

**CTE-5100 Series Thermostats:**

The CTE-5100 series thermostats are designed to be used with the CSP-5002 controller actuator. CTE-5100's are provided with limited and unlimited outputs. The limited output(s) is (are) used to provided minimum and maximum limits to a CSP-5002. The unlimited output(s) is (are) used to operate fan and heat sequences.

Models are available for cooling, cooling with reheat, cooling / heating changeover and day/night or set-back applications. Temperature averaging and/or overrides may be accomplished. Consult Nailor control submittal for applicable thermostat model.

<p><b>Models:</b></p> <p>CTE-5101 Single setpoint; Direct Acting          CTE-5103 Dual setpoint; Direct &amp; Reverse Acting          CTE-5104 Dual setpoint; Direct &amp; Reverse Acting          CTE-5105 Dual setpoint; both Direct Acting</p>	<p><b>Supply Voltage:</b> 16 Vdc (14 - 20 Vdc)  <b>Output Range:</b> 0 to 10Vdc  <b>Connections:</b> Wire clamp type: 14-22 AWG  <b>Temperature Range:</b> 55°F - 85°F (13°C - 29°C)</p>
<p><b>Thermostat Action:</b></p> <p>CTE-5101 Direct Acting (DA) T1/T3          CTE-5103 Direct Acting (DA) T1/T3, Reverse Acting (RA) T2/T4          CTE-5104 Direct Acting (DA) T1/T3, Reverse Acting (RA) T2          CTE-5105 Direct Acting (DA) T1/T2/T3/T4</p> <p><b>Base Material:</b>          Black ABS, UL Flame Class 94HB</p> <p><b>Size</b> 2 9/16" (65 mm) x 3 7/16" (87 mm)</p>	<p><b>Proportional Band:</b></p> <p>CTE-5101/3/5 2°F, (1.1°C) w/limits output (T1/T2)          4°F, (2.2°C) w/o limits output (T3/T4)</p> <p>CTE-5104 2°F, (1.1°C) w/limits output (T1)          2°F, (1.1°C) w/limits output (T2/T3)</p>

**Table 1.** Thermostat Specifications.

**Installation:**

Thermostats must be mounted horizontally,(or vertically by using an optional vertical scale plate), utilizing the HMO-5030/5031 backplates for mounting to a standard 2" x 4" electrical box, or the optional HMO-5023 drywall bracket for mounting to hollow walls. Thermostats should be mounted on a wall in an area not affected by sunlight or drafts, to sense the average room temperature.

**Electrical box mounting:**

Install the HMO-5030/5031 backplate to the electrical box using the two 6-32 screws, supplied with backplate – do not tighten. The backplate is provided with one slotted mounting hole for leveling. Level the backplate and tighten the two mounting screws. Pull thermostat wires through backplate and decorative trim plate. Connect thermostat wires to the thermostat according to the wiring diagram supplied with the unit. Position the trim between the back plate and the thermostat, secure the assembly with the two 6-32 x 2" self tapping screws supplied.

**Hollow wall mounting:**

Loosely mount the HMO-5023 bracket to the thermostat using the two 6-32 x 2" screws. Pull all thermostat wiring through the opening on the bracket. Connect thermostat wires to the thermostat according to the wiring diagram supplied with the unit. Center and align the thermostat while tightening the mounting screws.

Thermostat Terminals	5101	5103 5105	5104	Terminals Description
V1	X	X	X	Velocity input for readout, connect to "out" on CSP-5002
T3	X	X	X	Upper setpoint output w/o limits (0 -10 Vdc)
R1	X	X	X	T1 override, connect to "-" if unused. Voltage applied subtracts from T1
T1	X	X	X	Upper setpoint output w/limits. Adjustable at pot.on front of thermostat
+	X	X	X	16 Vdc power supply input
12V	X	X	X	12 Vdc power output
A	X	X	X	Temperature averaging input
-	X	X	X	Ground reference
T2		X	X	Lower setpoint, output w/limits. * Adjustable at pot. on front of thermostat
R2		X	X	T2 override connect to "-" if unused **
T4		X		Lower setpoint output w/o limits (0 -10 Vdc)
V2		X		Velocity input for readout

\* Except 5104; T2 lower setpoint output is w/o limits.

\*\* R2 is auxiliary limit trigger on model 5104. Voltage above 1 Vdc @ R2 indexes T1 to the auxiliary flow limit. Install jumper R2-T2 for automatic indexing of aux. flow setting.

**Table 2.** Thermostat Wiring Terminals and Description.

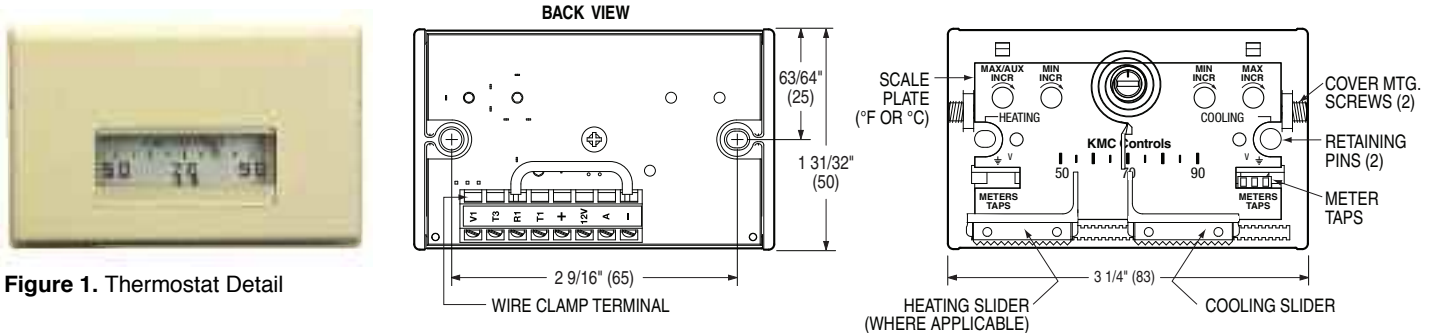


Figure 1. Thermostat Detail

**Maintenance:**

No routine maintenance is required. Each component's design and material selection assures dependable long-term reliability and performance. Careful installation will also enhance long term reliability and performance.

