/TP token passing, the value of MAC ID has to be within the value limit that has been set by another Master's Max Master Property.
6. Check if BACnet communication is working properly.

4. BACnet related Keypad Parameter

| Code | Parameter name | Default | Range | Description |
|--------|----------------|----------|--|---|
| IO-91 | Baud rate | 9600 bps | 1200 bps 2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 76800 bps 115200 bps | Set baud rate. From the range provided by IO-91, BACnet only supports 9600 bps, 19200 bps, 38400 bps, 76800 bps. When unsupported baud rate is set and COM-67 Comm Update is set to "Yes," the default of IO-91 automatically changes to 9600 bps. |
| COM-01 | Opt B/D | - | - | Displays the Communication card installed on the inverter. (Displays RS485, when BACnet Communication card is installed) |
| COM-03 | Opt Version | - | - | Displays version of the BACnet Communication card that has been installed on the inverter. |
| COM-61 | Opt Para-1 | 1 | 1~127 | MAC ID |
| COM-62 | Opt Para-2 | 127 | 1~127 | Max Master |
| COM-63 | Opt Para-3 | 237 | 0~4194 | BACnet Device Instance |
| COM-64 | Opt Para-4 | 000 | 0~999 | BACnet Device Instance |
| COM-65 | Opt Para-5 | 0 | 0~32767 | A password used on Warm/Cold Start. |
| COM-66 | Opt Para-6 | 12345 | - | - |
| COM-67 | Comm Update | No | No Yes | In order to modify BACnet related parameters such as MAC ID, Baud Rate and Device Instance, the modified parameter value has to be set to "Yes." |

(1) Baud rate (IO-91)

- ✓ Baud rate is the parameter for setting communication speed, which is to be used in the network and the default is 9600bps. If the user sets a baud rate that is not supported and sets the COM-67 Comm Update to "Yes," the IO-91 baud rate gets automatically set to default 9600bps and so does the BACnet Communication card.

(2) MAC ID (COM-61)

- ✓ Every MAC ID of the BACnet Communication card has to be set up before connecting to the Bus. Above all, the set up

value of the baud rate parameter has to match with the one of the Master Configuration.

- ✓ MAC ID needs its unique value in the network to be connected.

- ✓ Slave is used in 128~154 of the MAC ID and both Master, Slave is used in 1~127.

- ✓ BACnet communication card's MAC ID range is 1~127 because it is used for master. If you set MAC ID under 0 or over 127, and the COM-67 Comm Update as 'Yes' to apply the MAC ID to the BACnet communication card, then the COM-61 Opt Para-1 will be 1 which is the default value automatically.

- ✓ If you set the MAC ID more than the value of COM-62 Max Master, and the COM-67 Comm UpDate as 'Yes', then COM-61 MAC ID will be 1 which is the default value automatically.

- ✓ It is encouraged for the MS/TP router to use MAC ID value 0 and for the Broadcast 255.

(3) Max Master (COM-62)

- ✓ Max Master's range is 1~127, and the initial value is 127.
- ✓ If you set the Max Master over 128, and the COM-67 Comm Update as 'Yes' to apply the value, then the COM-62 Max Master's initial value will be 127 automatically.

(4) BACnet Device Instance (COM-63, COM-64)

- ✓ Because BACnet Device Instance is used to identify BACnet Device, it has to be set up with a unique value in the network. It is conveniently used, when searching for BACnet Device among other devices while installing.
- ✓ The value of (COM63 X 1000) + COM64 is applied for the Device Instance. In other words, COM-63 is the value over 1000 in the Device Instance and COM-64, under 100.
- ✓ Because the Device Instance has a value range of 0~4,194,302, COM-63 has a range of 0~5194 and COM-64, 0~999.
- ✓ If the user sets up a value bigger than 4,194,302 for COM-62 and COM-63, the Device Instance will automatically set up to the maximum value, which is 4,194,302.

