

# Applications Guide



<b>CEP-4000 General Information .....</b>	<b>2</b>
<b>Overview .....</b>	<b>2</b>
<b>Maintenance.....</b>	<b>2</b>
<b>Model History and Replacement Issues .....</b>	<b>3</b>
<b>CEP-4995 Universal Replacement .....</b>	<b>4</b>
<b>Wiring .....</b>	<b>4</b>
<b>Rotation Setup and Override .....</b>	<b>5</b>
<b>Voltage/Velocity Correlation .....</b>	<b>6</b>
<b>Basic Control Logic.....</b>	<b>7</b>
<b>The Controller .....</b>	<b>7</b>
<b>The Flow Sensor .....</b>	<b>7</b>
<b>The Thermostat.....</b>	<b>7</b>
<b>Controller/System Checkout/Troubleshooting Procedure .....</b>	<b>8</b>
<b>Verifying Proper Operation .....</b>	<b>8</b>
<b>Overriding to Open .....</b>	<b>8</b>
<b>Other Troubleshooting .....</b>	<b>8</b>
<b>SSE-1000/2000 Flow Sensors .....</b>	<b>9</b>
<b>Thermostats .....</b>	<b>9</b>
<b>CTE-1000/1100/5000 Series.....</b>	<b>9</b>
<b>CEE-1000 Series with Remote Sensor .....</b>	<b>10</b>
<b>Thermostat Troubleshooting .....</b>	<b>11</b>
<b>VAV Single Duct Cooling/Heating Applications .....</b>	<b>12</b>
<b>Cooling.....</b>	<b>12</b>
<b>Cooling with Morning Warm-Up .....</b>	<b>13</b>
<b>Cooling with 3-Stage Reheat .....</b>	<b>14</b>
<b>Cooling/Heating Changeover .....</b>	<b>15</b>
<b>Cooling with Proportional Hot Water Reheat.....</b>	<b>16</b>
<b>Fan Box with Reheat.....</b>	<b>17</b>
<b>Day/Night with Fan Box Reheat .....</b>	<b>18</b>
<b>Damper Tracking (Master/Slave).....</b>	<b>19</b>
<b>VAV Dual Duct Cooling/Heating Applications .....</b>	<b>20</b>
<b>Heating and Cooling VAV .....</b>	<b>20</b>
<b>Heating/Cooling Constant Volume w/ Hot Deck Make-Up.....</b>	<b>21</b>
<b>Index.....</b>	<b>22</b>

# CEP-4000 General Information

## Overview

The CEP-4000 series is a pressure-independent combination controller-actuator designed primarily for use on variable air volume terminal units. Cooling and heating air flow is sensed by a temperature-compensated hot-wire anemometer. Velocity sensing is unaffected by changes in the duct air temperature.

The CEP-4000 series offers full-range flow control of VAV terminal units when used with the CTE-1000/1100/5000 series room thermostats. Air-velocity flow control limits are set at the room thermostat or remotely with the REE-1012 remote-limits accessory module.

The actuator section provides a magnetic clutch that allows the actuator to be stalled at either end of stroke, eliminating the requirement for mechanical stops or end switches. The controller-actuator is available with (100°, 60°, and 45°) built-in stops or (360°) no stops.

Combined with available REE-1000/4000 series accessory modules, the controllers provide proportional or multi-position electric or hot-water reheat, cooling/heating changeover, and dual-duct applications.

For more specifications and mounting instructions, see the Data Sheet and the Installation Guide for the CEP-4000 series.

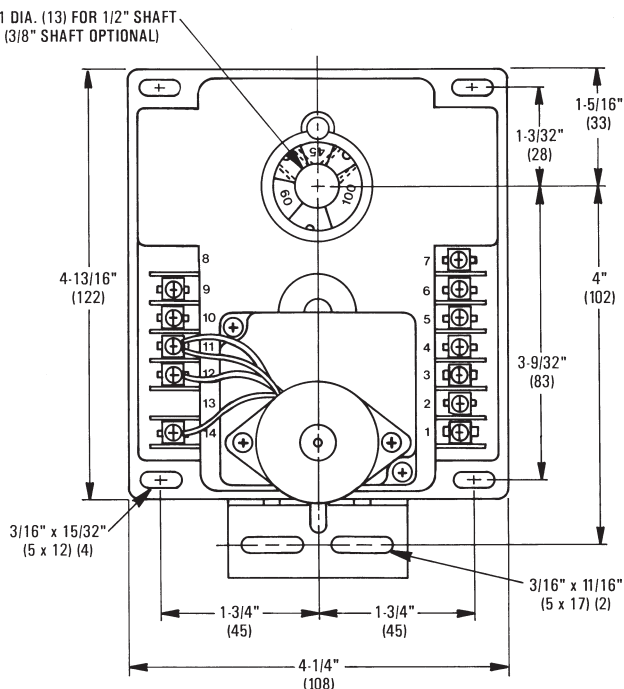
## Terminal Definitions:

1. Flow sensor terminal 1
2. Flow sensor terminal 2 (live flow reading with 9–18 VDC = 0–3000 fpm)\*
3. Flow sensor terminal 3
4. Thermostat (-) ground\*
5. Thermostat (+) 9.1 VDC\*
6. Requested flow from T1 or T2 thermostat (3–6 VDC = 0–3000 fpm)
7. Live flow sensor readout (1–5 VDC = 0–3000 fpm)
8. Unused
9. 24 VAC (-) common
10. 24 VAC (~) phase
11. Motor common
12. Motor drive to increase air velocity (open)\*†
13. Unused
14. Motor drive to decrease air velocity (close)\*†

## ⚠ CAUTION

\*Do not short terminals 12 and 14, 4 and 5, or 2 and 4.

†Do not apply voltage to terminals 12 or 14.



## Maintenance

No routine maintenance is required. The motors are permanently lubricated and all internal gear-train components are oil-impregnated. Careful installation will also ensure long term reliability and performance.

# Model History and Replacement Issues

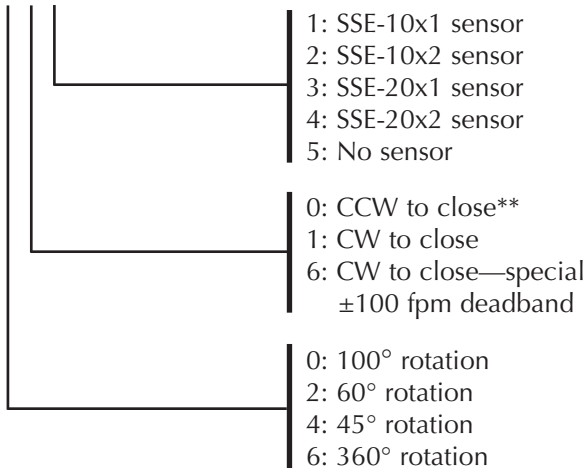
The CEP-4000 series uses a “half-wave” power circuit, which is not compatible with some of the REE-1000 series accessories module relays (that may be found in earlier installations). **Therefore, when replacing a CEP-1000 or CEP-3000 series controller, the REE-1000 series relay may also need to be replaced with the equivalent REE-4000 series module:**

REE-1001	replace with	REE-4001
REE-1002	replace with	REE-4002
REE-1006	replace with	REE-4006
REE-1011	replace with	REE-4011
REE-1015	replace with	REE-4015
REE-1017	replace with	REE-4017
REE-1019	replace with	REE-4019

**Determine the controller model number from the chart below.** All units have a predefined stroke range with factory-installed stops (or full 360° rotation with no stops). Each model is defined by which direction the damper closes (field adjustable) and which of the four sensor options are shipped with the unit. (Sensors are field replaceable, but recalibration is then required.)

The **CEP-4995** (100° rotation, CW to close, no sensor) is a “**universal replacement**” for most applications and will replace **MOST** CEP-1000/3000/4000 series controllers. (See the CEP-4995 Universal Replacement section on the next page.)

CEP- 4X Y Z (C)\*

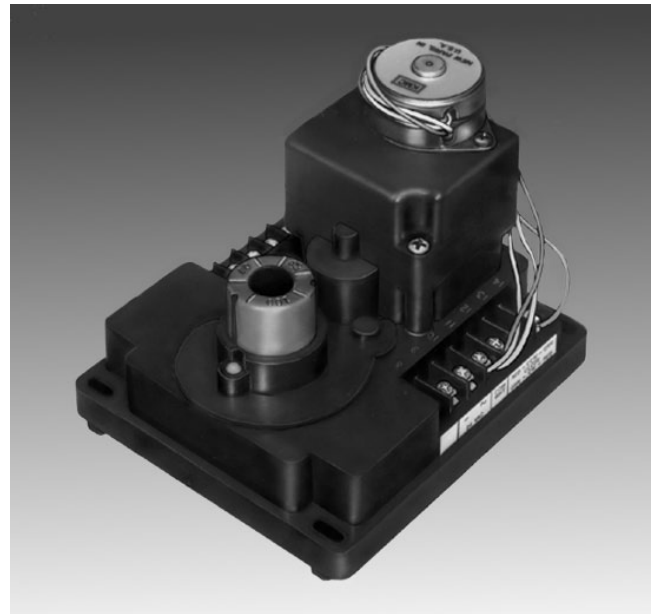


**\*NOTE:** A “C” at the end indicates a silicon conformal coating on SSE-1011/1012/2011/2012 sensors for airstreams that may be contaminated with corrosive materials or high humidity. See also the data sheet for the SSE-1000/2000 Series.



With Electric Motor used **before** data code 9225.

(Motor Gearbox replacement was HPO-0013, but it is **no longer available.**)



With Electric Motor used **after** data code 9226.

(Motor Gearbox replacement is HPO-0062.)

**\*\*NOTE:**The default rotation direction can easily be reversed by swapping the red and blue motor wires. (See the Rotation Setup and Override section.)

**NOTE:** Not all options implied by the chart may be currently available. See also the data sheet for the CEP-4000 Series.

## CEP-4995 Universal Replacement

The CEP-4995 (100° rotation, CW to close, no sensor) is a “universal replacement” for most applications and will replace **MOST** CEP-1000/3000/4000 series controllers. The CEP-4995 is factory-wired to rotate clockwise (CW) to close and has internal stops that limit actuator rotation to 100 degrees. No sensor is included, and the unit must be calibrated with the existing sensor. **In addition to the instructions elsewhere in this document, note these additional instructions for this model.**

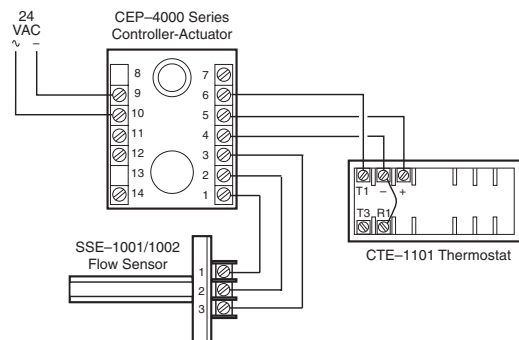
1. Before installing, verify that the terminal unit has damper stops in the closed position before replacing the controller/actuator.

