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This application note describes a method using the NetSensor to balance air flow using a flow hood, the NetSensor as a service tool and the balancer override program which is included in Anemostat BACnet VAV controllers.

Program 4 in a BACnet preprogrammed VAV controller is a balancer override routine. By enabling this program (toggling BV29) the VAV controller is forced to control at either minimum flow or maximum flow. This is used to simplify the VAV box balancing procedure.

This reference includes the following:

1. Purpose & Overview
2. BACstage Configuration
3. NetSensor Detail
4. Balancer Instruction Sheet

Overview

Anemostat VAV controllers are pre-programmed with NetSensor function keys defined to turn the NetSensor into a simple balancing tool. With this feature, a balance technician can:

• Adjust setpoints for Minimum and Maximum air flow (CFM).

• Enter volume conversion factors.

• View air flow (CFM) readings.

• When necessary, establish sensor correction factors (flow correction).
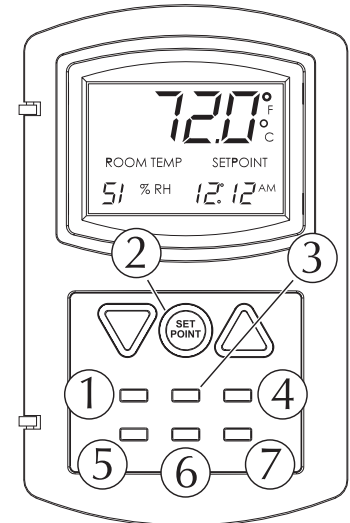
Related materials

In addition to the material presented in this application note, review and have available the following reference materials:

• Installation and operation guides for the applicable ABC VAV controllers.

• BACstage Reference Guide.

• System plans with VAV box locations, VAV box sizes and flow values.

Additional equipment

The air flow balancing method described in this application note requires the following equipment:

• Flow hood or other accurate tool to measure air flow.

• NetSensor and cable for installations that use a temperature sensor instead of a NetSensor.

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Each button of the NetSensor has an assignment for viewable and configurable variables in the VAV controller to which it is connected. These button assignments are clearly referenced in the chart below.

Button	Descriptor	Analog Value	Function
1	SPACE-TEMP	AV1	**Space Temperature (NetSensor)** Displays the temperature detected by the NetSensor. This value is not used in the balancing routine.
2	ACTIVESP	AV26	**Active Setpoint** **Normal Mode:** With Program 4 (BV29) is *"OFF"* this button shows the active temperature setpoint. **Balancer Mode:** When program 4 (BV29) is *"ON"*, set this value to 0 for minimum air flow or 1 for maximum air flow. Negative numbers and numbers greater than 1 can be displayed for this button but these values will be corrected once the NetSensor updates its information with the connected controller. The controller will determine if the value is valid, and will display a legal value within 15 seconds.
3	VOLUME1	AV27	**CFM Actual** This is the controller measured flow reading. *CFM = Velocity x sensor correction x volume conversion = AI4xAV22xAV21*
4	VOLFACTR	AV22	**Volume Conversion Factor** See Table A for inlet size of Anemostat Velocity Wing Sensor and VolFactor to use.
5	MIN-FLOW	AV20	**Minimum CFM Setpoint** Displays the minimum flow setpoint for the VAV box.
6	SENS-CORR	AV23	**Sensor Correction Factor** This value multiplies against the flow reading to correct for duct irregularities and tube placement.
7	MAX-FLOW	AV21	**Maximum CFM Setpoint** Displays the maximum flow setpoint for the VAV box.

Button Configuration:

• **VOLFACTR - Volume Conversion Factor**
The value entered in this Analog Value is from table A for the size inlet shown. This value is multiplied by the Actual flow measured on AI1 which will convert the value from feet per minute into CFM .

Table A Volume Conversion Factors for Velocity Wing Sensors

Nom Terminal Inlet Size	VOLFACTOR
5	0.112
6	0.183
7	0.239
8	0.338
9	0.428
10	0.528
12	0.703
14	0.963
16	1.313
24 x 16	2.481

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Using a NetSensor as a Balancer Service Tool

To start the Balancer Routine with the NetSensor, press buttons 5 and 7 on the ABC–1161 or ABC–1181 at the same time. Then press the up arrow button to toggle the auxiliary input (or a.k.a. button 8) from Off to On. This will activate Program 4, the "Balancer Override Mode".

