Exhibit A-3
SOLE SOURCE FACILITY JUSTIFICATION TRANSMITTAL

Public Contract Code section 3400 provides, in pertinent part, that:

"(a) The Legislature finds and declares that it is the intent of this section to encourage contractors and manufacturers to develop and implement new and ingenious materials, products, and services that function as well, in all essential respects, as materials, products, and services that are required by a contract, but at a lower cost to taxpayers.

(b) No agency of the state, nor any political subdivision, municipal corporation, or district, nor any public officer or person charged with the letting of contracts for the construction, alteration, or repair of public works, shall draft or cause to be drafted specifications for bids, in connection with the construction, alteration, or repair of public works, (1) in a manner that limits the bidding, directly or indirectly, to any one specific concern, or (2) calling for a designated material, product, thing, or service by specific brand or trade name unless the specification is followed by the words "or equal" so that bidders may furnish any equal material, product, thing, or service. In applying this section, the specifying agency shall, if aware of an equal product manufactured in this state, name that product in the specification. Specifications shall provide a period of time prior to or after, or prior to and after, the award of the contract for submission of data substantiating a request for a substitution of "an equal" item. If no time period is specified, data may be submitted any time within 35 days after the award of the contract.

(c) Subdivision (b) is not applicable if the awarding authority, or its designee, makes a finding that is described in the invitation for bids or request for proposals that a particular material, product, thing, or service is designated by specific brand or trade name for any of the following purposes:

(2) In order to match other products in use on a particular public improvement either completed or in the course of completion."

Honeywell Spyder BACnet Programmable Controllers

This is a sole source procurement because:

- ☐ This is a sole provider of a licensed, copyrighted or patented good or service.
- ☑ This is a sole provider of items compatible with existing equipment or systems.
- ☐ This is a sole provider of factory-authorized warranty service.
- ☑ This is a sole provider of goods or services that perform a unique function in order to meet the specialized needs of the District. Please provide specific detail below.

  Honeywell Spyder BACnet Programmable Controllers and related family of unitary controllers provide flexible, free programmable demand led control to benefit the District energy management system. These programmable controllers provide seamless plug and play integration with the Honeywell JACE 8000 building controller while using the work bench field level software for its diagnostics and programming, the same software which is used with the Tridium IAS and the Honeywell JACE 8000 building controller.

☑ There are overriding circumstances upon which the Board can find that the exception found in Public Contract Code section 3400 (c) (2) applies to the identified product(s). Please provide specific detail below as to what those circumstances are, and why this sole source procurement would be in the best interest of the District.

The District's has maintained a very sophisticated HVAC energy management system over the last 26 years which uses field level controllers to maintain interior building temperatures. The risk factors and challenges stated below present overriding circumstances which would negate the benefit that any competitive bid could offer:

- Risk of comfort control within the campus building
- Lack of quality control as it relates to competitive products
- Potential for system incompatibility and/or failure to integrate with new Tridium Niagara 4 server level software, which has already been sole sourced
- Cost of removal, disassembly and replacement of existing serve and client level software
- Cost of additional training of staff and field level diagnosis equipment

What steps were taken to verify that these goods or services are not available elsewhere?

There are no other comparable programmable controllers which integrate with the existing building systems design developed by the District's building systems control consultants SC Engineering.

See Supplier and Contractor Information Page Below For Contact Details.

This is a restricted brand or trade name, and no substitutions are allowed because:

☑ The requested product is an integral repair part or accessory compatible with existing equipment or systems.

Existing Equipment/System: Programmable Controllers
Manufacturer/Model Number: Honeywell Spyder BACnet Programmable Controllers

☑ The District has standardized on the requested product, and use of another brand/model would require considerable time and funding to evaluate or implement. Please provide additional detail below.

From the advice of the District's building management controls consultant, SC Engineering, the District has standardized on Honeywell Spyder BACnet Programmable Controllers.

Supplier or Contractor Information:

Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422

Customer@honeywell.com
(877) 841-2840

RECOMMENDATION

Sufficient evidence has been provided upon which the Board can find that the exception found in Public Contract Code section 3400 (c) (2) applies to the identified product(s). Approve a finding to authorize use of the above stated exception for Honeywell Spyder BACnet Programmable Controllers in the MiraCosta Design Standards Manual for all the projects in the MM program. Require that said finding be included in all pertinent bid/proposal documents for those projects where such product(s) will be used.

SIGNATURE:

Tom Macias, Facilities Director	12/23/19 **Date**
Geoff Bachanas, PMO Director	12/18/19 **Date**

steinberg hart

Exhibit B-3
SOLE SOURCE ARCHITECT/ENGINEERING JUSTIFICATION SUMMARY REPORT TRANSMITTAL

December 20, 2019

Re: Honeywell Spyder BACnet Programmable Controller

Within the Design & Construction Standards MiraCosta CCD has identified or designed various proprietary systems or products that meet specific District performance requirements, allow for seamless integration into existing systems, provide ease of maintenance, and afford a lower total cost of ownership. In these instances, the District is requesting that these systems and products shall be provided without substitution. The following Specification Section 28 09 00 is one that meets these special requirements.

Our experience working with other Colleges and Universities shows that single sources for some materials, products, equipment, and systems is a common approach to achieving best value.

We have reviewed the facility justification transmittal for the above-referenced item and believe that the District's sole-sourcing of this specification section meets the requirements for District's benefit as described above.

Sincerely,

Rob Barthelman
Principal

Honeywell

Spyder® BACnet® Programmable Controllers

PRODUCT DATA

PRODUCT DESCRIPTION

The PUB and PVB controllers are part of the Spyder family. These controllers are BACnet MS/TP network devices designed to control HVAC equipment. These controllers provide many options and advanced system features that allow state-of-the-art commercial building control. Each controller is programmable and configurable through software.

The Spyder BACnet controllers require the Spyder BACnet Programmable Feature to be licensed in the WEBpro workbench tool and the WEBS AX JACE Controller for programming and downloading. The Spyder BACnet Models are also available as Individually Licensed Controllers (ILC). The ILC versions are identical in design and capability in every detail except for the licensing. The Individual Licensing of the Spyder ILCs (the License is built in) allows them to be programmed and downloaded with any brand of the Niagara Workbench or JACE controller. The Spyder ILCs are identified with a suffix on the Part Number of -ILC. Example: PUB6438S-ILC follows all the same Installation Instructions information as the PUB6438S.

These controllers are for use in VAV (Variable Air Volume), Unitary and advanced HVAC control applications. Each controller has flexible, universal inputs for external sensors, digital inputs, and a combination of analog and digital Triac outputs. All the models are described in Table 1. The photo to the left is the model PVB6436AS, which includes the actuator.

Table 1. Controller configurations.

