Spyder® BACnet®
Programmable Controllers

APPLICATION

The PUB and PVB controllers are part of the Spyder family. The nine 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 using the NIAGARA FRAMEWORK® 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.

The controllers are for use in VAV (Variable Air Volume), Unitary, and advanced HVAC control applications. Each controller contains a host microcontroller to run the main HVAC application and a second microcontroller for BACnet MS/TP network communications. Each controller provides flexible, universal inputs for external sensors, digital inputs, and a combination of analog outputs and digital outputs.

The photo shown is the PVB6436AS, which includes the Series 60 floating actuator.

FEATURES

- Uses BACnet MS/TP network communication.
- EIA-485 communications network. Capable of baud rates between 9.6 and 115.2 kbits/s.
- Capable of stand-alone operation, but can also use BACnet MS/TP network communications.
- Sylk™ bus for use with Sylk-enabled sensors.
- Support for up to 40 controllers per BACnet MS/TP segment (under 30 is recommended).
- Field configurable and programmable for control, input, and output functions using the NIAGARA FRAMEWORK® software.
- Function Block engine, which allows the application designer to program the controller to perform a wide variety of HVAC applications.
- Built-in Zone Control functions include a remote wall module interface and a scheduler.
- Pressure-independent or pressure-dependent single or dual duct Variable Air Volume (VAV) control as well as Unitary equipment control.
- Microbridge air flow sensor with dual integral restriction design (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS, and PVB6438NS).
- Easy user access to air flow sensor inputs.
- Actuator (PVB0000AS, PVB4022AS, and PVB6436AS) mounts directly onto VAV box damper shaft and has up to 44 lb-in. (5 Nm) torque, 90-degree stroke, and 90 second timing at 60 Hz.
- All wiring connections are made to removable terminal blocks to simplify controller installation and replacement.
- Both controller housing and actuator are UL plenum rated.
DESCRIPTION

The programmable VAV/Unitary controllers are available in three models, as described in Table 1.

Table 1. Controller Configurations.

<table>
<thead>
<tr>
<th>Controller Model</th>
<th>Programmable Type</th>
<th>UI (Universal Input)</th>
<th>DI (Digital Input)</th>
<th>AO (Analog Output)</th>
<th>DO (Digital Output)</th>
<th>Velocity Pressure Sensor (Microbridge)</th>
<th>Series 60 Floating Actuator</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUB1012S</td>
<td>Unitary</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PUB4024S</td>
<td>Unitary</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PUB6438S</td>
<td>Unitary</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PUB6438SR</td>
<td>Unitary</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>8 Relays</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PVBO0000AS</td>
<td>VAV</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>PVBO222AS</td>
<td>VAV</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>PVBO424NS</td>
<td>VAV</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>PVBO436AS</td>
<td>VAV</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>PVBO638NS</td>
<td>VAV</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>


Each controller is programmable because the user chooses which function blocks to use and how to connect them. It is configurable because each Function Block has user-defined behavior.

The PUB6436AS and PUB6438NS models are Variable Air Volume (VAV) controllers, and the PUB6438S and PUB6438SR models are Unitary controllers.

VAV Equipment Control (PVBO000AS, PVBO222AS, PVBO424NS, PVBO436AS, and PVBO638NS)

The VAV controllers provide pressure-independent air flow control and pressure-dependent damper control. VAV systems generally provide cool air only to zones. However, each controller has additional programmable inputs and outputs that may be used to control devices, such as a fan or VAV box reheat coils. Heaters can be staged electric or modulating hot water. Supply and exhaust pressurization control are provided on a zone basis.

Unitary Equipment Control (PUB1012S, PUB4024S, PUB6438S, and PUB6438SR)

Unitary equipment includes natural convection units, radiant panels, unit heaters, unit ventilators, fan coil units, and heat pumps. Unitary equipment does not require a central fan. Depending on design, unitary equipment may perform one or all of the functions of HVAC—ventilation, filtration, heating, cooling, humidification and distribution. Unitary equipment frequently requires a distribution system for steam or hot and/or chilled water.

SPECIFICATIONS

Electrical

Rated Voltage: 20-30 Vac; 50/60 Hz
Power Consumption:
- 100 VA for controller and all connected loads (including the actuator on model PVBO6436AS)
- Controller only Load: 5 VA maximum; models PVBO6438NS, PUB6438S, and PUB6438SR
- Controller and Actuator Load: 9 VA maximum; model PVBO6436AS
External Sensors Power Output: 20 Vdc ±10% @ 75 mA maximum

Environmental

VAV Operating & Storage Temperature Ambient Rating (models PVBO000AS, PVBO222AS, PVBO424NS, PVBO436AS, and PVBO638NS):
- Minimum 32° F (0° C); Maximum 122° F (50° C)

Unitary Operating & Storage Temperature Ambient Rating (models PUB1012S, PUB4024S, PUB6438S, and PUB6438SR):
- Minimum -40° F (-40° C); Maximum 150° F (65.5° C)

Relative Humidity: 5% to 95% non-condensing

Dimensions (H/W/D)

See Fig. 1 to Fig. 4 beginning on page 6 for dimensioned drawings.