(5) Password (COM-65)

- ✓ It is the password when you restart a machine with Warm/Cold Start. COM-65 Password's parameter is allowed to set 0~32767 and the initial value is 0. Warm/Cold Start operates with the parameter 1~32768 when both the password set on the BACnet Master and the COM-65 value are equal.
- ✓ If the COM-65 Password is 0, the password on the BACnet Master is ignored and the Warm/Cold Start is operated constantly.
- ✓ If you set the COM-65 Password over 32769, and the COM-67 Comm Update as 'Yes' to apply the value to the

BACnet communication card, then the COM-65 Password's initial value will be 0.

- ✓ There are three ways to apply the value of COM-65 Password to the communication card. The first is that you set the COM-67 Comm Update as 'Yes', the second is that you do the Warm/Cold Start operation, and the last is that you turn the power of the inverter off and on.

(6) Signature (COM-66)

- ✓ It is encouraged for the user not to use COM-66.

(7) Comm UpDate (COM-67)

- ✓ In order to modify and apply parameters which are related to the BACnet, such as MAC ID, Baud Rate, Delay Time, Device Instance, communication command loss time, communication command loss method, etc., you had better set the COM-67 Comm Update as 'Yes' to apply to the BACnet communication card.
- ✓ Communication card's LED goes on and off CPU→TXD→RXD→ERR in order.

※ Note)

There are three ways to apply the changed parameters to the BACnet communication card by a keypad.

- 1) Set the COM-67 Comm Update, keypad parameter, as 'Yes'.
- 2) Turn the power of the inverter off and on again.
- 3) Carry out the Cold Start or the Warm Start (ReinitializeDeiveControl). Both Cold Start and Warm Start are the same operation. After the Cold/Warm Start, the BACnet communication card's LED will go on and off CPU→TXD→RXD→ERR in order.

※ Note) Max Master and MAC ID have a big effect on the network communication.

You had better set the Max Master as small value as possible. MAC ID is better be set with continuous values. Each master wants to send a token to its device (MAC ID + 1). Therefore, you can operate an effective Token Passing Configuration, if you set the values of the Max Master and the MAC ID as has been mentioned above.

5. General Communication related Keypad Parameter

| Code | Parameter Name | Default | Range | Description |
|----------|----------------|---------|---|---|
| DRV-91 | Drive mode2 | Fx/Rx-1 | Keypad Fx/Rx-1 Fx/Rx-2 | Multi-function input of IO-20~27 should be set as LOC / REM so that DRV-91, DRV-92 can be shown on Keypad. |
| DRV-92 | Freq mode2 | Keypad1 | Keypad1 Keypad2 V1 V1S I V1+I Pulse | |
| IO-20~27 | M1~M8 define | - | - | Related to communication when setting up Main-drive, one of multifunction's messages. |
| IO-92 | Com Lost Cmd | None | None FreeRun Stop | Sets up mode for communication command loss. |
| IO-93 | COM Time Out | 1.0 sec | 0.1~120.0 sec | Sets up time for communication command loss. |
| IO-94 | Delay Time | 5 ms | 2~1000 ms | BACnet turnaround time. Set up IO-94 Delay Time correctly according to the setting value of IO-91 Baudrate. Recommendation is as follows. 9600 bps (range) = 5 ms, 19200 bps = 3 ms, 38400 bps = 2 ms, 76800 bps = 2 ms |
| COM-02 | Opt mode | None | None Cmd Freq Cmd+Freq | Sets up mode. (Inverter operation, frequency command, both) Select 'Cmd+Freq' only to communicate with both inverter operation and frequency command. |

6. Protocol Implement

(1) Service provided by BACnet Communication card

- ✓ I-Am (Answer to “Who-Is,” Broadcast after Power-up or when “Reset”)
- ✓ I-Have (Answer to “Who-Has”)
- ✓ ReadProperty
- ✓ WriteProperty
- ✓ DeviceCommunicationControl
 - Password is ignored on the DeviceCommunicationControl.