If a Space Sensor is used instead of NetSensor for controlling the space temperature at the VAV box, then a NetSensor and cable can be used to plug into the controller to balance that individual VAV box.
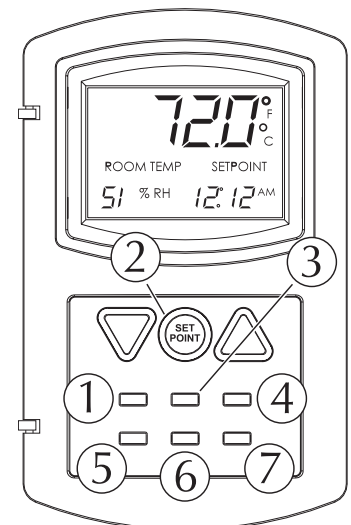
Note: When the Balancer Override routine takes control over the standard temperature control routine, accurate space temperature control may not be maintained. You may want to repeat the previous step to turn the balancing routine off to return control to the normal temperature sequence. Not to worry if you forget to turn off the balancer routine it will be canceled automatically after 30 minutes.

Balance Method

The following is a procedure for balancing a VAV box using the NetSensor. Other methods may be used just as effectively. Always remember that there is up to 15 seconds between updates of the NetSensor. Modifications at the NetSensor will not take effect at the controller until an update has occurred. Follow these steps after plugging the NetSensor into the controller. The display should show a valid space temperature.

Maximum Flow Balancing

1. Determine the flow units desired and the box size.

2. Button 4: Enter the size (area) of the VAV box from Table A. This value is known as the "Volume Conversion Factor" and converts feet per minute (ft/min) into the desired units. The default value is 1.0 if the controller has NOT been programmed by Anemostat.

3. Button 5: Enter or verify minimum flow CFM setpoint.

4. Button 7: Enter or verify maximum flow CFM setpoint.

5. Press buttons 5 and 7 together and then press the up arrow button to turn "ON" the Balancing routine.

6. Button 2: Enter a 1 or greater. This will drive the box to the maximum CFM setpoint value as set in button 7. Wait (may take up to 5 minutes) for the value at button 3 to settle in at or near maximum CFM setpoint.

7. Measure with flow hood or other measurement device and add up the flow from each supply outlet to get the total supplied air at maximum. Differences between the displayed flow reading and field measurements may be due to sensor mounting location or turbulence. If the readings differ greatly, the flow reading can be adjusted by placing a multiplier in button 6.

8. Button 6: Enter the sensor correction factor. This value is a calculated multiplier to adjust the CFM reading at button 3 to match the actual CFM measured by the Balancer. See formula. **B# = Button**
   Actual CFM (Balancer) / B3 (CFM reading) x B6 (Current sensor correction factor) = B6 (new sensor correction factor)

9. Repeat step 7. If the values are still too far apart then repeat step 8 and then check values again.

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Minimum Flow Balancing

1. Set button 2 to 0 or less; This will drive the box to the minimum CFM setpoint value as set in button 7. Wait (may take up to 5 minutes) for the value at button 3 to settle in at or near minimum CFM setpoint.

2. Measure with flow hood or other measurement device and add the flow from each supply outlet to get the total supplied air at minimum.

3. If the readings are to far apart then change the minimum CFM setpoint on button 5 to compensate for the error. Note: do not change the Sensor Correction Factor (B6) to correct for errors or the maximum flow balancing will be affected.

4. Repeat step 2. If the values are still too far apart then repeat step 8 then check values again.

Halting the Balance Routine

Press buttons 5 and 7 together and then press the down arrow button to turn "OFF" the Balancing routine. Wait approximately 10 seconds for the NetSensor to send the change to the device before disconnecting the NetSensor and moving to the next VAV box.

Note: not to worry if you forget to turn off the balance routine the program will automatically shut off after 30 minutes.