**NOTE:** Most VAV terminal units with 45 or 60 degree rotation have damper stops as part of the damper blade design. Terminal units that rotate 90 degrees have stops integrated into the actuator and do not require damper stops. If stops do not exist in the closed position, the CEP-4995 will not work and a correct replacement unit must be ordered.

2. The majority of CEP controllers are used on CW to close VAV terminals. To convert a CEP-4995 to CCW to close, see the Rotation Setup and Override section.
3. Mounting the CEP in the open position is recommended practice. To manually cycle the unit into an open position, see the Rotation Setup and Override section.
4. If sensor resistance (measured between terminals 1 and 3) is between 100 and 400 ohms the sensor is operational. The CEP-4995 must still be calibrated to the sensor. See the Adjustments and Calibration section.
5. If the existing controller/actuator is a CEP-1000 or CEP-3000 series, determine if any relays are on the VAV terminal. REE-1001/1002/1006/1011/1015/1017/1019 relays must be replaced by their REE-4000 series equivalent (REE-4001/4002/4006/4011/4015/4017/4019).
6. For future reference of the original model number, use a permanent marker to cross out the “4995” part of the new unit’s model number and write in the model number of the old controller/actuator.

## Wiring

1. Connect the CEP to an SSE sensor:
  - A. Terminal 1 to sensor terminal 1.
  - B. Terminal 2 to sensor terminal 2.
  - C. Terminal 3 to sensor terminal 3.
2. Connect the CEP to a CTE thermostat:
  - A. Terminal 4 to thermostat terminal “-”.
  - B. Terminal 5 to thermostat terminal “+”.
  - C. Terminal 6 to thermostat terminal “T1” for cooling (CTE-1001) or “T2” for heating airflow (CTE-1002).
3. Connect the CEP to a 24 VAC, -15%/+20%, 50/60 Hz power source (disconnect the power to the transformer while wiring the CEP):
  - A. Terminal 9 to the “-” common side of the transformer.
  - B. Terminal 10 to the “~” phase side of the transformer.
4. Optionally, the duct airflow can be read by measuring the voltage on:
  - A. Terminal 2 (+) and 4 (-) for 9–18 VDC = 0–3000 fpm.
  - B. Terminal 7 (+) and 4 (-) for 1–5 VDC = 0–3000 fpm.

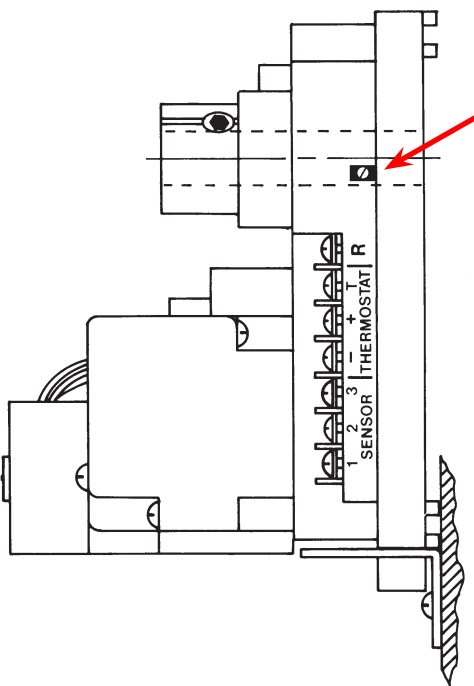


CEP-4000 Basic Connections

## Adjustments and Calibration

Each CEP-4000 is calibrated to its SSE series sensor at the factory. No further calibration is needed. **If the units are replaced or become mismatched, complete the following steps to recalibrate the controller and sensor.**

1. **Follow steps 1 and 3 under the Wiring section.**  
Connection of the thermostat is not necessary.
2. Connect the voltmeter “+” to CEP terminal 2 and “-” to CEP terminal 4.
3. Ensure zero airflow in the duct or remove the sensor from the duct and place it in a horizontal position with **zero** airflow.
4. Wait 5 minutes for the CEP and SSE units to stabilize.
5. Access the trimpot through the slot in the CEP-4000’s side. The slot is normally covered by a label and is on the sensor/thermostat connection side (see illustration below).
6. Adjust the trimpot until the voltmeter reads 9 volts. When the adjustment is made, the voltage will immediately overshoot and then stabilize. This establishes the baseline. (See the Voltage/Velocity Correlation section.)
7. Wait an additional 5 minutes for the CEP and SSE units to stabilize.
8. Readjust if necessary.



CEP-4000 Trim Potentiometer

## Rotation Setup and Override

If desired, the **rotation direction can be reversed** by swapping the red and blue motor wires according to the following table:

Rotation to Close	Motor Wire to Terminal 12	Motor Wire to Terminal 14
CCW	Red	Blue
CW	Blue	Red

NOTE: Motor wires must remain connected to terminal screws (11, 12, and 14) due to components beneath terminals.

To **manually drive** the controller/damper **open or closed** (with 24 VAC on terminals 9 and 10), remove the wiring to terminal 6, and temporarily jumper terminal 6 to:

- Terminal 5 (9.1 VDC) = Open
- Terminal 4 (- VDC) = Closed

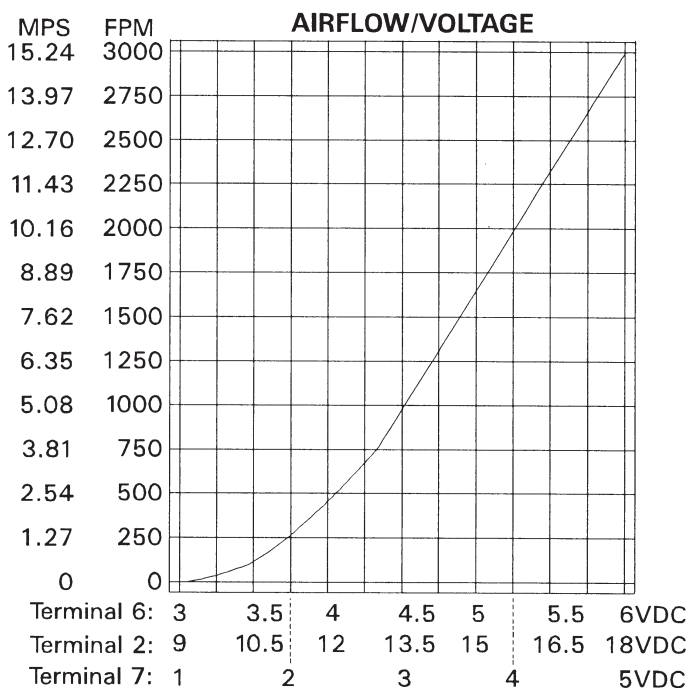
NOTE: Full rotation may take five to six minutes because the actuator rotates at 18° per minute. A magnetic slip-clutch inside the actuator allows motor to continue running even when end-stops have been reached.

### ⚠ CAUTION

**Do not short terminals 12 and 14, 4 and 5, or 2 and 4.**

# Voltage/Velocity Correlation

Requested Flow from Thermostat (VDC) Terminal 6*	Live Flow Sensor Reading (VDC)		Velocity (FPM)
	Terminal 2	Terminal 7**	
3.00	9.00	1.00	0
3.10	9.30	1.13	20
3.20	9.60	1.27	40
3.30	9.90	1.40	65
3.40	10.20	1.53	95
3.50	10.50	1.67	130
3.60	10.80	1.80	175
3.70	11.10	1.93	225
3.80	11.40	2.07	290
3.90	11.70	2.20	370
4.00	12.00	2.33	450
4.10	12.30	2.47	550
4.20	12.60	2.60	650
4.30	12.90	2.73	760
4.40	13.20	2.87	875
4.50	13.50	3.00	1000
4.60	13.80	3.13	1133
4.70	14.10	3.27	1267
4.80	14.40	3.40	1400
4.90	14.70	3.53	1533
5.00	15.00	3.67	1667
5.10	15.30	3.80	1800
5.20	15.60	3.93	1933
5.30	15.90	4.07	2067
5.40	16.20	4.20	2200
5.50	16.50	4.33	2333
5.60	16.80	4.47	2467
5.70	17.10	4.60	2600
5.80	17.40	4.73	2733
5.90	17.70	4.87	2867
6.00	18.00	5.00	3000



Voltages in the chart are in reference to terminal 4.

For more accurate velocity versus voltage settings, the formula  $\text{DESIRED VDC} = [(\text{VDC}_1 - \text{VDC}_2) / (\text{FPM}_1 - \text{FPM}_2)] \times (\text{DESIRED FPM} - \text{FPM}_2) + \text{VDC}_2$  can be used to interpolate the desired voltage.

For example, a desired velocity of 575 fpm is required for minimum setting, but the chart above only shows 550 fpm at 4.10 VDC and 650 fpm at 4.20 VDC. Using the formula, the 575 fpm should equate to a desired voltage of  $[(4.2 - 4.1) / (650 - 550)] \times (575 - 550) + 4.10 = 4.125$  VDC.

\*Voltage increments shown for terminal 6 are in 0.10 VDC.

\*\*Prior to date code 9321 this signal was 0–5 (instead of 1–5) VDC.

# Basic Control Logic

## The Controller

The CEP-4000 Series Controller Actuator is designed to:

- Receive a “Requested Flow” signal from the thermostat (3–6 VDC on terminal 6). (See the Voltage/Velocity Correlation section.)
- Compare it to “Actual Flow” (1–5 VDC on terminal 7 or 9–18 VDC on terminal 2).
- Then drive the damper open or closed as required to match the airflow.

## The Flow Sensor

The CEP-4000 series controller uses SSE-1000/2000 series “hot wire anemometer” sensors. These sensors consist of two coils of wire mounted in the air stream: one monitors airflow, while the other is a reference used for duct temperature compensation. The SSE-2000 series sensors also include a temperature sensor for use with heating/cooling “changeover” applications (requires an additional relay module).

### ⚠ CAUTION

To prevent damage to the SSE series sensors, do not touch or handle the interior wire windings.

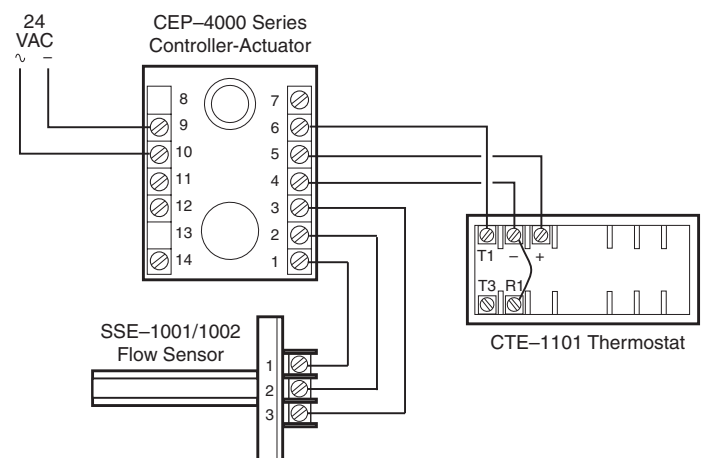


## The Thermostat

The CTE-1000/1100/5000 series thermostats can be used with the CEP-4000 series. These thermostats measure room temperature, compare it to the set-point, and output an appropriate signal to the CEP-4000 to reset airflow accordingly.

