Using Yaskawa E7U and P7U VFDs with Delta Controls' DAC-322-MOD-YSD (UUX000373) BACnet/MODBUS Gateway

1. INTRODUCTION

The following information describes utilizing the Yaskawa E7U and P7U Variable Frequency Drives with Delta Controls' DAC-322-MOD-YSD BACnet to Modbus RTU gateway (Yaskawa part number UUX000373) to achieve BACnet control, monitoring and parameter access. This document contains the general setup, connections, drive parameters and gateway objects available to the E7U and P7U drives.

2. INTENDED AUDIENCE

This document assumes that the reader is familiar with Yaskawa E7U and P7U Drives, Delta Controls' DAC-322-MOD-YSD gateway (UUX000373), BACnet, BACnet MS/TP and RS485.

3. REFERENCES

Yaskawa E7 Drive User Manual -- **TM.E7.01**

Yaskawa E7 Drive Programming Manual -- **TM.E7.02**

Yaskawa P7 Drive User Manual -- **TM.P7.01**

Yaskawa P7 Drive Programming Manual -- **TM.P7.02**

Delta Controls' DAC-322 Installation Guide

4. TERMS

BACnet	Building Automation Control network
Modbus RTU	A subset of the Modbus Protocol. In this case, functions 0x03, 0x06, 0x08 and 0x10 are supported.
MS/TP	Master/Slave Token Passing

5. GENERAL SETUP

The figures below show a general system and its connections. This was the system setup for this application note and used to test the gateway.

Note: The control software listed in the figure below should not be considered as a Yaskawa endorsement of said software. The software is listed as an example only.
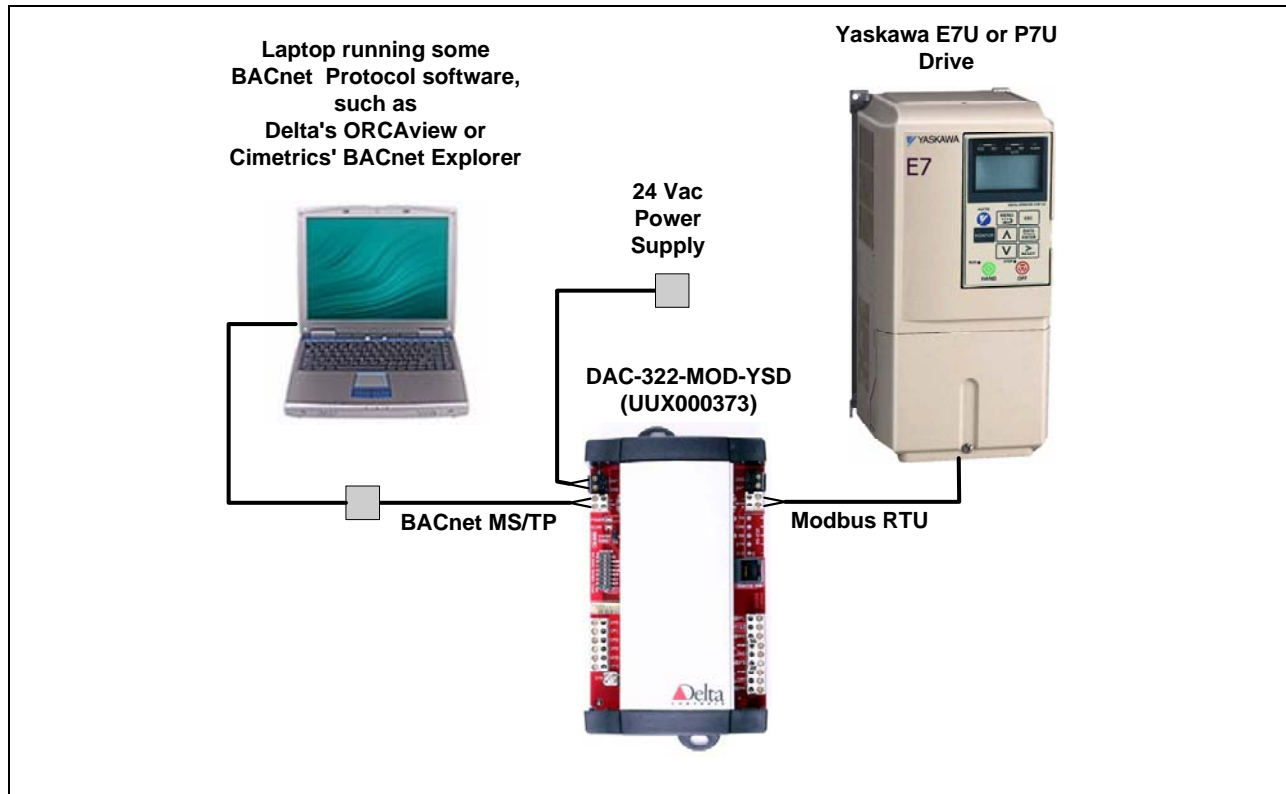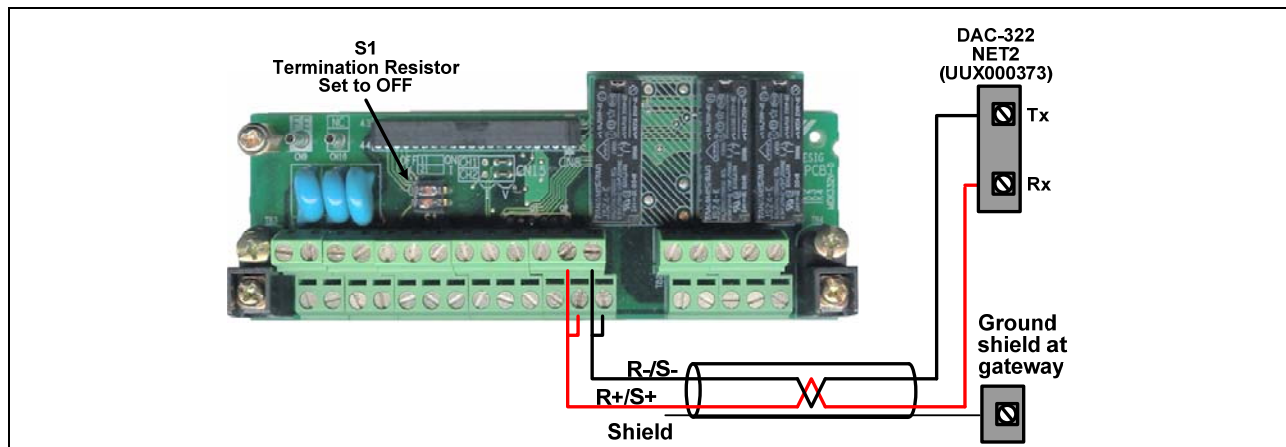