PUB1012S, PUB4024S, and PUB4024NS: 6.25 x 4.81 x 2.26 in. (15.92 x 12.20 x 5.74 cm)

PVBO000AS, PVBO222AS (including Actuator): 6.60 x 8.28 x 2.26 in. (16.70 x 21.10 x 5.74 cm)

PVBO638AS (including Actuator): 6.17 x 10.316 x 2.26 in. (15.92 x 26.20 x 5.74 cm)

PVBO638NS: 5.76 x 6.85 x 2.26 in. (14.62 x 17.40 x 5.74 cm)

PUB6438S, PUB6438SR: 5.45 x 6.85 x 2.26 in. (13.84 x 17.40 x 5.74 cm)
Approval Bodies
UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
CSA (LR95329-3) listed.
Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
Meets Canadian standard C108.8 (radiated emissions).
EMC Directive: 2014/30/EU:
Standards Applied:
— IEC 61000-4-8:2009
— IEC 61000-4-11:2004
RoHS Directive: 2011/65/EU
Standards Applied:
— EN 50581: 2012
BTL B-ASC (BACnet Testing Laboratories, BACnet Application Specific Controller)

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)

Velocity Pressure Sensor
(PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS, and PVB6438NS)
Operating Range: 0 to 1.5 in. H₂O (0 to 374 Pa)

Series 60 Floating Actuator
(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

Inputs and Outputs
Each controller has four digital inputs (DI), six or eight digital outputs (DO), three analog outputs (AO), and six universal input (UI) circuits.
The PVB6436AS has only 6 digital Triac outputs available, the PVB6438NS and PUB6438S each have eight digital Triac outputs available, and PUB6438SR has eight digital relay outputs available.

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, 800 mA (AC rms) for 60 milliseconds

Digital Relay Output (DO) Circuits
(PUB6438SR only)
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 are individually configurable 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 specifications:

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Sensor Type</th>
<th>Operating Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room/Zone Discharge Air</td>
<td>20K Ohm</td>
<td>-40° F to 199° F</td>
</tr>
<tr>
<td>Outdoor Air Temperature</td>
<td>NTC</td>
<td>(-40° C to 93° C)</td>
</tr>
<tr>
<td>Outdoor Air Temperature</td>
<td>C7031G a</td>
<td>-40° to 120°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-40° to 49°C)</td>
</tr>
<tr>
<td></td>
<td>C7041F a</td>
<td>-40° to 250°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-40° to 121°C)</td>
</tr>
<tr>
<td>TR23 Setpoint Potentiometer</td>
<td>500 Ohm</td>
<td>-4° DDC to 4° DDC</td>
</tr>
<tr>
<td></td>
<td>10,500 Ohm</td>
<td>(-8° DDC to 7° DDC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 50° F to 90° F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10° C to 32° C)</td>
</tr>
<tr>
<td>Resistive Input</td>
<td>Generic</td>
<td>100 Ohms to 100K Ohms</td>
</tr>
<tr>
<td>Voltage Input</td>
<td>Transducer, Controller</td>
<td>0 - 10 Vdc</td>
</tr>
<tr>
<td>Discrete Input</td>
<td>Dry Contact</td>
<td>Open Circuit ≥ 30000Ω</td>
</tr>
<tr>
<td></td>
<td>closure</td>
<td>Closed Circuit &lt; 3000Ω</td>
</tr>
<tr>
<td>Pulse Input b</td>
<td>Counter/Meter</td>
<td>Max. frequency: 15 Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min. pulse width: 20 ms</td>
</tr>
</tbody>
</table>

Hardware (PVB0000AS, PUB1012S, PUB4024S, PVB4022AS, and PVB4024NS)

CPU
Each controller uses a 32 bit ATMEAL ARM 7 microprocessor.

Memory Capacity
Flash Memory: 512 kilobytes. The controller is able to retain Flash memory settings for up to ten (10) years.
RAM: 128 kilobytes

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 3.

Hardware (PVB6438S, PUB6438SR, PVB6436AS, and PVB6438NS)

CPU
Each controller uses a pair of microprocessors. The first is a 16-bit Texas Instruments MSP430 family microprocessor that is used to manage the Inputs, Outputs and Control. The second is a 32-bit ATMEAL ARM 7 microprocessor that manages communication for the Spyder BACnet.

Memory Capacity
Flash Memory: 372 kilobytes. The controller is able to retain Flash memory settings for up to ten (10) years.
RAM: 72 kilobytes

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 4.
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 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, Low Cap, 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 BACnet MS/TP network is polarity sensitive. 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.

Table 4. BACnet Status LED States.