The thermostat can output a signal of 0 to 6 VDC to the controller. The Voltage/Airflow Correlation section shows that a value of 3.0 VDC requests zero fpm flow, while 6.0 VDC requests 3000 fpm. Anything less than 3.0 VDC to the controller is requesting zero airflow. By limiting the output of the thermostat to a certain voltage, minimum or maximum flow is set on the controller.

For example, if the minimum adjustment on the thermostat is set for 3.8 VDC (Terminal 6), the thermostat will never request less than approximately 290 fpm airflow from the controller. Similarly, the maximum adjustment can be 6.0 VDC or less to define a maximum flow limit (e.g., 5.40 VDC = 2200 fpm).



# Controller/System Checkout/Troubleshooting Procedure

## Verifying Proper Operation

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

1. Verify supply voltage of 24 VAC at terminals 10 (phase) and 9 (ground).
  - A. Tolerance can be -15% to +20% (20.4–28.8 VAC). If the voltage is outside this range, replace the transformer.
  - B. If there is no voltage, be sure power is turned on. If power is turned on, turn power off and determine why the transformer was damaged before replacing it and turning power back on.
2. Verify supply voltage to the thermostat of 9.1 VDC at terminals 5 (+) and 4 (-).
  - A. Power supply to thermostat tolerance is 8.7–9.6 VDC.
  - B. If not correct, disconnect the thermostat and recheck. If voltage is still not within tolerance, replace the CEP controller.
3. Check “Requested Flow” voltage on terminal 6 (+) and 4 (-).
  - A. See the Voltage/Velocity Correlation section to correlate voltage into feet per minute.
  - B. If the reading is not what is desired, see the Thermostats section to check out and/or adjust.
4. Check “Actual Flow” voltage on terminal 2 (+) and 4 (-) for (9–18 VDC).
  - A. You can also measure on terminal 7 (+) and 4 (-) for (1–5 VDC).
  - B. See the Voltage/Velocity Correlation section to correlate voltage into feet per minute.
  - C. If the result is not logical or realistic (within about 50 fpm), check the sensor (see the SSE Series Flow Sensors section) and/or replace/calibrate controller.

5. Check mechanical movement issues.
  - A. If the damper does not move, observe the CEP’s drive shaft for rotation. If it rotates, but the damper does not, tighten the setscrews and retry.
  - C. If it still does not move, loosen the two setscrews on the shaft (or remove the CEP) and verify that the damper can move freely through a full range of motion on its own. Fix any binding of the damper and retighten the setscrews.
  - D. Verify the damper is not at the end of its travel. Change “Requested Flow” to make the CEP drive the opposite direction (via thermostat or overriding the controller). Loosen the two setscrews and reposition the damper shaft.
  - E. Verify correct rotation direction. Swap the red and blue motor wires on terminals 12 and 14 to reverse the rotation if necessary. (See the Rotation Setup section.)

## Overriding to Open

1. To drive the controller/damper open, remove the wiring from terminal 6 “Requested Flow.”
2. Jumper terminal 5 (9.1 VDC) to terminal 6. This commands the unit to control at 3000 fpm (full airflow). (Assuming the actual flow is less than 3000 fpm, the unit should open damper.)

## Overriding to Closed

1. To drive the controller/damper closed, remove the wiring from terminal 6 “Requested Flow.”
2. Jumper 4 (-) to terminal 6. This commands the unit to control at zero fpm. (Assuming the actual flow is more than 0 fpm, the unit should close the damper.)

NOTE: A magnetic slip-clutch inside the actuator allows motor to continue running even when end-stops have been reached.

## ▲ CAUTION

Never jumper Terminal 4 to Terminal 5 since this would cause a dead short.

## Other Troubleshooting

1. Check the wiring for correct connections and loose or broken wires.
2. Check the sensor. See the SSE Series Flow Sensors section.
3. Check the thermostat. See the Thermostats section.



## SSE-1000/2000 Flow Sensors

The SSE-1000/2000 series are “hot wire anemometer” sensors. The sensor consists of two coils of wire mounted in the air stream: one monitors airflow, while the other is a reference used for duct temperature compensation. The SSE-2000 series sensors also include a temperature sensor for use with heating/cooling “changeover” applications (requires an additional relay module).

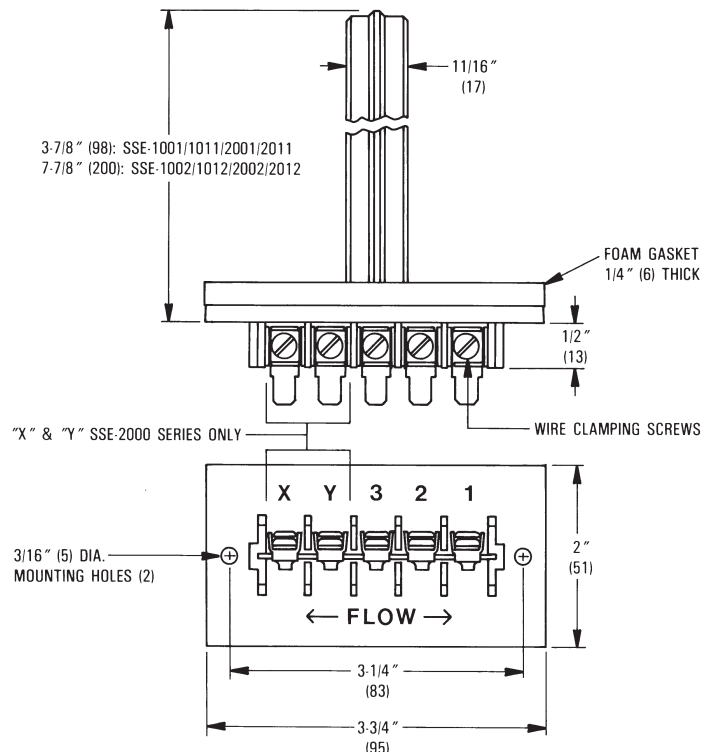
Each CEP-4000 is calibrated to its SSE series sensor at the factory. No further calibration is needed. **If the units are replaced or become mismatched**, see the Adjustments and Calibration section.

The SSE series flow sensor can be tested by measuring resistance between terminals 1 and 3.

1. Disconnect ALL wiring from the SSE sensor.
2. Measure resistance between terminals 1 and 3 with an ohmmeter. Resistance should be between 100–400 ohms. If not, replace the sensor and recalibrate controller to the new sensor. See the Adjustments and Calibration section.
3. SSE-2000 series sensors have additional terminals marked “X” and “Y” for use with the heat/cool changeover relay module. Resistance between “X” and “Y” should be between 2,000 and 20,000 ohms.

### ⚠ CAUTION

To prevent damage to the SSE series sensors, do not touch or handle the interior wire windings.

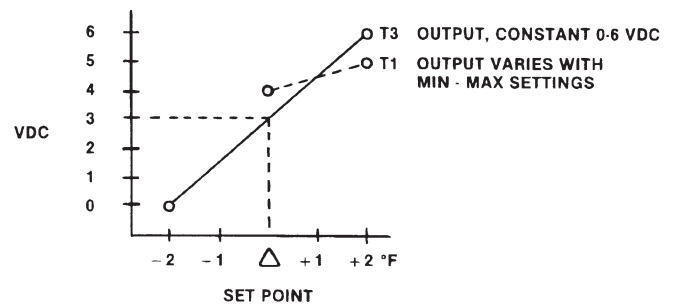
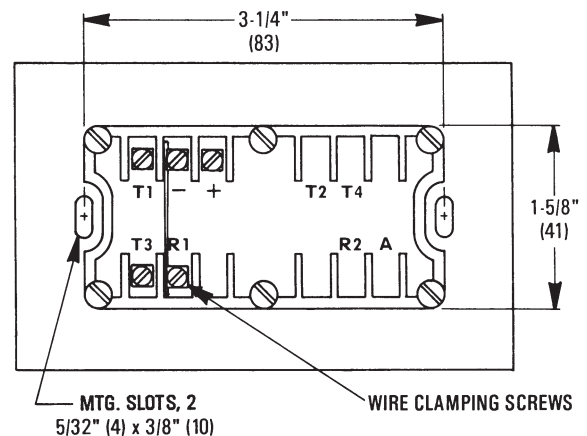


## Thermostats

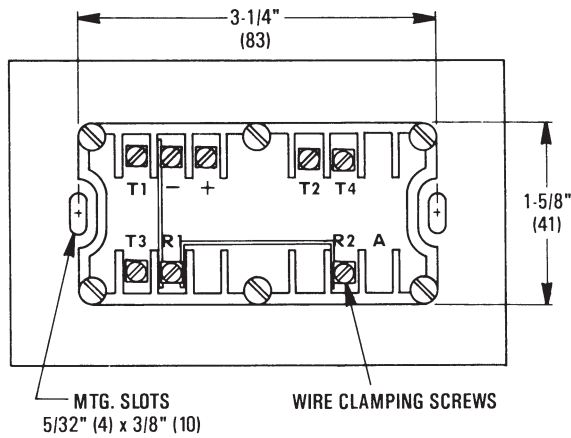
### CTE-1000/1100/5000 Series

The CTE-1000/1100/5000 series thermostats operate on a 9.1 VDC power supply from the CEP controller and output a 0–6 VDC signal on the **T(x) terminals**. See the Applications sections for details on which “T” terminals are used for each model thermostat. Generally T1/T3 are used for the cooling mode and T2/T4 for heating. T1 and T2 are adjustable; T3 and T4 are fixed.

**Terminal “R”** (on the thermostat) is available to provide a flow override command—such as forcing the box to a “close-off” on a dual-duct application. Any voltage (1–6 VDC) applied to the “R1” terminal subtracts that value from the “T1” signal. Similarly, use “R2” to subtract from the “T2” signal. If this function is not being used, a factory-installed jumper connects the appropriate “R” terminal to ground (–) for zero offset.