Controller Model	Programmable Type	Universal Inputs (UI)	Digital Inputs (DI)	Analog Outputs (AO)	Digital Outputs (DO)	Velocity Pressure Sensor (Microbridge)	Series 60 Floating Actuator
PUB1012S	Unitary	1	0	1	2	NO	NO
PUB4024S	Unitary	4	0	2	4	NO	NO
PUB6438S	Unitary	6	4	3	8	NO	NO
PUB6438SR	Unitary	6	4	3	8 Relays	NO	NO
PVB0000AS	VAV	0	0	0	0	YES	YES
PVB4022AS	VAV	4	0	2	2	YES	YES
PVB4024NS	VAV	4	0	2	4	YES	NO
PVB6436AS	VAV	6	4	3	6	YES	YES
PVB6438NS	VAV	6	4	3	8	YES	NO

Each controller communicates via an EIA-485 BACnet MS/TP communications network, capable of baud rates between 9.6 and 115.2 kbits/s.
Controllers are field-mountable to either a panel or a DIN rail.

63-2689-07

SPECIFICATIONS

General Specifications

Rated Voltage: 20–30 Vac; 50/60 Hz
Power Consumption:
100 VA for controller and all connected loads (including the actuator on models PVB0000AS, PVB4022AS and PVB6436AS).
Controller Only Load: 5 VA maximum; models PUB1012S, PUB4024S, PUB6438S, PVB4024NS and PVB6438NS.
Controller and Actuator Load: 9 VA maximum; models PVB0000AS, PVB4022AS and PVB6436AS.
External Sensors Power Output: 20 Vdc ±10% @ 75 mA maximum.
VAV Operating & Storage Temperature Ambient Rating (models PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS):
Minimum 32 ⊠F (0 ⊠C); Maximum 122 ⊠F (50 ⊠C)
Unitary Operating & Storage Temperature Ambient Rating (models PUB1012S, PUB4024S and PUB6438S):
Minimum -40 ⊠F (-40 ⊠C); Maximum 150 ⊠F (65.5 ⊠C)
Relative Humidity: 5% to 95% non-condensing
LED: Provides status for normal operation, controller download process, alarms, manual mode, and error conditions

Velocity Pressure Sensor (models PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)

Operating Range: 0 to 1.5 in. H_2O (0 to 374 Pa)

Series 60 Floating Actuator (models PVB0000AS, PVB4022AS and PVB6436AS)

Rotation Stroke: 95° ± 3° for CW or CCW opening dampers
Torque Rating: 44 lb-in. (5 Nm)
Run Time for 90° rotation: 90 seconds at 60 Hz
Operating Temperature: -4 ⊠F to 140 ⊠F (-20 to 60 ⊠C)

Real Time Clock

Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic daylight savings time adjustment to occur at 2:00 a.m. local time on configured start and stop dates
Power Failure Backup: 24 hours at 32°F to 100°F (0°C to 38°C), 22 hours at 100°F to 122°F (38°C to 50°C)
Accuracy: ±1 minute per month at 77 °F (25 °C)

Digital Input (DI) Circuits

Voltage Rating: 0 to 30 Vdc open circuit
Input Type: Dry contact to detect open and closed circuit
Operating Range: Open circuit = False; Closed circuit = True
Resistance: Open circuit > 3,000 Ohms; Closed circuit < 500 Ohms

Digital Triac Output (DO) Circuits

Voltage Rating: 20 to 30 Vac @ 50/60Hz
Current Rating: 25 mA to 500 mA continuous, and 800 mA (AC rms) for 60 milliseconds

Digital Relay Output (DO) Circuits (PUB6438SR)

Voltage Rating: 20 to 30 Vac @ 50/60Hz
Current Rating: 0 mA to 1 A continuous, 3.5 A inrush (AC RMS) for 100 milliseconds

Analog Output (AO) Circuits

Analog outputs can be individually configured for current or voltage.

ANALOG CURRENT OUTPUTS:
Current Output Range: 4.0 to 20.0 mA
Output Load Resistance: 550 Ohms maximum

ANALOG VOLTAGE OUTPUTS:
Voltage Output Range: 0.0 to 10.0 Vdc
Maximum Output Current: 10.0 mA

Analog outputs may be configured as digital outputs and operate as follows:
- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc, (22 mA)

Universal Input (UI) Circuits

See Table 2 for the UI circuit specifications.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number. If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Environmental and Combustion Controls Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386
3. http://customer.honeywell.com or http://customer.honeywell.ca

International Sales and Service Offices in all principal cities of the world. Manufacturing in Belgium, Canada, China, Czech Republic, Germany, Hungary, Italy, Mexico, Netherlands, United Kingdom, and United States.

Table 2. Universal input circuit specifications.

Input Type	Sensor Type	Operating Range
Room/Zone Discharge Air Outdoor Air Temperature	20K Ohm NTC	-40 to 199 °F (-40 to 93 °C)
Outdoor Air Temperature	C7031G[a]	-40 to 120 °F (-40 to 49 °C)
	C7041F[a]	-40 to 250 °F (-40 to 121 °C)
	PT1000 (IEC751 3850)	-40 to 199 °F (-40 to 93 °C)
TR23 Setpoint Potentiometer	500 Ohm to 10,500 Ohm	-4° DDC to +4° DDC (-8° DDF to +7° DDF) or 50 F to 90 F (10 C to 32 C)
Resistive Input	Generic	100 Ohms to 100K Ohms
Voltage Input	Transducer, Controller	0–10 Vdc
Discrete Input	Dry Contact closure	Open Circuit > 3000 Ohms Closed Circuit < 3000 Ohms
Pulse Input[b]	Counter/ Meter	Max. frequency: 15 Hz Min. pulse width: 20 ms

[a] C7031G and C7041F are recommended for use with these controllers, due to improved resolution and accuracy when compared to the PT1000.

[b] One Universal Input (UI-1*) on the PUB1012S, PUB4042S, PVB4022AS, and PVB4042NS is user selectable as a fast digital pulse meter.

BEFORE INSTALLATION

The controller is available in three models (see Table 1).

Review the power, input, and output specifications on page 2 before installing the controller.

— Hardware driven by Triac outputs must have a minimum current draw, when energized, of 25 mA and a maximum current draw of 500 mA.

— Hardware driven by the analog current outputs must have a maximum resistance of 550 Ohms, resulting in a maximum voltage of 11 volts when driven at 20 mA. If resistance exceeds 550 Ohms, voltages up to 18 Vdc are possible at the analog output terminal.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or property damage.

Disconnect power supply before beginning wiring or making wiring connections to prevent electrical shock or equipment damage.

INSTALLATION

The controller must be mounted in a position that allows clearance for wiring, servicing, removal, connection of the BACnet MS/TP Molex connector and access to the MS/TP MAC address DIP switches (see Fig. 15 on page 15).

The controller may be mounted in any orientation.

IMPORTANT

Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the controller, or in areas where escaping gas or other explosive vapors are present. Fig. 6–Fig. 7 on page 6 for mounting dimensions.

For the PVB6436AS model, the actuator is mounted first and then the controller is mounted. For the other models, go to "Mount Controller" on page 5 to begin the installation.

