Honeywell

Installation and Operations Guide

TB3026B, TB3026B-W

31-00098-01

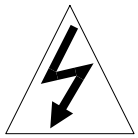
Important safety information and installation precautions

Read all instructions

Failure to follow all instructions may result in equipment damage or a hazardous condition. Read all instructions carefully before installing equipment.

Local codes and practices

Always install equipment in accordance with the National Electric Code and in a manner acceptable to the local authority having jurisdiction.



Electrostatic sensitivity

This product and its components may be susceptible to electrostatic discharge (ESD). Use appropriate ESD grounding techniques while handling the product. When possible, always handle the product by its non-electrical components.

High voltage safety test

Experienced electricians, at first contact, always assume that hazardous voltages may exist in any wiring system. A safety check using a known, reliable voltage measurement or detection device should be made immediately before starting work and when work resumes.

Lightning and high-voltage danger

Most electrical injuries involving low-voltage wiring result from sudden, unexpected high voltages on normally low-voltage wiring. Low-voltage wiring can carry hazardous high voltages under unsafe conditions. Never install or connect wiring or equipment during electrical storms. Improperly protected wiring can carry a fatal lightning surge for many miles. All outdoor wiring must be equipped with properly grounded and listed signal circuit protectors, which must be installed in compliance with local, applicable codes. Never install wiring or equipment while standing in water.

Wiring and equipment separations

All wiring and controllers must be installed to minimize the possibility of accidental contact with other potentially hazardous and disruptive power and lighting wiring. Never place 24VAC or communications wiring near other bare power wires, lightning rods, antennas, transformers, or steam or hot water pipes. Never place wire in any conduit, box, channel, duct or other enclosure containing power or lighting circuits of any type. Always provide adequate separation of communications wiring and other electrical wiring according to code. Keep wiring and controllers at least six feet from large inductive loads (power distribution panels, lighting ballasts, motors, etc.). Failure to follow these guidelines can introduce electrical interference and cause the system to operate erratically.

Warning

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

Questions, corrections, or comments?

To improve our information products and better serve our readers, your feedback is vital. If you have any questions, corrections, or comments about this publication or any other information products, please send e-mail to **WEBsSquad@honeywell.com**.

Contents

About the BACnet FF

The Honeywell BACnet FF (models TB3026B and TB3026B-W) is a communicating sensor/fixed application controller with built-in humidity sensor. The TB3026B-**W** is the wireless version with an onboard wireless receiver for wireless occupancy control.

Electrical inputs and outputs wire directly to field equipment. The BACnet FF comes pre-loaded with nineteen applications that support common uses. These applications can be selected and some of the parameters adjusted at the controller without the need for a BACnet front end.

Operational information and control data is available to other building controllers and systems through the BACnet protocol (ANSI/ASHRAE standard). This enables a BACnet FF to share data and execute commands initiated from other BACnet-compliant devices.

About this document and related publications

This document provides information about installing and wiring a BACnet FF to equipment, power, and communication channels. It also shows how to operate the user interface.

IMPORTANT Always install equipment in accordance with the National Electric Code and in a manner acceptable to the local authority having jurisdiction (AHJ). No guidelines, instructions, installation practices, or other information presented in this guide may be interpreted to supersede or modify the local codes and practices of the AHJ.

Table 1 Other documentation related to BACnet FFs

Document (ID)	Contains
Installation Instructions (31-00093)	Instructions on how to install, wire and perform initial configuration for the BACnet FF
Product Data (31-00096)	Summary of capabilities and specifications
WEBs-AX Configuration Wizard Guide (31-00097)	Instructions on how to configure the BACnet FF through the WEBs based wizard

BACnet FF dimensions

The BACnet FF consists of a mounting plate and a circuit board with a plastic cover. See the BACnet FF Installation Instructions (31-00093) for more information.

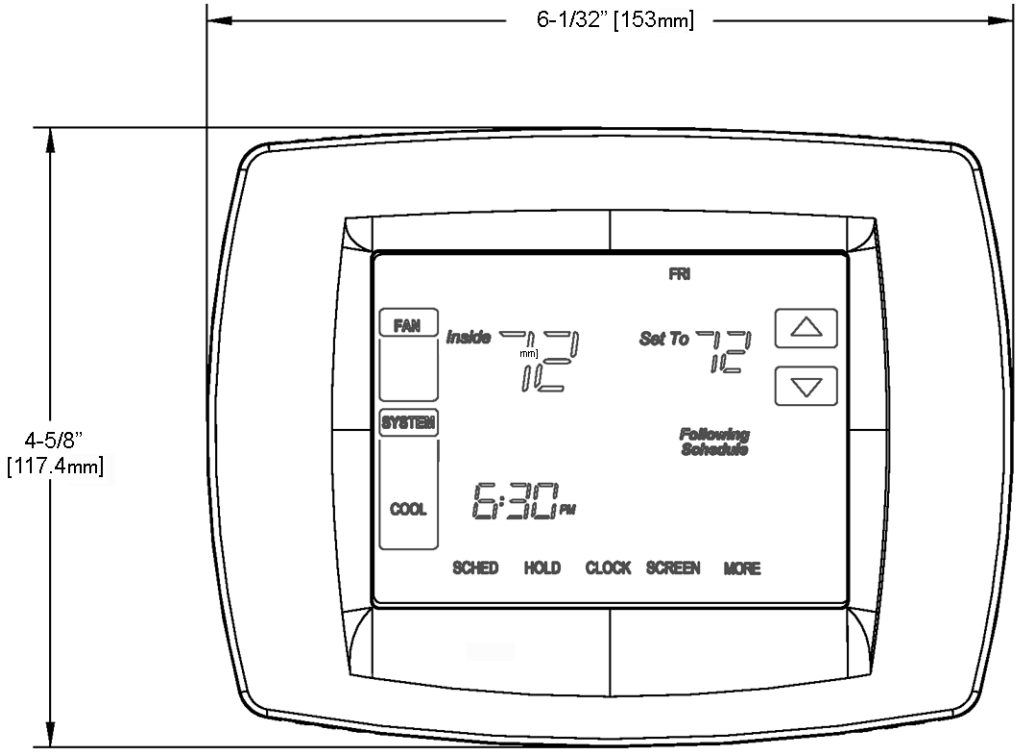


Figure 1 TB3026B and TB3026B-W dimensions

Mounting guidelines

The BACnet FF is designed to be wall-mounted indoors, with dimensions ideal for mounting to a single-gang electrical box.

Mount in a clean, dry location away from windows, air ducts, and other places where environmental factors may affect temperature and humidity readings. If you mount the BACnet FF on the interior of an outside wall, thoroughly insulate so outside air behind the sensor does not affect the sensor reading.

To meet requirements of the Americans with Disabilities Act, mount no higher than 48" from the floor and with a minimum clear floor space of 30" X 48" (760 X 1220 mm).

CAUTION Thoroughly read all instructions before mounting and wiring. Always install equipment in accordance with applicable electric codes and the instructions.

Installing the wallplate

The BACnet FF can be mounted horizontally on the wall or on a 4 in. x 2 in. (101.6 mm x 50.8 mm) wiring box.

▶ **To install the wallplate**

1. Position and level the wallplate (for appearance only).
2. Use a pencil to mark the mounting holes.

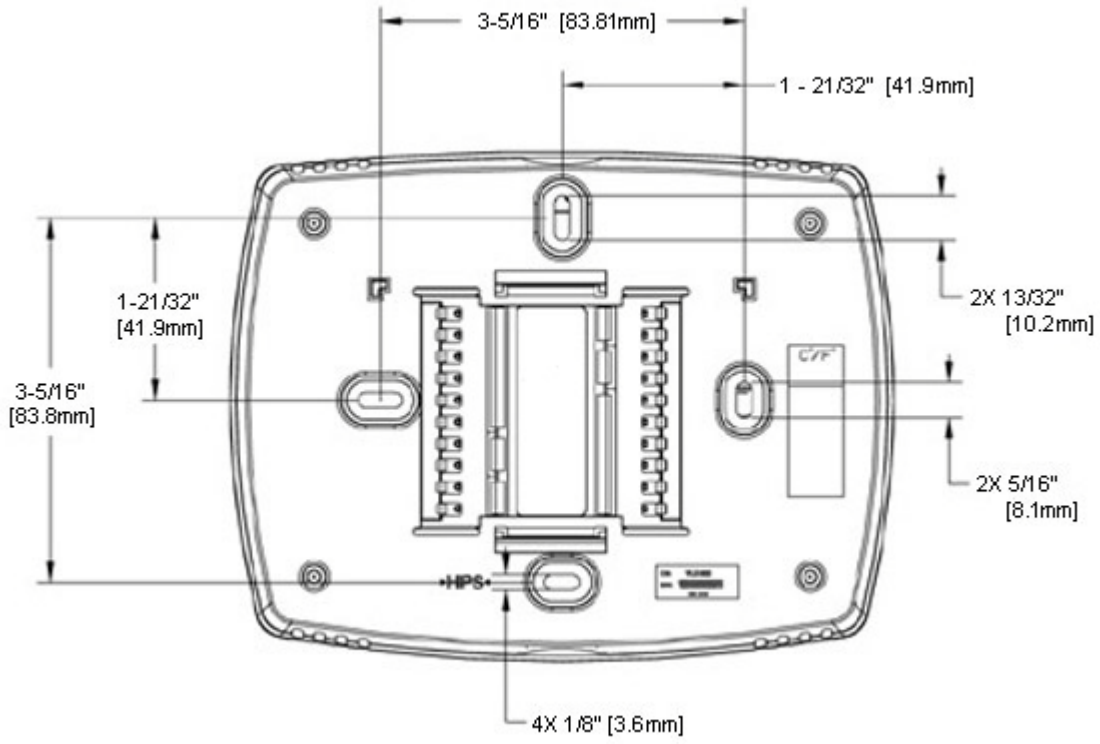


Figure 2 Wallplate dimensions

3. Remove the wallplate from the wall and, if drywall, drill two 3/16-in. holes in the wall, as marked. For firmer material such as plaster, drill

two 7/32-in. holes. Gently tap anchors (provided) into the drilled holes until flush with the wall.

4. Position the wallplate over the holes, pulling wires through the wiring opening.

5. Insert the mounting screws into the holes and tighten.

Wiring the wallplate

CAUTION Disconnect power before wiring. Failure to do so may result in electrical shock or equipment damage.

▶ **To wire the wallplate**

1. Connect wires to the terminal block using Figure 3 as a guide.

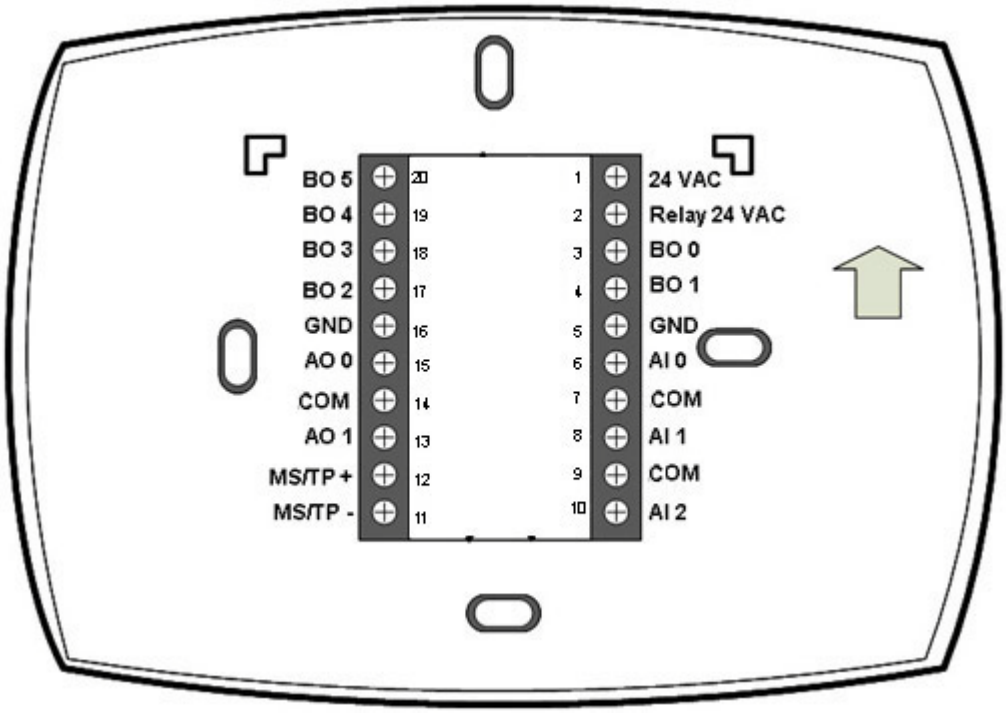


Figure 3 Terminal assignments and pin numbers

2. Securely tighten each screw.

3. Push excess wire back into the hole.

4. Plug the hole with nonflammable insulation to prevent drafts from affecting the BACnet FF.

Note A jumper is pre-installed between pins 1 and 2 (24 VAC and Relay 24 VAC). This supplies 24 VAC to BO 1, BO 3, and BO 4. It can be removed if you want to power these inputs from a separate power supply.

Mounting the BACnet FF faceplate

To mount the BACnet FF faceplate, align the terminal blocks with the pins on the back of the BACnet FF and push the faceplate straight onto the wallplate.

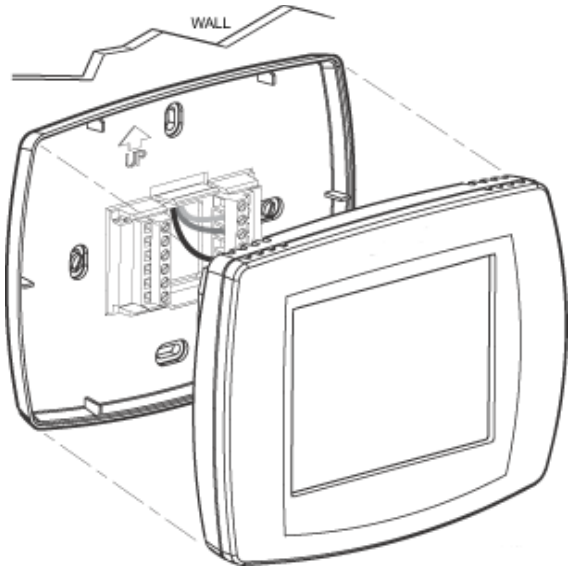


Figure 4 BACnet FF faceplate mounting

Mounting a door/window sensor

These instructions apply to the primary door sensor and an optional second door/window sensor, WSK-24.

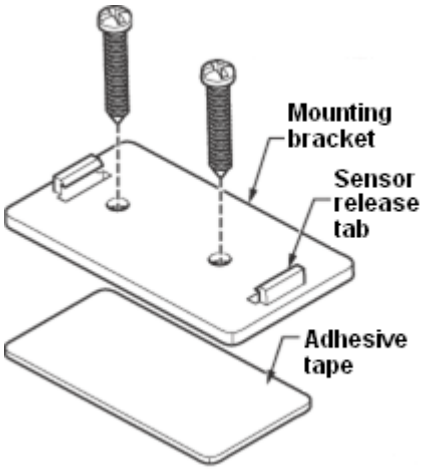
Note The BACnet FF supports a maximum of 8 door/window sensors.

▶ **To mount a door sensor**

1. Remove the battery tab.

   Note Completely remove the battery tab or the BACnet FF will not operate.

2. Remove the plastic mounting bracket from the door sensor housing.
3. Place the mounting bracket for the door sensor high on the frame of the door. Secure the bracket to the door frame using the two screws or adhesive tape provided.



4. Door sensor bracket mounting
5. Make sure the notched side of the door sensor is pointing in the direction that you will mount the magnet.
6. Snap the sensor into the mounting bracket.
7. Align one end of the magnet with the notched side of the door sensor housing.
8. Mount the magnet a maximum of 3/4 in. (19 mm) from the door sensor.

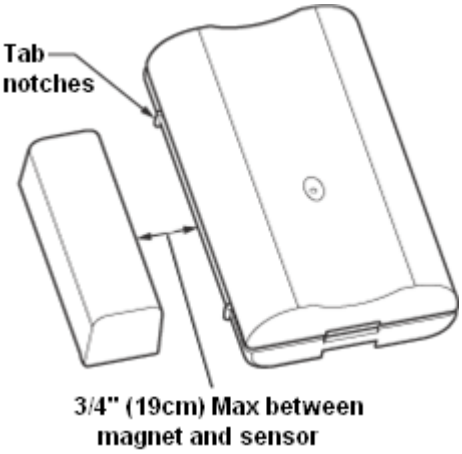


Figure 5 Maximum distance between door sensor and magnet

9. Secure the magnet to the door by using the two screws or adhesive tape provided. An optional spacer is provided.
10. Open and close the door to ensure that there is no interference.

Mounting a PIR occupancy motion sensor

Note The BACnet FF supports a maximum of 3 passive infrared (PIR) sensors.

▶ **To mount a PIR motion sensor**

1. Take off the cover by removing the cover release screw on the bottom of the PIR backplate.

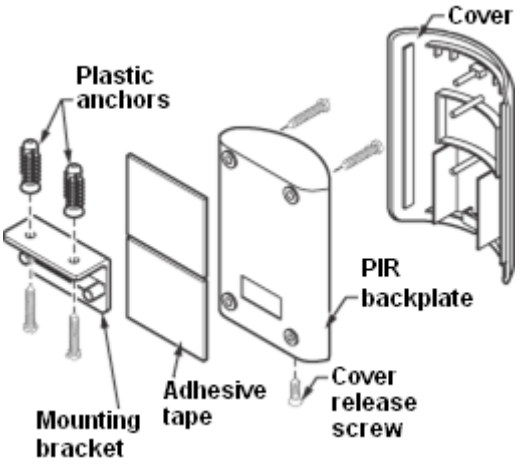


Figure 6 PIR occupancy motion sensor mounting options

2. Insert three AAA batteries.
3. Secure the PIR sensor to the wall using one of the following options:
   - Wall Mount option 1: Use adhesive tape to secure the PIR backplate to the wall.
   - Wall mount option 2: Using either the top or bottom two holes of the PIR backplate, insert the two long screws to secure the PIR backplate to the wall.
   - Ceiling mount option: Align the mounting bracket and PIR backplate. Insert the two small screws into the top holes of the backplate and secure it to the bracket. Use the two long screws (and, if necessary, the optional plastic anchors) to mount the bracket and PIR backplate to the ceiling.
4. Replace the PIR sensor cover and cover release screw.

Terminals and wiring

The BACnet FF label identifies wiring terminals by number and function. Terminals are numbered from top to bottom, beginning with 1 on the upper right side of the wallplate and continuing top-to-bottom on the right side of the controller. I/O terminals carry an additional numeric identifier that corresponds to the software I/O. Use this section to identify terminals on the BACnet FF. See later sections for more specific instructions, cautions, and recommendations.

Power supply terminals

Use terminals 1 and 5 to connect the 24VAC power supply to the BACnet FF.

Ground terminals

These terminals are used for terminating the grounded leg of the 24VAC circuit and the return grounds of BOs.

COM terminals

These terminals are used for terminating the return grounds of AIs and AOs.

Universal inputs (AIs)

Use these terminals (in conjunction with adjacent GND terminals) to connect universal inputs. Input terminals accept a variety of signal types.

Binary outputs (BOs)

Use these terminals to connect BO loads (ON/OFF control). Terminate the BO return ground to the panel/enclosure ground or a GND terminal on the BACnet FF.

WARNING! Do not apply line voltage to source pins.

Analog outputs (AOs)

Use these terminals to connect AO-loads (modulating control). The AO-return ground must terminate to the nearest GND terminal.

MS/TP LAN terminals

Use terminals 11(MS/TP-) and 12 (MS/TP+) to connect the BACnet MS/TP LAN to the BACnet FF. Maintain polarity throughout the entire LAN. See “MS/TP LAN Wiring” on page 16 for more information.

Using terminal blocks

The BACnet FF uses header-style termination blocks to simplify field wiring of power, communications, and I/Os. Terminal blocks accept wire gage from 12–24 AWG.

▶ To terminate wire to a BACnet FF

1. Strip approximately 1/8” of the wire jacket from the end of the wire.
2. Use a small screwdriver (1/8” max) to turn the adjustment screw fully counter-clockwise. The clamps in the wire slot separate as you turn the screw.
3. Insert the stripped end of the wire into it (try to get the jacket flush with the terminal block). If using stranded wire, be sure to insert all strands into the wire slot. If terminating multiple wires, trim wires to same length and tightly twist exposed wire together.
4. Hold the wire in place and turn the adjustment screw clockwise to tighten it until the clamps in the wire slot secure the wire.
5. Tug gently on the wire to ensure it is secure.

Power supply guidelines and requirements

BACnet FF uses 24VAC power from a UL Listed Class 2 24VAC transformer (not provided). The BACnet FF uses a half-wave rectifier to convert the AC power supply to onboard power. This enables multiple BACnet FFs with half-wave power supplies to be powered from a single, grounded transformer.

CAUTION Half-wave devices and full-wave devices must not use the same AC transformer. If a BACnet FF will share its power supply with another device, make sure that the other device utilizes a half-wave rectifier and that polarity of wiring is maintained. Failure to do so can result in equipment damage.

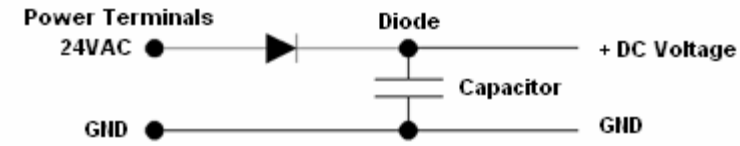


Figure 7 Internal BACnet FF power wiring schematic, half-wave rectifier

BACnet FF power ratings

The BACnet FF minimum current draw is 24 VAC @50ma leading to ~1.2VA.

The minimum applies when the BACnet FF supports no binary output (BO) loads. If the BACnet FF supports AOs, the minimum VA rating includes the draw of all AO-loads energized at maximum rating. The maximum power draw is the minimum VA rating plus the power draw when all BOs are energized at maximum capacity.

Selecting a transformer

The safest way to size a transformer is to ensure that the maximum VA load rating of the BACnet FF is less than 85% of the Nameplate VA rating of the transformer. Even if all outputs are not presently used, this ensures that each BACnet FF has sufficient power for future equipment additions.

IMPORTANT Transformer sizing should never exceed the maximum UL Class 2 rating.

Power supply grounding and wiring

When connecting power to the BACnet FF, ensure that one leg of the VAC secondary circuit connects to a known earth ground. Also ensure that the GND terminal on the BACnet FF connects to the same known earth ground.

Supplying a high-quality ground connection to a BACnet FF and then properly connecting the BACnet FF to the ground is one of the most important things you can do to ensure a trouble-free installation.

The 24VAC secondary leads are not interchangeable. Once a lead connects to the GND terminal on the BACnet FF, it is the grounded lead. Observe and maintain polarity for subsequent connections. The GND terminal provides a reference ground for the circuit board and communications wiring. Use 18 AWG cable for best results.

WARNING Ensure that all BACnet FF power, communications, and I/O cabling are grounded according to these instructions. Failure to follow these instructions may result in BACnet FF operational and communication failures or equipment damage.

Power supply wire selection

If you are considering long power supply wiring runs, using the right wire size is critical. If the wire is too small, the resistance may be too high, resulting in a low voltage supply to the BACnet FF. This is known as *line loss.* The wire size is based on the length of the wire run and the current draw of the BACnet FF. Use Figure 8 to determine wire size; obtain additional information from the transformer manufacturer.

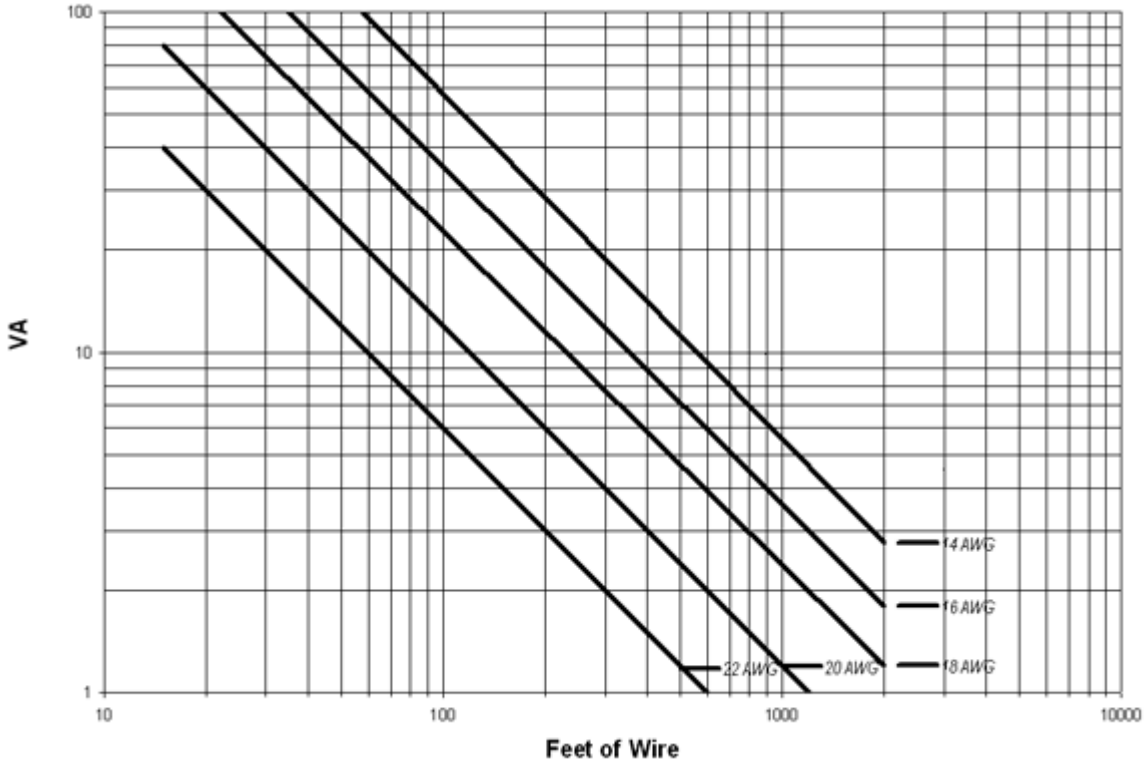


Figure 8 BACnet FF wiring recommendations

Backup power

The BACnet FF features a built-in supercapacitor that will run the on-board clock for ten days in the event of power loss.

MS/TP LAN Wiring

The BACnet FF communicates on the site-wide BACnet system over a twisted-pair MS/TP LAN, which uses the EIA–485 signaling standard. BACnet FFs are master devices on the MS/TP LAN.

Each BACnet FF employs a high-quality EIA–485 transceiver and exerts ¼ unit load on the MS/TP LAN.

Table 2 MS/TP LAN facts

Transmission speed	9.6, 19.2, 38.4, 76.8 Kbps (configured at global controller).
Layout	Bus.
Cabling	BACnet specifies the following. Shielded, twisted-pair cabling with characteristic impedance between 100 and 130W. Distributed capacitance between conductors must be less than 30 pF/foot (100 pF/m). Distributed capacitance between conductor and shield must be less than 60 pF/foot (200 pF/m). Foil or braided shield acceptable.
Segment length	4000 ft. (1071 m.) per segment using recommended wire.
Maximum devices overall	Depends on classification of devices as master or slave. Maximum number of master devices is 128. Maximum number of slave devices or devices overall (mixed master and slave) is 255. This includes BACnet FFs, BACnet global controllers (all are considered masters) and any other devices, regardless of their relative unit loads.
Maximum devices per segment	Depends on relative unit load of devices (see “Terminating MS/TP LAN cabling” on page 16).
Repeaters	Required when making runs longer than 4000 ft. Three repeaters maximum between any two devices.
Terminating resistors	Matched resistors required at each end of segment bus wired across (+) and (–). Use matched precision resistors rated ¼W ±1% / 80 - 130 Ohms.
Shield grounding	Ground shield drain wire at single point earth (panel) ground, *not* BACnet FF *ground*. Tape off shield drain wire at other end. Tie shield drain wire through at each BACnet FF.

Terminating MS/TP LAN cabling

MS/TP terminations are located on the lower left of the BACnet FF wallplate.

Maintain polarity of the MS/TP wire run throughout the MS/TP LAN.

Grounding the MS/TP LAN shield

Proper shield grounding of the MS/TP cabling can help minimize the risk of communications problems and damage to equipment because of transient voltage spikes (for example, lightning strikes).

Follow these guidelines for grounding MS/TP cable shields:

- Each MS/TP segment should have a single point of shield ground, preferably as close to the middle of the cabling run as possible.
- Do not ground the MS/TP shield using a BACnet FF terminal.
- Never ground both ends of a shield; differences in potential between the grounds may induce current on the shield, causing interference.
- At termination connecting points, tie the shield through with a wire nut.
- At ungrounded, exposed shield points (the end of a segment), tape back the shield to the wire jacket or, for optimum transient shunting, use 100 V gas discharge tubes or 120 V MOVs between shield and ground.

Terminating resistors

Matched terminating resistors wired across MS/TP+ and MS/TP– are required at the last device on each end of the MS/TP segment for signal integrity (Figure 9).

Optimum segment performance typically requires “tuning,” a process by which the value of the terminating resistors is selected based on the wave form of signals on the segment. View wave forms using an industrial scope meter. The goal is to have as square a wave form as possible with an amplitude greater than 200 mV. Resistors affect the wave form as follows:

- When the resistance value decreases, the amplitude of the wave form decreases and becomes more square.
- When the resistance value increases, the amplitude of the wave form increases and becomes less square.

Typically, precision resistors in the range 80-130 Ohms ($\pm$1%) yield acceptable results. 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 100 Ohm, install 100 Ohm matched precision resistors.

CAUTION Do not mismatch terminating resistors. Ensure that both resistors on a segment have the same value.

Note Typically, White is Data - and Black is Data +.

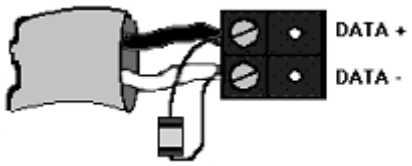


Figure 9 Terminating resistor detail

Configuration

Once the BACnet FF is mounted and wired, configure it from the BACnet FF touchscreen.

Adjusting the date and time

When the controller is first powered up, you may need to set the date and time. These are set at the factory, but the on-board power supply may have run down. If this happens, adjust the date and time.

▶ **To adjust the time**

1. Touch **Clock** at the bottom of the screen.
1. Use the arrows to adjust the year, month, and day.
2. Press **DONE**.
3. Adjust the time and press **DONE**.

To manually adjust the date and time after initial setup, see “Clock operation” on page 25.

Setting the MAC address and device instance

The factory default MAC address is 0. Valid MAC addresses are 0-127. The default device instance is 0009999. Valid device instances are 0-4194302.

Note The device instance can also be set using a BACnet Supervisor

▶ **To set the MAC address and device instance at the display**

1. From the home screen, press SYSTEM (left side of the screen).

   Five blank touch keys will appear at the bottom of the screen.

2. Press and hold the two blank keys on either side of the center key for approximately five seconds (see Figure 10).

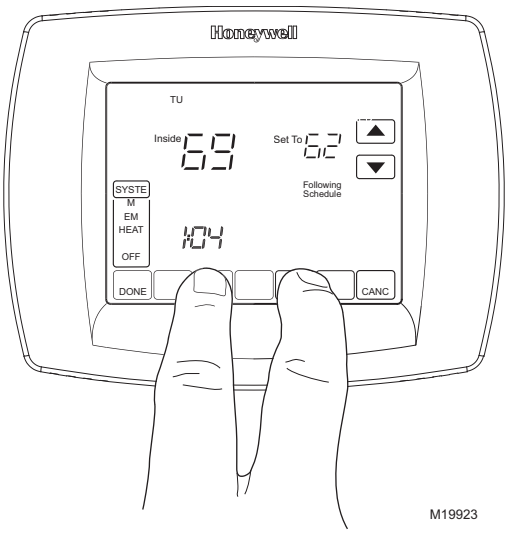


Figure 10 Entering ISU mode

The installer setup (ISU) screen appears. An ISU code is displayed in the lower left. It is a four-digit code beginning with zero. The current setting is displayed in the lower right.

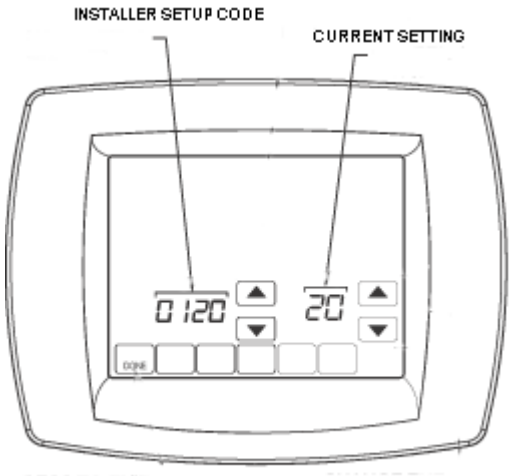


Figure 11 ISU screen

3. Use the down arrow next to the installer setup code to advance to ISU code 800.

4. Use the up and down arrows next to the current setting to set ISU code 800 (MAC address) to a value between 0 and 127.

5. Set ISU code 801 (first digit of device instance) to a value between 0 and 4.

   Note The device instance is set by entering values in four separate ISU codes. See example on page 20.

6. Set ISU code 802 (second and third digits of device instance) to a value between 00 and 99.
7. Set ISU code 803 (fourth and fifth digits of device instance) to a value between 00 and 99.
8. Set ISU code 804 (sixth and seventh digits of device instance) to a value between 0 and 99.
9. Press **Done** to exit installer setup.

   For example, if you want to set the MAC address to 15 and the device instance to 1876, you would use these settings:

   ISU code 800=15
   ISU code 801=0
   ISU code 802=00
   ISU code 803=18
   ISU code 804=76

Installer setup (ISU) codes

Installer setup mode provides access to functions specific to installation of a BACnet FF. Some BACnet FF configuration parameters can be altered from the ISU screens. The ISU parameters can also be accessed via BACnet.

You can require a PIN to access ISU mode by setting AV-133 to a non-zero, four-digit number.

▶ To access the ISU screens

1. From the home screen, press SYSTEM (left side of the screen).
2. Five blank touch keys appear on the bottom of the screen between the **Done** and **Cancel** keys. Press and hold the two blank keys on either side of the center key for approximately five seconds. See Figure 10.
3. If a PIN code is required, use the top arrows to select the first two digits of the code and the bottom arrows to select the third and fourth digits of the code, and then press **DONE**.

   The ISU screen appears.
4. Use the arrows to select parameters and values. See Table 3 for details.
5. Press **DONE**.

Note After five minutes of inactivity, the ISU screen reverts to the main screen.

Table 3 provides a list of ISU parameters

Table 3 ISU parameters

ISU Parameter Code	Description	Allowed Values
120	Year, first 2 digits	19-21
130	Year, second 2 digits	00-99 (00-54 if ISU 200=21)
140	Month	1-12
150	Day	1-31
160	Schedule format BV-133	0 – not programmable (BV-133=0) 4 – 7 day programmable (BV-133=1)
280	Backlight control BV-79	0 – on for 20 seconds after keypress 1 – low always on, bright after keypress
320	Swap English/Metric BV-69	1 – show opposite units to specified in DDC header
330	Daylight saving AV-127	0 – off; no automatic adjustments 1 – pre 2007 scheme 2 – 2007 and later scheme
500	Filter change reminder AV-124	0 – reminder not used 1 – 10 days 2 – 30 days 3 – 60 days 4 – 90 days 5 – 120 days 6 – 365 days
510	Hum pad change reminder AV-125	0 – reminder not used 1 – 90 days 2 – 180 days 3 – 365 days
520	UV lamp change reminder AV-126	0 – reminder not used 1 – 365 days
540	Program periods AV-129	2 – Wake/Sleep 4 – Wake/Leave/Return/Sleep
640	Clock format BV-83	12 – 12 hour (BV-83=0) 24 – 24 hour (BV-83=1)
670	Keypad lock AV-128	0 – no lock 1 – access temperature settings only 2 – fully locked

Table 3 ISU parameters

ISU Parameter Code	Description	Allowed Values
700	Sensed room temperature offset (AV-138)	-4 to +4 degrees F
701	Sensed room humidity offset (AV-139)	-5% TO +5% Humidity cannot be adjusted above 100% or below 0%.
702	Sensed outside air temperature offset (AV-140)	-4 to +4 degrees F
703	Sensed outside humidity offset (AV-141)	-5% TO +5% Humidity cannot be adjusted above 100% or below 0%.
800	MS/TP MAC	0-127
801	BACnet Device Instance - first digit	0-4
802	BACnet Device Instance second and third digits	00-99
803	BACnet Device Instance forth and fifth digits	00-99
804	BACnet Device Instance sixth and seventh digits	00-99

Pairing a sensor to a wireless BACnet FF

The BACnet FF and wireless sensor kits (WSK-24) ship unpaired, verified by two dashes in the Sensor Status field on the BACnet FF's Wireless Sensor Setup screen. To pair them, issue a pairing command from the BACnet FF and then activate the sensor.

Accessed from Field Service Mode, the BACnet FF's Wireless Sensor Setup Mode includes diagnostic screens for configuration and checkout of associated sensors. With :UC displayed in Field Service Mode, press the blank key (blank area) just to the left of the blank center key, and then press the down arrow key next to the :UC parameter.

Door/window sensors may be paired to any available sensor number in the range 1-8. When cycling through sensor numbers on the Wireless Sensor Setup screen, unpaired sensor numbers show a status of --.

PIR sensors may be paired to any available sensor number in the range 1-3.