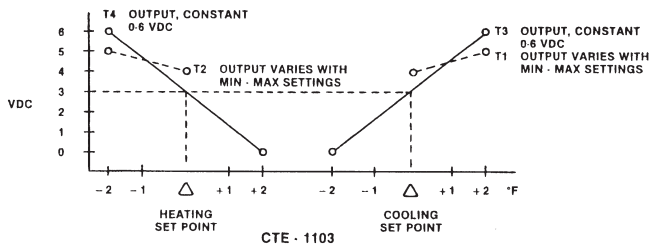


CTE-1101

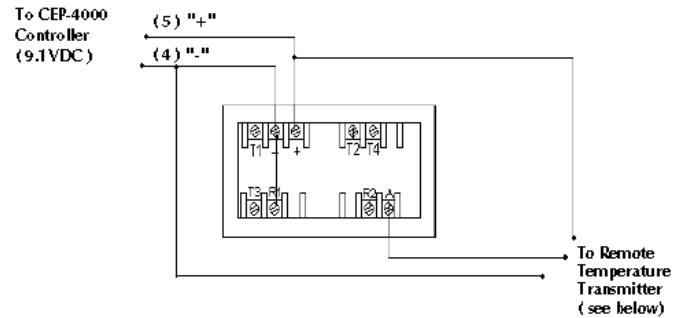


## CEE-1000 Series with Remote Sensor

This series of thermostat is similar to the corresponding model of CTE thermostat, but the CEE Series requires use of a "remote" temperature sensor. For specific application details on each model refer to the relevant product Data Sheet and/or Installation Guide.



**CTE-1103**

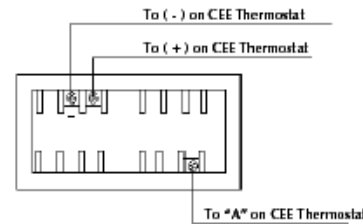


**Typical CEE Series Thermostat**

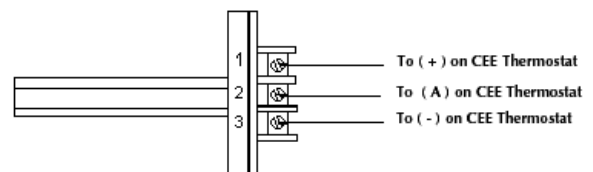
When wiring these thermostats, 18 to 20 AWG wire is recommended. Make sure all jumper wires under terminal screws have a secure connection.

1. Verify 9.1 VDC between (+) and (-) terminals.
2. Measure "T(x)" output voltage. (Use the calibration procedure on the appropriate model's Installation Guide to adjust limits if desired.) Adjust setpoint above and below current room temperature and observe changes in appropriate "T" voltage.

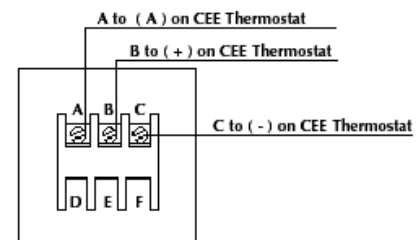
**NOTE:** To more easily measure the appropriate "T" or meter taps on the front of thermostat, use HSO-5001 meter leads.



**TTE-1001 Room Temperature Sensor**



**TTE-2001 Duct Temperature Sensor**



**TTE-5001/5011 Mini-Stat Sensor**

# Thermostat Troubleshooting

1. Verify MIN VELOCITY voltage:
    - A. Adjust the CTE series thermostat's setpoint slider for minimum airflow.
    - B. Verify the minimum setpoint adjustment capability by reading the thermostat voltage output (at the CEP terminals 4 and 6 or the equivalent connections on the thermostat terminals using the front meter taps and HSO-5001 meter leads), adjusting the MIN VELOCITY potentiometer fully **clockwise**, and measuring a maximum voltage setpoint between 6.0 and 7.5 VDC.
    - C. Then adjust the MIN VELOCITY potentiometer fully **counterclockwise** and verify a minimum voltage setpoint between 0 and 0.5 VDC.
    - D. Leave the MIN VELOCITY setpoint temporarily at minimum voltage. If the thermostat's MIN VELOCITY cannot adjust from 0.5 to 6.0 VDC, then replace the thermostat.
  2. Verify MAX VELOCITY voltage:
    - A. Adjust the CTE series thermostat's setpoint slider for maximum airflow.
    - B. Verify the maximum setpoint adjustment capability by reading the thermostat voltage output, adjusting the MAX VELOCITY potentiometer fully **counterclockwise**, and measuring a minimum voltage setpoint between 0 and 0.5 VDC.
    - C. Then adjust the MAX VELOCITY potentiometer fully **clockwise** and verify a minimum voltage setpoint between 6.0 and 7.5 VDC.
    - D. Leave the MAX VELOCITY setpoint temporarily at maximum voltage. If the thermostat's MAX VELOCITY cannot adjust from 0.5 to 6.0 VDC, replace the thermostat.
  3. Verify fully open and fully closed positions:
    - A. With the MIN VELOCITY setpoint adjusted for no flow and the MAX VELOCITY setpoint adjusted for full flow, adjust the thermostat's setpoint slider for minimum airflow (no flow).
    - B. Verify the CEP positions the damper to the fully closed position.
    - C. After the damper is fully closed, adjust the thermostat's setpoint slider for maximum airflow (full flow).
    - D. Verify the CEP positions the damper to the fully open position.
  4. If the CEP does not position the damper to the fully open or fully closed position, verify the following mechanical issues:
    - A. Are upstream velocities capable of achieving 3000 fpm? If not, fix obstructions or restrictions to increase airflow (if practical) or take reduced airflow into account for expected readings.
    - B. Are there any mechanical stops or binding limiting the travel of the damper in either direction? If so, adjust or repair. Repeat step 3.
    - C. Is the damper's travel being limited by the CEP's internal stops? If so, loosen the two setscrews and synchronize the actuator with the shaft (i.e., the CEP is fully open when the damper is fully open). Repeat step 3.
  5. If the CEP will not turn in either direction when the setpoint slider calls for a change in airflow, verify correct voltage to the motors:
    - A. 24 VAC voltage is applied (the red/blue wire on terminal 12/14 and the white wire on terminal 11) to the motor.
- NOTE: Whenever the motor is called to run, there should be voltage on **both** 12 and 14 in reference to 11. These voltages, however, are phase-shifted through a capacitor.
- B. If either or both of the wiring leads/terminals do not have the 24 VAC, replace the CEP and calibrate the new CEP with the sensor. Repeat all of the above steps.
6. After the operation of the system has been verified, return the MIN VELOCITY and MAX VELOCITY setpoints to their correct voltages.

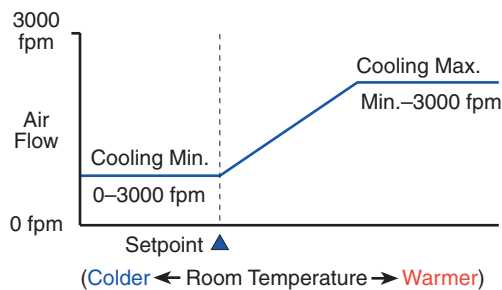
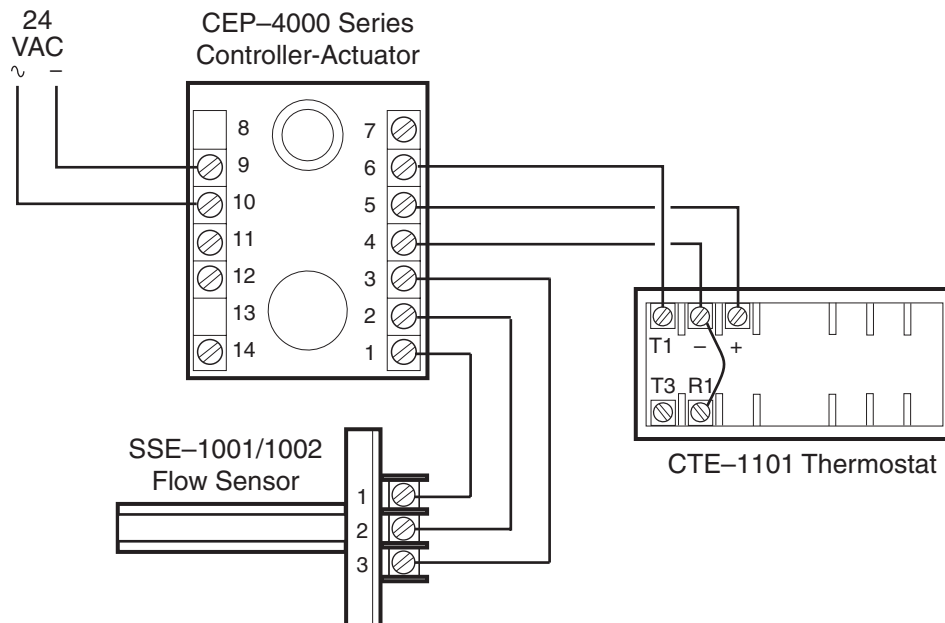
# VAV Single Duct Cooling/Heating Applications

## Cooling

(Former Ref. # APE-1-4001)

CTE-1001/1002/1101 single-setpoint thermostats are designed for use with CEP-4000 series electronic VAV controllers to operate damper boxes and/or valves in the HVAC system. A “requested flow” voltage signal (T1 or T2) is wired to the CEP-4000 series controller to adjust airflow from minimum to maximum flow according to space demand. Both minimum and maximum flow limit adjustments can be made at the thermostat.

An additional “unrestricted” output (T3 or T4) is not affected by min./max. limits and can be used to operate reheat equipment or other control devices by using REE-series relays. The CTE-1001/1101 is Direct Acting (DA) reset, and the CTE-1002 is Reverse Acting (RA) reset.

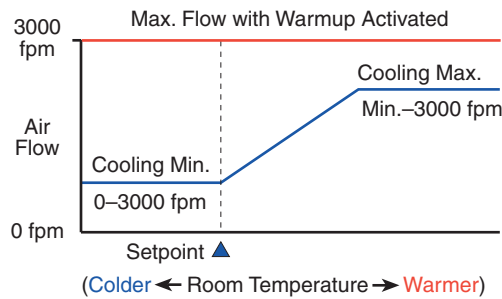
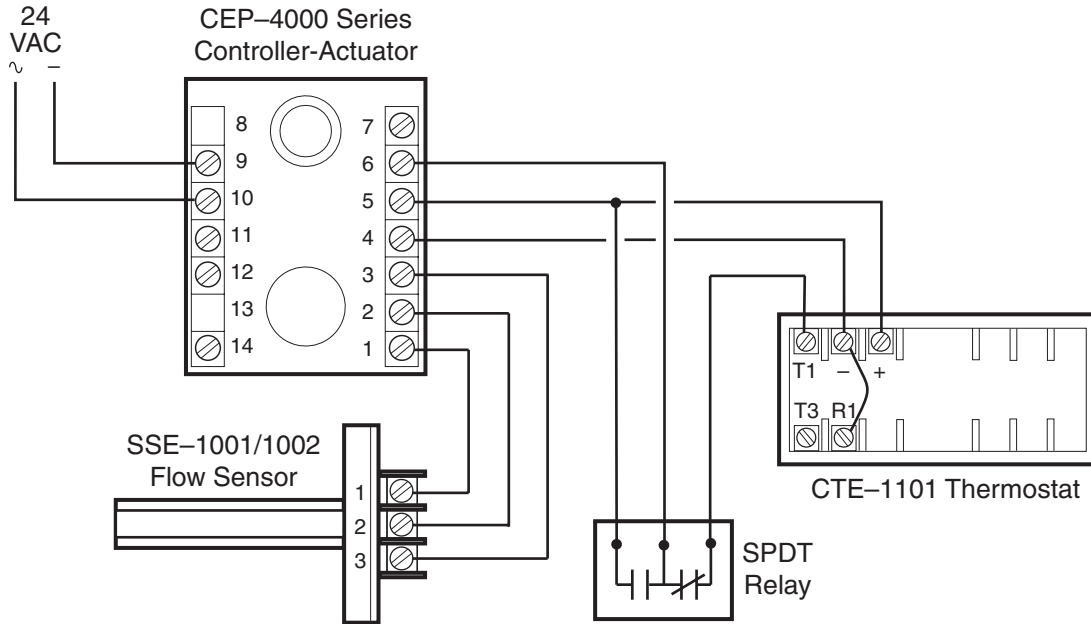


# Cooling with Morning Warm-Up

(Former Ref. # APE-1-4007)

Adding a single-pole double-throw relay to basic heating or cooling configuration commands the unit to a “full open” position when the relay contacts are energized. As shown in the diagram below, terminal

6 (requested flow) is connected to either “T1” (normal) or to terminal 5 (9.1 VDC for full flow) on activation of the relay.