Figure 1, General System Layout

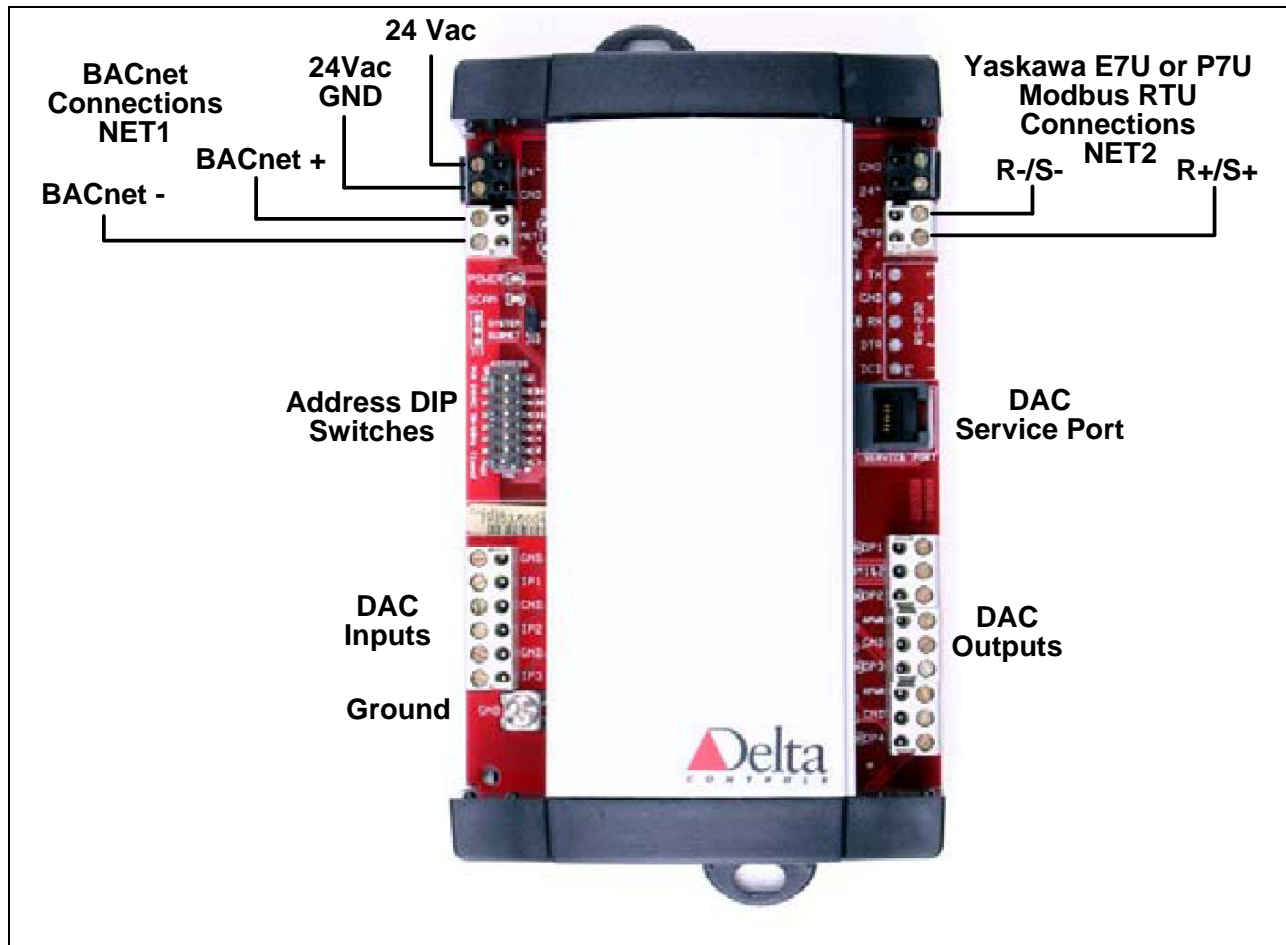**Figure 2, E7U and P7U Drive Connections**