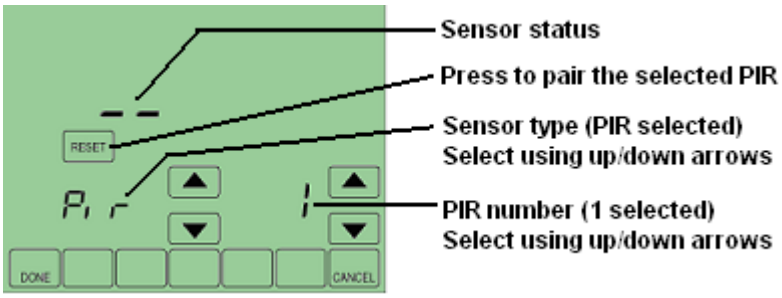


Figure 12 Wireless Sensor Setup screen

▶ **To pair a sensor to a BACnet FF**

1. Make sure the battery is installed and activated in the sensor.
2. If the sensor is a door/window switch, align the magnet so that the sensor is in the closed position. If the sensor is a PIR sensor, cover the PIR.
   IMPORTANT! Verify that the sliding door/window contact is closed and cover all other PIRs to prevent interference during the pairing process.
3. On the BACnet FF select the sensor to pair and then press **Reset**.
   The RESET key disappears and WAIT is displayed indicating that the BACnet FF is waiting to pair the sensor with the next device that receives a radio signal.
4. Activate the sensor you want to pair.

   Note Pairing times out after 10 seconds of no pairing activity.
5. Verify that the BACnet FF and sensor successfully paired.
   Paired = sensor status is displayed, replacing --.
   Timed out = RESET is displayed and sensor status is --.

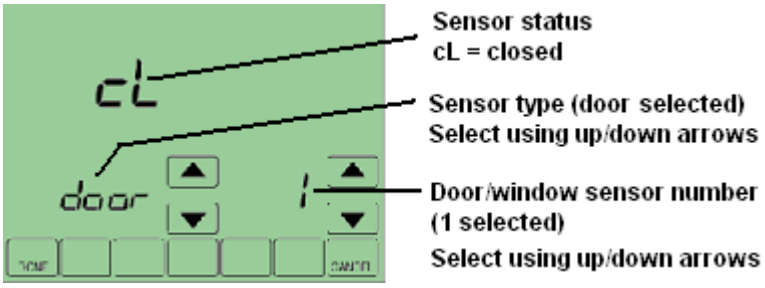


Figure 13 Door sensor number 1 paired and in closed status.

▶ **To erase sensor-to-BACnet FF pairings**

1. While viewing any sensor status screen while pairing is not taking place, press the blank key to the left of CANCEL.
2. Press the blank key to the right of DONE.
   The sensor status field displays --, indicating unpaired.

Fixed field service codes

Field service mode enables technicians to query and command key operating variables in the BACnet FF while at the BACnet FF touchscreen. A technician presses a particular key sequence at the BACnet FF to enter field service mode. In field service mode a technician uses the left arrows to scroll through data codes and the right arrows to change the value associated with a code.

The lower left of the LCD shows the two-digit data code and the main area displays the data value. A pre-defined list of data codes is available within the description of each application. See Table 8 as an example for applications 0 and 1. "Configuring a DDCMULTI application" on page 27 provides more information about these settings.

Note When using the local user interface to change applications (AV-49), the application defaults will NOT change and must be changed manually.

You can deny users access to field service mode by setting BV-68 to ON. You can also require a PIN code in order to enter field service mode by setting AV-132 to the desired PIN number.

Field service mode ends automatically if there is no key activity for five minutes.

Setting field service codes

▶ **To set field service codes**

1. From the home screen, press SYSTEM (left side of the screen).
2. Press and hold the center bottom key (blank) for about five seconds. See Figure 10.
3. If a PIN code is required, use the top arrows to select the first two digits of the code and the bottom arrows to select the third and fourth digits of the code, and then press **DONE**.

   The field service screen appears.
4. Press the left up or down arrows until the desired code appears. See Table 8 on page 42 for the list of Setup Codes. NOTE: All applications use the same Setup Codes.
5. Press the right up or down arrows to adjust the value associated with the code.
6. Press the left up or down arrows to accept the change and scroll to a different code.
7. Press **DONE** to exit field service mode.

Operational overview

The BACnet FF operates in one of three modes - Setpoint, Occupancy Single Setpoint, and Occupancy Dual Setpoint.

Common features

This section describes features common to all operating modes. For descriptions of mode-specific features, see “Checking MS/TP communication” on page 26 and “Checking MS/TP communication” on page 26.

LCD backlight operation

BV-79 controls backlight operation. If BV-79 is OFF, the backlight turns ON when any key is pressed and stays on for 20 seconds after there is no key activity. If BV-79 is ON, the backlight is ON continuously.

Clock operation

The BACnet FF’s real-time clock provides time and date for displaying the date and time, implementing daylight savings settings, and implementing schedules. If AC power is lost, a supercapacitor will power the clock for ten days. If the date and time are lost, the BACnet FF will display the set time and date screens when powered up.

Note The real-time clock is separate from the CPU time keeping utility. It only affects the items listed in this section.

Daylight savings (DLS) settings can be controlled by a BACnet FF or by a BACnet Supervisor. If installer setup (ISU) parameter 330 is set to non-zero, the BACnet FF will control DLS settings. If ISU 330 is zero, DLS is controlled by a BACnet Supervisor.

The clock accepts time syncs from a BACnet Supervisor. If configured in DDC, the date and time can also be set manually using the display. To deny a user permission to set the clock, set BV-116 to 1.

The last time command, whether from the user screen or BACnet, takes precedence.

▶ **To adjust the real-time clock**

1. Press **CLOCK**.
2. Use the arrow keys to select a year, month, and day.
3. Press **DONE**.
4. Select a time.
5. Press **DONE**.

MORE key navigation

The MORE key allows a programmer to make additional screens available to users. Enabling the display of one or more of these screens causes the MORE key to appear on the main screen. The screens that can be made available are:

- Outside air temperature
- Inside/outside humidity

When the user presses **MORE**, the first enabled screen appears. Pressing **MORE** again displays the next screen.

Touchscreen cleaning

If the display screen needs to be cleaned, the user presses **SCREEN**. The display will lock for 30 seconds allowing the user to wipe the screen without pressing any keys. When the display reads 0, press **SCREEN** to continue cleaning or **DONE** to quit. Use a non-abrasive glass cleaner.

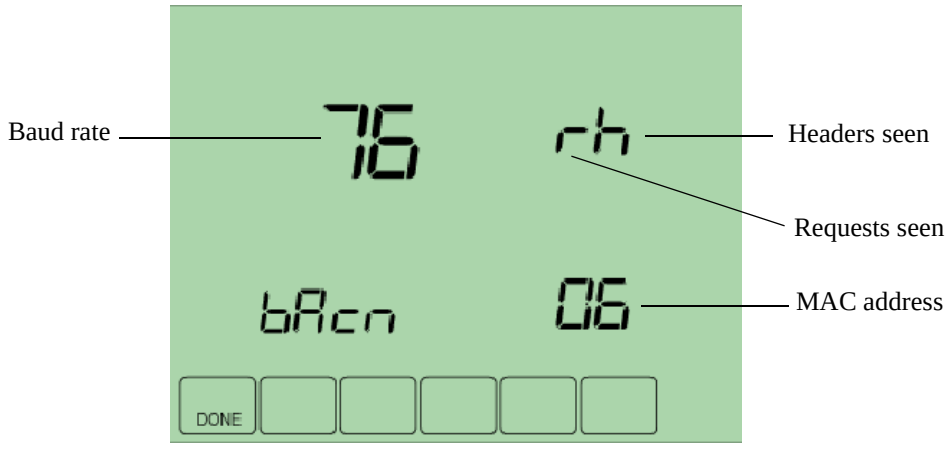
Checking MS/TP communication

You can check MS/TP communication from the display. The BACnet FF will indicate if MS/TP packets and headers have been seen, the baud rate, and the MAC address.

▶ **To check MS/TP communication**

1. Enter field service mode. See “To set field service codes” on page 24.
2. Ensure the UC code is displayed.
3. Press the blank key usually labeled **MORE** (bottom row, second from right).
4. Press the down arrow near the UC code.

   The MS/TP communication screen appears.



5. Press **DONE** twice to exit.

Configuring a DDCMULTI application

The BACnet FF is pre-loaded with DDC that lets you select one of multiple applications. Applications for heat pumps, A/C units, and fan coil units are all contained in the same DDC file. Using one of these applications, an installer can configure the controller in the field - just set the MS/TP parameters, device instance, and application [AP] (AV-49) parameters and it is ready to go.

Note When using the local user interface to change applications (AV-49), the application defaults will NOT change and must be changed manually. However, The Niagara-based configuration wizard will change the application specific default values.

Advanced application settings will require a BACnet connection to a BACnet BMS. These detailed application settings need to be reviewed to ensure all are set correctly before enabling the device's outputs.

CAUTION Setting the [OE] field service code to ON powers up the outputs. Ensure that the outputs are configured correctly before setting OE to ON.Failure to do so may result in equipment damage.

1. Set field service code [OE] (BV-2) to ON to power up the outputs.
2. Press **DONE**.

Application Sequences and Configuration Settings

Table 4 shows settings for all 19 applications and should be referenced accordingly

Table 4 Primary settings for the 19 apps

Code	Point	Value	Default	Options	Units	Notes
160	BV-133	Internal Sched Enable	Inactive	Inactive/Active		
280	BV-79	Backlight ON	Inactive			
320	BV-69	Swap Eng - Don't use this is on custom screen				
330	AV-127	Day Light Savings Option	2	0-2		0 - disable, 1 - pre 2007, 2 - 2007+
500	AV-124	Filter Period	0	0		
510	AV-125	Pad Period	0	0		
520	AV-126	UV Period	0	0		
540	AV-129	Prog Periods	0	0		
640	BV-83	Clock Fmt Inactive 12 hr Active 24 hr				
670	AV-128	Keypad Lock 0-no lock, 1-temp settings only, 2-locked				
700	AV-138	Temp Offset	0	0		
701	AV-139	Humidity Offset	0	0		
702	AV-140	OA Temp Offset	0	0		
703	AV-141	Humidity Offset	0	0		
	BV-141	Deny Schedule Edits	Inactive	Inactive/Active		
	BV-114	Deny Schedule View	Inactive	Inactive/Active		
	BV-115	Deny Permanent Hold	Inactive	Inactive/Active		
	BV-130	Deny Vacation Hold	Inactive	Inactive/Active		
	BV-116	Deny Clock Adjust	Inactive	Inactive/Active		
	AV-132	FS PIN	0	0		Pin locks field service access
	AV-133	ISU PIN	0	0		Pin locks ISU service access

Heat Pumps: Apps 0 and 1

[AP] 0: Air-to-air heat pump and [AP] 1: Water-source heat pump

Single-speed fan with binary output start/stop. optional analog variable-speed fan control, 1-stage auxiliary heat, optional floating or analog economizer.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 5 Inputs and Outputs: [AP] 0 and [AP] 1

Point	Function
AI-0	Optional: Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional standby input (for PIR/door/window sensor)
AI-2	Supply-air sensor (optional, but required for economizer option)
BI-2	Normally-open condensate sensor (optional)
BO-0	Fan
BO-1	Heat-pump compressor
BO-2	Reversing valve
BO-3	Heating stage 1 (optional)

Table 5 Inputs and Outputs: [AP] 0 and [AP] 1

Point	Function
BO-4	Economizer open (optional)
BO-5	Economizer close (optional)
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagrams

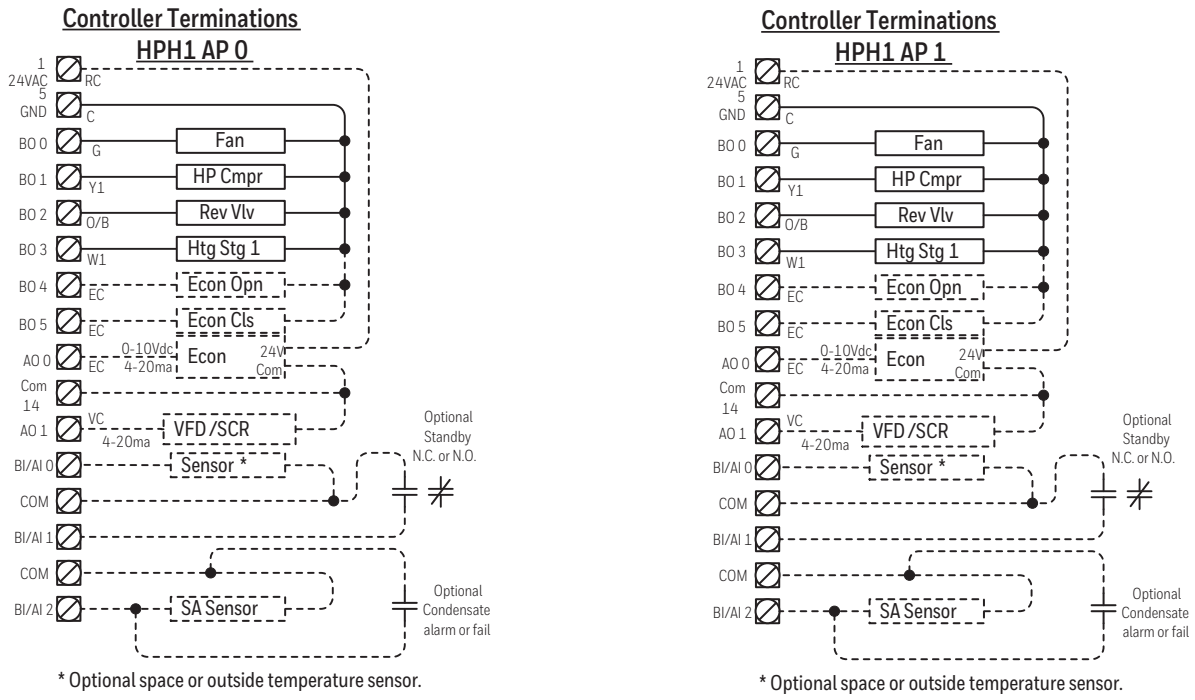


Figure 14 Controller terminations: [AP] 0, [AP] 1

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OF/On is in the OF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

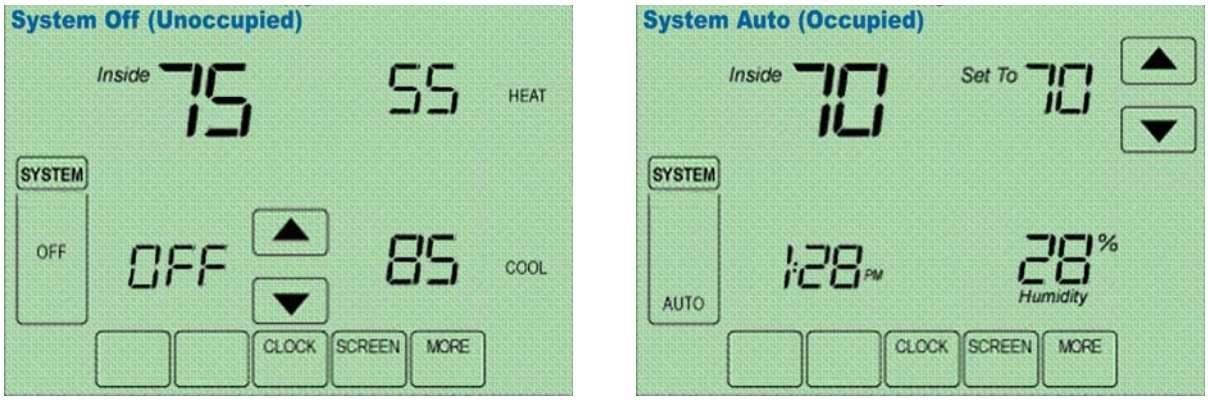


Figure 15 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 6 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint

Table 6 Setpoint values in Occupancy control

Field Code	Description
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These ***setpoints*** are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode ***schedules*** are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

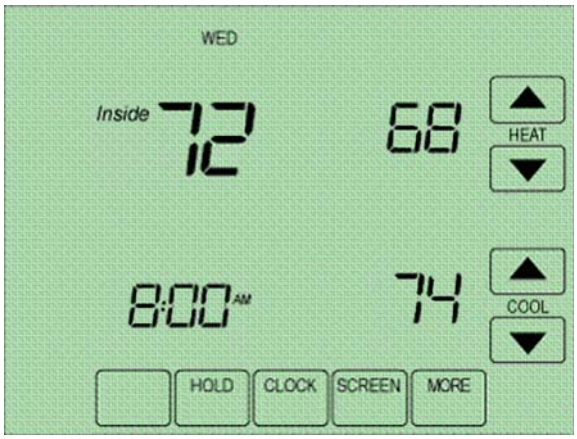


Figure 16 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the

beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator

workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

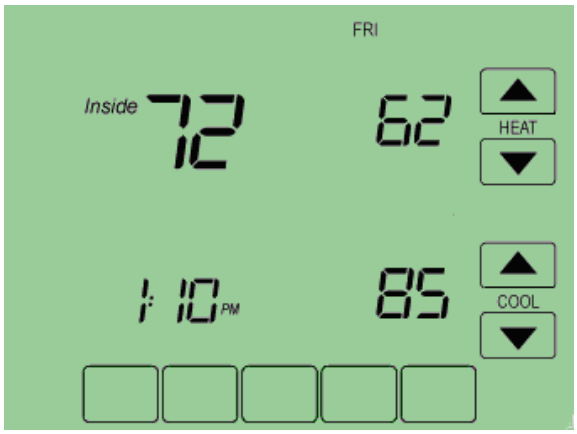


Figure 17 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to Standby Heating and Cooling calculated Setpoints above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Compressor Control

Reversing Valve

The reversing valve does not change positions until the compressor has been OFF for at least 60 seconds. The reversing valve is set to the heating position (ON) when the heating signal exceeds 10 and the heating lockout is OFF. Otherwise the reversing valve is in the cooling position. Anti-cycle protection prevents the valve from changing positions more than once every two minutes. Some air-to-air heat pumps require the reversing valve to be activated in order to have the coil in Cooling mode. For cooling with the reversing valve active (ON), change [HC] or BV-21 to reverse the valve action.

AC-HP Control Mode (AV-40 set to 1)

The compressor commanded cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. The compressor command setpoints are adjustable from the display. When the fan requests AC cooling, BV-7 is ON. When BV-7 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short-cycling the compressor.

AV-68 AC-HP Compr Start Demand % (set at 20% default).

AV-69 AC-HP CMPR Stop Deadband % (default set at 1%)

AV-27 is minimum On time MON in minutes (anti-cycle).

AV-57 is minimum OFF time MOF in seconds (anti-cycle).

AC-HP control mode (AV-40, default set at 2)

Note AC or HP mode 1= ON-OFF (Demand Compare Control), 2= Analog to Binary Cycle Time Control.

The compressor control signal is selected between the Heating signal and the Cooling signal, depending on the status of the Heating/Cooling mode.

For Heating mode, the compressor signal ranges 0-100 as the Heating signal ranges 0-65. The Heating signal range 65-100 is reserved for auxiliary heat control.

For Cooling mode, the compressor signal ranges 0-100 as the Cooling signal ranges 0-100.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor-control signal. The Compressor Cycle Time [Cc] is adjustable from the display. Recommended cycle time range is 6-12 minutes. The compressor does not start unless the fan is ON. When the reversing valve changes position, there is a short delay before compressor operation is allowed. The Cooling or Heating Signal is processed by an analog-to-binary timer that controls the BO's ON/OFF duration. Runtime and compressor starts are accumulated.

When either the Cooling Lockout is ON or the Low-Supply-Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

When the Heating Lockout is ON, the compressor control signal is set to zero. The heating lock out temperature is controlled by the [hL] setting.

Compressor timing

Cycle times and minimum on/off times need to be set for operation of the heat-pump compressor.

- AV-26 [Cc] AC-HP Compressor Cycle Time: (CYC) time in minutes (factory default = 12 minutes)
- AV-27 [cc] AC-HP Compressor Minimum ON-OFF: (MON) and (MOF) time in minutes (factory default = 3 minutes)

Water source [AP] 1

The compressor control (BV-31 WS HP Water Loop OK) must be enabled from the display or a BMS, ensuring that the water-source temperature is within the operating range for the heat pump and that water is flowing in the water-source loop. Heat Pump safeties need to be hard wired with the compressor's binary output. The control sequence is identical to the air-to-air heat pump.

Staged auxiliary heating

Auxiliary heating is controlled by the upper portion of the Heating Signal range. The auxiliary heat signal ranges 0-100 as the Heating Signal ranges 65-100. Auxiliary heating is staged ON for a percentage of each set Heating-Cycle period [Hc] based on the value of the auxiliary heat signal. [Hc] operation is locked out when the outside-air temperature is above the Auxiliary Heating Lockout Temperature [hL]. Runtime is accumulated for auxiliary heating.

High and low refrigerant pressure cutouts must be separately provided, preferably hard-wired, to stop compressor operation in the event of these conditions. Outdoor coil defrost control and any provisions to allow oil sump

heaters to be effective must also be included in the equipment manufacturer's controls or otherwise provided for.

Single-stage auxiliary heating

Auxiliary heat responds to the range of 65-100 of the Heating signal.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stages. Staged heating will not run if either of the following two values are zero.

- AV-28 [Hc] Heating Stages Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stages Minimum ON-OFF: (MON) and (MOF) time in minutes. (factory default = 1 minute)

Compressor and Heating-stages Binary Control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal. For example, if the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 7 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer logic is enabled when Economizer Damper Stroke Time [ES] AV-63 is set to 5 seconds or above. If the economizer option will not be used, [ES] AV-63 should be set to 0 (factory default); this will prevent the economizer relays from clicking. If the analog modulating option is to be used, [ES] AV-63 should be set to 5. The economizer sequence requires that a supply air sensor be wired to AI-2.

As the Cooling signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

The Economizer Damper Stroke Time [ES] is used in combination with the current economizer commanded position to estimate the actual current position of the economizer damper. A BMS is required to set the values for AV-60, AV-66, and AV-67.

Analog modulating economizer

The economizer is controlled directly by the economizer command output on AO-0.

3-point floating motor economizer

The economizer is controlled directly by the economizer command. As the command signal increases, BO-4 is active, driving the economizer open. As the command signal decreases, BO-5 is active, driving the economizer closed.

Heat Pump Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

When condensate is sensed, e.g., BI-2 is shorted (active), AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

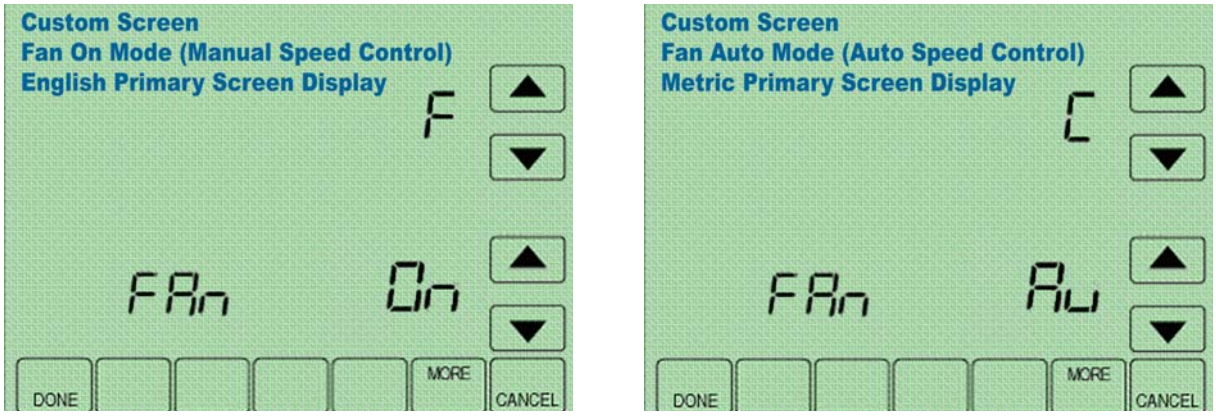


Figure 18 Display: Metric (C) or English (F); Fan Auto (Au) or Fan Manual (On)

Note BV-55 controls Fan Auto/Fan ON display. Setting BV-55 inactive hides Fan Auto/Fan ON. Setting BV-55 active shows Fan Auto/Fan ON status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 8 Setup codes: [AP] 0 or [AP] 1

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	0-1	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 8 Setup codes: [AP] 0 or [AP] 1

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 9 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run App 1 Active
	BV-53	Enable RH Fan Circ Cycle	OFF	OFF/ON		
	BV-71	English (OFF)/Metric (ON)	OFF	OFF/ON		System level settings impact DDC temperature control settings and are not used for display settings.
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active

Table 9 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		

Table 9 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

Heat Pumps: Apps 2 and 3

[AP] 2: Air-to-air heat pump and [AP] 3: Water source heat pump

Single-speed fan with binary output start/stop. optional analog variable-speed fan control, 2-stage auxiliary heat, and analog economizer.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 10 Inputs and Outputs: [AP] 2 and [AP] 3

Point	Function
AI-0	Optional: Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional standby input (for PIR/door/window sensors)
AI-2	Supply-air sensor (optional, but required for economizer option)
BI-2	Optional normally-open condensate sensor
BO-0	Fan
BO-1	Heat-pump compressor
BO-2	Reversing valve
BO-3	Heating stage 1

Table 10 Inputs and Outputs: [AP] 2 and [AP] 3

Point	Function
BO-4	Heating stage 2
BO-5	Not used
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagrams

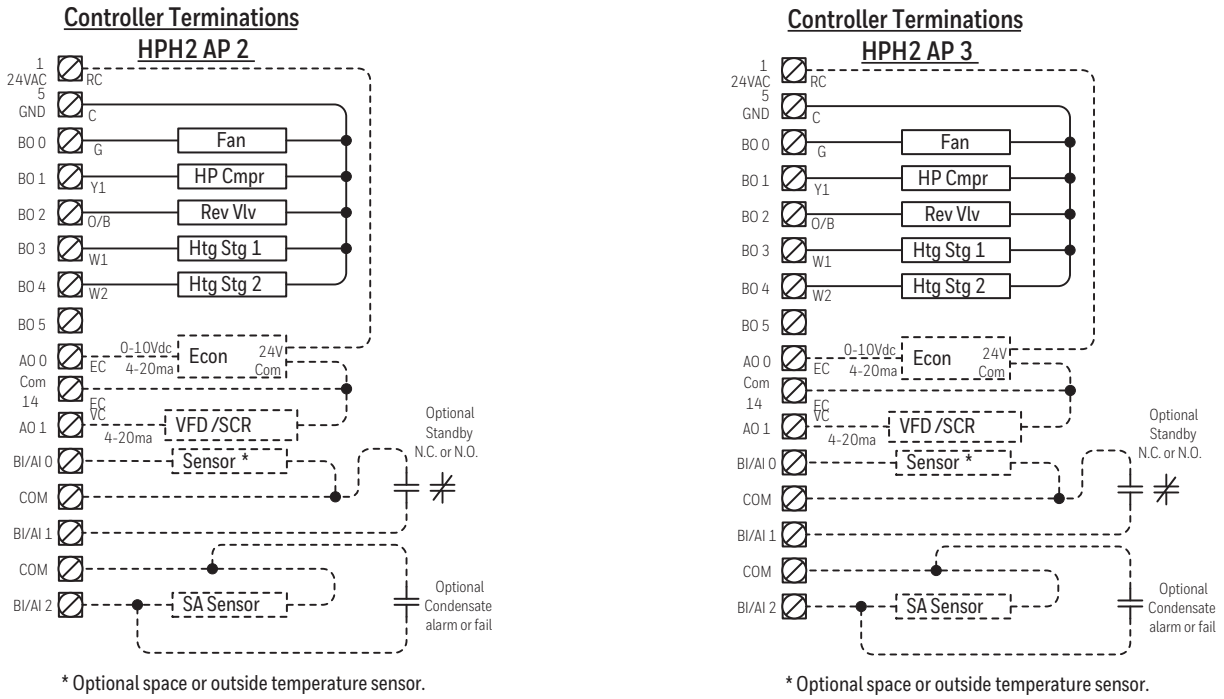


Figure 19 Controller terminations: [AP] 2, [AP] 3

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

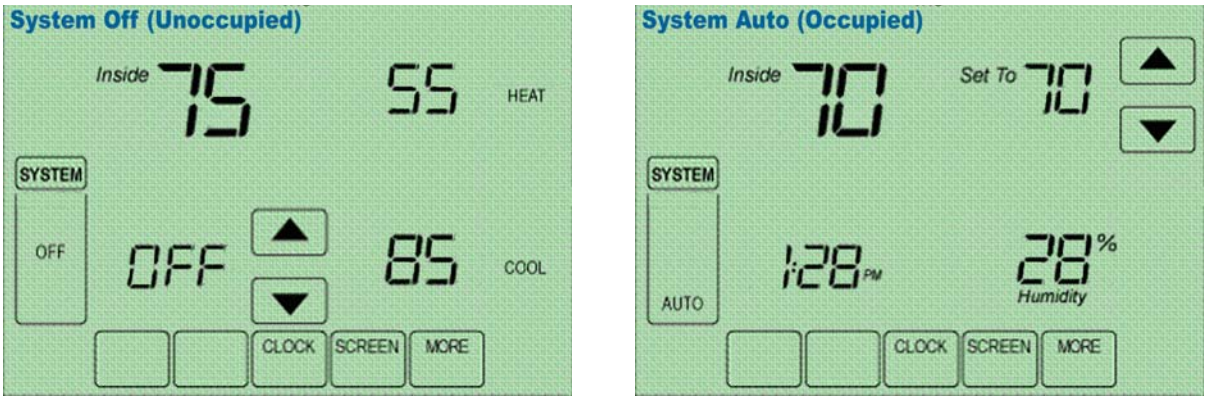


Figure 20 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 11 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint

Table 11 Setpoint values in Occupancy control

Field Code	Description
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

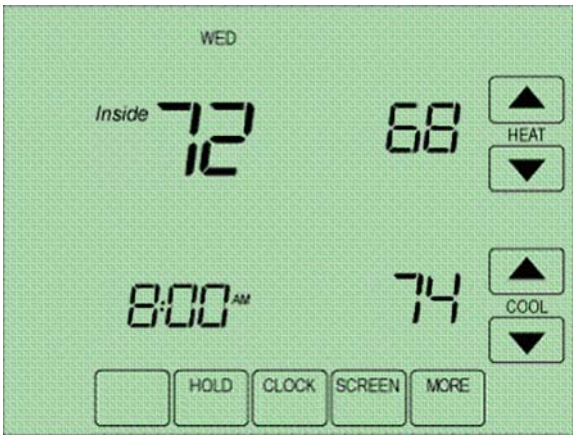


Figure 21 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the

beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator

workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

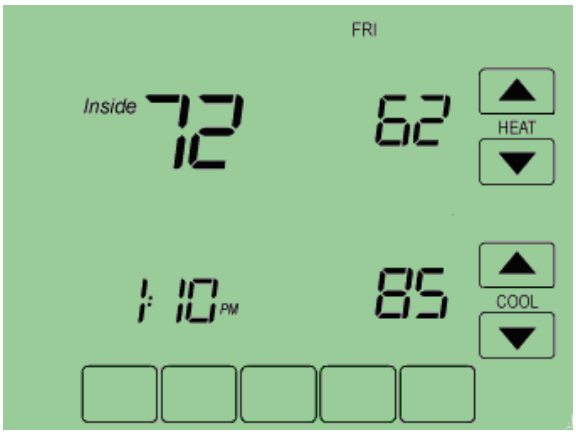


Figure 22 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

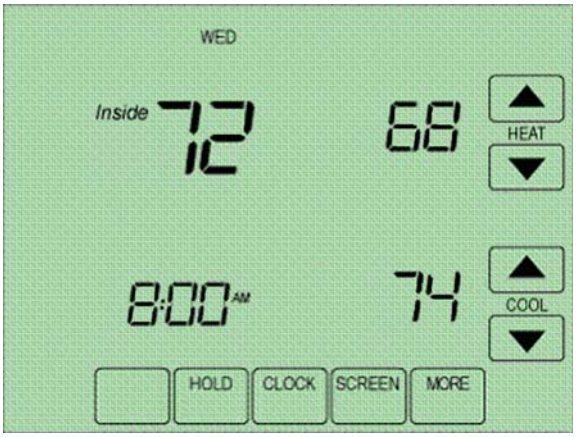


Figure 23 Setpoint mode display: single-speed fan

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously.

When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.

- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to Standby Heating and Cooling calculated Setpoints above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected

after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Compressor Control

Reversing Valve

The reversing valve does not change positions until the compressor has been OFF for at least 60 seconds. The reversing valve is set to the heating position (ON) when the heating signal exceeds 10 and the heating lockout is OFF. Otherwise the reversing valve is in the cooling position. Anti-cycle protection prevents the valve from changing positions more than once every two minutes. Some air-to-air heat pumps require the reversing valve to be activated in order to have the coil in Cooling mode. For cooling with the reversing valve active (ON), change [HC] or BV-21 to reverse the valve action.

AC-HP Control Mode (AV-40 set to 1)

The compressor commanded cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. The compressor command setpoints are adjustable from the display. When the fan requests AC cooling, BV-7 is ON. When BV-7 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short-cycling the compressor.

AV-68 AC-HP Compr Start Demand % (set at 20% default).

AV-69 AC-HP CMPR Stop Deadband % (default set at 1%)

AV-27 is minimum On time MON in minutes (anti-cycle).

AV-57 is minimum OFF time MOF in seconds (anti-cycle).

AC-HP control mode (AV-40, default set at 2)

Note AC or HP mode 1= ON-OFF (Demand Compare Control), 2= Analog to Binary Cycle Time Control.

The compressor control signal is selected between the Heating signal and the Cooling signal, depending on the status of the Heating/Cooling mode.

For Heating mode, the compressor signal ranges 0-100 as the Heating signal ranges 0-65. The Heating signal range 65-100 is reserved for auxiliary heat control.

For Cooling mode, the compressor signal ranges 0-100 as the Cooling signal ranges 0-100.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor-control signal. The Compressor Cycle Time [Cc] is adjustable from the display. Recommended cycle time range is 6-12 minutes. The compressor does not start unless the fan is ON. When the reversing valve changes position, there is a short delay before compressor operation is allowed. The Cooling or Heating Signal is processed by an analog-to-binary timer that controls the BO's ON/OFF duration. Runtime and compressor starts are accumulated.

When either the Cooling Lockout is ON or the Low-Supply-Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

When the Heating Lockout is ON, the compressor control signal is set to zero. The heating lock out temperature is controlled by the [hL] setting.

Compressor timing

Cycle times and minimum on/off times need to be set for operation of the heat-pump compressor.

- AV-26 [Cc] AC-HP Compressor Cycle Time: (CYC) time in minutes (factory default = 12 minutes)
- AV-27 [cc] AC-HP Compressor Minimum ON-OFF: (MON) and (MOF) time in minutes (factory default = 3 minutes)

Water source [App 3]

The compressor control (BV-31 WS HP Water Loop OK) must be enabled from the display or a BMS, ensuring that the water-source temperature is within the operating range for the heat pump and that water is flowing in the water-source

loop. Heat Pump safeties need to be hard wired with the compressor's binary output. The control sequence is identical to the air-to-air heat pump.

Staged auxiliary heating

Auxiliary heating is controlled by the upper portion of the Heating Signal range. The stage 1 auxiliary heat signal ranges 0-100 as the Heating Signal ranges 65-75. The stage 2 auxiliary heat signal ranges 0-100 as the Heating Signal ranges 75-100. Each auxiliary heating stage is turned ON for a percentage of each set Heating-Cycle period [Hc] based on the respective auxiliary heat stage signal. [Hc] operation is locked out when the outside-air temperature is above the Auxiliary Heating Lockout Temperature [hL]. Runtime is accumulated for each stage of auxiliary heating.

High and low refrigerant pressure cutouts must be separately provided, preferably hard-wired, to stop compressor operation in the event of these conditions. Outdoor coil defrost control and any provisions to allow oil sump heaters to be effective must also be included in the equipment manufacturer's controls or otherwise provided for.

2-stage auxiliary heating

The first stage of heat responds to the range 65-75 of the Heating signal. The second state of heat responds to the range 75-100 of the Heating signal.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stages. Staged heating will not run if either of the following two values are zero.

- AV-28 [Hc] Heating Stages Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stages Minimum ON-OFF: (MON) and (MOF) time in minutes (factory default = 1 minute)

Compressor and Heating-stages Binary Control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal.

Example: If the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds the humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 12 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2.