# Cooling with 3-Stage Reheat

(Former Ref. # APE-1-4005)

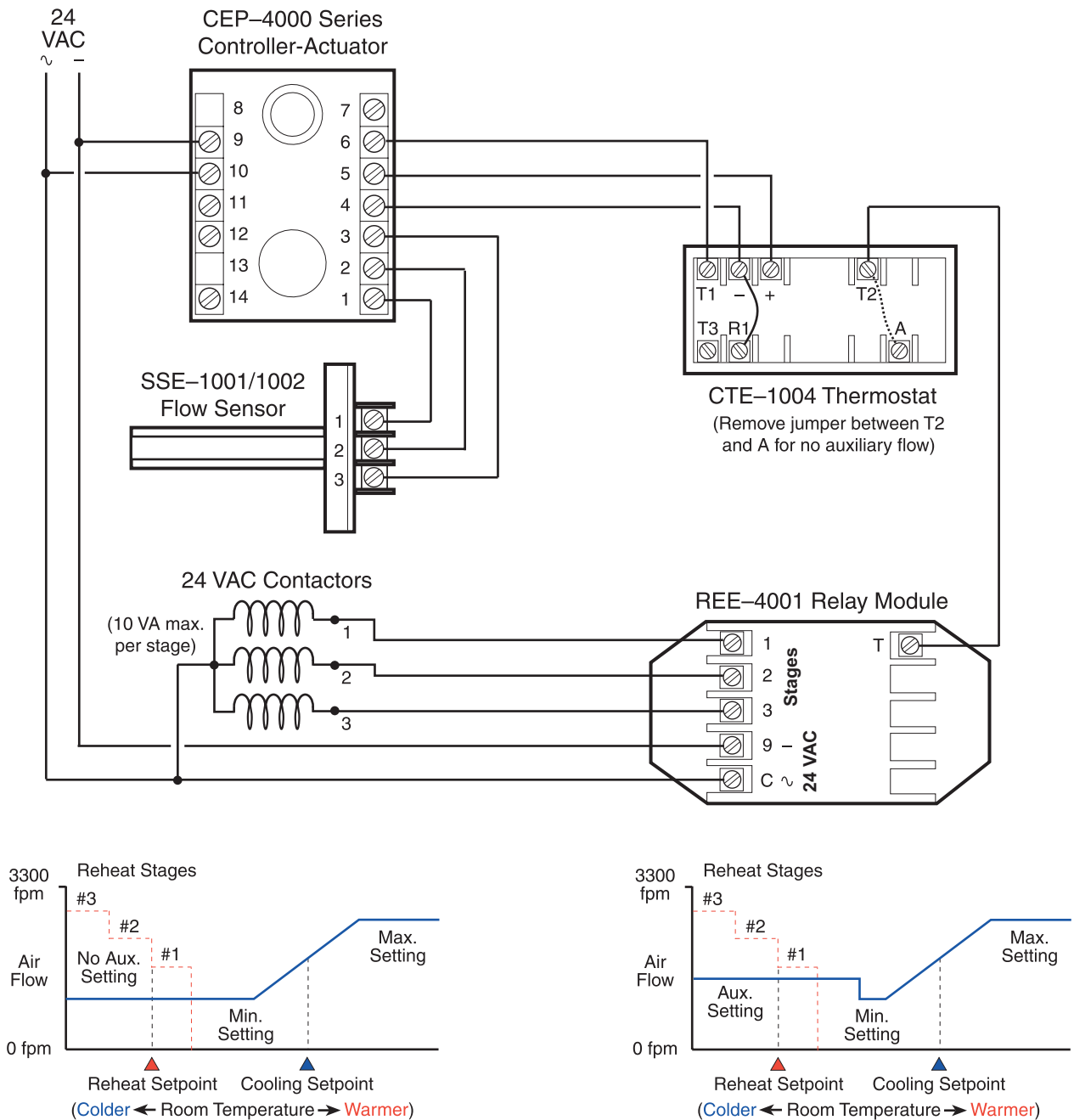
The CTE-1004 electronic thermostat is a dual setpoint thermostat for heating (RA) and cooling (DA) applications. The application below uses an SSE-1000 series sensor, an REE-4001 relay module, and three 24 VAC contactors for three stages of reheat.

The transformer must supply a minimum of 14 VA plus the requirements for the reheat contactor coils (10 VA maximum per stage).

Chart 1 below shows the jumper between "T2" and "A" on the thermostat was removed to prevent

auxiliary flow. (If auxiliary flow is not being used you should rotate the auxiliary potentiometer fully CCW to make sure it will not have an effect.) As the temperature drops below setpoint, the first stage of reheat begins. If the temperature continues to drop, the second stage begins, and finally the third stage if necessary.

When the jumper is left on for auxiliary flow (Chart 2), a second minimum flow (Aux. Flow) may be set before enabling the reheat stages.



**Chart 1**

**Chart 2**

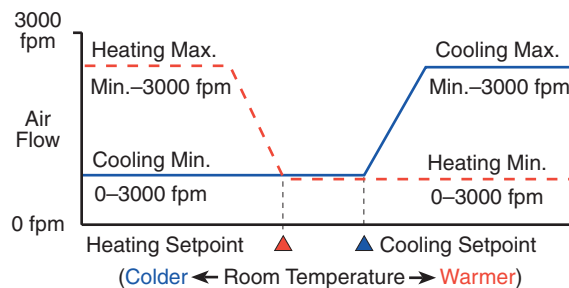
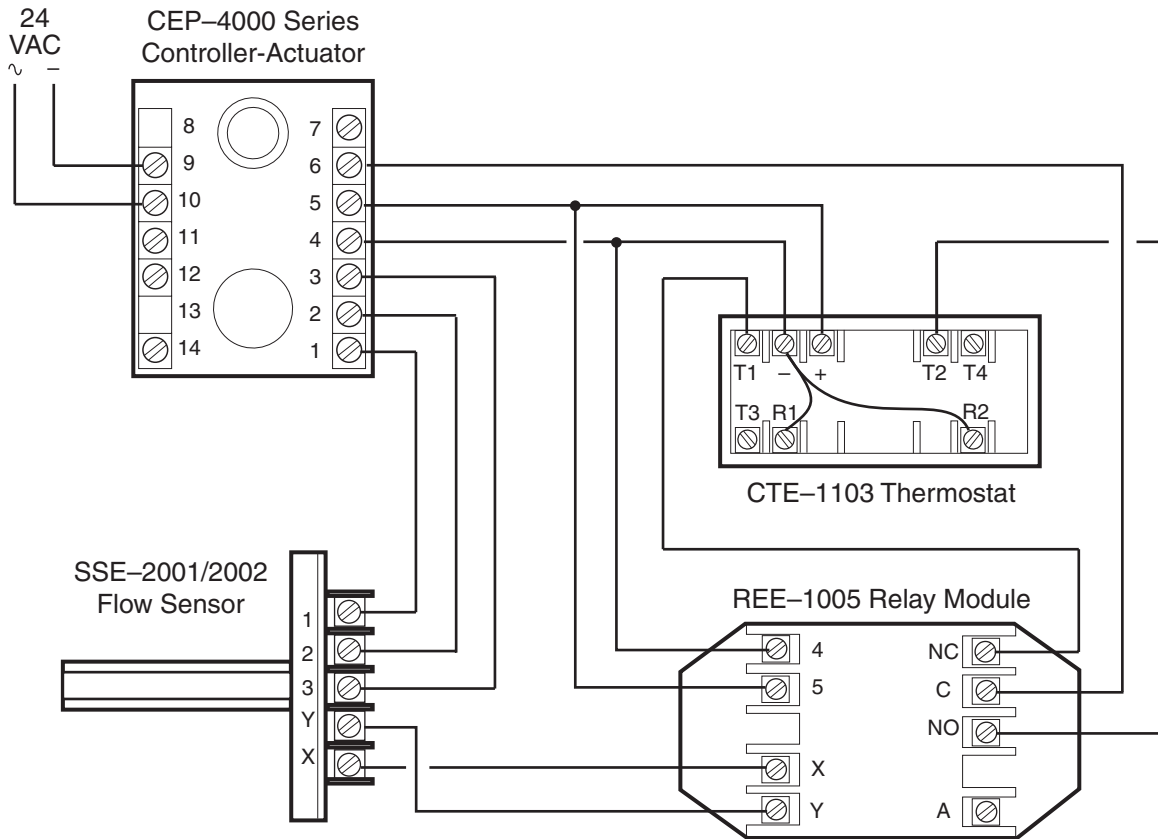
# Cooling/Heating Changeover

(Former Ref. # APE-1-4014)

The CTE-1103 electronic thermostat is a dual setpoint thermostat for heating (RA) and cooling (DA) applications. When using an SSE-2000 series sensor and an REE-1005 relay module (as shown below), an automatic changeover is provided for heating/cooling applications. The sensor and relay combination will switch between the T1 (cooling) and T2 (heating) signal to the VAV terminal based on

the **temperature of the supply air**. Factory-defined switch points use the T2 heating setpoint when duct temperature is greater than  $77 \pm 4^\circ \text{F}$  and the T1 cooling setpoint when duct temperature is less than  $77 \pm 4^\circ \text{F}$ .

NOTE: Minimums can be set at zero airflow, but a minimum airflow greater than zero is required to assure quick changeover.



