CONTROLS MANUAL

INSTALLATION

ADJUSTMENT

OPERATION

TROUBLESHOOTING

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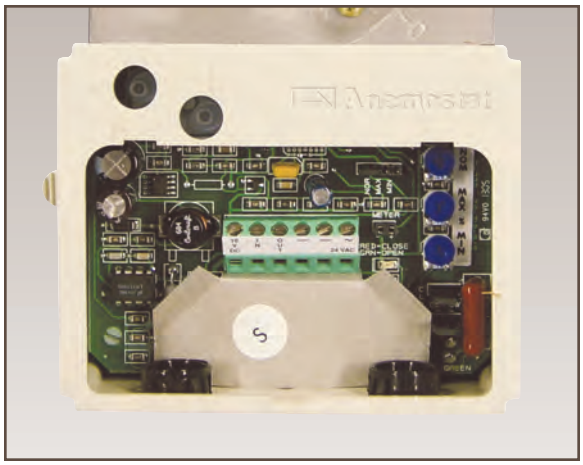

ANALOG ELECTRONIC CONTROLS

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ANALOG ELECTRONIC CONTROLS

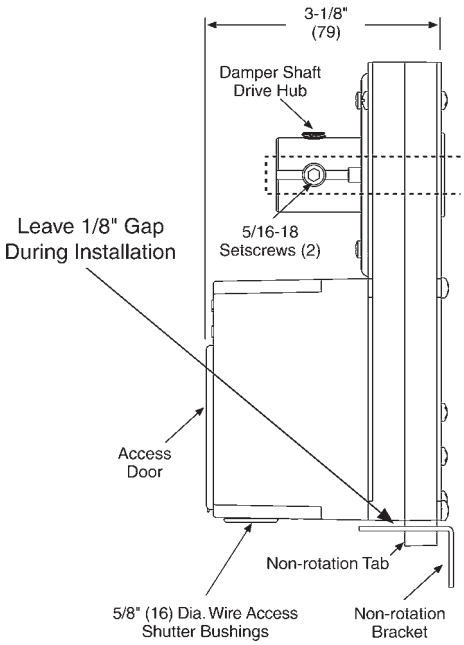
A. GENERAL

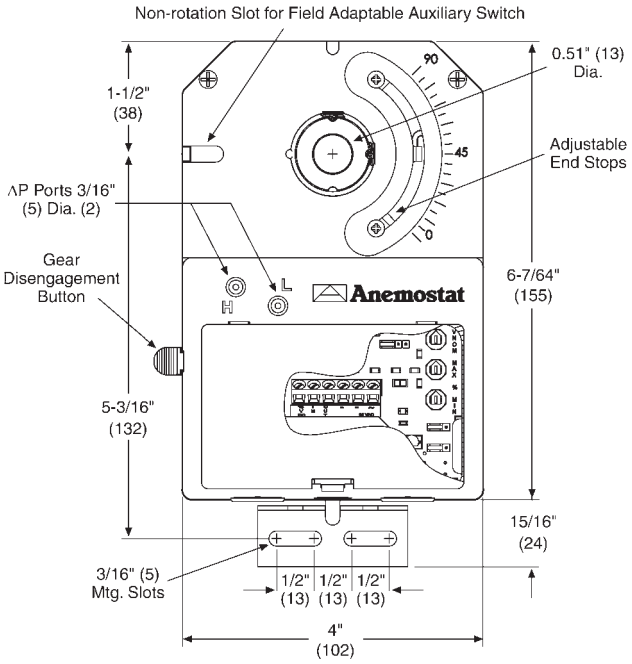
The electronic analog C51 VAV flow controller-actuators are pressure-independent combination controller-actuators designed primarily for use on variable air volume terminal units. Air flow is sensed by using a differential pressure airflow sensor, such as the Anemostat Velocity Wing sensor. Designed with an on-board flow-through sensor utilizing twin platinum resistance temperature detectors, these models are capable of controlling a velocity setpoint with an accuracy of 3%.

The C51 offers full range flow control of VAV terminal units when used with the CTE–5100 series room thermostats. Air flow control limits may be set at the thermostat or internal to the C51 (see applicable control package). The actuator section provides adjustable stops, magnetic clutch and a gear disengagement button.

On older models, a tri-color LED indicates green for opening, red for closing and white/off for satisfied damper positions. On newer models, two separate red and green LEDs indicate opening and closing.

Typically, the C51 is factory set for a CCW damper rotation to close, but this should be verified based on the type of air terminal.





B. MOUNTING

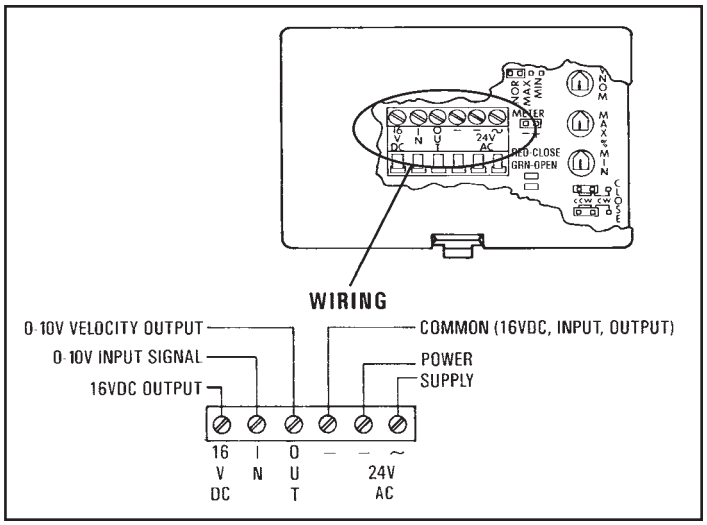
The CSP–5001/5002 is designed to mount on a standard 1/2" (13 mm) diameter shaft or a 3/8" (9.5 mm) shaft using the optional HF0-0011 adapter.

Standard Instructions

1. Slide the CSP–5001/5002 directly onto the 1/2" diameter damper shaft. The shaft must extend a minimum of 1-3/4" from the mounting surface.
2. Place the non-rotation bracket (supplied) on the non-rotation tab. Leave a gap of 1/8" between the bottom surface of the CSP-5001/5002 and the bracket to allow for play during operation (see illustration).
3. Attach the non-rotation bracket to the mounting surface using (2) #8 or #10 self-tapping screws (not included).
4. Depress the gear disengagement button and:
   A. Rotate the drive hub until the indicator stops at the "90" mark if the damper is clockwise to close.
   B. Rotate the drive hub to the "0" mark if the damper is counterclockwise to close.
5. Position the damper to full open.
6. Torque the two 5/16-18 setscrews to 75 - 85 in. lb.
7. Depress the gear disengagement button and rotate the drive hub/damper to the closed position.
8. Loosen the adjustable end stop, position against the damper position indicator, and retighten.

C. WIRING

1. Remove the C51's wiring access door by pulling back on the door's tab and lifting upward.
2. Access for wire or cable is via two 5/8 in.diameter snap-in shutter bushings located on the rear of the C51's cover.
3. Connect the C51 to a CTE–5100 thermostat and other control components as shown on the control package wiring diagram.
4. Replace wiring access door.



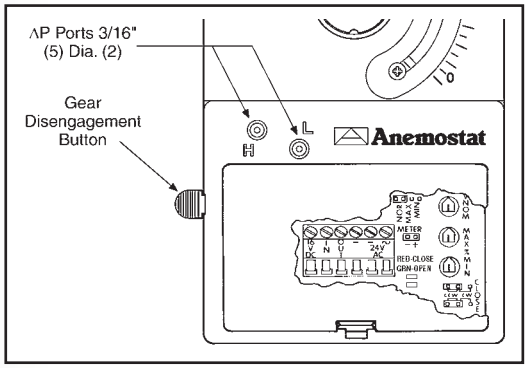
D. AIR FLOW SENSOR CONNECTION

The VAV controller includes an on-board flow-thru type sensor, and therefore, the length & size of pneumatic tubing (and fittings and kinks in the tubing) will affect the relationship between the airflow rate (cfm) through the air terminal and controller signal generated for that airflow rate, ie the flow curves. Our flow curves which depict VDC vs. CFM were developed in the lab with the tubing lengths as follows (no fittings):

Inlet Size	1/4" OD Tubing Length	3/8" OD Tubing Length
5"ø, 6"ø	14"	8"
7"ø - 10"ø	14"	10"
12"ø	14"	12"
14"ø	14"	15"
16"ø	14"	18"
24" x 16"	14"	18"

The 1/4" tubing is inserted 1/2" into the 3/8" tubing and glued.

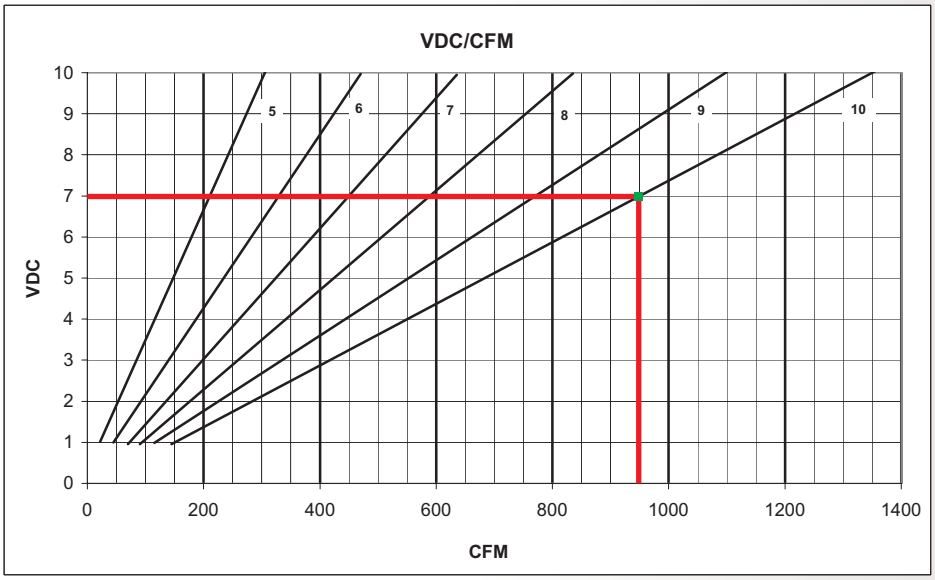
1. Connect the "H" port of the C51 controller to the (high side) "H" of the sensor.
2. Connect the "L" port to the C51 controller to the (low side) "L" of the sensor.

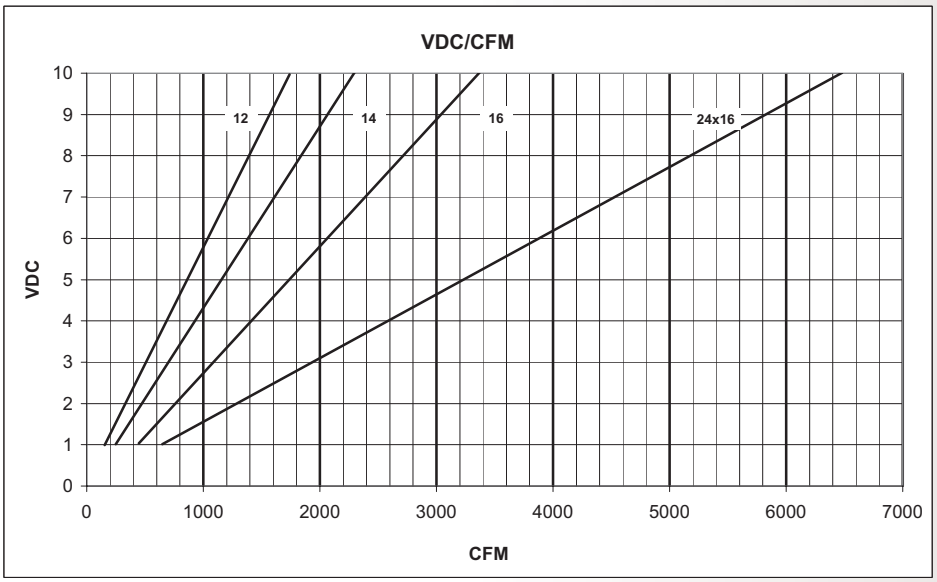


Magnehelic Gauge to Airflow Rate Chart

This airflow chart is an example of the chart affixed to the VAV box. Each chart is specific for the type of flow sensor located in the inlet side of the VAV box. Read the differential pressure of the Magnehelic gauge, follow the line horizontally until it crosses the diagonal inlet size of box. Read straight down from this intersection to determine the flow rate.

NOTE: This chart is for illustration only! Do not use this chart to obtain your values. It is NOT intended for calibration of your Minimum and Maximum adjustments.

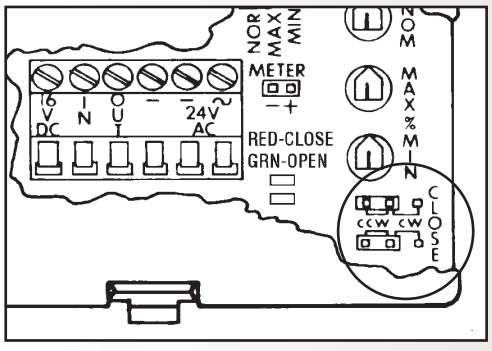




E. ROTATION SETUP

The C51 is factory-set for proper rotation. If the rotation needs to be changed:

1. Remove the access door by pulling back on the door's tab and lifting upward.
2. Position both jumpers in either the CW or CCW positions as needed. See the diagram.



F. ACTUATOR TESTING

Test the C51 actuator's motor operation:

1. Temporarily disconnect the thermostat reset connection at Terminal "IN".
2. Jumper "IN" terminal to the "16 VDC" terminal. The green Open LED should illuminate. The shaft drive hub should be rotating the damper open (typically CW). The damper should go to full open unless the maximum limit was set at the C51, and then the damper will only go to the maximum setting. If the damper is rotating closed (typically CCW), the "Close" jumpers must be changed. Refer to the Rotation Setup section.
3. Jumper "IN" terminal to the "–" terminal. The red Close LED should illuminate. The shaft drive hub should be rotating the damper closed (typically CCW). The damper should go to full closed unless the minimum limit was set at the C51, and then the damper will only go to the minimum setting. If the damper is rotating open (typically CW), the "Close" jumpers must be changed. Refer to Rotation Setup section.

G. SYSTEM TROUBLESHOOTING

The following troubleshooting guide is directed towards single duct cooling applications, but the same concepts can be applied to other configurations.

1. Verify 24 volts AC at terminals "~" (phase) and "–" (ground). Tolerance can be –15% to +20% (20.4 to 28.8 volts AC)

NOTE: When using the same transformer for more than one control, the phase and ground must be consistent with each device.

2. Verify 16 volts DC at terminals "(16 VDC)" and "(–)". Tolerance is 15.0 to 17.0 volts DC, power supply to thermostat. If not correct, disconnect the thermostat and recheck. If still incorrect, replace the C51 controller.
3. Check "Requested Flow" voltage on the "IN" and "–" terminals. Reference the VDC vs. CFM flow curves.
4. Check "Actual Flow" voltage on terminal "OUT" and "–" for (0–10 volts DC). The "IN" and "OUT" voltages should match (within a reasonable tolerance). If they do not, change the setpoint all the way up or down, wait at least five minutes, and measure again. If they still do not match, check for the following:
   A. There is low static pressure in the system and the design airflow rate cannot be achieved. The damper will typically be wide open when this occurs.
   B. The actuator position and damper position is out of synchronization.
   C. The setscrews on the actuator shaft may be slipping.
   D. The VNOM potentiometer may have been changed from its factory setting. See the VNOM Range Setting section.
5. If the "Requested Flow" and "Actual Flow" match, but the reading from a flow hood over the duct outlet is substantially different, one of the following may be at fault:
   A. The tubing to the controller's flow sensor may be kinked, too long, or pulled off (fix the tubing).
   B. The flow sensor in the controller may be bad (replace the controller).
6. Check box movement, damper rotation, etc.
   A. Review "Requested Flow" and "Actual Flow" above to determine if unit should be satisfied (within 50 fpm) or driving open or closed.
   B. If damper is not moving, verify damper is not stuck or at end of travel. Check rotation jumpers for proper position.
   C. Change "Requested Flow "to drive the unit in the opposite direction. This can be accomplished by moving the setpoint sliders or the steps below.

⚠ CAUTION

Never jumper terminal "16 VDC" to terminal "–" since this would cause a short and possibly damage the power supply.

i. To manually open the box, remove wiring from terminal "IN" and jumper terminal "IN" to terminal "16 VDC". This will tell unit to control at full airflow, the green LED should turn on, and the box should drive open (typically CW).

ii. To manually close the box, remove wiring from terminal "IN", and jumper "IN" terminal to "–" terminal. This will tell unit to control at zero airflow, the red LED should be on and the box should drive closed (typically CCW).

H. CONTROLLER CALIBRATION

Minimum and Maximum Flow Limits

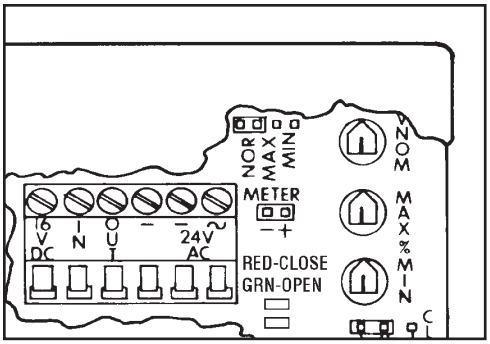
Minimum and maximum flow limits are typically set at the CTE–5100 series wall thermostat. See the CTE–5100 Series thermostat reference section and applicable control package. Anemostat does not recommend setting the flow limits at the controller, and this procedure should not be followed if the applicable control package specifically indicates "Adjustments at Thermostat". If required, the minimum and maximum limits can be defined by adjusting the appropriate setpoints within the C51 controller (see below) instead, but do not try to set the limits at BOTH the controller and the thermostat (or else the limits will not reflect either the controller's or the thermostat's limits).

To set the airflow limits at the C51:

1. Remove the access door by pulling back on the door's tab and lifting upward.
2. Connect a voltmeter to the meter taps (using HSO–5001 test leads).
3. Move the jumper from the NOR (normal) position (two left-most pins) to the MIN position (two right-most pins).
4. Adjust the MIN potentiometer for the desired minimum voltage.

NOTE: MIN must be adjusted first.

5. Move the jumper to the MAX position (two center pins).
6. Adjust the MAX potentiometer to the desired maximum voltage.
7. Return the jumper to the NOR position.



I. VNOM (CFM) RANGE SETTING

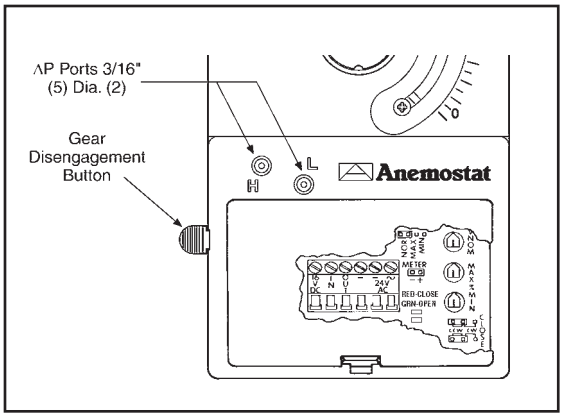
The C51 range is factory-calibrated with the VNOM potentiometer centered.

Leaving the VNOM at the factory setting is recommended! Changing the VNOM potentiometer from the factory setting will alter the calibration between the "IN" and "OUT" voltages. However, the VNOM can be adjusted to match 0–10 volts to a specific velocity range if desired.

NOTE: In the controller, VNOM stands for "NOMinal Volumetric flow rate."

To set the VNOM range:

1. Remove the access door by pulling back on the door's tab and lifting upward.
2. Supply the desired airflow rate to the "H" and "L" ports.
3. Connect a voltmeter between the "OUT" and "–" terminals and adjust the VNOM potentiometer until the voltage equals 10 volts DC.



A. CTE–5100 SERIES THERMOSTAT REFERENCE

Checkout and Calibration

The thermostat (CTE–5100 series) operates on a 16 volt DC power supply from the C51 controller and outputs a 0–10 volt DC signal on the T(x) terminals (Direct Acting T1 and Reverse Acting T2). See the CTE–5100 Series Thermostat Reference Page for details on which 'T' terminals are used on each model thermostat. The applicable control package will indicate which terminals are used. There are two types of thermostat outputs – those which can be limited by adjustment (within the range of 0-10VDC), and those which are unlimited and non-adjustable (0-10VDC over the proportional band)

NOTE: Airflow limits are typically set at the wall thermostat, but can be set at the C51 or the CTE thermostat. If setting the min/max limits at the CTE thermostat, the C51's Min. dial must be set fully CCW to 0 and the Max. dial set fully CW to 100. This will ensure that the C51 will not have any effect on the limits.

1. Required tools:

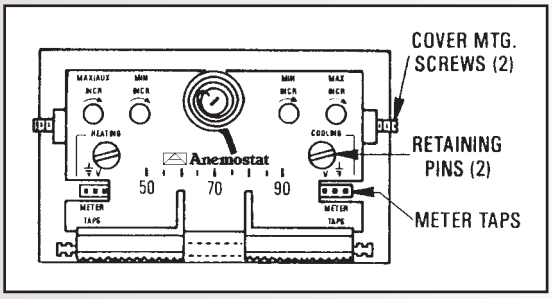
   1/16-inch hex/key wrench

   Small flat blade (1/8-inch) screwdriver

   Digital voltmeter capable of displaying a 0–10 volt DC range which will display in hundredths of a volt.

   HSO–5001 test leads (optional for meter taps)

2. Remove the thermostat cover by loosening the setscrews on each side of the thermostat (see illustration). Using a 1/16-inch hex key wrench, turn the setscrews clockwise until the cover is loose.



3. Check voltages:

   A. Verify 16 volts DC between (+) and (–) terminals.

   B. Measure "T(x)" to "–" for output voltage. Use the calibration procedures below to adjust limits if desired. Adjust the setpoint above and below current room temperature and observe changes in appropriate "T" voltage. Remove setpoint slider stops (HFO–0027) if necessary.

B. THERMOSTAT AIR FLOW ADJUSTMENT PROCEDURES

Basic adjustment procedures are shown for the various types of thermostats that may be used for a specific control package. These are typical adjustment procedures which are used for most applications. However, unique control strategies may employ other functionality and these basic adjustment procedures may not apply.

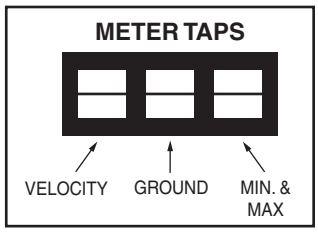
Refer to Voltage vs. CFM curves to relate the voltage setting at the thermostat for the air flow rate required based on the size of the air terminal. A secondary measuring device such as a flow hood should be used to verify actual flow rates into the space. A shortfall in air quantity may be due to closed dampers, or insufficient fan static pressure required for the system.

Note: ALWAYS adjust the minimum flow limit first. To properly set the min and max flow setpoints, the ambient room temperature must be between 55-85°F.

Maximum limits will always be greater than the minimum limits (maximum is additive to the minimum). If in doubt, turn the maximum limit fully clockwise (increase) before proceeding.

Dials rotate approximately 200° (8 to 4 o'clock). Turn clockwise to increase or counterclockwise to decrease. Do not use excessive force on the dials. They should turn freely and effortlessly. DO NOT force dial beyond the stop.

Connect voltmeter to one of the two meter taps (#HSO-5001 test lead adapter makes this easier and is available through your local Anemostat representative). There is a HEATING (Left Side) and a COOLING (Right Side) meter tap, so connect to the proper tap when adjustments are being made.



