

Start-up Procedures for TEC Custom Solutions
Variable Air Volume Cooling and Heating
Terminal Box Controller with Two-Inch Water
Column Measurement Range — Electronic
Output

TEC 0831.11

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Verifying Power to Controller

NOTE: Update each controller at the field panel immediately after you have completed the controller start up procedures and made all other changes to the controller's point database, including balancing, tuning, etc.

Verify that the Terminal Box Controller is powered up. Check that the BST LED on the controller is flashing (Figure 1). If the BST LED does not flash on/off once per second, then refer to the *APOGEE Automation Service Procedures Manual* in InfoLink for troubleshooting information.

NOTE: The Controller Interface Software (CIS) used with the Terminal Box Controller – Electronic Output (firmware revision VE10 or higher) must be Rev. 2.0 or greater. Voyager's point database may also be used for start-up.

Enabling the Damper Actuator

Using the portable operator's terminal, follow these steps to set the damper actuator run time:

1. Verify that APPLICATION (Point 2) is set to **2091** (slave mode).
2. Display the STARTUP report.
3. Set MTR1 TIMING (Point 51) to the correct run time of the actuator. Refer to Table 1.

Table 1. Damper Actuator Run Time.

Possible Damper Actuators	Setting (seconds)	
	50 Hz	60 Hz
349-0101	106	88
GDE 131.1U	108	90
GDE 131.1P	108	90
GLB 131.1P	150	125
¹ GBB 171.1U	150	150
² GDE 161.1P	108	90
² GLB 161.1P	150	125

¹ GBB 171.1U run time is independent of Hz.

² Analog output 0-10V.

See the Manufacturer's Installed Controls (MIC) web page on Landscape <http://landscape.us.abatos.com/mic/> for specific manufacturers' damper opening details (90°/60°/etc.).