# Cooling with Proportional Hot Water Reheat

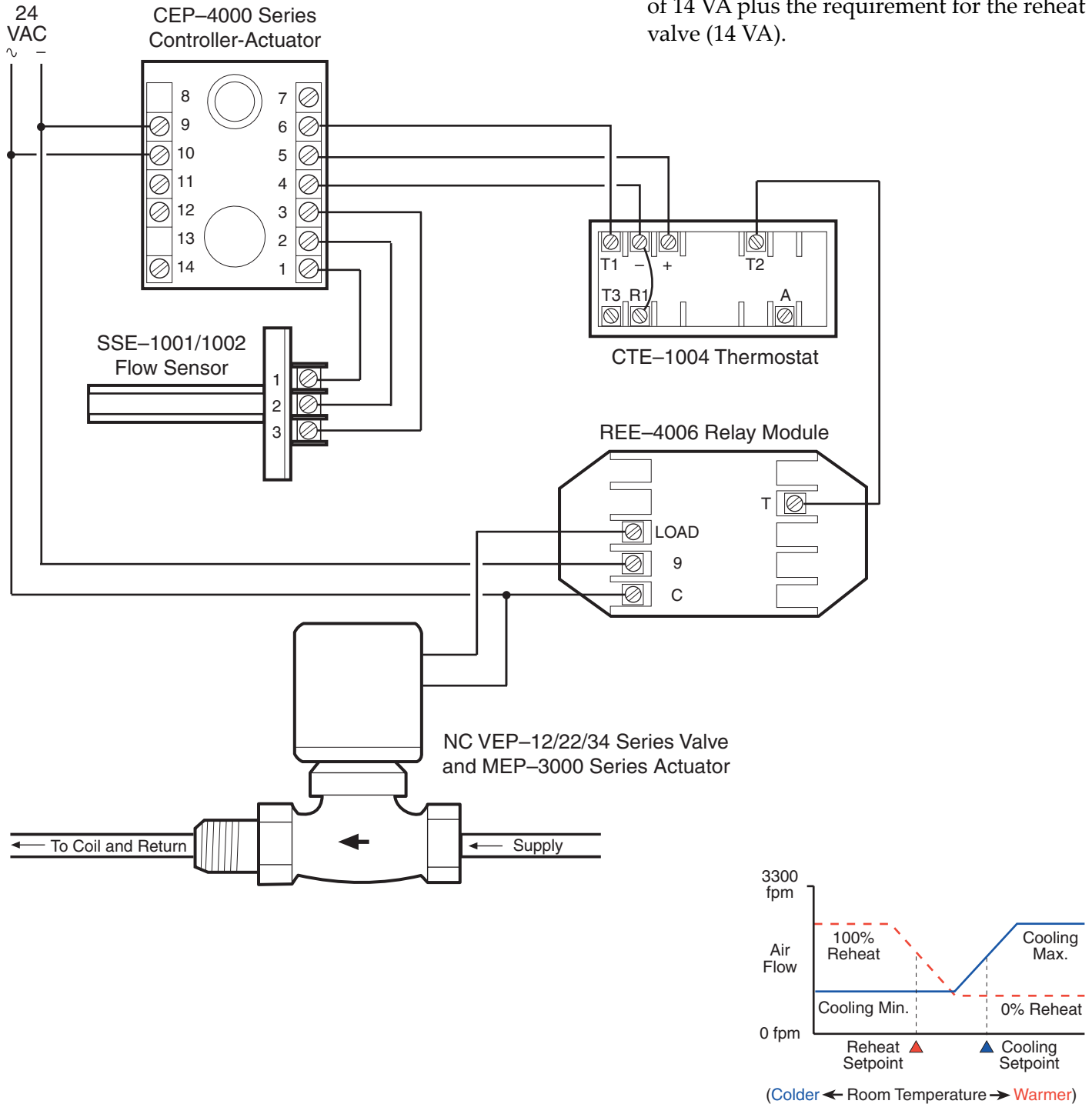
(Former Ref. # APE-1-4017)

In this application, with limits at the thermostat, the CTE-1004 (DA cooling and RA heating) is used in conjunction with the REE-4006 time proportioning relay module and the (NC) VEP-12/22/34 series hot water valve. The REE-4006 relay is designed for time proportioning control of electrical hot water valves.

After the thermostat drops below setpoint, it energizes the relay to open the hot water valve for heat. As the thermostat temperature decreases, the percent on-time of the water valve increases, forcing it open. Once the thermostat is satisfied the process reverses.

To use a NO hot water valve, replace the REE-4006 in this application with the REE-4023 Relay Module.

**NOTE:** The transformer must supply a minimum of 14 VA plus the requirement for the reheat valve (14 VA).





# Fan Box with Reheat

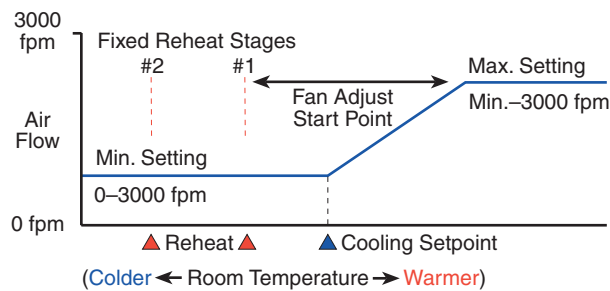
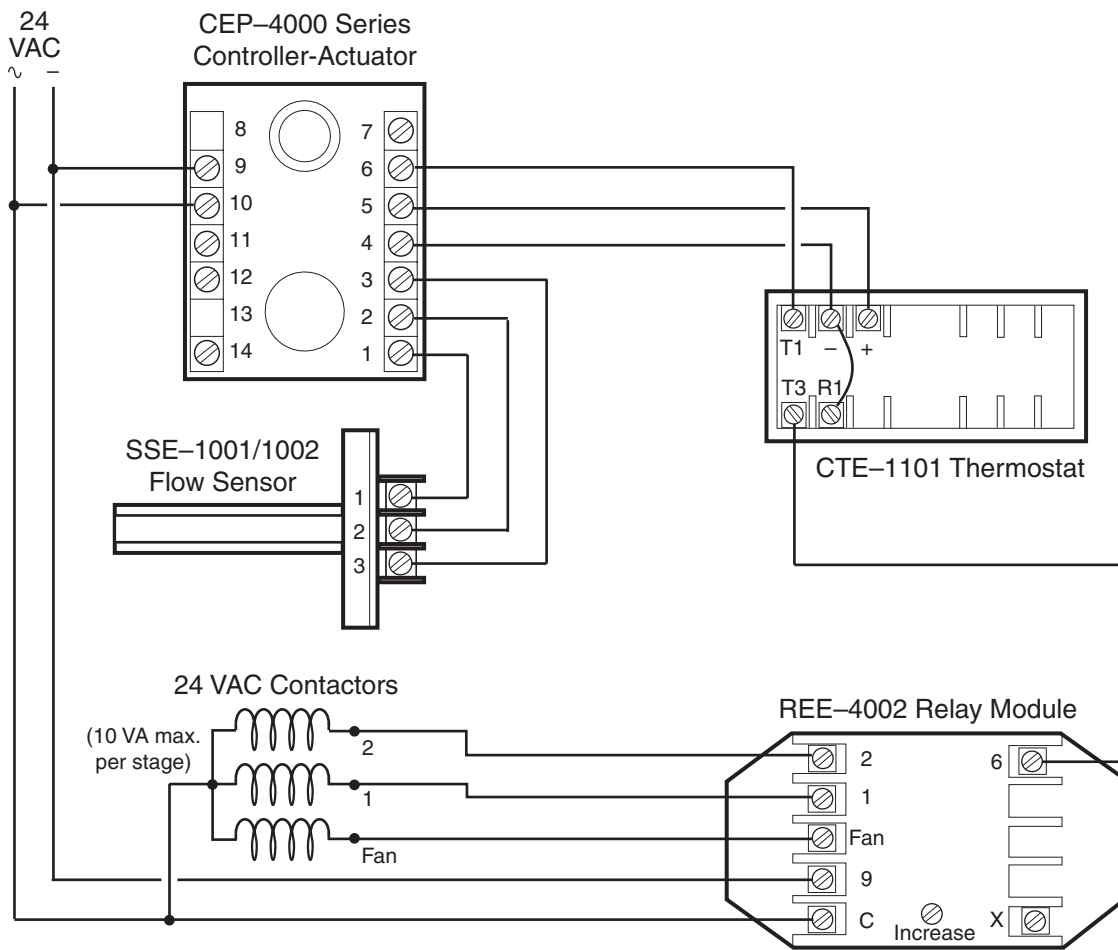
(Former Ref. # APE-3-4001)

The CTE-1101 electronic thermostat is a single-setpoint thermostat for cooling (DA). In this application, the thermostat is used with the REE-4002 relay module, a fan, and two coils for two stages of reheat. The REE-4002 was designed primarily for use with VAV fan powered induction boxes.

If the thermostat drops below setpoint, the relay senses the decrease in voltage and starts the fan. As

the temperature continues to drop, the first stage of reheat begins, and the second stage of reheat follows if the thermostat is still not satisfied. Once the thermostat has reached setpoint, the process reverses.

**NOTE:** The transformer must supply a minimum of 14 VA plus the requirement for the reheat contactor coils (10 VA max per stage).