A. Connect to the middle and right terminal (see illustration) of the 3-pin meter tap for the min and max VDC reading.

B. Connect to the middle and left terminal of the 3-pin meter tap for measuring actual flow velocity (the thermostat must be wired to a C51 controller for this option).

Model CTE-5101 Thermostats (DA Cooling):

1. Connect voltmeter to the COOLING meter tap.
2. Adjust the minimum cooling flow first:
   a. Move the setpoint slider all the way to the right to call for minimum cooling.
   b. Set the minimum flow voltage as desired using the MIN dial (on the cooling side of the thermostat).
3. Adjust the maximum cooling flow last:
   a. Move the setpoint slider all the way to the left to call for maximum cooling.
   b. Set the maximum flow voltage as desired using the MAX dial (on the cooling side of the thermostat).
4. Set slider back to the desired room temperature setpoints and replace cover.

Model CTE-5102 Thermostats (RA Heating):

1. Connect voltmeter to the HEATING meter tap.
2. Adjust the minimum heating flow first:
   a. Move the setpoint slider all the way to the left to call for minimum heating.
   b. Set the minimum flow voltage as desired using the MIN dial (on the heating side of the thermostat).
3. Adjust the maximum heating flow last:
   a. Move the setpoint slider all the way to the right to call for maximum heating.
   b. Set the maximum flow voltage as desired using the MAX dial (on the heating side of the thermostat).
4. Set slider back to the desired room temperature setpoints and replace cover.

Model CTE-5103 Thermostats (DA Cooling / RA Heating):

1. Connect voltmeter to the COOLING meter tap.
2. Adjust the minimum cooling flow first:
   a. Move the right-hand setpoint slider all the way to the right to call for minimum cooling.
   b. Set the minimum flow voltage as desired using the MIN dial (on the cooling side of the thermostat).
3. Adjust the maximum cooling flow last:
   a. Move the right-hand setpoint slider all the way to the left to call for maximum cooling.
   b. Set the maximum flow voltage as desired using the MAX dial (on the cooling side of the thermostat).
4. Connect volt meter to the HEATING meter tap.
5. Adjust the minimum heating flow first:
   a. Move the left-hand setpoint slider all the way to the left to call for minimum heating.
   b. Set the minimum flow voltage as desired using the MIN dial (on the heating side of the thermostat).
6. Adjust the maximum heating flow last:
   a. Move the left-hand setpoint slider all the way to the right to call for maximum heating.
   b. Set the maximum flow voltage as desired using the MAX dial (on the heating side of the thermostat).
7. Set sliders back to the desired room temperature setpoints and replace cover.

Model CTE-5104 Thermostats (DA Cooling w/ Auxiliary Flow):

1. Connect voltmeter to the COOLING meter tap.
2. Adjust the minimum cooling flow first:
   a. Move the right-hand setpoint slider all the way to the right to call for minimum cooling.
   b. Set the minimum flow voltage as desired using the MIN dial (on the cooling side of the thermostat).
3. Adjust the maximum cooling flow last:
   a. Move the right-hand setpoint slider all the way to the left to call for maximum cooling.
   b. Set the maximum flow voltage as desired using the MAX dial (on the cooling side of the thermostat).

NOTE: *If R2-T2 jumper wire is used on thermostat, then AUX FLOW is enabled and is adjusted as follows:*

4. Connect voltmeter to the HEATING meter tap.
   a. Move the left-hand setpoint slider all the way to the right to call for maximum heating.
   b. Adjust the auxiliary flow voltage as desired using the MAX/AUX dial (on the heating side of the thermostat).
5. Set sliders back to the desired room temperature setpoints and replace cover.

Model CTE-5105 Thermostats (DA Day / DA Night):

Adjust the upper (DAY) setpoints first:

1. Connect voltmeter to the COOLING meter tap.
2. Adjust the DAY minimum cooling flow first:
   a. Move the right-hand setpoint slider all the way to the right to call for minimum cooling.
   b. Set the minimum flow voltage as desired using the MIN dial (on the cooling side of the thermostat).
3. Adjust the DAY maximum cooling flow last:
   a. Move the right-hand setpoint slider all the way to the left to call for maximum cooling.
   b. Set the maximum flow voltage as desired using the MAX dial (on the cooling side of the thermostat).

Adjust the lower (NIGHT) setpoints next:

4. Connect voltmeter to the HEATING meter tap.
5. Adjust the NIGHT minimum cooling flow first:
   a. Move the left-hand setpoint slider all the way to the right to call for minimum cooling.
   b. Set the minimum flow voltage as desired using the MIN dial (on the heating side of the thermostat).
6. Adjust the NIGHT maximum cooling flow last:
   a. Move the left-hand setpoint slider all the way to the left to call for maximum cooling.
   b. Set the maximum flow voltage as desired using the MAX dial (on the heating side of the thermostat).
7. Set sliders back to the desired room temperature set points and replace cover.

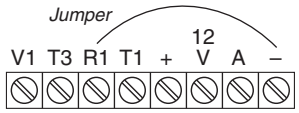
C. CTE–5100 SERIES CROSS-REFERENCE

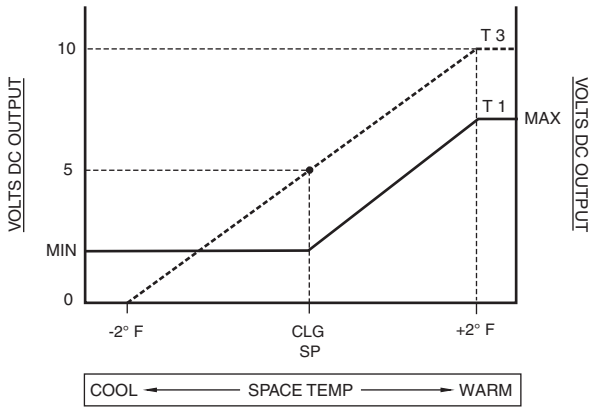
CTE–5100 Series Thermostat Cross-reference					
Thermostat Terminals	**5101**	**5102**	**5103/ 5105**	**5104**	**Terminal Description**
V1	X		X	X	Velocity input; connect to “out” terminal on CSP for readout.
T3	X		X	X	Upper set point output w/o limits (0–10 volt fixed signal; can be measured on back of stat).
R1	X		X	X	T1 override, connect to “–” if unused. Voltage applied subtracts from T1.
T1	X		X	X	Upper set point output, with limits; adjustable at pot. on front of the thermostat.
+	X	X	X	X	16 volts DC power supply input.
12V	X	X	X	X	12 volts DC output for temperature averaging.
A	X	X	X	X.	Temperature averaging input.
–	X	X	X	X	Ground reference.
T2		X	X	X	Lower setpoint output with limits; adjustable at potentiometer on front of the thermostat.
R2*		X	X	X	T2 override, connect to “–” if unused.* Voltage applied subtracts from T2.
T4		X	X		Lower set point output w/o limits.
V2		X	X		Velocity input for readout; connect to “out” terminal on CSP for readout.

*R2 is auxiliary limit trigger on CTE–5104. Voltage above 1 volt triggers T1 to the Aux. Flow Limit.

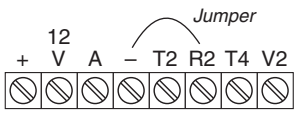
NOTE: If desired, the thermostat scale plate can be reversed so that a blank metal plate appears in the thermostat window instead of the temperature coil indicator and scale. To do so, remove the cover, pull out the two retaining pins, reverse the plate, reinsert the pins, and reinstall the cover. This does not affect the thermostat operation.

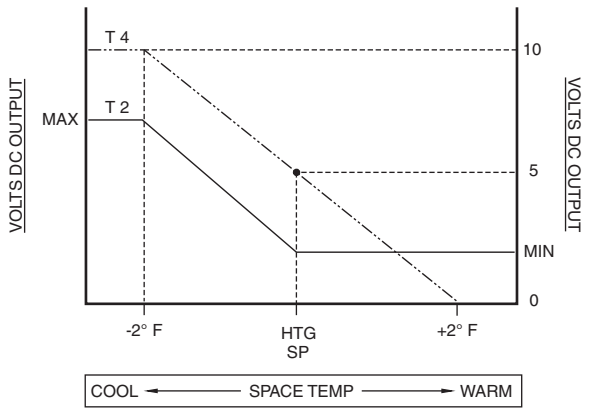
CTE-5101 DA Thermostat



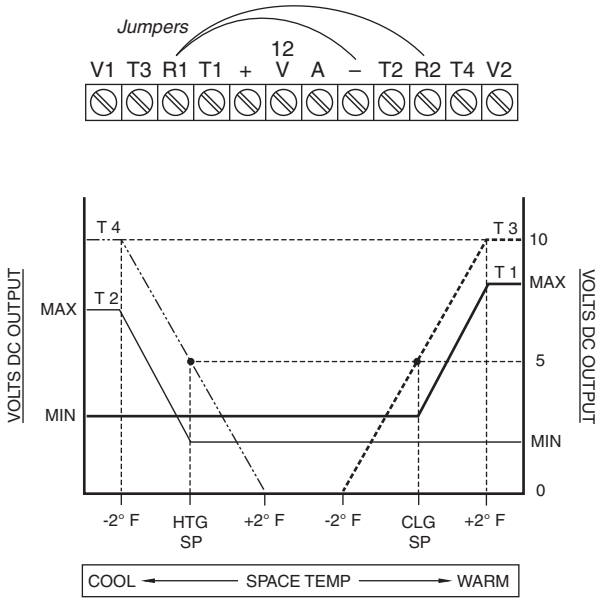


CTE-5102 RA Thermostat

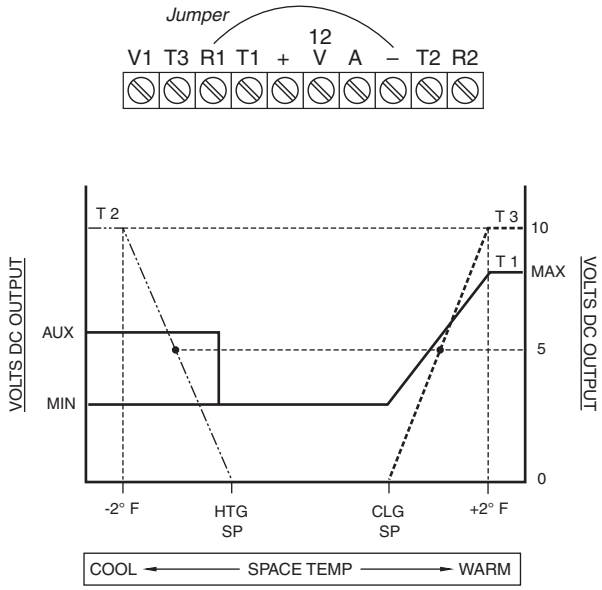




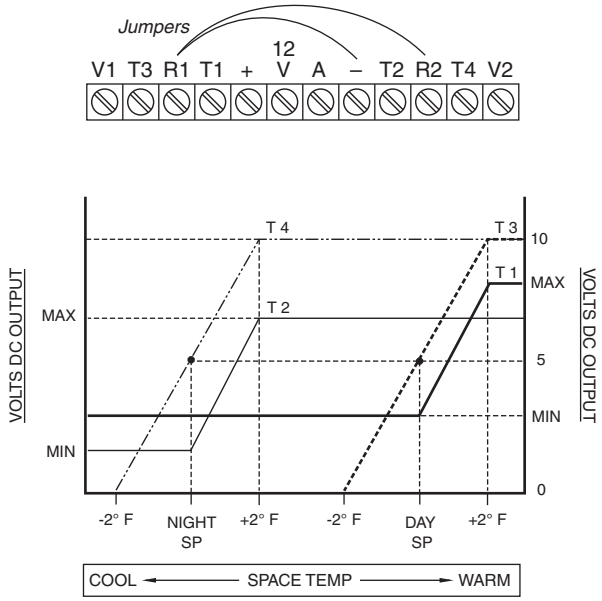
CTE-5103 DA/RA Thermostat



CTE-5104 DA/RA Thermostat



CTE-5105 DA/DA Thermostat



D. CHANGING A CTE–5100 THERMOSTAT TO A REMOTE SENSOR

A thermostat controller with an external temperature sensor provides a means to remotely locate the temperature sensor in the supply or return air duct or in an area where remote adjustment of the setpoint is desired.

The CTE–5100 series thermostat can be easily modified to accomplish this application. Since the CTE–5100 series thermostats have an averaging temperature input, a thermistor can be wired to this input and the thermostat's thermistor can be removed.

The thermistor is clearly visible once the scale plate is removed, simply clip both leads underneath the thermistor to remove it. The remote thermistor is then wired to terminals "+12 V" and to "A" (as shown in chart below).

TTE series remote temperature sensor/transmitters include a three wire sensor with "+", "A", and "–" connections. When the TTE series are used as remote sensors for the CTE–5100 series, only the "+" and "A" connections are used. These two connections are to the thermistor (resistance) only (not a voltage output). The chart below illustrates the various TTE models and the appropriate terminal designations.

CTE–5100 Series Connections for Remote Sensor

Model	Type	"+12 V" Connection	"A" Connection
TTE–1001	Room Sensor	Terminal +	Terminal A
TTE–2001	Duct Sensor	Terminal 1	Terminal 2
TTE–5001/5011	Room Sensor	Terminal B	Terminal A

DESCRIPTION AND APPLICATION

The Anemostat CTE-5202 thermostat is a dual-setpoint, analog electronic controller with a digital LCD display for use in many new and replacement room temperature control applications. It provides two independent electronic PI (Proportional + Integral) control loops with heating and cooling setpoints. The thermostat drives two (adjustable span) 0-12 VDC analog outputs for control of external devices. The easy to understand LCD display and push but-tons enable viewing of current temperature, chang-ing of setpoints, and simple device configuration. The thermostat is typically used with Anemostat CEP/ CSP-4000 and CSP-5000 series of electronic pressure-independent VAV controllers, MEP-4002 proportional electronic actuators in pressure-dependent VAV applications, and VEB-43/46 series proportional control valves in baseboard and other heating/cool-ing applications. Application sequences may be se-lected for the following types of room and terminal unit control:

- Single-duct pressure-independent VAV terminals, with or without reheat and auxiliary minimum airflow (see Sequence 2 on page 3)
- Single-duct pressure-dependent VAV terminals with or without reheat (Sequence 1 for single set-point or Sequence 2 for dual setpoint and/or aux. minimum)
- Single-duct fan-powered VAV terminals with or without reheat using REE-5xxx staging modules (Sequence 1)
- Dual-duct VAV applications with independent control of heating and cooling outputs (Sequence 3)
- Proportional heating and cooling applications, such as baseboard heating and chilled beams (Sequence 1 and 3)

Common application features for morning warm-up, changeover, and unoccupied/night setback are enabled via an external temperature sensor and/or contact closure provided by a remote building auto-mation system.

NOTE: For many examples of new and retrofit applications, see the CTE-5202 Applications Guide.

Features

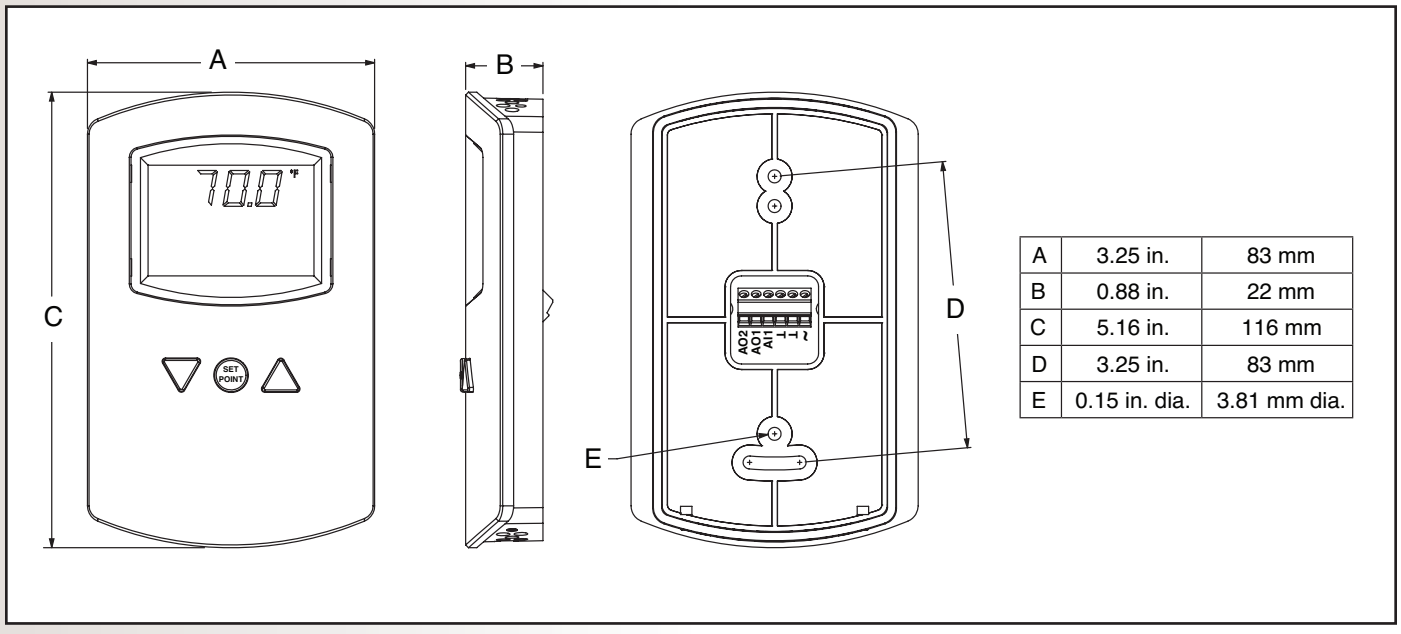
- Large LCD display for easy viewing (or can be blanked if desired) and configuration
- Display room temperature in either degrees Fahr-enheit or Celsius
- Easy setpoint adjustment via front Up and Down buttons
- Heating and cooling setpoints with three select-able sequences
- Outputs configurable to conventional spans be-tween 0 and 12 VD
- Adjustable min./max./aux. limits (span), dead-band, proportional band, integral, temperature offset, setback offset, and changeover
- External input for changeover sensor and setback contact
- Functionally replaces most Barber Colman TP-81xx, Anemostat CTE-1x0x/CTE-50xx/CTE-51xx, and other room thermostats with a more contempo-rary version that includes an LCD display and configurable sequences and limits

SPECIFICATIONS

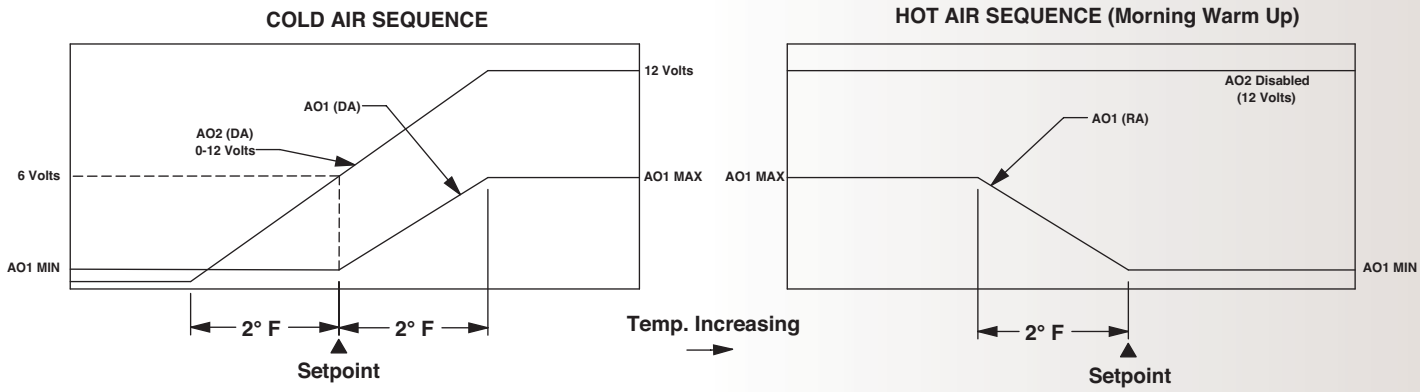
Supply Voltage	24 VAC (+20/-15%), Class 2, or 14 to 35 VDC (for full output; @ 9.1 VDC thermostat is fully functional except that AO1 and AO2 max. output voltage is reduced to about 5.3 VDC)
Supply Power	1 VA (VAC) or 0.5 W (VDC)
Temperature Sensor	10K ohm Type II thermistor with ±0.36° F (±0.2° C) accuracy
Ext. Input (AII)	Analog Input (10K ohm pull-up resistor for Type III therm-istor as optional changeover sensor—or a contact to initiate setback)
Outputs (AO1/AO2)	(Adjustable span) 0 to 12 VDC (10K ohm max. load)
Output Limits/Span	Minimum, maximum, and auxiliary limits adjustable 0 to 12 VDC (defaults min. = 0, max. = 12, aux. = 0)
Setpoint Range	55 to 85° F (13 to 30° C), with default 74° (for cooling or 70° for heating)
Changeover	Adjustable from 55 to 85° F, with 77° F default
Deadband	Minimum setpoint differential adjustable 1 to 10° F (0.5 to 5.5° C), with default of 2° F
Proportional Band	Adjustable from 1 to 10° F (0.5 to 5.5° C), with 2° F default
Integral Time	0 to 60 minutes; default setting is 30; 0 = cancel integral action
Offsets	Room temperature offset (adjustable ±5° F) and standby setback offset (adjustable 1 to 10° F, default 2° F, does not apply to morning warm-up)
Display	Multifunctional LCD, 1.88 x 1.25 inches (48 x 32 mm) with temperature continuously up-dated (can be blanked); heat/ cool icons and other informa-tion displayed when relevant
Connector Type	Wire clamp terminals, 16 to 26 AWG
Weight	4.2 ounces (119 grams), in-cluding backplate
Material	Light almond or white flame-resistant plastic
Mounting	Thermostat secured to back-plate by two concealed screws; backplate mounts to vertical 2 x 4 inch standard handy box; mounts to most other boxes with an HMO-1161 wall plate
Approvals	UL 873 Temperature Indicating and Regulating Equipment; FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B; SASO PCP Registration KSA R-103263; CE compliant

Environmental Limits

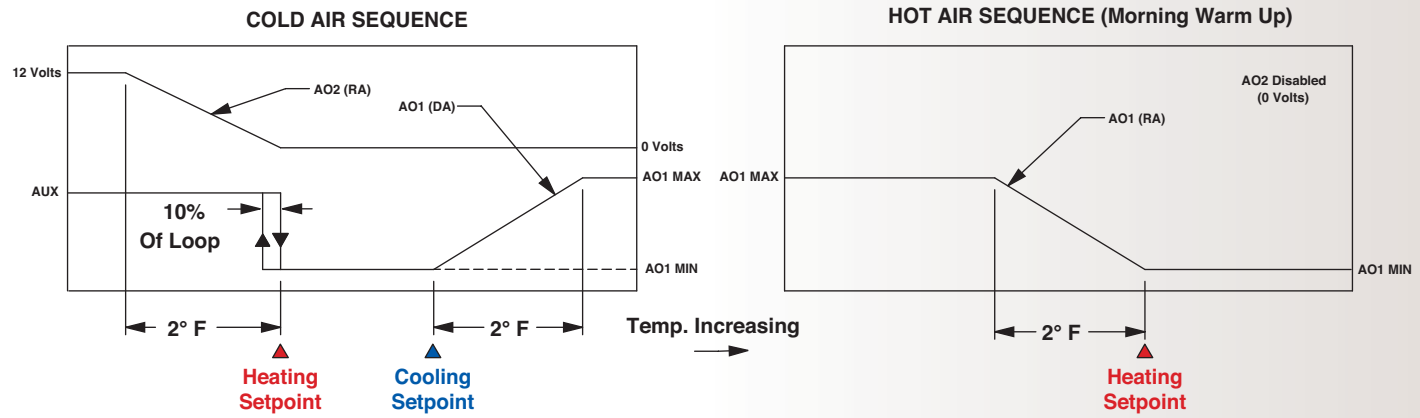
Operating	32 to 140° F (0 to 49° C)
Humidity	0 to 95% RH, non-condensing
Shipping	-40 to 160° F (-40 to 71° C)



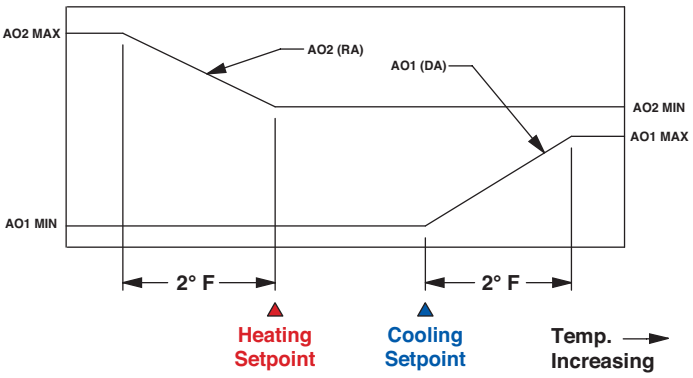
A	3.25 in.	83 mm
B	0.88 in.	22 mm
C	5.16 in.	116 mm
D	3.25 in.	83 mm
E	0.15 in. dia.	3.81 mm dia.