Mount Actuator onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

PVB0000AS, PVB4022AS and PVB6436AS controllers include the direct-coupled actuator with Declutch mechanism, which is shipped hard-wired to the controller.

The actuator mounts directly onto the VAV box damper shaft and has up to 44 lb-in. (5 Nm) torque, 90-degree stroke, and 90 second timing at 60 Hz. The actuator is suitable for mounting onto a 3/8 to 1/2 in. (10 to 13 mm) square or round VAV box damper shaft. The minimum VAV box damper shaft length is 1-9/16 in. (40 mm).

The two mechanical end-limit set screws control the amount of rotation from 12° to 95°. These set screws must be securely fastened in place. To ensure tight closing of the damper, the shaft adapter has a total rotation stroke of 95° (see Fig. 1).

NOTES:

1. The actuator is shipped with the mechanical end-limit set screws set to 95 degrees of rotation. Adjust the two set screws closer together to reduce the rotation travel. Each "hash mark" indicator on the bracket represents approximately 6.5° of rotation per side.
2. The Declutch button, when pressed, allows you to rotate the universal shaft adapter (see Fig. 1).

IMPORTANT

Determine the damper rotation and opening angle prior to installation. See Fig. 2 below and Fig. 3 on page 4 for examples.

Fig. 1. Series 60 Floating Actuator.

Fig. 2. Damper with 90 degree CW rotation to open.

IMPORTANT

Mount actuator flush with damper housing or add a spacer between the actuator mounting surface and damper box housing.

Before Mounting Actuator onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

Tools required:
- Phillips #2 screwdriver - end-limit set screw adjustment
- 8 mm wrench - centering clamp

Before mounting the actuator onto the VAV box damper shaft, determine the following:

1. Determine the damper shaft diameter. It must be between 3/8 in. to 1/2 in. (10 to 13 mm).
2. Determine the length of the damper shaft. If the length of the VAV box damper shaft is less than 1-9/16 in. (40 mm), the actuator cannot be used.
3. Determine the direction the damper shaft rotates to open the damper (CW or CCW) (see Fig. 3). Typically, there is an etched line on the end of the damper shaft that indicates the position of the damper. In Fig. 2, the indicator shows the damper open in a CW direction.
4. Determine the damper full opening angle (45, 60, or 90 degrees). In Fig. 2, the damper is open to its full open position of 90 degrees.

Fig. 3. Determining the rotation direction (CW or CCW) for damper opening.

Mounting Actuator Onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

The unit is shipped with the actuator set to rotate open in the clockwise (CW) direction to a full 95 degrees. The extra 5 degrees ensures a full opening range for a 90 degree damper. The installation procedure varies depending on the damper opening direction and angle:

1. If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 90 degrees:
   a. Manually open the damper fully (rotate clockwise).
   b. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
   c. Mount the actuator to the VAV damper box and shaft.
   d. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque). When the actuator closes, the damper rotates CCW 90 degrees to fully close.
2. If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 45 or 60 degrees:
   a. Manually open the damper fully (rotate clockwise).
   b. The actuator is shipped with the mechanical end-limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
   c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; (26.5–31 lb-in. [3.0–3.5 Nm] torque).
   d. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
   e. Mount the actuator to the VAV damper box and shaft.

f. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque).
g. When the actuator closes, the damper rotates CCW either 45 or 60 degrees to fully close.

3. If the damper rotates counterclockwise (CCW) to open, and the angle of the damper open-to-closed is 90 degrees:
a. Manually open the damper fully (rotate counter-clockwise).
b. Using the Declutch button, rotate the universal shaft adapter fully counterclockwise.
c. Mount the actuator to the damper box and shaft.
d. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque). When the actuator closes, the damper rotates CW 90 degrees to fully close.

4. If the damper rotates counterclockwise to open, and the angle of the damper open-to-closed is 45 or 60 degrees:
a. Manually open the damper fully (rotate counter-clockwise).
b. The actuator is shipped with the mechanical end-limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; (26.5–31 lb-in. [3.0–3.5 Nm] torque).
d. Using the Declutch button, rotate the universal shaft adapter fully counter-clockwise.
e. Mount the actuator to the VAV damper box and shaft.
f. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque).
g. When the actuator closes, the damper rotates CW either 45 or 60 degrees to fully close.

IMPORTANT

Special precautions must be taken for dampers that open in a CCW direction. The actuator is shipped with its rotation direction set to CW to Open, which applies to the damper direction in steps 1 and 2 above. If the damper shaft rotates in the CCW direction to open, the controller software must be programmed to change the rotation to "Reverse to Open," which applies to the damper direction in steps 3 and 4 above.

IMPORTANT

It is advisable to leave the dampers in an open position after installation to avoid the possibility of over-pressurizing the duct work on fan startup. Use the Declutch button (see Fig. 1 on page 4) to open the box damper on controllers that are powered down, to prevent over-pressurization in the duct work on fan startup. To Declutch, press and hold the button to disengage the motor. Turn the damper shaft until the damper is open and release the button. When power is restored to the controller, the controller synchronizes the damper actuator, so that the damper is in the correct position upon startup.

Mount Controller

NOTE: The controller may be wired before mounting to a panel or DIN rail.

Terminal blocks are used to make all wiring connections to the controller. Attach all wiring to the appropriate terminal blocks (see "Wiring" on page 9).

Fig. 4. Panel mounting - controller dimensions in inches (mm) for PUB1012S, PUB4024S and PVB4024NS only (PUB4024S and PVB4024NS shown).

Fig. 5. Panel mounting - controller and actuator dimensions in inches (mm) for PVB0000AS and PVB4022AS only (PVB4022AS shown).

Fig. 6. Panel mounting - controller and actuator dimensions in inches (mm) for PVB6436AS.

Fig. 7. Panel mounting - controller dimensions in inches (mm) for models PUB6438S, PVB6438NS and PUB6438SR.

Panel Mounting

The controller enclosure is constructed of a plastic base plate and a plastic factory-snap-on cover.

NOTE: The controller is designed so that the cover does not need to be removed from the base plate for either mounting or wiring.

The controller mounts using four screws inserted through the corners of the base plate. Fasten securely with four No. 6 or No. 8 machine or sheet metal screws.

The controller can be mounted in any orientation. Ventilation openings are designed into the cover to allow proper heat dissipation, regardless of the mounting orientation.

DIN Rail Mounting (PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS)

To mount the PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS controllers on a DIN rail [standard EN50022; 1-3/8 in. x 9/32 in. (7.5 mm x 35 mm)], refer to Fig. 8 and perform the following steps:

1. Holding the controller with its top tilted in towards the DIN rail, hook the two top tabs on the back of the controller onto the top of the DIN rail.
2. Push down and in to snap the two bottom flex connectors of the controller onto the DIN rail.

IMPORTANT

To remove the controller from the DIN rail, perform the following:

1. *Push straight up from the bottom to release the top tabs.*
2. *Rotate the top of the controller out towards you and pull the controller down and away from the DIN rail to release the bottom flex connectors.*

Fig. 8. Controller DIN rail mounting (models PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS).

Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)

Air flow Pickup

For PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS, connect the air flow pickup to the two restrictor ports on the controller (see Fig. 9).

NOTES:

- Use 1/4 inch (6 mm) outside diameter, with a 0.040 in. (1 mm) wall thickness, plenum-rated 1219 FR (94V-2) tubing.
- Always use a fresh cut on the end of the tubing that connects to the air flow pickups and the restrictor ports on the controller.

Connect the high pressure or upstream tube to the plastic restrictor port labeled (+), and the low pressure or downstream tube to the restrictor port labeled (–). See labeling in Fig. 9. When twin tubing is used from the pickup, split the pickup tubing a short length to accommodate the connections.

NOTES:

- If controllers are mounted in unusually dusty or dirty environments, an inline, 5-micron disposable air filter (use 5-micron filters compatible with pneumatic controls) is recommended for the high pressure line (marked as +) connected to the air flow pickup.
- The tubing from the air flow pickup to the controller should not exceed three feet (0.914 m). Any length greater than this will degrade the flow sensing accuracy.
- Use caution when removing tubing from a connector. Always pull straight away from the connector or use diagonal cutters to cut the edge of the tubing attached to the connector. Never remove by pulling at an angle.

Fig. 9. Air flow pickup connections (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS).

Power

Before wiring the controller, determine the input and output device requirements for each controller used in the system. Select input and output devices compatible with the controller and the application. Consider the operating range, wiring requirements, and the environment conditions when selecting input/output devices. When selecting actuators for modulating applications consider using floating control. In direct digital control applications, floating actuators will generally provide control action equal to or better than an analog input actuator for lower cost.

Determine the location of controllers, sensors, actuators and other input/output devices and create wiring diagrams. Refer to Fig. 18–Fig. 24 beginning on page 17 for illustrations of typical controller wiring for various configurations.

The application engineer must review the control job requirements. This includes the sequences of operation for the controller, and for the system as a whole. Usually, there are variables that must be passed between the controller and other Spyder BACnet controller(s) that are required for optimum system wide operation. Typical examples are the TOD, Occ/Unocc signal, the outdoor air temperature, the demand limit control signal, and the smoke control mode signal.

It is important to understand these interrelationships early in the job engineering process, to ensure proper implementation when configuring the controllers. Refer to the controller Application Guides.

Power Budget

A power budget must be calculated for each device to determine the required transformer size for proper operation. A power budget is simply the summing of the maximum power draw ratings (in VA) of all the devices to be controlled. This includes the controller itself and any devices powered from the controller, such as equipment actuators (ML6161 or other motors) and various contactors and transducers.

IMPORTANT

- *When multiple controllers operate from a single transformer, connect the same side of the transformer secondary to the same power input terminal in each device. The earth ground terminal (terminal 3) must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10).*
- *Half-wave devices and full-wave devices must not use the same AC transformer. If a Spyder controller will share its power supply with another device, make sure the other device utilizes a half-wave rectifier and that the polarity of the wiring is maintained.*

POWER BUDGET CALCULATION EXAMPLE

Table 3 is an example of a power budget calculation for a typical PVB6436AS controller. While the example is shown for only this model, the process is applicable for all controller models.

Table 3. Power budget calculation example.

Device	VA Information	Obtained From
PVB6436AS controllers (include Series 60 Floating Damper Actuator)	9.0	See "Specifications" on page 2.
R8242A Contactor fan rating	21.0	TRADELINE® Catalog inrush rating
D/X Stages	0.0	For example, assume cooling stage outputs are wired into a compressor control circuit and have no impact on the budget.
M6410A Steam Heating Coil Valve	0.7	TRADELINE® Catalog, 0.32A 24 Vac
TOTAL	30.7	

The system example above requires 30.7 VA of peak power. Therefore, a 100 VA AT92A transformer could be used to power one controller of this type. Because the total peak power is less than 33 VA, this same transformer could be used to power three of these controllers and meet NEC Class 2 restrictions (no greater than 100 VA).

See Fig. 11–Fig. 12 beginning on page 10 for illustrations of controller power wiring. See Table 4 for VA ratings of various devices.

Table 4. VA ratings for transformer sizing.

Device	Description	VA
PVB6436AS controllers and Series 60 Floating Damper Actuator	Controller and Actuator	9.0
PUB6438S or PVB6438NS	Controller	5.0
ML684	Versadrive Valve Actuator	12.0
ML6161	Damper Actuator, 35 lb-in.	2.2
ML6185	Damper Actuator SR 50 lb-in	12.0
ML6464	Damper Actuator, 66 lb-in.	3.0
ML6474	Damper Actuator, 132 lb-in.	3.0
R6410A	Valve Actuator	0.7
R8242A	Contactor	21.0

For contactors and similar devices, the in-rush power ratings should be used as the worst case values when performing power budget calculations. Also, the application engineer must consider the possible combinations of simultaneously energized outputs and calculate the VA ratings accordingly. The worst case, which uses the largest possible VA load, should be determined when sizing the transformer.

Each controller requires 24 Vac power from an energy-limited Class II power source. To conform to Class II restrictions (U.S. only), transformers must not be larger than 100 VA. A single transformer can power more than one controller.

GUIDELINES FOR POWER WIRING ARE AS FOLLOWS:

- For multiple controllers operating from a single transformer, the same side of the transformer secondary must be connected to the same power input terminal in each device. The earth ground terminal must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10). Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only).
- See Fig. 11 on page 10 for controller power wiring used in UL 1995 equipment (U.S. only).
- Many controllers require all loads to be powered by the same transformer that powers the controller.
- Keep the earth ground connection wire run as short as possible (refer to Fig. 11–Fig. 12 beginning on page 10).
- Do not connect earth ground to the controller's digital or analog ground terminals (refer to Fig. 11 and Fig. 12).
- Unswitched 24 Vac power wiring can be run in the same conduit as the LONWORKS® Bus cable.

Line-Loss

Controllers must receive a minimum supply voltage of 20 Vac. If long power or output wire runs are required, a voltage drop due to Ohms Law (I x R) line-loss must be considered. This line-loss can result in a significant increase in total power required and thereby affect transformer sizing. The following example is an I x R line-loss calculation for a 200 ft. (61m) run from the transformer to a controller drawing 37 VA and using two 18 AWG (1.0 sq mm) wires.

The formula is:

Loss = [length of round-trip wire run (ft.)] x [resistance in wire (ohms per ft.)] x [current in wire (amperes)]

From specification data:

18 AWG twisted pair wire has a resistance of 6.52 ohms per 1000 feet.

Loss = [(400 ft.) x (6.52/1000 ohms per ft.)] x [(37 VA)/(24V)] = 4.02 volts

This means that four volts are going to be lost between the transformer and the controller. To assure the controller receives at least 20 volts, the transformer must output more than 24 volts. Because all transformer output voltage levels depend on the size of the connected load, a larger transformer outputs a higher voltage than a smaller one for a given load. Fig. 10 shows this voltage load dependence.