**CSP-5002 DAMPER CONTROLLER/ACTUATOR**

All Nailor standard right hand (and optional left hand) terminal units have a 1/2" (13), diameter drive shaft and a clockwise to close damper rotation (Dual Duct Left Hand Deck CCW to close). Full damper shaft rotation is 45 or 90 degrees depending on model. The CSP-5002 should be mounted on the damper drive shaft so the actuator will stall at either end of the stroke to ensure tight shut-offs and full rotation.

Ensure the two jumpers are set for the correct damper rotation.

The CSP-5002 has a tri-color LED that indicates the current action of the damper: RED – Closing, GREEN – Opening, WHITE – Satisfied.

The CSP-5002 provides pressure independent VAV control for terminal unit primary valves. Primary air volume is monitored by the use of a multi-point flow sensor located in the inlet duct. Differential pressure is measured by an onboard platinum transducer. The changes in the inlet static pressure will vary the position of the inlet damper. Flow limit adjustments are made using a digital DC voltmeter at the thermostat. The CSP-5002 is factory calibrated with VNOM adjustment centered for the enclosed voltage - airflow charts. Do not adjust. Dampers are always shipped in the full open position.

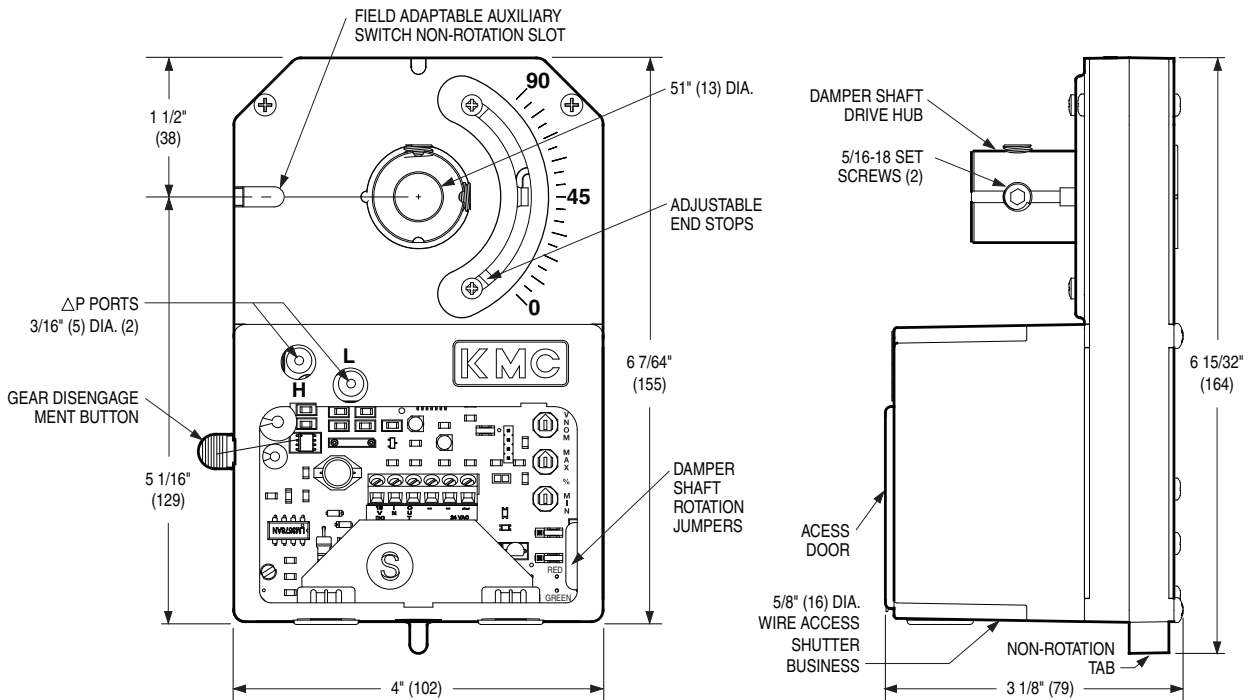


Figure 2. CSP-5002 Controller / Actuator

**POWER REQUIREMENTS:**

Controller / actuator / thermostat is 7VA plus any output loads for fan relays, heating contactors and control valves (assume 10 VA each). Always switch control voltage off prior to disconnecting any wires from the controller.

## ANALOG CONTROL CALIBRATION CHARTS

### VOLTAGE VS. AIRFLOW

When field adjustment or field calibration of the CTE-5100 series thermostats is necessary, desired limit control can be calculated using the tables in Figure 3 and the following formulas, or the charts presented in Figures 4 through 8.