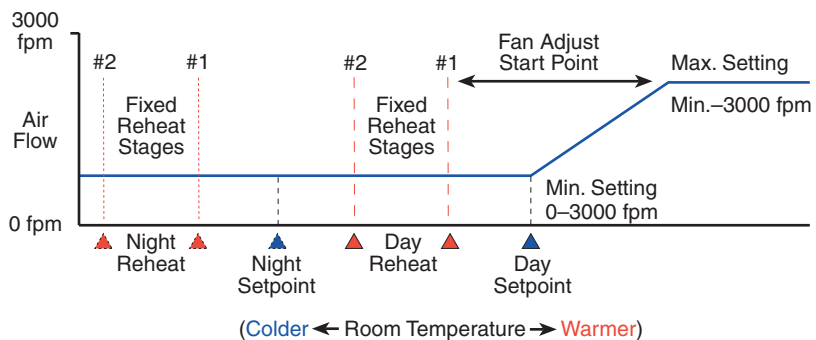
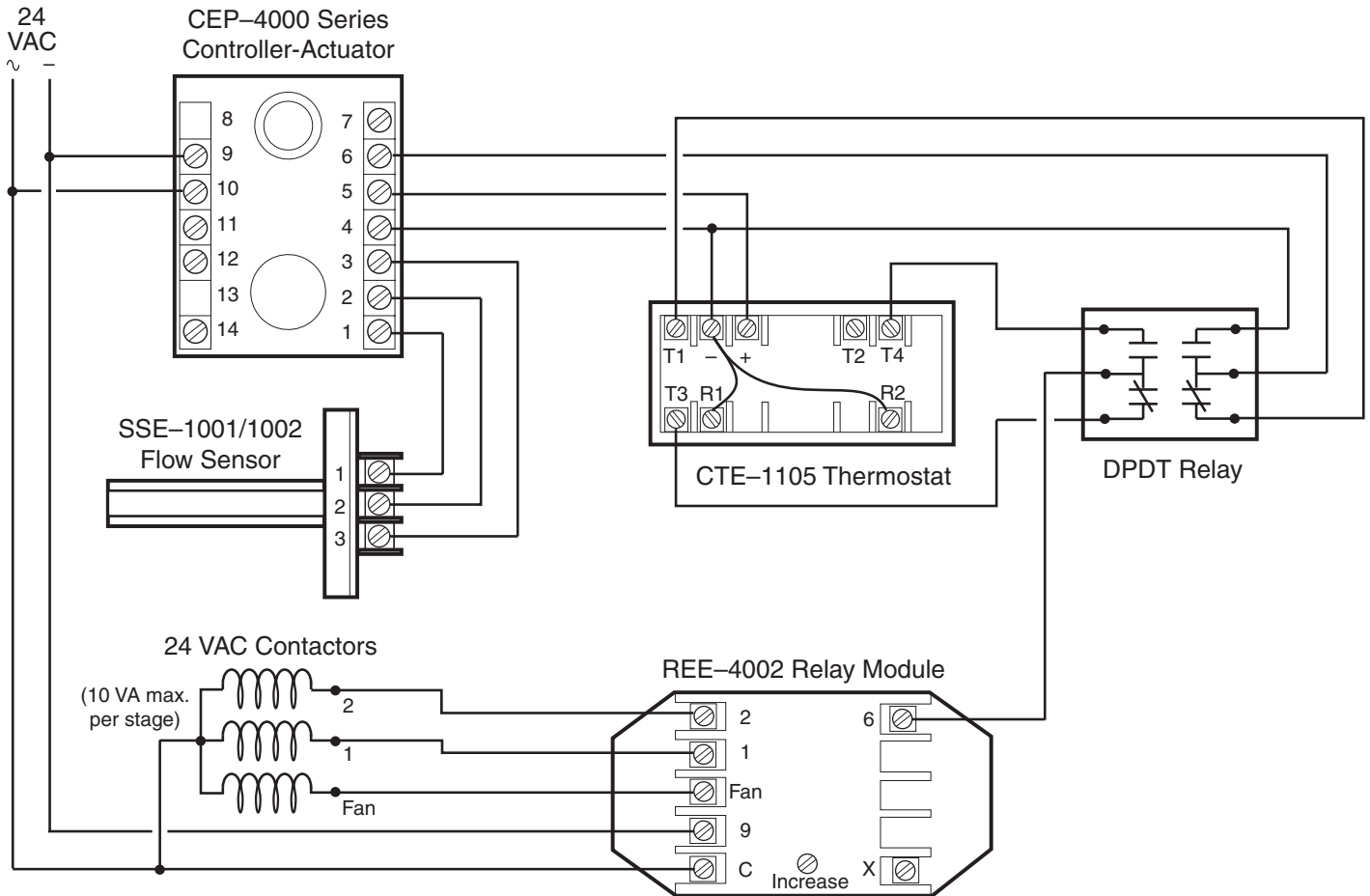


# Day/Night with Fan Box Reheat

(Former Ref. # APE-3-4003)

The CTE-1105 (DA) and CTE-1108 (RA) electronic thermostats are dual-setpoint "Day-Night" units, typically used for temperature setback/setup applications. This application shows a separate relay (often energized by a time clock or switch) used to toggle the "requested flow" signal from the thermostat to the controller according to the mode of operation.

In this example, the Day mode has "T1" sending a signal to the controller, while the Night mode keeps the controller at minimum flow or 0 volts (optionally, T2 could have been used). A second set of contacts on the relay also switches signals to the reheat module between T3 (Day) and T4 (Night) accordingly. For details on the reheat sequences, see the Fan Box with Reheat section.



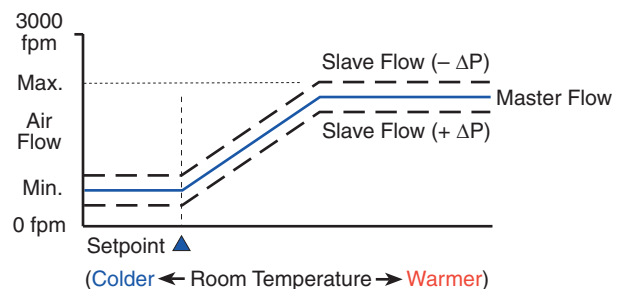
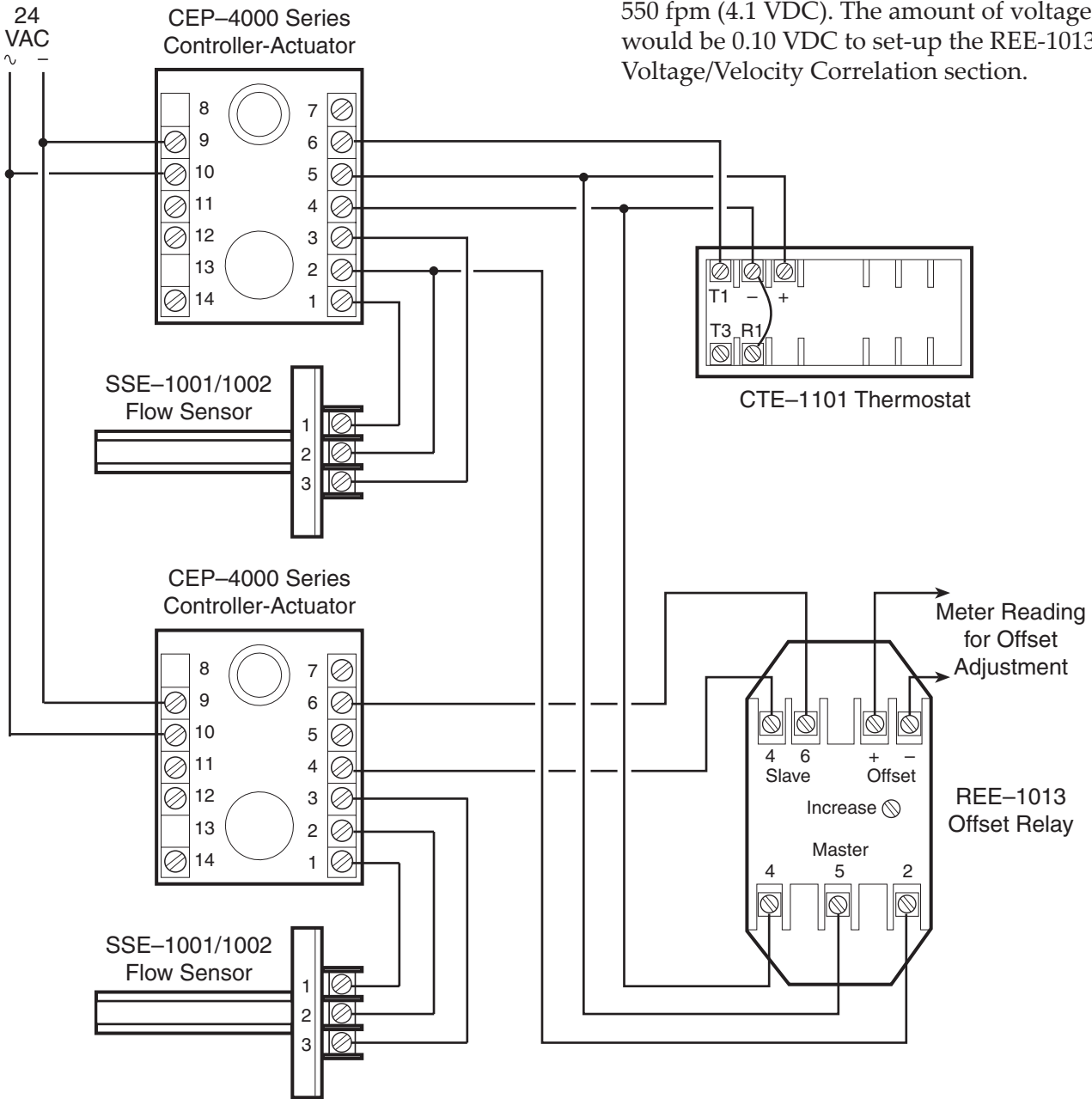
# Damper Tracking (Master/Slave)

(Former Ref. # APE-5-4001)

The configuration is used for special applications where a differential pressure is needed (either positive or negative). The CTE-1101 DA thermostat controls the “master” controller-actuator and an REE-1013 relay is utilized to control the “slave”

controller. The relay takes the voltage reading from the master controller and repeats it to the slave controller plus or minus a given offset.

As an example, the master controller is supplying a velocity of 450 fpm (4.0 VDC on terminal 6), and the relay commands the slave controller to exhaust 550 fpm (4.1 VDC). The amount of voltage “offset” would be 0.10 VDC to set-up the REE-1013. See the Voltage/Velocity Correlation section.



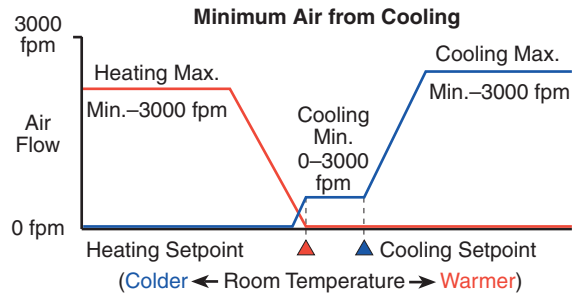
# VAV Dual Duct Cooling/Heating Applications