In the preceding I x R loss example, even though the controller load is only 37 VA, a standard 40 VA transformer is not sufficient due to the line-loss. Looking at Fig. 10, a 40 VA transformer is just under 100 percent loaded (for the 37 VA controller) and has a secondary voltage of 22.9 volts. (Use the lower edge of the shaded zone in Fig. 10 that represents the worst case conditions.) When the I x R loss of four volts is subtracted, only 18.9 volts reaches the controller. This is not enough voltage for proper operation.

In this situation, the engineer has three alternatives:

1. Use a larger transformer. For example, if an 80 VA model is used, an output of 24.4 volts, minus the four volt line-loss, supplies 20.4V to the controller (see Fig. 10). Although acceptable, the four-volt line-loss in this example is higher than recommended.

IMPORTANT

No installation should be designed where the line-loss is greater than two volts. This allows for nominal operation if the primary voltage drops to 102 Vac (120 Vac minus 15 percent).

2. Use heavier gauge wire for the power run. 14 AWG (2.0 sq mm) wire has a resistance of 2.57 ohms per 1,000 ft. Using the preceding formula results in a line-loss of only 1.58 volts (compared with 4.02 volts). This would allow a 40 VA transformer to be used. 14 AWG (2.0 sq mm) wire is the recommended wire size for 24 Vac wiring.
3. Locate the transformer closer to the controller. This reduces the length of the wire run, and the line-loss.

The issue of line-loss is also important in the case of the output wiring connected to the Triac digital outputs. The same formula and method are used. Keep all power and output wire runs as short as practical. When necessary, use heavier gauge wire, a bigger transformer, or install the transformer closer to the controller.

To meet the National Electrical Manufacturers Association (NEMA) standards, a transformer must stay within the NEMA limits. The chart in Fig. 10 shows the required limits at various loads.

With 100 percent load, the transformer secondary must supply between 23 and 25 volts to meet the NEMA standard. When a purchased transformer meets the NEMA standard DC20-1986, the transformer voltage regulating ability can be considered reliable. Compliance with the NEMA standard is voluntary.

Fig. 10. NEMA Class 2 transformer voltage output limits.

The Honeywell transformers listed in Table 5 meet the NEMA standard DC20-1986.

Table 5. Honeywell transformers that meet NEMA standard DC20-1986.

Transformer Type	VA Rating
AT40A	40
AT72D	40
AT87A	50
AK3310 Assembly	100

NOTE: The AT88A and AT92A transformers do not meet the voluntary NEMA standard DC20-1986.

Wiring

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located on the top and the bottom of the device.

⚠ WARNING

Electrical Shock Hazard.

Can cause severe injury, death or property damage.

Disconnect power supply before beginning wiring or making wiring connections, to prevent electrical shock or equipment damage.

NOTES:

— For multiple controllers operating from a single transformer, the same side of the transformer secondary must be connected to the same power input terminal in each controller. Controller configurations will not necessarily be limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only). For power and wiring recommendations, See "Power" on page 7. The earth ground terminal (terminal 3) must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10).

- All loads on the controller must be powered by the same transformer that powers the controller itself. A controller can use separate transformers for controller power and output power.
- Keep the earth ground connection (terminal 3) wire run as short as possible.
- Do not connect the universal input COM terminals, analog output COM terminals or the digital input/output COM terminals to earth ground. Refer to Fig. 17–Fig. 22 beginning on page 16 for wiring examples.

The 24 Vac power from an energy limited Class II power source must be provided to the controller. To conform to Class II restrictions (U.S. only), the transformer must not be larger than 100 VA.

Fig. 11 depicts a single controller using one transformer.

IMPORTANT

Power must be off prior to connecting to or removing connections from the 24 Vac power (24 Vac/24 Vac COM), earth ground (EGND), and 20 Vdc power (20 Vdc) terminals.

IMPORTANT

Use the heaviest gauge wire available, up to 14 AWG (2.0 sq mm), with a minimum of 18 AWG (1.0 sq mm), for all power and earth ground wiring.

Screw-type terminal blocks are designed to accept up to one 14 AWG (2.0 sq mm) conductor or up to two 18 AWG (1.0 sq mm) conductors. More than two wires that are 18 AWG (2.0 sq mm) can be connected with a wire nut. Include a pigtail with this wire group and attach the pigtail to the terminal block.

IMPORTANT

Connect terminal 2, (the 24 Vac common [24 VAC COM] terminal) to earth ground (see Fig. 11).

NOTE: Unswitched 24 Vac power wiring can be run in the same conduit as the LONWORKS® cable.

Fig. 11. Power wiring details for one controller per transformer.

More than one controller can be powered by a single transformer. Fig. 12 shows power wiring details for multiple controllers.

NOTE: Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only). For power wiring recommendations, see "Power" on page 7.

Fig. 12. Power wiring details for two or more controllers per transformer.

Communications

Each controller uses a BACnet MS/TP communications port. The controller's data is presented to other controllers over a twisted-pair MS/TP network, which uses the EIA-485 signaling standard capable of the following baud rates: 9.6, 19.2, 38.4, 76.8 or 115.2 kilobits per second (configured at global controller). The Spyder BACnet controllers are master devices on the MS/TP network. Each Spyder BACnet controller uses a high-quality EIA-485 transceiver and exerts 1/4 unit load on the MS/TP network.

Cabling should be selected that meets or exceeds the BACnet Standard which specifies the following: An MS/TP EIA-485 network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 130 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot). Distributed capacitance between conductors and shield shall be less that 200 pF per meter (60 pF per foot). Foil or braided shields are acceptable. The Honeywell tested and recommended MS/TP cable is Honeywell Cable 3322 (18 AWG, 1-Pair, Shielded, Plenum cable), alternatively Honeywell Cable 3251 (22 AWG, 1-Pair, Shielded, Plenum cable) is available and meets the BACnet Standard requirements (www.honeywellcable.com).

The maximum BACnet MS/TP network Bus segment length is 4,000 ft. (1,219 m) using recommended wire. Repeaters must be used when making runs longer than 4,000 ft. (1,219 m). A maximum of three repeaters can be used between any two devices.

Setting the MS/TP MAC address

The MS/TP MAC address for each device must be set to a unique value in the range of 0-127 on an MS/TP network segment (address 0, 1, 2, & 3 should be avoided as they are commonly used for the router, diagnostic tools, and as spare addresses). DIP switches on the Spyder BACnet controller are used to set the controller's MAC address.

To set the MS/TP MAC address of a Spyder BACnet controller:

1. Find an unused MAC address on the MS/TP network to which the Spyder BACnet controller connects.
2. Locate the DIP switch bank on the Spyder BACnet for addressing. This is labeled MAC Address
3. With the Spyder BACnet Controller powered down, set the DIP switches for the MAC Address you want. Add the value of DIP switches set to ON to determine the MAC address. See Table 6. Example, if only DIP switches 1, 3, 5, and 7 are enabled the MAC address would be 85
   (1 + 4 + 16 + 64 = 85).