**Formulas:**

$$CFM = K (VDC - \text{Offset}) \quad VDC = (CFM/K) + \text{Offset}$$

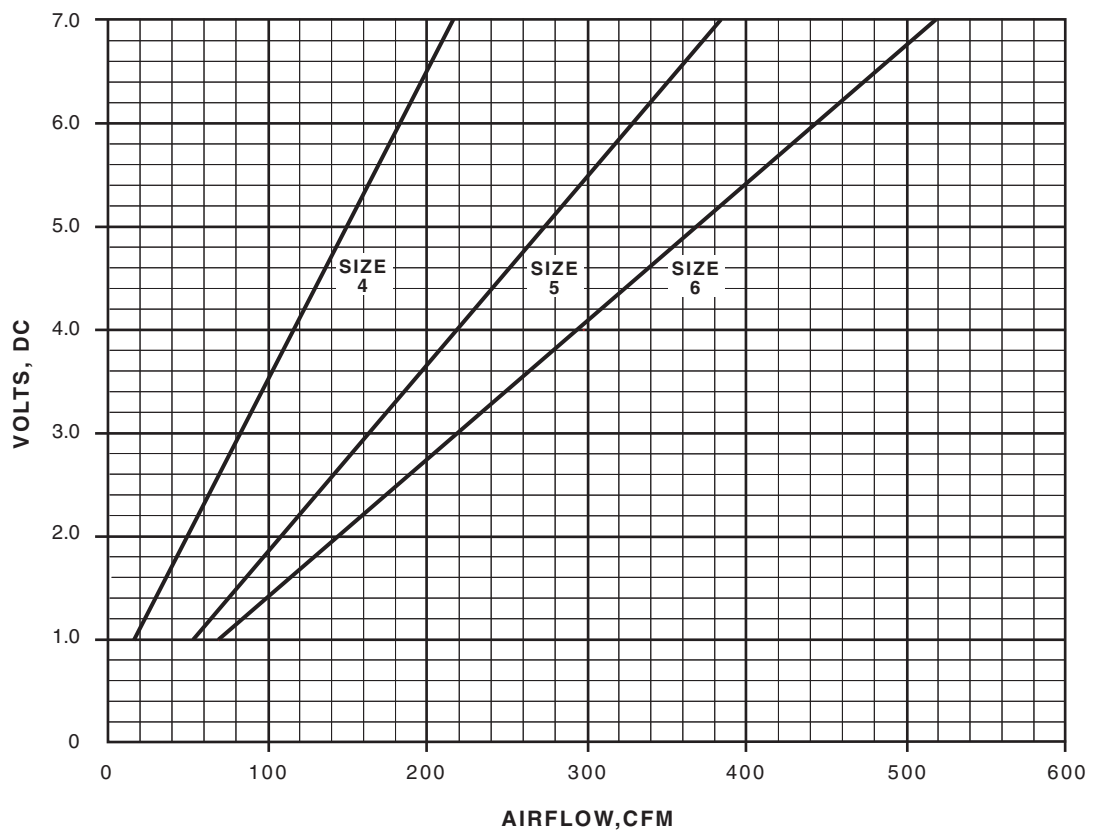
Follow the individual calibration procedure for the thermostat model(s) as required.

Inlet size	K factor	Offset
4 in. Round	33	+ 0.44
5 in. Round	55	+ 0.02
6 in. Round	75	+ 0.08
7 in. Round	115	- 0.19
8 in. Round	143	+ 0.32
9 in. Round	175	+ 0.10
10 in. Round	233	+ 0.09
12 in. Round	357	- 0.04
14 in. Round	500	- 0.07
16 in. Round	625	- 0.25

Inlet size	K factor	Offset
12 in. Oval	333	- 0.22
14 in. Oval	417	- 0.47
16 in. Oval	588	+ 0.05
18 in. Oval	759	- 0.27