- ✓ ReinitializeDevice
 - Warm/Cold Start is supported(Password is supported)
During the operation of Warm/Cold Start, Communication card’s LED goes on and off
CPU→TXD→RXD→ERR in order.
 - Start Backup, End Backup, Start Restore, End Restore, and Abort Restore are not supported.

(2) Data Link Layer

- ✓ BACnet Communication card puts through MS/TP Master Data Link Layer. All standard MS/TP provides 9600, 19200, 38400, 76800 bps.

(3) MAC ID/Device Object Instance

- ✓ Set COM-61 MAC ID
- ✓ Set Device Object Instance from COM-63, COM-64

(4) Max Master Property

- ✓ It is possible to configure Device Object Max Master Property by setting up the value of COM-62 Max Master

7. Object Map

| Property | Object Type | | | | | | |
|----------------------------------|-------------|----|----|----|----|-----|-----|
| | Device | BI | BV | AI | AO | MSI | MVI |
| Object Identifier | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Object Name | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Object Type | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| System Status | ○ | | | | | | |
| Vendor Name | ○ | | | | | | |
| Vendor Identifier | ○ | | | | | | |
| Model Name | ○ | | | | | | |
| Firmware Revision | ○ | | | | | | |
| Apply Software Revision | ○ | | | | | | |
| Location | ○ | | | | | | |
| Protocol Version | ○ | | | | | | |
| Protocol Revision | ○ | | | | | | |
| Services Supported | ○ | | | | | | |
| Object Types Supported | ○ | | | | | | |
| Object List | | | | | | | |
| Max APDU Length | ○ | | | | | | |
| UTC Offset | ○ | | | | | | |
| Daylight Savings Status | ○ | | | | | | |
| APDU Timeout | ○ | | | | | | |
| Number APDU Retries | ○ | | | | | | |
| Time Synchronizations Recipients | ○ | | | | | | |
| Max Master | ○ | | | | | | |
| Max Info Frames | ○ | | | | | | |
| Device Address Binding | ○ | | | | | | |
| Database Revision | ○ | | | | | | |
| Present Value | | ○ | ○ | ○ | ○ | ○ | ○ |
| Description | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Status Flags | | ○ | ○ | ○ | ○ | ○ | ○ |
| Event State | | ○ | ○ | ○ | ○ | ○ | ○ |
| Reliability | | ○ | ○ | ○ | ○ | ○ | ○ |
| Out-of-Service | | ○ | ○ | ○ | ○ | ○ | ○ |
| Number of states | | | | | | ○ | ○ |
| State text | | | | | | ○ | ○ |
| Units | | | | ○ | ○ | | |
| Polarity | | ○ | | | | | |
| Active Text | | ○ | ○ | | | | |
| Inactive Text | | ○ | ○ | | | | |

- BI – Binary Input
- BV – Binary Value
- AI – Analog Input
- AV – Analog Value
- MSI – Multi-state Input
- MSV – Multi-state Value

Location and Description(Device Object) is available for Read/Write access. Maximum number of character of these is 29 characters

7.1 Analog Value Object Instance

| Instance ID | Object Name | Description | Range | Units | Present Value Access Type |
|-------------|-------------|----------------------------|---------------|-------|---------------------------|
| AV1 | CommTimeout | Lost Communication Timeout | 0.1 ~ 120.0 | Secs. | R / W |
| AV2 | AccelTime | Acceleration Time | 0.0 ~ 600.0 | Secs. | R / W |
| AV3 | DecelTime | Deceleration Time | 0.0 ~ 600.0 | Secs. | R / W |
| AV4 | CommandFreq | Command Frequency | 0.00 ~ FU1-30 | Hz | R / W |

Data Type is Real when "Write."

※ Note) AV4 is able to be set within the value of the FU1-30 Max Freq. FU1-30 is allowed to input 0.00~120.00.