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Heat Pump Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

When condensate is sensed, e.g., BI-2 is shorted (active), AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C." The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

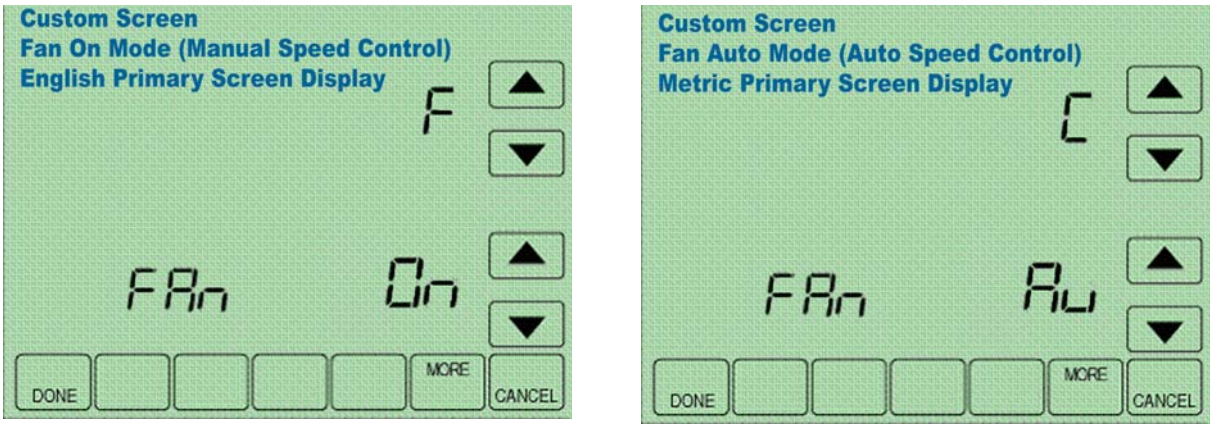


Figure 24 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 13 Setup codes: [AP] 2 or [AP] 3

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	2 or 3	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 13 Setup codes: [AP] 2 or [AP] 3

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 14 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run. Active App 3.
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure

Table 14 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control

Table 14 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

Air Conditioning Unit: App 4

1-stage compressor, 1-stage heating, 3-point floating or analog economizer, analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 15 Inputs and Outputs: [AP] 4

Point	Function
AI-0	Optional: Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional standby input (for PIR/door/window sensor)
AI-2	Supply-air sensor (optional, but required for economizer option)
BI-2	Normally-open condensate sensor (optional)
BO-0	Fan
BO-1	Compressor stage 1
BO-2	Not used
BO-3	Heating stage 1 (optional)
BO-4	Economizer open (optional)
BO-5	Economizer close (optional)
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

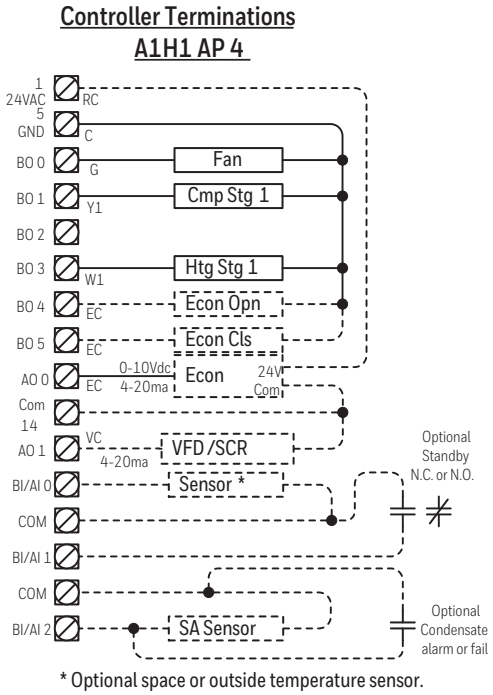


Figure 25 Controller terminations: [AP] 4

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan

will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

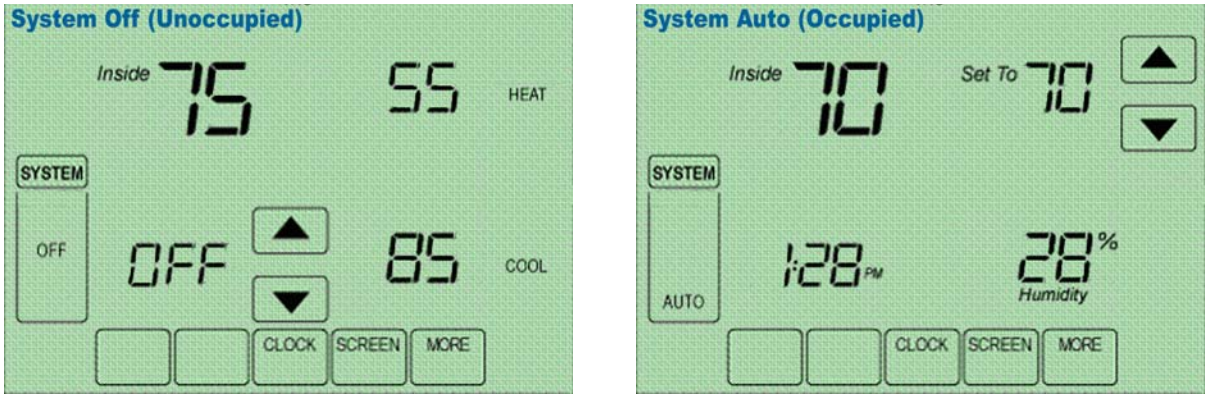


Figure 26 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-43.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5

minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 16 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

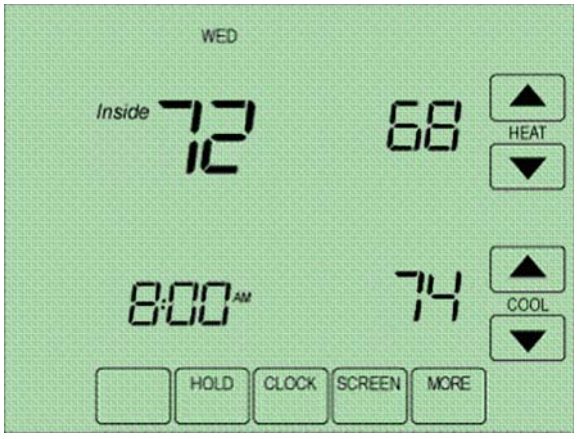


Figure 27 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

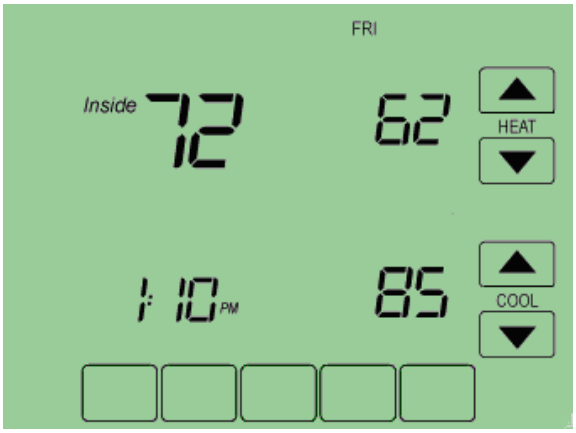


Figure 28 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to Standby Heating and Cooling calculated Setpoints above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the

Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Compressor Control

AC-HP Control Mode (AV-40 set to 1)

The compressor commanded cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. The compressor command setpoints are adjustable from

the display. When the fan requests AC cooling, BV-7 is ON. When BV-7 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short-cycling the compressor.

AV-68 AC-HP Compr Start Demand % (set at 20% default).

AV-69 AC-HP CMPR Stop Deadband % (default set at 1%)

AV-27 is minimum On time MON in minutes (anti-cycle).

AV-57 is minimum OFF time MOF in seconds (anti-cycle).

AC-HP control mode (AV-40, default set at 2)

The compressor control signal ranges 0-100 as the Cooling signal AV-1 ranges 0-100 if the economizer option is disabled. When the economizer option is enabled, the economizer utilizes the Cooling signal range 0-30, and the compressor control signal ranges 0-100 as the Cooling signal AV-1 ranges 30-100.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor-control signal. The Compressor Cycle Time [Cc] is adjustable from the display. Recommended cycle time range is 6-12 minutes. The compressor does not start unless the fan is ON. Runtime and compressor starts are accumulated.

- When either the Cooling Lockout is ON or the Low Supply Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Compressor timing

Cycle times and minimum on/off times need to be set for operation of the heat-pump compressor.

- AV-26 [Cc] AC-HP Compressor Cycle Time: (CYC) time in minutes (factory default = 12 minutes)
- AV-27 [cc] AC-HP Compressor Minimum ON-OFF: (MON) and (MOF) time in minutes (factory default = 3 minutes)

Auxiliary heating

Auxiliary heating is controlled by the upper portion of the Heating Signal range. The auxiliary heat signal ranges 0-100 as the Heating Signal ranges 65-100. Auxiliary heating is staged ON for a percentage of each set Heating-Cycle period [Hc] based on the value of the auxiliary heat signal. [Hc] operation is locked out when the outside-air temperature is above the Auxiliary Heating Lockout Temperature [hL]. Runtime is accumulated for auxiliary heating.

High and low refrigerant pressure cutouts must be separately provided, preferably hard-wired, to stop compressor operation in the event of these conditions. Outdoor coil defrost control and any provisions to allow oil sump

heaters to be effective must also be included in the equipment manufacturer's controls or otherwise provided for.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stages. Staged heating will not run if either of the following two values are zero.

- AV-28 [Hc] Heating Stages Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stages Minimum ON: (MON) time in minutes. (factory default = 1 minute)
- AV-80 [?] Heating stages minimum OFF (MOF) 60 seconds

Compressor and Heating-stages Binary Control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal. For example, if the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31.When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 17 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer logic is enabled when Economizer Damper Stroke Time [ES] AV-63 is set to 5 seconds or above. If the economizer option will not be used, [ES] AV-63 should be set to 0 (factory default); this will prevent the economizer relays from clicking. If the analog modulating option is to be used, [ES] AV-63 should be set to 5. The economizer sequence requires that a supply air sensor be wired to AI-2.

As the Cooling signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

The Economizer Damper Stroke Time [ES] is used in combination with the current economizer commanded position to estimate the actual current position of the economizer damper. A BMS is required to set the values for AV-60, AV-66, and AV-67. The economizer sequence requires that a supply air sensor be wired to AI-2.

Analog modulating economizer

The economizer is controlled directly by the economizer command output on AO-0.

3-point floating motor economizer

The economizer is controlled directly by the economizer command. As the command signal increases, BO-4 is active, driving the economizer open. As the command signal decreases, BO-5 is active, driving the economizer closed.

AC Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

When condensate is sensed, e.g., BI-2 is shorted (active), AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

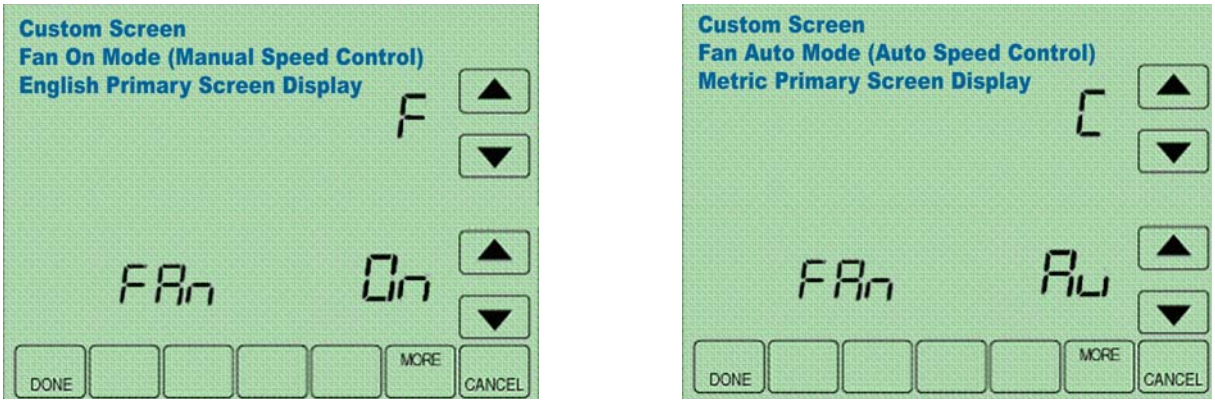


Figure 29 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 18 Setup codes: [AP] 4

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	4	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 18 Setup codes: [AP] 4

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 19 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure

Table 19 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control

Table 19 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

Air Conditioning Unit: App 5

2-stage compressor, 2-stage heating, analog economizer, single-speed fan, optional analog fan control.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 20 Inputs and Outputs: [AP] 5

Point	Function
AI-0	Optional: Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional standby input (for PIR/door/window sensor)
AI-2	Supply-air sensor (optional, but required for economizer option)
BI-2	Normally-open condensate sensor (optional)
BO-0	Fan
BO-1	Compressor stage 1
BO-2	Compressor stage 2
BO-3	Heating stage 1 (optional)
BO-4	Heating stage 2 (optional)
BO-5	Not used
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

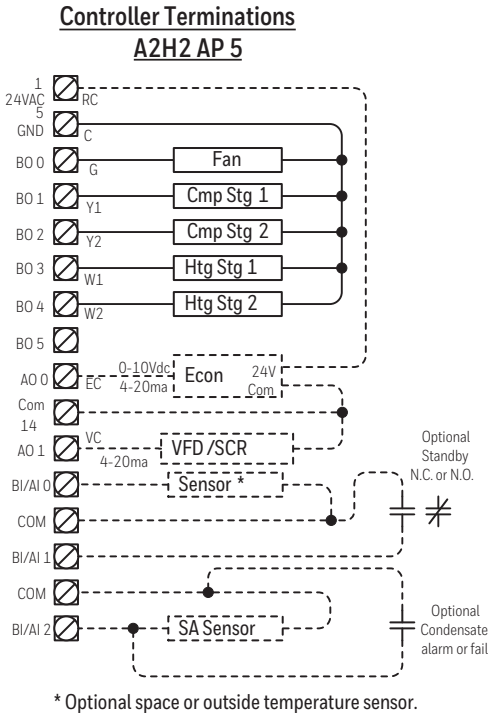


Figure 30 Controller terminations: [AP] 5

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan

will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

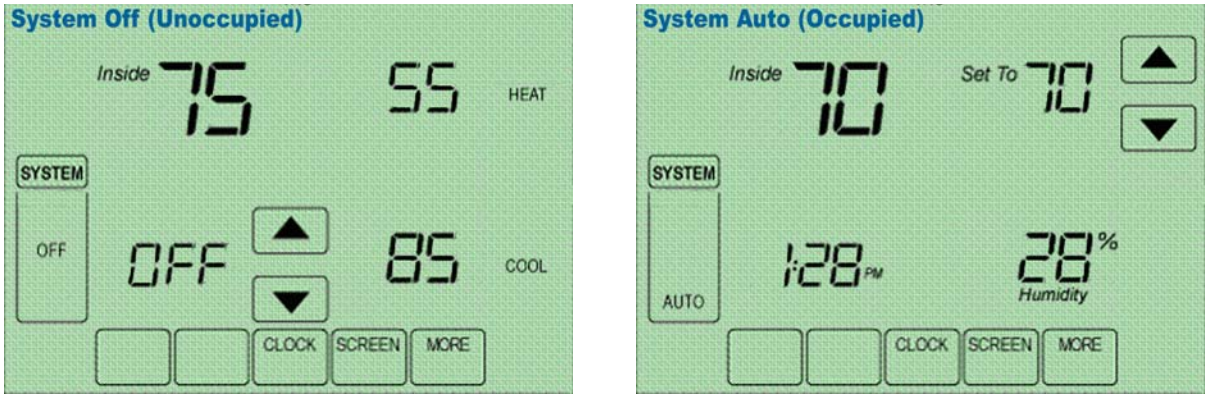


Figure 31 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5

minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 21 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

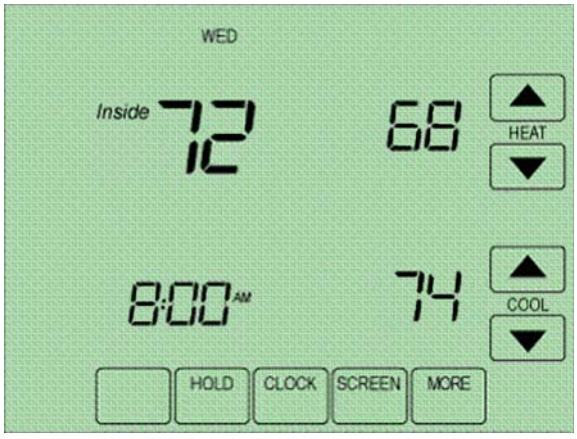


Figure 32 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

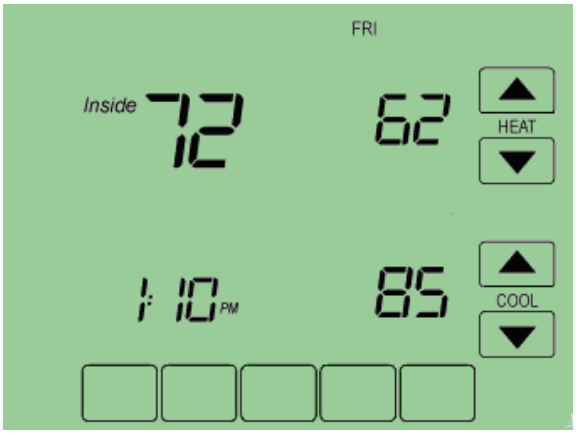


Figure 33 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to Standby Heating and Cooling calculated Setpoints above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Compressor Control

AC-HP Control Mode (AV-40 set to 1)

The compressor commanded cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. The compressor command setpoints are adjustable from the display. When the fan requests AC cooling, BV-7 is ON. When BV-7 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short-cycling the compressor.

AV-68 AC-HP Compr Start Demand % (set at 20% default).

AV-69 AC-HP CMPR Stop Deadband % (default set at 1%)

AV-27 is minimum On time MON in minutes (anti-cycle).

AV-57 is minimum OFF time MOF in seconds (anti-cycle).

AC-HP control mode (AV-40, default set at 2)

Note AC or HP mode 1= ON-OFF (Demand Compare Control), 2= Analog to Binary Cycle Time Control.

The compressor control signal is selected between the Heating signal and the Cooling signal, depending on the status of the Heating/Cooling mode.

For Heating mode, the compressor signal ranges 0-100 as the Heating signal ranges 67-100. The Heating signal range 65-100 is reserved for auxiliary heat control.

For Cooling mode, the compressor signal ranges 0-100 as the Cooling signal ranges 0-67.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor-control signal. The Compressor Cycle Time [Cc] is adjustable from the display, but it is limited to a minimum of six minutes, and a maximum of twelve minutes. The compressor does not start unless the fan is ON. When the reversing valve changes position, there is a short delay before compressor operation is allowed. The Cooling or Heating Signal is processed by an analog-to-binary timer that controls the BO's ON/OFF duration. Runtime and compressor starts are accumulated.

When either the Cooling Lockout is ON or the Low-Supply-Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

When the Heating Lockout is ON, the compressor control signal is set to zero. The heating lock out temperature is controlled by the [hL] setting.

When BV-6, Heat Pump Fan Request is ON, the fan runs. When BV-6 is OFF, the fan stops after a short delay.

Compressor Stages

The stage 1 compressor control signal ranges 0-100 as the Cooling signal AV-1 ranges 0-65 if the economizer option is not enabled. When the economizer option is enabled, the range 0-30 of the Cooling signal AV-1 is reserved for controlling the economizer, and the stage 1 compressor control signal ranges 0-100 as the Cooling signal AV-1 ranges 30-65.

The stage 2 compressor control signal ranges 0-100 as the Cooling signal AV-1 ranges 65-100.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor control signal. The Compressor

Cycle Time [Cc] is adjustable from the display. Recommended range of [Cc] is from 6-12 minutes (factory default = 12). The compressor does not start unless the fan is ON. Runtime and compressor starts are accumulated for each compressor stage.

When either the Cooling Lockout is ON or the Low-Supply-Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Compressor timing

Cycle times and minimum on/off times need to be set for operation of the heat-pump compressor.

- AV-26 [Cc] AC-HP Compressor Cycle Time: (CYC) time in minutes (factory default = 12 minutes)
- AV-27 [cc] AC-HP Compressor Minimum ON-OFF: (MON) and (MOF) time in minutes (factory default = 3 minutes)

Staged auxiliary heating

The auxiliary heat stage 1 signal ranges 0-100 as the Heating signal ranges 0-50. The auxiliary heat stage 2 signal ranges 0-100 as the Heating signal ranges 50-100. Auxiliary heat stages are turned ON for an increasing portion of each set Heating Cycle period [Hc] as the corresponding auxiliary heat stage signals vary between 0 and 100. [Hc] operation is locked out when the outside-air temperature is above the Auxiliary Heating Lockout Temperature [hL]. Runtime is accumulated for auxiliary heating stage.

High and low refrigerant pressure cutouts must be separately provided, preferably hard-wired, to stop compressor operation in the event of these conditions. Outdoor coil defrost control and any provisions to allow oil sump heaters to be effective must also be included in the equipment manufacturer’s controls or otherwise provided for.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stages. Staged heating will not run if either of the following two values are zero.

- AAV-28 [Hc] Heating Stages Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stages Minimum ON: (MON) time in minutes. (factory default = 1 minute)
- AV-80 [?] Heating stages minimum OFF (MOF) 60 seconds

Compressor and Heating-stages Binary Control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal. For example, if the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 22 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2.

As the Cooling signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

AC Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

When condensate is sensed, e.g., BI-2 is shorted (active), AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller’s main display for English “F” or Metric “C”. The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting

BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

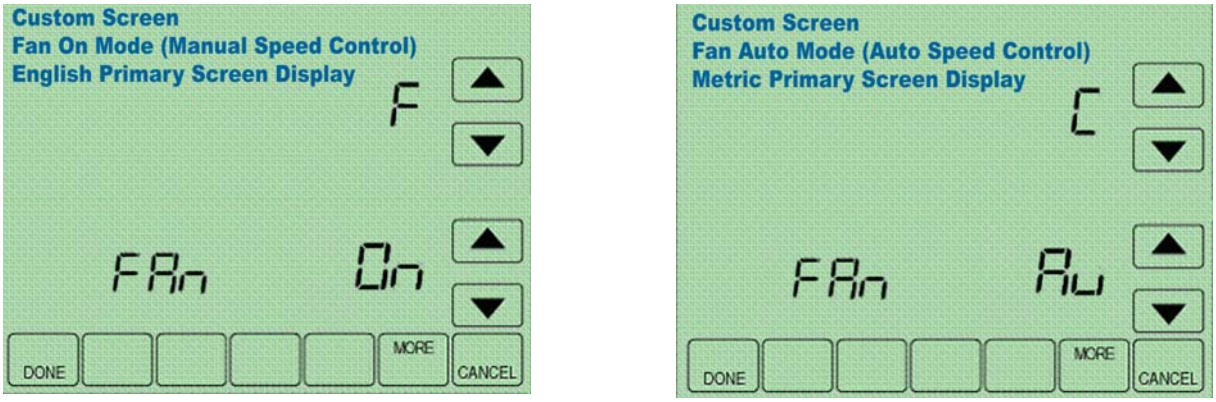


Figure 34 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 23 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	5	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		

Table 23 Setup codes

Code	Object		Default	Options	Units	Notes
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 24 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		

Table 24 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	

Table 24 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		

Table 24 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

4 Pipe Fan Coil Unit: App 6

3-point floating cooling and heating valves, analog economizer, single-speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 25 Inputs and Outputs: [AP] 6

Point	Function
AI-0	Optional: Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional standby input (for PIR/door/window sensor)
AI-2	Supply-air sensor (optional, but required for economizer option)
BO-0	Fan
BO-1	Cooling Valve Open
BO-2	Cooling Valve Close
BO-3	Heating Valve Open
BO-4	Heating Valve Close
BO-5	Not used
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

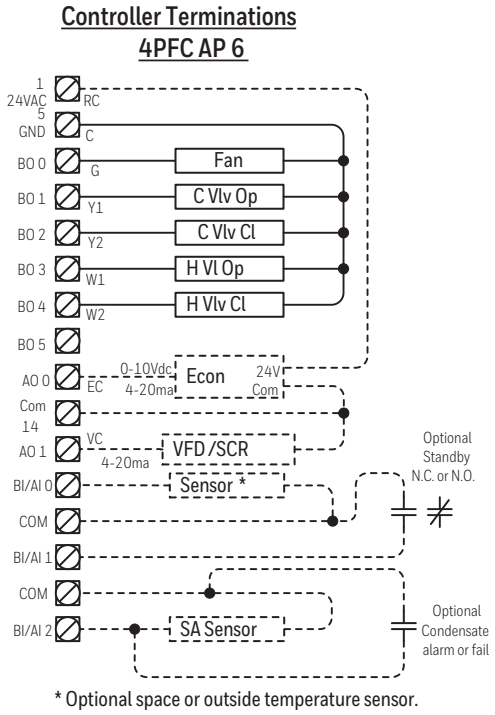


Figure 35 Controller terminations: [AP] 6

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan

will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

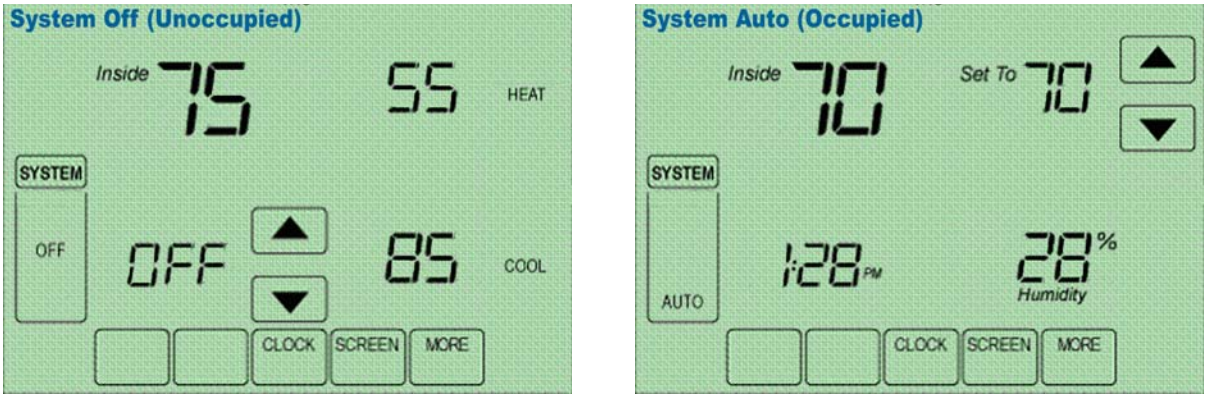


Figure 36 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 26 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint

Table 26 Setpoint values in Occupancy control

Field Code	Description
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

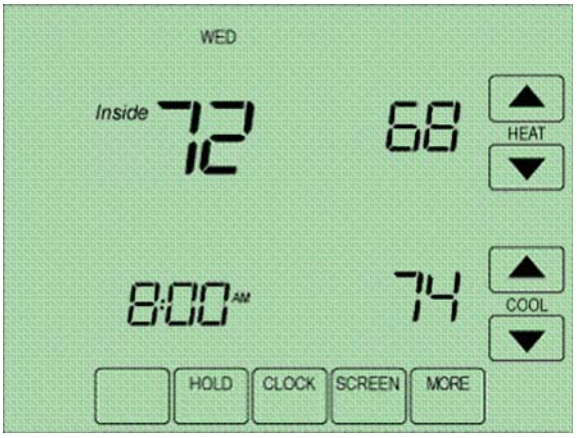


Figure 37 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending

time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator

workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

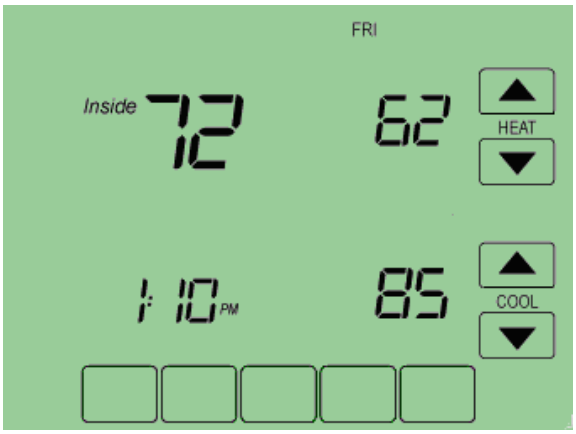


Figure 38 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During Occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

During Occupied state or Unoccupied state, if ABV-8 Cooling signal or AV-13 Heating signal is equal to or greater than the Auto Fan Start Setpoint (AV-46), then BV-13 Htg-Clg Vlv Demand Fan Request is active. The Htg-Clg Vlv Demand Fan Request remains active until the heating/cooling signal falls below the Auto Fan Stop Deadband SP (AV-53). AV-46 adjustable default is 20% minus AV-53 adjustable default of 5%.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to Standby Heating and Cooling calculated Setpoints above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Valve Control

Cooling — 3 Point Floating Motor

The cooling valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the cooling valve control signal.

BV-15 active causes the cooling valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. A PI loop computes the cooling valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

As the cooling valve control signal increases BO-1 is active driving the cooling valve open. As the cooling valve control signal decreases BO-2 is active driving the cooling valve closed.

The cooling valve is driven closed if any of the following are true:

- Cooling Valve Stroke Time AV-64 (factory default = 3) is set to less than 3 minutes
- Cooling Lockout is in effect
- Fan is OFF

Heating – 3 Point Floating Motor

The heating valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the heating valve control signal.

BV-15 active causes the heating valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Heating signal AV-1, the current supply air temperature, and the supply air temperature high limit. A PI loop computes the heating valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

As the heating valve control signal increases BO-3 is active driving the heating valve open. As the heating valve control signal decreases BO-4 is active driving the heating valve closed.

The heating valve is driven closed if any of the following are true:

- Heating Valve Stroke Time AV-65 (factory default = 3) is set to less than 3 minutes
- Heating Lockout is in effect
- Fan is OFF

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 27 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2.

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Economizer Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller’s main display for English “F” or Metric “C”. The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting

BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

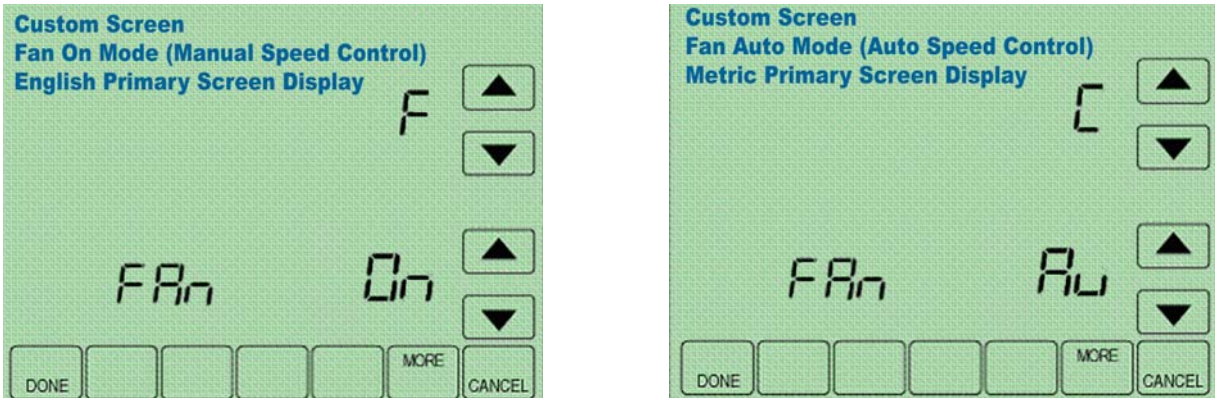


Figure 39 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 28 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	6	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		

Table 28 Setup codes

Code	Object		Default	Options	Units	Notes
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 29 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		

Table 29 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	

Table 29 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		

Table 29 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

4 Pipe Fan Coil Unit: App 7

3 point floating cooling and heating valves, analog economizer, single-speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating/cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 30 Inputs and Outputs: [AP] 7

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for PIR/door/window sensors (BV-47 inactive, default)
AI-2	Reserved for Main door sensor on BI-2 (BV-47 inactive, default) Optional configuration as Supply-air sensor (optional, required for economizer option)
BI-2	Main door sensor (BV-47 inactive, default)
BO-0	Fan
BO-1	Cooling Valve Open
BO-2	Cooling Valve Close
BO-3	Heating Valve Open
BO-4	Heating Valve Close
BO-5	Not used
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

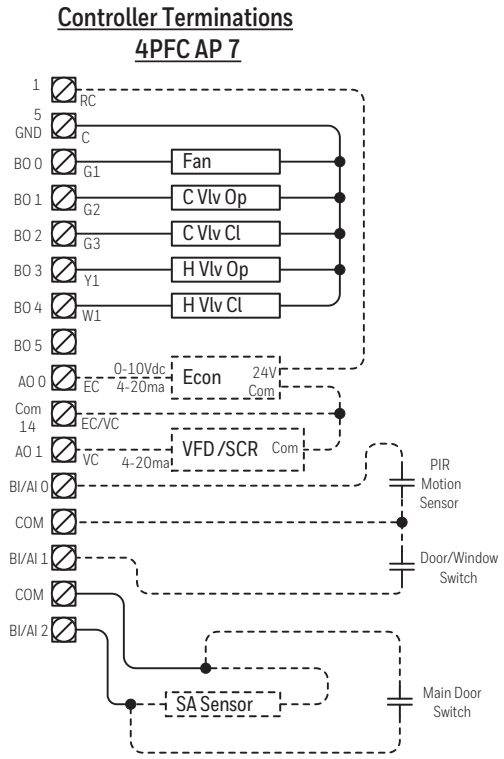


Figure 40 Controller terminations: [AP] 7

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan

will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

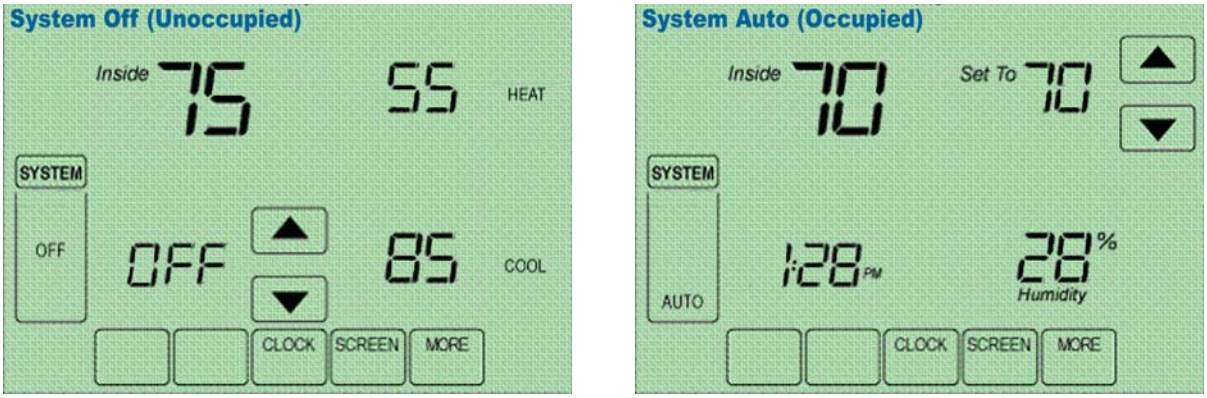


Figure 41 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 31 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint

Table 31 Setpoint values in Occupancy control

Field Code	Description
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

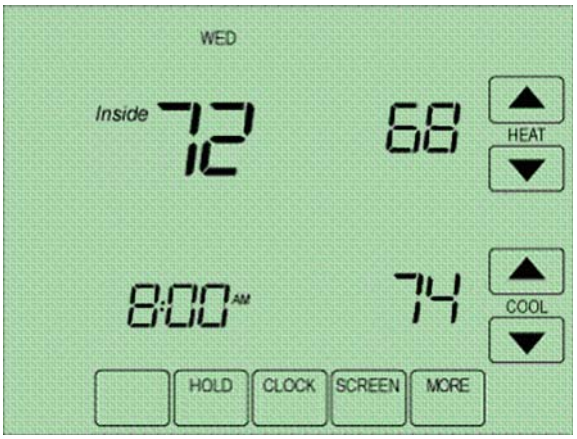


Figure 42 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the

beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator

workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

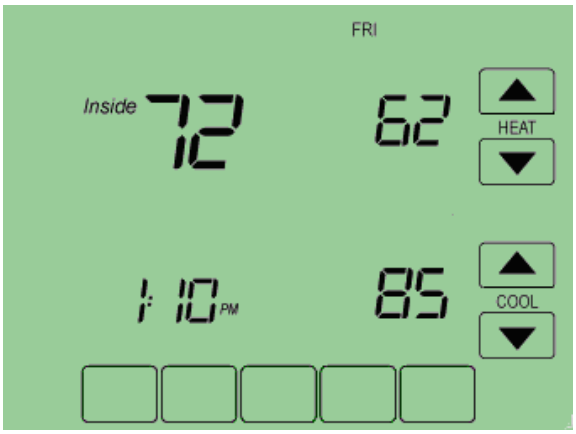


Figure 43 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

During Occupied state or Unoccupied state, if ABV-8 Cooling signal or AV-13 Heating signal is equal to or greater than the Auto Fan Start Setpoint (AV-46), then BV-13 Htg-Clg Vlv Demand Fan Request is active. The Htg-Clg Vlv Demand Fan Request remains active until the heating/cooling signal falls below the Auto Fan Stop Deadband SP (AV-53). AV-46 adjustable default is 20% minus AV-53 adjustable default of 5%.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-2 Main Door and BI-1 (optional door/window) are monitored during Occupied mode state. If the doors or window are opened longer than the Standby Delay AV-20, the unit sets to Standby mode state. After the doors or window are closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby mode state. During Standby mode state if the PIR on BI-0 triggers the unit resets to Occupied mode state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Valve Control

Cooling — 3 Point Floating Motor

The cooling valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the cooling valve control signal..

BV-15 active causes the cooling valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. A PI loop computes the cooling valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

As the cooling valve control signal increases BO-1 is active driving the cooling valve open. As the cooling valve control signal decreases BO-2 is active driving the cooling valve closed.

The cooling valve is driven closed if any of the following are true:

- Cooling Valve Stroke Time AV-64 (factory default = 3) is set to less than 3 minutes
- Cooling Lockout is in effect
- Fan is OFF

Heating – 3 Point Floating Motor

The heating valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the heating valve control signal.