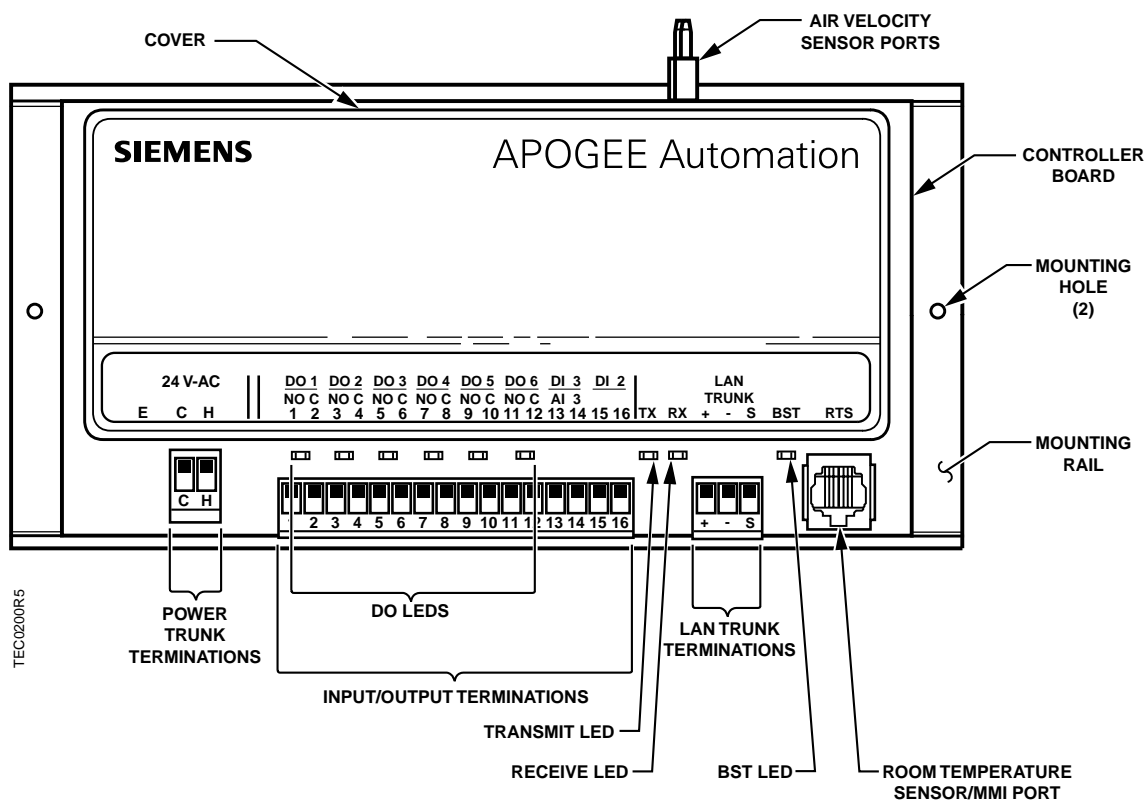


Figure 7. Terminal Box Controller – Electronic Output.

4. If the damper rotation angle is a value other than 90°, then set DPR1 ROT ANG (Point 56) to the appropriate value.
5. Enable the damper actuator by setting MTR SETUP (Point 58) to **1**. Verify that the damper closes completely. If it does not close completely, reverse the action of the damper actuator by setting MTR SETUP to **3**.

If the damper still does not close completely, then the actuator has been installed or set up incorrectly. Refer to the damper actuator installation instructions, set up information, Table 2, or the *APOGEE Automation Service Procedures Manual* in InfoLink for more information.

Table 2. Motor Enable/Reverse Values for MTR SETUP (Point 58).

	Motor 1 Enabled			Motor 1 Enabled and Reversed			Motor 1 Not Used		
	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed
Motor 3 Not Used	1	5	13	3	7	15	0	4	12
Motor 3 Enabled	17	21	29	19	23	31	16	20	28
Motor 3 Enabled and Reversed	49	53	61	51	55	63	48	52	60

Enabling Valve 1 Actuator

If applicable, follow these steps to enable the valve 1 actuator:



CAUTION:

If an Autozero Module is used, then do not enable MTR3 or valve 2.

1. Set MTR2 TIMING (Point 55) to the correct run time of the valve 1 actuator. Refer to Table 3.

Table 3. Valve Actuator Run Time.

Possible Valve Actuators	Setting (seconds)	
	50 Hz	60 Hz
SSB81U (Powermite – MZ Series)	180	150
SQS 82	155	130
SQS 65U (analog output 0-10V)	35	30
SQS 65.5U (analog output 0-10V)	35	30
SSB 61U (analog output 0-10V)	N/A	150

- 1.
2. Enable the valve 1 actuator by changing MTR SETUP (Point 58) as follows:
 - If a damper actuator is present and enabled (MTR SETUP = 1), then also enable the valve 1 actuator by changing MTR SETUP to **5**.
 - If a damper actuator is present, enabled, and reverse acting (MTR SETUP = 3), then also enable the valve 1 actuator by changing MTR SETUP to **7**.

3. Verify that valve 1 closes and remains closed. If the valve does not close, then reverse the action of the valve 1 actuator by changing MTR SETUP as follows:
 - If the damper actuator is enabled, then change MTR SETUP to **13**.
 - If the damper actuator is enabled and reverse acting, then change MTR SETUP to **15**.

Enabling Valve 2 Actuator

Applications 2420 through 2427: If applicable, then follow these steps to enable the valve 2 actuator:

1. Set MTR3 TIMING (Point 39) to the correct run time of the valve 2 actuator. Refer to Table 3.
2. Enable valve 2 actuator by changing MTR SETUP (Point 58) as follows:
 - If a damper actuator is present and enabled (MTR SETUP = 1), then enable the valve 2 actuator by changing MTR SETUP to **17**.
 - If a damper actuator is present, enabled, and reverse acting (MTR SETUP = 3), then enable the valve 2 actuator by changing MTR SETUP to **19**.
 - If a damper and a valve 1 actuator are both present, and enabled (MTR SETUP = 5), then enable the valve 2 actuator by changing MTR SETUP to **21**.
 - If a damper actuator is present and is enabled, and a valve 1 actuator is present, enabled, and reverse acting (MTR SETUP = 13), then enable the valve 2 actuator by changing MTR SETUP to **29**.
 - If a damper actuator is present, enabled, reverse acting, and a valve 1 actuator is present and is enabled (MTR SETUP = 7), then enable the valve 2 actuator by changing MTR SETUP to **23**.
 - If a damper and a valve 1 actuator are both present, enabled, and reverse acting (MTR SETUP = 15), then enable the valve 2 actuator by changing MTR SETUP to **31**.
3. Verify that the valve 2 actuator closes and remains closed when commanded. If valve 2 does not close, then reverse the action of the valve 2 actuator by adding the value **32** to MTR SETUP.