<table>
<thead>
<tr>
<th>BACnet LED Status</th>
<th>Status or Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid on</td>
<td>Controller has power, loader is not running.</td>
</tr>
<tr>
<td>Solid on, blinking once in 2.5 sec.</td>
<td>Controller is in reflash mode, no MS/TP communication.</td>
</tr>
<tr>
<td>Solid on, blinking twice in 2.5 sec.</td>
<td>Controller is in reflash mode, MS/TP communication present.</td>
</tr>
<tr>
<td>Solid on, blinking three times in 2.5 sec.</td>
<td>Controller is in reflash mode, MS/TP communication data transfer in progress.</td>
</tr>
<tr>
<td>Solid off, there is no power</td>
<td>No power to processor, LED damaged, low voltage to board, or loader damaged.</td>
</tr>
<tr>
<td>Solid off, blinking on once in 2.5 sec.</td>
<td>Controller is running, no MS/TP communication.</td>
</tr>
<tr>
<td>Solid off, blinking on twice in 2.5 sec.</td>
<td>Controller is running, MS/TP communication present.</td>
</tr>
<tr>
<td>Solid off, blinking on three times in 2.5 sec.</td>
<td>Controller is running, MS/TP communication data transfer in progress.</td>
</tr>
</tbody>
</table>

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. DIP switches on the Spyder BACnet controller are used to set the controller’s MAC address.

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.

NOTE: For complete instructions on how to set the MS/TP MAC address or set the Device Instance Number refer to the Installation Instructions, form 62-0310.

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 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 Sylko-enabled sensor and a Sylko-enabled controller. Using Sylko-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. Sylko sensors are configured using the latest release of the Spyder Tool for WEBPro and WEBStation.
Table 5. BACnet Interoperability Building Blocks (BIBBs) Supported.*

<table>
<thead>
<tr>
<th>BIBB</th>
<th>Service</th>
<th>Initiates</th>
<th>Responds to</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS-RP-A/B</td>
<td>ReadProperty</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DS-RPM-B</td>
<td>ReadPropertyMultiple</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DS-WP-A/B</td>
<td>WriteProperty</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DS-WPM-B</td>
<td>WritePropertyMultiple</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-BR-B</td>
<td>AtomicReadFile</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-BR-B</td>
<td>AtomicWriteFile</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-DDB-A/B</td>
<td>Who-I-Am</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DM-DDB-A/B</td>
<td>I-Am</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DM-DOB-B</td>
<td>Who-I-Has</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-DOB-B</td>
<td>I-I-Have</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-DCC-B</td>
<td>DeviceCommunicationControl</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-TS-B</td>
<td>TimeSynchronization</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>DM-UTC-B</td>
<td>UTCTimeSynchronization</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

* Refer to the PICS (Protocol Implementation Conformance Statement) for complete details.

**Accessories**

- TR70, TR70-H Zio LCD Wall Module
- 201052A,B,C Auxiliary Switches (one, two or three switches)
- C7041B,C,D,P,R Air Temperature Sensor (indoor)
- C7770A Air Temperature Sensor (indoor/plenum)
- C7031G Air Temperature Sensor (outdoor)
- C7041F Air Temperature Sensor (outdoor)
- TR23 Wall Module
- C7400A Enthalpy Sensor
- P7640 Pressure Transducer Family
- C7232 CO₂ Sensor Family
- C7600 Humidity Sensor Family
- H7625, H7635, and H7655 Humidity and Temperature Sensors

Refer to the "Sensors Product Overview," form 63-9285, for additional accessories.

**PVBXXXXAS Mounting (Controllers with actuators)**

The PVBXXXXAS controllers include the direct-coupled actuator with Declutch mechanism, which is shipped hard-wired to the controller (using digital outputs 7 and 8).

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).

After the actuator is mounted to the damper shaft, the controller mounts to a panel by using four No. 6 or No. 8 machine or sheet metal screws inserted through the corners of the base plate.

**Mounting**

The controller enclosure is constructed of a plastic base plate and a plastic factory-snap-on cover. The cover does not need to be removed from the base plate for either mounting or wiring. Removable terminal blocks are used for all wiring connections, which allow the controller to be wired before or after mounting.

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.

**NOTE:** The controller must be mounted in a position that allows clearance for wiring, servicing, and removal.

**NOTE:** For complete mounting information, refer to the Installation Instructions, form 62-0310.

Fig. 1. Panel mounting—controller dimensions in inches (mm) for PUB1012S, PUB4024S, and PVB4024NS only (PUB4024S and PVB4024NS shown).
Fig. 2. Panel mounting—controller and actuator dimensions in inches (mm) for PVB0000AS and PVB4022AS only (PVB4022AS shown).

PUBXXXXS and PUBXXXXNS Mounting (Controllers with no actuators)
The controller mounts to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

- For panel mounting, use four No. 6 or No. 8 machine or sheet metal screws inserted through the corners of the base plate.
- For DIN rail mounting, refer to the Installation Instructions, form 62-0310.

Fig. 3. Panel Mounting Model PVB6436AS, Dimensions in inches (mm).

Fig. 4. Panel Mounting Models PVB6438NS, PUB6438S, and PUB6438SR, Dimensions in inches (mm) (PVB6438NS and PUB6438S shown).
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