BV-15 active causes the heating valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Heating signal AV-1, the current supply air temperature, and the supply air temperature high limit. A PI loop computes the heating valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

As the heating valve control signal increases BO-3 is active driving the heating valve open. As the heating valve control signal decreases BO-4 is active driving the heating valve closed.

The heating valve is driven closed if any of the following are true:

- Heating Valve Stroke Time AV-65 (factory default = 3) is set to less than 3 minutes
- Heating Lockout is in effect
- Fan is OFF

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 32 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2. The economizer option is not available if Standby detection is enabled.

As the Cooling Control Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Economizer Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

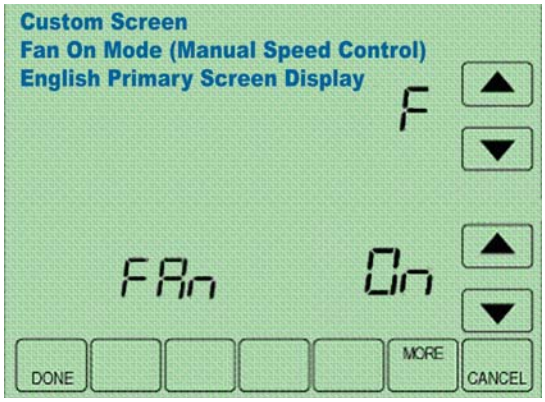
Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller’s main display for English “F” or Metric “C”. The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting

BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.



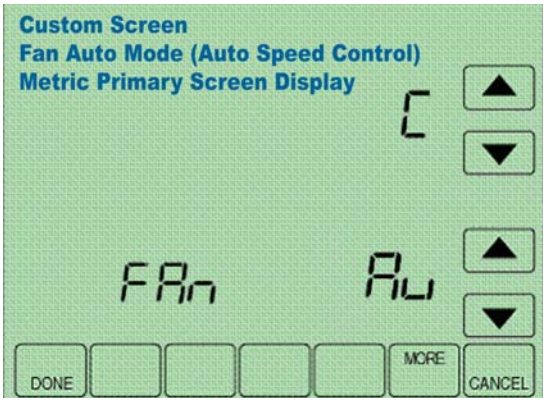


Figure 44 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 33 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	7	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		

Table 33 Setup codes

Code	Object		Default	Options	Units	Notes
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 34 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		

Table 34 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	

Table 34 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		

Table 34 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

4 Pipe Fan Coil Unit: App 8

2 position cooling and heating valves, analog economizer, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 35 Inputs and Outputs: [AP] 8

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for PIR/door/window sensors (BV-47 inactive, default)
AI-2	Reserved for Main door sensor on BI-2 (BV-47 inactive, default) Optional configuration as Supply-air sensor (optional, required for economizer option). Use a 10K type 2 thermistor.
BI-2	Main door sensor (BV-47 inactive, default)
BO-0	Fan Low

Table 35 Inputs and Outputs: [AP] 8

Point	Function
BO-1	Fan Medium
BO-2	Fan High
BO-3	Cooling 2 Position Valve Open/Close
BO-4	Heating 2 Position Valve Open/Close
BO-5	Not used
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

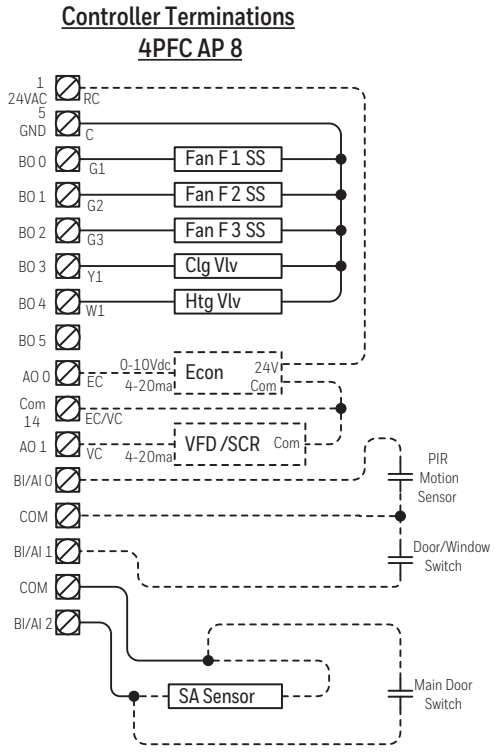


Figure 45 Controller terminations: [AP] 8

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

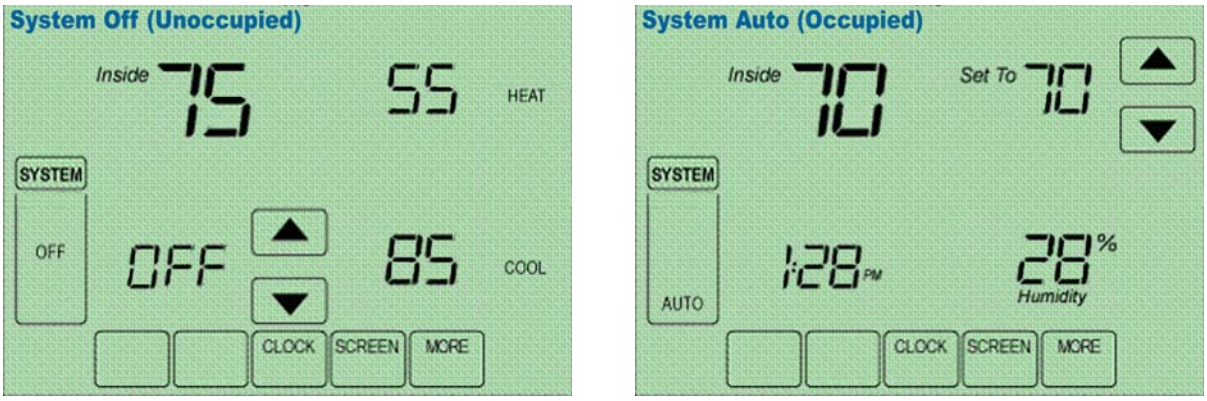


Figure 46 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller's SYSTEM Block is set to "OFF" by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active. BV-9 MUST be set to 'Active' for proper application control based on schedules.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 36 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

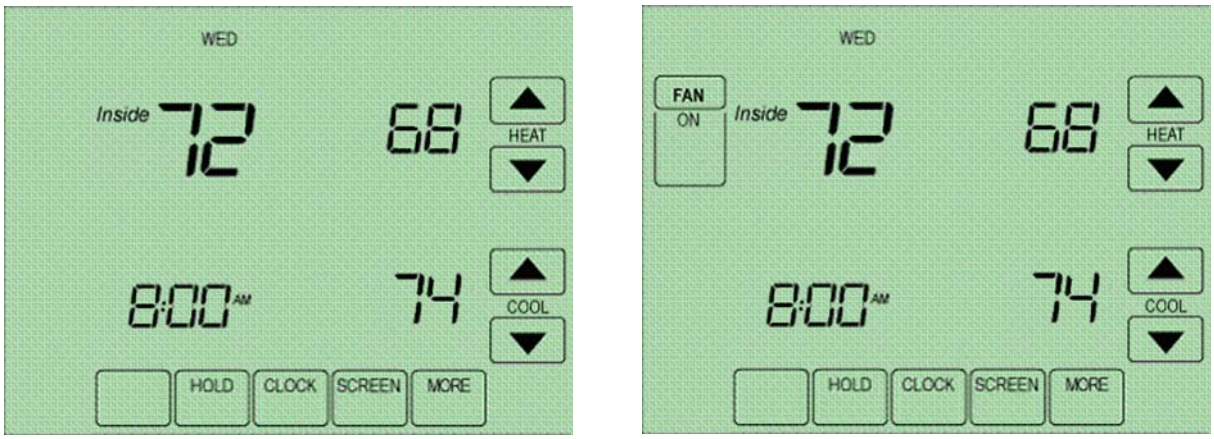


Figure 47 Setpoint mode display: single-speed fan and 3-speed fan

Note Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

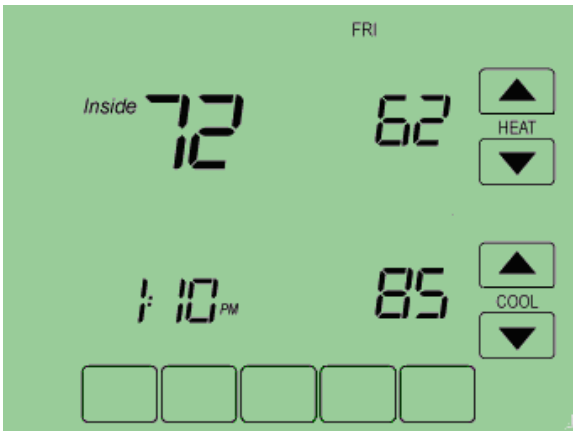


Figure 48 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.0

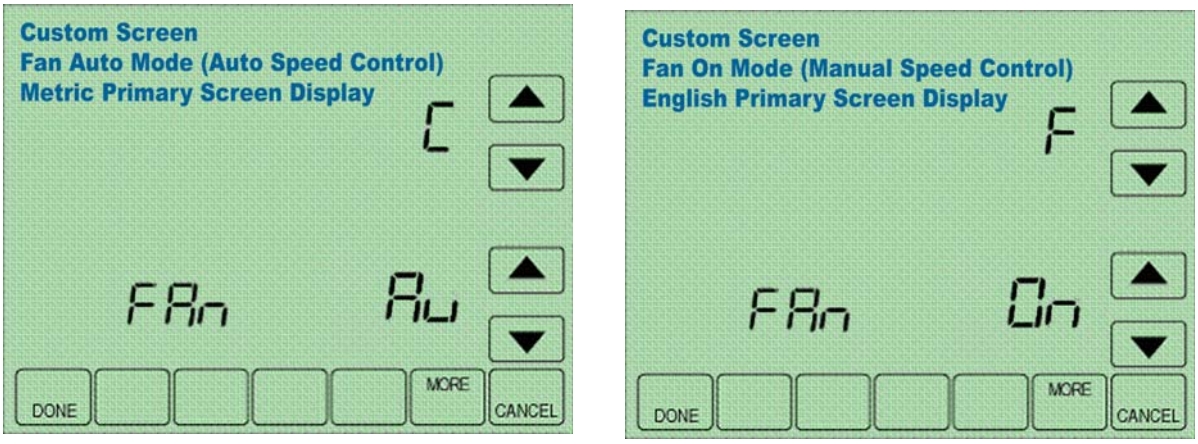


Figure 49 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will re-sync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-2 Main Door and BI-1 (optional door/window) are monitored during Occupied state. If the doors or window are opened longer than the Standby Delay AV-20, the unit sets to Standby state. After the doors or window are closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby mode state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Valve Control

Cooling — 2 Position Valve Open/Close

The cooling valve control signal is 0 (closed) if any of the following are true:

- Fan is Off
- Cooling Lockout is active
- Heating mode is selected
- Cooling mode has been selected less than 60 seconds

Otherwise, the Cooling signal is used as the cooling valve control signal.

Heating – 2 Position Valve Open/Close

The heating valve control signal is 0 (closed) if any of the following are true:

- Fan is Off
- Heating Lockout is active
- Cooling mode is selected

Otherwise, the heating valve control signal ranges 0-100 as the Heating signal ranges 0-100.

Physical heating/cooling valve control has three options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the heating valve. If the heating valve signal is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the heating valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the heating valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the heating valve signal is 75, then during each 5 minute cycle the heating valve will be commanded open for the first 3 minutes and 45 seconds.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse width) from 0 to 2.55 seconds as cooling or heating varies from 0-100. If the signal is 0, the output remains OFF. The pulse width is calculated using a nonlinear conversion to better match the thermal modulating valve (TMV).

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 37 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2. The economizer option is not available if Standby detection is enabled.

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Economizer Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C." The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

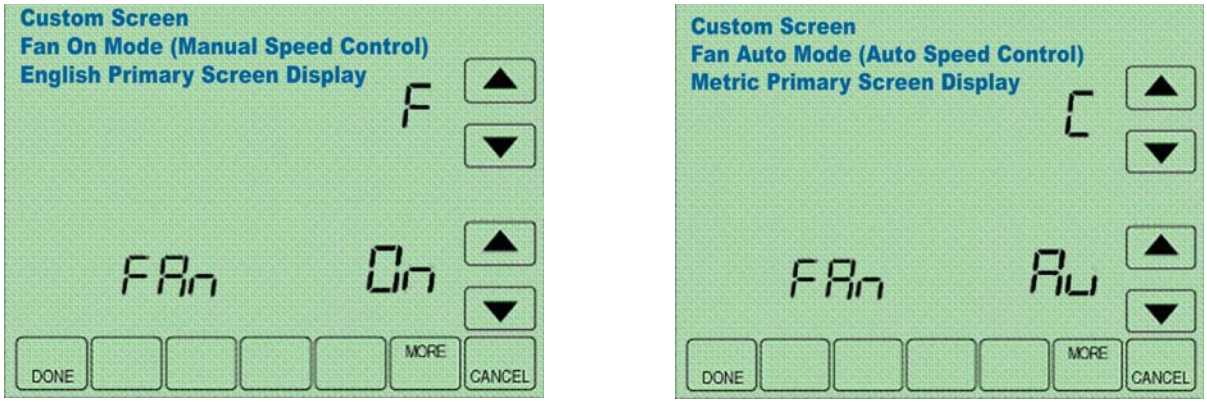


Figure 50 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 38 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	8	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 38 Setup codes

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 39 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 39 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Active	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure. BV-9 MUST be 'Active' for applications 8 and 9 for proper application control.
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.

Table 39 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 39 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

4 Pipe Fan Coil Unit: App 9

2 position cooling and heating valves, 1 stage auxiliary heat, analog economizer, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 40 Inputs and Outputs: [AP] 9

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for PIR/door/window sensors (BV-47 inactive, default)
AI-2	Reserved for Main door sensor on BI-2 (BV-47 inactive, default) Optional configuration as Supply-air sensor (optional, required for economizer option). Use a 10K type 2 thermistor.
BI-2	Main door sensor (BV-47 inactive, default)

Table 40 Inputs and Outputs: [AP] 9

Point	Function
BO-0	Fan Low
BO-1	Fan Medium
BO-2	Fan High
BO-3	Cooling 2 Position Valve Open/Close
BO-4	Heating 2 Position Valve Open/Close
BO-5	Auxiliary Heat
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

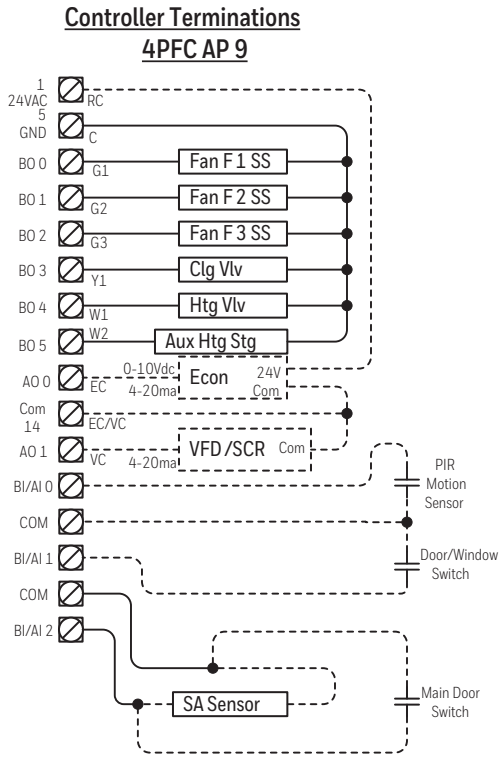


Figure 51 Controller terminations: [AP] 9

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller

display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is off. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

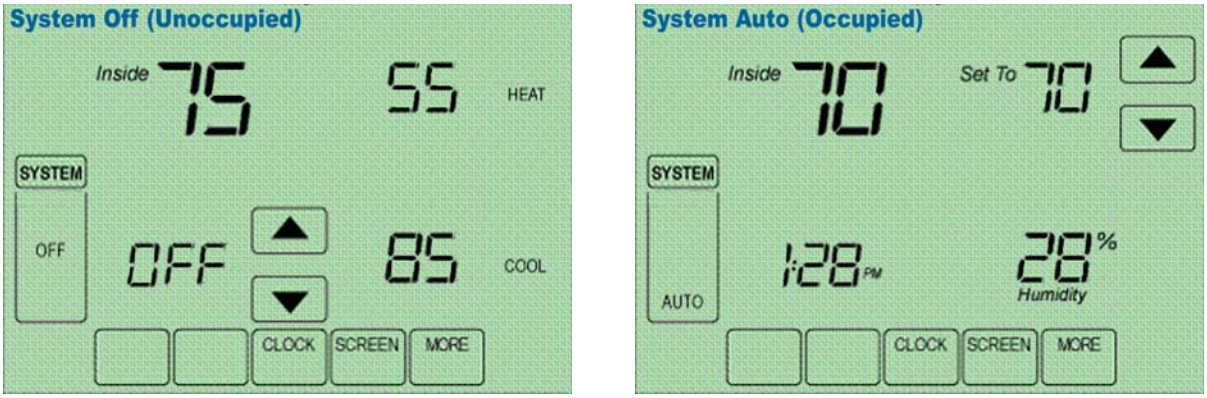


Figure 52 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller's SYSTEM Block is set to "OFF" by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active. BV-9 MUST be set to 'Active' for proper application control based on schedules.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 41 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

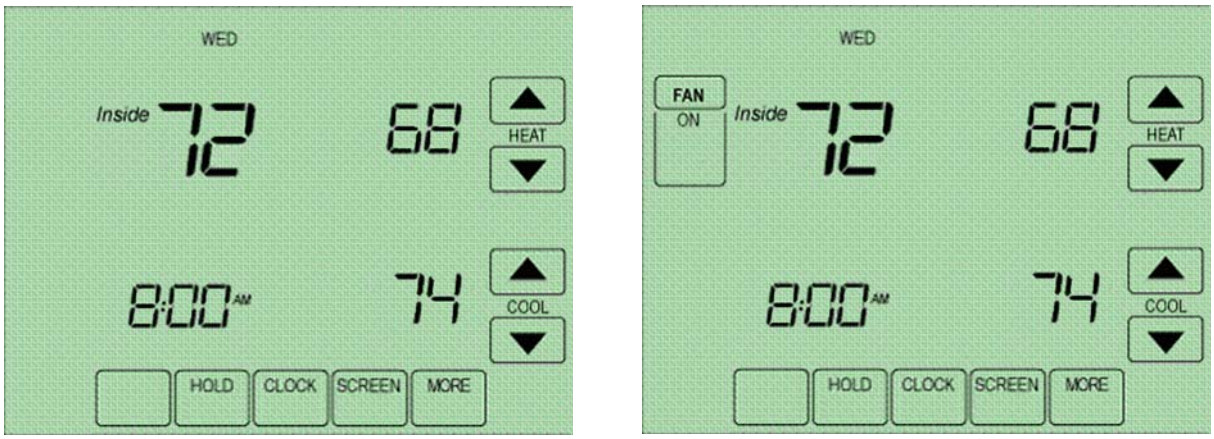


Figure 53 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

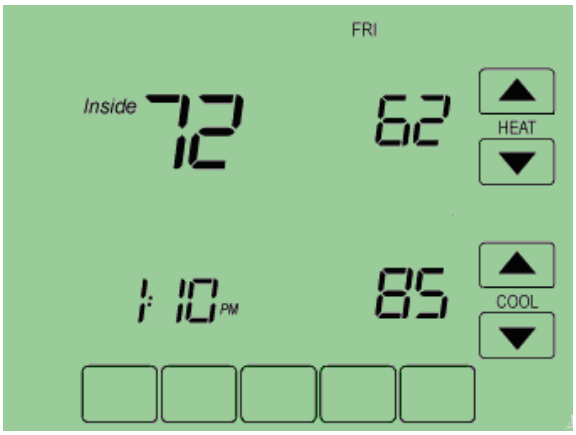


Figure 54 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

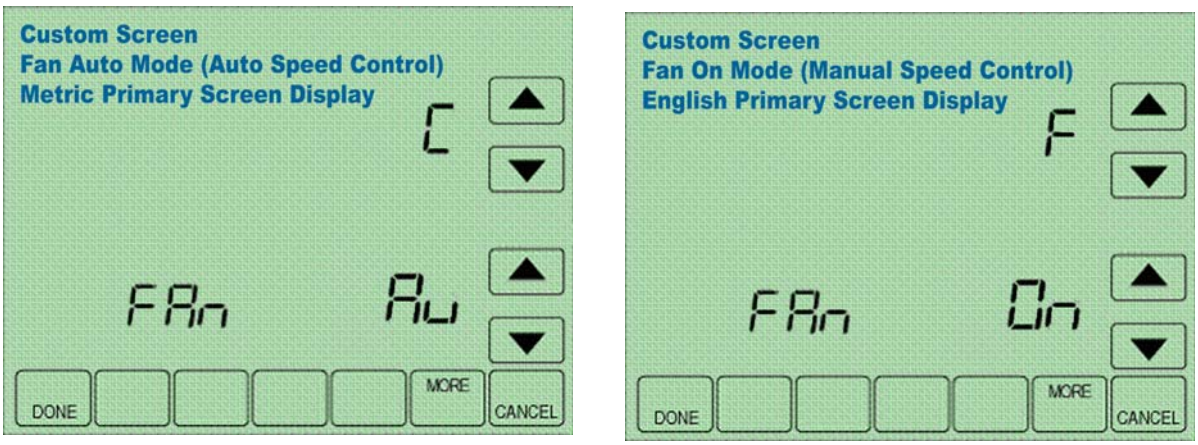


Figure 55 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-2 Main Door and BI-1 (optional door/window) are monitored during Occupied state. If the doors or window are opened longer than the Standby Delay AV-20, the unit sets to Standby state. After the doors or window are closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby mode state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp [hP] (AV-41) and Heating Signal Ki [hi] (AV-42). The Cooling Signal PI settings are Cooling Signal Kp [cP] (AV-43) and Cooling Signal Ki [ci] (AV-44).

Valve Control

Cooling — 2 Position Valve Open/Close

The cooling valve control signal is 0 (closed) if any of the following are true:

- Fan is Off
- Cooling Lockout is active
- Heating mode is selected
- Cooling mode has been selected less than 60 seconds

Otherwise, the Cooling signal is used as the cooling valve control signal.

Heating – 2 Position Valve Open/Close

The heating valve control signal is 0 (closed) if any of the following are true:

- Fan is Off
- Heating Lockout is active
- Cooling mode is selected

Otherwise, the heating valve control signal ranges 0-100 as the Heating signal ranges 50-75.

The 2 position heating/cooling valve control has three options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the heating valve. If the heating valve signal is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the heating valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the heating valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the heating valve signal is 75, then during each 5 minute cycle the heating valve will be commanded open for the first 3 minutes and 45 seconds.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse width) from 0 to 2.55 seconds as the cooling or heating varies from 0-100. If the signal is 0, the output remains OFF. The pulse width is calculated using a non-linear conversion to better match the thermal modulating valve (TMV).

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 2 position valve.

Staged auxiliary heating

Auxiliary heating is controlled by the 75-100 range of the Heating signal. The stage 1 auxiliary heat signal ranges 0-100 as the Heating Signal ranges 75-100. The auxiliary heating stage is turned ON for a percentage of each set Heating-Cycle period [Hc] based on the auxiliary heat signal. [Hc] operation is locked out when the outside-air temperature is above the Auxiliary Heating Lockout Temperature [hL]. Runtime is accumulated for auxiliary heating.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stage. Staged heating will not run if either of the following two values are zero.

- AV-28 [Hc] Heating Stages Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stages Minimum ON: (MON) time in minutes. (factory default = 1 minute)
- AV-80 Heating stages minimum OFF (MOF) 60 seconds

Heating-stage Binary Control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal. For example, if the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 42 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer option is supported by a modulating analog economizer command signal on AO-0. The economizer sequence requires that a supply air sensor be wired to AI-2. The economizer option is not available if Standby detection is enabled.

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Economizer Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

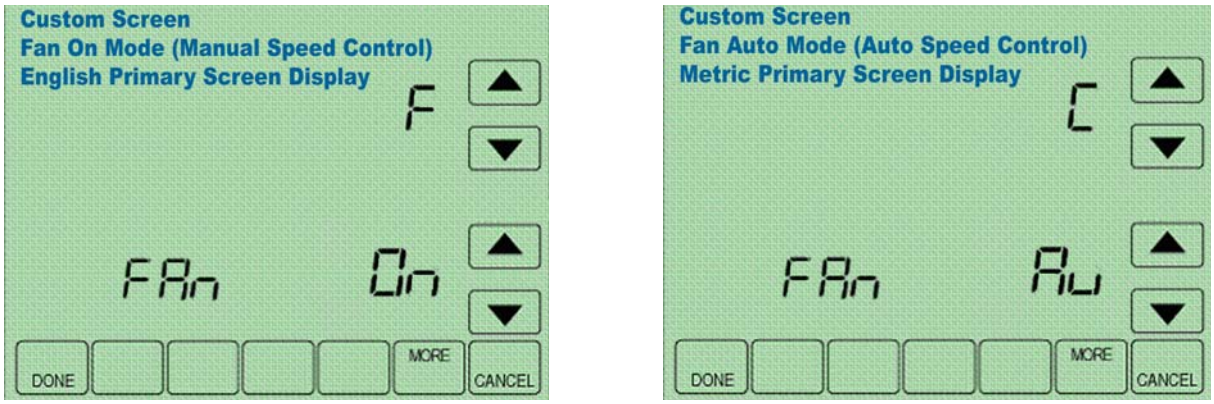


Figure 56 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 43 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	9	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	

Table 43 Setup codes

Code	Object		Default	Options	Units	Notes
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 44 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy or Setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	5	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Active	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure BV-9 MUST be 'Active' for applications 8 and 9 for proper application control.

Table 44 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-10	Enable System OFF	Inactive	Inactive/Active		
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Setting for all single speed fan applications
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control

Table 44 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

Air to Air Heat Pump: App 10

3-speed fan with binary output start/stop, optional analog variable-speed fan control, auxiliary heating, analog economizer.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections:

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 45 Inputs and Outputs: [AP] 10

Point	Function
AI-0	Optional: Temperature sensor Use as space sensor in place of the internal space sensor AV-104 (Set BV-32 active and BV-47 inactive) Use as an outdoor-air sensor; maps to display AV-103 (Set BV-47 active and BV-32 inactive)
BI-1	Optional Standby input for PIR/door/window sensors
BI-2	Optional, normally open condensate sensor
AI-2	Supply-air sensor (optional, required for economizer option)
BO-0	Fan Low Speed
BO-1	Fan Medium Speed
BO-2	Fan High Speed

Table 45 Inputs and Outputs: [AP] 10

Point	Function
BO-3	Heat Pump Compressor
BO-4	Reversing Valve
BO-5	Auxiliary Heat
AO-0	Economizer (optional)
AO-1	Analog fan speed (optional)

Wiring diagram

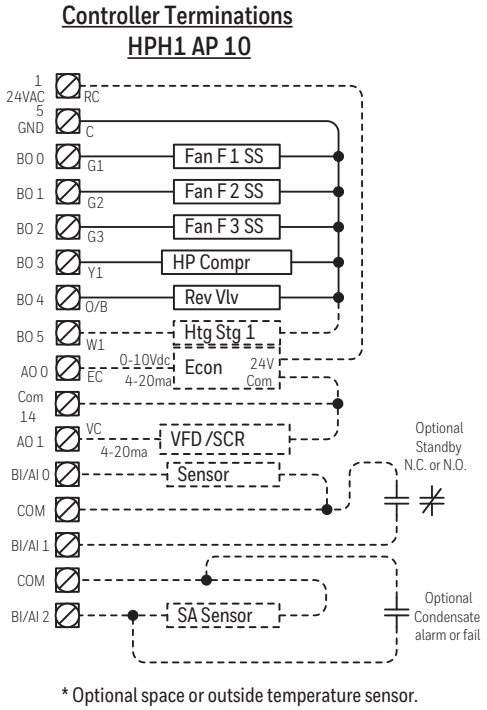


Figure 57 Controller terminations: [AP] 10

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

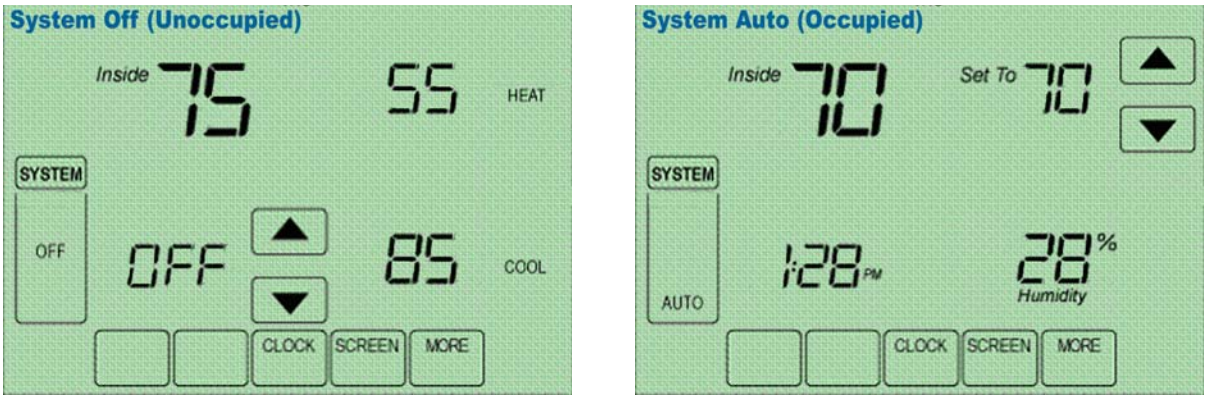


Figure 58 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 46 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

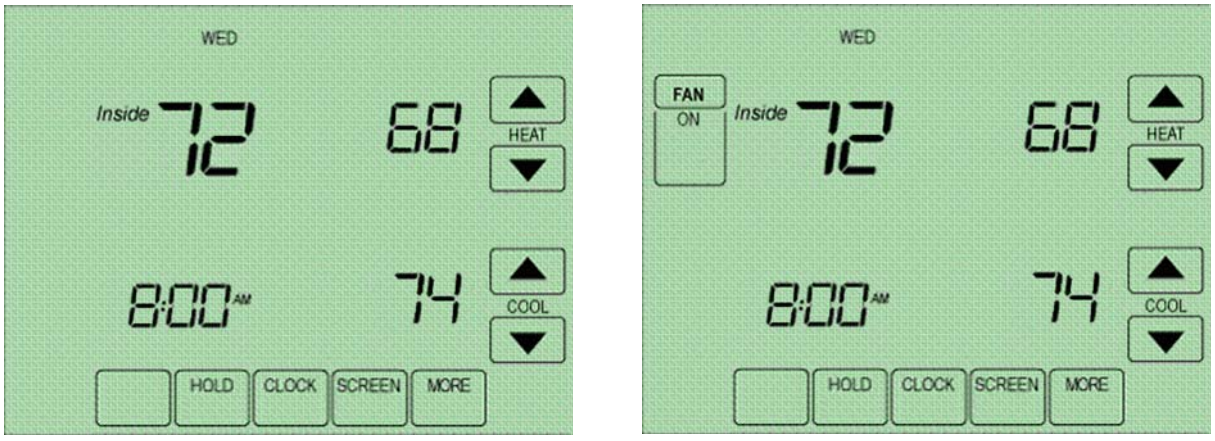


Figure 59 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

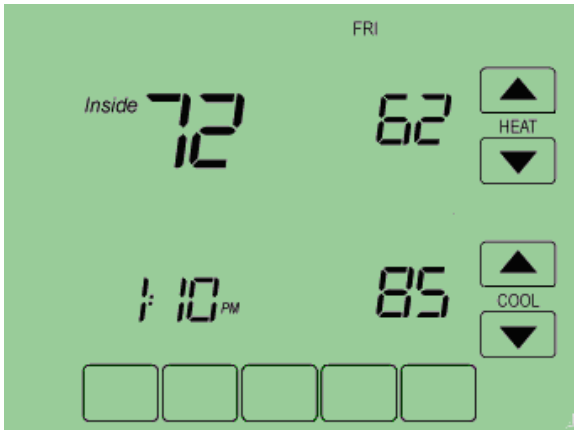


Figure 60 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

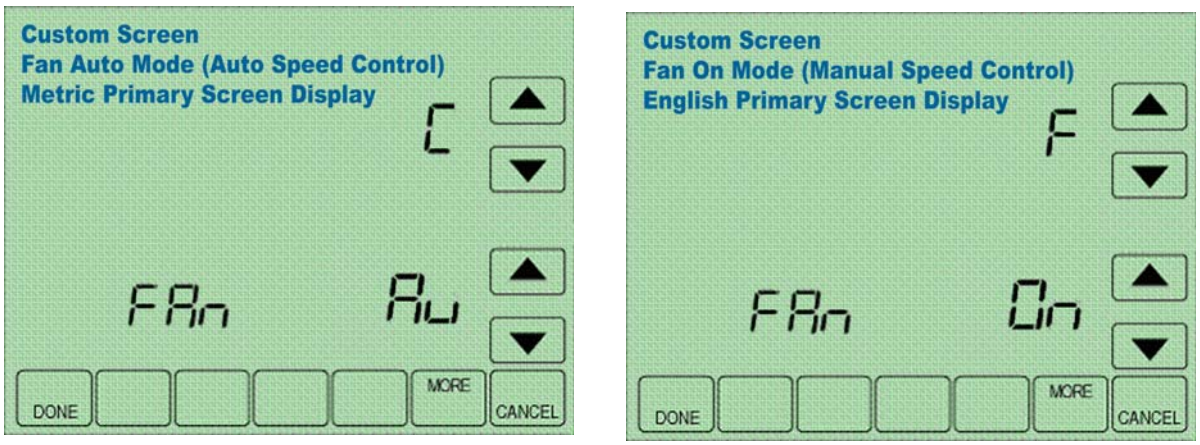


Figure 61 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to "Standby Heating and Cooling Setpoints" above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active. The value of the Standby Offset, AV-19, is transferred to the Demand Offset, AV-106. The AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BI-1 is active. The value of the Standby Offset, AV-19, is transferred to the Demand Offset, AV-106. The AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Compressor Control

Reversing Valve

The reversing valve does not change positions until the compressor has been OFF for at least 60 seconds. The reversing valve is set to the heating position (ON) when the heating signal exceeds 10 and the heating lockout is OFF. Otherwise the reversing valve is in the cooling position. Anti-cycle protection prevents the valve from changing positions more than once every two minutes. Some air-to-air heat pumps require the reversing valve to be activated in order to have the coil in Cooling mode. For cooling with the reversing valve active (ON), change [HC] or BV-21 to reverse the valve action.

AC-HP Control Mode (AV-40 set to 1)

The compressor commanded cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. The compressor command setpoints are adjustable from the display. When the fan requests AC cooling, BV-7 is ON. When BV-7 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short-cycling the compressor.

AV-68 AC-HP Compr Start Demand % (set at 20% default).

AV-69 AC-HP CMPR Stop Deadband % (default set at 1%)

AV-27 is minimum On time MON in minutes (anti-cycle).

AV-57 is minimum OFF time MOF in seconds (anti-cycle).

AC-HP control mode (AV-40, default set at 2)

Note AC or HP mode 1= ON-OFF (Demand Compare Control), 2= Analog to Binary Cycle Time Control.

The compressor control signal is selected between the Heating signal and the Cooling signal, depending on the status of the Heating/Cooling mode.

For Heating mode, the compressor signal ranges 0-100 as the Heating signal ranges 67-100. The Heating signal range 65-100 is reserved for auxiliary heat control.

For Cooling mode, the compressor signal ranges 0-100 as the Cooling signal ranges 0-67.

The compressor cycles ON for a percentage of the Compressor Cycle Time [Cc] according to the current value of the compressor-control signal. The Compressor Cycle Time [Cc] is adjustable from the display, but it is limited to a minimum of six minutes, and a maximum of twelve minutes. The compressor does not start unless the fan is ON. When the reversing valve changes position, there is a short delay before compressor operation is allowed. The Cooling or Heating Signal is

processed by an analog-to-binary timer that controls the BO's ON/OFF duration. Runtime and compressor starts are accumulated.

When either the Cooling Lockout is ON or the Low-Supply-Temperature Alarm is ON, the compressor-control signal is set to zero, disabling the compressor without overriding the minimum ON time. The cooling lockout setting is controlled by [cL]. A normally-open condensate sensor can be connected across BI-2. If BI-2 is shorted (indicating condensate is sensed) AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

When the Heating Lockout is ON, the compressor control signal is set to zero. The heating lock out temperature is controlled by the [hL] setting.

When BV-6, Heat Pump Fan Request is ON, the fan runs. When BV-6 is OFF, the fan stops after a short delay.

Compressor timing

Cycle times and minimum on/off times need to be set for operation of the heat-pump compressor.

- AV-26 [Cc] AC-HP Compressor Cycle Time: (CYC) time in minutes (factory default = 12 minutes)
- AV-27 [cc] AC-HP Compressor Minimum ON: (MON) time in minutes
- AV-57 AC-HP Compressor Minimum OFF: (MOF) time in seconds (factory default is 60 seconds)

AC-HP control mode (AV-40 set to 1)

The compressor command cycles ON when the current value of the compressor control signal is equal to or greater than the compressor start demand setpoint. The compressor command remains ON until the control signal drops below the stop setpoint. Compressor command setpoints are adjustable from the display. When the Heat Pump Fan Request, BV-6, is ON the fan is commanded ON. When BV-6 is OFF, the fan stops after a short delay. The compressor will not start unless the fan is ON. An anti-cycle timer prevents short cycling of the compressor.