If the valve 2 actuator still does not close completely, then the actuator has been installed incorrectly. Refer to the valve actuator installation instructions, set up information, Table 2, or the *APOGEE Automation Service Procedures Manual* in InfoLink for more information.

Setting the Application

NOTE: If you are going to enter an LCTLR point at the field panel, then keep track of the application, override time, controller address, duct shape, and duct dimensions you enter at the portable operator's terminal. You will be required to enter these values again at the field panel.

Set APPLICATION (Point 2) to the appropriate Terminal Box Controller application.

Refer to Table 4 for application names and numbers.

Table 4. Terminal Box Controller – Electronic Output Applications.

Application	Revision VE10 or Higher
VAV Cooling Only with Two-Inch Water Column Measurement Range	2420
VAV Cooling or Heating with Two-Inch Water Column Measurement Range	2421
VAV with Electric Reheat or Baseboard Radiation, Two-Inch Water Column Measurement Range	2422
VAV with Hot Water Reheat, Two-Inch Water Column Measurement Range	2423
VAV Series Fan Powered with Electric Reheat, Two-Inch Water Column Measurement Range	2424
VAV Series Fan Powered with Hot Water Reheat, Two-Inch Water Column Measurement Range	2425
VAV Parallel Fan Powered with Electric Reheat, Two-Inch Water Column Measurement Range	2426
VAV Parallel Fan Powered with Hot Water Reheat, Two-Inch Water Column Measurement Range	2427
Slave Mode	2091

After you set the application, the controller will go through a shut-down/load sequence as it switches from slave mode to the application selected. After the application loads, the OVERVIEW report appears and the calibration cycle begins.

Waiting for Air Velocity Sensor Calibration

The air velocity sensor calibration cycle takes from 2 to 5 minutes to complete. The air damper closes during calibration.

At the start of the calibration cycle, the controller automatically sets CAL AIR (Point 94) to YES. When the cycle is complete, it sets CAL AIR to NO.

NOTE: For a controller used without an Autozero Module, the damper is commanded closed to get a zero airflow reading during calibration. For a controller used with an Autozero Module, calibration occurs without closing the damper. Calibration of a hot water valve (if used) is done while the controller is calibrating the transducer by commanding the valve to closed. Calibration of the valve is not affected by the presence of an Autozero Module.

Wait until the calibration cycle is complete (CAL AIR is set to NO) before continuing with this start-up procedure.

Selecting the Automatic Calibration Option

In order to choose the most efficient method of triggering the calibration routine, follow this procedure to set CAL SETUP (Point 95):

NOTE: The air velocity sensor must be calibrated at least once every 24 hours. Make sure that the sensor has been calibrated before balancing takes place as this will affect the balancer's results.

1. Display the first report in the REPORTS selection box. (The report will be named "VAV*app*", where *app* is a description of the particular application you are using.)
2. Select the calibration option from Table 5 that best meets your job requirements.
3. Set CAL SETUP to the value chosen.

Table 5. CAL SETUP Options.