   NOTE: See Fig. 15 on page 15 for DIP switch orientation and arrangement.

Table 6. DIP Switch Values For MS/TP MAC Address.

DIP	7	6	5	4	3	2	1
VALUE	64	32	16	8	4	2	1

Setting the Device Instance Number

The Device Instance Number must be unique across the entire BACnet system network because it is used to uniquely identify the BACnet devices. It may be used to conveniently identify the BACnet device from other devices during installation. The Spyder BACnet Controllers Device Instance Number is automatically set when it is added to a WEBStation-AX project. The Device Instance Number can be changed by the user, which may be necessary when integrating with a third party or when attempting to replace an existing controller and it is desired to maintain the existing Device Instance Number.

To edit the Device Instance Number using WEBs AX:

1. Identify an unused Device Instance Number on the BACnet Network, in the range of 0 - 4194302.
2. Open the Spyder Bacnet Device Mgr View
   a. Double click on the BacnetNetwork located in the Nav tree.
   b. Select the Spyder Controller to be modified.
   c. Click on the Edit button.
   d. Enter an unused value in the Device Id field.
   e. Select OK
3. Right Click on the Spyder Controller and select Actions > Write Device Instance to complete the update

Termination Resistors

Matched terminating resistors are required at each end of a segment bus wired across (+) and (-). Use matched precision resistors rated 1/4W ±1% / 80 - 130 Ohms. Ideally, the value of the terminating resistors should match the rated characteristic impedance of the installed cable. For example, if the installed MS/TP cable has a a listed characteristic impedance of 120 Ohm, install 120 Ohm matched precision resistors.

NOTE: The controller does not provide any network biasing.

Shield Terminating

Following proper MS/TP cabling shield grounding procedures is important to minimize the risk of communication problems and equipment damage caused by capacitive coupling. Capacitive coupling is caused by placing MS/TP cabling close to lines carrying higher voltage. The shield should be grounded on only one end of the MS/TP segment (typically the router end). Tie the shield through using the SHLD (terminal 4) on the Spyder BACnet Controller.

Sylk™ Bus

Sylk is a two wire, polarity insensitive bus that provides both 18 VDC power and communications between a Sylk-enabled sensor and a Sylk-enabled controller. Using Sylk-enabled sensors saves I/O on the controller and is faster and cheaper to install since only two wires are needed and the bus is polarity insensitive. Sylk sensors are configured using the latest release of the Spyder Tool for WEBPro and WEBStation.

Fig. 13. Termination modules.

Wiring Method

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning wiring, or making wiring connections, to prevent electrical shock or equipment damage.

NOTE: When attaching two or more wires to the same terminal, other than 14 AWG (2.0 sq mm), be sure to twist them together. Deviation from this rule can result in improper electrical contact (see Fig. 14).

Each terminal can accommodate the following gauges of wire:
- Single wire: from 22 AWG to 14 AWG solid or stranded
- Multiple wires: up to two 18 AWG stranded, with 1/4 watt wire-wound resistor

Prepare wiring for the terminal blocks, as follows:
1. Strip 1/2 in. (13 mm) insulation from the conductor.
2. Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
3. If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them (see Fig. 14).
4. Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
5. Pull on each wire in all terminals to check for good mechanical connection.

Fig. 14. Attaching two or more wires at terminal blocks.

Wiring Details

Each controller is shipped with the digital outputs, which switch the 24 Vac to the load (High Side).

The three analog outputs (AO) are used to control modulating heating, cooling and economizer equipment. Any AO may be used as a digital output, as follows:
- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc (22 mA)

The wiring connection terminals described in Tables 7 and 8 are shown in Fig. 15 and Fig. 16 starting on page 15.

Table 7. Description of wiring terminal connections for PUB6438S, PUB6438SR, PVB6436AS, and PVB6438NS.

Terminal	Label	Connection
INPUT POWER & GROUND		
1	24 Vac	24 Vac Power
2	24 Vac COM	24 Vac Power
3	EGND	Earth Ground
4	SHLD	MS/TP Shield
5	SBUS 1	Sylk
6	SBUS 2	Sylk
NETWORK CONNECTIONS		
7	BAC +	BACnet communications
8	BAC -	BACnet communications
DIGITAL OUTPUTS[a]		
9	DO-1	Digital Output
10	DO-2	Digital Output
11	COM	Common
12	DO-3	Digital Output
13	DO-4	Digital Output
14	COM	Common
15	DO-5	Digital Output
16	DO-6	Digital Output
17	COM	Common
18	DO-7	Digital Output
19	DO-8	Digital Output
20	COM	Common
ANALOG OUTPUTS[b]		
21	AO-1	Analog Output
22	COM	Common
23	AO-2	Analog Output
24	AO-3	Analog Output
25	COM	Common
DIGITAL INPUTS[c]		
26	DI-1	Digital Input
27	DI-2	Digital Input
28	COM	Common
29	DI-3	Digital Input
30	DI-4	Digital Input
ATTACHED DEVICE(S) POWER		
31	20 Vdc	20 Vdc Power
UNIVERSAL INPUTS		
32	UI-1	Universal Input
33	COM	Common
34	UI-2	Universal Input
35	UI-3	Universal Input
36	COM	Common
37	UI-4	Universal Input
38	UI-5	Universal Input
39	COM	Common
40	UI-6	Universal Input

[a] For the PVB6436AS controller ONLY, terminals 18, 19, and 20 (DO7, DO8, & COM) are not present. The actuator is internally hardwired to these terminals.

[b] Analog outputs may be configured as digital outputs and operate as follows:
– False (0%) produces 0 Vdc, (0 mA)
– True (100%) produces the maximum 11 Vdc (22 mA)

[c] Digital inputs: Open circuit = False; Closed circuit = True

Table 8. Description of wiring terminal connections for PUB1012S, PUB4024S, PVB0000AS, PVB4022AS, PVB4024NS.

Terminals, PUB4024S, PVB4024NS	Terminals, PVB4022AS	Terminals, PUB1012S	Terminals, PVB0000AS	Label	Connection
INPUT POWER & GROUND					
1	1	1	1	24VAC	24 Vac Power
2	2	2	2	24VAC COM	24 Vac Power
3	3	3	3	EGND	Earth Ground
4	4	4	4	20VDC	20 Vdc Power
5	5	5	5	S-BUS	Sylk
6	6	6	6	S-BUS	Sylk
NETWORK CONNECTIONS					
7	7	7	7	BAC+	BACnet communication
8	8	8	8	BAC-	BACnet communication
9	9	9	9	SHIELD	Shield
DIGITAL OUTPUTS[b]					
10	NA[a]	NA	NA	DO-3	Digital Output
11	NA	NA	NA	COM	Common
12	NA[a]	NA	NA	DO-4	Digital Output
13	13	13	NA	DO-2	Digital Output
14	14	14	NA	COM	Common
15	15	15	NA	DO-1	Digital Output
ANALOG OUTPUTS[c]					
16	16	NA	NA	AO-2	Analog Output
17	17	17	NA	COM	Common
18	18	18	NA	AO-1	Analog Output
UNIVERSAL INPUTS					
19	19	NA	NA	UI-4	Universal Input
20	20	NA	NA	COM	Common
21	21	NA	NA	UI-3	Universal Input
22	22	NA	NA	UI-2	Universal Input
23	23	23	NA	COM	Common
24	24	24	NA	UI-1[d]	Universal Input

[a] For the PVB0000AS and PVB4022AS controllers, DO3 and DO4 are internally hardwired to the actuator.