- AV-68 HP Compr Start Demand % (set at 20% default).
- AV-69, AC-HP Cmpr Stop Deadband % (default set at 1%).
- AV-27 is minimum ON time, MON in minutes (anti-cycle).
- AV-57 is minimum OFF time, MOF in seconds (anti-cycle).

Staged auxiliary heating

The Auxiliary Heating is controlled by the upper portion of the Heating-Signal range. Auxiliary Heating is staged ON for an increasing portion of each set Heating-Cycle period [hc] as the Heating Signal varies between 65 and 100. [hc] has Minimum OFF and Minimum ON times of 3 minutes. The [hc] time is adjustable from 3 to 12 minutes (default). [hc] operation is locked out when the outside-air temperature is above the Auxiliary-Heating-Lockout Temperature [hL]. Runtime is accumulated for [hc].

High and low refrigerant pressure cutouts must be separately provided, preferably hard-wired, to stop compressor operation in the event of these

conditions. Outdoor coil defrost control and any provisions to allow oil sump heaters to be effective must also be included in the equipment manufacturer's controls or otherwise provided for.

Staged heating timing

Cycle times and minimum on/off times need to be set for operation of the electric heating stage. Staged heating will not run if either of the following two values are zero.

- AV-28 [Hc] Heating Stage Cycle Time: (CYC) time in minutes (factory default = 3 minutes)
- AV-29 [hc] Heating Stage Minimum ON: (MON) time in minutes (factory default = 1 minute)
- AV-80 Heating Stage Minimum OFF time in seconds (factory default is 60 seconds)

Compressor and heating-stage binary control

DDC cycles the output ON for a percentage of each cycle time (CYC), based on a 0.0 to 100.0 analog input control signal. For example, if the control signal is 75.0, then the output will be ON only for the first 75% of the cycle time.

The minimum ON time (MON) and minimum OFF time (MOF) prevent short cycling. The output turns ON only if the calculated ON time is greater than the MON. If the output is ON, it remains ON until it has been ON for the calculated ON time and the MON has expired. The output remains ON continuously if the calculated OFF time is less than the MOF.

- Inputs must be positive numbers.
- Time resolution is 1 second
- CalculatedOnTime = CycleTime (Input/100.0)
- CalculatedOffTime = CycleTime minus CalculatedOnTime

De-humidification control in Occupied state (optional)

A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles to low speed until sensed humidity drops below the trigger setpoint minus the dead band. Normal fan operation resumes.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger

setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

If binary S/S fan option is used, the fan cycles at low speed (BO-0 ON).

If analog fan speed option is used, AO-1 is set to Minimum% Fan Speed AV-18 during fan ON cycles, and 0 during fan OFF cycles

Table 47 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

A BMS is required to set the values for AV-60, AV-66, and AV-67. The economizer sequence requires that a supply air sensor be wired to AI-2.

Analog modulating economizer

The economizer is controlled directly by the Cooling Signal PI control loop, AV-1, demand % command. As the demand signal increases and decreases, AO-0 is active, modulating the economizer open and closed.

Heat Pump Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

When condensate is sensed, e.g., BI-2 is shorted (active), AI-2 reads 572. Compressor operation is locked out until the condensate alarm lock out clears.

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

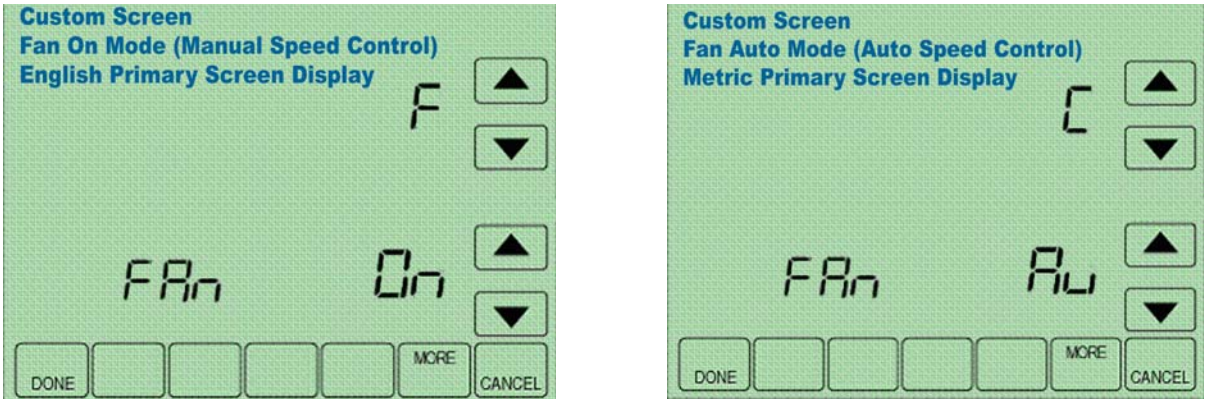


Figure 62 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 48 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	0-1	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	10	0-18	Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 48 Setup codes

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 49 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 49 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	20		%	Apps 0-5 and 10.

Table 49 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 49 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit: App 11

3 point floating cooling/heating valve, analog cooling/heating valve option, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 50 Inputs and Outputs: [AP]11

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Optional use as space sensor to replace internal space sensor AV-104 (BV-47 inactive, set BV-32 active)
BI-2	Main door sensor (BV-47 inactive, BV-32 inactive default)
BO-0	Fan Low Speed

Table 50 Inputs and Outputs: [AP]11

Point	Function
BO-1	Fan Medium Speed
BO-2	Fan High Speed
BO-3	Cooling/Heating Valve Open
BO-4	Cooling/Heating Valve Close
BO-5	Not used
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

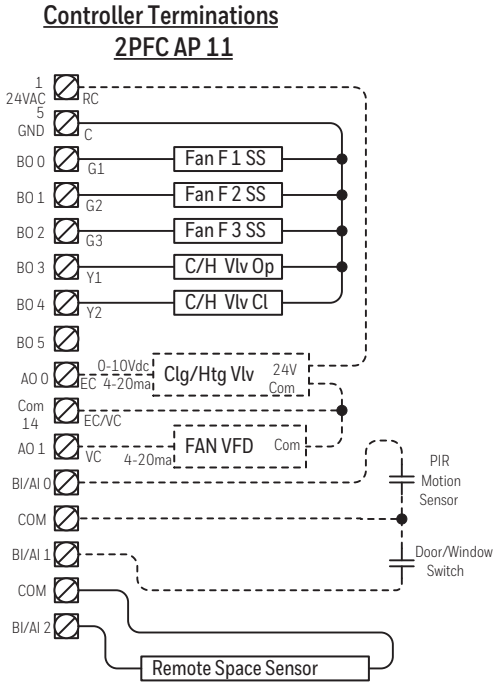


Figure 63 Controller terminations: [AP] 11

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

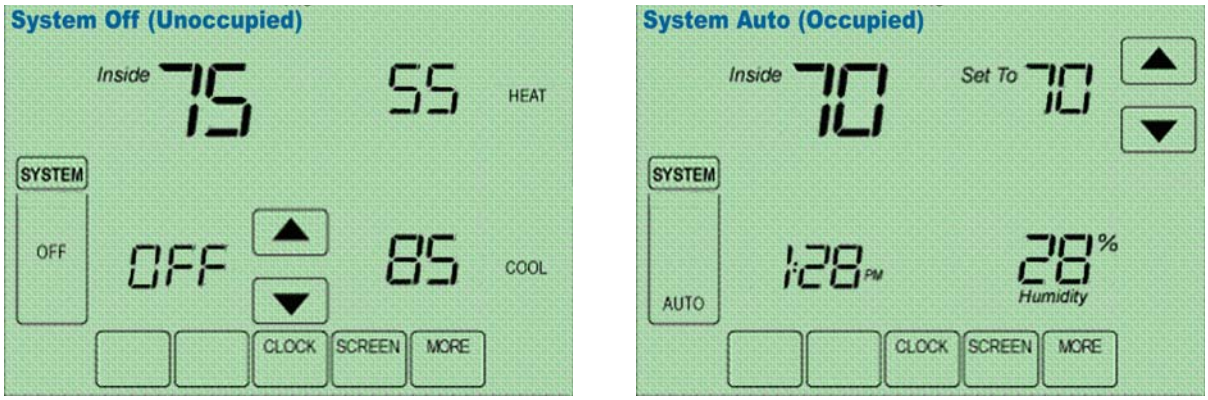


Figure 64 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller's SYSTEM Block is set to "OFF" by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 51 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

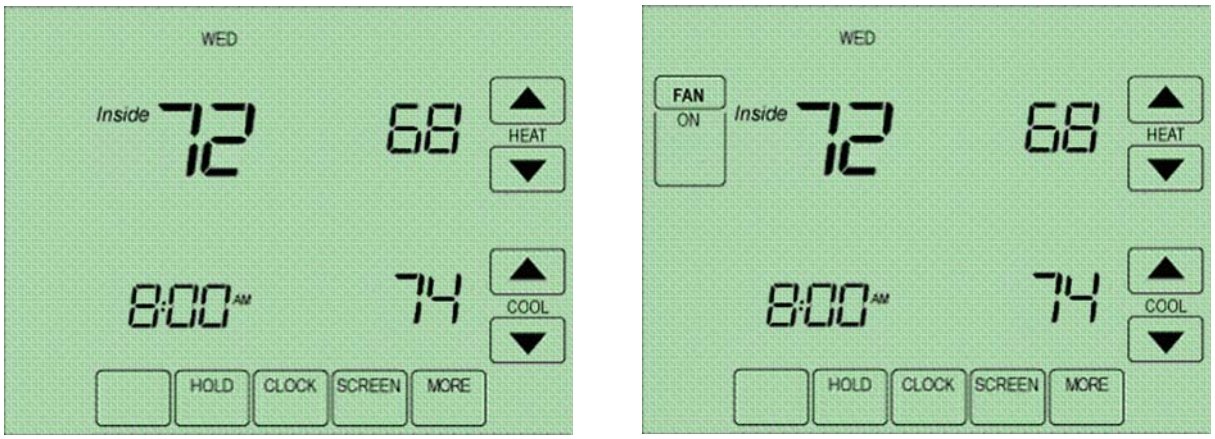


Figure 65 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

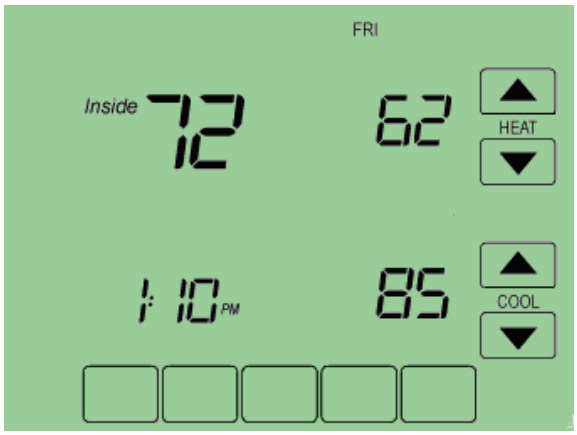


Figure 66 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

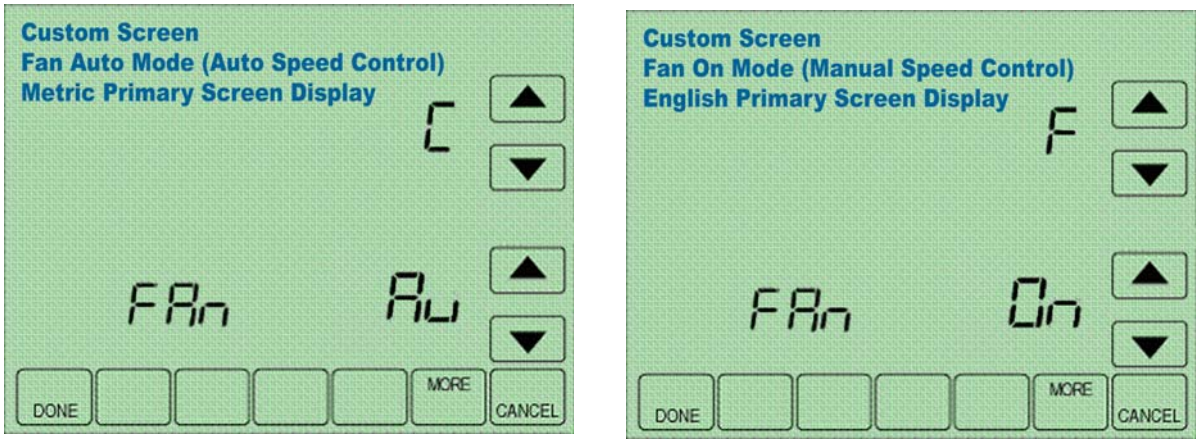


Figure 67 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to "Standby Heating and Cooling Setpoints" above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active. The value of the Standby Offset, AV-19, is transferred to the Demand Offset, AV-106. The AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BI-1 is active. The value of the Standby Offset, AV-19, is transferred to the Demand Offset, AV-106. The AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

2P Water Loop Temp AV-15 should be sent to this unit by a BMS for this application to function properly. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2P Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The cooling signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the valve control signal.

BV-15 active causes the cooling to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. The 2P Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2P Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Heating

The heating signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the valve control signal.

BV-15 active causes the heating to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the heating signal AV-0, the current supply air temperature, and the supply air temperature high limit. The 2P Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2P Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 52 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

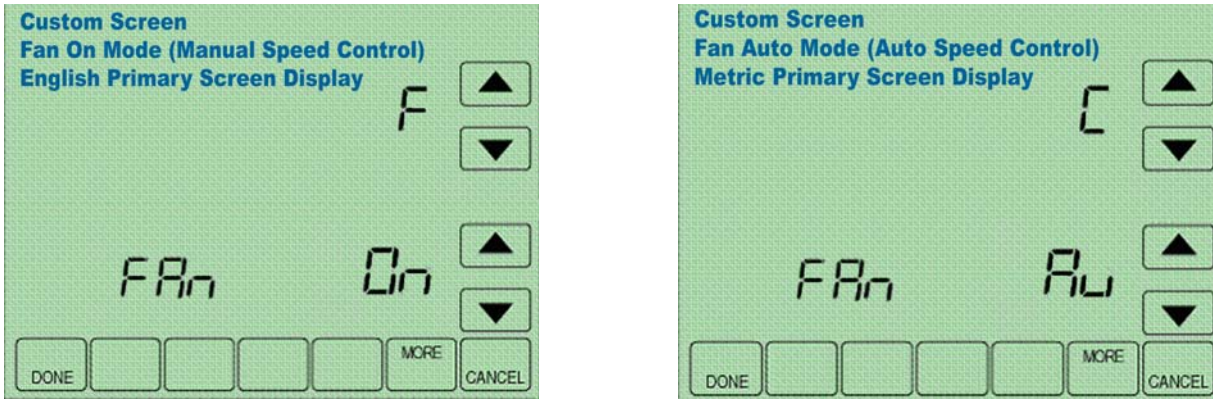


Figure 68 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 53 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	11	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	

Table 53 Setup codes

Code	Object		Default	Options	Units	Notes
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 54 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 54 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.

Table 54 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 54 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit: App 12

3 point floating cooling/heating valve, analog cooling/heating valve option, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 55 Inputs and Outputs: [AP] 12

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Reserved for Main door sensor on BI-2 (BV-47 inactive, BV-32 inactive default)
BI-2	Main door sensor (BV-47 inactive, BV-32 inactive default)
BO-0	Fan Low Speed
BO-1	Fan Medium Speed

Table 55 Inputs and Outputs: [AP] 12

Point	Function
BO-2	Fan High Speed
BO-3	Cooling/Heating Valve Open
BO-4	Cooling/Heating Valve Close
BO-5	Not used
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

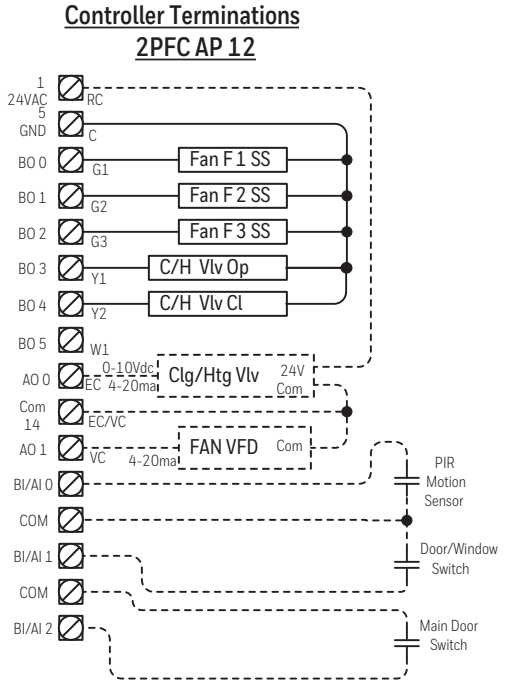


Figure 69 Controller terminations: [AP] 12

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

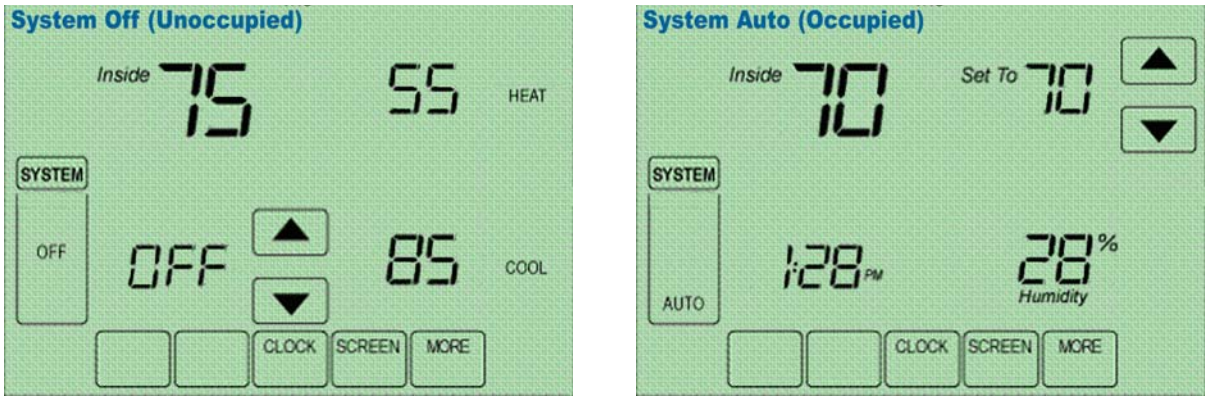


Figure 70 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller's SYSTEM Block is set to "OFF" by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 56 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

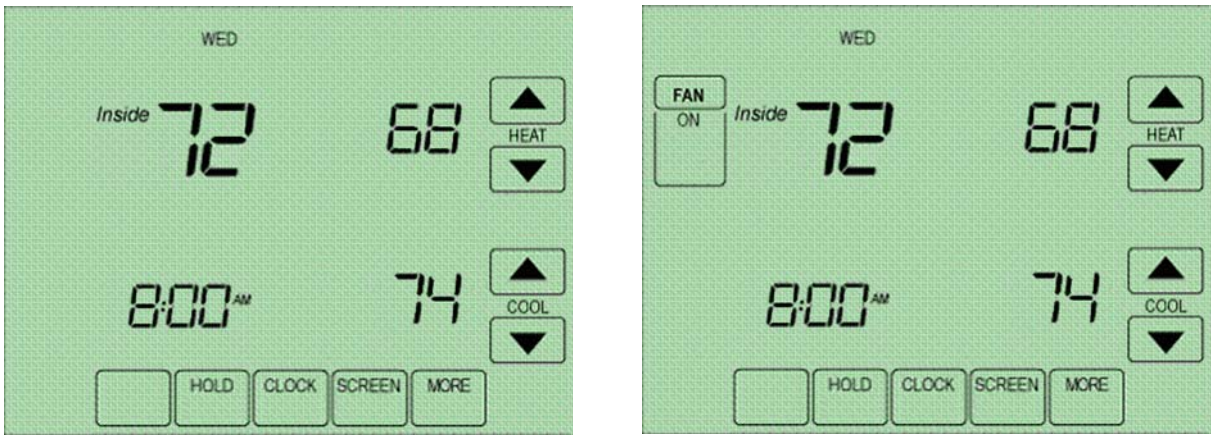


Figure 71 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

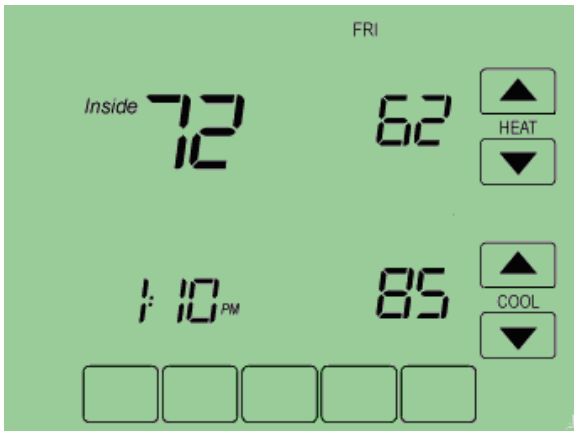


Figure 72 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

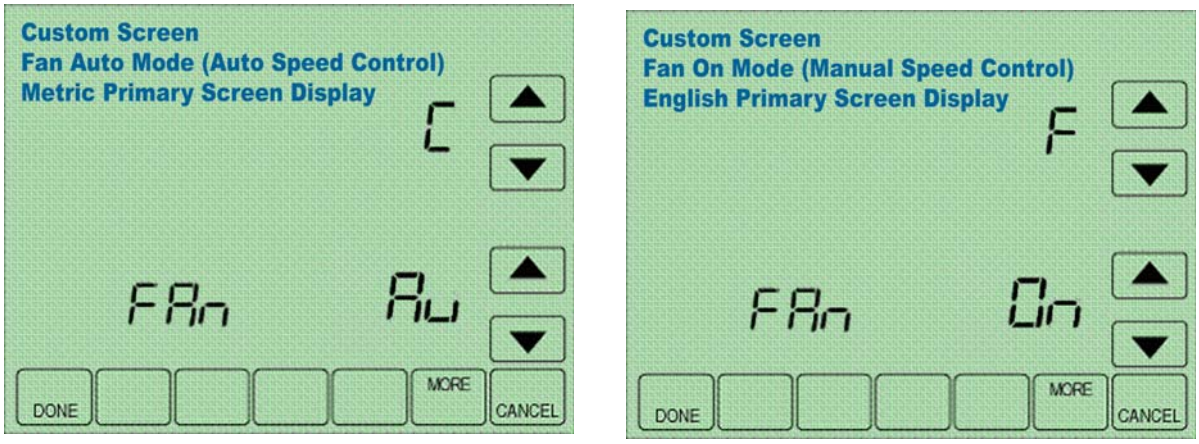


Figure 73 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-2 Main Door and BI-1 (optional door/window) are monitored during Occupied state. If the doors or window are opened longer than the Standby Delay AV-20, the unit sets to Standby state. After the doors or window are closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby mode state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

2P Water Loop Temp AV-15 should be sent to this unit by a BMS for this application to function properly. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2P Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The cooling signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the valve control signal.

BV-15 active causes the cooling to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. The 2 Position Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2 Position Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Heating

The heating signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the valve control signal.

BV-15 active causes the heating to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the heating signal AV-0, the current supply air temperature, and the supply air temperature high limit. The 2P Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2P Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 57 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter

replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

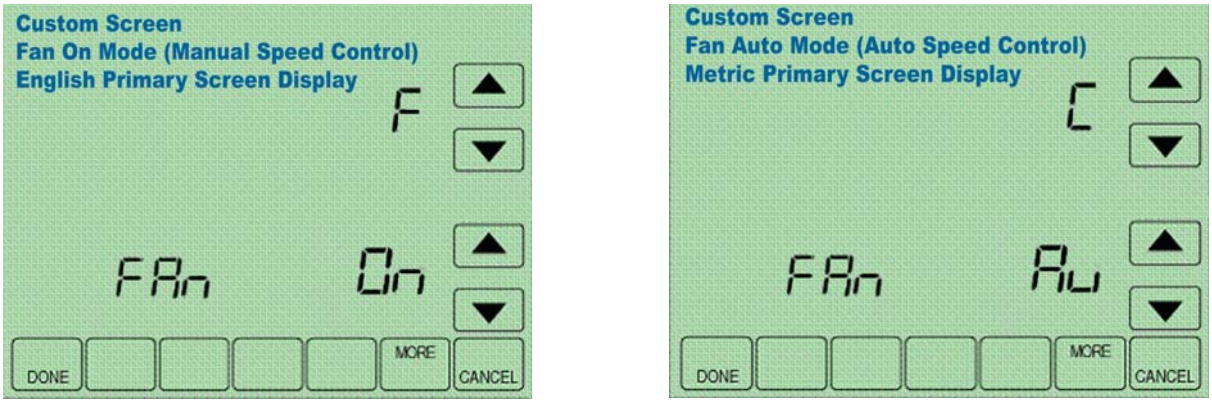


Figure 74 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 58 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	12	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	

Table 58 Setup codes

Code	Object		Default	Options	Units	Notes
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 59 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 59 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.

Table 59 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 59 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit with Change Over Control: App 13

3 point floating cooling valve, analog cooling/heating valve option, electric coil heat, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Note A water temperature sensor wired to AI-2 is required for this application.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 60 Inputs and Outputs: [AP] 13

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Water temperature sensor
BO-0	Fan Low Speed
BO-1	Fan Medium Speed
BO-2	Fan High Speed

Table 60 Inputs and Outputs: [AP] 13

Point	Function
BO-3	Cooling/Heating Valve Open
BO-4	Cooling/Heating Valve Close
BO-5	Electric Coil Heat
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

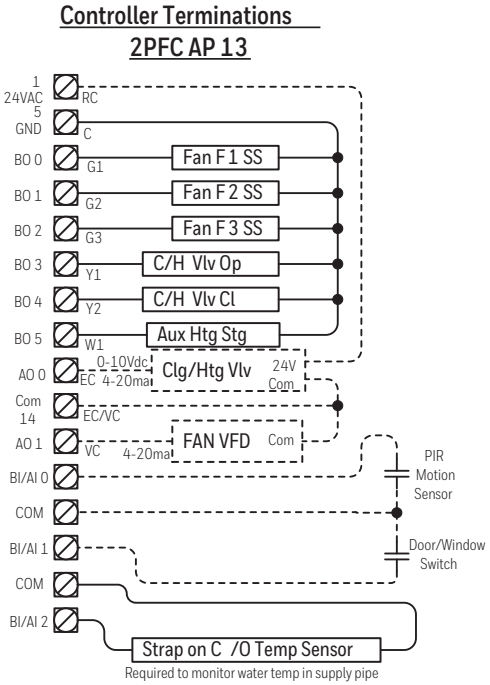


Figure 75 Controller terminations: [AP] 13

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

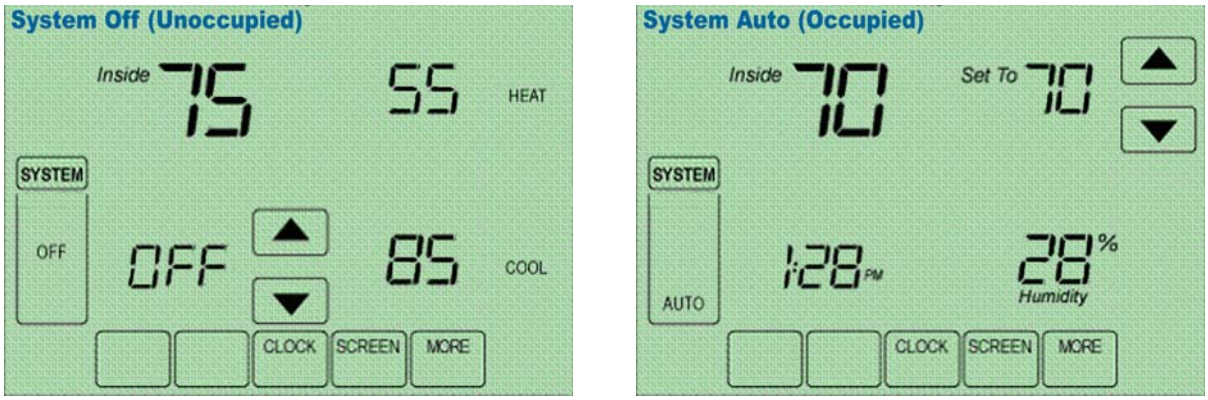


Figure 76 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 61 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

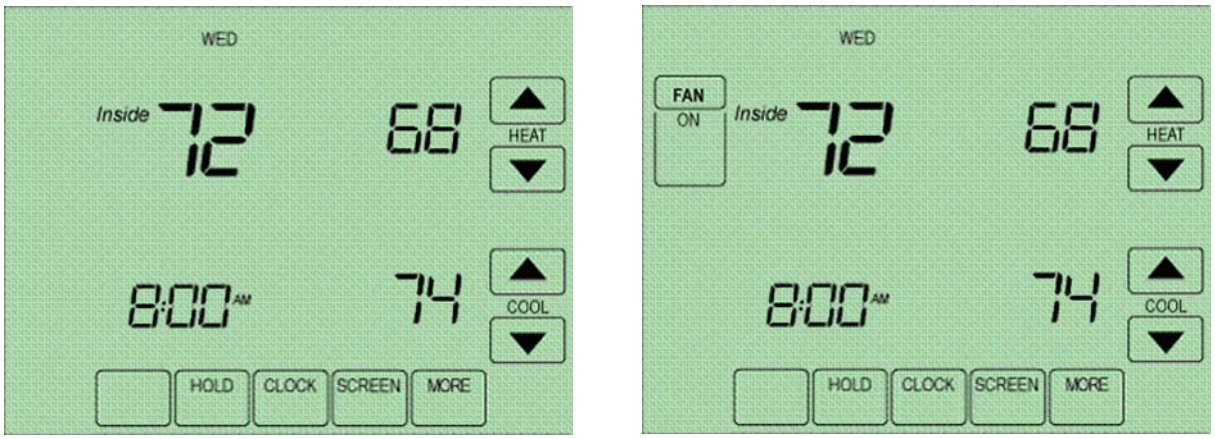


Figure 77 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

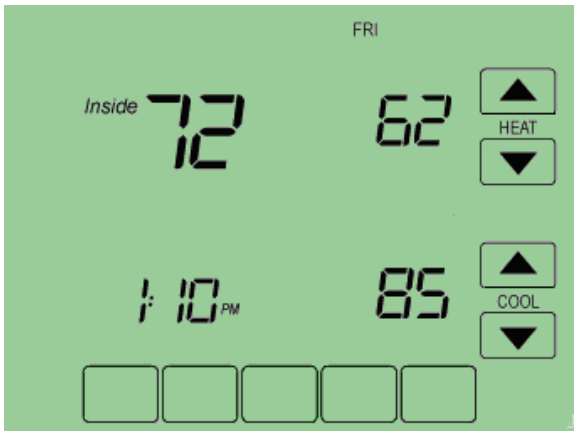


Figure 78 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

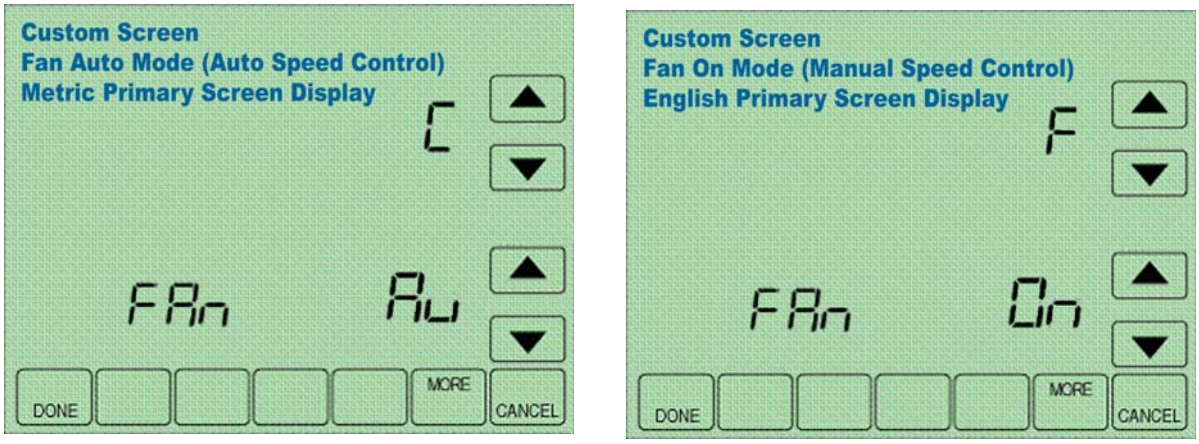


Figure 79 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-2 Main Door and BI-1 (optional door/window) are monitored during Occupied state. If the doors or window are opened longer than the Standby Delay AV-20, the unit sets to Standby state. After the doors or window are closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby mode state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

IMPORTANT! A temperature sensor for water loop temperature must be connected to AI-2 for this application.

The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2 Pipe Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The Cooling signal AV-1, is transferred to AV-23.the 2 Pipe Valve Command.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2 Pipe Valve Command AV-23.

The 2 Pipe Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Heating

The Heating signal AV-0, is transferred to AV-23.the 2P Valve Command.

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Electric Coil Heater

The Heating Signal AV-0 is used to drive the electric coil heater. The coil heater will be turned on for that percentage of the Heating Stages Cycle Time AV-28

that corresponds to the heating signal. The coil heater ON and OFF times are limited by the value of Heating Stages Min ON AV-29 and Min OFF AV-80. Coil Heater runtime is accumulated.

The heating signal range is controlled by the state of BV-18, 2P-Coil Water is Hot. When BV-18 is inactive and there is demand for heating, the heating signal spans from 0% to 100% as the electric coil becomes the primary heat source. When BV-18 is active the heating signal spans from 70% to 100% as the electric coil is the secondary heat source.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 62 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric.

Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

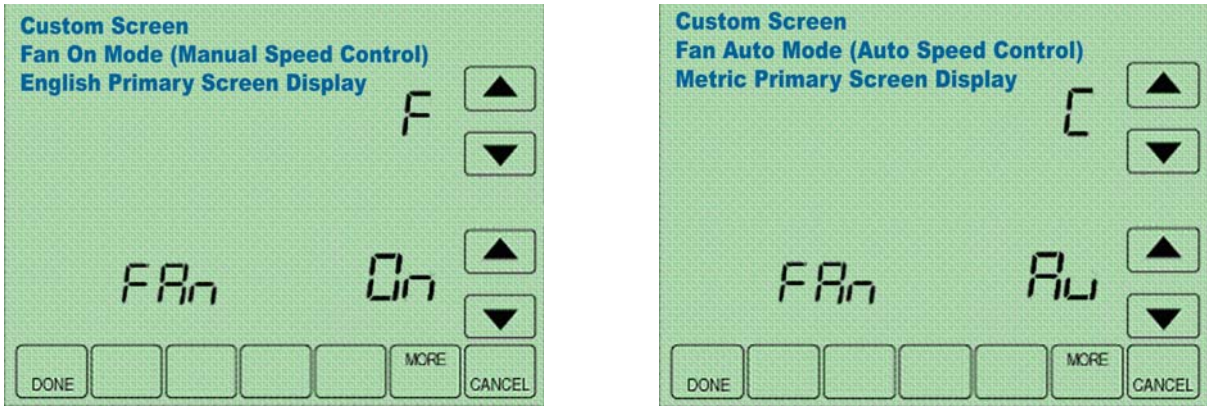


Figure 80 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 63 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	13	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output

Table 63 Setup codes

Code	Object		Default	Options	Units	Notes
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 64 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 64 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	20		%	Apps 0-5 and 10.

Table 64 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 64 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit with Change Over Control: App 14

2 position cooling/heating valve, analog cooling/heating valve option, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Note This application requires a water loop temperature sensor wired to AI-2.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 65 Inputs and Outputs: [AP] 14

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Water temperature sensor
BO-0	Fan Low Speed
BO-1	Fan Medium Speed
BO-2	Fan High Speed
BO-3	Cooling/Heating Valve Open/Close 2 Position

Table 65 Inputs and Outputs: [AP] 14

Point	Function
BO-4	Not used
BO-5	Not used
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

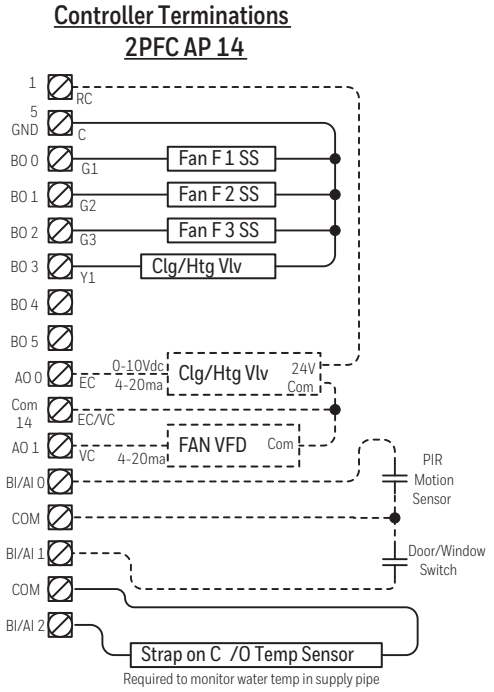


Figure 81 Controller terminations: [AP] 14

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do

not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block "OFF" setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to "Auto." Set BV-10 to active to allow this option.