CAL SETUP Options	Description
0	Calibration occurs ONLY when CAL AIR (Point 94) is set to YES.
1	Calibration occurs when the field panel commands a day/night mode changeover. Actual calibration is subject to a time delay of 0, 1, 2, or 3 minutes. This delay is determined by CTLR ADDRESS (Point 1) divided by 4 and the remainder is the time delay in minutes. Example: If CTLR ADDRESS = 11, then the controller will wait 3 minutes ($11 \div 4 = 2 \text{ R}3$) after it receives the day/night mode changeover command before beginning the calibration routine.
2	Calibration occurs immediately after the override switch is pressed.
4 (factory default value)	Calibration occurs on the time interval set in CAL TIMER (Point 96). For example, if CAL TIMER = 12, then the calibration period is 12 hours. Actual calibration is subject to a time delay based on the value of CTLR ADDRESS. Refer to the example in Option 1 above. This is the recommended option when using a controller with an Autozero Module.

NOTE: Options can be combined by summing their numbers. For example, to calibrate as in Options 1 and 2, set CAL SETUP to 3.

Setting the Room Temperature Set Points

1. Display the SETPOINTS report.
2. If the room temperature sensor has a set point dial, and if RM STPT DIAL (Point 13) is to be used by the controller, then set STPT DIAL (Point 14) to **YES**; otherwise, set STPT DIAL to **NO**.

NOTE: If STPT DIAL is set to YES, then DAY HTG STPT (Point 7) and DAY CLG STPT (Point 6) are not used. Instead, the value of RM STPT DIAL is used.

3. If there is no set point dial on the room temperature sensor, then verify that STPT DIAL is set to **NO**.

Set the following points to the appropriate values:

- DAY CLG STPT (Point 6)
 - DAY HTG STPT (Point 7)
 - NGT CLG STPT (Point 8)
 - NGT HTG STPT (Point 9)
4. If the room temperature sensor has a set point dial and the set point dial will be used, then set RM STPT MIN (Point 11) and RM STPT MAX (Point 12) for the minimum and maximum allowable room temperature set point values, respectively. Valid values range from 55° to 95°F (13° to 35°C). Common values for these points are 65°F (18°C) for RM STPT MIN and 80°F (27°C) for RM STPT MAX.

Setting the Override Time

1. Display the STARTUP report.
2. If using night override, then set OVRD TIME (Point 20) to the number of whole hours that an override should last. If set at zero (the default), then night override is disabled.

Setting the stages of electric reheat

Applications 2422, 2424, and 2426: Check the hardware to verify the number of stages of electric reheat used. Set STAGE COUNT (Point 88) to this value.

Setting the Number of Valves

Application 2423 only: Set VALVE COUNT (Point 88) to the number of valves used (enabled).

Setting the Controller Address

Set the controller address by setting CTRLR ADDRESS (Point 1) to the appropriate number.

Setting the Duct Area

1. Using the portable operator's terminal, press **F4** to display the **Duct Dimensions Menu**.
2. At the Duct Dimensions Menu, use the arrow keys to select the applicable duct shape. Press **ENTER**. The software prompts you for the dimensions of the duct.
3. Enter the dimensions as prompted. Press **ENTER** after each dimension you enter.

Setting the Flow Coefficient

1. Display the BALANCING report.
2. Set FLOW COEFF (Point 36) to the appropriate value found in Tables 6 through 8. This value is a starting point for the air balancer.

To fine tune the flow coefficient, use the following formula:

$$\text{new flow coefficient} = (\text{actual volume} \div \text{TEC volume}) \times \text{old flow coefficient}$$

The actual volume is the actual value obtained from the balancer's measurements. The TEC volume is the value obtained from AIR VOLUME (Point 35). If the TEC volume is not within 5% of the actual volume, then repeat the procedure until it is within 5%.

Table 6. Suggested TEC Initial Flow Coefficients for VAV Manufacturer and Box Sizes.