Inlet size	K factor	Offset
14 x 10	417	- 0.14
24 x 16	1250	- 0.07

**Figure 3.** Diamond Flow Sensor K Factors.



**Figure 4.** Inlet Sizes 4, 5, 6 Round

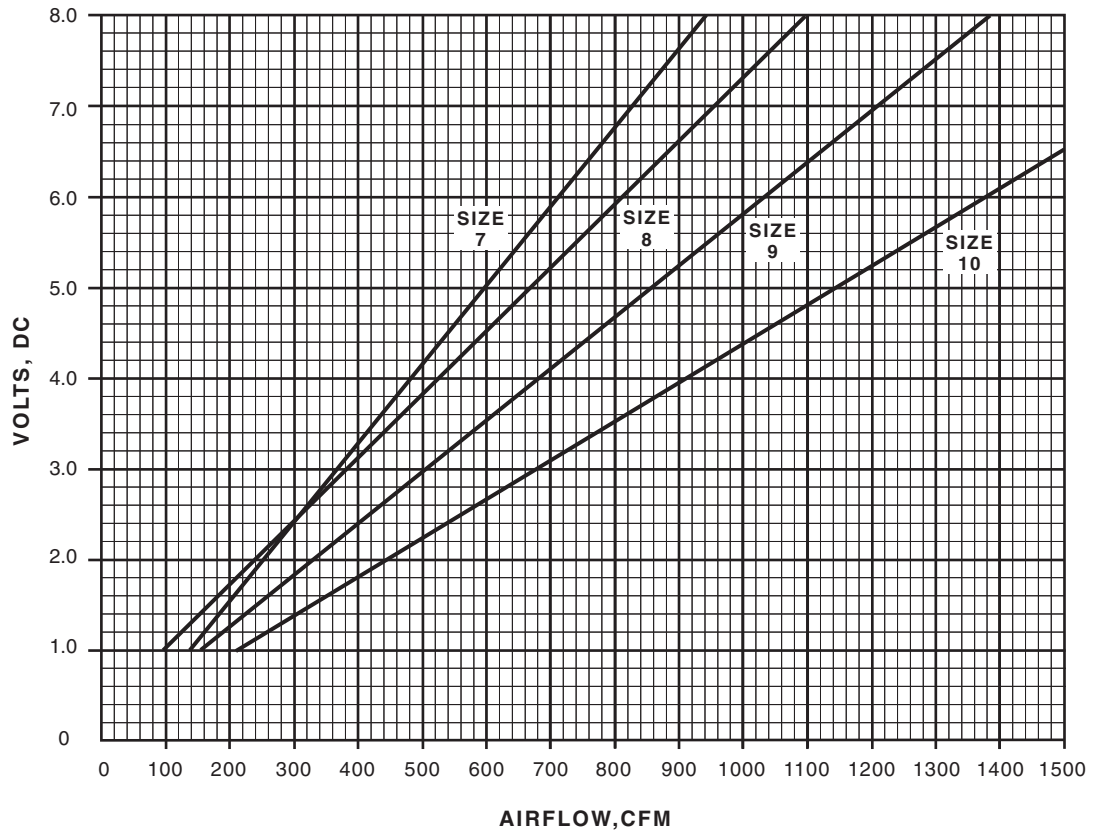


Figure 5. Inlet Sizes 7, 8, 9, 10 Round

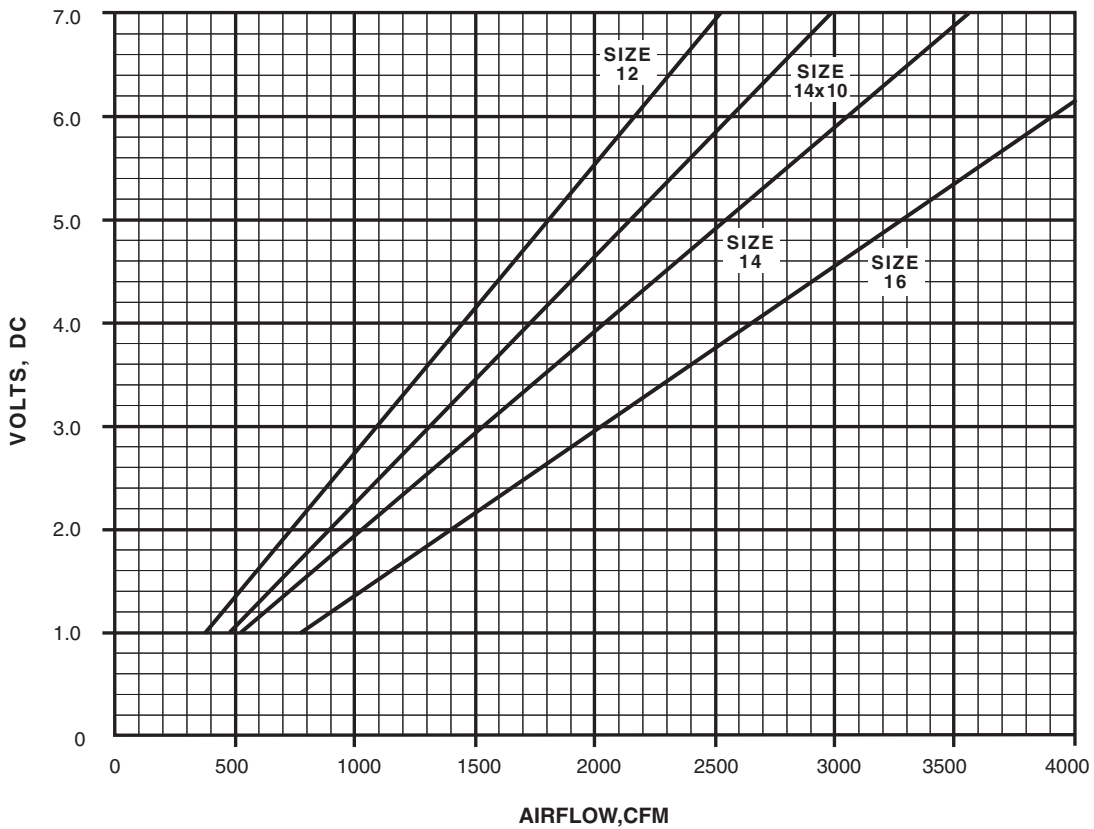
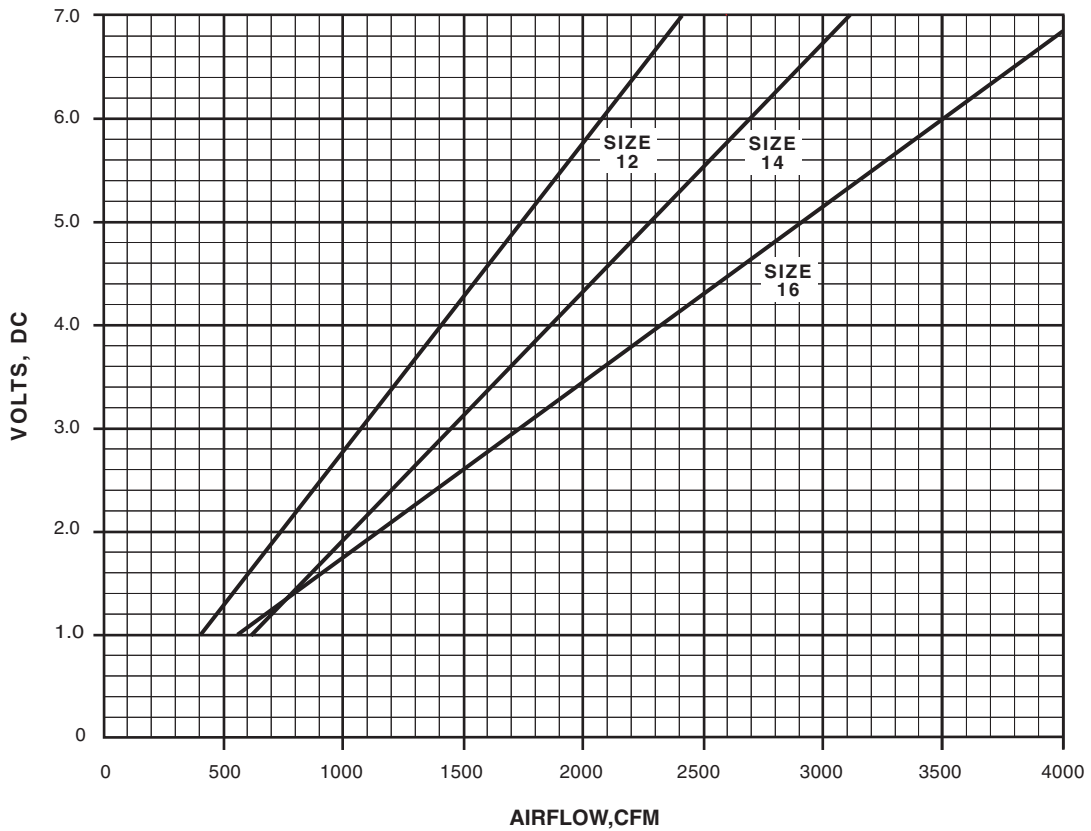
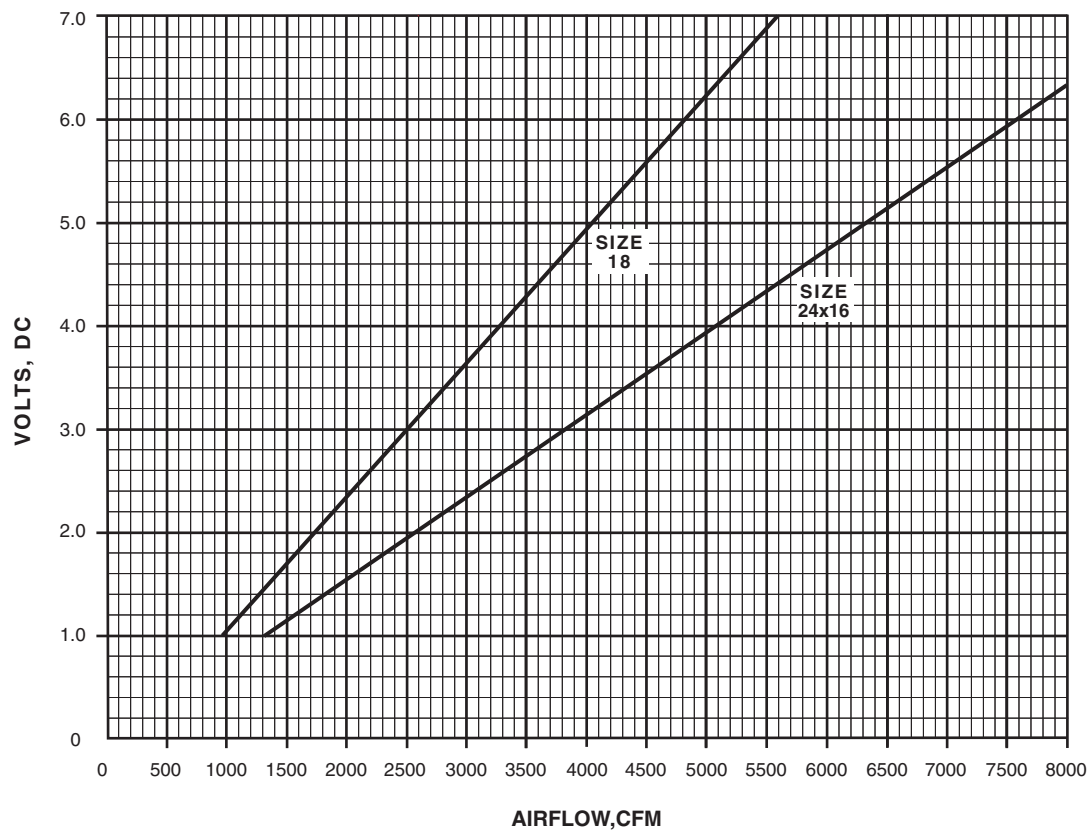