## Heating and Cooling VAV

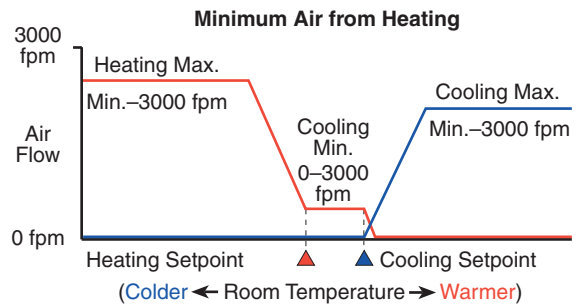
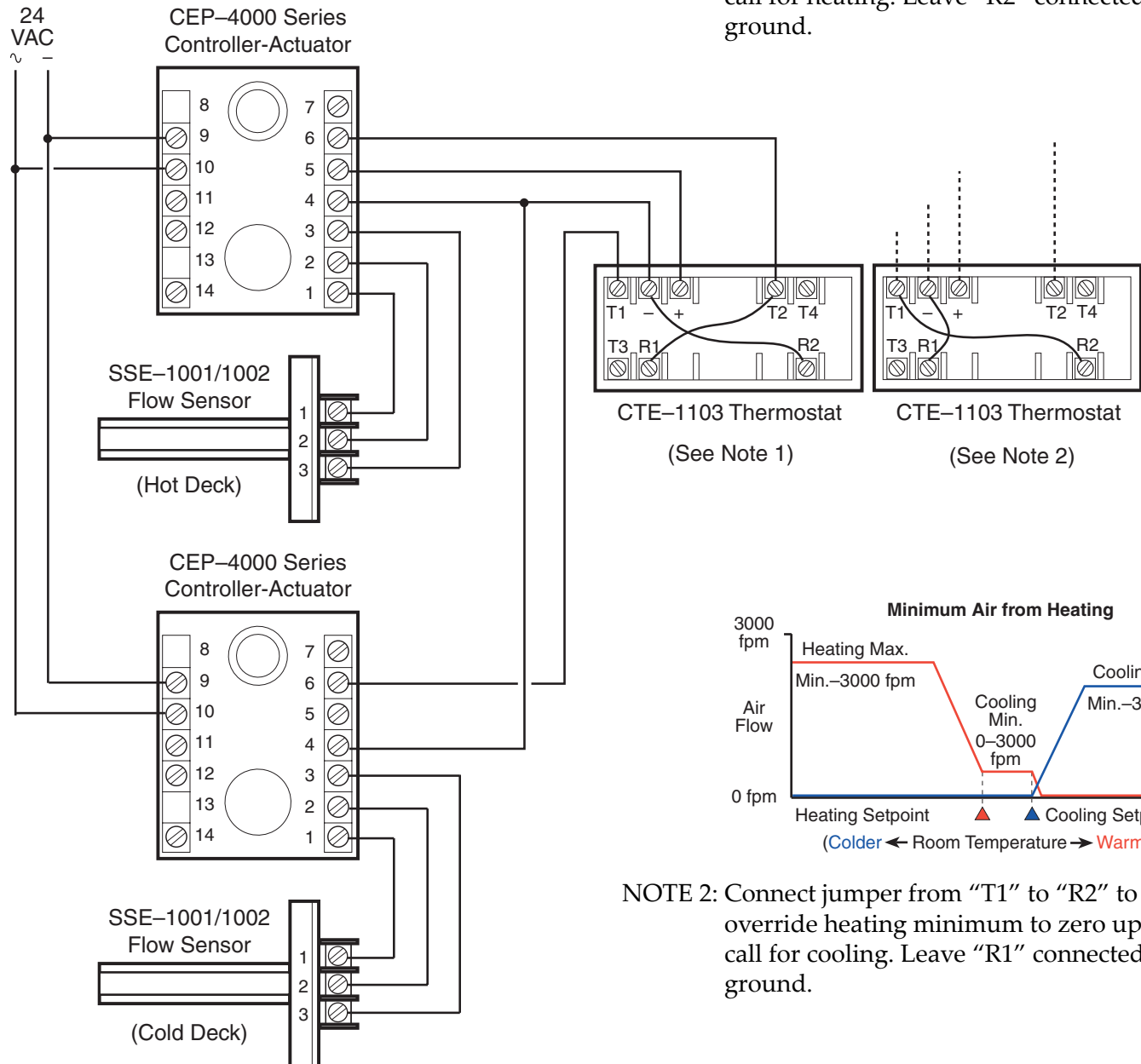
(Former Ref. # APE-2-4001)

Dual duct applications are easily accomplished by connecting two CEP-4000 series controllers with a dual setpoint (RA/DA) thermostat as shown below. In this application, the CEP controllers are mounted separately on the hot and cold air-duct dampers, with each utilizing its own flow sensor.

The hot deck controller receives its requested flow signal from "T2", while the cold deck uses the "T1" signal from the thermostat. Both units can be set independently for minimum and maximum flow settings. In addition, by using the "R" override terminal on the thermostat cold deck, minimum flow can be overridden to zero upon a call for heating (or vice versa).



NOTE 1: Connect jumper from "T2" to "R1" to override cooling minimum to zero upon call for heating. Leave "R2" connected to ground.



NOTE 2: Connect jumper from "T1" to "R2" to override heating minimum to zero upon call for cooling. Leave "R1" connected to ground.

# Heating/Cooling Constant Volume w/ Hot Deck Make-Up (Former Ref. # APE-2-4005)

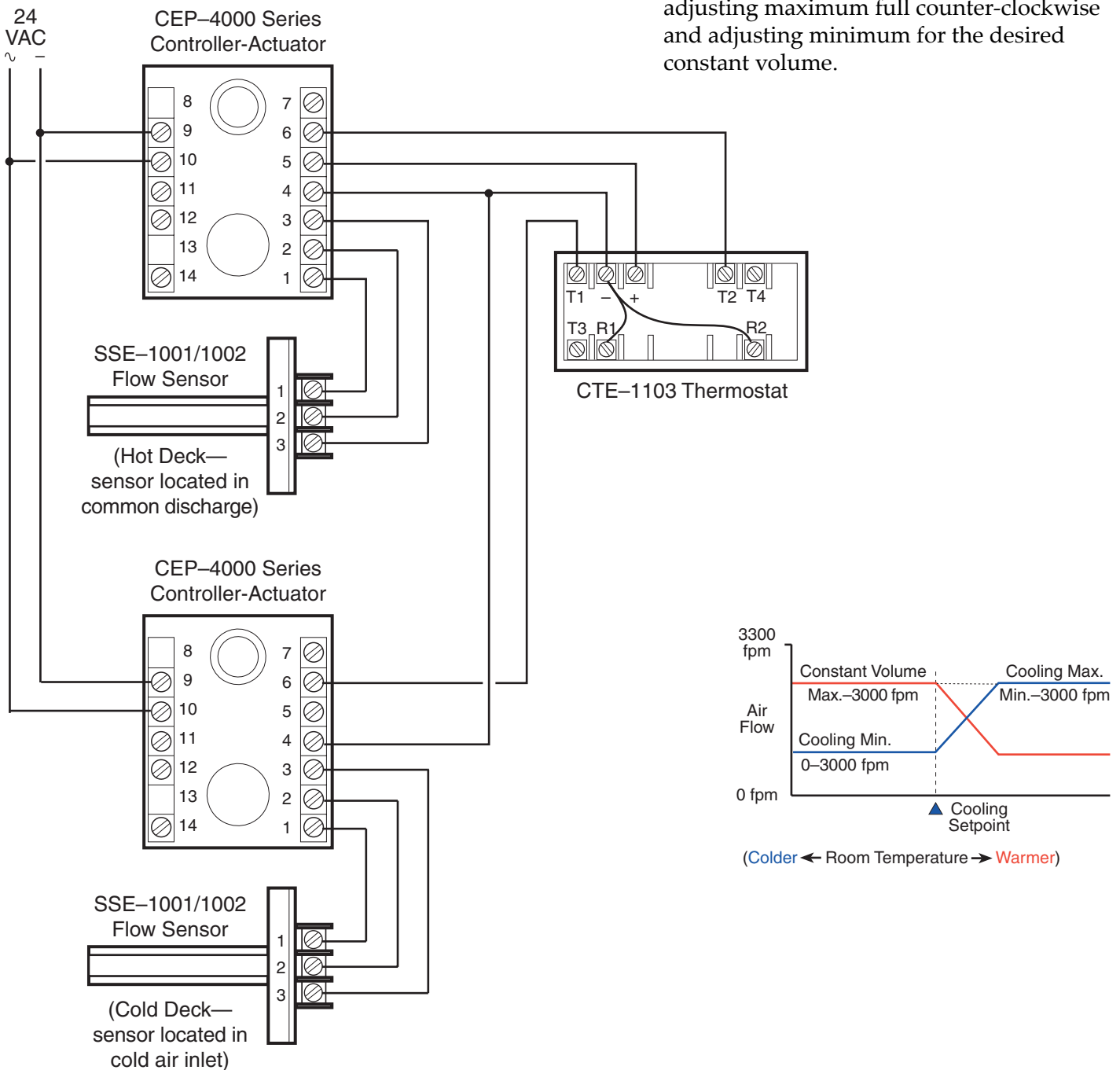
The following application is designed for dual-duct installations requiring a constant volume of airflow into the space at all times. In this application, a single-duct cooling controller is mounted on the cold air duct, and its minimum and maximum flow is reset by the room thermostat. A second "slave" controller is mounted on the hot air duct as a constant volume unit, with the flow sensor measuring downstream "total flow" into the space (the "slave" controller has no reset from the thermostat).

In summary, as the cold deck resets from maximum to minimum flow, the hot deck controller senses a decrease in "total flow" to the space, opens the hot air duct to compensate, and thus maintains a constant combined airflow into the room.

NOTE: Minimum and maximum to be set on the cooling side for VAV.

**Constant volume setting must be equal to or greater than cooling maximum.**

Set constant volume on the heating side by adjusting maximum full counter-clockwise and adjusting minimum for the desired constant volume.



# Index

- A**  
“Actual Flow” Signal: **7**  
Adjustments: **5**
- C**  
Calibration: **5**  
CEE-1000 Series: **10**  
CEP-1000 Series: **3**  
CEP-3000 Series: **3**  
CEP-4995 “Universal Replacement”: **3, 4**  
Checkout/Troubleshooting: **8**  
Cold Deck: **20, 21**  
Conformal Coating: **3**  
Constant Volume: **20, 21**  
Cooling: **12**  
Cooling/Heating Changeover: **15**  
Cooling with 3-Stage Reheat: **14**  
Cooling with Morning Warm-Up: **13**  
Cooling with Proportional Hot Water Reheat: **16**  
CTE-1000/1100/5000 Series: **9**  
CTE-1001/1101: **12**  
CTE-1002: **12**  
CTE-1004: **14, 16**  
CTE-1101: **13, 17, 19**  
CTE-1103: **15, 20, 21**  
CTE-1105: **18**  
CTE-1108: **18**
- D**  
Damper Tracking (Master/Slave): **19**  
Day/Night with Fan Box Reheat: **18**  
Dual Duct: **20**  
Duct  
    Dual: **20**  
    Single: **12**
- F**  
Fan Box with Reheat: **17**  
Flow Sensors: **7, 9**
- H**  
Heating and Cooling VAV: **20**  
Heating/Cooling Constant Volume w/ Hot Deck Make-Up: **21**  
Hot Deck: **20, 21**  
Hot Water Valve: **16**  
HPO-0062 Motor Gearbox: **3**
- M**  
Master/Slave: **19**  
Motor Gearbox HPO-0062: **3**
- O**  
Overview: **2**
- R**  
REE-1000 Series: **3**  
REE-1005: **15**  
REE-1013: **19**  
REE-4000 Series: **3**  
REE-4001: **14**  
REE-4002: **17, 18**  
REE-4006: **16**  
REE-4023: **16**  
“Requested Flow” Signal: **7**  
Rotation Setup and Override: **5**
- S**  
Single Duct: **12**  
SSE-1000/2000 Series: **7, 9**
- T**  
Terminals: **2**  
Theory, Basic Control Logic: **7**  
Thermostat: **7**  
Troubleshooting  
    System: **8**  
    Thermostat: **11**
- V**  
Valve: **16**  
VAV: **12, 20**  
Voltage/Velocity Correlation: **6**
- W**  
Wiring: **4**

**KMC Controls, Inc.**  
19476 Industrial Drive  
New Paris, IN 46553  
574.831.5250  
www.kmcccontrols.com  
info@kmcccontrols.com