Figure 3, DAC-322 (UUX000373) Connection Detail

Make sure all power is disconnected before making any connections.

* Note in this example a Delta DSM-RTR router and Delta's ORCAview software was used to interface to the gateway.

The DAC-322 (UUX000373) requires an external 24 Vac power supply in order to function. The power supply should be connected to the **PWR** connector on the top left of the gateway as shown in the figure above. Refer to the DAC-322-MOD-YSD Installation and Application Guide for more detail on the power supply.

Connect the wires from the drive's **R+/S+** and **R-/S-** terminals to the **NET2 Rx** and **Tx** terminals on the gateway as shown in the figure above. *Note that the polarity of the connections for NET1 and NET2 are reversed*. Shielded twisted pair wire should be used with the shield tied to the ground point only at the gateway. Be sure to install the jumper wires between drive terminals R+ and S+ and between terminals R- and S-. Set switch S1 on the drive terminal assembly to OFF.

Connect the BACnet network wires to the **NET1 Rx** and **Tx** terminals on the top left side of the gateway. Make sure to connect the BACnet "+" wire to the gateway "+" terminal and the BACnet "-" wire to the gateway "-" terminal. *Note that the polarity of the connections for NET1 and NET2 are reversed*. Refer to the Delta Controls' documentation of the DAC-322-MOD-YSD for information on wiring and setting up the gateway.

6. Gateway Setup

Set the **ADDRESS** dip switches to the desired node address of the gateway and install the jumper at **J12** so that **DNA** is enabled.

The baud rates are defaulted to the values shown below. These may be changed, but require access to the DAC service port. Consult Yaskawa or a Delta Controls representative to change these values from their defaults.