[b] Digital outputs: Open circuit = False; Closed circuit = True

[c] Analog outputs may be configured as digital outputs and operate as follows:
- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc (22 mA)

[d] UI-1* is a hybrid input. It can be configured as either a DI (fast digital pulse meter) or a UI.

IMPORTANT

If the controller is not connected to a good earth ground, the controller's internal transient protection circuitry is compromised and the function of protecting the controller from noise and power line spikes cannot be fulfilled. This could result in a damaged circuit board and require replacement of the controller. Refer to installation diagrams for specific wiring.

All controllers have the terminal arrangements similar to the examples shown in Fig. 15 and 16 as described in Table 7 on page 13 and Table 8 on page 14.

MS/TP MAC ADDRESS DIP SWITCHES

The MS/TP MAC address DIP switches are used to set the unit's MAC address. Each Spyder BACnet on an MS/TP network must have a unique MAC address in the range of 0-127 (address 0 should be avoided as it is the Honeywell factory default MAC address for all MS/TP devices).

MS/TP SERVICE CONNECTOR PINS

Local device MS/TP network connection is provided via the molex connector pins (0.100-in. molex connector—part number: 22-01-2035).

Fig. 15. Controller Terminal Connections, MS/TP MAC address DIP switches, MS/TP service connector pins, and BACnet Status LED for the PUB's and PVB's (PVB6438NS shown).

Fig. 16. Controller Terminal Connections (PUB4024S shown).

Wiring Applications (Examples)

Fig. 17–Fig. 23, beginning on page 16, illustrate controller wiring for the following configurations.

- Typical controller wiring for VAV application using the TR23 Wall Module and a C7770A Air Temperature Sensor (see Fig. 17 on page 16).
- Typical controller wiring for VAV application with staged reheat (see Fig. 18 on page 17).
- Typical controller wiring for PWM reheat and PWM peripheral heat valve actuator (see Fig. 19 on page 18).
- Typical controller wiring for AHU application (see Fig. 20 on page 19).
- Typical controller wiring for 4 to 20 mA enthalpy sensors and digital inputs (see Fig. 21 on page 20).
- Typical controller wiring for 4 to 20 mA heating, cooling, and model ML6161 floating motor control (see Fig. 22 on page 21).
- Typical controller wiring for a pneumatic transducer, model RP7517B (see Fig. 23 on page 22).

1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.

2 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.

3 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

Fig. 17. Controller wiring diagram (model PVB6438NS shown) for typical VAV application, using the TR23 wall module and a C7770A air temperature sensor. (For note 2, refer to Fig. 14.)

Fig. 18. Controller wiring diagram (model PVB6436AS shown) for typical VAV application with staged reheat. (For note 2, refer to Fig. 14.)

1 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.

2 TURN POWER OFF BEFORE SETTING THE DIP SWITCHES.

3 MAKE SURE ALL TRANSFORMER/POWER WIRING IS AS SHOWN: REVERSING TERMINATIONS WILL RESULT IN EQUIPMENT MALFUNCTION.

Fig. 19. Controller wiring diagram (model PUB6438S shown) for typical PWM reheat and PWM peripheral heat valve actuator. (For note 2, refer to Fig. 14.)

NOTE: Make sure to set the Configuration DIP Switch as shown in Fig. 19. Switches 1 through 3 set the timing of the ML7984B valve actuator to match the controller outputs (0.1 second minimum with a maximum time of 25.6 seconds). Switch 4 determines the action of the actuator (Off = Direct Acting, On = Reverse Acting).

Fig. 20. Controller wiring diagram (model PUB6438S shown) for typical AHU application. (For note 2, refer to Fig. 14.)

Fig. 21. Controller wiring diagram (model PUB6438S shown) with 4 to 20 mA enthalpy sensors and digital inputs. (For note 2, refer to Fig. 14.)

1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.

2 EARTH GROUND WIRE LENGTH SHOULD BE HELD TO A MINIMUM. USE THE HEAVIEST GAUGE WIRE AVAILABLE, UP TO 14 AWG (2.0 MM²) WITH A MINIMUM OF 18 AWG (1.0 MM²), FOR EARTH GROUND WIRE.

3 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.

4 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

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Fig. 22. Controller wiring diagram (model PUB6438S shown) with 4 to 20 mA heating, cooling, and model ML6161 damper actuator. (For note 2, refer to Fig. 14.)

Fig. 23. Controller wiring diagram (model PUB6438S shown) for RP7517B pneumatic transducer.

CHECKOUT

Step 1. Check Installation and Wiring

Inspect all wiring connections at the controller terminals, and verify compliance with installation wiring diagrams. If any wiring changes are required, *first* be sure to remove power from the controller *before* starting work. Pay particular attention to:

- 24 Vac power connections. Verify that multiple controllers being powered by the same transformer are wired with the transformer secondary connected to the same input terminal numbers on each controller. Use a meter to measure 24 Vac at the appropriate terminals (see Fig. 12 on page 10). Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only).
- Be sure that each controller has terminal 3 wired to a verified earth ground, using a wire run as short as possible with the heaviest gauge wire available, up to 14 AWG (2.0 sq mm) with a minimum of 18 AWG (1.0 sq mm) for each controller in the group (see Fig. 12 on page 10).
- Check that the MS/TP network polarity has been connected properly on each controller. BACnet MS/TP is polarity sensitive; communication will be lost for the entire segment if one controller is connected improperly (see Fig. 13 on page 12).
- Verify that Triac wiring of the digital outputs to external devices uses the proper load power and 24 Vac common terminal (digital output common terminals) for High-Side switching.

NOTE: All wiring must comply with applicable electrical codes and ordinances or as specified on installation wiring diagrams.

For guidelines for wiring run lengths and power budget, see "Power" on page 7.

VERIFY END-OF-LINE TERMINATION RESISTOR PLACEMENT

The installation wiring diagrams should indicate the locations for placement of the end of line termination resistors. See Fig. 13 on page 12.

Correct placement of the end-of-line termination resistors is required for proper LONWORKS® Bus communications.

Step 2. Startup

Refer to Fig. 24 and the following text for startup information.

Fig. 24. LED, service, and network connection locations.

SET THE MS/TP MAC ADDRESS

The MS/TP MAC address DIP switches are used to set the unit's MAC address. Each Spyder BACnet on an MS/TP network must have a unique MAC address in the range of 0-127 (address 0 should be avoided as it is the Honeywell factory default MAC address for all MS/TP devices).