SEQUENCE 1: Single Duct Cooling, Fan Box (with REE-5002 or REE-5017)



SEQUENCE 2: Single Duct Cooling with Reheat and Auxiliary Flow



SEQUENCE 3:
Independent Heating and Cooling Control
(Dual Duct VAV, Baseboard, Single Zone AHU)

NOTE: AO1 is typically used to control the cooling output (primary air damper or cooling valve), and AO2 is used to control the heating output (VAV reheat or heating valve).

Hot/Cold Changeover

For hot/cold changeover on Sequence 1 or 2, connect a changeover sensor to the All input. The sensor should be a Type III thermistor (10K ohm @ 77° F), such as Anemostat STE-140x duct or STE-1454/1455 strap-on sensors. (An internal 10K ohm pullup resistor is provided on All .) Leave sensor off for continuous cold air mode.

Unoccupied/Standby Setback

Contact closure across All and Common initiates the unoccupied/standby setback sequence, which causes the cooling setpoint to increase and the heating set-point (where applicable) to decrease by the amount of the (selectable) setback offset. In Sequence 2 or 3, it would shift both the cooling setpoint and the heat-ing setpoint. (This setback does not apply during the morning warm-up sequence.)

PROCEDURE FOR CONTROL PACKAGES WITH SEQUENCE 1:

To Set the Operation Sequence:

1. Press and hold both the UP and DOWN arrow buttons for about (10) seconds until the display starts flashing "LIMITS".
2. When the menu is flashing, press the UP/DOWN arrow button to display the next menu item (LIMITS, ADVANCE, SYSTEM, or EXIT). Press the SETPOINT button to select **SYSTEM**.
3. Press the UP/DOWN arrow button to show the sequence options (SEQ1, SEQ2, or SEQ3). Press the SETPOINT button to select **(SEQ1)**.
4. Press the UP/DOWN arrow button to show the unit-of-measurement options (ENGISH or METRIC). Press the SETPOINT button to select the option required.
5. Press the UP/DOWN arrow button to shown the display options (BLANK NO or BLANK YES). Press the SETPOINT button to select the option required.
6. BACK would be shown. Press the UP/DOWN arrow button to show the setting options (BACK or EXIT). Press the SETPOINT button to select **EXIT** to save changes. **(Letting the menu time-out (about 30 seconds) will not permanently save changes).**

To Set Min and Max CFM:

1. Press and hold both the UP and DOWN arrow buttons for about (10) seconds until the displays start flashing "LIMITS". Press the SETPOINT button to select **LIMITS**.
2. A01 MIN would be shown. It controls the Min CFM and is default at 0.0(VDC). Press the UP/DOWN arrow button to adjust the voltage required. Press the SETPOINT button when done.
3. A01 MAX would be shown. It controls the Max CFM and is default at 12.0(VDC). Press the UP/DOWN arrow button to adjust the voltage required. Press the SETPOINT button when done.
4. A01 AUX, A02 MIN, and A02 MAX would be shown in sequence. Press the SETPOINT button to bypass these setting as those are not required.
5. BACK would be shown. Press the UP/DOWN arrow button to show the setting options (BACK or EXIT). Press the SETPOINT button to select **EXIT** to save changes. **(Letting the menu time-out (about 30 seconds) will not permanently save changes).**

To Change the Setpoint:

1. Press the UP/DOWN arrow or SETPOINT button to show the current setpoint.
2. Press the UP/DOWN arrow button to adjust the setpoint.
3. Press the SETPOINT button when done and show the current room temperature.

PROCEDURE FOR CONTROL PACKAGES WITH SEQUENCE 2:

To Set the Operation Sequence:

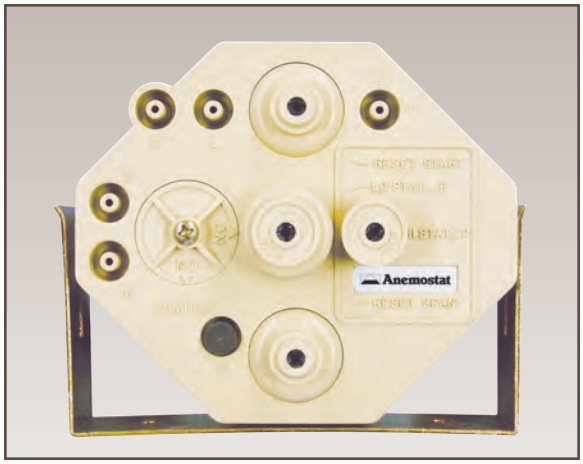
1. Press and hold both the UP and DOWN arrow buttons for about (10) seconds until the display starts flashing "LIMITS".
2. When the menu is flashing, press the UP/DOWN arrow button to display the next menu item (LIMITS, ADVANCE, SYSTEM, or EXIT). Press the SETPOINT button to select **SYSTEM**.
3. Press the UP/DOWN arrow button to show the sequence options (SEQ1, SEQ2, or SEQ3). Press the SETPOINT button to select SEQ2.
4. Press the UP/DOWN arrow button to show the unit-of-measurement options (ENGISH or METRIC). Press the SETPOINT button to select the option required.
5. Press the UP/DOWN arrow button to shown the display options (BLANK NO or BLANK YES). Press the SETPOINT button to select the option required.
6. BACK would be shown. Press the UP/DOWN arrow button to show the setting options (BACK or EXIT). Press the SETPOINT button to select **EXIT** to save changes. **(Letting the menu time-out (about 30 seconds) will not permanently save changes).**

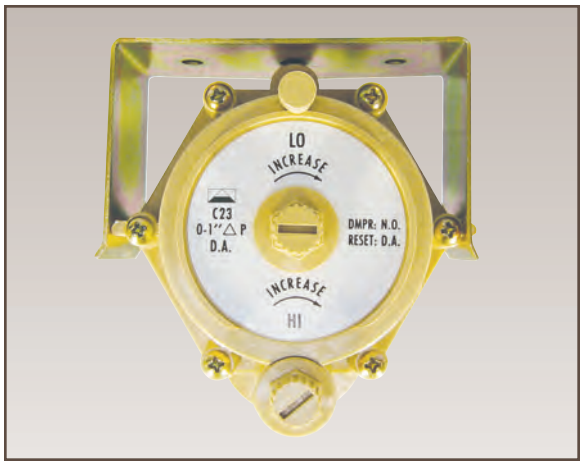
To Set Min, Max, and Aux CFM and Heater output Signal:

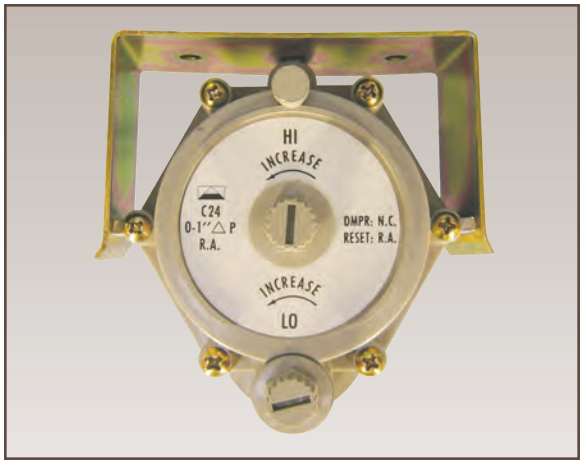
1. Press and hold both the UP and DOWN arrow buttons for about (10) seconds until the display start flashing "LIMITS". Press the SETPOINT button to select **LIMITS**.
2. A01 MIN would be shown. It controls the Min CFM and is default at 0.0(VDC). Press the UP/DOWN arrow button to adjust the voltage required. Press the SETPOINT button when done.
3. A01 MAX would be shown. It controls the Max CFM and is default at 12.0(VDC). Press the UP/DOWN arrow button to adjust the voltage required. Press the SETPOINT button when done.
3. A01 AUX would be shown. It controls the heater CFM under Cold Air Sequence and is default at 0.0(VDC). Press the UP/DOWN arrow button to adjust the voltage required. Press the SETPOINT button when done.
4. A02 MIN would be shown. It controls the lower limit of the heater output signal and is default at 0.0(VDC). Keep the value at 0.0 and press the SETPOINT button.
5. A02 MAX would be shown. It controls the upper limit of the heater output signal and is default at 12.0(VDC). Press the DOWN arrow button to lower the value to 10.0. Press the SETPOINT button when done.
6. BACK would be shown. Press the UP/DOWN arrow button to show the setting options (BACK or EXIT). Press the SETPOINT button to select **EXIT** to save changes. **(Letting the menu time-out (about 30 seconds) will not permanently save changes).**

To Change the Setpoint:

1. Press the SETPOINT button to show the current COOLING setpoint.
2. Press the UP/DOWN arrow button to adjust the COOLING setpoint.
3. Press the SETPOINT button again to show the current HEATING setpoint.
4. Press the UP/DOWN arrow button to adjust the HEATING setpoint.
5. Press the SETPOINT button again when done and show the current room temperature.







PNEUMATIC CONTROLS

Anemostat®
AIR DISTRIBUTION

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GENERAL INFORMATION

CSC–2000 Series Overview

The CSC–2000s are differential-pressure (dP), submaster controllers with adjustable minimum and maximum airflow settings. A master controller, typically a room thermostat, resets the CSC velocity setpoint.

CSC–2000s are available as direct acting for normally open VAV terminal units, and reverse acting for normal closed VAV terminal units. Each unit is equipped with separate adjustment knobs for minimum and maximum airflow settings. Calibrate all models using standard airflow measuring equipment.

The spring range of the actuator does not matter to the controller. However, sufficient main air is required to provide the actuator with enough force to operate the damper/linkage.

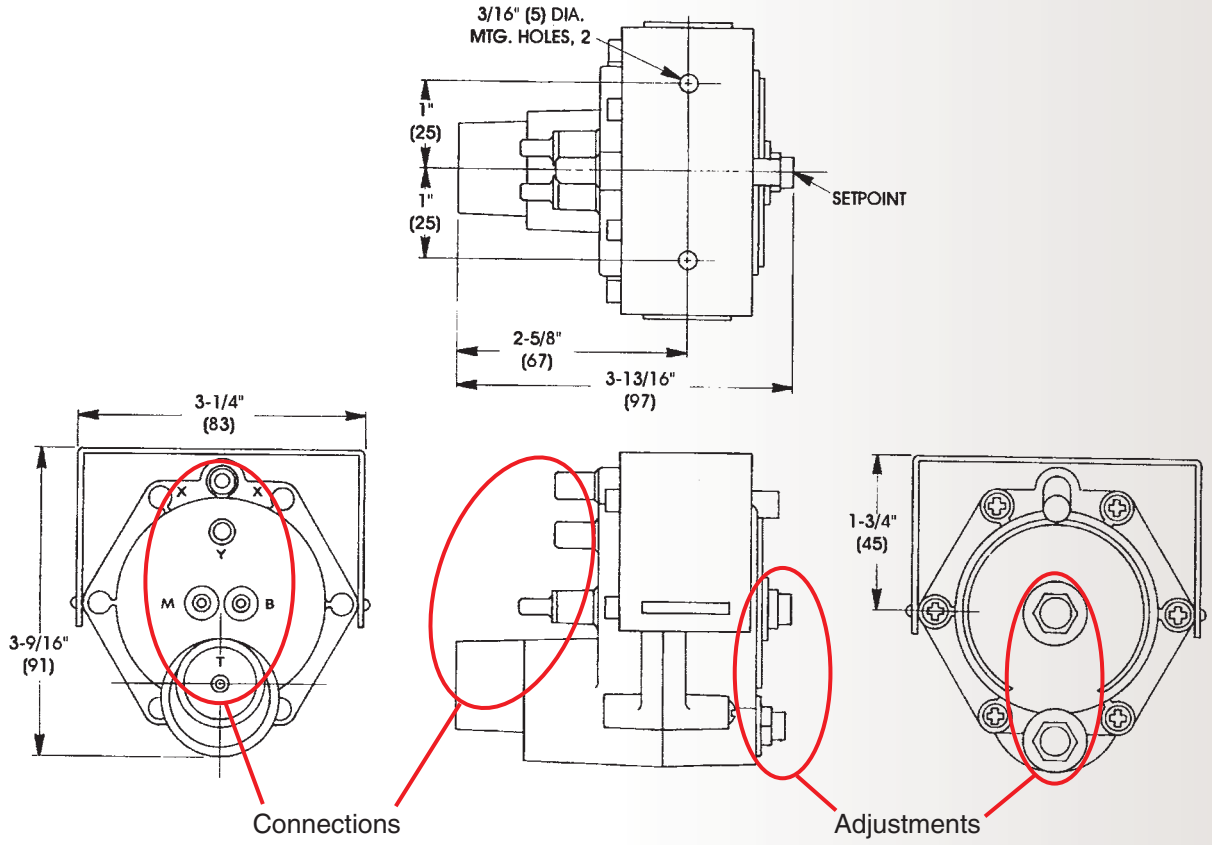
Any sequencing with other controllers, valves, or pneumatic-electric relays must be sequenced with the controller's reset range, not the actuator's spring range.

These controllers are typically used on single-duct applications but may be found in dual-duct applications. When working on dual-duct applications it may be necessary to work on one duct at a time while closing off the other.

The CSC–2000 series controllers are position sensitive. See the Mounting section for the proper vertical/horizontal orientation for the different models.

CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.



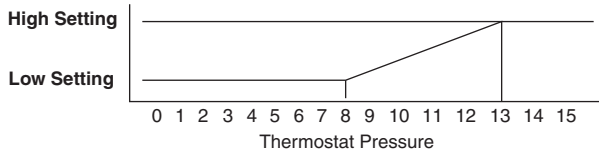
MODELS AND SPECIFICATIONS

Output Sensitivity	0 to 1" range unit, 5 psig/0.02" wg (35 kPa/5 Pa) 0 to 2" range units, 5 psig/0.04"wg (35 kPa/10 Pa)
Main Air Pressure	15 to 30 psig (103 to 207 kPa)
Max. Signal Pressure	6" wg (1493 Pa) applied to either port (X or Y)
Material	ABS (beige or gray) UL Flame Class 94 HB
Output Capability	0 to supply pressure
Weight	7.5 oz. (213 grams)
Temperature Limits	
Operating	40° to 120° F (4° to 49° C)
Shipping	–40° to 140° F (–40° to 60° C)

The table below illustrates the appropriate model for each application.

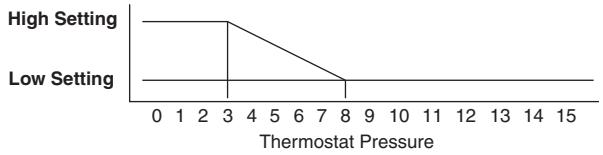
Direct Acting BEIGE units (C23) are designed for normally open dampers with direct-acting thermostats for cooling and reverse-acting thermostats for heating.

FLOW CHARACTERISTICS



Reverse Acting GRAY units (C24) are designed for normally closed dampers with reverse-acting thermostats for cooling and direct-acting thermostats for heating.

FLOW CHARACTERISTICS



Direct Acting (Beige Controllers) for Normally Open Dampers						
Model	**Thermostat Required**		**Setpoint Range**		**Reset Pressure Band**	**Air Consumption**
	For Cooling	**For Heating**	**Minimum**	**Maximum**		
C23	Direct Acting	Reverse Acting	0 to 1.0" wg (249 Pa)	Min. plus 1" wg (249 Pa)	8 ±0.5 to 13 psig (55 ±3.5 to 90 kPa)	14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)

Reverse Acting (Gray Controllers) for Normally Closed Dampers						
Model	**Thermostat Required**		**Setpoint Range**		**Reset Pressure Band**	**Air Consumption**
	For Cooling	**For Heating**	**Minimum**	**Maximum**		
C24	Reverse Acting	Direct Acting	0 to 1.0" wg (249 Pa)	Min. plus 1" wg (249 Pa)	3 ±0.5 to 8 psig (21 ±3.5 to 55 kPa)	14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)

MOUNTING

As close to the flow sensor pickup as is feasible, fasten the mounting bracket to the mounting surface with two self-threading screws in the two 3/16 in. (5 mm) holes. (Make sure to leave enough room to make connections.)

The CSC–2000 series are position sensitive:

- The minimum and maximum flow limits must be set (calibrated) in the same position the controller will be mounted.
- May be mounted horizontally (preferred),with the adjustment knobs up or down, or mounted vertically (the diaphragm inside must be in a horizontal or vertical plane).

CONNECTIONS

Use 1/4 in. (6 mm) O.D. "FR" tubing for the following connections:

1. Connect the main air supply to port "M".
2. Connect the actuator to port "B".
3. Connect the thermostat to port "T".

C23 Units

Use 3/8 in. O.D. "FR" tubing with a maximum length of 24 in. to connect:

1. High pressure to port "X".
2. Low pressure to port "Y".

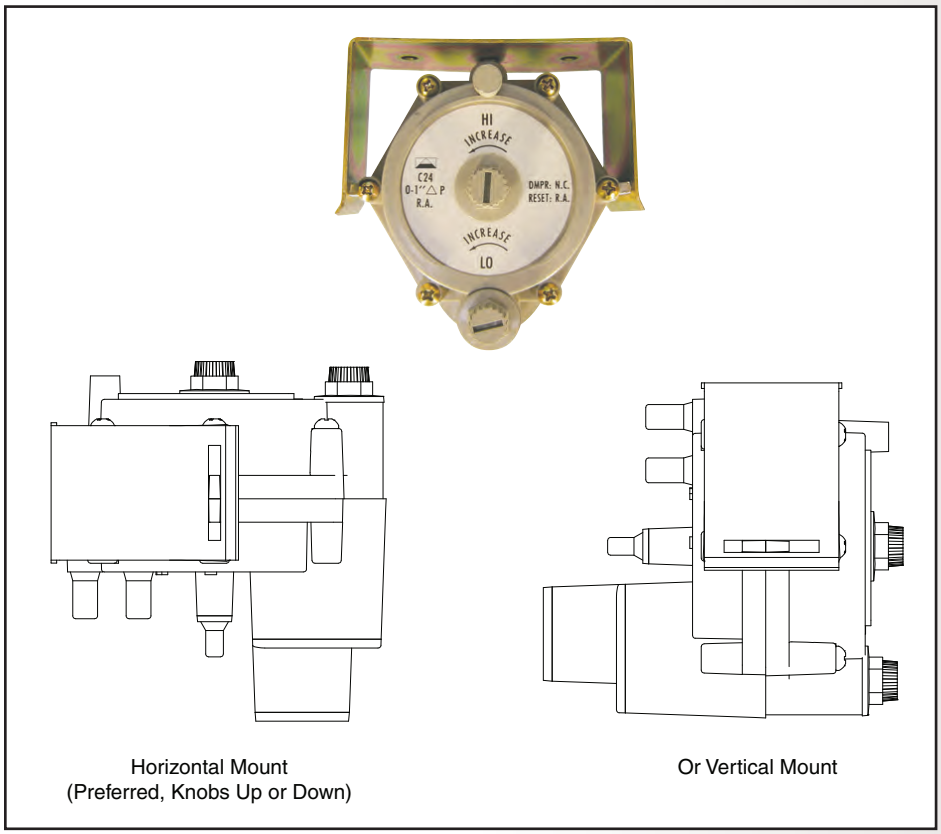
C24 Units

Use 3/8 in. O.D. "FR" tubing with a maximum length of 24 in. to connect:

1. Low pressure to port "X".
2. High pressure to port "Y".

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.



Horizontal Mount
(Preferred, Knobs Up or Down)

Or Vertical Mount

ADJUSTMENTS, CALIBRATION, AND OPERATION OF C23 CONTROLLERS

Adjustments and Calibration

1. Check that there is 0 psi at the "T" Port.
2. Use a flow hood or "tee" a Magnehelic® (or equivalent) differential pressure gauge between the controller and the dP pick-up.
3. The "LO" flow setting limit (center knob) must be set first. Temporarily adjust the thermostat for a branch pressure lower than the 8 psig reset start point (minimum cooling); typically 6 psig or less is best. Removing the thermostat branch line would be another acceptable method. Adjust the "LO" knob (center knob) clockwise to increase or counterclockwise to decrease dP limit. Normally one-half turn will cause a 0.1 dP change. Allow for reaction time. Depending on actuator size and position, timing will vary. To position an actuator/damper from closed to open may take several minutes.

NOTE: If the "LO" flow setting limit must be set at"0" (zero minimum), do not turn the "LO" knob fully counterclockwise. The knob will adjust three to four full turns after a zero minimum is reached. Turning the "LO" knob fully counterclockwise will result in a negative reset condition. This means that when the controller is beginning to reset at 8 psig from the thermostat, it must first overcome the negative adjustment and will not begin to reset until a higher thermostat reset pressure is reached. This negative reset will also reduce the effective range of the controller by reducing the high end and narrowing the reset span. If a zero minimum is required, adjust the "LO" knob until the controller just begins to crack the damper open, then back-off one-fourth turn and verify zero airflow.

4. The "HI" flow setting limit (outer knob) must beset after the "LO". Temporarily adjust the thermostat for a branch pressure higher than the 13 psig reset stop point (maximum cooling); typically 17 psig or greater is best. Removing the thermostat branch line and teeing-in to the main air line would be another acceptable method. Adjust the "HI" knob (outer knob) clockwise to increase or counterclockwise to decrease dP limit. Nominally one-half turn will cause a 0.1 dP change. Allow for reaction time.
5. Recheck the "LO" and the "HI" settings at least twice, verify settings, and fine tune each time if necessary. This procedure will remove internal component tensions and confirm settings.
6. Reconnect the thermostat branch line if necessary, and adjust the thermostat to the desired room temperature setpoint.

NOTE: The"HI" adjustment limits the travel of the reset mechanism. Therefore, the reset span will be less than 5 psig, the upper limit being less than 13 psig.

NOTE: Always make adjustments in the same plane/orientation as the one in which the unit will operate.

NOTE: No routine maintenance is required. Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long-term dependability.

NOTE: For information about C24 controllers see the Adjustments, Calibration, and Operation of C24 Controllers section.

PRESSURE INDEPENDENT OPERATION

Differential pressure is sensed via a dP pickup mounted upstream of the damper (VAV terminal inlet). The dP pickup is a dual pressure pickup sensing both high pressure and low pressure. The high pressure is connected to the "X" port and the low pressure is connected to the "Y" port. These two pressures are compared across the static diaphragm, which takes a position relative to the difference of the two pressures, the force of the LO limit adjustment spring in the upper chamber, and the force of the HI limit adjustment spring in the lower chamber.