> NET 1 Baud (BACnet MS/TP): 76800
>
> NET 2 Baud (Modbus RTU to Drive): 19200

From ORCAView Navigator select **Find New Devices** from the drop down menu of **BACnet Protocol**. Both the router and the gateway should be displayed as devices*. The router will be displayed as a device on the **BACnet Protocol** network and the gateway will be displayed as a **Yaskawa E7 VFD** device on the router. Select **Yaskawa E7 VFD** from the list of displayed devices and **Modbus Gateway** from the list of device objects displayed. From the **Setup** tab, check **Enable** and select the **Port** and **Speed** (baud rate) to be used in communicating with the drive. Since **NET1** is already used for the BACnet connection, select **NET2** for the **Yaskawa E7 VFD** port. Of the baud rates available, only baud rates of 9600bps and 19200bps are compatible with the drive. 19200bps was selected in this case.
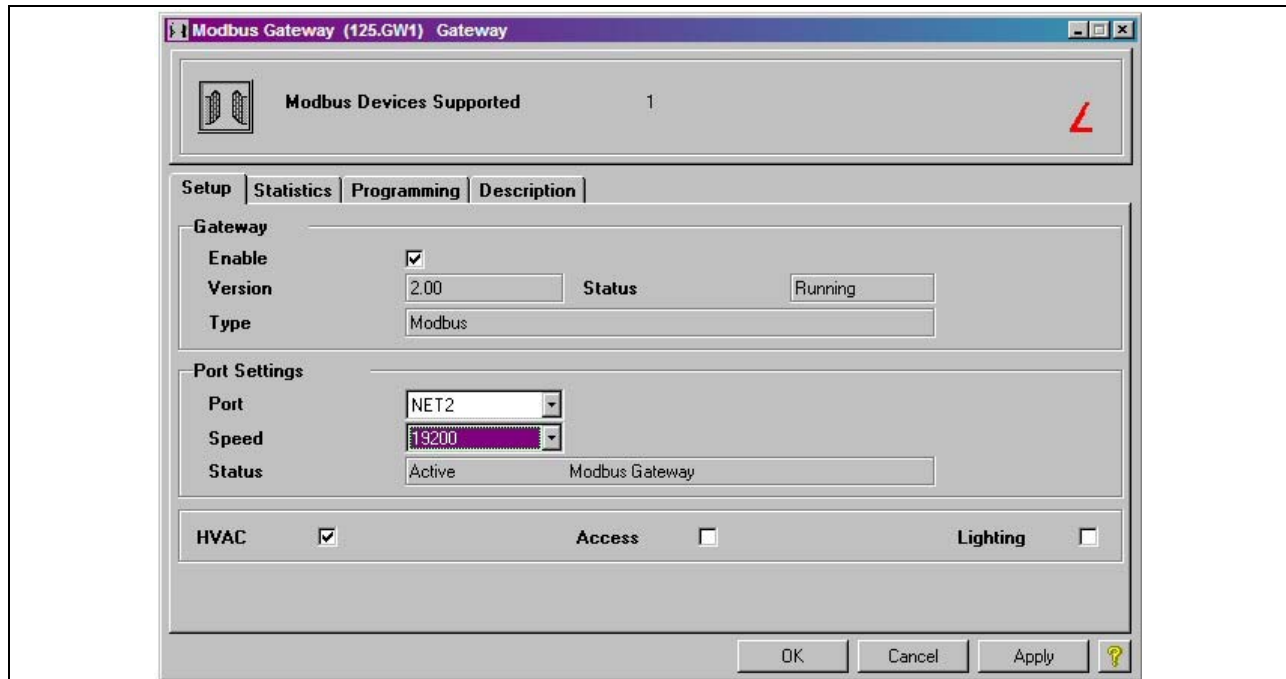
Figure 4, DAC Gateway Modbus Gateway Setup

** If the gateway is not displayed, first check the power and network wiring. If the wiring is verified, the baud rate selected of the BACnet MS/TP **NET1** network in the router may not have been set correctly. Go back to the router device, **BACnet Settings** object and try the various baud rates until the gateway is displayed as a device.*

Refer to the documentation specific to the router and gateway used for setup information.

7. Set Drive Parameters

The E7U and P7U drives communicate with the gateway utilizing an embedded Modbus RTU protocol to map the BACnet objects to the appropriate drive registers and parameters. Be aware that a 2-wire, 3-wire or user reset of the drive could cause the values of the parameters listed below to change. Make sure to check these parameters as part of any troubleshooting.

The table below shows the drive parameters that affect communications with the gateway. Refer to the E7U or P7U Drive User or Programming manuals for information on other parameters and their settings.