Figure 6. Inlet Sizes 12, 14, 16 Round. 14 x 10 Rectangular



**Figure 7.** Inlet Sizes 12, 14, 16 Oval (Single Duct Only)



**Figure 8.** Inlet Size 18 Oval. 24 x 16 Rectangular

**CALIBRATION PROCEDURE FOR AIR VOLUME ADJUSTMENTS MADE AT THERMOSTAT**

Thermostats are factory calibrated when minimum and maximum airflow limits are provided. Field calibrations are as follows:

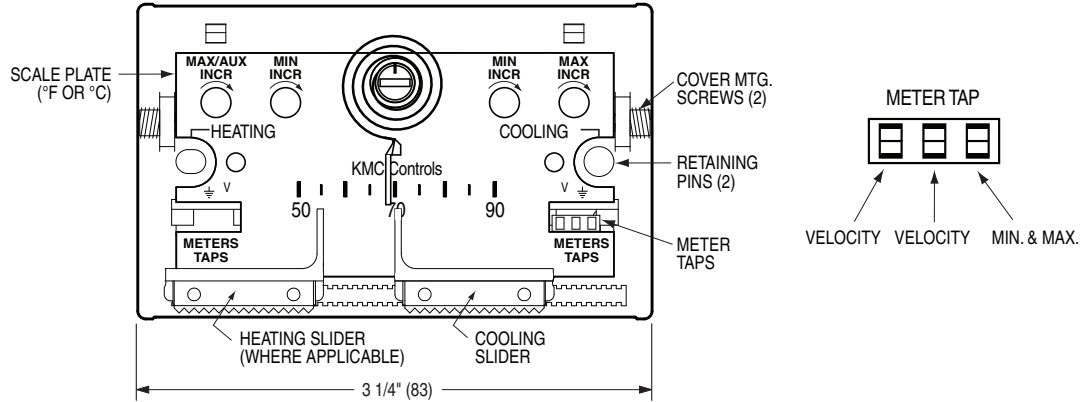
Minimum and maximum setpoints (air volume limits), are set at the thermostat. Check the CSP-5002 controller to ensure that the minimum and maximum potentiometers are dialed completely out (min. CCW, max. CW), so that the thermostat signal is not restricted.

**A – Required Tools:**

1. Small flat blade screwdriver 1/8" / 3 mm
2. Digital voltmeter w/DC range to hundredths
3. Hex Wrench 1/16" / 2mm for the cover screws
4. A test lead (HSO-5001) is recommended for meter readings

**B – Remove Thermostat Cover:**

Thermostat cover is removed by turning the two set screws CW, (which are located on the short sides of the thermostat). Remove cover and setpoint slider stops if installed.



**Figure 9.** Thermostat scaleplate detail.

**CTE – 5101 SINGLE SETPOINT THERMOSTAT**

(DA T1 with limits, T3 without limits)

1. Ambient temperature at the thermostat must be between 55°F – 85°F (13°C – 29°C).
2. Adjust the setpoint slider all the way to the right for minimum cooling. Connect voltmeter to the cooling (right side) voltmeter taps. The center and right tap provide the VDC readings (min/max airflow). The center and left tap provide the actual air volume (live velocity) reading when thermostat V1, is connected to the controller OUT terminal.
3. Read the VDC across the taps. Adjust the MIN INCR potentiometer to the VDC equal to the desired air volume as shown on the chart.  
NOTE: The minimum setpoint must be set first. Adjustment of the minimum potentiometer directly affects the maximum setpoint.
4. Adjust the setpoint slider all the way to the left for maximum cooling.
5. Read the VDC across the taps. Adjust the MAX INCR potentiometer to the VDC equal to the desired air volume as shown on the chart.  
NOTE: The maximum setpoint must be set last. Adjustment of the minimum potentiometer directly affects the maximum setpoint.
6. Return the setpoint slider to the desired setpoint. Install the optional setpoint stops if required and replace thermostat cover.