Turning the "LO" knob clockwise (to increase) relaxes the LO limit adjustment spring, placing a lesser downward force on the diaphragm, reducing the pressure at the "B" port, and increasing airflow through the VAV terminal. Turning the "HI" knob adjustment spring counterclockwise positions the HI limit stop downward, limiting the travel of the piston cup, limiting the amount of reset, and setting the maximum airflow through the VAV terminal.

When the "HI" knob is turned fully counterclockwise, the HI limit will equal the LO limit, and the controller will function as a constant volume controller.

An increase in airflow is sensed via the increase in dP across the static diaphragm, positioning the static diaphragm closer to the nozzle, increasing the "B" port pressure to the actuator, and decreasing airflow until the static diaphragm comes into balance at the desired dP setpoint.

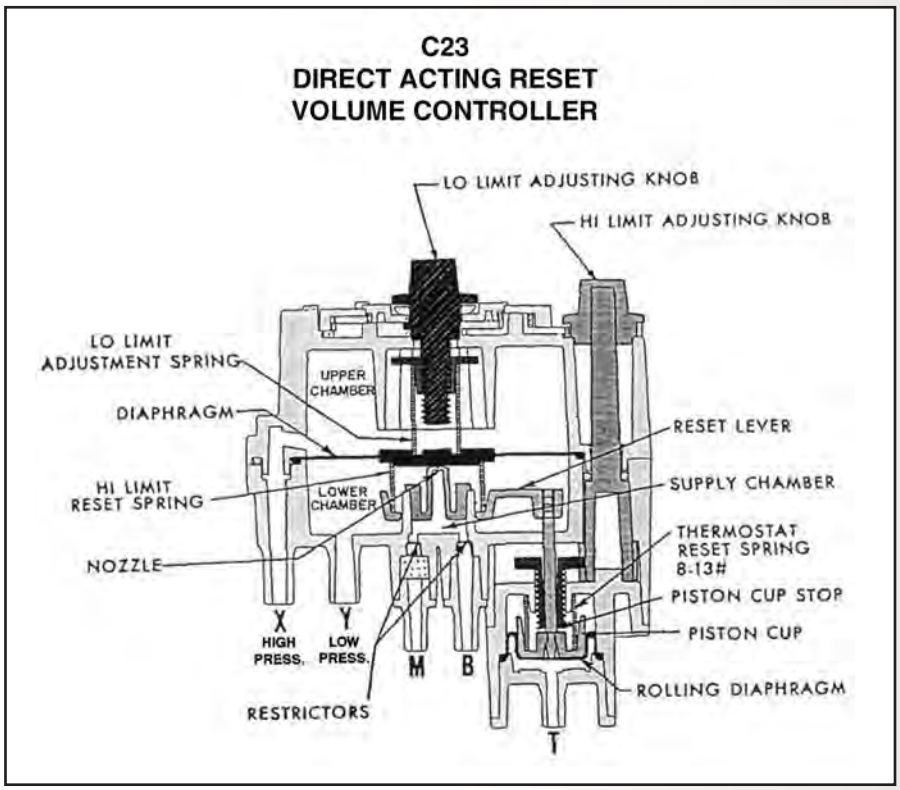
A decrease in airflow is sensed via the decrease in dP across the static diaphragm, positioning the static diaphragm away from the nozzle, decreasing the "B" port pressure to the actuator, and increasing airflow until the static diaphragm comes into balance at the desired dP setpoint.

RESET OPERATION

With sufficient airflow and a thermostat signal connected to the "T" port of less than 8 psig, the controller will position the actuator to regulate airflow at the LO limit setting. In this state, the static diaphragm is balanced over the nozzle through the forces of the opposing springs and forces of the high and low pressures.

When the thermostat signal increases above 8 psig, the piston cup will begin to position the reset lever upward, increasing the force of the HI limit spring, positioning the static diaphragm away from the nozzle, opening the damper for greater airflow, and requiring a higher dP to rebalance the static diaphragm.

The dP setpoint of the controller has been reset upwards with the increasing thermostat signal. The stroke of the piston cup is limited via the HI limit knob. Lowering the HI limit will reduce the top end of the reset span, narrowing the reset span. At each new dP setpoint, as dictated by the thermostat signal, the static diaphragm will again balance.



ADJUSTMENTS, CALIBRATION, AND OPERATION OF C24 CONTROLLERS

Adjustments and Calibration

1. Check that there is 0 psi at the "T" Port.
2. Use a flow hood or "tee" a Magnehelic® (or equivalent) differential pressure gauge between the controller and the dP pick-up.
3. The "HI" flow setting limit (center knob) must be set first. Temporarily adjust the thermostat for a branch pressure lower than the 3 psig reset start point (maximum cooling); typically 1 psig or less is best. Removing the thermostat branch line would be another acceptable method. Adjust the "HI" knob (center knob) counterclockwise to increase or clockwise to decrease dP limit. Normally one-half turn will cause a 0.1 dP change. Allow for reaction time. Depending on actuator size and position, timing will vary. To position an actuator/damper from closed to open may take several minutes.
4. The "LO" flow setting limit must be set after the"HI". Temporarily adjust the thermostat for a branch pressure higher than the 8 psig reset stop point (minimum cooling); typically 12 psig or greater is best. Removing the thermostat branch line and teeing-in to the main air line would be another acceptable method. Adjust the "LO" knob (outside knob) counterclockwise to increase or clockwise to decrease dP limit. Normally one-half turn will cause a 0.1 dP change. Allow for reaction time.
5. Recheck the "HI" and the "LO" settings at least twice, verify settings, and fine tune each time if necessary. This procedure will remove internal component tensions and confirm settings.
6. Reconnect the thermostat branch line if necessary, and adjust the thermostat to the desired room temperature setpoint.

NOTE: The"LO" adjustment limits the travel of the reset mechanism. Therefore, the reset span will be less than 5 psig, the upper limit being less than 8 psig.

NOTE: Always make adjustments in the same plane/orientation as the one in which the unit will operate.

NOTE: No routine maintenance is required. Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long-term dependability.

PRESSURE INDEPENDENT OPERATION

Differential pressure is sensed via a dP pickup mounted upstream of the damper (VAV terminal inlet). The dP pickup is a dual pressure pickup sensing both high pressure and low pressure. The low pressure is connected to the "X" port and the high pressure is connected to the "Y" port. These two pressures are compared across the static diaphragm, which takes a position relative to the difference of the two pressures, the force of the HI limit adjustment spring in the upper chamber, and the force of the LO limit adjustment spring in the lower chamber.

Turning the "HI" knob counterclockwise (to increase) compresses the HI limit adjustment spring, placing a greater downward force on the diaphragm, increasing the pressure at the "B" port, and increasing air through the VAV terminal. Turning the "LO" knob adjustment spring counterclockwise positions the LO limit stop downward, limiting the travel of the piston cup, limiting the amount of reset, and setting the minimum airflow through the VAV terminal.

When the "LO" knob is turned fully counterclockwise, the LO limit will equal the HI limit, and the controller will function as a constant volume controller.

An increase in airflow is sensed via the increase in dP across the static diaphragm, positioning the static diaphragm away from the nozzle, decreasing the "B" port pressure to the actuator, and decreasing airflow until the static diaphragm comes into balance at the desired dP setpoint.

A decrease in airflow is sensed via the decrease in dP across the static diaphragm, positioning the static diaphragm closer to the nozzle, increasing the "B" port pressure to the actuator, and increasing airflow until the static diaphragm comes into balance at the desired dP setpoint. 3.

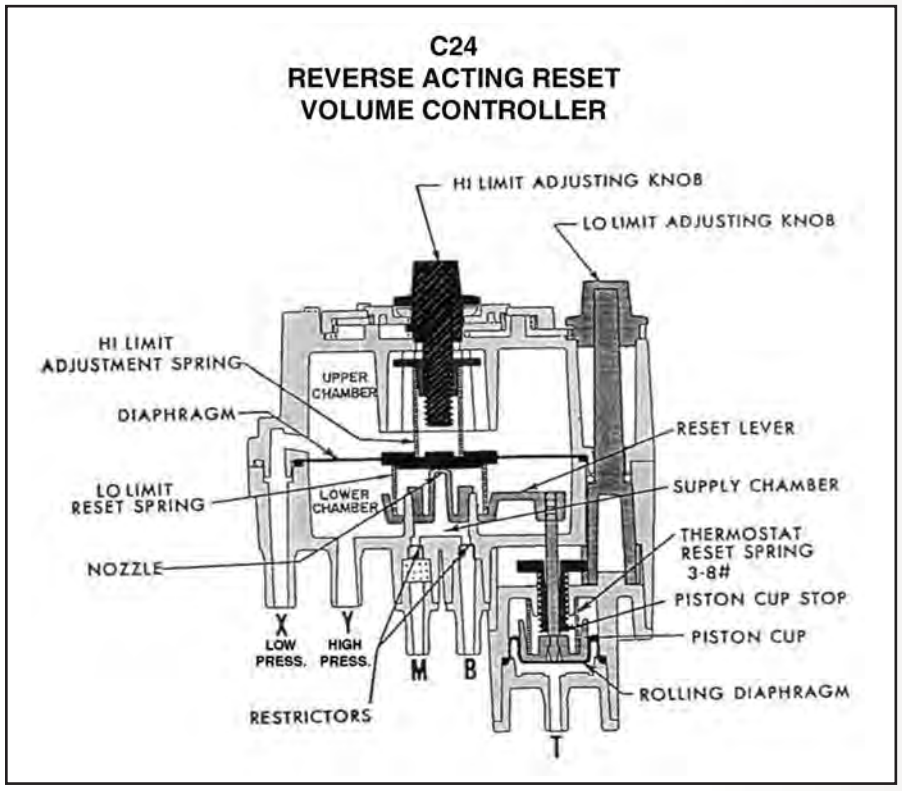
RESET OPERATION

With sufficient airflow and a thermostat signal connected to the "T" port of less than 3 psig, the controller will position the actuator to regulate airflow at the HI limit setting. In this state, the static diaphragm is balanced over the nozzle through the forces of the opposing springs and forces of the high and low pressures.

When the thermostat signal increases above 3 psig, the piston cup will begin to position the reset lever upward, increasing the force of the LO limit spring, positioning the static diaphragm away from the nozzle, closing the damper for less airflow, and requiring a lower dP to rebalance the static diaphragm.

The dP setpoint of the controller has been reset downwards with the increasing thermostat signal. The stroke of the piston cup is limited via the LO limit knob. Raising the LO limit will reduce the top end of the reset span, narrowing the reset span. At each new dP setpoint, as dictated by the thermostat signal, the static diaphragm will again balance.

NOTE: For information about C23 controllers see the Adjustments, Calibration, and Operation of C23 Controllers section.



GENERAL INFORMATION

C31 Series Overview

These C31 series reset volume controllers are designed for use on heating or cooling systems with (normally open or normally closed) VAV terminal units and (direct or reverse acting) thermostat.

They are sub-master air velocity controllers. Each is equipped with separate adjustment knobs for minimum and maximum airflow setpoints. Models are available with various reset start points. A master controller, typically a room thermostat, resets the CSC between the minimum and maximum velocity setpoints.

The universal design of the C31 series is intended for new or replacement applications that call for direct or reverse acting reset on normally open or normally closed VAV terminal units.

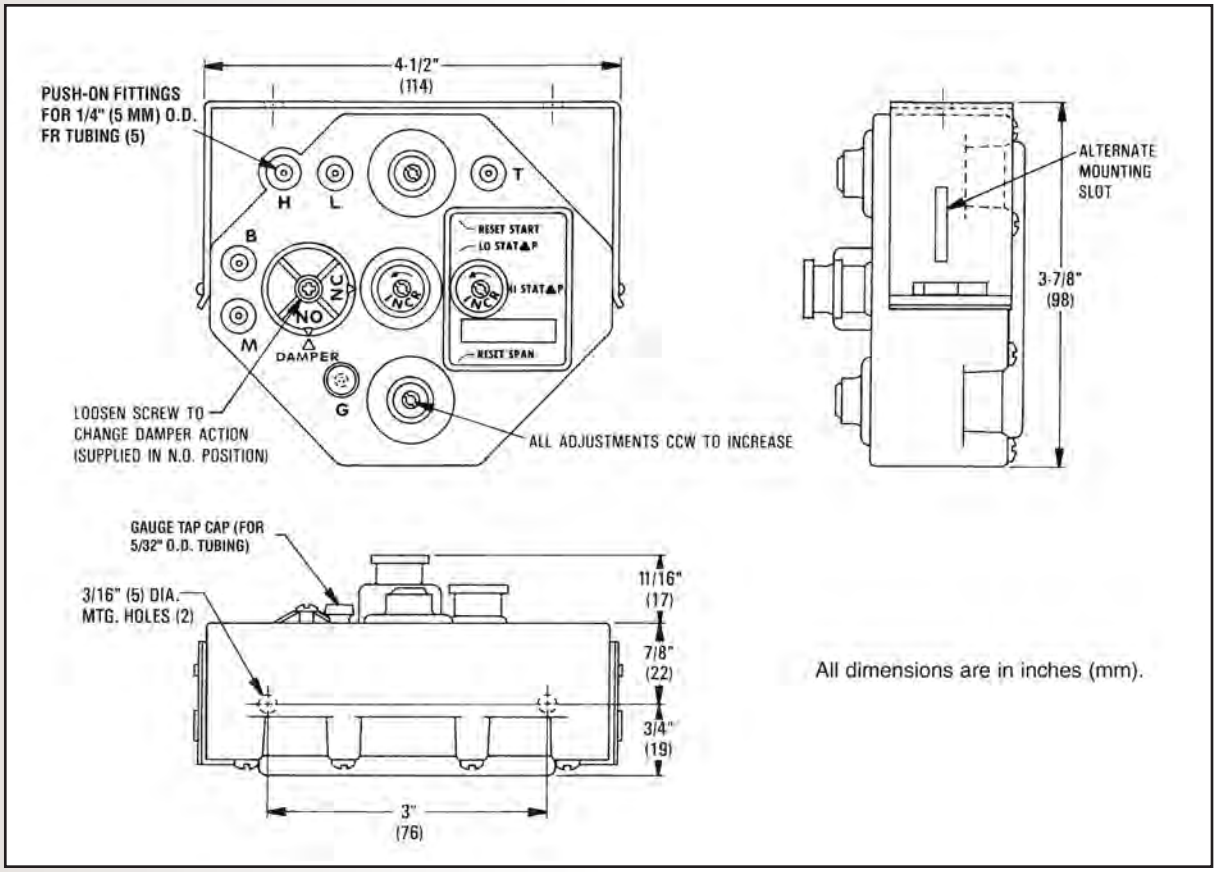
Note: These controllers are used on single and dual duct applications. When working on dual duct applications, it may be necessary to work on one duct at a time.

Note: Any sequencing with other controllers, valves, or pneumatic-electric relays must be done with the controller's reset range, NOT the actuator's spring range.

Mounting

The C31 series are position sensitive. They must be mounted and calibrated in either the horizontal or vertical plane.

1. As near to the flow sensor pickup as is feasible, connect the mounting bracket to the mounting surface with two self-threading screws in the two 3/16" (5 mm) mounting holes. Be sure to leave enough room to make connections.
2. Insert the controller, face down, up, right or left. The controller must be installed and adjusted in the same plane or readjustment will be necessary.



CONNECTIONS

Use 1/4" (5 mm) O.D. "FR" tubing on the following push-on fittings:

1. Connect the clean, dry, oil-free main air supply to Port "M" (15 to 30 psig).
2. Connect the damper actuator to Port "B".
3. Connect the thermostat output to Port "T".
4. Connect the high pressure tap on the airflow sensor to Port "H".
5. Connect the low pressure tap on the airflow sensor to Port "L".
6. Check for proper connections. Make sure all tubes are snug on their fittings. If loose, trim the end of the tubing and reconnect it to ensure there are no leaks.

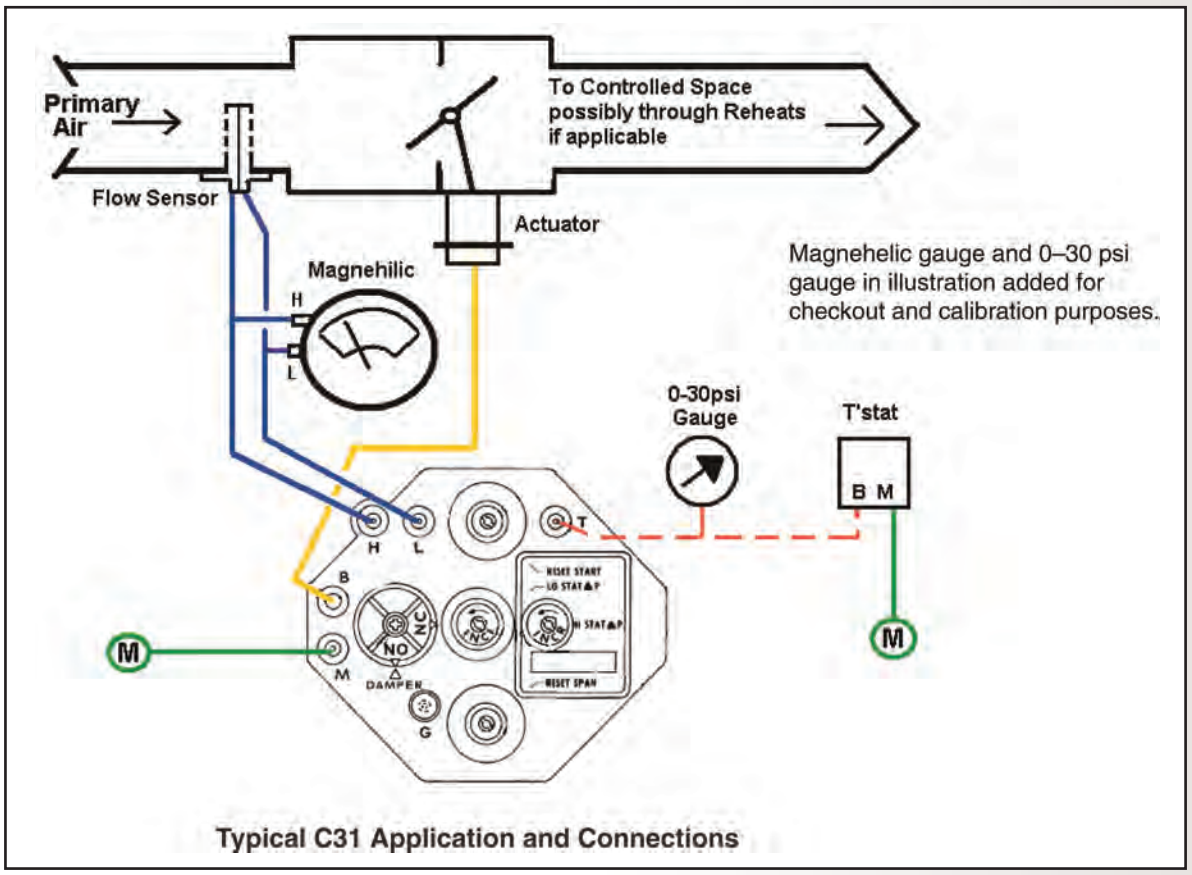
NOTE: Over time, the tube may stretch or develop microcracks. Trim the end of tube back to undamaged material and reconnect. Replace the tubing if it is brittle or discolored.

NOTE: You can easily test for leaks with a squeeze bulb to ensure there are no leaks at the actuator diaphragm or fittings.

7. Use a flow hood or "tee" a Magnehelic® (or equivalent) differential pressure gauge between the controller and the dP pick-up to determine airflow.

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.



Typical C31 Application and Connections

ADJUSTMENTS AND CALIBRATION

Damper Action

The damper action is factory-set at Normally Open (N.O.). To change to Normally Closed (N.C.), perform the following steps:

1. Loosen the damper selection screw.
2. Turn the selection dial clockwise until the "NC" arrow aligns with the "DAMPER" arrow.

NOTE: Accuracy in the alignment of the arrows is very important. Make this adjustment as exact as possible.

3. Tighten the selection screw. Be sure the screw is tight (2 to 4 in-lbs. of torque), but if over-tightened, the plastic will strip out.

Determining the Type of Reset

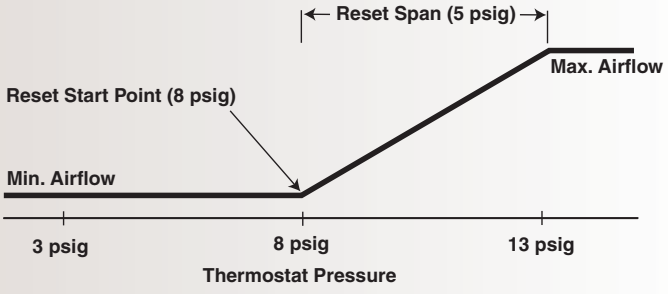
The following table sows when Direct Reset or Reverse Reset is required. Determine the reset type based on the temperature of the primary air entering the VAV box and whether the thermostat in the space is direct or reverse acting.

Primary Air	Thermostat	Reset Type
Cooling	DA	Direct Reset
	RA	ReverseReset
Heating	DA	ReverseReset
	RA	Direct Reset

Adjusting Minimums and Maximums

When adjusting the minimum and maximum airflow settings, the output responds slowly to changes in the setpoint. Wait for the flow rate to stabilize after making an adjustment (usually 20 to 30 seconds) before making further adjustments. Also, if the damper position is all the way closed or open when starting this step, turn the adjustment one full turn, and then wait 20 to 30 seconds for a change in the flow reading of the Magnehelic gauge. If no change occurs after this time, repeat until the flow rate changes.

Direct Reset Minimum and Maximum



NOTE: The direct reset illustration above assumes no relays are connected between the thermostat and the "T" port.

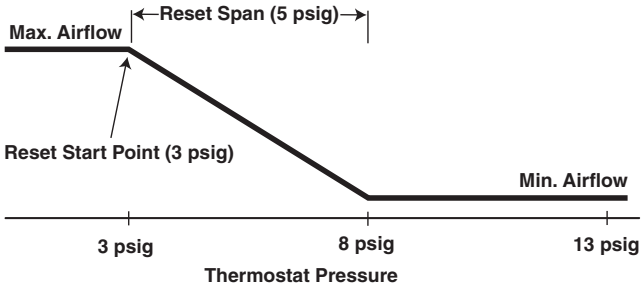
For Direct Reset (DA thermostat for cooling or RA thermostat for heating), perform the following steps:

1. Adjust the thermostat to a setting that will cause the output pressure to be as high as possible (15 psi or more). This can be done in the following manner:
   a. For Direct Acting thermostats, lower the setting to the lowest possible setting.
   b. For Reverse Acting thermostats, raise the setting to the highest possible setting.
2. On the C31, disconnect the "T" port. Temporarily plug the tubing. (Do NOT plug the port.)
3. Adjust the LO STAT dP (center dial) one adjustment (1/4 to 1/2 knob rotation) at a time until the desired Minimum airflow is read at the Magnehelic gauge and is stable.

NOTE: If the LO STAT dP Limit must be set at "O" (zero minimum), do not turn the LO STAT dP knob fully clockwise. The knob will adjust one and one-half turns after a zero minimum is reached. Turning the LO STAT dP knob fully clockwise will result in a negative reset condition. This means that when the controller begins to reset at the reset start point it must first overcome the negative adjustment and will not begin to reset from "O" until a higher thermostat reset pressure is reached. This negative reset will also reduce the effective range of the controller by reducing the low end reset; narrowing the reset span. If a zero minimum is required, adjust the LO STAT dP knob until the controller just begins to crack the damper open, then back-off one-quarter turn and verify zero airflow. (This is typically 2-1/2 knob rotations counterclockwise from the fully clockwise position.)

4. Reconnect the thermostat tubing to the "T" port. This will put 15 PSI or more on the "T" port.
5. Adjust the HI STAT dP (dial on right) one adjustment (1/4 to 1/2 knob rotation) at a time until the desired Maximum airflow is read at the Magnehelic gauge and is stable.
6. Repeat Steps 2 through 5 to verify the settings to be correct and fine tune if necessary.