Table 1, E7U and P7U Communication Parameters

Drive Parameter	Parameter Name	Value	Description
b1-01	Reference Source	2	For BACnet network control of the drive frequency reference set b1-01 to 2. If BACnet is used for monitoring only set b1-01 to either 0 or 1 as specified in the application.
b1-02	Run Source	2	For BACnet network control of the drive run command set b1-02 to 2. If BACnet is used for monitoring only set b1-02 to either 0 or 1 as specified in the application.
H5-01	Serial Comm Adr	1	Sets the address of the node that the gateway looks to communicate.
H5-02	Serial Baud Rate	4	The baud rate should be set to 4 (19,200 bps). Some older gateway units were programmed to communicate at 9,600 bps. Check the gateway setup to determine the correct baud rate. Program H5-02 accordingly.
H5-03	Serial Com Sel	0	Parity should be set to 0 (none).
H5-04	Serial Fault Sel	3	The Alarm Only selection (3) allows the drive to continue operation in the event of a communications fault. If your application calls out for a stopping method as a result of a communications fault, select 0, 1 or 2 as the application requires.
H5-05	Serial Fault Detect	0/1	Set to enabled or disabled as the application requires.
H5-06	Transmit WaitTIM	5	This value should not be changed unless told to do so by a Yaskawa application engineer.
H5-07	RTS Control Sel	1	RTS must be enabled.
H5-08	Protocol Select	0	Memobus(Modbus) must be selected.
H5-09	CE Detect Time	2.0	This value should not be changed unless told to do so by a Yaskawa application engineer.

8. BACnet Objects Supported

The tables below list the BACnet objects that are implemented in the DAC-322-MOD-YSD (UUX000373).

BACnet Object	Object Name	R/W	Parameter	Parameter Address	BACnet BV Reference
...					

BACnet Object	Object Name	R/W	Parameter	Parameter Address	BACnet BV Reference
AV1	Command	W	n/a	0001h	BV1 – BV11
AV2	Frequency	W	n/a	0002h	
AV3	PI Setpoint	W	n/a	0003h	
AV4	Analog Output 1	W	n/a	0007h	
AV5	Analog Output 2	W	n/a	0008h	
AV6	Multi Function Contact	W	n/a	0009h	BV12 – BV15
AV7	Reference Selections	W	n/a	0010h	BV16 – BV19
AV8	Drive Status	R	n/a	0020h	BV20 – BV26
AV9	Fault Details	R	n/a	0021h	BV27 – BV41
AV10	Data Link Status	R	n/a	0022h	
AV11	Frequency Reference	R	U1-01	0023h	
AV12	Output Frequency	R	U1-02	0024h	
AV13	Output Voltage	R	U1-06	0025h	
AV14	Output Current	R	U1-03	0026h	
AV15	Output Power	R	U1-08	0027h	
AV16	Torque Reference	R	U1-09	0028h	
AV17	Sequence Input Status	R	U1-10	002Bh	BV42 – BV48
AV18	Drive Status 2	R	n/a	002Ch	BV49 – BV64
AV19	Multifunction Digital Status	R	U1-11	002Dh	
AV20	Main Circuit DC Voltage	R	U1-07	0031h	
AV21	PI Feedback Level	R	U1-24	0038h	
AV22	PI Input Level	R	U1-36	0039h	
AV23	PI Output Level	R	U1-37	003Ah	
AV24	CPU Software Number	R	U1-28	003Bh	
AV25	Flash Software Number	R	U1-14	003Ch	
AV26	Communications Error Details	R	U1-39	003Dh	BV65 – BV71
AV27	kVA Setting	R	n/a	003Eh	
AV28	Control Method	R	n/a	003Fh	
AV29	Acceleration Time (x10)	W	C1-01	0200h	
AV30	Deceleration Time(x10)	W	C1-02	0201h	

Table 2, BACnet Analog Values (AV's)