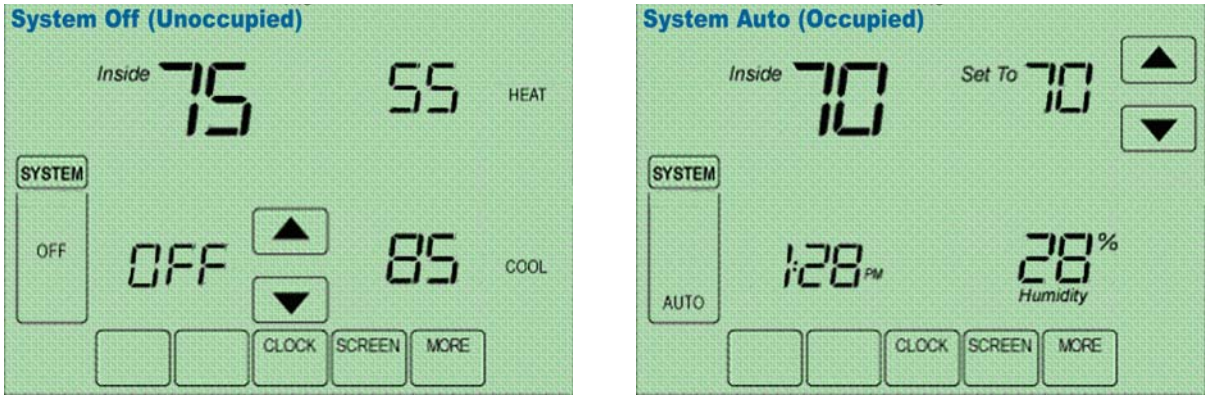


Figure 82 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller's SYSTEM Block "AUTO" is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller's SYSTEM Block is set to "OFF" by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 66 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

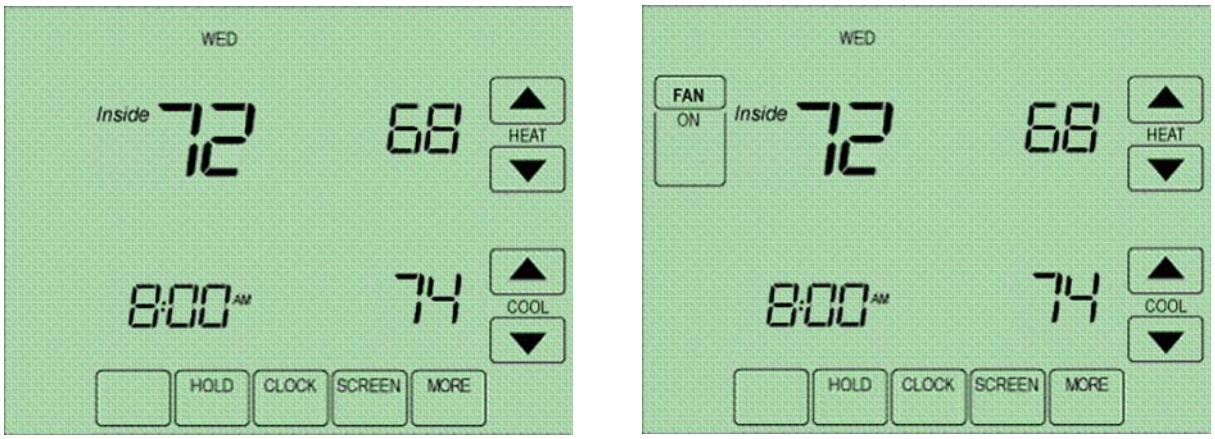


Figure 83 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

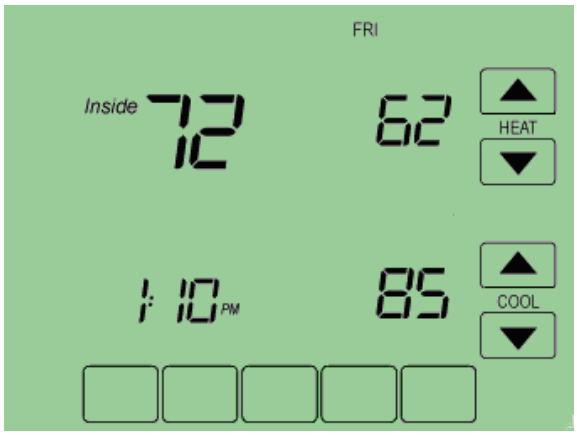


Figure 84 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

Note During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

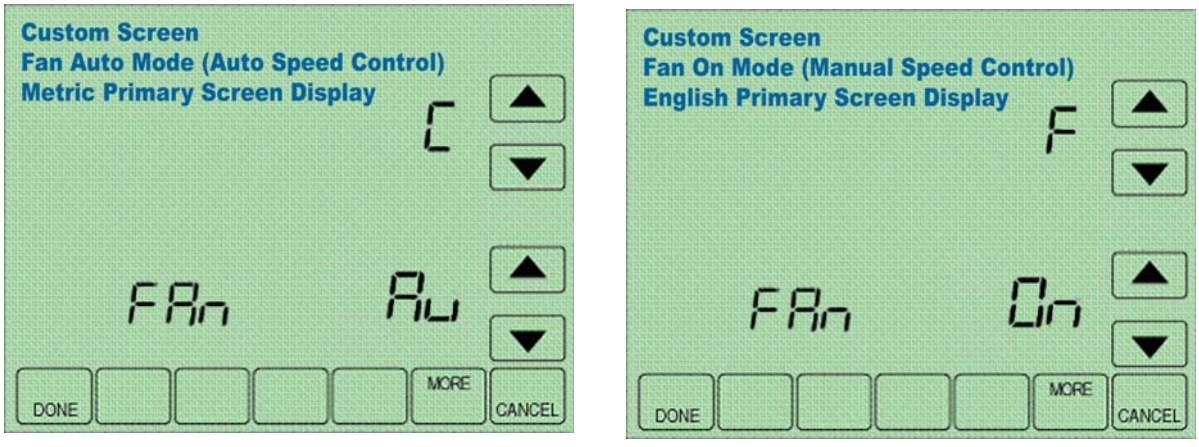


Figure 85 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-1 Door/window is monitored during Occupied mode state. If the door or window is opened longer than the Standby Delay AV-20, the unit sets to Standby mode state. After the door or window is closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

A temperature sensor for water loop temperature must be connected to AI-2 for this application. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2 Pipe Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The Cooling signal AV-1, is transferred to AV-23.the 2P Valve Command.

Heating

The Heating signal AV-0, is transferred to AV-23.the 2P Valve Command.

The 2 position heating/cooling valve control has three options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the valve. If the 2P Valve Command signal AV-23 is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the valve signal is 75, then during each 5 minute cycle the valve will be commanded open for the first 3 minutes and 45 seconds.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse

width) from 0 to 2.55 seconds as the cooling or heating varies from 0-100. If the signal is 0, the output remains OFF. The pulse width is calculated using a non-linear conversion to better match the thermal modulating valve (TMV).

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 2 position valve.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 67 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting

BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

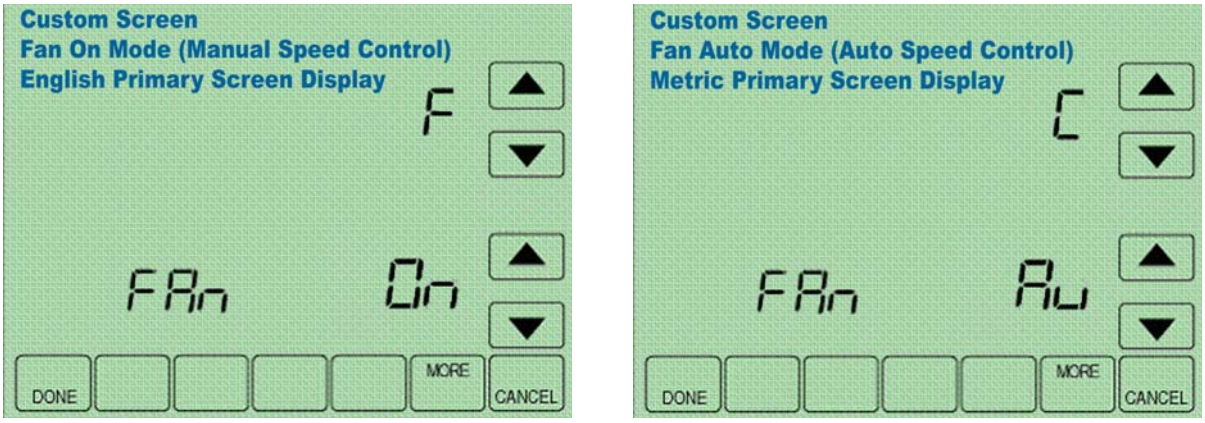


Figure 86 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 68 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	14	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		

Table 68 Setup codes

Code	Object		Default	Options	Units	Notes
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 69 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 69 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.

Table 69 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 69 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit: App 15

2 position cooling/heating valve, analog cooling/heating valve option, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Note This application requires a water loop temperature sensor wired to AI-2.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 70 Inputs and Outputs: [AP] 15

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Reserved for Main door sensor on BI-2 (BV-47 inactive, BV-32 inactive default)
BI-2	Main door sensor (BV-47 inactive, BV-32 inactive default)
BO-0	Fan Low Speed
BO-1	Fan Medium Speed
BO-2	Fan High Speed

Table 70 Inputs and Outputs: [AP] 15

Point	Function
BO-3	Cooling/Heating Valve Open/Close 2 Position
BO-4	Not used
BO-5	Not used
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

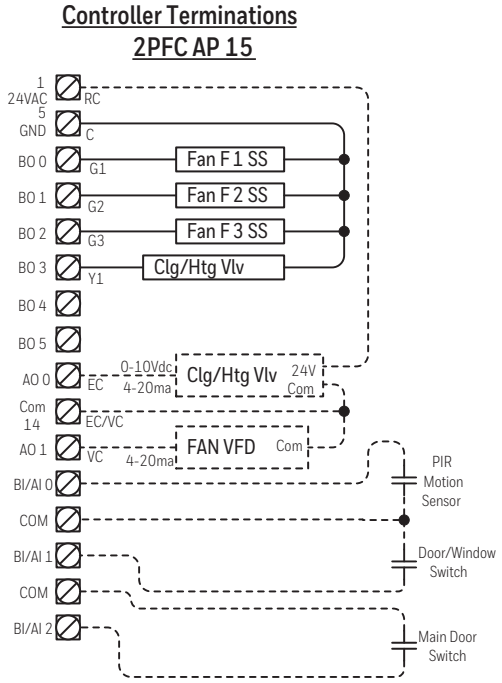


Figure 87 Controller terminations: [AP] 15

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

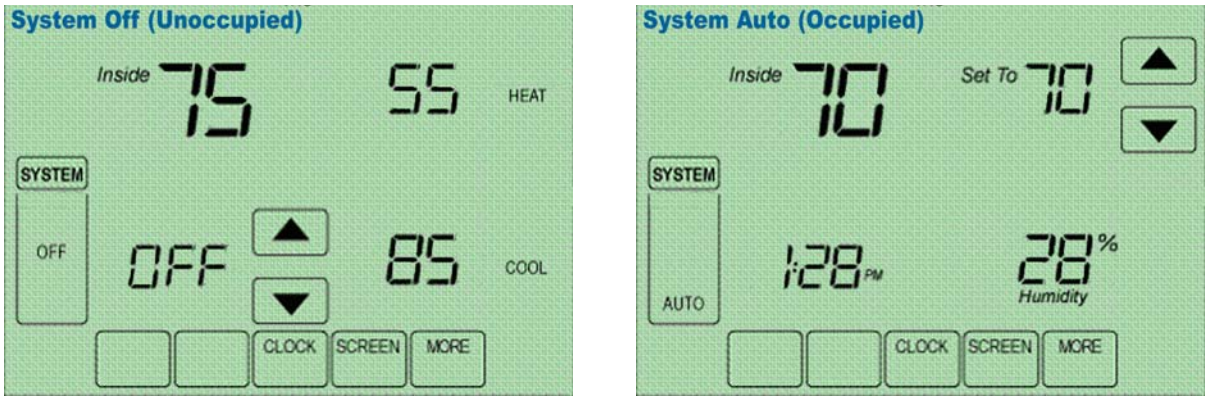


Figure 88 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 71 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96 Unoccupied Heating Setpoint

Table 71 Setpoint values in Occupancy control

Field Code	Description
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

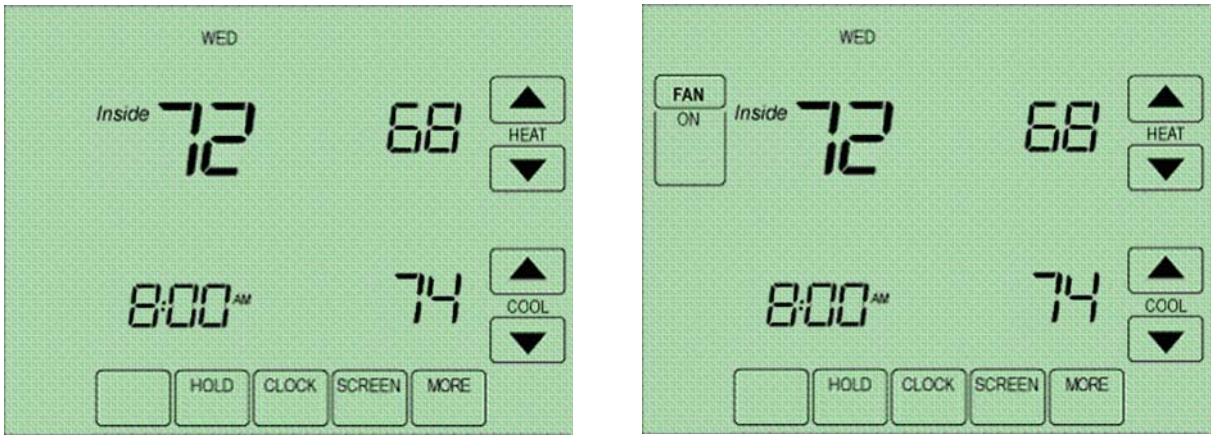


Figure 89 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator

workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

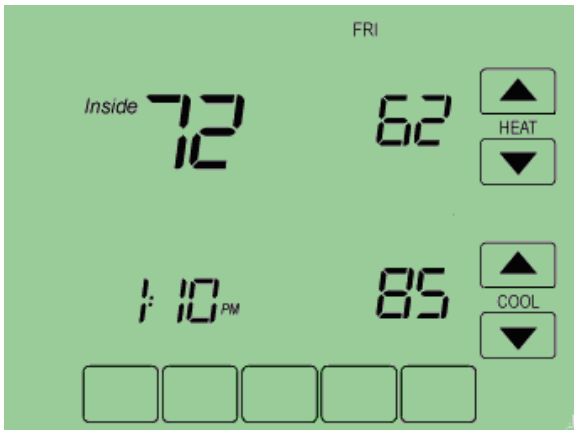


Figure 90 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

Note During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains

ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

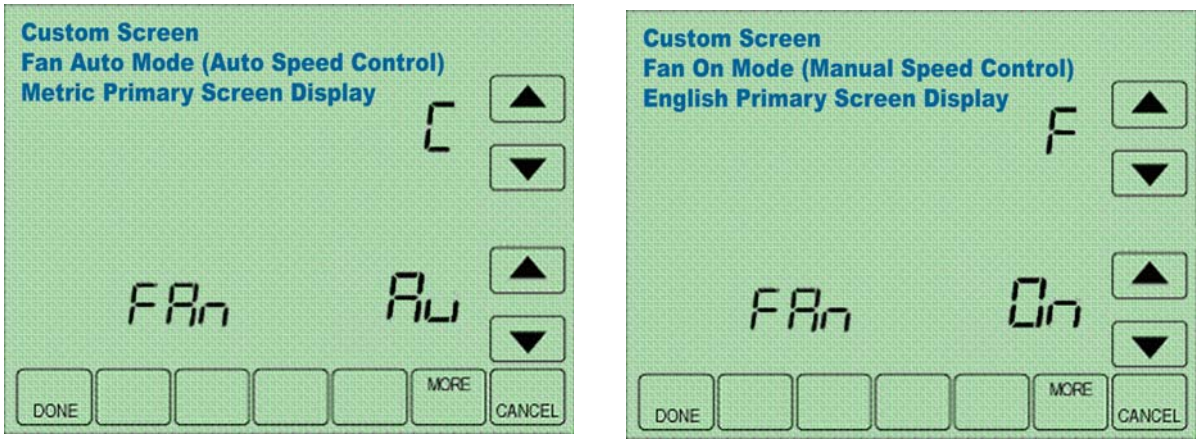


Figure 91 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-1 Door/window is monitored during Occupied mode state. If the door or window is opened longer than the Standby Delay AV-20, the unit sets to Standby mode state. After the door or window is closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

2P Water Loop Temp AV-15 should be sent to this unit by a BMS for this application to function properly. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2 Pipe Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The Cooling signal AV-1, is transferred to AV-23.the 2P Valve Command.

Heating

The Heating signal AV-0, is transferred to AV-23.the 2P Valve Command.

The 2 position heating/cooling valve control has three options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the valve. If the 2P Valve Command signal AV-23 is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the valve signal is 75, then during each 5 minute cycle the valve will be commanded open for the first 3 minutes and 45 seconds.

The 2 Pipe Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 2 position valve.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse width) from 0 to 2.55 seconds as the cooling or heating varies from 0-100. If the signal is 0, the output remains OFF. The pulse width is calculated using a non-linear conversion to better match the thermal modulating valve (TMV).

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 72 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

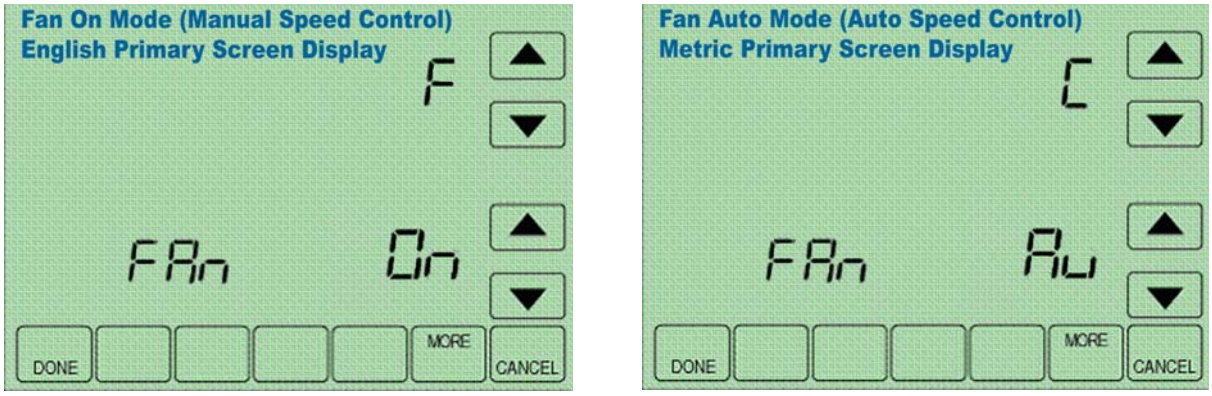


Figure 92 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 73 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	15	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	

Table 73 Setup codes

Code	Object		Default	Options	Units	Notes
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 74 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block “OFF” overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		

Table 74 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	

Table 74 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		

Table 74 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit with Change Over Control: App 16

3 point floating cooling/heating valve, analog modulating cooling/heating valve option, electric coil heat, 3 speed fan with binary output start/stop, optional analog variable-speed fan control.

Note A water temperature sensor wired to AI-2 is required for this application.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 75 Inputs and Outputs: [AP] 16

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Optional input for door/window sensors (BV-47 inactive, default)
AI-2	Water Temperature Sensor
BO-0	Fan Low Speed
BO-1	Fan Medium Speed
BO-2	Fan High Speed

Table 75 Inputs and Outputs: [AP] 16

Point	Function
BO-3	Cooling/Heating Valve Open/CLose 2 Position
BO-4	Not used
BO-5	Electric Coil Heat
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog fan speed (optional)

Wiring diagram

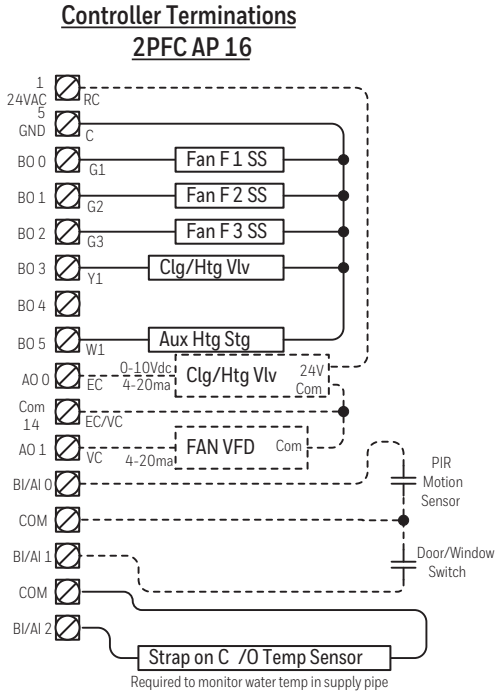


Figure 93 Controller terminations: [AP] 16

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

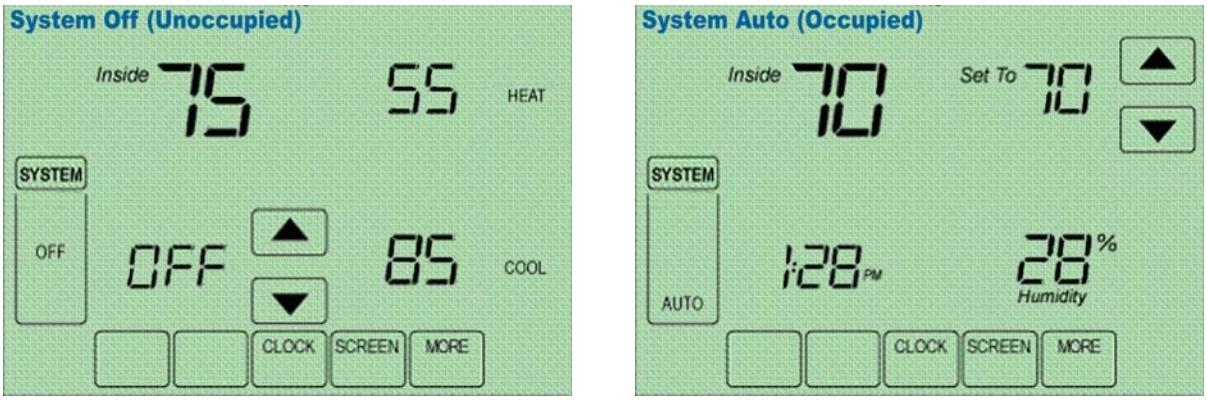


Figure 94 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 76 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

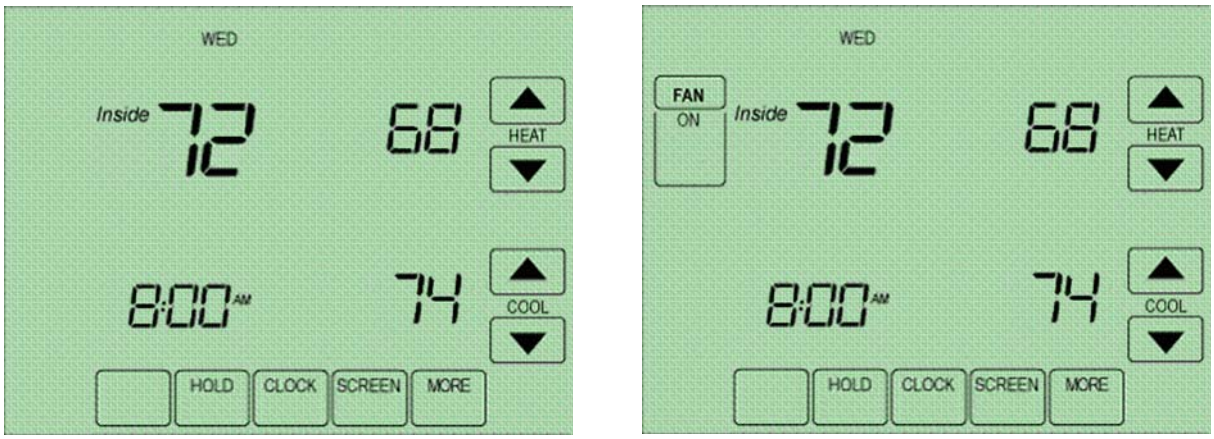


Figure 95 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

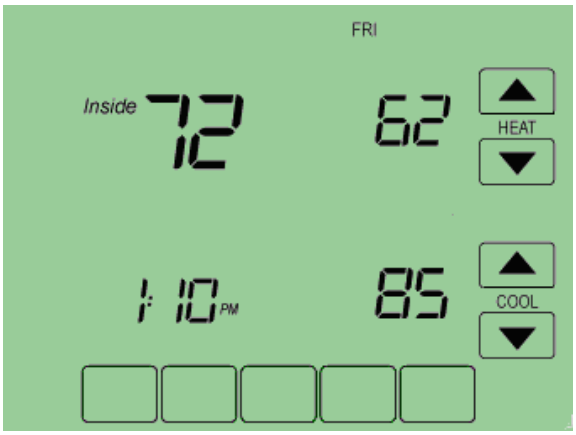


Figure 96 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

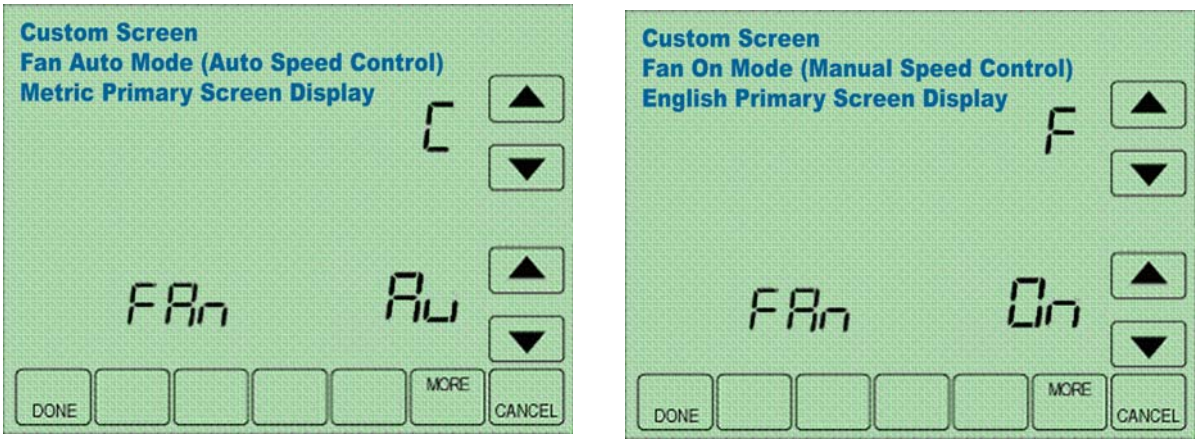


Figure 97 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-1 Door/window is monitored during Occupied mode state. If the door or window is opened longer than the Standby Delay AV-20, the unit sets to Standby mode state. After the door or window is closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

A temperature sensor for Water Loop Temperature must be connected to AI-2 for this application. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2 Pipe Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

The 2-pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2 Pipe Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The Cooling signal AV-1, is transferred to AV-23.the 2P Valve Command.

The 2 position heating/cooling valve control has three options, selected by AV-34.

Heating

The Heating signal AV-0, is transferred to AV-23.the 2P Valve Command.

The 2 position heating/cooling valve control has three options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the valve. If the 2P Valve Command signal AV-23 is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the valve signal is 75, then during each 5 minute cycle the valve will be commanded open for the first 3 minutes and 45 seconds.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse width) from 0 to 2.55 seconds as the cooling or heating varies from 0-100. If the signal is 0, the output remains OFF. The pulse width is calculated using a non-linear conversion to better match the thermal modulating valve (TMV).

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Electric Coil Heater

The Heating Signal AV-0 is used to drive the electric coil heater. The coil heater will be turned on for that percentage of the Heating Stages Cycle Time AV-28 that corresponds to the heating signal. The coil heater ON and OFF times are limited by the value of Heating Stages Min ON AV-29 and Min OFF AV-80. Coil Heater runtime is accumulated.

The heating signal range is controlled by the state of BV-18, 2P-Coil Water is Hot." When BV-18 is inactive and there is a demand for heating, the heating signal spans from 0% to 100% as the electric coil becomes the primary heat source. When BV-18 is active the heating signal spans from 70% to 100% as the electric coil is the secondary heat source.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 77 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

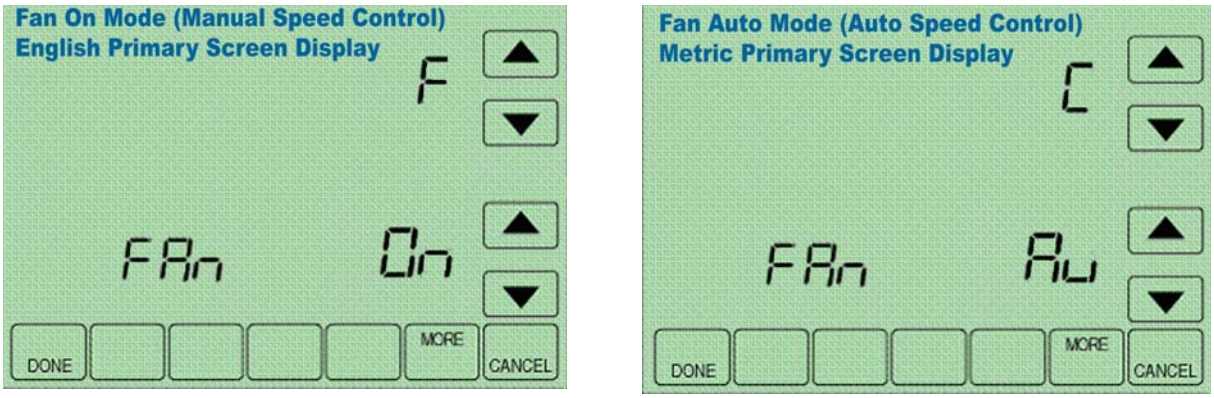


Figure 98 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 78 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	16	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	

Table 78 Setup codes

Code	Object		Default	Options	Units	Notes
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 79 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 79 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	20		%	Apps 0-5 and 10.

Table 79 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 79 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

4 Pipe Fan Coil Unit: App 17

Analog cooling and heating valves, three point floating economizer, 3 speed fan with binary output start/stop.

Fan mode control (AV-17)

- 1 = Continuous
- 2 = Continuous with cooling, cycles with heating
- 3 = Cycles with heating/cooling

Fan speed control

Fan block selections

- OF = OFF
- F1 = Low speed
- F2 = Medium speed
- F3 = High speed

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 80 Inputs and Outputs: [AP] 17

Point	Function
AI-0	Reserved for Motion Detector on BI-0 (BV-47 inactive, default) Use as an Outside Air Sensor (BV-47 active) - (Optional)
BI-0	Motion Detector PIR (BV-47 inactive, default)
BI-1	Door/window sensor (BV-47 inactive, default)
AI-2	Supply-air sensor (required for economizer option, BV-32 inactive, default) Optional use as space sensor to replace internal sensor (BV-32 active, BV-47 inactive)
BO-0	Fan Low Speed
BO-1	Fan Medium Speed

Table 80 Inputs and Outputs: [AP] 17

Point	Function
BO-2	Fan High Speed
BO-3	Not used
BO-4	Economizer Open
BO-5	Economizer Close
AO-0	Analog Cooling Valve
AO-1	Analog Heating Valve

Wiring diagram

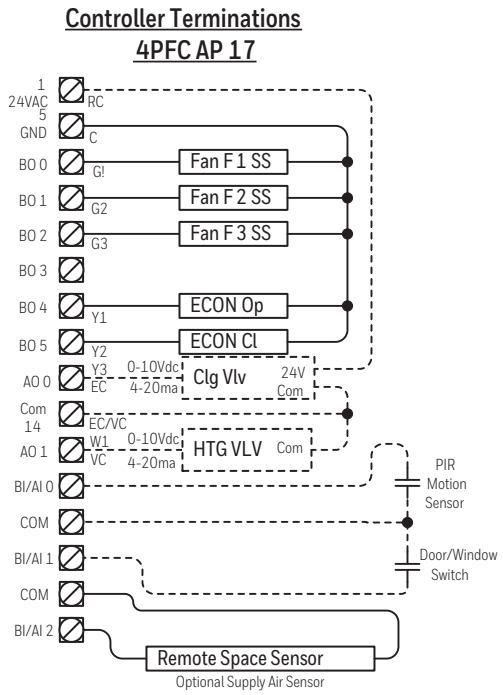


Figure 99 Controller terminations: [AP] 17

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

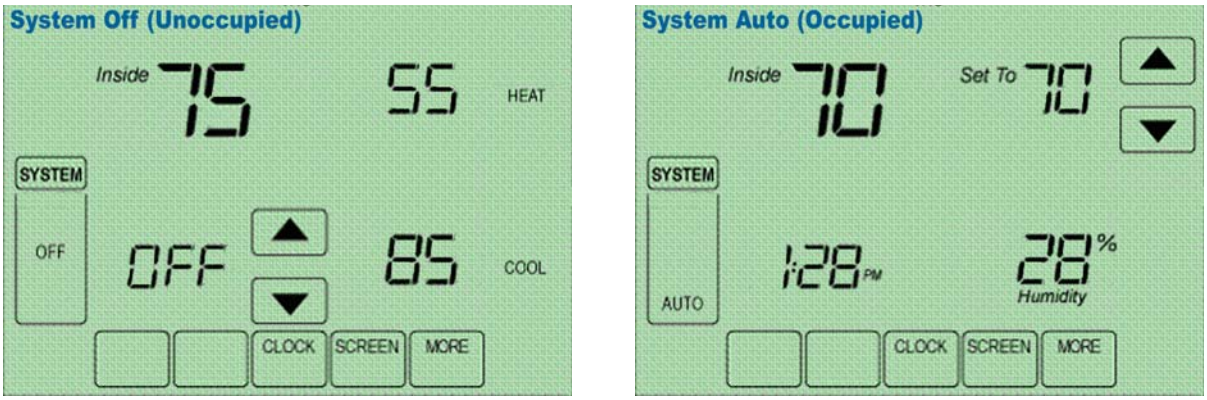


Figure 100 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 81 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

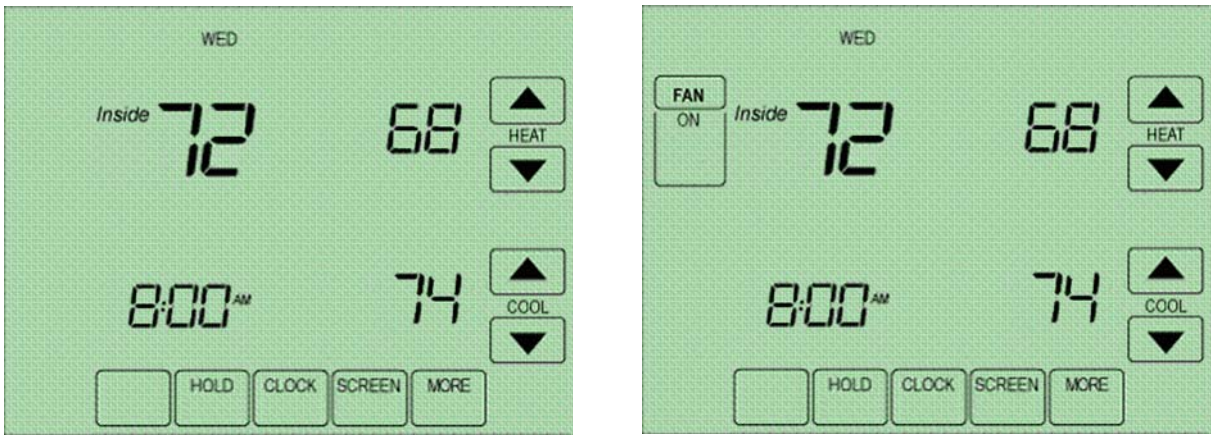


Figure 101 Setpoint mode display: single-speed fan and 3-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

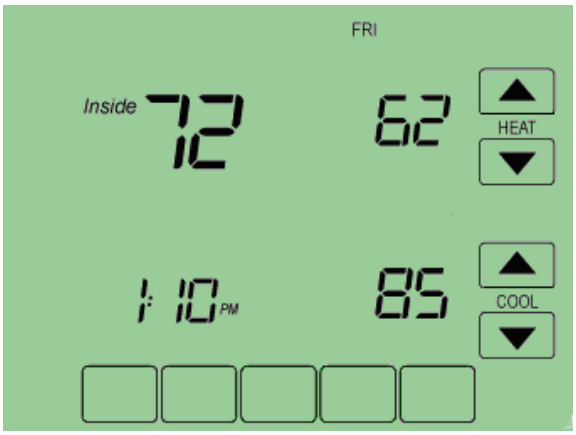


Figure 102 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan Control

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

During occupancy state or unoccupied state, if the cooling signal or heating signal is equal to or greater than the Auto Fan Start Setpoint (AV-46), BV-13, Htg-Clg Vlv Demand Fan Request is active. The Htg-Clg Vlv Demand Fan Request remains active until the cooling/heating signal falls below AV-46. Default 20%, adjustable from the display.

3 Speed fan control

A variety of user options can be selected to implement 3 speed fan control.

Fan Auto/On BV-59 (factory default inactive) controls.

Enable Fan Control (BV-55, factory default inactive) controls whether Fan Auto/On (BV-59) can be viewed and changed at the BACnet FF custom screen.

Unoccupied 3 speed fan control

Note During unoccupied state the fan operates independent of the selected fan mode (1. Continuous, 2. Cycle Heating, 3. Cycle Heating and Cooling). The fan cycles ON high speed when the heating or cooling demand signal rises above the calling control logic's demand setpoints. The Fan Block is set to F3 (high speed) and OF, F1, F2 are disabled. On any transition from ON to OFF the fan remains ON for a short delay to dissipate the heating/cooling. Fan short-cycling is prevented with a minimum fan ON time of 3 minutes, and a minimum OFF time of 1 minute.