**CTE - 5103 DUAL SETPOINT THERMOSTAT (Heat / Cool Changeover)**

(DA T1/T3. RA T2/T4. T1, T2 with limits, T3, T4 without limits)

**Cooling side of thermostat**

1. Follow steps 1 through 5 for the CTE-5101 thermostat. Note: Be sure to adjust the cooling setpoint slider all the way to the left for maximum cooling. (The heating setpoint slider will have to be adjustable all the way to the left also).

**Heating side of thermostat**

1. Ambient temperature at the thermostat must be between 55°F - 85°F (13°C - 29°C).
2. Adjust the heating setpoint slider all the way to the left for minimum heating. Connect voltmeter to the heating (left side) voltmeter taps. The center and right tap provides the VDC readings (min/max airflow).
3. Read the VDC across the taps. Adjust the MIN INCR potentiometer to the VDC equal to the desired air volume as shown on the chart.  
NOTE: The minimum setpoint must be set first. Adjustment of the minimum potentiometer directly affects the maximum setpoint.
4. Adjust the heating slider all the way to the right for maximum heating.
5. Read the VDC across the taps. Adjust the MAX INCR potentiometer to the VDC equal to the desired air volume as shown on the provided chart.  
NOTE: The minimum setpoint must be set first. Adjustment of the minimum potentiometer directly affects the maximum setpoint.
6. Return both setpoint sliders to the desired setpoints. Install the optional setpoint stops if required and replace thermostat cover.

## CTE – 5104 DUAL SETPOINT THERMOSTAT

(DA T1/T3. RA T2. T1 with limits, T2, T3 without limits)

### Cooling side of the thermostat

- Follow steps 1 through 5 for the CTE-5101 single setpoint thermostat. Note: Be sure to adjust the cooling setpoint slider all the way to the left for maximum cooling. (the heating setpoint slider will have to be adjustable all the way to the left also).

### Adjustment of the Auxiliary Setpoint - Higher reheat minimum (if required).

- Read the VDC across the meter taps on the heating (left) side of the thermostat. With the left hand slider in the full heat position, completely to the right, adjust the MAX/AUX INCR potentiometer to the VDC equal to the desired air volume as shown on the chart. If a higher Aux Min is not required, dial fully CCW.
- Return both setpoint sliders to the desired setpoints. Install the optional setpoint stops if required and replace thermostat cover.

## CTE – 5105 DAY / NIGHT THERMOSTAT (Night Temperature Set Back)

(DA T1/T2/T3/T4. T1/T2 with limits, T3/T4 without limits)

### Day side of thermostat

- Follow steps 1 through 5 for the CTE-5101 thermostat.

Note: Be sure to adjust the day setpoint slider all the way to the left for maximum cooling. The night setpoint slider will have to be adjusted all the way to the left also.

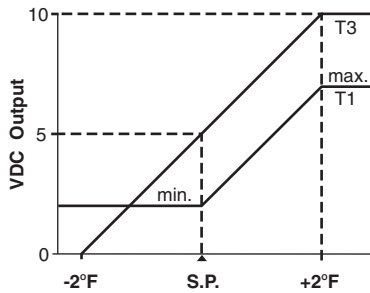
- Return both setpoint sliders to the desired setpoints. Install the optional setpoint stops if required and replace thermostat cover.

### Night side of thermostat

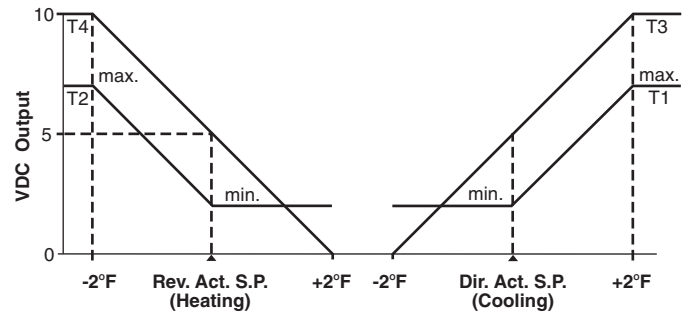
- Follow steps 1 through 5 for the CTE-501 thermostat.

Note: Be sure to adjust the night setpoint slider all the way to the right for minimum cooling. The day setpoint slider will have to be adjusted all the way to the right also.

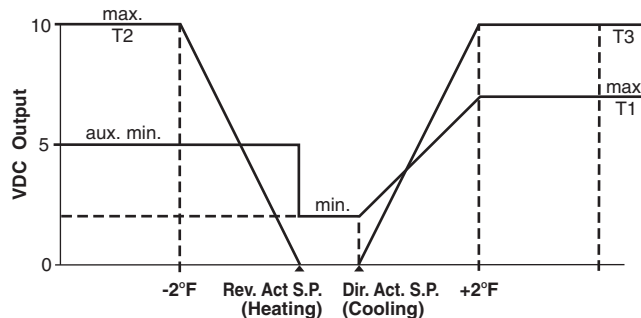
- Return both setpoint sliders to their desired setpoints. Install the optional setpoint stops if required and replace thermostat cover.



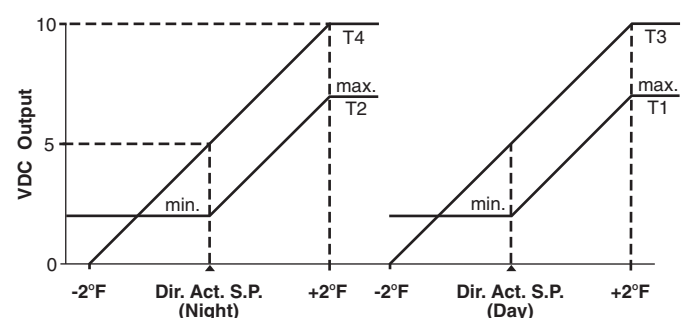
CTE-5101 Thermostat



CTE-5103 Thermostat



CTE-5104 Thermostat



CTE-5105 Thermostat

Figure 10. Thermostat action schematics.