**Table 3, BACnet Binary Values (BV's)**
BACnet Object	**Object Name**	**R/W**	**Active Text**	**Inactive Text**	**BACnet AV Reference**
BV1	Command Forward Run	W	Forward	Stop	AV1
BV2	Command Reverse Run	W	Reverse	Stop	AV1
BV3	Command External Fault	W	Fault	Normal	AV1
BV4	Command Fault Reset	W	ON	OFF	AV1
BV5	Command ComNet	W	ON	OFF	AV1
BV6	Command ComCtr	W	ON	OFF	AV1
BV7	Command MFDI 3	W	ON	OFF	AV1
BV8	Command MFDI 4	W	ON	OFF	AV1
BV9	Command MFDI 5	W	ON	OFF	AV1
BV10	Command MFDI 6	W	ON	OFF	AV1
BV11	Command MFDI 7	W	ON	OFF	AV1
BV12	MFCO BO1	W	ON	OFF	AV6
BV13	MFCO BO2	W	ON	OFF	AV6
BV14	MFCO Fault Contact Enable	W	Enable	Disable	AV6
BV15	MFCO Fault Contact	W	ON	OFF	AV6
BV16	Reference Selection Input PI Setpoint	W	ON	OFF	AV7
BV17	Reference Selection BDT S5 Input	W	ON	OFF	AV7
BV18	Reference Selection BDT S6 Input	W	ON	OFF	AV7
BV19	Reference Selection BDT S7 Input	W	ON	OFF	AV7
BV20	Drive Status - Operation	R	Running	Stopped	AV8
BV21	Drive Status - Direction	R	Reverse	Forward	AV8
BV22	Drive Startup Complete	R	YES	NO	AV8
BV23	Drive Status - Fault	R	Fault	Normal	AV8
BV24	Drive Status - Data Setting Error	R	Fault	Normal	AV8
BV25	Drive Status - MFDO1 Status	R	ON	OFF	AV8
BV26	Drive Status - MFDO2 Status	R	ON	OFF	AV8
BV27	Overcurrent Ground Fault	R	Fault	Normal	AV9
BV28	Main Circuit Overvoltage	R	Fault	Normal	AV9
BV29	Drive Overload	R	Fault	Normal	AV9
BV30	Drive Overheat	R	Fault	Normal	AV9
BV31	Fuse Blown	R	Fault	Normal	AV9
BV32	PI Feedback Reference Lost	R	Fault	Normal	AV9
BV33	External Error	R	Fault	Normal	AV9
BV34	Hardware Error	R	Fault	Normal	AV9
BV35	Motor Overload	R	Fault	Normal	AV9
BV36	PG Broken Wire Detected Overspeed Speed Deviation	R	Fault	Normal	AV9
BV37	Main Circuit Undervoltage Detected	R	Fault	Normal	AV9
BV38	Main Circuit UV Control PS Error Inrush Prevention Circuit Error	R	Fault	Normal	AV9
BV39	Missing Output Phase	R	Fault	Normal	AV9
BV40	MODBUS Comm Error	R	Fault	Normal	AV9
BV41	Operator Disconnected	R	Fault	Normal	AV9
BV42	Input Terminal S1	R	ON	OFF	AV17
BV43	Input Terminal S2	R	ON	OFF	AV17
BV44	MSDIT S3	R	ON	OFF	AV17

Table 3, BACnet Binary Values (BV's)

BACnet Object	Object Name	R/W	Active Text	Inactive Text	BACnet AV Reference
BV45	MSDIT S4	R	ON	OFF	AV17
BV46	MSDIT S5	R	ON	OFF	AV17
BV47	MSDIT S6	R	ON	OFF	AV17
BV48	MSDIT S7	R	ON	OFF	AV17
BV49	Drive Status	R	Running	Stopped	AV18
BV50	Zero Speed	R	YES	NO	AV18
BV51	Frequency Agree	R	Agree	Disagree	AV18
BV52	Desired Frequency Agree	R	Agree	Disagree	AV18
BV53	Frequency Detection 1	R	YES	NO	AV18
BV54	Frequency Detection 2	R	YES	NO	AV18
BV55	Drive Startup Completed	R	YES	NO	AV18
BV56	Low Voltage Detection	R	YES	NO	AV18
BV57	Baseblock	R	YES	NO	AV18
BV58	Frequency Reference Mode	R	Local	Communication	AV18
BV59	Run Command Mode	R	Local	Communication	AV18
BV60	Overtorque Detection	R	Fault	Normal	AV18
BV61	Frequency Reference Lost	R	Fault	Normal	AV18
BV62	Retrying Error	R	Fault	Normal	AV18
BV63	Error	R	Fault	Normal	AV18
BV64	MODBUS COMM Timeout	R	Fault	Normal	AV18
BV65	CRC Error	R	Fault	Normal	AV26
BV66	Invalid Data Length	R	Fault	Normal	AV26
BV67	Not Used	R			AV26
BV68	Parity Error	R	Fault	Normal	AV26
BV69	Overrun Error	R	Fault	Normal	AV26
BV70	Framing Error	R	Fault	Normal	AV26
BV71	Time Out	R	Fault	Normal	AV26

Table 4, BACnet Multi-State Variables (MV's)

BACnet Object	Object Name	R/W	State Text			
			0	1	2	3
MV1	Reference Operation Mode Select (b1-01)	W	Operator	Terminal	Serial	Option
MV2	Run Command Mode Select (b1-02)	W	Operator	Terminal	Serial	Option
MV3	Stop Mode Select (b1-03)	W	Ramp	Coast	DC Injection	Coast w/ Timer

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