REVERSE RESET Minimum and Maximum



NOTE: The reverse reset illustration above assumes no relays are connected between the thermostat and "T" port.

For Reverse Reset (RA thermostat for cooling or DA thermostat for heating), perform the following steps:

1. Adjust the thermostat to a setting that will cause the output pressure to be as high as possible (15 psi or more). This can be done in the following manner:
   a. For Direct Acting thermostats, lower the setting to the lowest possible setting.
   b. For Reverse Acting thermostats, raise the setting to the highest possible setting.
2. On the C31, disconnect the "T" port and leave it open. Temporarily plug the open tubing.
3. Adjust the LO STAT dP (center dial) one adjustment (1/4 to 1/2 knob rotation) at a time until the desired MAximum airflow is read at the Magnehelic gauge and is stable.
4. Reconnect the thermostat tubing to the "T" port. This will put 15 PSI or more on the "T" port.
5. Adjust the HI STAT dP (dial on the right) one adjustment (1/4 to 1/2 knob rotation) at a time until the desired Minimum airflow is read at the Magnehelic gauge and is stable.

NOTE: If the HI STAT dP Limit must be set at"O" (zero minimum), do not turn the HI STAT dP knob fully clockwise. The knob will adjust past where a zero minimum is reached. Turning the HI STAT dP knob fully clockwise will result in a negative reset condition. This means that the controller will get to zero before going through the whole reset span. If a zero minimum is required, adjust the HI STAT dP knob until the controller just begins to crack the damper open, then back off slightly and verify zero airflow.

6. Repeat Steps 2 through 5 to verify the settings to be correct and fine tune if necessary.

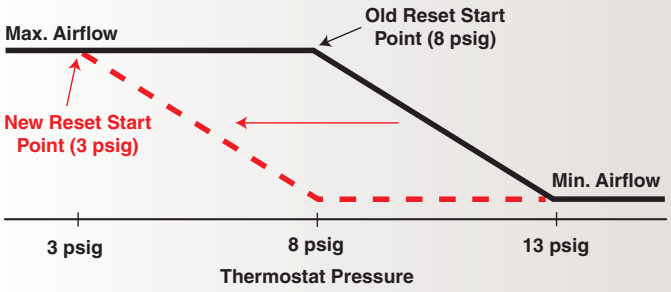
Reset Start Point

The reset start point is the pressure from the thermostat at which the controller begins to reset from LO STAT to the HI STAT setting.

If a reset start point is needed other than the default setting, all models are field adjustable between 0 and 10 psig. (If the reset start point is changed, the reset span may need to be adjusted as well.) To adjust the reset start point, carry out the following steps:

1. Put the thermostat pressure at the desired start point pressure (e.g., 3 psig).
2. Remove rubber plug at the "G" port and read pressure at "G" with a 0 - 30 psi gauge (requires 5/32" O.D. tubing).
3. With a small flat-blade screwdriver, adjust (counterclockwise to increase; clockwise to decrease) the reset start point control (at the top of the controller) until the pressure read at "G" port is just beginning to move off zero (0) psig.

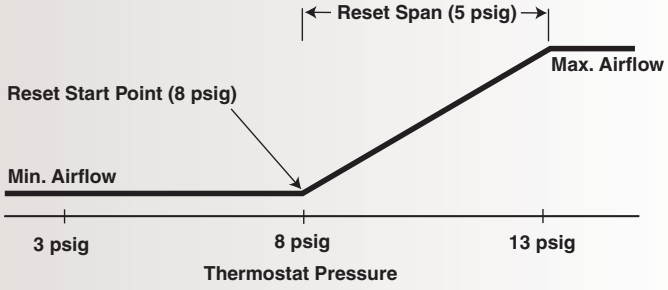
NOTE: If the controller does not respond correctly after all adjustments have been made, it may be necessary to correct the reset span adjustment.



(Reverse) Reset Start Point Adjusted from 8 to 3 psig

Reset Span

The reset span is the thermostat's effective reset range for the controller. A reset span 5 psig means that it will take a 5 psig pressure change measured from the reset start point to reset the flow rate of the VAV box.



NOTE: Reset span is the pressure change at "T" above the reset start point that causes the flow setpoint to move from one extreme to the other. In a direct reset application, the flow setpoint will change from minimum to maximum flow above the start point. In a reverse reset application, the reset will change from maximum to minimum flow above the start point.

If necessary, the reset span can be adjusted (between 0 and 10 psig). If the reset span is changed, the minimum and maximum flows may need to be readjusted.

To adjust the reset span to another value, perform the following steps:

1. Adjust the thermostat to a higher pressure, beyond working range (20 psig is best).
2. Attach a pressure gauge to the "G" port (requires 5/32" O.D. tubing).
3. With a small flat-blade screwdriver, adjust (counterclockwise to increase; clockwise to decrease) the reset span control (at the bottom of the controller) until pressure at the "G" port equals the desired reset span pressure. Pressure read at this port will always be between 0 and the active reset span setting.

Troubleshooting

The C31 is position sensitive. Be sure to mount the controller with the correct orientation. See the Mounting section. If the controller is calibrated in a position other than the final mounting position, the calibration (minimum and maximum flow limits) will be off.

The spring range of the actuator does not matter. However, sufficient main air is required to provide the actuator with enough force to operate the damper/linkage. Also there can be no leaks in the actuator since even small leaks can cause the actuator to not stroke. You can easily test for leaks with a squeeze bulb to ensure there are no leaks at the actuator diaphragm or fittings.

Any sequencing with other controllers, valves, or pneumatic-electric relays must be sequenced with the controller's reset range, not the actuator's spring range.

These controllers are typically used on single-duct applications but may be found in dual-duct applications. When working on dual-duct applications it may be necessary to work on one duct at a time.

Maintenance

No routine maintenance is required. Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long-term dependability.

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will result in the device's eventual failure.

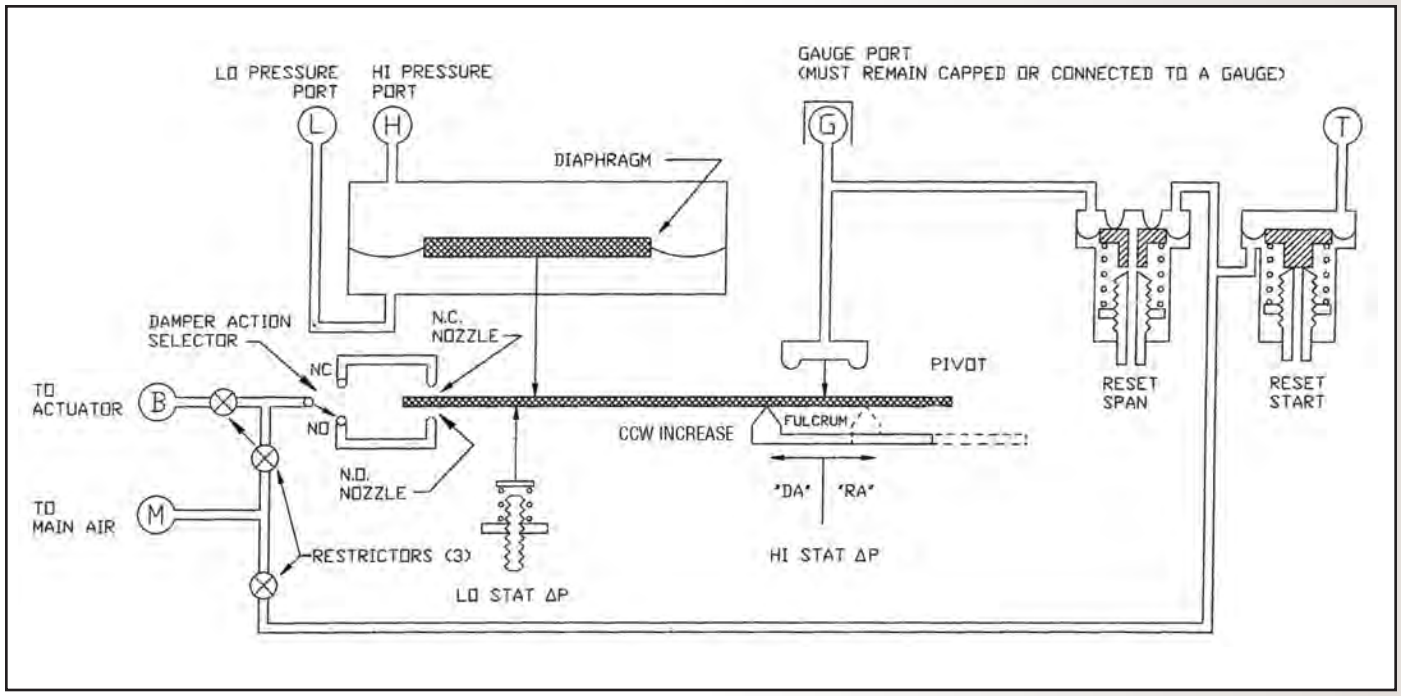
Pressure Independent Operation Principles

Differential pressure is sensed via a dP pick-up mounted ahead of the damper (VAV terminal inlet). The dP pick-up is a dual pressure pick-up sensing both high and low pressures. The high pressure is connected to the "H" port and the low pressure is connected to the "L" port. These two pressures are compared across the diaphragm. (No air is transferred between the "H" and "L" port.) The diaphragm positions a reset lever relative to the pressure difference between the force of the LO STAT dP spring and the position of the HI STAT dP setting.

Turning the LO STAT dP knob counterclockwise (to increase) repositions the reset lever away from the normally open nozzle and towards the normally closed nozzle. LO STAT dP adjustments must be done with the "T" port pressure being less than the RESET START pressure.

- **"NO"** DAMPER selection (normally open dampers) – Turning the LO STAT dP knob counterclockwise (increase) will reposition the reset lever away from the normally open nozzle, decreasing the "B" port pressure and increasing airflow through the terminal unit.
- **"NC"** DAMPER selection (normally closed dampers) – turning the LO STAT dP knob counterclockwise (increase) will reposition the reset lever towards the normally closed nozzle, increasing the "B" port pressure and increasing the airflow through the terminal unit.

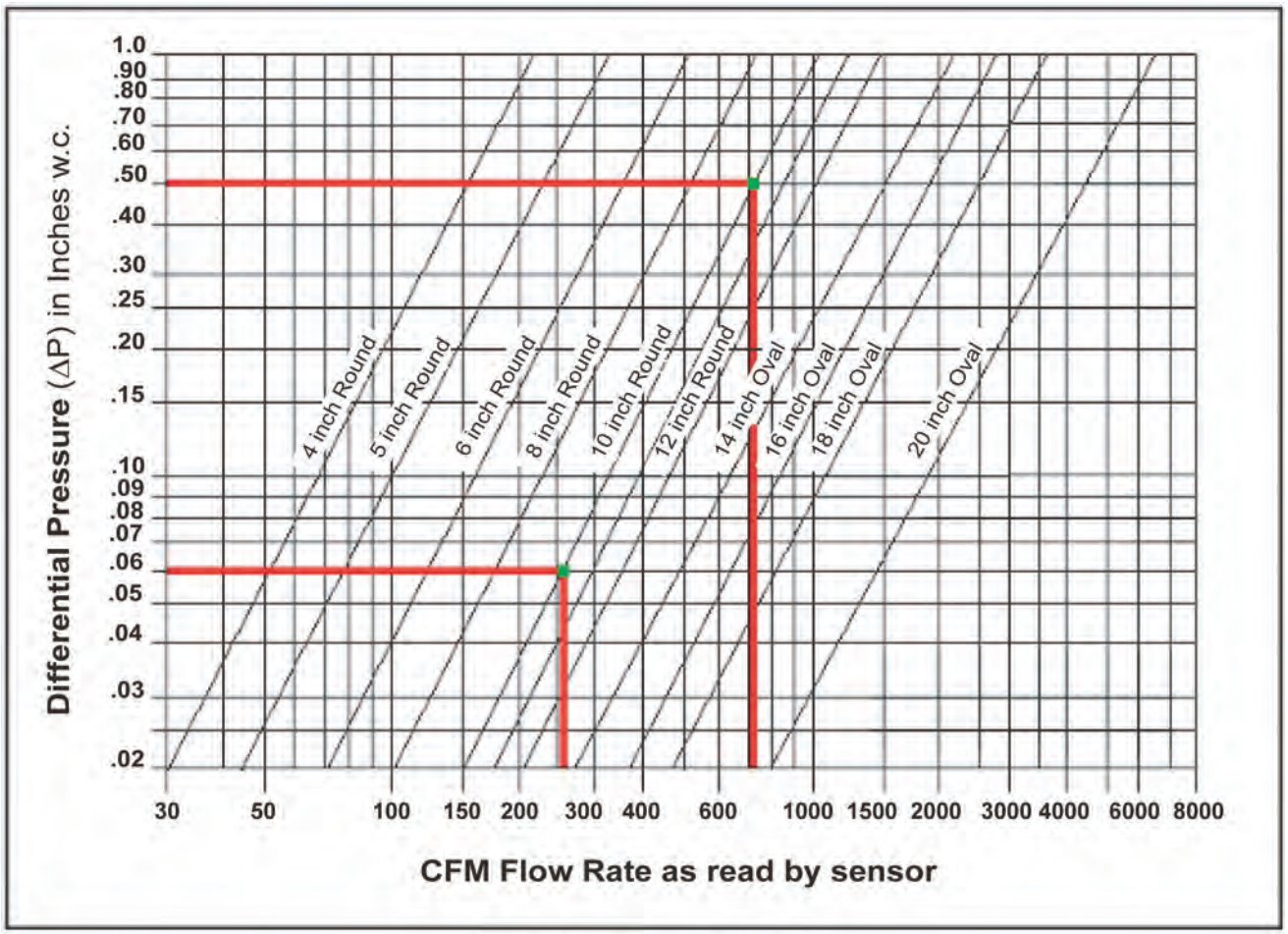
Turning the HI STAT dP knob counterclockwise (to increase) repositions the fulcrum towards the nozzles. HI STAT dP adjustments must be done with the "T" port pressure being greater than the RESET START pressure plus the RESET SPAN pressure.



Magnehelic Gauge to Airflow Rate Chart

This airflow chart is an example of the chart affixed to the VAV box. Each chart is specific for the type of flow sensor located in the inlet side of the VAV box. Read the differential pressure of the Magnehelic gauge, follow the line horizontally until it crosses the diagonal inlet size of box. Read straight down from this intersection to determine the flow rate.

NOTE: This chart is for illustration only! Do not use this chart to obtain your values. It is NOT intended for calibration of your Minimum and Maximum adjustments.



VAV Airflow Rate by Duct Size

C31 SERIES
RESET VOLUME CONTROLLERS

Description and Application

These C31 series reset volume controllers are designed for use on heating or cooling systems with (normally open or normally closed) VAV terminal units and (direct or reverse acting) thermostats.

They are sub-master air velocity controllers. Each is equipped with separate adjustment knobs for minimum and maximum airflow setpoints. Models are available with various reset start points. A master controller, typically a room thermostat, resets the C31 between the minimum and maximum velocity setpoints.

The universal design of the C31 series is intended for new or replacement applications that call for direct or reverse acting reset on normally open or normally closed VAV terminal units.

Models

NOTE: See the Model Selection Chart on the next page.

C31 0 to 1" range

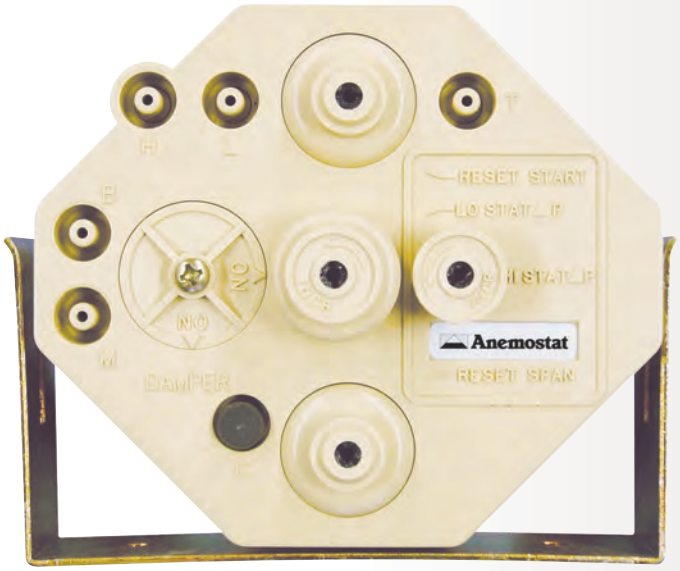
NOTE: These C31 Series controllers are position sensitive. They must be mounted and calibrated in either the horizontal or vertical plane.

FEATURES

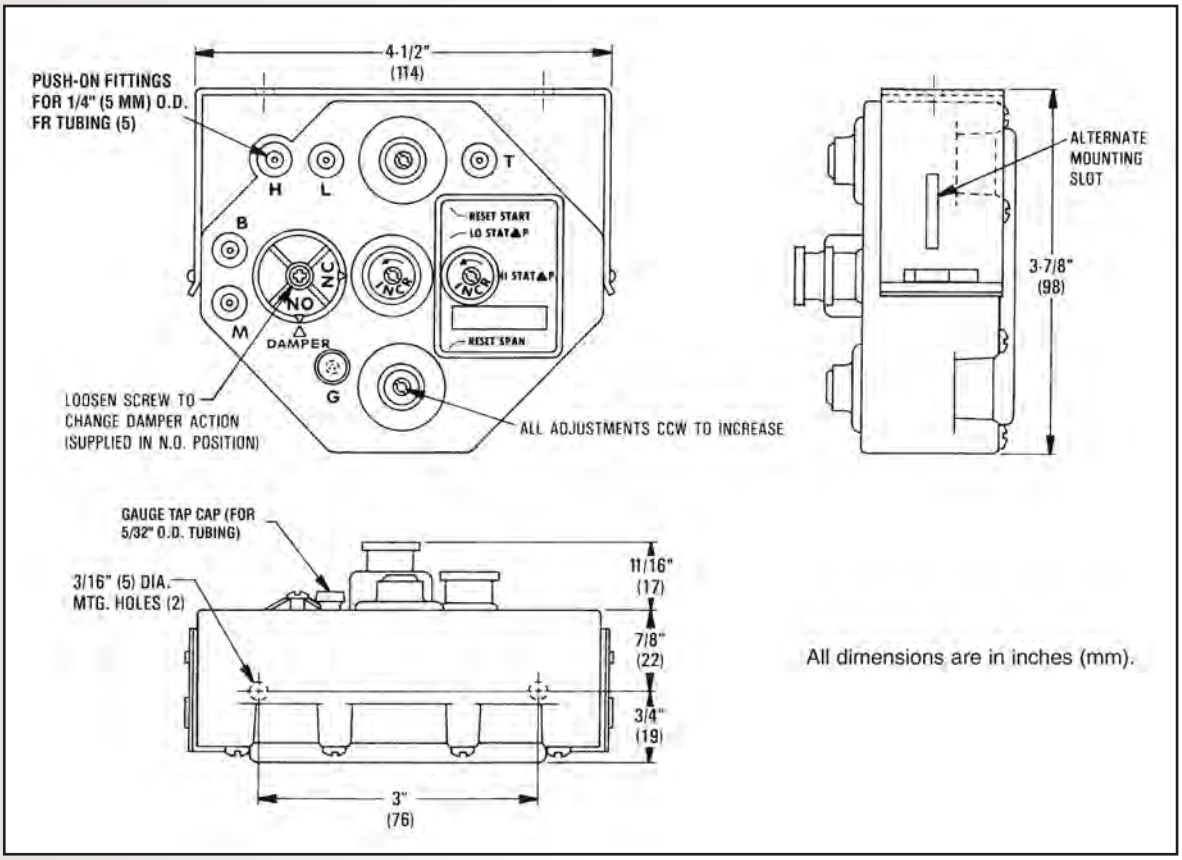
- Adjustable direct or reverse acting reset (normally open or normally closed damper settings)
- Adjustable minimum and maximum setpoints
- Available with factory-set 3, 8, or 10 psig reset start points (field-adjustable 0–10 psig if necessary)
- See the Specifications section for more details

FACTORY CONFIGURED

- All controls are factory calibrated and adjusted as required by the applicable control sequence.



DETAILS



SPECIFICATIONS

Model	Reset Start Point Factory Set (all field-adjustable 0–10 psig)	Differential Pressure	Min. Setpoint	Max. Setpoint	Output Sensitivity	Air Consumption
C31	8 psig (55 kPa)	0 to 1.0" wc (249 Pa)	0 to 1.0" wc (249 Pa)	Min. to 1.0" wc (249 Pa)	5 psi/0.02" wc (35 kPa/5 Pa)	28.8 scim @ 20 psig (7.87 mL/s @ 138 kPa)

Damper Action Factory set, adjustable for NC or NO

Thermostat Action Direct or reverse action

Main Air Pressure 15 to 30 psig (103 to 207 kPa)

Max. Signal Pressure 6" we (1493 Pa) applied to either port (H or L)

Reset Span Factory set @ 5 psig (35 kPa)

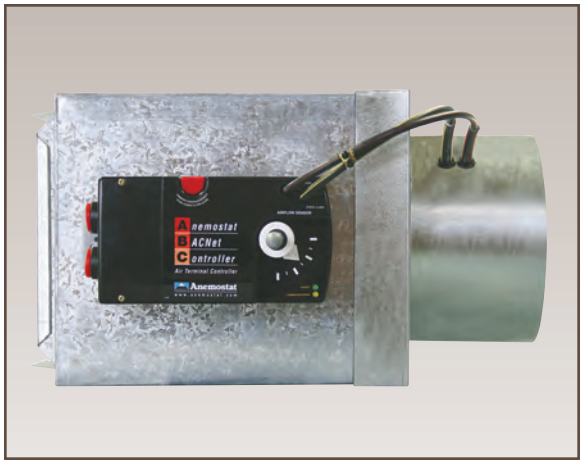
Temperature Limits
Operating 40° to 120° F (4° to 49° C)
Shipping –40° to 140° F (–40° to 60° C)

Material ABS

Weight 11 oz. (312 grams)

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.



DIRECT DIGITAL CONTROLS

Anemostat®
AIR DISTRIBUTION

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DIRECT DIGITAL CONTROLS

The ABC-7001 are native BACnet, direct digital controllers designed for VAV terminal units. An integrated actuator and the supplied programs make these ideal controllers for temperature setback, overrides, proportional reheat and other HVAC sequences. Install these versatile controllers in stand-alone environments or networked to other BACnet devices. As part of a complete facilities management system, the ABC-7001 controllers provide precise monitoring and control of connected points.

- BACnet MS/TP compliant
- Automatically assigns the MAC address and the device instance
- Standard VAV control sequences are incorporated to provide pressure independent control of a single-duct VAV unit.
- On-board airflow sensor for use with a single or multi-point differential pressure measuring station or pitot tube.
- Use to control heating, cooling, cooling with heat change-over, cooling with time proportional reheat or three-stage, sequential reheat.

SPECIFICATIONS

Inputs

Universal inputs	3
Air flow sensor	1
Key features	Universal inputs programmable as analog, binary or accumulator objects. Standard units of measure. Overvoltage input protection
Pull–up resistors	Switch select none or 10kΩ
Connector	Removable screw terminal block, wire size 14–22 AWG
Conversion	10–bit analog–to–digital conversion
Pulse Counting	Up to 16 Hz
Input range	0–5 volts DC
NetSensor	Compatible with models ABC-1161 and ABC-1181.