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## GENERAL INFORMATION FOR ALL TERMINAL UNITS

### Checkout Procedure

The CSP-5002 actuator will take up to 2.5 minutes for a 45 degree stroke damper and up to 5.0 minutes for a 90 degree stroke damper to cycle from its minimum to its maximum setting and vice versa. It is important therefore when verifying minimum and maximum flow limits, by moving the slider(s) right or left as previously described, to wait sufficient time to ensure the actuator has moved to its correct position and that the live velocity read-out (if used) has settled.

### Live Supply Volume Readout

A voltage output corresponding to actual primary air volume may be monitored at the room thermostat to assist in balancing and troubleshooting. The output signal is the same as the airflow volume vs. DC voltage calibration curve. The test lead (HSO-5001) is connected to the innermost meter taps on the thermostat scaleplate (see Figure 9).

### Supply Air Temperature Sensing

A duct mounted temperature sensor (thermistor) is used to measure primary air temperature in control sequences involving automatic changeover (ACO) or morning warm-up (MWU). The probe is attached to the inlet collar and wired to the low voltage controls enclosure. To ensure proper operation for auto changeover, a minimum flow setting should be used for both heating and cooling modes. This allows airflow to constantly pass over the duct temperature sensor.

### Proportional Reheat Control

Hot water valves and SCR controllers with a 0 -10 Vdc control signal (10mA max,) are wired (+) to terminal 'T2' on the thermostat and (-) to the grounded side of the low voltage control circuit. T2 is an output with limits and it must therefore be ensured that the thermostat limits are dialed out (max. pot. fully CW and min. pot fully CCW) for unrestricted operation.

## FAN POWERED TERMINAL UNITS

### Night Shut Down

Units ordered with optional Night Shut Down (NSD) sequences employ an airflow switch to sense when primary air has been shut down. When the airflow switch opens the fan and optional heat are shut down. Upon the primary air starting, the airflow switch will close and return the unit to normal operation.

### Night Temperature Setback

Units ordered with optional Night Temperature Setback (NTSB) sequences employ an airflow switch to sense when the primary air (central air handler) has been shut down. When the airflow switch opens, a lower night time temperature setpoint is initiated. The unit fan and optional supplementary heat will cycle intermittently to maintain night setpoint temperature. Upon start up of the central air handler, the unit will return to daytime operation. Amount of setback is either fixed or adjustable dependent on control sequence. Refer to control submittal.

### Night Cycle

On series units with optional night cycle sequences, an airflow switch de-energizes unit fan upon loss of primary (central system) air. Upon a call for heat, the thermostat will override the airflow switch and cycle the unit fan followed by any supplementary heat intermittently to maintain day setpoint temperature.

On parallel units, basic control sequences cycle the fan and supplementary heat intermittently as standard in response to thermostat demand. This will therefore still occur at night when the central air has been shutdown.

### Checkout Procedure (Day / Occupied Mode)

Series Fan Powered Terminal Units: The fan should be energized regardless of slider(s) position. Dependent on control sequence ordered, thermostat may have one or two sliders. Consult control sequence submittal / wiring diagram and thermostat calibration procedure.

Parallel Fan Powered Terminal Units: Fan will only cycle upon a call for heat. Move single slider (or both if a separate heating or night slider is present) full right to energize fan. Dependent on control sequence ordered, thermostat may have one or two sliders. Consult control sequence submittal / wiring diagram and thermostat calibration procedure.

### Checkout Procedure (Night / Unoccupied Mode)

Move thermostat slider(s) full right to energize fan and supplementary heat.

## REE – 5002 Relay Module Fan with 2 Stage Reheat

The REE-5002 is used in all parallel flow terminal units, and specific series flow terminal units with the night cycle or setback options. The relay cycles the fan and activates up to 2 stages of heat in response to a direct acting 0 -10 Vdc thermostat output. The fan start point is adjustable from 3-8 Vdc which equates to -0.8 to +1.2°F, (-0.4 to +0.7°C), around setpoint. The factory setting is 4 Vdc (-0.4F below cooling setpoint / min. primary airflow setting). To field adjust, read the Vdc across terminals "X" and "-". Adjust the potentiometer to Vdc desired setpoint. The two stages of heat are sequenced to energize after the fan is activated when the desired room temperature continues to decrease.

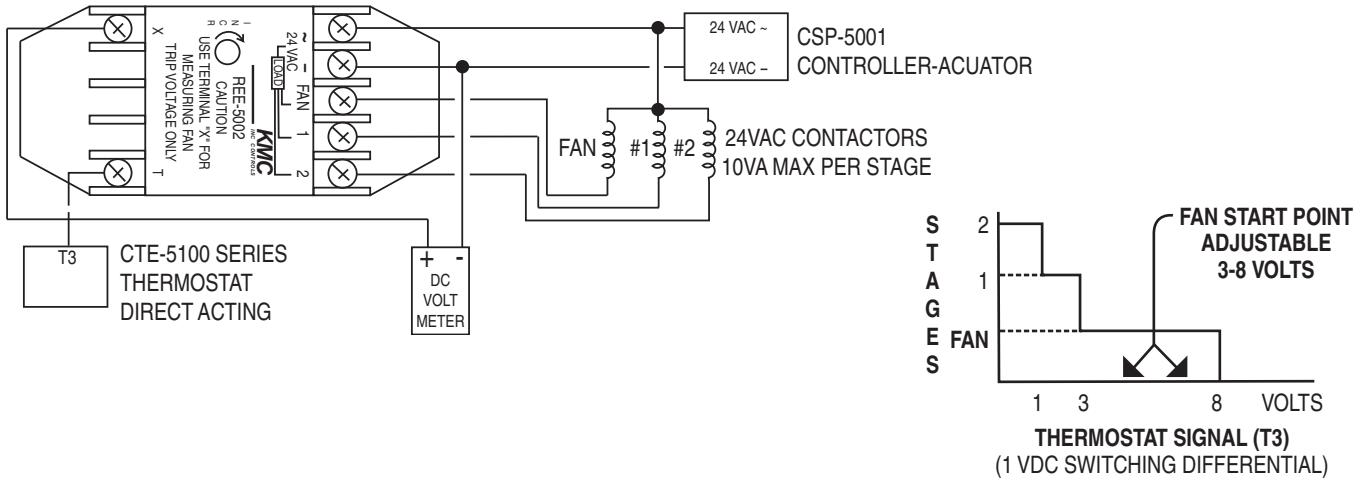


Figure 11. Ree-5002 Relay Module. Fan with 2 stage reheat.