	Air velocity sensor type	Round ductwork (inlet) sizes in inches.												
		4	5	6	7	8	9	10	12	14	16	18	19	20
Anemostat	PX-2 cross, "P" range		0.77	0.74	0.75	0.78	0.74	0.81	0.81	0.85	0.80			
Anemostat	Traverse, "H" range		0.77	0.74	0.75	0.78	0.74	0.81	0.81	0.85	0.80			
Anemostat	PX-2 cross, "Q" range		0.56	0.51	0.56	0.57	0.59	0.60	0.64	0.65	0.72			
Anemostat	Traverse, "L" range		0.51	0.51	0.56	0.57	0.59	0.60	0.64	0.65	0.72			
Carrier	Linear averaging	0.75	0.71	0.64	0.63	0.62	0.62	0.61	0.61	0.58	0.54	0.58		
Carnes	"Standard sensor"		0.77	0.70	0.69	0.68		0.67	0.69	0.69	0.70			
Carnes	"Cross-flow sensor"		0.68	0.60	0.65	0.68		0.65	0.68	0.70	0.69			
Continental	AVS model "RSZ"			0.73		0.67		0.72	0.64	0.62	0.57		0.99	0.99
E.H. Price	CP101	1.04	0.83	0.64	0.68	0.66	0.72	0.75	0.80	0.85	0.80			
Environmental Tech.	sdr, vfr, cfr	0.79	0.78	0.59		0.62		0.64	0.65	0.66	0.66		0.59	0.66
H&C/Tuttle & Bailey	"Flo-cross" sensor	0.69	0.67	0.60	0.56	0.57		0.56	0.60	0.57	0.60	0.58		
H&C/Tuttle & Bailey	Flo-cross w/ total	0.59	0.55	0.50							0.51			
Krueger	General sensor	0.77	0.73	0.66	0.68	0.70	0.68	0.69		0.67				
Metal Ind. Fan powered only.	Fvi, fc, sv, rt, th, ct, dd (6 DO)									0.70	0.70			
Metal Ind. VAV & dual duct.	fvi, fc, sv, rt, th, ct, dd (6 DO)								0.50					
* Metal Ind. Dual duct only	fvi, fc, sv, rt, th, ct, dd (8 DO)			0.74		0.68		0.72						
Nailor Industries	Flow sensor	0.74		0.73		0.75		0.64						
Pottorff Inc.	TU-100			0.85		0.95		0.82	0.91	0.89	0.88			
Reddi-I-Inc.	Flowmaster			0.66		0.60		0.61	0.55	0.58	0.65			
Titus Inc.	Flowcross	0.92	0.81	0.63	0.61	0.64	0.62	0.63	0.64					
Trane (Rushville)	Air-valve (ring type)		0.64	0.60		0.64		0.65	0.65	0.65				
Tempmaster/York	All VAV, DD round	0.81	0.76		0.70	0.71		0.65	0.65	0.72	0.73			
Tempmaster/York	All VAV, DD Oval													
Warren Tech.	Kreuter SSS series			1.00		1.00		1.00	1.00	1.00	1.00			

* Inlet "Low Flow" air sensors should not be used if flow is less than 300 FPM.

Table 7. Suggested TEC Initial Flow Coefficients for VAV manufacturer and Box Sizes.

	Air velocity sensor type	Rectangular ductwork (inlet) sizes in inches													
		4x7	4x10	6x9	6x12	6x15	8x11	8x14	8x17	8x20	8x24	9x12	9x14	19(-3)	22(-3)
Anemostat	PX-2 cross, "P" range														
Anemostat	Traverse, "H" range														
Anemostat	PX-2 cross, "Q" range														
Anemostat	Traverse, "L" range														
Carrier	Linear averaging														
Carnes	"Standard sensor"											0.68			
Carnes	"Cross-flow sensor"											0.65			
Continental	AVS model "RSZ"														
E.H. Price	CP101														
***Environmental Tech.	sdr, vfr, cfr													0.61	0.64
H&C/Tuttle & Bailey	"Flo-cross" sensor														
H&C/Tuttle & Bailey	Flo-cross w/ total														
Krueger	General sensor														
Metal Ind. Fan powered only.	Fvi, fc, sv, rt, th, ct, dd (6 DO)														
Metal Ind. VAV & dual duct.	fvi, fc, sv, rt, th, ct, dd (6 DO)														
* Metal Ind. Dual duct only.	fvi, fc, sv, rt, th, ct, dd (8 DO)														
Nailor Industries	Flow sensor														
Pottorff Inc.	TU-100														
Reddi-I-Inc.	Flowmaster														
Titus Inc.	Flowcross														
Trane (Rushville)	Air-valve (ring type)														
Tempmaster/York	All VAV, DD round														
**Tempmaster/York	All VAV, DD Oval	0.72	0.73	0.73	0.73	0.72	0.73	0.74	0.72	0.72	0.74				
Warren Tech.	Kreuter SSS series														

* Inlet "Low Flow" air sensors should not be used if flow is less than 300 FPM.