Outputs

Universal Outputs	3
Key features	Output short protection Universal outputs programmable as analog or binary objects.Standard units of measure
Connector	Removable screw terminal block Wire size 14–22 AWG
Output voltage	0–10 volts DC analog 0–12 volts DC binary
Output current	100 mA per output

Communications

BACnet MS/TP	EIA–485 operating at rates up to 76.8 kilobaud. Automatic baud detection. Automatically assigns MAC addresses and device instance numbers Removable screw terminal block. Wire size 14–22 AWG
NetSensor	Compatible with models ABC-1161 and ABC-1181, Connects through RJ–12 connector.

Programmable features

Control Basic	10 program areas
PID loop objects	4
Value objects	40 analog and 40 binary
Supported objects BACnet objects	See PIC statement for supported

Schedules

	8 schedule objects
	3 calendar object
Trend objects	8 each of which holds 256 samples

Alarms and events

Intrinsic reporting	Supported for input, output, value, accumulator, trend and loop objects.
Notification class objects	8
Memory	Programs and program parameters are stored in nonvolatile memory. Auto restart on power failure
Applications programs	Anemostat supplies the ABC-7001 with programming sequences for VAV applications: • Heating-cooling changeover • VAV with time proportional reheat • VAV with three-stage reheat. • Custom sequences per specification
Air sensor features	Platinum-ceramic flow-through

Actuator specifications

Torque	50 in-lb. (5.7 N•m) minimum 70 in-lb. (7.9 N•m) maximum
Angular rotation	0 to 95° Adjustable end stops at 45/60/90° rotation
Motor timing	18°/minute at 60 Hz 15°/minute at 50 Hz
Shaft size	Fits 0.5 inch (13 mm) round shafts. See Shaft adapters on page 7 for 0.38 inch shafts.
Regulatory	UL 916 Energy Management Equipment FCC Class B, Part 15, Subpart B BACnet Testing Laboratory listed

Installation

Supply voltage	24 volts AC, -15%, +20% 25 VA
Weight	2.4 lb. (1.1 kg)
Case material	Flame retardant green plastic

Environmental limits

Operating	32 to 120°F (0 to 49°C)
Shipping	–40 to 140°F (–40 to 60°C)
Humidity	0–95% relative humidity (non-condensing)

DIMENSIONS

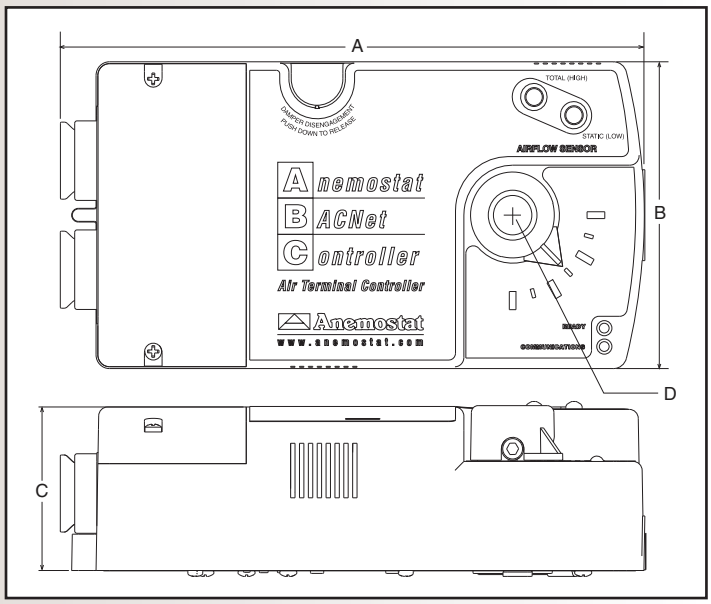


Table 1-1 ABC-7001 Dimensions

A	B	C	D
8.23 in.	4.22 in.	2.25 in.	0.51 in.
209 mm	107 mm	57 mm	13 mm

ACCESSORIES

Shaft adapters

HF0-0011	3/8 inch (9.5 mm) shaft adapter

SAFETY CONSIDERATIONS

Anemostat assumes the responsibility for providing you a safe product and safety guidelines during its use. Safety means protection to all individuals who install, operate, and service the equipment as well as protection of the equipment itself. To promote safety, we use hazard alert labeling in this manual. Follow the associated guidelines to avoid hazards.

Danger

Danger represents the most severe hazard alert. Bodily harm or death will occur if danger guidelines are not followed.

Warning

Warning represents hazards that could result in severe injury or death.

Caution

Caution indicates potential personal injury or equipment or property damage if instructions are not followed.

Note

Notes provide additional information that is important.

Detail

Provides programming tips and shortcuts that may save time.

The ABC-7003 are native BACnet, direct digital controllers designed for VAV terminal units. An integrated actuator and the supplied programs make these ideal controllers for temperature setback, overrides, proportional reheat and other HVAC sequences. Install these versatile controllers in stand-alone environments or networked to other BACnet devices. As part of a complete facilities management system, the ABC-7003 controllers provide precise monitoring and control of connected points.

- BACnet MS/TP compliant
- Automatically assigns the MAC address and the device instance
- Standard VAV control sequences are incorporated to provide pressure independent control of a single-duct VAV unit.
- On-board airflow sensor for use with a single or multi-point differential pressure measuring station or pitot tube.
- Use to control heating, cooling, cooling with heat change-over, cooling with time proportional reheat or three-stage, sequential reheat.

SPECIFICATIONS

Inputs

Universal inputs	3
Air flow sensor	1
Key features	Universal inputs programmable as analog, binary or accumulator objects. Standard units of measure. Overvoltage input protection
Pull–up resistors	Switch select none or 10kΩ
Connector	Removable screw terminal block, wire size 14–22 AWG
Conversion	10–bit analog–to–digital conversion
Pulse Counting	Up to 16 Hz
Input range	0–5 volts DC
NetSensor	Compatible with models ABC-1161 and ABC-1181.

Outputs

Universal Outputs	1
Key features	Output short protection Universal outputs programmable as analog or binary objects. Standard units of measure
Connector Wire size 14–22 AWG	Removable screw terminal block
Output voltage	0–10 volts DC analog 0–12 volts DC binary
Output current	100 mA per output
Outputs, Relay	1
Key features	Maximum switching 30 volts AC at 2 ampere
Connector	Removable screw terminal block Wire size 14–22 AWG
Outputs, Single-stage triac	1
Key features	Optically isolated triac output. Programmable a binary object.
Connector	Removable screw terminal block Wire size 14-22 AWG
Output range	Maximum switching 30 volts AC at 1 ampere

Communications

BACnet MS/TP	EIA–485 operating at rates up to 76.8 kilobaud. Automatic baud detection. Automatically assigns MAC addresses and device instance numbers Removable screw terminal block. Wire size 14–22 AWG
NetSensor	Compatible with models ABC-1161 and ABC-1181, Connects through RJ–12 connector.

Programmable features

Control Basic	10 program areas
PID loop objects	4
Value objects	40 analog and 40 binary
Supported objects	See PIC statement for supported BACnet objects
Schedules	8 schedule objects 3 calendar object
Trend objects	8 each of which holds 256 samples

Alarms and events

Intrinsic reporting	Supported for input, output, value, accumulator, trend and loop objects.
Notification class objects	8
Memory	Programs and program parameters are stored in nonvolatile memory. Auto restart on power failure
Applications programs	Anemostat supplies the ABC-7003 with programming sequences for three single-duct VAV applications: • Heating-cooling changeover • VAV with time proportional reheat • VAV with three-stage reheat. • Custom sequences per specification
Air sensor features	Platinum-ceramic flow-through

Actuator specifications

Torque	50 in-lb. (5.7 N•m) minimum 70 in-lb. (7.9 N•m) maximum
Angular rotation	0 to 95° Adjustable end stops at 45/60/90° rotation
Motor timing	18°/minute at 60 Hz 15°/minute at 50 Hz
Shaft size	Fits 0.5 inch (13 mm) round shafts. See Shaft adapters on page 7 for 0.38 inch shafts.

Regulatory	UL 916 Energy Management Equipment FCC Class B, Part 15, Subpart B BACnet Testing Laboratory listed
Installation	
Supply voltage	24 volts AC, -15%, +20% 25 VA Weight 2.4 lb. (1.1 kg)
Case material	Flame retardant green plastic
Environmental limits	
Operating	32 to 120°F (0 to 49°C)
Shipping	–40 to 140°F (–40 to 60°C)
Humidity	0–95% relative humidity (non-condensing)

DIMENSIONS

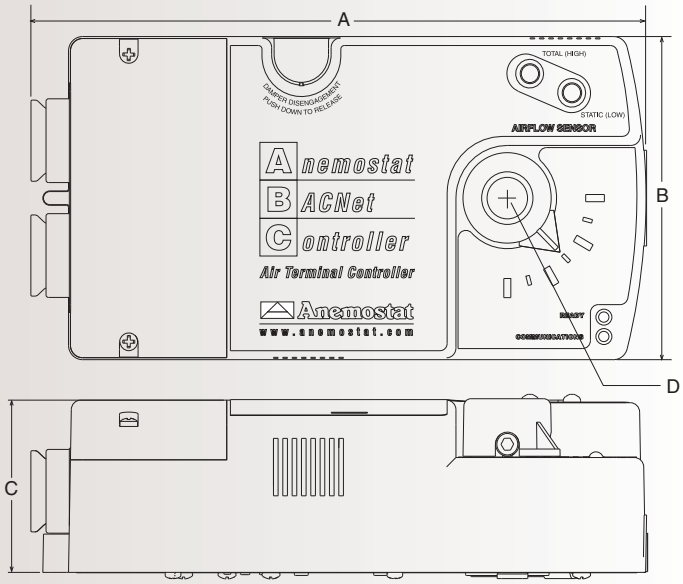


Table 1-2 ABC-7003 Dimensions

A	B	C	D
8.23 in.	4.22 in.	2.25 in.	0.51 in.
209 mm	107 mm	57 mm	13 mm

ACCESSORIES

Shaft adapters

HF0-0011	3/8 inch (9.5 mm) shaft adapter

SAFETY CONSIDERATIONS

Anemostat assumes the responsibility for providing you a safe product and safety guidelines during its use. Safety means protection to all individuals who install, operate, and service the equipment as well as protection of the equipment itself. To promote safety, we use hazard alert labeling in this manual. Follow the associated guidelines to avoid hazards.

Danger

Danger represents the most severe hazard alert. Bodily harm or death will occur if danger guidelines are not followed.

Warning

Warning represents hazards that could result in severe injury or death.

Caution

Caution indicates potential personal injury or equipment or property damage if instructions are not followed.

Note

Notes provide additional information that is important.

Detail

Provides programming tips and shortcuts that may save time.

INSTALLING THE CONTROLLER

This section provides important instructions and guidelines for installing the controller. Carefully review this information prior to attempting installation.

Set the rotation limits

Note

Before mounting the controller, set the rotational limits with two supplied stop pins. These settings limit the shaft rotation in the clockwise (CW) and counterclockwise (CCW) directions. (See Illustration 2-1.)

Caution

Before setting the rotation limits on the controller, refer to the damper position specifications in the VAV control box to which the controller will be attached. Setting rotation limits that do not match the VAV damper may result in improper operation or equipment damage.

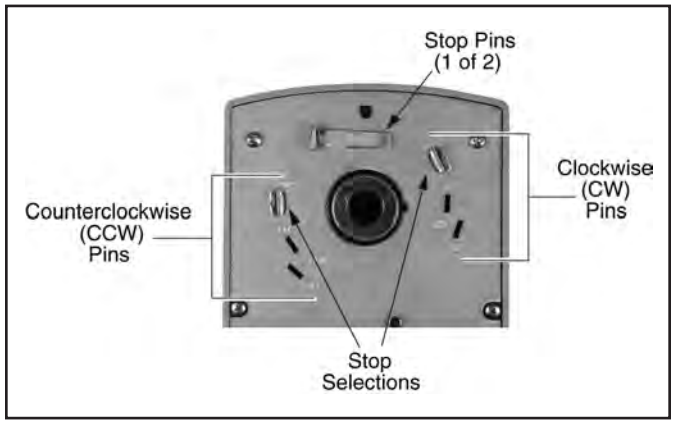


Illustration 2-1 Controller stop selections

To set the rotational limits:

1. Turn the controller over so you have access to the back.
2. Locate the two stop pins installed in the back of the unit. (You will find one pin in a CCW setting and one in a CW setting.)
3. Identify the limits for the VAV damper.

The maximum amount of shaft rotation is 90°. Placing a stop pin in both 90° slots allows the actuator the full 90° of travel. Placing a stop pin in any other slot restricts actuator motion in the indicated direction (CW or CCW). Refer to Illustration 2-2 for pin placement and travel. The first number represents the CCW pin and the second the CW pin (CCW/CW).

Caution

Both stop pins must be installed to prevent actuator damage.

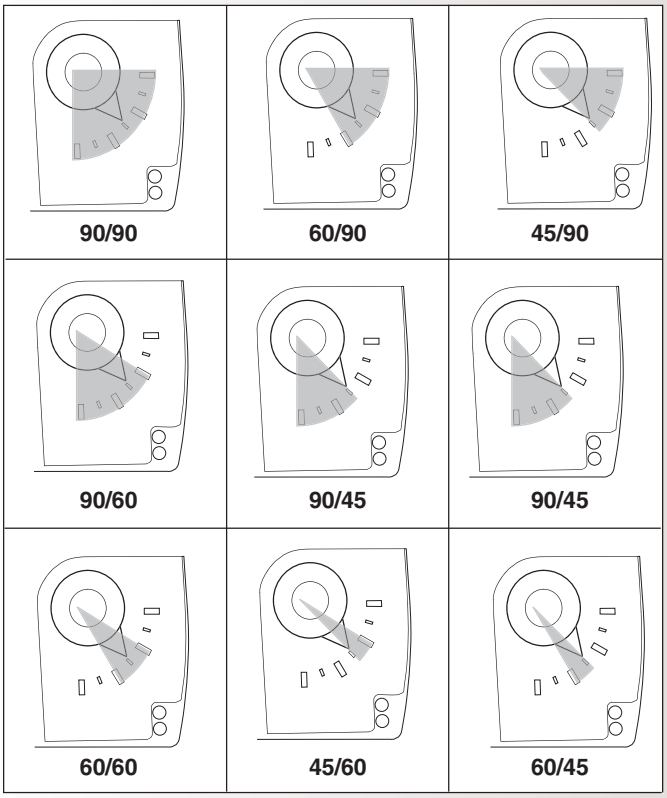


Illustration 2-2 Controller travel and stop selections

4. If the stop pins are positioned as required, you may leave them in place. If not, remove the appropriate pin(s) and place it in the correct slot.

MOUNTING

Mount the controller inside of a metal enclosure. To maintain RF emissions specifications, use either shielded connecting cables or enclose all cables in conduit.

Mount the controller directly over the damper shaft. A minimum shaft length of 1.75 inch (45 mm) is required. The base of the controller must contact the mounting surface to allow installation of a bracket to prevent the controller from rotating.

Note

Mount the controller close enough to the pitot tubes to keep the tubing length to be less than 24 inches between the controller's inputs and the tubes.

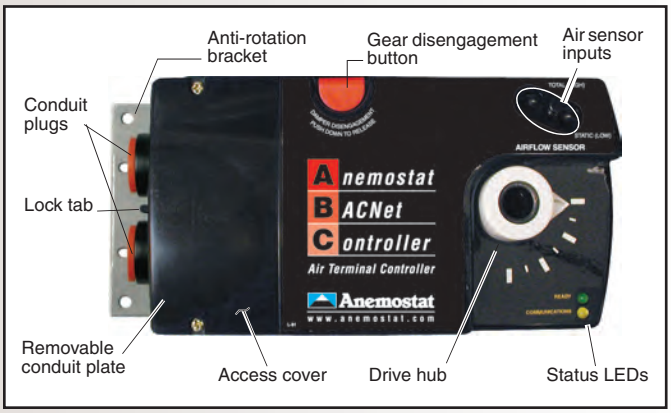


Illustration 2-3 (controls and indicators)

Mount the controller as follows:

1. Back the set screws out of the drive hub until the shaft can fit through the collar.

2. Place the controller on the damper shaft in the approximate final position.

3. Position the anti-rotation bracket and secure it using #8 or #10 self-tapping screws. Verify the notch in the bracket securely engages the lock tab on the controller. (Refer to Illustration 2-3.)

4. Manually position the damper in the full open position.

5. Adjust the drive hub as follows:

   a. If the damper rotates counter clockwise to close, depress the gear disengagement button and rotate the drive hub to the full clockwise position then release the button.

   b. If the damper rotates clockwise to close, depress the gear disengagement button and rotate the drive hub to the full counter clockwise position then release the button.

6. Tighten the two set screws in the drive hub to approximately 50–inch pounds (5.65 N•m) to lock the hub to the shaft.

WIRING COMPARTMENT

The controller comes with a removable conduit plate. The plate provides two 0.5 inch female threaded conduit couplings. If conduit is to be used, note the following:

- The conduit plate may be removed by removing the two screws that secure the access cover and removing the cover. Connect the required conduit and replace the plate in the controller housing.
- The plugs may also be sliced to allow wiring to enter the controller with a minimum of outside contaminates.

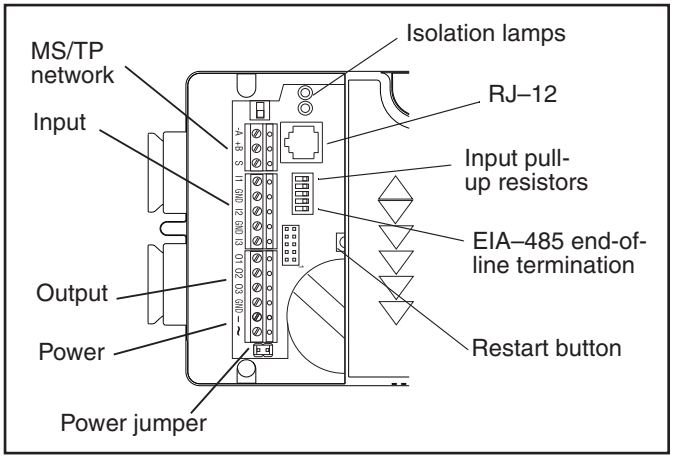


*Illustration 2-4a **ABC-7001** Connection points inside wiring compartment*

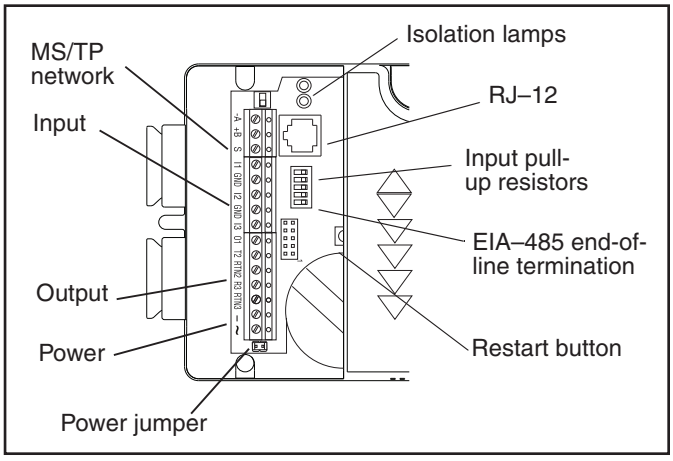


*Illustration 2-4b **ABC-7003** Connection points inside wiring compartment*

All input, output, power and network connections are made using the connectors beneath the access cover. Remove the two screws that secure this cover to remove the cover.

CONNECTING INPUTS

The ABC-7003 controller has three universal inputs. Each input can be configured to receive either analog or digital signals. By using the pull-up resistors, either passive or active devices may be connected to the inputs.

Note

Control Basic programs assigns input 1 (I1) to the space temperature sensor input. If the programs are not used or are modified, input 1 is available for other use.

Pull–up resistors

For passive input signals, such as thermistors or switch contacts, use a pull-up resistor. For thermistors and most other applications set the switch to the On position. See Illustration 2-5 for the pull-up switch location.

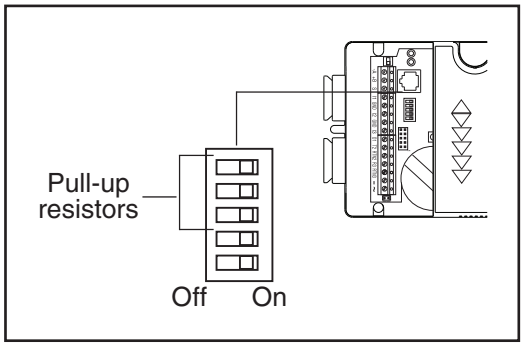


Illustration 2-5 Pull-up resistors

4–20 mA inputs

To use a 4–20 current loop input, connect a 250 ohm resistor from an input to ground. The resistor will convert the current input to a voltage which can be read by the controller analog-to-digital converter. Set the pull-up switch to the Off position.

Ground terminals

Input ground terminals are located next to the input terminals. Up to two wires, size 14–22 AWG, can be clamped into each ground terminal. If more than two wires must be joined at a common point, use an external terminal strip to accommodate the additional wires.

Pulse inputs

Connect pulse inputs under the following conditions:

- If the pulse input is a passive input such as switch contacts, then place the input pull-up in the On position.
- If the pulse is an active voltage (up to a maximum of +5 volts DC), then place the input pull-up switch in the Off position.

CONNECTING OUTPUTS

ABC-7001 provides three universal outputs. Returns are connected to the GND terminal next to output 03. (Refer to Illustration 2-6)

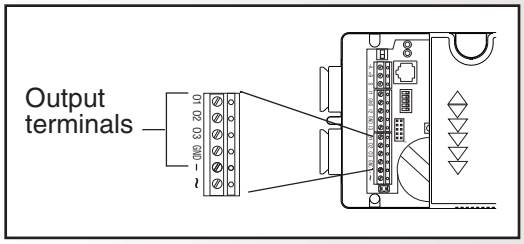


*Illustration 2-6a **ABC-7001** Output terminals*

The ABC-7003 includes one single-stage triac, one relay and one universal output. The triac output is rated for 24 volt, 1 ampere loads, switch on zero crossing and are optically isolated. The relay contacts are rated for 24-volts at 2 amperes.

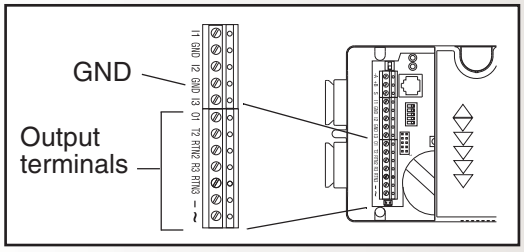


*Illustration 2-6b **ABC-7003** Output terminals*

Caution

When connecting loads to the triac or relay output, use only the terminal marked RTN associated with the triac or relay for the 24-volt circuit.

Output 1 This output is a universal output that can be programmed as either an analog or digital object. Use the GND termination the input connector block for the ground.

Output 2 This is a triac which can be programmed to switch valve actuators or 24-volt reheat circuits.

Output 3 This normally open relay contact is typically programmed to control a 24-volt fan starting circuit.

Output 4 Output 4 is internally connected to the actuator motor.

CONNECTING TO A NETSENSOR

The Network RJ–12 connector provides a connection port to a NetSensor model ABC-1161 or ABC-1181. Link the controller to a NetSensor with an approved cable up to 75 feet long. See the installation guide supplied with the NetSensor for complete NetSensor installation instructions.