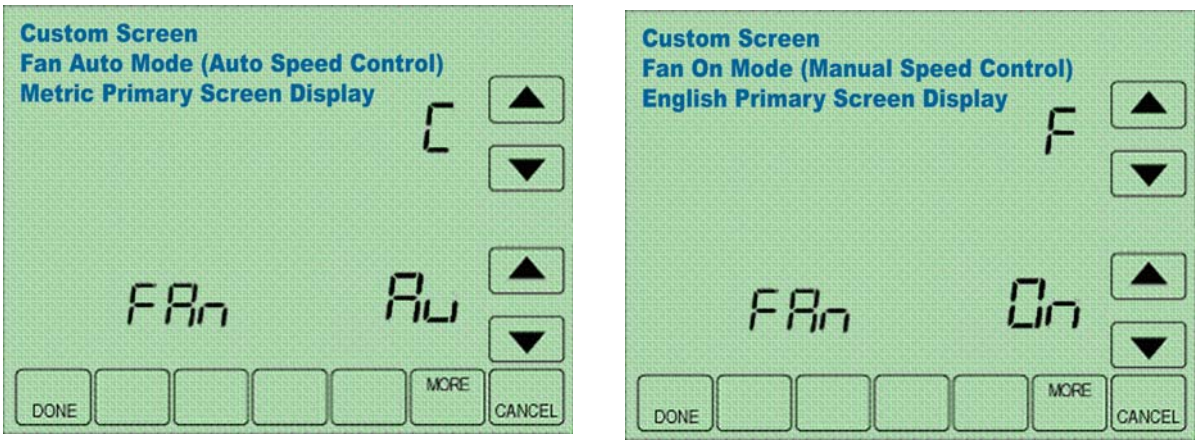


Figure 103 Fan Au (Auto) and Fan On (Manual) screen display

Occupancy mode

Fan block selections:

- OF = OFF
- F1 = Low speed:
  - AV-46, adjustable start setpoint (default set at 20%).
  - Fan setpoint deadband fixed at 2% below start values.
- F2 = Medium speed:
  - AV-85, adjustable start setpoint (default set at 40%).
  - Fan setpoint deadband fixed at 2% below start values.
- F3 = High speed:
  - AV-89, adjustable start setpoint (default set at 70%).
  - Fan setpoint deadband fixed at 2% below start values.
- Disable OF (OFF) for continuous fan, set BV-126 inactive.
- Cycle fan speed with heating/cooling demand % with user selectable fan speed settings (AV-227=1, default)
  - The fan speed will resync a user setting back to match demand % as demand increases or decreases.
- Cycle fan speed by users selectable fan speed settings (AV-127=2)
  - User selectable fan speed settings. Fan speeds do not respond to demand % signal.

Setpoint mode

- AV-227 =1: Fan cycles on for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. When the Standby input is active, the economizer is controlled to its fully-closed position. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts

BV-47 must be set inactive (factory default) to enable this option.

BI-1 Door/window is monitored during Occupied mode state. If the door or window is opened longer than the Standby Delay AV-20, the unit sets to Standby mode state. After the door or window is closed, if the PIR on BI-0 does not trigger within the Standby Delay AV-20, the unit is set to Standby state. During Standby state if the PIR on BI-0 triggers the unit resets to Occupied state.

Standby logic: In Standby state BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Valve Control

Cooling

The cooling valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the cooling valve control signal.

BV-15 active causes the cooling valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. A PI loop computes the cooling valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

The cooling valve control signal is output on AO-0.

The cooling valve is driven closed if any of the following are true:

- Cooling Valve Stroke Time AV-64 (factory default = 3) is set to less than 3 minutes
- Cooling Lockout is in effect
- Fan is OFF

Heating

The heating valve can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the heating valve control signal..

BV-15 active causes the heating valve to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Heating signal AV-1, the current supply air temperature, and the supply air temperature high limit. A PI loop computes the heating valve control signal based on the difference of the actual supply air temperature from the target supply air temperature.

The heating valve control signal is output on AO-1.

The heating valve control signal is 0 (closed) if any of the following are true:

- Fan is Off
- Heating Lockout is active
- Cooling mode is selected

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger

setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 82 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Economizer sequence (optional)

The economizer logic is enabled when Economizer Damper Stroke Time [ES] AV-63 is set to 5 seconds or above. If the economizer option will not be used, [ES] AV-63 should be set to 0 (factory default); this will prevent the economizer relays from clicking. The economizer sequence requires that a supply air sensor be wired to AI-2. The economizer option is not available if AI-2 is being used for OSA sensing (BV-32 active).

As the Cooling Signal varies between 0 and 30, the economizer command varies between the current minimum position [AV-66] and full open position. When either the Occupied command or the After-hours Timer is ON, the current minimum position [AV-66] is set to the specified Economizer Minimum Position; otherwise it is zero. The default minimum position is 20. The Economizer Minimum Position is set to zero if the fan is OFF.

The economizer minimum position will only work when "Schedule Mode" is configured as "Setpoint Mode". It will be forced to the current minimum position when any of the following are true:

- Outside Air Temperature goes above the Economizer Lockout Temperature [AV-67]
- Supply Temperature goes below the Low Supply Temperature Limit [AV-60]
- the unit is in Heat Mode

The economizer option is controlled by the economizer command signal. As the signal increases, BO-4 is commanded ON to open the valve. As the signal decreases, BO-5 is commanded ON to close the valve.

A BMS is required to set the values for AV-60, AV-66, and AV-67.

Economizer Alarms

If the Supply Temperature (AI-2) drops below the Supply Air Low Temp Limit [LL] for more than 20 seconds, the Lo Limit Alarm (BV-20) is triggered. The alarm automatically resets when the Supply Temperature exceeds the Supply Air Low Temp Limit [LL] by 7 degrees and the Supply Temperature remains above the Supply Air Low Temp Limit [LL] for 10 minutes. The Supply Air Low Temp Limit [LL] default is 40º F (5º C).

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller's main display for English "F" or Metric "C". The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric. Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

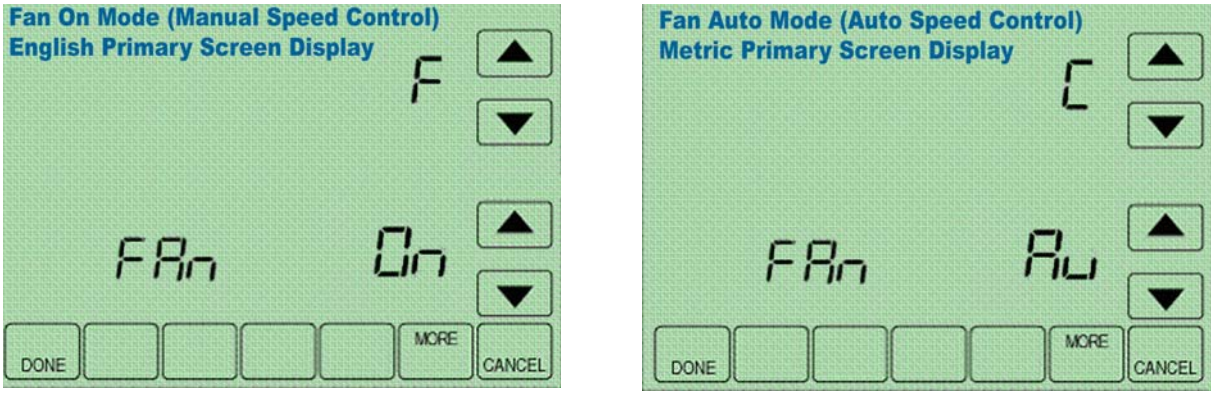


Figure 104 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 83 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	17	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	0		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output

Table 83 Setup codes

Code	Object		Default	Options	Units	Notes
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 84 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
Apps 8-17	AV-227	FAN Au (1), Fan On (2)	1	1,2		Fan auto Fan On custom display. Fan auto mode fan speed tracks temp demand, fan on fan tracks user command.
Apps 8-17	BV-126	Enable FAN OFF select	Active	Inactive/Active		Set BV-126 inactive to remove user control of fan-speed setting to OFF, use for continuous ventilation requirements in occupancy or setpoint mode.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		

Table 84 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	1	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	101		%	Apps 0-5 and 10.

Table 84 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		

Table 84 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

2 Pipe Fan Coil Unit with Change Over Control: App 18

3 point floating cooling/heating valve, 2 position heating/cooling valve option, analog cooling/heating valve option, electric coil heat, single speed fan with binary output start/stop, optional analog variable-speed fan control.

Note A water temperature sensor wired to AI-2 is required for this application.

Fan mode control (AV-17)

- 1 = continuous
- 2 = cycle with heating
- 3 = cycle with heating /cooling

Configurable Occupancy Modes

- SYSTEM Block: AUTO/OFF selection (Occupied/Unoccupied)
- Occupancy mode (AV-123=0, default): Schedules Occupancy states
- Setpoint mode (AV-123=1): Schedules Setpoints
- Dual setpoint mode (AV-123=2): Dual setpoints when Occupied
- Internal schedules enabled when BV-133 is active or ISU 160=4
- BMS schedules enabled when BV-56 is active

Inputs and Outputs

Table 85 Inputs and Outputs: [AP] 18

Point	Function
AI-0	Supply Air Temperature
BI-1	Optional input for standby detection
AI-2	Water temperature sensor
BO-0	Fan
BO-1	Not used
BO-2	Cooling/Heating Valve (2 Position Option)
BO-3	Cooling Valve Open (3 Point Floating Option)
BO-4	Cooling Valve Close (3 Point Floating Option)
BO-5	Electric Coil Heat
AO-0	Analog Modulating Cooling/Heating Valve
AO-1	Analog Fan Speed (optional)

Wiring diagram

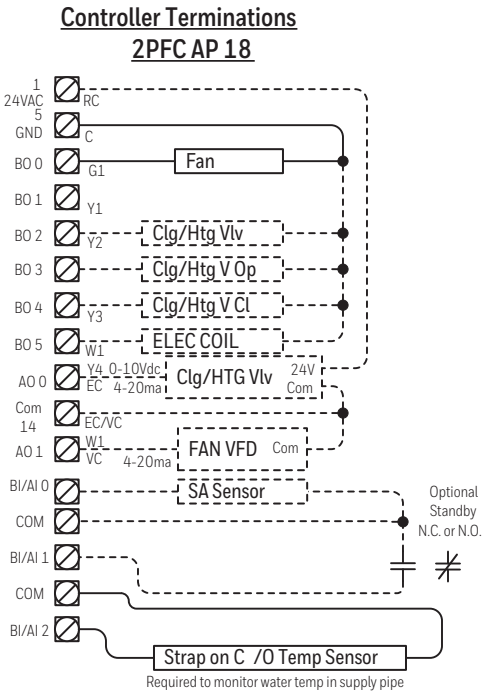


Figure 105 Controller terminations: [AP] 18

Sequences of Operation

Controller outputs are disabled when Enable Outputs [OE] BV-2 OFF/ON is in the OFF (inactive) state. Do not enable outputs until you are certain the wiring and configuration is correct and complete.

SYSTEM Block Control (BV-102)

When the unit is configured to run in Occupancy Mode, the SYSTEM Block allows the user direct control of occupied or unoccupied state from the controller display. Selecting “Auto” places the controller in Occupied state. Selecting “OFF” places the controller in unoccupied state.

The SYSTEM Block can be hidden by setting BV-102 inactive. When the SYSTEM Block is hidden occupancy states are controlled exclusively by the onboard or BMS schedules.

If onboard or BMS schedules are enabled, the “OFF” selection will override the controller’s scheduled state and force the unit into Unoccupied state. If you do not want the user to have this ability, set BV-102 inactive to hide the SYSTEM Block.

You can optionally change the behavior of the SYSTEM Block “OFF” setting so that instead of placing the controller in the Unoccupied state, the controller will turn the fan off. Heating and cooling are disabled when the fan is OFF. The fan

will remain off until the user changes the SYSTEM Block to “Auto.” Set BV-10 to active to allow this option.

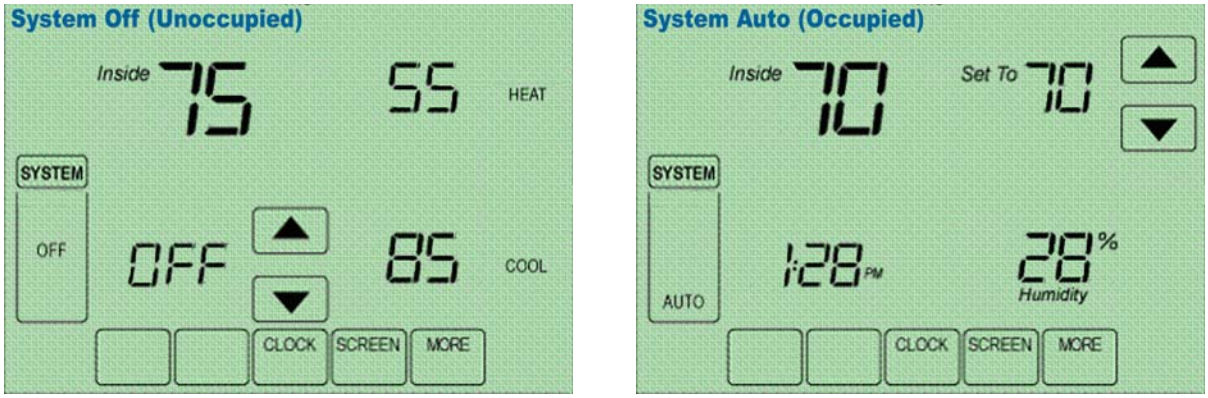


Figure 106 Display: SYSTEM Block OFF; SYSTEM Block AUTO

Configure schedules

The BACnet FF can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. The BACnet FF may also be scheduled by a BMS. Set BV-56 to active to enable BMS schedules. BV-133 changes to inactive when BV-56 is active.

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

Occupancy control (AV-123 = 0, default)

The controller operates in Occupied state when the Occupied Command (BV-64) is turned ON by any of the following:

- When the controller’s SYSTEM Block “AUTO” is selected by the user
- By local internal schedule, which writes to BV-40 at priority 16
- By a command sent from a BMS schedule or BMS operator override, writing to BV-40.

  Note If the user is allowed to command the SYSTEM Block, this command is at priority 10. BMS schedules should write to one of the BV-40 priorities 12-16 to avoid overriding the user command.

- When the occupant has initiated an after-hours override by pressing the override arrows on the touch screen.

The Unoccupied Setpoints are activated when the controller’s SYSTEM Block is set to “OFF” by the user.

When operating in the Unoccupied state, the override up/down arrows can be pressed to force the controller into the Occupied state for up to 4 hours (default value). The override time limit (AV-97) is adjustable from a minimum of 0.2 hours to a maximum of 9.5 hours.

When operating in the Unoccupied state, the fan runs when the heating/cooling demand is equal to or greater than 20% demand signal and stops when the heating/cooling demand drops below 10%.

Setting BV-9 to active enables the controller to default to Occupied state whenever communication with the BMS is lost continuously for more than 5 minutes. The command to Occupied state is implemented by setting BV-64 to active.

Occupied, Unoccupied, and Standby Heating and Cooling Setpoints

When operating in the Unoccupied state, the cooling and heating setpoint revert to specific values:

- Current Cooling Setpoint (AV-99) = Unoccupied Cooling Setpoint (AV-95)
- Current Heating Setpoint (AV-100) = Unoccupied Heating Setpoint (AV-96)

When operating in the Occupied state, the cooling and heating setpoints are calculated as offsets from the user adjustable Space Setpoint (AV-90):

- Current Cooling Setpoint (AV-99) = AV-90 plus AV-93 plus Demand Offset (AV-106)
- Current Heating Setpoint (AV-100) = AV-90 minus AV-94 minus Demand Offset (AV-106)

When operating in the Standby mode, the Current Cooling Setpoint and Current Heating Setpoint are calculated as for occupied mode as described above. However the standby offset ([SO]:, AV-19) is transferred to the Demand Offset (AV-106) before the computations, resulting in relaxed setpoints during standby operation.

User adjustment of the Space Setpoint (AV-90) value is limited by the Setpoint High Limit (AV-91) and the Setpoint Low Limit (AV-92).

Table 86 Setpoint values in Occupancy control

Field Code	Description
[:SP]	AV-90 Space Setpoint
[:HI]	AV-91 Setpoint High Limit
[:LO]	AV-92 Setpoint Low Limit
[:CO]	AV-93 Cooling Setpoint Offset
[:HO]	AV-94 Heating Setpoint Offset
[:UC]	AV-95 Unoccupied Cooling Setpoint
[:UH]	AV-96Unoccupied Heating Setpoint
[CS]	AV-99 current calculated Cooling Setpoint
[HS]	AV-100 current calculated Heating Setpoint
--	AV-106 demand offset (AV-106 value updates AV-99, AV-100)
[SO]	AV-19 standby offset; 0 minimum, 6 maximum degrees DDC transfers value to AV-106

Setpoint control (AV-123 = 1)

In setpoint mode, the controller logically emulates residential thermostats. The space temperature is controlled to "SP Mode Cooling SP" (AV-108) and "SP Mode Heating SP" (AV-109). These setpoints are writable using BACnet. Each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day -- Wake and Sleep. A value of 4 specifies four periods per day -- Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible using BACnet. The only way to view, edit and save a schedule is from the unit's LCD screen.

Note ***Setpoints*** are writable using BACnet but ***schedules*** are not accessible using BACnet.

If the Standby mode is active, the heating and cooling setpoints are adjusted by the standby offset ([SO]:, AV-19).

Note The SYSTEM Block is hidden when the controller is in Setpoint control mode.

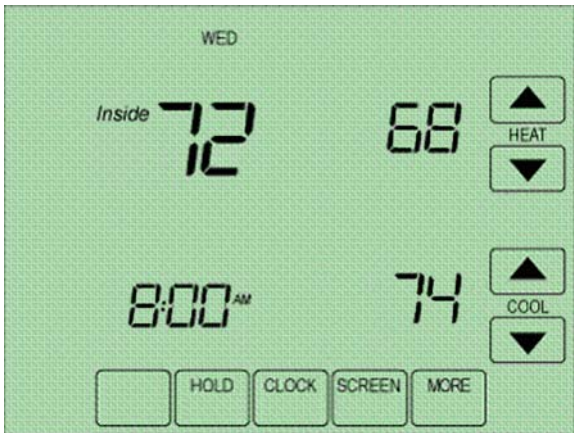


Figure 107 Setpoint mode display: single-speed fan

Schedule setpoint overrides in Setpoint mode

An override is created using one of three modes.

Temporary- press an arrow next to a setpoint. The words "Hold Temperature Unit" appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent- press HOLD. The words “Permanent Hold" appear below the time display and the override takes effect.

Vacation- while in Permanent Hold, press **HOLD**. The words "Hold Temperature Unit" appear above the time display. Use the arrows to select the number of days (1-365) you want to override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the BACnet FF to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV-130), and the number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

Note A user's ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Dual setpoint mode (AV-123 = 2)

In dual setpoint mode, the following quantities are used:

- Occupied Heating SP (AV-109)
- Occupied Cooling SP (AV-108)
- Unoccupied Heating SP (AV-96)
- Unoccupied Cooling SP (AV-95)
- Heating SP Limit (how high the heating setpoint can be set) (AV-92)
- Cooling SP Limit (how low the cooling setpoint can be set) (AV-91)

AV-109 and AV-108 are used to control Occupied Cooling and Occupied Heating Setpoints. Both are writable using BACnet or the device screen. When the space is occupied (BV-67 = Active), AV-109 and AV-108 are transferred to the current heating and cooling setpoints (AV-100 and AV-99).

IMPORTANT! DDC should not use AV-109 or AV-108 directly.

When the space is unoccupied, the Unoccupied Heating and Cooling Setpoints (AV-96 and AV-95) get transferred to the current heating and cooling setpoints (AV-100 and AV-99). The Unoccupied heating and cooling setpoints are not user-adjustable but they are adjustable using field service mode or an operator workstation. Unoccupied heating and cooling setpoints are not transferred to AV-109 and AV-108 during unoccupied periods.

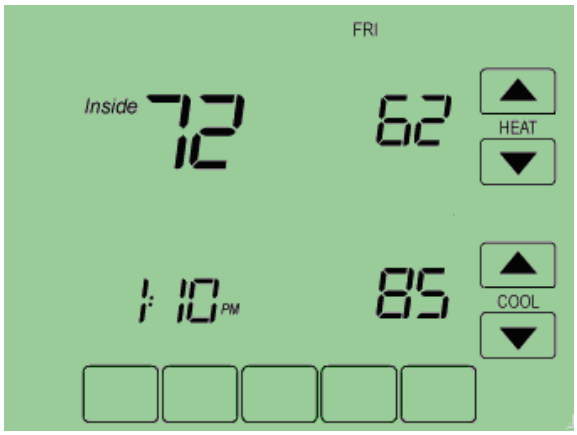


Figure 108 Dual setpoint display in Occupied mode: occupied heating setpoint AV-109, user-adjustable and occupied cooling setpoint AV-108, user-adjustable.

Note Use the MORE key to view OSA temperature and humidity values on subsequent screens.

Writes to AV-109 and AV-108 are limited by the Setpoint High and Low Limits (AV-91 and AV-92). Writes to AV-109 and AV-108 are also limited to the heating setpoint less than the cooling setpoint by a minimum of one degree.

Fan mode control

Occupancy mode

During occupancy mode the fan operates based on the selected Fan Mode.

- Fan Control AV-17 = 1: Fan runs continuously for ventilation.
- Fan Control AV-17 = 2: Fan runs continuously for cooling and cycles on for heating demand. When in Cooling mode, the fan runs continuously. When in Heating mode, the fan cycles on only when the heating signal calls for the fan to run.
- Fan Control AV-17 = 3: Fan cycles on when cooling or heating is selected or during Unoccupied mode only when called to run by cooling or heating demand.

Setpoint mode

- AV-227 =1: Fan cycles ON for cooling and for heating demand.
- AV-227 =2: Fan runs continuously.

Analog fan speed control (optional)

The fan speed analog output AO-1 will ramp from 0-100% based on the heating or cooling signal demand.

Note Variable speed drives run at minimum motor RPM even if AO-1 is zero when in run mode.

Standby Heating and Cooling setpoints

Standby state is a power-saving function of Occupancy mode. It occurs when the space is scheduled Occupied, but sensors detect there are no humans in the space. In this case the occupied heating and cooling setpoints are relaxed by the Standby Offset [SO]. The value of the Standby Offset [SO] may be set between a minimum of 0 and a maximum of 12 degrees.

Examples: If [:CS] = 72, [:HS] = 69, and [SO] = 4 then the setpoints are relaxed to [:CS] = 76, and [:HS] = 65.

Occupied Standby state, wired contacts (TB3026B-W only)

A door/window contact, light switch, or PIR is wired to the standby input BI-1. The switch polarity normally open/normally closed is configured by BV-3 [uL]. Set BV-3 inactive for normally open contacts, active for normally closed contacts. When the controller is in the Occupied state and the Standby input (BI-1) is triggered, the room status switches to Occupied Standby state (refer to “Standby Heating and Cooling Setpoints” above). A BMS can also be configured to monitor BI-1 for door/window ajar alarms.

Standby logic: In Standby state, BI-1 is active (e.g. a window is open). BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Occupied Standby state, wireless contacts (TB3026B-W only)

The wireless-controller interface sets BV-149 active. BV-149 in the active state overrides the wired input at BI-1, which no longer has standby control

functionality. If normal standby operation is required, BV-148 should be set to inactive allowing BI-1 to have standby control as it does on the non-wireless version. Any of up to 3 wireless PIR motion sensors can be configured and paired to the controller to sense room occupancy. Any of up to 8 wireless Window/Door sensors can be configured and paired to the controller to monitor open/closed status of windows or doors. When the controller is scheduled Occupied, if any window or door is opened and closed with no motion detected after 180 seconds, the room status switches to Occupied Standby state. The controller returns to the Occupied state when motion is detected. If a door or window is left open for more than 180 seconds, the controller sets to Standby state.

Standby logic: In Standby state, BV-4 is active and the value of the Standby Offset, [SO] AV-19, is transferred to the Demand Offset, AV-106. The [SO] AV-19 default is 4, the minimum is 0, and the maximum is 12.

Optional BI-1 input configuration (TB3026B-W only)

Input BI-1 on the BACnet FF may be used for point monitoring by a BMS.

- A dry contact normally open (e.g., filter status DPS, etc.)
- Standby Offset AV-19 is used by the wireless standby monitoring logic. Do Not set to zero (0).

Heating and Cooling Demand

Heating (AV-0) and Cooling (AV-1) signals are generated from the Space Temperature and the current Heating and Cooling Setpoints using a proportional-integral (PI) control algorithm. The two signals are compared, and the smaller one is set to zero to prevent any simultaneous heating and cooling. In the event of a Bad Space Sensor Alarm, both heating and cooling signals are set to zero.

Upon power-up or any transition to Occupied state, the integral component is re-initialized for both the Heating Signal and Cooling Signal PI control loops.

Heating and Cooling Signals — PI settings

The Heating signal PI settings are Heating Signal Kp (AV-41) and Heating Signal Ki (AV-42). The Cooling Signal PI settings are Cooling Signal Kp (AV-43) and Cooling Signal Ki (AV-44).

Water Loop Monitoring

A temperature sensor for water loop temperature must be connected to AI-2 for this application. The water loop temperature can be monitored either by this application or by a remote entity, selectable by Remote/Local Water Temp BV-29 (default inactive, Local Mode).

When in Local Mode (BV-29 inactive), this application monitors 2P Water Loop Temp AV-15 and performs the following tasks:

- Sets Bad Water Sensor Alarm BV-30 to active if the water loop temperature is not in the range -20 deg C to 120 deg C, or -20 deg F to 240 deg F.
- Selects 2P Coil Mode AV-23 (0-not in use, 1-Cooling, 2-Heating) based on the water loop temperature. The coil water is considered cold (Water

is Cold BV-17 active) if the water loop temperature is below the room temperature minus 5F/3C. The coil water is considered hot (Water is Hot BV-19 active) if the water loop temperature is above the room temperature plus 5F/3C.

When in Remote Mode (BV-29 active) a BMS should control Bad Water Sensor Alarm BV-30, determine the 2P Coil Mode AV-23, and set Water is Cold BV-17 and Water is Hot BV-18 as appropriate.

Valve Control

Valve control options of 2 Position, 3 Point Floating, or Analog are determined by wiring configuration. No other selection is required.

The 2-Pipe coil valve remains closed until operation is required. Valve operation is disabled unless the Fan Status BV-5 is ON, Bad Water Sensor Alarm BV-30 is inactive, and the water cold/hot indication (BV-17/BV-18) matches the current demand for cooling/heating. The status of 2P Allow Valve Operation BV-19 reflects whether these conditions are met.

Cooling

The cooling signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Cooling signal AV-1 to be used as the valve control signal.

BV-15 active causes the cooling to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-1, the current supply air temperature, and the supply air temperature low limit. The 2P Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2P Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

The 2 position heating/cooling valve has three control options, selected by AV-34

AV-34 = 1 selects trigger signal thresholds for opening and closing the valve. If the 2P Valve Command signal AV-23 is above the 2P Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the valve signal. 2P-Valve Minimum ON/OFF AV-29 (factory default 1 minute) prevents short-cycling.

Example: If AV-28 is 5 minutes and the valve signal is 75, then during each 5 minute cycle the valve will be commanded open for the first 3 minutes and 45 seconds. The 2 position valve is controlled using the BO-2 output.

AV-34 = 3 selects the Thermal Valve, Modulating Output control that pulses the binary output ON every 2.55 seconds, varying the ON time of the output (pulse width) from 0 to 2.55 seconds as the cooling or heating varies from 0-100. If the

signal is 0, the output remains OFF. The pulse width is calculated using a nonlinear conversion to better match the thermal modulating valve (TMV).

3 Point Floating

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

Analog Modulating

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Heating

The heating signal can be controlled using either of two options selected by BV-15.

BV-15 inactive (factory default) causes the Heating signal AV-0 to be used as the valve control signal.

BV-15 active causes the heating to be controlled by algorithms that are based on the supply air temperature. A target supply air temperature is computed based on the value of the Cooling signal AV-0, the current supply air temperature, and the supply air temperature high limit. The 2P Valve Command signal AV-23 is computed using a PI with target supply air temperature as setpoint and current supply air temperature as feedback. The 2P Valve Stroke Time AV-64 (factory default 3 minutes) needs is used compute an integral factor for this PI.

Physical 2 position valve control has two options, selected by AV-34

AV-34 = 1 selects set/reset signal thresholds for opening and closing the valve. If the 2P Valve Command signal AV-23 is above the 2P-Valve Set DB% AV-78 (factory default 20), then the valve will be commanded open until the valve signal falls below AV-78 minus the 2P-Valve Reset DB% AV-79 (factory default 1).

AV-34 = 2 (factory default) selects analog-to-binary control. In this mode the valve is commanded open for that percentage of the 2P-Valve Cycle Time AV-28 (factory default 3 minutes) dictated by the valve signal. 2P-Valve Minimum On/Off AV-29 (factory default 1 minute) prevents short-cycling. For example, if AV-28 is 5 minutes and the valve signal is 75, then during each 5 minute cycle the valve will be commanded open for the first 3 minutes and 45 seconds.

3 Point Floating

The 3 point floating valve is controlled via the open BO-3 and close BO-4outputs to the position (0-100%) indicated by 2P Valve Command AV-23.

Analog Modulating

The 2P Valve Command signal AV-23 is also output at AO-0 for use of a modulating analog valve instead of a 3 point floating valve.

Electric Coil Heater

The Heating Signal AV-0 is used to drive the electric coil heater. The coil heater will be turned on for that percentage of the Heating Stages Cycle Time AV-28

that corresponds to the heating signal. The coil heater ON and OFF times are limited by the value of Heating Stages Min On/Off AV-29. Coil Heater runtime is accumulated.

The heating signal range is controlled by the state of BV-18 “2P-Coil Water is Hot.” When BV-18 is inactive and there is a demand for heating, the heating signal spans from 0% to 100% as the electric coil becomes the primary heat source. When BV-18 is active the heating signal spans from 70% to 100% as the electric coil is the secondary heat source.

Air stratification and humidity control in Unoccupied state (optional)

Set BV-53 active to enable additional humidity control during Unoccupied Mode. A humidity trigger setpoint is entered as AV-30, with humidity dead band entered as AV-31. When sensed humidity equals or exceeds humidity trigger setpoint, the fan cycles ON/OFF at low speed until sensed humidity drops below the trigger setpoint minus the dead band.

Example: If AV-30 is set for 75 and AV-31 is set for 5: The fan will cycle when the space humidity is >= 75 and continue to cycle until the space humidity drops below 70.

The fan cycles ON for AV-48 seconds (default 1800) and OFF for AV-47 seconds (default 300) when stratification and humidity control is active.

Table 87 Unoccupied air stratification and humidity controls

	Point	Value	Units
Enable RH Fan Circulation Cycle	BV-53	Active	Unoccupied state
Fan ON Cycle Time Low Speed	AV-48	1800	Seconds
Fan OFF Cycle Time Low Speed	AV-47	300	Seconds
Sensed Space Humidity %RH	AV-105	%RH	Humidity
Space Humidity %RH Setpoint	AV-30	User Value	Humidity
Space Humidity %RH Deadband	AV-31	User Value	Humidity

Space Temperature Alarms

A Bad Space-Sensor Alarm is activated if the room-temperature sensor indicates a temperature greater than 120°F/50°C or less than 40°F/5°C.

Runtimes

Separate runtimes are accumulated for the fan and the filter based on fan operation. The runtimes can be reset independently in the event of filter replacement. A filter alarm, BV-16, is triggered if the filter runtime exceeds the filter-alarm setpoint. AV-86 will reset the runtime on the filter.

English/Metric units configuration

The display contains adjustment arrows to change the controller’s main display for English “F” or Metric “C”. The controller internal units English or Metric are set by BV-71. BV-71 is set to inactive (default) for English or active for Metric.

Selecting either adjustment arrow will update the display units F or C. Setting BV-8 (Lock Display Units Swap) to active will display the opposite units as indicated by BV-71 and will lock out changes to the display.

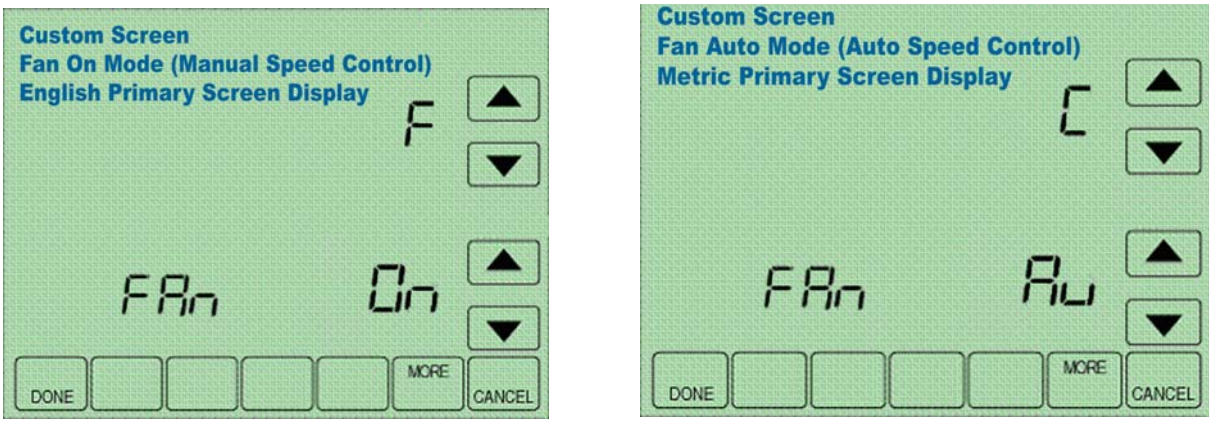


Figure 109 Display: English (F) or Metric (C)

Note BV-55 controls Fan Auto/Fan On display. Setting BV-55 inactive hides Fan Auto/Fan On. Setting BV-55 active shows Fan Auto/Fan On status. If BV-55 is inactive, BV-58 inactive/active control by BMS toggles Fan Auto/Fan/ON.