7.2 Multi-state Value Object Instance

| Instance ID | Object Name | Description | - | Present Value Access Type |
|-------------|-------------|-----------------------------|---|---------------------------|
| MSV1 | LostCommand | Lost Communication Behavior | 1 None 2 FreeRun 3 Stop | R / W |
| MSV2 | OperateMode | Operating Mode | 1 None 2 Cmd 3 Freq 4 Cmd+Freq | R / W |
| MSV3 | DriveMode | Drive Mode2 Note1) | 1 Keypad 2 FX/RX-1 3 FX/RX-2 | R / W |
| MSV4 | FreqMode | Frequency Mode2 Note1) | 1 Keypad1 2 Keypad2 3 V1 4 V1S 5 I 6 V1+I 7 Pulse | R / W |

Note1) In order to see Drive Mode2, Freq Mode2 on the Keypad, IO-20~27 M1~M8 define has to be set as LOC/REM

Data Type is Unsigned when "Write."

7.3 Binary Value Object Instance

| Instance ID | Object Name | Description | Active / Inactive Text | Present Value Access Type |
|-------------|---------------|--------------------------------------|------------------------|---------------------------|
| BV1 | Stop | Binary Output Stop command | False/True | R / W |
| BV2 | RunForward | Binary Output Run Forward command | False/True | R / W |
| BV3 | RunReverse | Binary Output Run Reverse command | False/True | R / W |
| BV4 | ResetFault | Reset Fault | False/True | R / W |
| BV5 | EmergencyStop | Binary Output Emergency Stop command | False/True | R / W |

Data Type is Enumerated when "Write."

※ Note) False means 0, and True means 1.

7.4 Analog Input Object Instance

| Instance ID | Object Name | Description | Units | Present Value Access Type |
|-------------|-----------------|----------------------------|--------|---------------------------|
| AI1 | InvCap | Inverter Capacity | kW | R |
| AI2 | InvInputVoltage | Inverter Input Voltage | Volts | R |
| AI3 | OutputCurrent | Output Current | Amps | R |
| AI4 | OutputFreq | Output Frequency | Hz | R |
| AI5 | OutputVoltage | Output Voltage | Volts | R |
| AI6 | DCLinkVoltage | DC Link Voltage | Volts | R |
| AI7 | OutputPower | Output Power | kW | R |
| AI8 | V1 | V1 | Volts | R |
| AI9 | V2 | V2 | Volts | R |
| AI10 | I | Current | mA | R |
| AI11 | Speed | Drive Speed | RPM | R |
| AI12 | Pole | Pole Number | - | R |
| AI13 | TripInfo | Composite Trip Information | Note3) | R |
| AI14 | InvStatus | Composite Inverter Status | Note4) | R |

Note) AI8, AI9, and AI10 values are read related to voltage(0~15V) and current(0~22mA) in a linear form from 0~ to FFF

Note3) 16Bit Trip BIT Information

| | |
|-------|-------------------------|
| BIT0 | OCT1 |
| BIT1 | OV |
| BIT2 | EXT-A |
| BIT3 | BX |
| BIT4 | LV |
| BIT5 | RESERVE |
| BIT6 | GF (Ground Fault) |
| BIT7 | OHT (Inverter overheat) |
| BIT8 | ETH (Motor overheat) |
| BIT9 | OLT (Overload trip) |
| BIT10 | HW-Diag |
| BIT11 | RESERVE |
| BIT12 | OCT2 |
| BIT13 | OPT (Option Error) |
| BIT14 | PO (Phase Open) |
| BIT15 | IOLT |