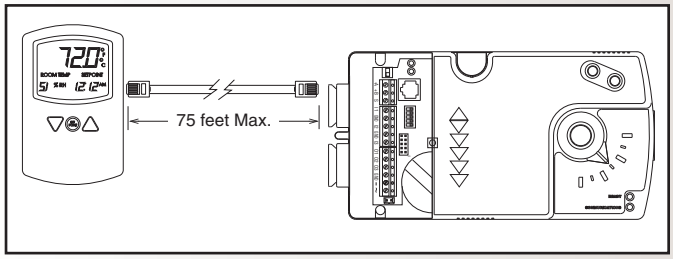


Illustration 2-7 Connecting to a NetSensor

CONNECTING TO AN MS/TP NETWORK

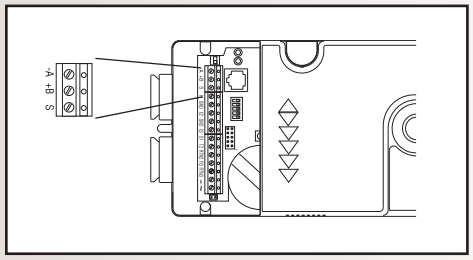


Illustration 2-8 MS/TP network connection

Connections and wiring

Use the following principles when connecting a controller to an MS/TP network:

- Connect no more than 128 addressable BACnet devices to one MS/TP network. The devices can be any mix of controllers or routers.
- To prevent network traffic bottlenecks, limit the MS/TP network size to 60 controllers.
- Use 18 gauge, twisted pair, shielded cable with capacitance of no more than 50 picofarads per foot for all network wiring. Belden cable model #82760 meets the cable requirements.
- Connect the -A terminal in parallel with all other - terminals.
- Connect the +B terminal in parallel with all other + terminals.
- Connect the shields of the cable together at each controller. For BACnet controllers use the S terminal.
- Connect the shield to an earth ground at one end only.
- Use a ABC–5575 repeater between every 32 MS/TP devices or if the cable length will exceed 4000 feet (1220 meters). Use no more than seven repeaters per MS/TP network.
- Place a ABC–5567 surge suppressor in the cable where it exits a building.

See Application Note, *Planning BACnet Networks* for additional information about installing controllers.

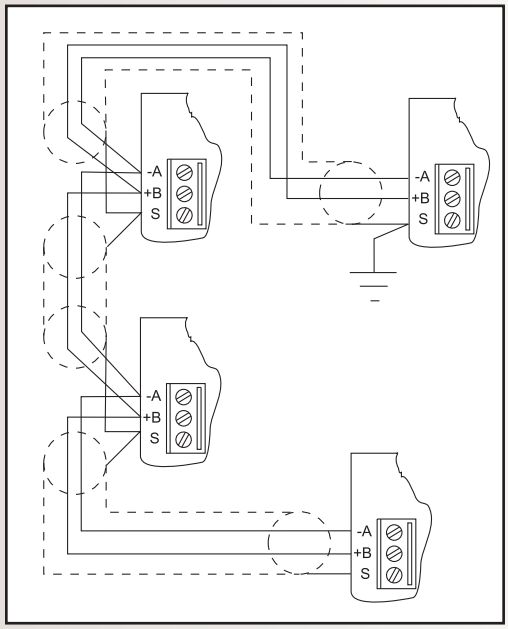


Illustration 2-9 MS/TP network wiring

Note

The MS/TP terminals are labeled -A,+B and S. The S terminal is provided as a connecting point for the shield. The terminal is not connected to the ground of the controller. When connecting to controllers from other manufacturers, verify the shield connection is not connected to ground.

End of line termination switches

The controllers on the physical ends of the EIA-485 wiring segment must have end-of-line termination installed for proper network operation. Set the end-of-line termination to On using the EOL switches.

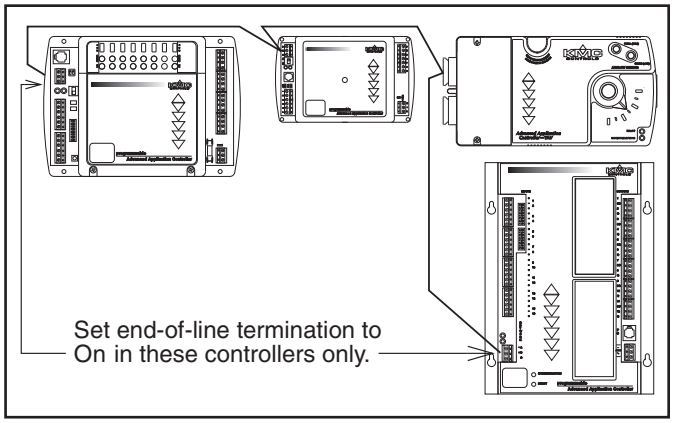


Illustration 2-10 End of line termination

Illustration 2-11 shows the position of the End-of-Line switches associated with the MS/TP inputs.

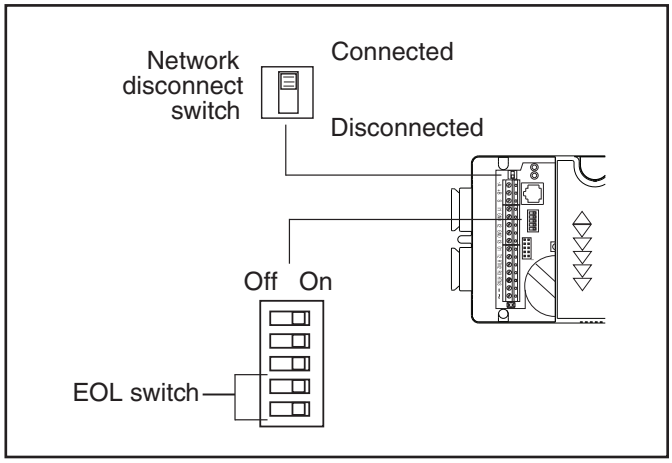


Illustration 2-11 Location of EOL Switch

CONNECTING AN AIRFLOW SENSOR

An airflow sensor is incorporated as one of the inputs to the controller. Remove the plugs and connect the tubing from the pitot assembly to the airflow sensor inputs above the drive hub. (See Illustration 2-12.). The airflow sensor is programmed as input 4.

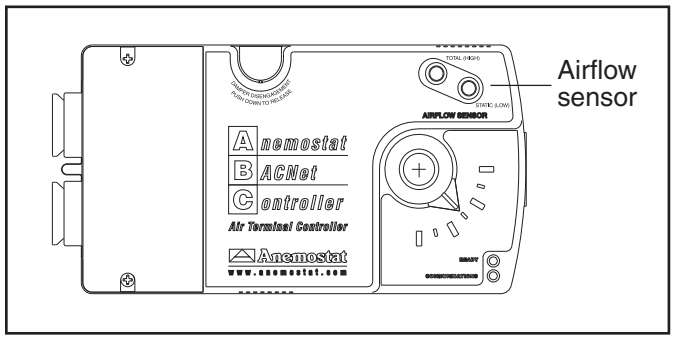


Illustration 2-12 Airflow sensor inputs

Note

Mount the controller close enough to the pitot tubes to keep the tubing length to be less than 24 inches between the controller's inputs and the tubes.

CONNECTING POWER

The controllers require an external, 24 volt, AC power source. Use the following guidelines when choosing and wiring transformers.

- Use a Class–2 transformer of the appropriate size to supply power to the controllers. Anemostat recommends powering only one controller from each transformer.
- When installing a controller in a system with other controllers, you may power multiple controllers with a single transformer as long as the total power drawn from the transformer does not exceed its rating and phasing is correct.
- If several controllers are mounted in the same cabinet, you can share a transformer between them provided the transformer does not exceed 100 VA or other regulatory requirements.
- Do not run 24 volt, AC power from within an enclosure to external controllers.

Connect the 24 volt AC power supply to the power terminal block on the lower right side of the controller near the power jumper. Connect the ground side of the transformer to the – or GND terminal and the AC phase to the ~(phase) terminal. Power is applied to the controller when the transformer is plugged in and the power jumper is in place.

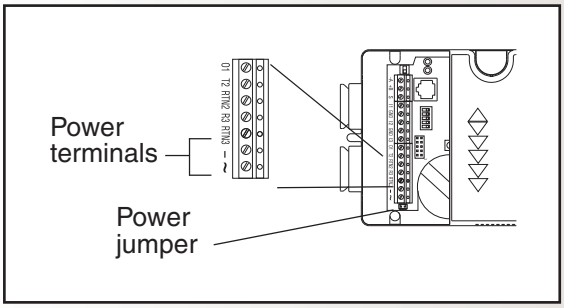


Illustration 2-13 Power terminals and jumper

Note

Typical Application Diagrams may be obtained by contacting Anemostat Engineering or from the Anemostat web site.

PROGRAMMING

Network configuration

For more information on installing, configuring, and programming HVAC system controllers, see the following documents available on the Anemostat web site:

- BACkstage User's Guide to Installation and Getting Started
- ABC-5000 Reference Guide
- TotalControl Reference Guide
- Application Note Planning BACnet Networks
- MS/TP Automatic MAC Addressing Installation Instructions

Supplied applications programming ABC-7001

Refer to the Digital Applications Manual for information on using the applications programs included with the controller, generally:

- Inputs 1-3 are programmed as universal inputs.
- If using the supplied applications program, input 1 is assigned as the space temperature input.
- Input 4 is the dedicated to the airflow sensor.
- Outputs 1-3 may be programmed as universal outputs.
- Output 4 is dedicated to the actuator motor.
- Anemostat factory programs each controller and I/O assignments may be different.

Supplied applications programming ABC-7003

Refer to the Digital Applications Manual for information on using the applications programs included with the controller, generally:

- Inputs 1-3 are programmed as universal inputs.
- If using the supplied applications program, input 1 is assigned as the space temperature input.
- Input 4 is the dedicated to the airflow sensor.
- Outputs 1 may be programmed as universal output.
- Outputs 2 and 3 may be programmed to switch 24-volt circuits.
- Output 4 is dedicated to the actuator motor.
- Anemostat factory programs each controller and I/O assignments may be different.

Programming drive time

- When programming the controller to open and close a damper, use the data in Table 2-1 to calculate drive time.

Table 2-1 Drive Time in Seconds

Rotation in degrees	Seconds
90	300
60	200
45	150

OPERATION

Once configured, programmed and powered, the controller requires very little user intervention.

CONTROLS AND INDICATORS

The following topics describe the controls and indicators found on the controller. Additional information for automatic addressing functions are described in the guide MS/TP Automatic MAC Addressing Installation Instructions that is available from the Anemostat web site.

Network disconnect switch

The network ON/OFF switch is located near the RJ–12 connector. Use this switch to enable or disable the EIA–485 network connection. When the switch is ON the controller can communicate on the network; when it is OFF, the controller is isolated from the network.

Alternately, you may remove the isolation bulbs to isolate the controller from the network.

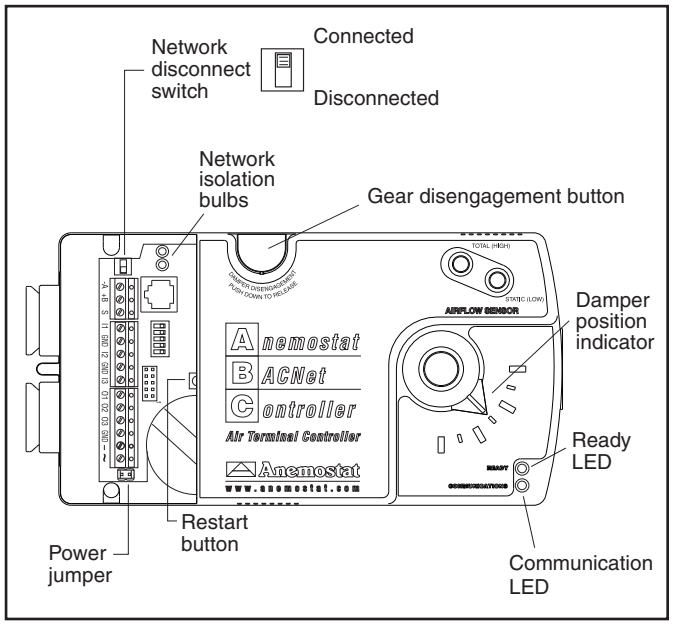


Illustration 3-1 Controls and indicators

Ready LED

The green Ready LED indicates the state of the controller. This includes automatic addressing functions that are fully described in the guide MS/TP Addressing For BACnet Controllers.

Power up During controller initialization, the Ready LED is continuously illuminated for 5 to 20 seconds. Once initialization is complete, the Ready LED begins flashing to indicate normal operation.

Normal operation During normal operation, the Ready LED flashes a repeating pattern of one second on and then one second off.

Restart button acknowledge The restart button includes several functions for automatic addressing that are acknowledged with the Ready LED. When the restart button is pressed, the Ready LED illuminates continuously until either of the following take place:

- The restart button is released.
- The restart button time-out period is reached and a restart operation is complete. Restart button operations are listed in the following table.

Table 3-1 Ready LED patterns for restart button operations

Controller state	*LED pattern*
The controller is set as an automatic addressing anchor. The MAC in the controller is set to 3	A rapid repeating pattern of a short flash followed by a short pause.
The controller has sent the automatic addressing lock command to the network	Two short flashes followed by a long pause. The pattern repeats until the restart button is released.
No restart operation	Ready LED remains unlit until the restart button is released.

Communications (Com) LED

The yellow Communications LED indicates how the controller is communicating with other controllers on the network.

Sole master Repeating pattern of a long flash and a short pause that repeats once a second. It indicates that the controller has either generated the token or is a sole MS/TP master and has yet to establish communications with other MS/TP devices.

Token passing A short flash each time the token is passed. The frequency of the flash is an indication of how often the device receives the token.

Nomad patterns There are three Com LED patterns that indicate that the controller is an automatic addressing nomad controller that is receiving valid MS/TP traffic.

Table 3-2 Automatic addressing nomad patterns

Controller state	*LED pattern*
Lost nomad	A long flash
Wandering nomad	A long flash followed by three short flashes
Assigned nomad	Three short flashes followed by a long pause.

Error conditions for the LEDs

The two isolation bulbs, located next to the network switch, serve three functions:

- Removing the lamps opens the EIA-485 circuit and isolates the controller from the network.
- If one or both lamps are lit, it indicates the network is improperly phased. This means that the ground potential of the controller is not the same as other controllers on the network.
- If the voltage or current on the network exceeds safe levels, the lamps operate as fuses and may protect the controller from damage.

Isolation bulbs

The two isolation bulbs, located next to the network switch, serve three functions:

- Removing the lamps opens the EIA-485 circuit and isolates the controller from the network.
- If one or both lamps are lit, it indicates the network is improperly phased. This means that the ground potential of the controller is not the same as other controllers on the network.
- If the voltage or current on the network exceeds safe levels, the lamps operate as fuses and may protect the controller from damage.

Gear disengagement button

Depress the gear disengagement button to manually position the damper.

RESTORING FACTORY SETTINGS

If the controller appears to be operating incorrectly, or is not responding to commands, you may need to reset the controller. Remove the cover and locate the red restart button.

To perform a reset or restart, locate the red restart push-button and then—in order—use one of the following procedures.

1. A warm start is the option least disruptive to the network and should be tried first.
2. If problems persist, then try a cold start.
3. If the problems continues, restoring the controller to factory settings may be required.

Caution

Read all of the information in this section before proceeding!

Note

Momentarily pushing the red reset button while the controller remains powered will have no effect on the controller.

Performing a warm start

A warm start changes the controller as follows:

- Restarts the controller's Control Basic programs.
- Leaves object values, configuration, and programming intact.

Caution

In the unlikely event that the checksum test in RAM fails during the warm start, the controller will automatically perform a cold start. During a cold start, controller outputs may abruptly turn connected equipment on and off. To prevent equipment damage, turn connected equipment off or temporarily remove the output terminal blocks from the controller before performing a warm start.

Do either of the following to perform a warm start:

- Reinitialize the controller with either BACkstage or TotalControl Design Studio.
- Remove the power jumper for a few seconds and then replace it.

Performing a cold start

Performing a cold start changes the controller as follows:

- Restarts the controller programs.
- Returns all object states to their initial factory settings until the controller programs update them.
- Leaves configuration and programming intact.

Caution

Returning object values to their relinquished defaults during a cold start may abruptly turn connected equipment on or off. To prevent equipment damage, turn connected equipment off or temporarily remove the output terminal blocks from the controller before performing a warm start.

To perform a cold start:

1. While the controller is powered, press and hold the restart button.
2. Remove the power jumper.
3. Release the red button before replacing the power jumper.

Note

A cold start performed by this method is the same as performing a cold start with BACkstage or from TotalControl Design Studio.

Restoring to factory settings

Restoring a controller to factory settings changes the controller as follows:

- Removes all programming.
- Removes all configuration settings.
- Restores the controller to factory default settings.

Caution

Resetting the controller erases all configuration and programming. After resetting to factory settings, you must configure and program the controller to establish normal communications and operation.

To reset the controller to factory settings.

1. If possible, use BACkstage or TotalControl Design Studio to backup the controller.
2. Remove the power jumper.
3. Press and hold the red restart button.
4. Replace the power jumper while continuing to hold the restart button.
5. Restore configuration and programming with BACkstage or TotalControl Design Studio.

DESCRIPTION

An ABC-1161A NetSensor® is a wall-mounted, temperature-sensing, programmable operator interface for use in a Anemostat direct digital controls system. The NetSensor allows easy, direct communication with the connected controller via a local access port.

The NetSensor includes nine function keys, seven of which are programmable. The simple and functional design combined with its programmable functions allows for a wide variety of key assignments.

FEATURES

These NetSensors provide the following features:

- Large, four-character LCD display for easy temperature viewing, plus smaller characters for time.
- Setpoint and up/down arrow buttons accessible through cover. Six additional function buttons behind the flip-open cover.
- Seven buttons may be programmed with the controller to display or control the state of any pointinthe attached controller.
- Four-pin EIA-485 (formerly RS-485) data port on the underside for easy temporary computer connection to the controller.

MODELS

- ABC-1161A Almond

ACCESSORIES

The following accessories and parts are available:

- HM0-1161 4 x 4 inch backplate, almond
- HP0-1161 Gasket
- HP0-0044 Replacement Allen screws (10)
- ABC-5690 25-foot plenum cable with connector
- ABC-5691 50-foot plenum cable with connector
- ABC-5692 75-foot plenum cable with connector

Model ABC-1161A NetSensor

SPECIFICATIONS

Display

Temperature continuously updated on 0.38-inch, four-character, liquid crystal display. Time is simultaneously updated and displayed on a smaller display.

Temperature Sensor

Type	Thermistor
Accuracy	±0.36° F (±0.2° C)
Resistance	10,000 Ω at 77° F (25° C)
Operating Range	48 to 96° F (8.8 to 35.5° C)

Controller Connection

Connector type
Six-wire modular RJ-12 jack.

Cable type and maximum length
Connect with cable not longer than 75 feet (22.9 meters) and conductors no smaller than #24 AWG. Anemostat plenum rated cable is recommended (see Accessories section).

Power

5 volts DC supplied from controller.

Environmental Limits

Operating	34 to 125° F (1.1 to 51.6° C)
Humidity	0 to 95% RH, non-condensing
Shipping	–40 to 140° F (–40 to 60° C)

Weight

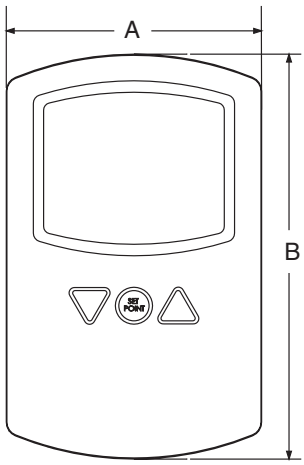
2.8 ounces (80 grams).

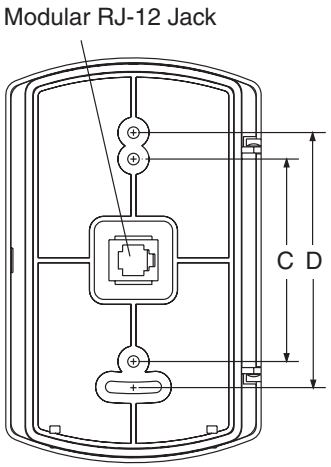
Material

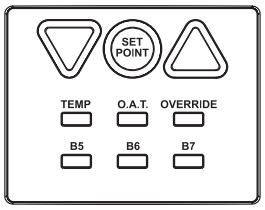
Light Almond ABS, UL Flame Class 94HB.

Mounting

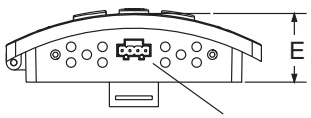
Backplate mounts to 2 x 4 inch vertical standard handy-box. The NetSensor is secured by two concealed Allen screws.







ABC-1161 Buttons



EIA-485 Data Port

A	B	C	D	E
3.25 in.	5.16 in.	2.58 in.	3.25 in.	0.87 in.
83 mm	116 mm	66 mm	83 mm	22 mm

DESCRIPTION

An ABC-1181A NetSensor® is a wall-mounted, temperature and humidity sensing, programmable operator interface for use in a Anemostat direct digital controls system. The NetSensor allows easy, direct communication with the connected controller via a local access port.

The NetSensor includes nine function keys, seven of which are programmable. The simple and functional design combined with its programmable functions allows for a wide variety of key assignments.

FEATURES

These NetSensors provide the following features:

- Large, four-character LCD display for easy temperature viewing, plus smaller characters for time and relative humidity.
- Setpoint and up/down arrow buttons accessible through cover. Six additional function buttons behind the flip-open cover.
- Seven buttons may be programmed with the controller to display or control the state of any pointinthe attached controller.
- Four-pin EIA-485 (formerly RS-485) data port on the underside for easy temporary computer connection to the controller.

MODELS

- ABC-1181A Almond

ACCESSORIES

The following accessories and parts are available:

- HMO-1161 4 x 4 inch backplate, almond
- HPO-1161 Gasket
- HPO-0044 Replacement Allen screws (10)
- ABC-5690 25-foot plenum cable with connector
- ABC-5691 50-foot plenum cable with connector
- ABC-5692 75-foot plenum cable with connector

Model ABC-1181A NetSensor

SPECIFICATIONS

Display

Temperature continuously updated on 0.38-inch, four-character, liquid crystal display. Time and relative humidity are simultaneously updated and displayed on a smaller display.

Temperature Sensor

Type	CMOS
Accuracy	±0.9°Fo?set(±0.5°C) from 40° to 104° F (4.4° to 40° C)
Resolution	±0.1°F (±0.1° C)
Operating Range	36 to 120° F (2.2 to 48.8° C)
Response Time	5 to 30 seconds

Humidity Sensor

Type	CMOS
Humidity	0 to 100% RH
Accuracy @ 25°C	± 2% RH (10 to 90% RH)
Response Time	Less than or equal to 4 seconds

Controller Connection

Connector type
Six-wire modular RJ-12 jack.

Cable type and maximum length
Connect with cable not longer than 75 feet (22.9 meters) and conductors no smaller than #24 AWG. Anemostat plenum rated cable is recommended (see Accessories section).

Power

5 volts DC supplied from controller.

Environmental Limits

Operating	34 to 125° F (1.1 to 51.6° C)
Humidity	0 to 95% RH, non-condensing
Shipping	–40 to 140° F (–40 to 60° C)

Weight

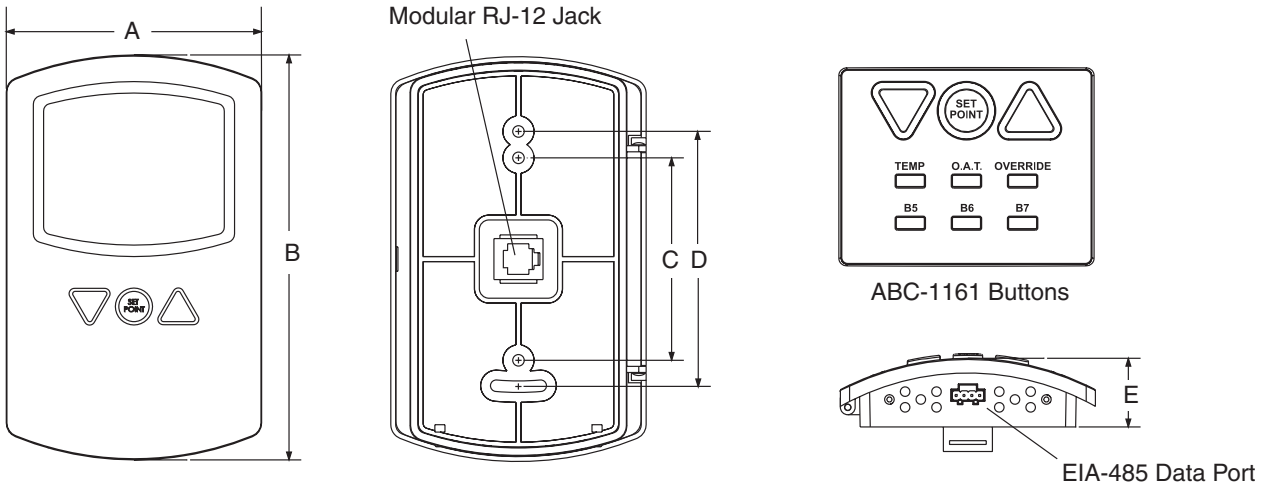
2.8 ounces (80 grams).