** Tempmaster oval duct area and COF were calculated as rectangular duct shapes.

***ETI 19" has a rectangular area of 2.72 sq/ft. ETI 22" (32.25" X 15.875") rectangular area is 3.555 sq/ft.

Table 8. Suggested TEC Initial Flow Coefficients for VAV manufacturer and Box Sizes.

	Air velocity sensor type	Rectangular ductwork (inlet) sizes In Inches									Oval sizes		
		12x14	12x16	12x18	12x28	12x24	16x18	16x24	16x28	20x26	12"	14"	16"
Anemostat	PX-2 cross, "P" range							0.79					
Anemostat	Traverse, "H" range												
Anemostat	PX-2 cross, "Q" range												
Anemostat	Traverse, "L" range												
Carrier	Linear averaging												
Carnes	"Standard sensor"						0.68	0.75					
Carnes	"Cross-flow sensor"						0.70	0.75					
Continental	AVS model "RSZ"												
E.H. Price	CP101		0.76					0.76					
H&C/Tuttle&Bailey	"Flo-cross" sensor												
H&C/Tuttle&Bailey	Flo-cross w/ total												
Krueger	General sensor							0.71					
Metal Ind. Fan powered only.	fvi, fc, sv, rt, th, ct, dd												
	(6 DO)												
Metal Ind. VAV & dual duct.	fvi, fc, sv, rt, th, ct, dd	0.56	0.57	0.58	0.62	0.57				0.58	0.50	0.70	0.70
	(6 DO)												
* Metal Ind. Dual duct only	fvi, fc, sv, rt, th, ct, dd									0.60	0.64	0.67	0.68
	(8 DO)												
Nailor Industries	Flow sensor										0.58	0.63	0.68
Pottorff Inc.	TU-100							0.80					
Reddi-I-Inc.	Flowmaster												
Titus Inc.	Flowcross												
Trane(Rushville)	Air-valve (ring type)												
Tempmaster/York	All VAV, DD round												
**Tempmaster/York	All VAV, DD Oval												
Warren Tech.	Kreuter SSS series												

* Inlet "Low Flow" air sensors should not be used if flow is less than 300 FPM.

** Tempmaster oval duct area and COF were calculated as rectangular duct shapes.

Setting the MIN and MAX Airflow Set Points

NOTE: The maximum flow must be greater than or equal to the minimum flow.

Follow these steps to set the minimum and maximum airflow set points:

1. Set CLG FLOW MIN (Point 31) to the desired minimum cooling airflow set point.
2. Set CLG FLOW MAX (Point 32) to the desired maximum cooling airflow set point.

Applications 2421 through 2427:

1. Set HTG FLOW MIN (Point 33) to the desired minimum heating airflow set point.
2. Set HTG FLOW MAX (Point 34) to the desired maximum heating airflow set point.



CAUTION:

If using electric reheat, then do not set HTG FLOW MIN (Point 33) to 0 CFM (0 LPS). At 0 CFM (0 LPS) during day mode, the electric heat is ON while there is no airflow across the heating coils in the terminal box. Equipment damage may occur.

Enabling the Wall Switch

If a wall switch is used for day/night control, then enable it by setting WALL SWITCH (Point 18) to **YES**.

Enabling the Autozero Module

Applications 2420 through 2423 only: If using the controller with an Autozero Module, then set CAL MODULE (Point 87) to **YES**.



CAUTION:

If an Autozero Module is used, then do not enable MTR3 or valve 2.

NOTE: Update each controller at the field panel immediately after you have completed the controller start-up procedures and made all other changes to the controller's point database (including balancing, tuning, etc.).

The start-up is complete.