Note4) Inverter Status BIT Information

| | |
|-------|-------------------------|
| BIT0 | Stop |
| BIT1 | Forward running |
| BIT2 | Reverse running |
| BIT3 | Trip |
| BIT4 | Accelerating |
| BIT5 | Decelerating |
| BIT6 | Speed arrival |
| BIT7 | DC Braking |
| BIT8 | Stopping |
| BIT9 | Not used |
| BIT10 | Brake Open |
| BIT11 | Forward run command |
| BIT12 | Reverse run command |
| BIT13 | REM R/S (Int 485, Opt) |
| BIT14 | REM Freq (Int 485, Opt) |
| BIT15 | Not used |

7.5 Binary Input Object Instance

| Instance ID | Object Name | Description | – | Present Value Access Type |
|-------------|----------------|---------------------------------|---|---------------------------|
| BI1 | Stopped | Inverter is Stopped | – | R |
| BI2 | RunningForward | Inverter is running forward | – | R |
| BI3 | RunningReverse | Inverter is running reverse | – | R |
| BI4 | Tripped | Inverter is Tripped | – | R |
| BI5 | Accelerating | Inverter is Accelerating | – | R |
| BI6 | Decelerating | Inverter is Decelerating | – | R |
| BI7 | FullSpeed | Inverter reached full speed | – | R |
| BI8 | DCBraking | Inverter is DC braking | – | R |
| BI9 | Stopping | Inverter is stopping | – | R |
| BI10 | BrakeOpen | Inverter Brake is Open | – | R |
| BI11 | FwdRunCommand | Inverter Forward Run Command | – | R |
| BI12 | RevRunCommand | Inverter Reverse Run Command | – | R |
| BI13 | REMRS | REM. R/S Int 485 OPT | – | R |
| BI14 | REMFreq | REM. Freq Int 485 OPT | – | R |
| BI15 | M1 | M1 Input Terminal | – | R |
| BI16 | M2 | M2 Input Terminal | – | R |
| BI17 | M3 | M3 Input Terminal | – | R |
| BI18 | M4 | M4 Input Terminal | – | R |
| BI19 | M5 | M5 Input Terminal | – | R |
| BI20 | M6 | M6 Input Terminal | – | R |
| BI21 | M7 | M7 Input Terminal | – | R |
| BI22 | M8 | M8 Input Terminal | – | R |
| BI23 | AUX1 | AUX1 Output Terminal Status | – | R |
| BI24 | AUX2 | AUX2 Output Terminal Status | – | R |
| BI25 | AUX3 | AUX3 Output Terminal Status | – | R |
| BI26 | AUX4 | AUX4 Output Terminal Status | – | R |
| BI27 | Q1 | Q1 (OC1) Output Terminal Status | – | R |
| BI28 | Q2 | Q2 (OC2) Output Terminal Status | – | R |
| BI29 | Q3 | Q3 (OC3) Output Terminal Status | – | R |
| BI30 | 30AC | 30AC Output Terminal Status | – | R |

7.6 Multi-state Input Object Instance

| Instance ID | Object Name | Description | - | Present Value Access Type |
|-------------|--------------|------------------------------|---------------|---------------------------|
| MSI1 | UnitsDisplay | Engineering Units on Display | 1 Hz 2 RPM | R |

8. Error message

| Display | Description |
|------------------|----------------------------|
| serviceserror+7 | Inconsistent parameters |
| propertyerror+9 | Invalid Data Type |
| serviceserror+10 | Invalid access method |
| serviceserror+11 | Invalid file start |
| serviceserror+29 | Service request denied |
| objecterror+31 | Unknown object |
| propertyerror+0 | Property other |
| propertyerror+27 | Read access denied |
| propertyerror+32 | Unknown property |
| propertyerror+37 | Value out of range |
| propertyerror+40 | Write access denied |
| propertyerror+42 | Invalid array index |
| clienterror+31 | Unknown device |
| resourceserror+0 | Resources other |
| clienterror+30 | Time out |
| abortreason+4 | Segmentation not supported |
| rejectreason+4 | Invalid tag |
| clienterror+0xFF | No invoke id |
| securityerror+26 | Password failure |