## TROUBLESHOOTING PROCEDURE

Note: Turn off power before making any wiring changes to the unit.

1. Verify 24 Vac at CSP-5002 controller / actuator terminals "~" (phase) and "-"(ground). Tolerance +20 / -15% (20.4-28.8 Vac). When using a common transformer for more than one CSP-5002, polarity should be observed.
2. Check correct field wiring from thermostat to terminal block in unit low voltage enclosure. Refer to Nailor control wiring diagram inside controls enclosure. Ensure all wiring connections are tight and secure.
3. Check tubing from unit inlet flow sensor to the controller / actuator is correct and no leaks. "Hi" side of sensor to "H" on controller / actuator and "Lo" side of sensor to "L" on controller / actuator.
4. Verify 16 Vdc at CSP-5002 terminals "16 VDC" and "-". Tolerance is 15 to 17 Vdc power supply to thermostat. If not correct, disconnect thermostat and recheck. If still incorrect, replace CSP-5002 controller / actuator.
5. Check requested minimum and maximum flow settings on terminals "IN" and "-". Refer to Vdc vs. Airflow setting charts at back of this document. If reading is not what is desired, refer to thermostat calibration procedure.
6. Check actual airflow (live velocity readout) voltage on terminal "OUT" and "-" (0 – 10 Vdc). Use calibration charts provided.
7. Check for damper movement and correct rotation.
  - a) Review "requested flow" and actual flow" above to determine if unit should be satisfied (within 50 fpm +/- 0.20 Vdc) or driving damper open or closed.
  - b) If damper is not moving, verify damper is not stuck at end of travel and has free movement. Use manual release clutch on CSP-5002. Check CW / CCW rotation jumpers for proper operation. Ensure damper actuator connection is correct and damper can travel fully open to fully closed within limits of the actuator stroke. Check actuator coupling to damper shaft setscrews are tight.
  - c) Change "requested flow" to make unit drive opposite direction (verifying correct damper movement). This can be accomplished by moving thermostat setpoint sliders or:
    - i) To manually open damper, remove wire from terminal "IN" and jumper terminal "IN" to 16Vdc". This will tell unit to control at full airflow and the green LED should turn on, driving damper fully open.
    - ii) To manually close damper, remove wire from terminal "IN" and jumper terminal "IN" to "-" terminal. This will tell unit to control at zero airflow and the red LED should be on, driving damper fully closed.

**Warning:** Never jumper terminal "16 Vdc" to "-", as this will cause short and possibly damage the power supply.

**COMPONENTS, ACCESSORIES, REPLACEMENT PARTS**

DESCRIPTION		VENDOR PART NO.	NAILOR PART NO.
KMC	Controller / Actuator	CSP-5002	V3004
(Kreuter)	Controller / Actuator	CSP-4606	V3005
	Controller / Actuator	CSP-4616	V3006
	In-line filter for CSP-4XXX	HFO-0034	V3007
<b>KMC (Kreuter) Room Thermostat and accessories:</b>			
CTE-5100 Series - (0 -10 Vdc):			
	DA clg. (base only)	CTE-5101	V3030
	DA clg. / RA htg. (base only)	CTE-5103	V3031
	DA clg./RA reheat (base only)	CTE-5104	V3032
	DA / DA (Day / Night) (base only)	CTE-5105	V3033
Accessories for CTE-5100 Series:			
	Thermostat Cover - light almond	HPO-1511	V1060
	- White	HPO-1512	V1061
	Backplate mounting kit		
	(for mounting to a 2 x 4 handy box) - light almond	HMO-5024	V1062
	- White	HMO-5026	V1063
	Mounting Strap kit (for mounting on hollow wall)	HMO-5023	V1064
	Horizontal Scale Plate - °F	HPO-0060-10	V1069
	- °C	HPO-0060-11	V1070
<b>Miscellaneous:</b>			
KMC	Electric reheat relay module, 3 stage	REE-5001	V3050
KMC	Wet heat time prop. relay module	REE-5106	V3053
	DA/NC valve	REE-5123	V3054
	RA/NO valve	REE-5002	V3055
KMC	Fan/elec. heat relay module, 2 stage	REE-5017	V3056
KMC	Fan/wet heat time prop. relay module	REE-5024	V3057
	DA/NC valve	REE-1004	V3058
	RA/NO valve	REE-1005	V3059
KMC	Constant volume relay module	REE-1005	V3059
KMC	Heat / Cool changeover module	STE-1002	V3060
KMC	Duct temp. changeover sensor (for use with REE-1005)	FS-BO-182	V3061
	Airflow Switch	9100-233Q323	V3062
	DPDT Relay 24V.		
<b>Transformers (foot mount):</b>			
120	to 24 V. 40 VA	-	VH1-669
120	to 24 V. 50 VA	-	VH1-692
208/240	to 24 V. 40 VA	-	VH1-670
208/240	to 24 V. 50 VA	-	VH1-685
277	to 24 V. 40 VA	-	VH1-675
277	to 24 V. 50 VA	-	VH1-674
277	to 24 V. 75 VA	-	VH1-677
480	to 24 V. 50 VA	-	VH1-686
208/240/480	to 24 V. 40 VA	-	VH1-671
120/208/240/480	to 24 V. 75 VA	-	VH1-689
24	to 24 V. 40 VA	-	VH1-673



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