CONTROLLER STATUS LED:

The LED on the front of the controller provides a visual indication of the status of the device. When the controller receives power, the LED appears in one of the following allowable states, as described in Table 9.

Table 9. Status LED States.

LED State	Blink Rate	Status or Condition
OFF	Not applicable	No power to processor, LED damaged, low voltage to board, first second of power up or loader damaged.
ON	ON steady; not blinking	Processor not operating. Application Program CRC being checked. This takes 1-2 seconds and occurs on each restart (power up, reset and reflash, and following configuration file download).
Very Slow Blink (continuous)	1 second ON, 1 second OFF	Controller is operating normally.
Slow Blink (continuous)	0.5 second ON, 0.5 second OFF	Controller alarm is active or controller in process of configuration file download.
Medium Blink (continuous)	0.3 second ON, 0.3 second OFF	Controller is in reflash mode or awaiting/receiving reflash data via the BACnet network.

BACNET STATUS LED:
The LED on the front of the controller, between the BACnet MS/TP terminals and MAC Address DIP Switches, provides a visual indication of the BACnet MS/TP communication status. When the controller receives power, the LED appears in one of the following allowable states, as described in Table 10.

Table 10. BACnet Status LED States.

BACnet LED Status	Status or Condition
Solid on	Controller has power, loader is not running.
Solid on, blinking off once in 2.5 sec.	Controller is in reflash mode, no MS/TP communication.
Solid on, blinking off twice in 2.5 sec.	Controller is in reflash mode, MS/TP communication present.
Solid on, blinking off thrice in 2.5 sec	Controller is in reflash mode, MS/TP communication data transfer in progress.
Solid off, there is no power	No power to processor, LED damaged, low voltage to board, or loader damaged.
Solid off, blinking on once in 2.5 sec.	Controller is running, no MS/TP communication.
Solid off, blinking on twice in 2.5 sec.	Controller is running, MS/TP communication present.
Solid off, blinking on thrice in 2.5 sec	Controller is running, MS/TP communication data transfer in progress.

Step 3. Checkout Completion

At this point the controller is installed and powered. To complete the checkout, the NIAGARA FRAMEWORK® application (run on a PC) is used to configure the I/O and functions of the controller. Refer to the Programming Tool User Guide, form no. 63-2662, for controller configuration and programming details.

CONTROLLER REPLACEMENT

There are no serviceable or repairable parts inside the controller.

⚠ WARNING
Fire, Explosion, or Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Do not attempt to modify the physical or electrical characteristics of this device in any way. Replace the controller if troubleshooting indicates a malfunction.

⚠ WARNING
Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning controller replacement to prevent electrical shock or equipment damage.

Terminal Block Removal

To simplify controller replacement, all terminal blocks are designed to be removed with the wiring connections intact and then re-installed on the new controller. See Fig. 25 and refer to the following procedure:

IMPORTANT

To prevent bending or breaking the alignment pins on longer terminal blocks, insert the screwdriver at several points to evenly and gradually lift up the terminal block.

Insert the screwdriver blade no more than 1/8 in. (3 mm) to prevent damage to the terminal block alignment pins on the controller circuit board.

Fig. 25. Removing Terminal Blocks.

1. Use a thin-bladed screwdriver to evenly raise the terminal block from its alignment pins:
   a. For short terminal blocks (1 to 5 terminals), insert screwdriver blade in the center of the terminal block and use a back and forth twisting motion to gently raise the terminal block from its alignment pins 1/4 in. (6.35 mm).
   b. For long terminal blocks (6 or more terminals), insert screwdriver blade on one side of the terminal block and gently rotate the blade 1/4 turn. Then, move to the other side of the terminal block and do the same. Repeat until the terminal block is evenly raised 1/4 in. (6.35 mm) from its alignment pins.

2. Once the terminal block is raised 1/4 in. (6.35 mm) from its alignment pins, grasp the terminal block at its center (for long terminal blocks grasp it at each end) and pull it straight up.

Controller Replacement (PVB0000AS, PVB4022AS and PVB6436AS)

For PVB0000AS, PVB4022AS and PVB6436AS controllers, which are hard-wired to an actuator, perform the following actions to replace the complete assembly (controller and actuator):

1. Remove all power from the controller.
2. Remove the two air flow pickup connections from the pressure sensor.
3. Remove the terminal blocks (See "Terminal Block Removal").
4. Remove the old controller and actuator assembly from its mounting.
   - Loosen the two bolts on the actuator clamp to release the actuator from the shaft.
   - Remove the controller's mounting screws.
   - Gently pull the controller and actuator assembly straight out, until the assembly is clear of the actuator shaft.
5. Mount the new controller and actuator assembly (See "Installation" on page 3.).
6. Reconnect the two air flow pickup tubes to the pressure sensor (See "Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)" on page 7.).
7. Replace the terminal blocks:
   - Insert each terminal block onto its alignment pins.
   - Press straight down to firmly seat it.
   - Repeat for each terminal block.
8. Restore power to the controller.
9. Perform "Checkout" on page 22.

Controller Replacement (PVB4024NS and PVB6438NS)

Perform the following to replace the PVB4024NS and PVB6438NS controllers:

1. Remove all power from the controller.
2. Remove the two air flow pickup connections from the pressure sensor.
3. Remove the terminal blocks.
   - See "Terminal Block Removal" on page 23.
4. Remove the old controller from its mounting.

IMPORTANT
(FOR CONTROLLERS MOUNTED TO A DIN RAIL):

1. *Push straight up from the bottom to release the top pins.*
2. *Rotate the top of the controller outwards to release the bottom flex connectors (see Fig. 8 on page 7).*

5. Mount the new controller.
   - See "Installation" on page 3.
6. Reconnect the two air flow pickup tubes to the pressure sensor (See "Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)" on page 7.).
7. Replace the terminal blocks:
   - Insert each terminal block onto its alignment pins.
   - Press straight down to firmly seat it.
   - Repeat for each terminal block.
8. Restore power to the controller.
9. Perform "Checkout" on page 22.

Controller Replacement (PUB1012S, PUB4024S, PUB6438S and PUB6438SR)

Perform the following to replace the PUB1012S, PUB4024S PUB6438S and PUB6438SR controllers:

1. Remove all power from the controller.
2. Remove the terminal blocks (See "Terminal Block Removal" on page 23.).
3. Remove the old controller from its mounting.

IMPORTANT
(FOR CONTROLLERS MOUNTED TO A DIN RAIL):

1. *Push straight up from the bottom to release the top pins.*
2. *Rotate the top of the controller outwards to release the bottom flex connectors (see Fig. 8 on page 7).*

4. Mount the new controller. (See "Installation" on page 3.)
5. Replace the terminal blocks:
   - Insert each terminal block onto its alignment pins.
   - Press straight down to firmly seat it.
   - Repeat for each terminal block.
6. Restore power to the controller.
7. Perform "Checkout" on page 22.

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