Table 88 Setup codes

Code	Object		Default	Options	Units	Notes
AP	AV-49	Application selection	18	0-18		
OE	BV-2	Outputs enable	OFF	OFF/ON		Set to ON to enable outputs
HC	BV-21	Rev Vlv Action HP or 4PHTG	OFF	OFF/ON		Apps 0-3, 6-9 & 17.
FC	AV-17	Fan1=Cont 2=CycHtg 3=CycHtgClg	1	1,2,3		
CC	AV-26	AC-HP Compr Cycle Time	12		Min	
C0	AV-27	AC-HP Compr Min ON	3		Min	
CF	AV-18	AC-HP Compr Min OFF	3		Min	
hC	AV-28	Heating Stages Cyc Time	12		Min	
h0	AV-29	Heating Stages Min ON	3		Min	
hF	AV-80	Heating Stages Min OFF	3		Min	
2C	AV-37	2 Pos Valves Cyc Time	3		Min	
2c	AV-38	2 Pos Valves Min ON	1		Min	
c5	AV-64	Clg or 2-pipe Valve Stroke Time	3		Sec	Cooling Valve Stroke Time: Value<=3 disables 3-point floating binary output
h5	AV-65	Htg Valve Stroke Time	3		Sec	Heating Valve Stroke Time: Value<=3 disables 3-point floating binary output

Table 88 Setup codes

Code	Object		Default	Options	Units	Notes
2P	AV-34	2PVlvMode 1=ON-OFF 2=ABOT 3=TMV	2	1,2,3		
FA	BV-55	Enable Fan CTL Display	OFF	OFF/ON		
cL	AV-70	Cooling Lockout Temp	55		Deg	
hL	AV-72	Heating Lockout Temp	62		Deg	
P5	BV-47	Enable AI-0 Sensor	OFF	OFF/ON		
5r	BV-32	Enable Remote Space Sensor	OFF	OFF/ON		
F1	AV-46	Auto Fan Start Demand %	20		%	Fan demand is based on AV-0 or AV-1 % signal
F5	AV-5	Fan Stop Delay Seconds SP	15		Sec	
F2	AV-85	Medium Speed Fan Start SP	40		%	Do not set less than AV-46 + 5
F3	AV-89	High Speed Fan Start SP	70		%	Do not set less than AV-85 + 5
uL	BV-3	Rev Standby Logic BI-1	OFF	OFF/ON		
50	AV-19	Standby Htg Offset		Deg		
SP	AV-90	Occupied Space Setpoint	70	70	Deg	
HI	AV-91	Setpoint High Limit	78	78	Deg	
LO	AV-92	Setpoint Low Limit	62	62	Deg	
CO	AV-93	Cooling Offset	2	2	Deg	
HO	AV-94	Heating Offset	1	1	Deg	
UC	AV-95	Unoccupied Clg Setpoint	85	85	Deg	
UH	AV-96	Unoccupied Htg Setpoint	55	55	Deg	
AL	AV-97	After Hours Limit	4	4	Hours	

Table 89 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-102	Show SYSTEM control	Active	Inactive/Active		A visible SYSTEM Block may or may not be required with schedules. SYSTEM Block "OFF" overrides scheduled occupied states to unoccupied.
	AV-123	Schedule Model	0	0 = Occupancy 1,2 = Setpoint		Sets mode as Occupancy, Setpoint, Occupancy with heat & cool setpoint.
2-Pipe	BV-29	Remote/Local Water Temp	Inactive	Inactive/Active		Set active BMS must control BV-17 and BV-18 for proper operation
	BV-17	2P-Coil Water is Cold	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-18	2P-Coil Water is Hot	Inactive	Inactive/Active		Controlled by DDC when temp sensor strapped to pipe. Use a small bullet sensor strapped to pipe, and BV-29 inactive
	BV-12	Dehumidify Mode On	Inactive	Inactive/Active		Enables dehumidification App 10 or with BV-53 enables dehumidification setpoint control with unoccupied dehumidification fan cycles
	BV-27	Heating Lockout	Inactive	Inactive/Active		
	BV-28	Cooling Lockout	Inactive	Inactive/Active		
	BV-31	WS HP Water Loop OK	Active	Inactive/Active		BMS enable allows heat pumps to run
	AV-20	Standby Delay Seconds	180	180	Sec	
	BV-56	Enable BMS Scheduling	Inactive	Inactive/Active		Overrides BV-133 internal schedules
	BV-53	Enable RH% Fan Circ Cycle	Inactive	Inactive/Active		
	AV-30	Dehumidify Setpoint Trigger	100	30-100	%RH	When set to a system set point usable value to enable dehumidification control when BV-12 or BV-12 & BV-55 are active
	AV-31	Humidity Reset DB	5	Less than AV-30	%RH	Works with AV-30and BV-53
	BV-9	Enable Communication Failure	Inactive	Inactive/Active		Set active to auto fail to occupied on MS/TP comm failure

Table 89 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-10	Enable System OFF	Inactive	Inactive/Active		When active, total system OFF, fans stopped
	AV-40	AC HP Mode	2	1,2		Setting 1, emulates thermostat control. Setting 2, analog to BIN control.
	AV-41	Heating Signal Kp	20			
	AV-42	Heating Signal Ki	1			
	AV-43	Cooling Signal Kp	20			
	AV-44	Cooling Signal Ki	1			
	AV-46	Auto Fan Start Demand %	20		%	
	AV-47	RH Circ OFF Time	1800		Sec	Unoccupied state fan dehumidification OFF cycle time
	AV-48	RH Circ ON Time	300		Sec	Unoccupied state fan dehumidification ON cycle time
	AV-53	Auto Fan Stop Deadband SP	5		%	Settings for all single speed fan applications
	AV-57	AC HP Comp Min OFF Time	60		Sec	Apps 0-3 and 10.
	AV-60	Supply Air Low Temp Limit	45		Deg	
	AV-61	Supply Temp. High Limit	78		Deg	
	AV-63	Econ. Damper Stroke Time	0	6-nnn	Sec	AV-63 Set to zero (0) to stop relay outputs if BO not used.
	AV-66	Economizer Min Position	20	0-100	%	
	AV-67	Economizer Lockout Temp	68	68	Deg	
	AV-68	AC HP Comp Start Deadband %	20		%	Apps 0-5 and 10.
	AV-69	AC HP Comp Stop Demand %	1		%	Apps 0-5 and 10
	AV-77	Filter Alarm SP	3000		Hours	
	AV-78	2PVlvMode Set DB%	20	20-100		
	AV-79	2PVlvMode Reset DB%	1	1-25		Must be less than AV-78

Table 89 Requires BMS to set

Code	Point	Value	Default	Options	Units	Notes
	BV-105	Show Unoccupied Htg/Clg SPs	Active	Active/Inactive		
	BV-210	Enable Custom Screen	Active			Inactive hides custom screen options
	BV-215	URHC Enable	Active			Inactive hides F/C selection
	BV-219	LLHC Enable	Active	Do Not Change		DDC control
	BV-222	LRHC Enable	Active	Do Not Change		DDC control
	BV-262	URHC Adi Arrows	Active	Do Not Change		DDC control
	BV-276	LRHC Adi Arrows	Active	Do Not Change		DDC control
	MV-8	OFF	1	Do Not Change		
	MV-9	F1	5	Do Not Change		
	MV-10	F2	5	Do Not Change		
	MV-11	F3	4	Do Not Change		
	MV-21	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-22	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	MV-23	Mode 1-Numeric, 2-Alpha Numeric	2	Do Not Change		
	AV-218	URHC delta	1	Do Not Change		
	AV-216	URHC Up Arrow Max	1	Do Not Change		
	AV-217	URHC Down Arrow Min	2	Do Not Change		
	AV-230	LRHC Up Arrow Max	1	Do Not Change		
	AV-231	LRHC Down Arrow Min	2	Do Not Change		
	AV-232	LRHC Delta	1	Do Not Change		

Appendix A: BACnet object and property reference

This section shows the BACnet objects available in the BACnet FF. The tables that follow list individual points and give details about the properties of each object listed.

BACnet FF objects

Object (instance range)	Remarks
AI-(0-2)	Analog input objects associated with physical, universal input terminals on BACnet FFs. AIs are identified as AI-nn, where nn is the input terminal number.
AO-(0-7)	Analog output objects associated with physical output terminals. AOs are identified as AO-nn, where nn is the output terminal number.
AV-(90–107)	RESERVED AVs.
AV-(0-89)	General use AVs.
AV-(108-136)	Screen control and feedback
AV-(210-233)	Custom screen control and feedback
BI (0-2)	Binary input objects associated with physical, universal input terminals on BACnet FF. BIs are identified as BI-nn, where nn is the input terminal number.
BO (0-5)	Binary output objects associated with physical output terminals on BACnet FF. BOs are identified as BO-nn, where nn is the output terminal number.
BV-(0-63)	General use BVs. BV-40 supports the priority-array property. BV-40 is used for occupancy commands.
BV-(90-147)	Screen control and feedback
BV-(200-202)	AI-current mode select
BV-(210-299)	Custom screen control and feedback
BV-(300-301)	AO-current mode detection feedback
BV-(400-402)	AI-pullup enables
MV-(0-23)	Multistate values RESERVED.
Device	Provides general information about a device
File (254)	Provides information about the operating system file.
File (0)	Provides information about the current DDC file.
Program 254	Firmware program. Entry into boot loader requires writing password to property HoneywellBP_DOWNLOAD_PASSWORD.

Object (instance range)	Remarks
Program 0	DDC program The Instance_Of property contains the DDC rep/job/application/display information The Reason_For_halt, Description_Of_Halt, and related properties display any DDC errors.
File 240	Legacy method of setting device instance. Has special security feature
File 254	File object used to do firmware download. Has special semantics.
File 260	AI-Linearization data. Only writable by halting associated program object.
File 261	AI-and AO-Calibration data. Only writable by halting associated program object
Program 260	Allows access to AI-linearization data when halted. Halting requires writing password to property HoneywellBP_DOWNLOAD_PASSWORD.
Program 261	Allows access to calibration data when halted. Halting requires writing password to property HoneywellBP_DOWNLOAD_PASSWORD.
Schedule 0	Internal schedule used only in Occupancy mode and only if enabled by BV-133

Object properties

Device object properties

Property	Access	Notes
Object Identifier	R/W	Not writable in BACnet FF
Object Name	R/W	
Object Type	R	
System Status	R	OPERATIONAL
Vendor Name	R	“Honeywell”
Vendor Identifier	R	91
Model Name	R	”Honeywell-XXXXXX”
Firmware Revision	R	(comes from boot loader) initially “RL 5.00 (build x)”
Application Software Version	R	“5.00 (build y)” or similar
Location	R/W	
Description	R/W	
Protocol Version	R	1
Protocol Revision	R	4
Protocol Services Supported	R	atomicReadFile, atomicWriteFile, readProperty, readPropertyMultiple, writeProperty, writePropertyMultiple, deviceCommunicationsControl, reinitializeDevice, i-Am, unconfirmedPrivateTransfer, timeSynchronization, who-Has, who-Is, utcTimeSynchronization
Protocol Object Types Supported	R	analog-input, analog-output, analog-value, binary-input, binary-output, binary-value, device, file, program, schedule
Object List	R	Too large to return in a single request, so returns “segmentation not supported”. Individual array entries can be read.
Max APDU Length Accepted	R	480
Segmentation Supported	R	no-segmentation
Local Time	R/W	Default = “00:00:00”
Local Date	R/W	Default = “Jan 1, 1900"
UTC Offset	R/W	Default = 0
Daylight Savings Status	R/W or R	Read-only if ISU parameter 330 is set to one of the auto-adjust options.
APDU Timeout	R/W	Default = 6000, limited to 100..60000
Number of APDU Retries	R/W	Default = 3, limited to 0..16
Max Master	R	127
Max Info Frames	RW	Default = 3, limited to 1..60
Device Address Binding	R	Empty List

AI-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AI nnn"
Object Type	R	
Present Value	R	
Description	R/W	Read only if configured in DDC header using DDCMULTI.
Status Flags	R	All false
Event State	R	NORMAL
Out Of Service	R	FALSE
Units	R	Value set in DDC file using DDCMULTI except where noted otherwise in the sequence of operation

AO-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AO-nn"
Object Type	R	
Present Value	R/W	Limit 0.0 .. 102.4
Description	R/W	Read only if configured in DDC header using DDCMULTI.
Status Flags	R	Usually no flags set. The out-of-service bit shall be set whenever the point is configured as such using DDCMULTI.
Event State	R	normal
Out Of Service	R	Value configured in DDC file using DDCMULTI. See below.
Units	R	Value configured in DDC file using DDCMULTI.
Priority Array	R/W	Limit 0.0 .. 102.4
Relinquish Default	R	Value configured in DDC file using DDCMULTI.

AV-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AV-nnn" except where noted otherwise
Object Type	R	
Present Value	R/W	As described below
Description	R/W	Read only if configured in DDC header using DDCMULTI.

Property	Access	Notes
Status Flags	R	No flags set
Event State	R	Normal
Out Of Service	R	FALSE
Units	R	As described below

BI object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	“BI nnn”
Object Type	R	BINARY INPUT
Present Value	R	
Description	R/W	Read only if configured in DDC header using DDCMULTI.
Status Flags	R	All false
Event State	R	NORMAL
Out Of Service	R	FALSE
Polarity	R	NORMAL

BO object properties

Property	Access	Default location and value
Object Identifier	R	
Object Name	R	“BO nn”
Object Type	R	BINARY OUTPUT
Present Value	R/W	
Description	R/W	Read only if configured in DDC header using DDCMULTI.
Status Flags	R	Usually no flags set. The out-of-service bit shall be set whenever the point is configured as such using DDCMULTI.
Event State	R	normal
Out Of Service	R	Selectable in DDC header
Polarity	R	NORMAL
Priority Array	R/W	RAM
Relinquish Default	R	Selectable in DDC header

BV-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"BV-nnn" for most BVs, except where otherwise noted
Object Type	R	
Present Value	R/W	
Description	R/W	Read only if configured in DDC header using DDCMULTI.
Status Flags	R	No flags set
Event State	R	NORMAL
Out Of Service	R	FALSE
Priority Array	R/W	BV-40 only
Relinquish Default	R/W	BV-40 only

MV-object properties

Property	Access	Notes
Out of Service	R	False
Event State	R	Normal
Status Flag	R	NO flags set
Object Name	R	"MV-nnn" except where otherwise noted
Description	R/W	
State Text	R	
Present Value	R	
Number of States	R	
Object ID	R	

Schedule object properties

Property	Access	Notes
Object Identifier	R/O	SCHEDULE 0
Object Name	R/O	"Schedule 0"
Object Type	R/O	SCHEDULE
Present_Value	R/O	
Description	R/O	"Main Schedule"
Effective_Period	R/O	ANYTIME (always in effect)
Weekly_Schedule	R/W	7 days, 6 events per day maximum. BTL compliant.
Schedule_Default	R/W	Inactive (enum 0)
List_Of_Object_Property_References	R/O	Empty

Property	Access	Notes
Priority_For_Writing	R/O	16
Status_Flags	R/O	All bits clear
Reliability	R/O	NO FAULT DETECTED
Out_Of_Service	R/O	FALSE

Standard AVs and BVs

This section lists the logical points in the BACnet FF. Points with access type of “R/O” are computed by the BACnet FF and provided as inputs to the user application. Points with access type “R/W” are written by the user application or via BACnet in order to provide information to the BACnet FF.

Mode select BVs

Point	Object Name	Access	Description
BV-200 ... BV-202	AI*n* Current Mode	R/W	ON: Configures the corresponding AI-in current mode OFF: Configures the corresponding AI-in voltage mode
BV-300 ... BV-301	AO*n* Current Mode	R/W	Read-only. “Active” indicates AO0..AO1 has detected current mode (load is 550 Ohms or less). “Inactive” indicates voltage mode (load is 1K Ohm or higher).
BV-400 ... BV-402	AI*n* Pullup	R/W	Enables the pullup on AI0..A3. Gets set to default value from DDC header at beginning of first pass of DDC, allowing DDC to override the default. An Active setting of one of these pullup BVs overrides the setting of the corresponding AI-current mode BV-(see above).

UI control AVs and BVs

The following AVs, BVs, and MVs control the BACnet FF user interface.

General control AVs

Point	Object Name	Access	Description
AV-110	SP Mode Setpoint Model	R/W	Setpoint Mode: Chooses the setpoint model, and also selects the layout of the Generic Backdrop display 0.0: use OFF Format (no setpoints shown) 1.0: use 1-setpoint format (cooling) 2.0: use 1-setpoint format (heating) 3.0: use 2-setpoint format Occupancy Mode: Ignored
AV-111	SYSTEM Setpoint Model	R/W	Provides a compatible output from the SYSTEM control that can be transferred into the setpoint model AV-110 (above) to reproduce default VisionPro behavior. The values produced by the SYSTEM control are limited by the configuration AVs, BVs, and MVs. 0.0: “OFF” selected 1.0: “COOL” selected 2.0: “HEAT”/”EM HEAT” selected 3.0: “AUTO” selected
AV-123	Occupancy Mode Select	R/W	Sets system to Occupancy mode.
AV-124	Filter Change Reminder	R/W	Enables the filter change reminder.
AV-125	Humidity Pad Change Reminder	R/W	Enables the humidity pad change reminder.

Point	Object Name	Access	Description
AV-126	UV Lamp Change Reminder	R/W	Enables the UV lamp change reminder.
AV-127	Daylight Savings	R/W	Sets Daylight savings to Off, pre-2007 scheme, or post-2007 scheme.
AV-128	Keypad Lock	R/W	Locks the keypad.
AV-132	Field Service Mode Security PIN	R/W	Allows access to Field Service mode only by authorized users.
AV-133	ISU Mode Security PIN	R/W	Allows access to ISU mode only by authorized users.
AV-137	Fan Setting Display Format	R/W	Selects the format in which fan settings are shown on the display.

General control BVs

Point	Object Name	Access	Description
BV-80	Enable Fan Speed Control	R/W	ON: Allow the “FAN” control to be visible to the end user OFF: FAN control is always hidden
BV-84	Enable Space Humidity	R/W	ON: Display space humidity as appropriate OFF: Never display the space humidity
BV-100	Enable OSA Temp	R/W	ON: Display the OSA temperature as appropriate OFF: Never display the OSA temp
BV-101	Enable OSA Humidity	R/W	ON: Display outside humidity as appropriate OFF: Never display outside humidity
BV-102	Enable System Control	R/W	ON: Allow the “SYSTEM” control to be visible OFF: The “SYSTEM” control is always hidden
BV-103	Hide Fan and System	R/W	ON: Hide the FAN and SYSTEM controls in unoccupied mode (regardless of other display settings) OFF: Show them if allowed
BV-104	Enable DOW	R/W	ON: Allow day of week to be shown is possible OFF: Never show the day of week
BV-105	Show Unocc Setpoints	R/W	ON: Display the unoccupied heating/cooling setpoints in unoccupied mode OFF: Don't display them

General control MVs

Point	Object Name	Access	Description
MV-0	Time Mode	R	Provides feedback about the device's time handling capability: Normal clock operation will result in a present value of 3. 1: “Time Of Day Unknown Mode” 2: “Time Of Day Available Mode” 3: “Date/Time Available Mode”
MV-1	Schedule Model	R	Provides feedback about the device's schedule model 1: “Setpoint”) 2: “Occupancy”
MV-2	Keypad Lock	R	Provides feedback about the keypad access level: 1: “full access” 2: “setpoints only” 3: “locked”
MV-3	DLS Mode	R	Provides feedback about the mode of Daylight Saving operation 1: “OFF” 2: “Auto (pre-2007)” 3: “Auto (2007 and later)”
MV-4	SP Increment	R	Amount of change in setpoint per arrow press 1: “1º F / 0.5º C” (default)
MV-5	Schedule Increment	R	Amount of change in schedule times per arrow press 1: “1 min” (default)

Optional screen segment control BVs

In Setpoint Mode, the setpoint layout is controlled by AV-110, see above.

Point	Object_Name	Access	Description
BV-77	Heating ICON	R/W	ON: Display “heat on” icon
BV-78	Cooling ICON	R/W	ON: Display “cool on” icon
BV-106	Show Wait	R/W	ON: Display “Wait”
BV-107	Show Aux heat on	R/W	ON: Display “Aux heat on”
BV-108	Show Recovery	R/W	ON: Display “Recovery”
BV-109	Show FROST	R/W	ON: Display “FROST”
BV-110	Show DEHUMIDIFIER	R/W	ON: Display “DEHUMIDIFIER”
BV-111	Force CHANGE FILTER	R/W	ON: Force “CHANGE FILTER” to be displayed (can also be automatically displayed due to filter timer)

Point	Object_Name	Access	Description
BV-112	Force CHANGE UV LAMP	R/W	ON: Force “CHANGE UV LAMP” to be displayed (can also automatically be displayed due to UV lamp timer)
BV-113	Force CHANGE HUMIDIFIER PAD	R/W	ON: Force “CHANGE HUMIDIFIER PAD” to be displayed (can also be displayed due to humidifier pad timer)
BV-114	Disable SCHED key	R/W	OFF: Allow “SCHED” key to be used to access standard scheduling UI (if appropriate) ON: The “SCHED” key is always invisible
BV-115	Disable Permanent HOLD key	R/W	OFF: Allow “HOLD” key to be used to access the Permanent Hold UI ON: the “HOLD” key is invisible or used for Vacation HOLD, if enabled.
BV-130	Disable Vacation HOLD key	R/W	OFF: Allow “HOLD” key to be used to access the standard Vacation Hold UI (if appropriate) ON: the “HOLD” key is invisible.
BV-116	Disable CLOCK key	R/W	OFF: Allow “CLOCK” key to be used to set clock (if appropriate) ON: the CLOCK key is always invisible
BV-131	Hotel Standby Mode	R/W	Set Active by DDC to indicate to the display that DDC is controlling to standby mode. Useful for visual indication if DDC mistakenly thinks the room is unoccupied.
BV-142	Master OFF	R/W	OFF: no effect ON: Override occupied status in Occupancy Mode. Home screen shows “OFF” without override arrows and user setpoint is not displayed. Used to implement user ON/OFF or fan control ON/OFF. Replaces the legacy BV65.

Schedule control BVs

Point	Object Name	Access	Description
BV-114	Deny schedule viewing	R/W	If set, the user is not allowed to view schedules.
BV-133	Enable internal schedule	R/W	ON: Internal 7-day scheduling is enabled (subject to other factors). The BACnet schedule object is visible via BACnet OFF: Disables use of internal scheduling mechanism. The BACnet schedule object is invisible. All UI components related to schedule editing are disabled. This is ISU parameter 160. BV-133=0 shown as ISU 160=0. BV-133=1 shown as ISU 160=4.
BV-141	Disable schedule edit	R/W	ON: Inhibits screen EDIT key. Internal schedules may be viewed but not edited.
AV-129	Weekday periods ISU value	R/W	2: Two schedule periods per day 4: Four schedule periods per day

Schedule control AVs

Point	Object Name	Units	Access	Description
AV-113	SP Override Mode AV		R/W	While in setpoint mode, indicates the setpoint override state. This point can be written in DDC to cancel the override status 1.0: scheduled 2.0: temporary 3.0: permanent 4.0: vacation 5.0: initial
AV-130	Hold until time	Minutes	R/W	While in setpoint mode, indicates the minute of the day (0-1440) at which a temporary or vacation override is to expire.
AV-131	Vacation days remaining	Days	R/W	While in setpoint mode, indicates the number of days remaining in a vacation override.

Schedule control MVs

Point	Object Name	Access	Description
MV-12	Schedule Format	R	This point is a human-friendly version of AV-129, ISU parameter 540 (see above) 1: “2 commands per day” 2: “4 commands per day”
MV-13	SP Override Mode	R	While in setpoint mode, indicates the setpoint override state. This point is a human-friendly version of AV-113 (see above) 1: “scheduled” 2: “temporary” 3: “permanent” 4: “vacation”

Filter timer control BVs

Point	Object Name	Access	Description
BV-134	Filter Enable	R/W	ON: Enable filter timer and automatic “change filter” warning OFF: detail display shall be skipped, “change filter” warning shall not be activated automatically
BV-135	Filter ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

Filter timer control AVs

Point	Object_Name	Units	Access	Notes
AV-114	Filter Runtime	Hours	R/W	Current filter runtime hours. Can be reset via DDC or by pressing **Reset** on the details display
AV-115	Filter Runtime Limit	Hours	R	Filter runtime limit

UV lamp timer control BVs

Point	Object_Name	Access	Description
BV-136	UV Lamp Enable	R/W	ON: Enable UV Lamp timer and automatic “UV Lamp” warning OFF: detail display shall be skipped, “UV Lamp” warning shall not be activated automatically
BV-137	UV Lamp ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

UV lamp timer control AVs

Point	Object_Name	Units	Access	Notes
AV-116	UV Lamp Runtime	Hours	R/W	Current UV Lamp runtime hours. Can be reset via DDC or by pressing **Reset** on the details display
AV-117	UV Lamp Runtime Limit	Hours	R	UV Lamp runtime limit

Humidifier pad timer control BVs

Point	Object_Name	Access	Description
BV-138	Humidifier Pad Enable	R/W	ON: Enable Humidifier Pad timer and automatic "Humidifier Pad" warning OFF: detail display shall be skipped, "Humidifier Pad" warning shall not be activated automatically
BV-139	Humidifier Pad ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

Humidifier pad timer control AVs

Point	Object_Name	Units	Access	Notes
AV-118	Humidifier Pad Runtime	Hours	R/W	Current Humidifier Pad runtime hours. Can be reset via DDC or by pressing **Reset** on the details display
AV-119	Humidifier Pad Runtime Limit	Hours	R	Humidifier Pad runtime limit

Dehumidifier and humidifier BVs

Point	Access	Description
BV-140	R/W	ON: Enable dehumidifier setpoint on detail screen (also requires humidity to be enabled or you cannot get to the detail screen) OFF: Dehumidifier setpoint not shown on detail screens
BV-143	R/W	ON: Enable humidifier setpoint on detail screens (also requires humidity to be enabled or you cannot get to the detail screen) OFF: Humidifier setpoint not shown on humidity detail screen
BV-144	R/W	ON: Enable AUTO/OFF user selection on humidifier detail screen OFF: AUTO/OFF option not shown on humidifier detail screen
BV-145	R/W	User humidifier AUTO/OFF selection. ON=AUTO.
BV-146	R/W	ON: Enable AUTO/OFF user selection on dehumidifier detail screen OFF: AUTO/OFF option not shown on dehumidifier detail screen
BV-147	R/W	User dehumidifier AUTO/OFF selection. ON=AUTO.

Dehumidifier and humidifier AVs

Point	Object_Name	Units	Access	Notes
AV-120	Dehumidifier Setpoint	% RH	R/W	Current dehumidifier setpoint
AV-121	Dehumidifier SP Max	% RH	R/W	Dehumidifier max. limit
AV-122	Dehumidifier SP Min	% RH	R/W	Dehumidifier min. limit
AV-134	Humidifier Setpoint	% RH	R/W	Current humidifier setpoint
AV-135	Humidifier SP Max	% RH	R/W	Humidifier max. limit
AV-136	Humidifier SP Min	% RH	R/W	Humidifier min. limit

Temperature and humidity offset AVs

Point	Object_Name	Units	Access	Notes
AV-138	Sensed Temperature Offset	Deg F/C	R/W	Limited to +/- 4 degrees F.
AV-139	Sensed Humidity Offset	%RH	R/W	Limited to +/- 5%.
AV-140	Sensed Outside Air Temperature Offset	Deg F/C	R/W	Limited to +/- 4 degrees F. Added to Sensed Outside Air Temperature (AV-103) to produce Displayed Outside Air Temperature (AV-13.
AV-141	Sensed Outside Air Humidity Offset	%RH	R/W	Added to AV-107 to generate OA humidity on the details screens. Limited to +/- 5%.

Appendix B: Ordered list of control points

Point	Object Name
AV-90	Setpoint (SP)
AV-92	Setpoint Low Limit
AV-94	Heating SP Offset
AV-96	Unoccupied Heating SP
AV-98	After Hours Timer
AV-100	Current Heating SP
AV-102	Displayed Room Humidity
AV-104	Sensed Room Temperature
AV-106	Demand Offset
AV-108	SP Mode Cooling SP
AV-110	SP Mode Setpoint Model
AV-113	SP Override Mode AV
AV-115	Filter Runtime Limit
AV-117	UV Lamp Runtime Limit
AV-119	Humidifier Pad Runtime Limit
AV-121	Dehumidifier SP Max
AV-123	Set system to Occupancy mode
AV-125	Humidity Pad Change Reminder
AV-127	Daylight savings
AV-129	Weekday periods ISU value
AV-131	Vacation days remaining
AV-133	ISU mode security PIN
AV-135	Humidifier SP Max
AV-137	Fan Setting Display Format
AV-139	Sensed Humidity Offset
AV-141	Sensed Outside Air Humidity Offset
AV-211	ULHC left character
AV-213	URHC number
AV-215	URHC 1 char
AV-217	URHC maximum
AV-219	LLHC number
AV-221	LLHC 1 char
AV-223	LLHC maximum

Point	Object Name
AV-91	Setpoint High Limit
AV-93	Cooling SP Offset
AV-95	Unoccupied Cooling SP
AV-97	After Hours Timer Limit
AV-99	Current Cooling SP
AV-101	Displayed Room Temperature
AV-103	Displayed Outside Air Temperature
AV-105	Sensed Room Humidity
AV-107	Displayed Outside Humidity
AV-109	SP Mode Heating SP
AV-111	SYSTEM Setpoint Model
AV-114	Filter Runtime
AV-116	UV Lamp Runtime
AV-118	Humidifier Pad Runtime
AV-120	Dehumidifier Setpoint
AV-122	Dehumidifier SP Min
AV-124	Filter Change Reminder
AV-126	UV Lamp Change Reminder
AV-128	Keypad lock
AV-130	Hold until time
AV-132	Field service mode security PIN
AV-134	Humidifier Setpoint
AV-136	Humidifier SP Min
AV-138	Sensed Temperature Offset
AV-140	Sensed Outside Air Temperature Offset
AV-210	UHLH number
AV-212	ULHC right character
AV-214	URHC 10 char
AV-216	URHC minimum
AV-218	URHC delta
AV-220	LLHC 10 char
AV-222	LLHC minimum
AV-224	LLHC delta

Point	Object Name
AV-225	LLHC 1000 char
AV-227	LRHC number
AV-229	LRHC 1 char
AV-231	LRHC maximum
BV-64	Time Schedule Output
BV-66	After Hours Timer Status
BV-68	Field service Lockout
BV-71	English (OFF) / Metric (ON)
BV-73	Fan stage 2
BV-77	Heating ICON
BV-79	Backlight ON
BV-81	Select Hotel Mode
BV-83	24Hr Time Format
BV-100	Enable OSA Temp
BV-102	Enable System Control
BV-104	Enable DOW
BV-106	Show Wait
BV-108	Show Recovery
BV-110	Show DEHUMIDIFIER
BV-112	Force CHANGE UV LAMP
BV-114	Disable SCHED key
BV-116	Disable CLOCK key
BV-118	Allow System HEAT
BV-120	Allow System AUTO
BV-122	System HEAT Mode
BV-124	System AUTO Mode
BV-130	Disable Vacation HOLD key
BV-133	Enable internal schedule
BV-135	Filter ON
BV-137	UV Lamp ON
BV-139	Humidifier Pad ON
BV-141	Disable schedule edit
BV-143	Enable humidifier setpoint on detail screens

Point	Object Name
AV-226	LLHC 100 char
AV-228	LRHC 10 char
AV-230	LRHC minimum
AV-232	LRHC delta
BV-65	User ON/OFF in Occupied Mode
BV-67	Occupied/Unoccupied Status
BV-69	Swap English/Metric
BV-72	Fan stage 1
BV-74	Fan stage 3
BV-78	Cooling ICON
BV-80	Enable Fan Speed Control
BV-82	Enable Time Display
BV-84	Enable Space Humidity
BV-101	Enable OSA Humidity
BV-103	Hide Fan and System
BV-105	Show Unocc Setpoints
BV-107	Show Aux heat on
BV-109	Show FROST
BV-111	Force CHANGE FILTER
BV-113	Force CHANGE HUMIDIFIER PAD
BV-115	Disable Permanent HOLD key
BV-117	Allow System OFF
BV-119	Allow System COOL
BV-121	Allow System EM HEAT
BV-123	System COOL Mode
BV-125	System EM HEAT Mode
BV-131	Hotel Standby Mode
BV-134	Filter Enable
BV-136	UV Lamp Enable
BV-138	Humidifier Pad Enable
BV-140	Enable dehumidifier setpoint on detail screen
BV-142	Master OFF
BV-144	Enable AUTO/OFF user selection on humidifier detail screen

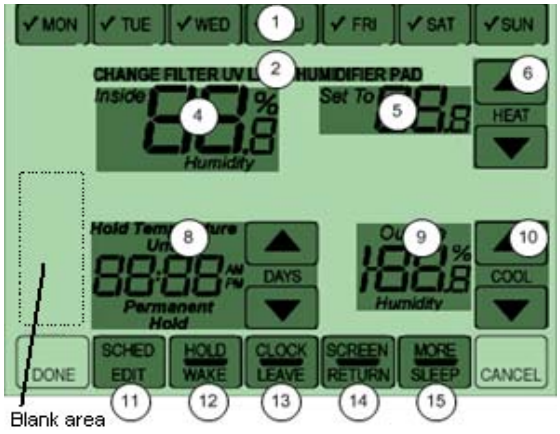
Point	Object Name
BV-145	User humidifier AUTO/OFF selection
BV-147	User dehumidifier AUTO/OFF selection
BV-210	Custom 1 Enable
BV-212	ULHC enable
BV-214	ULHC lead zero
BV-216	URHC decimal
BV-218	URHC edit
BV-220	LLHC lead zero
BV-222	LRHC enable
BV-224	LRHC lead zero
BV-226	LRHC leading 1
BV-228	Mon text
BV-230	Wed text
BV-232	Fri text
BV-234	Sun text
BV-236	Tue check
BV-238	Thu check
BV-240	Sat check
BV-242	Ok to pick
BV-244	Change
BV-246	UV Lamp
BV-250	Inside
BV-253	Set to
BV-255	Heat On
BV-257	Cool On
BV-259	Frost
BV-261	Recovery
BV-263	Pm
BV-265	Days
BV-268	Permanent
BV-270	Cancel Period
BV-272	DE
BV-274	LRHC Humidity
BV-276	LRHC Adj Arrows

Point	Object Name
BV-146	Enable AUTO/OFF user selection on dehumidifier detail screen
BV-200 - BV-202	AI*n* Current Mode
BV-211	Reset
BV-213	ULHC decimal
BV-215	URHC enable
BV-217	URHC lead zero
BV-219	LLHC enable
BV-221	LLHC edit
BV-223	LRHC decimal
BV-225	LRHC edit
BV-227	Day boxes
BV-229	Tue text
BV-231	Thu text
BV-233	Sat text
BV-235	Mon check
BV-237	Wed check
BV-239	Fri check
BV-241	Sun check
BV-243	Screen locked
BV-245	Filter
BV-247	Hum Pad
BV-251	ULHC % Humidity
BV-254	Aux
BV-256	Wait
BV-258	Heat Adjust
BV-260	Follow
BV-262	URHC Adj Arrows
BV-264	Am
BV-266	LLHC Adj Arrows
BV-269	Hold Until
BV-271	Outside
BV-273	HUMIDIFIER
BV-275	Minutes
BV-277	LLRC %

Point	Object Name
BV-278	LLRC minus
BV-280	Vent
BV-282	Tue key
BV-284	Thu key
BV-286	Sat key
BV-288	URHC up key
BV-290	LRHC up key
BV-292	LLHC up key
BV-294	RESET key
BV-297	FAN key
BV-300 - BV-301	AO*n* Current Mode
MV-0	Time Mode
MV-2	Keypad Lock
MV-4	SP Increment
MV-6	User SYSTEM selection
MV-8	Fan OFF text
MV-10	Fan stage 2 text
MV-12	Schedule Format
MV-20	ULHC mode
MV-22	LLHC mode

Point	Object Name
BV-279	Cool Adj
BV-281	Mon key
BV-283	Wed key
BV-285	Fri key
BV-287	Sun key
BV-289	URHC dn key
BV-291	LRHC dn key
BV-293	LLHC dn key
BV-295	CANCEL PERIOD key
BV-298	SYSTEM key
BV-400 - BV-402	AI*n* Pullup
MV-1	Schedule Model
MV-3	DLS Mode
MV-5	Schedule Increment
MV-7	Fan status
MV-9	Fan stage 1 text
MV-11	Fan stage 3 text
MV-13	SP Override Mode
MV-21	URHC mode
MV-23	LRHC mode

Appendix C: Quick reference



Field Service Codes

(Press the **SYSTEM** block and hold down bottom middle key.)

:UC	Unoccupied cooling setpoint (AV-95)
:UH	Unoccupied heating setpoint (AV-96)
:CO	Cooling offset (AV-93)
:HO	Heating offset (AV-94)
:HS	Occupied heating setpoint (AV-100)
:CS	Occupied cooling setpoint (AV-99)
:AL	Override limit (AV-97)
:HI	Setpoint high limit (AV-91)
:LO	Setpoint low limit (AV-92)
:SP	Occupant-selected space temperature setpoint (AV-90)

Installer Setup Codes

(Press the **SYSTEM** block and hold down keys on either side of bottom middle key.)

120	Year, first 2 digits
130	Year, second 2 digits
140	Month
150	Day
160	Schedule format (BV-133)
280	Backlight control (BV-79)
320	Swap English/Metric (BV-69)
330	Daylight saving (AV-127)
500	Filter change reminder (AV-124)
510	Hum pad change reminder (AV-125)
520	UV lamp change reminder (AV-126)
540	Program periods (AV-129)
640	Clock format (BV-83)
670	Keypad lock (AV-128)
700	Sensed temperature offset (AV-138)
701	Sensed humidity offset (AV-139)
702	Sensed outside air temperature offset (AV-140)
703	Sensed outside air humidity offset (AV-141)
800	MS/TP MAC address
801	BACnet Device Instance first digit
802	BACnet Device Instance second and third digits
803	BACnet Device Instance fourth and fifth digits
804	BACnet Device Instance sixth and seventh digits

	Function	Description
1	Days of Week	Shows the current day of the week. In Schedule Setup mode, shows all days; check marks appear beside selected days.
2	Maintenance needed messages	Flashes when it is time to change a filter, UV lamp, or humidifier pad.
4	Inside condition	Displays the current inside temperature and/or humidity.
5	Setpoint	Displays the current setpoint
6	Heating adjustment	Pressing the arrows adjusts the heating setpoint.
8	Schedule area	Displays schedule holds and allows users to change schedules.
9	Outside condition	Displays the current outside temperature and/or humidity.
10	Cooling adjustment	Pressing the arrows adjusts the cooling setpoint.
11	SCHED EDIT	Displays the current schedule. In schedule mode, displays the Edit Schedule screen.
12	HOLD WAKE	Allows users to place the system on Permanent or Vacation hold. In Edit Schedule mode, flashing bar indicates that WAKE is the active schedule period.
13	CLOCK LEAVE	Allows users to change the system date and time. When editing a schedule, flashing bar indicates that LEAVE is the active schedule period.
14	SCREEN RETURN	Locks the screen for cleaning. In Edit Schedule mode, flashing bar indicates that RETURN is the active schedule period.
15	MORE SLEEP	Displays additional screens. In Edit Schedule mode, flashing bar indicates that SLEEP is the active schedule period.

Appendix D: Canadian conformance statements

This Class B digital apparatus complies with Canadian ICES-003.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Cet équipement a été testé et jugé conforme aux limites de Classe B pour un appareil numérique, en vertu de l’article 15 de la réglementation de la FCC. Ces limites ont été instaurées pour fournir une protection raisonnable contre toute interférence nuisible dans une installation résidentielle. Cet équipement génère, utilise et peut émettre de l’énergie radiofréquence. S’il n’est pas installé et utilisé conformément aux instructions, il peut provoquer des interférences sur les communications radio. Cependant, il n’est pas garanti que des interférences ne se produiront pas dans certaines installations. Si cet équipement cause des interférences à la réception radio ou télévisée (ce qui peut être vérifi é en éteignant l’appareil puis en le remettant sous tension), l’utilisateur peut tenter de les résoudre en suivant une ou plusieurs des mesures ci-après :

- Réorienter ou déplacer l’antenne réceptrice.
- Augmenter l’espace entre l’appareil et le récepteur.
- Brancher l’appareil à une prise de courant différente de celle sur laquelle le récepteur est branché.

Pour obtenir de l’aide, contacter le vendeur ou un technician radio/télévision expérimenté.

Automation and Control Solutions
Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

31-00098—01 M.S. 07-16
Printed in United States

Honeywell