Material

Light Almond ABS, UL Flame Class 94HB.

Mounting

Backplate mounts to 2 x 4 inch vertical standard handy-box. The NetSensor is secured by two concealed Allen screws.



A	B	C	D	E
3.25 in.	5.16 in.	2.58 in.	3.25 in.	0.87 in.
83 mm	116 mm	66 mm	83 mm	22 mm

BALANCING VAV BOXES WITH ABC-1161A/1181A NETSENSOR

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. BACkstage 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.
- BACkstage 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.

Model ABC-1181 NetSensor

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.

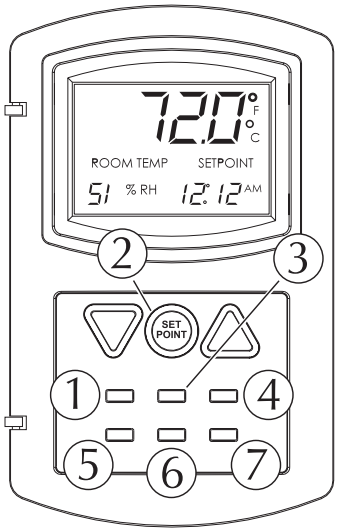
Button	Descriptor	Analog Value	Function
1	SPACE-TEMP	AV1	***Space Temperature (NetSensor)*** Displays the temperature detected by the NetSensor. This value is not used in the balancing routine.
2	ACTIVESP	AV26	***Active Setpoint*** **Normal Mode:** With Program 4 (BV29) is *"OFF"* this button shows the 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.

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

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 .



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.

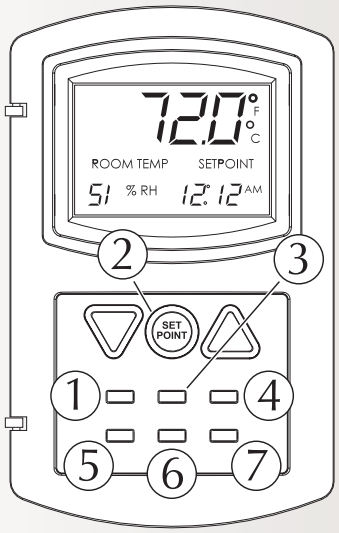
Minimum Flow Balancing

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.



DESCRIPTION

The SimplyVAV series of controllers are an easy and unique approach to operating a wide variety of VAV terminal units. The integrated actuators, internal airflow sensors, and wide variety of application programs make these BACnet Application Specific controllers ideal for either new or retrofit installations.

Easy to install Just mount the controller, wire it to a 24 volt transformer, and then connect airflow and temperature sensors. A SimplyVAV controller automatically detects sensors as they are connected without special programming or software tools.

Simple, menu driven setup The controllers feature simple, menu driven setup choices. No special programming skills or software tools are required to choose applications, enter setpoints, set network addressing, and balance airflow. All options can be set by using only an STE-8001 sensor which can be installed as the permanent room sensor or temporarily connected as a technician's service tool.

New or retrofit application The SimplyVAV controllers are ideal for new installations or upgrades of older, less efficient controller.

- Staged, modulated, floating, or time proportional reheat
- Series or parallel fan control
- Single or dual duct application

Native BACnet All models are BACnet Application Specific Controllers that are ready to connect to aBACnet MS/TP network. Device instance, MAC address, and baud rate are set from an STE-8001 without special software.

Easy system integration For SimplyVAV installations that are part of a BACnet building automation system, the controllers provide system diagnostic indicators. Through the MS/TP network, the controllers signal demands for higher static duct pressure, cooler or warmer supply air, and when to start air handler units.

SPECIFICATIONS

Inputs and outputs

All inputs and outputs for SimplyVAV controllers are set up at the factory and do not require field programming.

Inputs

- Sensors are automatically detected
- Inputs accept industry-standard 10K ohm thermistors sensors.
- Input over voltage protection up to 24 volts AC, continuous.
- 12-bit analog-to-digital conversion

Triac outputs

- Optically isolated triac output.
- Maximum switching 24 volts AC at 1.0 ampere for each output
- Maximum for controller is 3.0 amperes.

Analog outputs

- Short-circuit protected
- Output voltage 0–10 volts DC
- 30 mA per output, 30 mA total for all analog outputs
- 12–bit digital-to-analog conversion

Air flow sensor features

CMOS differential pressure 0-2 inches of water (0-500 Pa) measurement range. Internally linearized and temperature compensated.

- Configured as BACnet analog input object
- Span accuracy 4.5% of reading.
- Zero point accuracy 0.0008 in. H20/0.2 Pa at 25° C
- Barbed connections for 1/4 inch FR tubing.

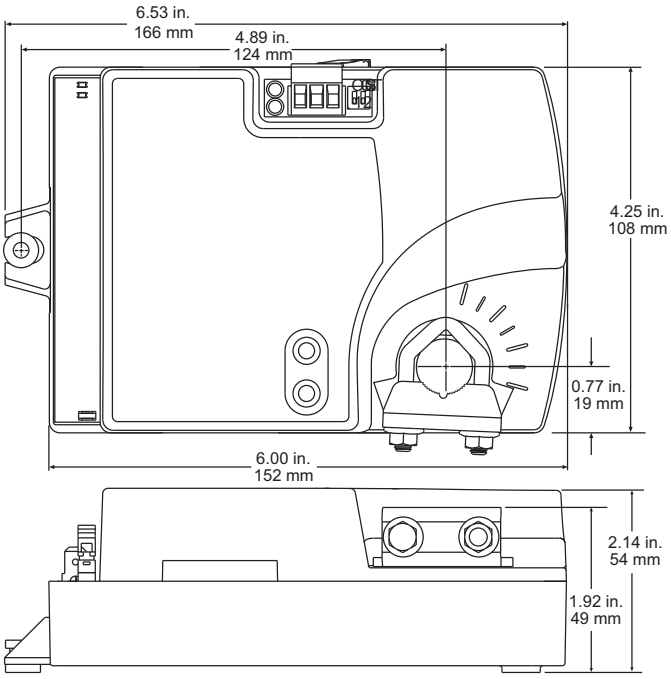
Actuator features

All models of SimplyVAV controllers include an integrated actuator.

Torque	40 in-lb. (4.5 N•m)
Angular Rotation	0 to 95° Adjustable end stops at 45 and 60° rotation
Motor Timing	
BAC-8001,	90 sec./90°at 60 Hz
BAC-8005, and BAC-8007	108 sec./90° at 50 Hz
BAC-8205	60 sec./90°at 60 Hz

Shaft size

Directly mounts on 3/8 to 5/8 inch (9.5 to 16 mm) round or 3/8 to 7/16 inch (9.5 to 11 mm) square damper shafts.



Operating Sequences

The following SimplyVAV models are supplied with factory included programs.

BAC-8001

Model BAC-8001 is supplied with inputs, outputs, and sequences of operation for the following functions.

- Single duct heating and cooling VAV
- Automatic heating/cooling changeover including morning warmup
- Occupancy setback—requires STE-8201
- System diagnostic indicators
- Airflow balancing

BAC-8005 and BAC-8205

Models BAC-8005 and BAC-8205 are supplied with inputs, outputs, and sequences of operation for the following functions.

- Single duct heating and cooling VAV
- Modulating, floating, time proportional, and staged reheat
- Series and parallel fan control
- Automatic heating/cooling changeover including morning warmup
- Discharge air temperature limiting
- Occupancy setback—requires STE-8201
- Actuator position feedback for true damper positioning (BAC-8205 only)
- System diagnostic indicators
- Airflow balancing

BAC-8007

Model BAC-8007 is supplied with inputs, outputs, and sequences of operation for the following functions.

- Dual-duct VAV heating and cooling
- Occupancy setback—requires STE-8201
- System diagnostic indicators
- Airflow balancing
- Uses TSP-8001 for secondary damper control

BACnet communication

- Integrated peer-to-peer BACnet MS/TP network communications.
- Network speed from 9600 to 76,800 baud
- Meets or exceeds ANSI/ASHRAE BACnet Standard 135-2008 for Application Specific Controllers.

INSTALLATION

Supply voltage	24 volts AC (–15%, +20%), 50-60 Hz, 5 VA, Class 2 only
Weight	13.2 ounces (376 grams)
Case material	Gray and black flame retardant plastic
Environmental limits	
Operating	32 to 120° F (0 to 49° C)
Shipping	–40 to 140° F (–40 to 60° C)
Humidity	0-95% relative humidity (non-condensing)

Regulatory

- UL 916 Energy Management Equipment
- BACnet Testing Laboratory listed as Application Specific Controller (ASC)
- CE compliant
- SASO PCP Registration KSA R-103263
- FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

ACCESSORIES

Airflow sensors

For VAV boxes without flow pickups, order one ofthe following airflow sensors

SSS-1012	3-5/32 in. length (80 mm)
SSS-1013	5-13/32 in. length (137 mm)
SSS-1014	7-21-32 in. length (195 mm)
SSS-1015	9-29/32 in. length (252 mm)
Kit-8001	A 3-5/32 inch sensor with 3 feet of FR tubing

SimplyVAV digital sensors

STE-8001W80	SimplyVAV sensor and digital display
STE-8201W80	SimplyVAV sensor and digital display with motion sensor

SimplyVAV discrete temperature sensors

STE-6010W80	Temperature sensor with RJ-45 connector
STE-6014W80	Temperature sensor with rotary setpoint dial, RJ-45 connector
STE-6017W80	Temperature sensor with rotary setpoint dial, override button, RJ-45connector

Dual duct actuator

TSP-8001	VAV actuator with airflow inputs (required for dual duct)

Model description	Model number
BACnet ASC: VAV Cooling/Heating, 40 in-lbs, 90 sec actuator	BAC-8001
BACnet ASC: VAV Fan and Reheat, 40 in-lbs, 90 sec actuator	BAC-8005
BACnet ASC: VAV Dual Duct, 40 in-lbs, 90 sec actuator	BAC-8007
BACnet ASC: VAV Fan and Reheat, Position, 40 in-lbs, 60 sec actuator	BAC-8205

Controller selection guide

Models	Single duct heating and cooling	Dual duct heating and cooling	DAT limiting	1,2,3 staged reheat	Floating reheat	Modulating reheat	Time proportional reheat	Series fan	Parallel fan	True damper positioning	90 second rotation	60 second rotation
BAC-8001	◆										◆	
BAC-8005	◆		◆	◆	◆	◆	◆	◆	◆		◆	
BAC-8007		◆									◆	
BAC-8205	◆		◆	◆	◆	◆	◆	◆	◆	◆		◆

Sensor selection guide

For sensor details see the data sheet for each sensor model.

Model	Temperature sensor	Setpoint dial	Override button	Setpoint buttons	Motion sensor	Digital display	Configuration tool	Balancing tool
STE-8001W80	◆			◆		◆	◆	◆
STE-8201W80	◆			◆	◆	◆	◆	◆
STE-6010W80	◆							
STE-6014W80	◆	◆						
STE-6017W80	◆	◆	◆					

BACnet International

DESCRIPTION

The TSP-8001 is a secondary actuator for SimplyVAV dual-duct installations. The actuator connects directly to a BAC-8007 SimplyVAV controller for easy installation.

- Integrated airflow sensor
- No set up required. All programing and sequences are built into the SimplyVAV BAC 8007 dual duct primary controller.
- All inputs and outputs for SimplyVAV controllers are set up at the factory. No field programming required.

SPECIFICATIONS

Inputs and outputs

All inputs and outputs connect directly to a BAC 8007 SimplyVAV controller. Connections are made with screw terminals that accept wire size 12 16 AWG.

Air flow sensor features

CMOS differential pressure 0-2 inches of water (0 500 Pa) measurement range. Internally linearized and temperature compensated.

- Configured as BACnet analog input object.
- Span accuracy 4.5% of reading.
- Zero point accuracy 0.0008 in. H20/0.2 Pa at 25° C
- Barbed connections for 1/4 inch FR tubing.

Actuator features

Torque	40 in-lb. (4.5 N•m)
Angular Rotation	0 to 95° Adjustable end stops at 45 and 60° rotation
Motor Timing	90 sec./90°at 60 Hz

Shaft size

Directly mounts on 3/8 to 5/8 inch (9.5 to 16 mm) round or 3/8 to 7/16 inch (9.5 to 11 mm) square damper shafts.

Regulatory

- UL 916 Energy Management Equipment
- CE compliant
- SASO PCP Registration KSA R-103263
- FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

INSTALLATION

Supply voltage	24 volts AC (–15%, +20%), 50 60 Hz, 5 VA,Class 2 only
Weight	13.2 ounces (376 grams)
Case material	Gray and black flame retardant plastic

Environmental limits

Operating 32 to 120° F (0 to 49° C)

Shipping –40 to 140° F (–40 to 60° C)

Humidity 0-95% relative humidity (non condensing)

ACCESSORIES

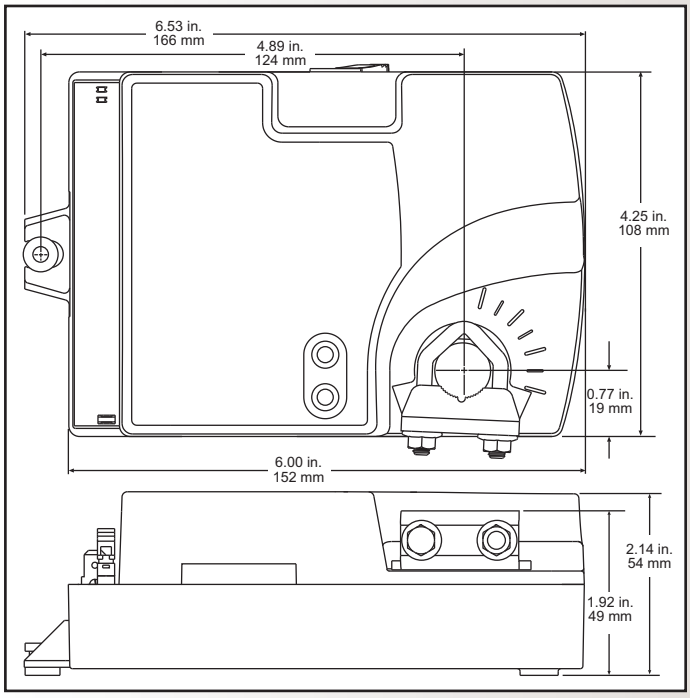
Airflow sensors

For VAV boxes without flow pickups, order one of the following airflow sensors. A 3/16 to 1/4 inch tubing adaptor is required.

Kit-8001	An SSS-1002 sensor, 3 ft. of 0.25 in FR tubing, and adaptors
SSS-1002	3-5/32 in. length (80 mm)
SSS-1003	5-13/32 in. length (137 mm)
SSS-1004	7-21-32 in. length (195 mm)
SSS-1005	9-29/32 in. length (252 mm)

ORDERING INFORMATION

TSP-8001	Dual duct VAV secondary actuator with airflow inputs



DESCRIPTION

The SimplyVAV digital sensors are wall-mounted, temperature sensors for use with SimplyVAV series controllers. Key features include the following:

- Integrated operator interface that is ready to use with SimplyVAV series controllers
- Large LCD display
- Simple three-button interface
- Continuously displays temperature and time
- Use as a service tool to set up SimplyVAV controllers
- Optional motion sensor to detect space occupancy and control temperature setback

SPECIFICATIONS

Display

- Multifunctional LCD
- 1.88 x 1.25 in. (48 x 32 mm)

Compatibility

SimplyVAV controllers

Controller Connection

Connector type	Eight-wire RJ-45 modular jack
Cable type	Standard Ethernet cable up to 75 feet (22.9 meters)
Power	Supplied by connected controller
Mounting	Surface mount directly to any flat surface or to a 2 x 4 inch or 4 x 4 inch handy-box. Mounting on a 4 x 4 inch box requires a mounting backplate.
Weight	2.8 ounces (80 grams)
Material	Flame retardant plastic

Sensor accuracy

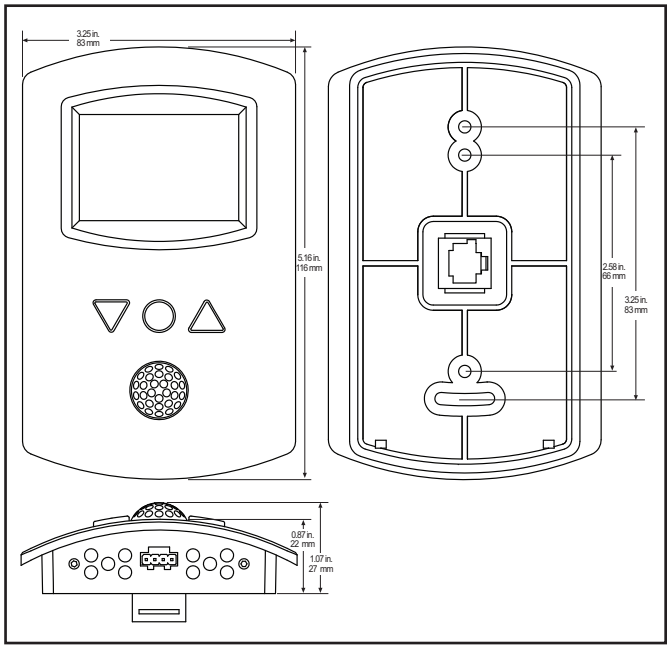
Type	Thermistor
Accuracy	±0.36° F (±0.2° C)
Resistance	10,000 Ω at 77° F (25° C)
Operating range	48 to 96° F (8.8 to 35.5° C)

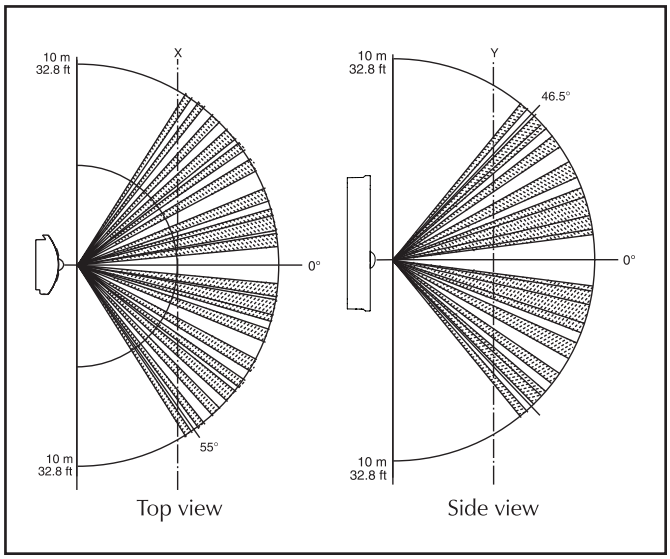
Environmental Limits

Operating	34° to 125° F (1.1 to 51.6° C)
Temperature	
Shipping	–40° to 140° F (–40°C to 60° C)
Humidity	0 to 95% relative humidity non-condensing

Motion sensor

Detector type	Passive infrared
Range	33 feet (10 meters) See diagrams





REGULATORY

- CE compliant
- SASO PCP Registration KSA R-103263
- FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

ACCESSORIES

HMO-1161W80	4 x 4 inch backplate, white
HPO-1161	Foam insulating gasket

Sensor selection guide

Model	Temperature sensor	Setpoint dial	Override button	Setpoint buttons	Motion sensor	Digital display	Configuration tool	Balancing tool
STE-8001W80	◆			◆		◆	◆	◆
STE-8201W80	◆			◆	◆	◆	◆	◆

Ordering information

Model description	Model number
SimplyVAV digital temperature sensor	STE-8001W80
SimplyVAV digital temperature and motion sensor	STE-8201W80

DESCRIPTION

These compact, stylish, and economical room temperature sensors are designed to use with SimplyVAV controllers. They install easily without programming or configuration.

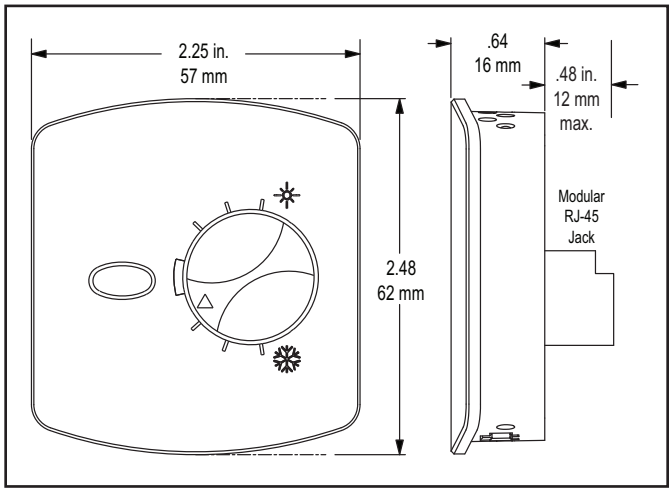
- The durable, low-profile, thermostat-style cover is visually appealing.
- Easy connections with standard Ethernet patch cable.
- Surface mounts on a hollow wall or on a standard electrical box with the appropriate backplate.

STE-6014W80 STE-6010W80 STE-6017W80

MODEL DESCRIPTIONS

The following SimplyVAV STE-6000 series models are available:

STE-6010W80	A simple, temperature sensor only.
STE-6014W80	A temperature sensor with a rotary dial for adjusting the room setpoint.
STE-6017W80	In addition to the temperature sensor and rotary dial, this model features an push button for overriding temperature setback.



SPECIFICATIONS

Connections	RJ-45 jack
Material	Flame-retardant white plastic
Weight	Approx. 1.25 oz. (35 grams)
Sensor	
Type	Type II thermistor
Accuracy	± 0.36° F (± 0.20° C)
Resistance	10,000 ohms at 77° F (25° C)
NTC	4.37%/° C @ 25° C
Dissipation Constant	2 mW/° C
Rotary Setpoint Pot.	0–10K ohms ±20% (54–90° F or 12–32° C) linear
Approvals	CE compliant
Environmental Limits	
Operating	34 to 125° F (1.1 to 51.6° C)
Shipping	–40 to 140° F (–40 to 60° C)
Humidity	0 to 95% RH non-condensing

ACCESSORIES

HMO-1161W80	Backplate, 4.8 x 5.5 inches, White
HMO-6036W80	Universal Backplate, White

Sensor selection guide

Model	Temperature sensor	Setpoint dial	Override button	Setpoint buttons	Motion sensor	Digital display	Configuration tool	Balancing tool
STE-8001W80	◆			◆		◆	◆	◆
STE-8201W80	◆			◆	◆	◆	◆	◆
STE-6010W80	◆							
STE-6014W80	◆	◆						
STE-6017W80	◆	◆	◆					

Ordering information

Model description	Model number
Discrete temperature sensor with RJ-45 connector	STE-6010W80
Discrete Temperature sensor with rotary setpoint dial, RJ-45 connector	STE-6010W80
Discrete temperature sensor with rotary setpoint dial, override button, RJ-45 connector	STE-6010W80