

TITUS I, II, and IIA Pneumatic Controls Installation, Operation, and Maintenance Manual

Adjusting Minimum and Maximum Air Flow

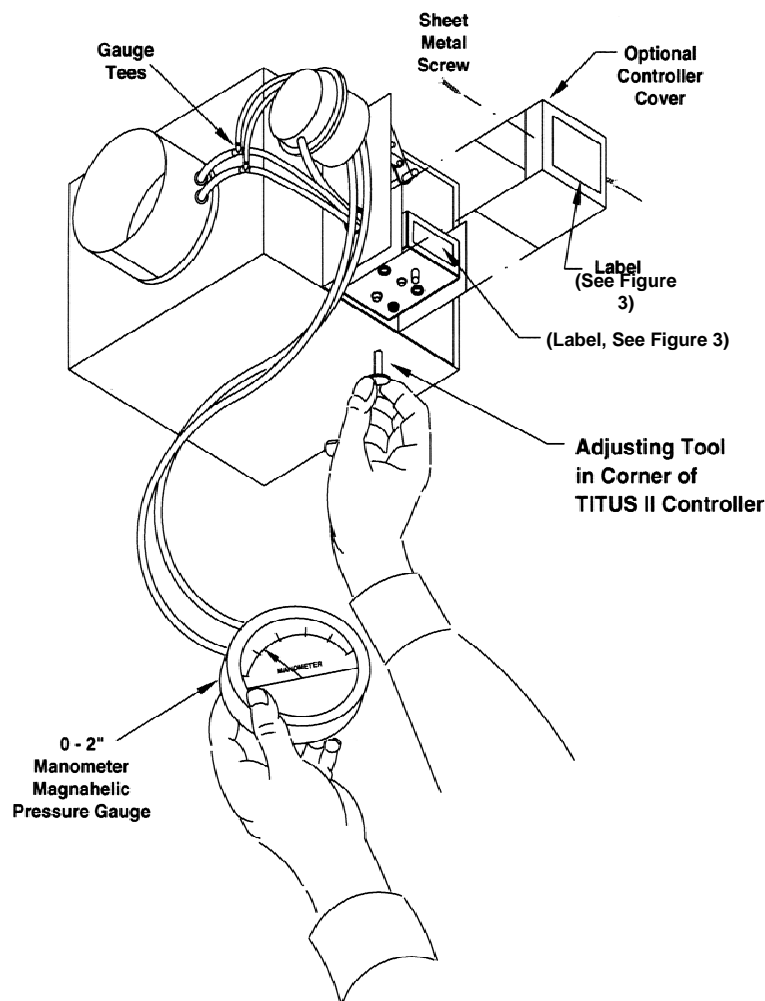


Figure 1. Adjusting Air Flow


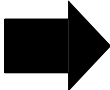

 Titus <i>The Leader in Air Management</i>				AIR FLOW 	
MODEL NO:	PESV	SIZE:	08	UP	
TOTAL CFM:	600	MIN. CFM:	150	TOT _575	MIN _036
LOCATION:	VAV-1				
FACTORY NO:	XXXXX	ITEM:	1	TITUS II 303002	
MOTOR:	TITUS				
COIL:	1R-LH				
THST:	RA-NO				
DPR. POSITION:					

Figure 2. Unit Label

Airflow limits are printed on the label on the optional controller cover (or the side of the terminal) and the side of the controller (Figures 2 and 3).

If field adjustment becomes necessary, follow the procedure outlined below.

AIR FLOW ADJUSTING PROCEDURES FOR ALL CONTROLLERS

- Remove the optional controller cover (Figure 1).
- The action of the controller must match the settings printed on the labels (Figures 2 and 3).
 - TITUS I—Direct acting, normally open, (control color—beige).
 - TITUS I—Reverse acting, normally closed, (control color—gray).
 - TITUS IIA—Direct or reverse acting thermostat. No adjustment necessary.
 - TITUS IIA—Verify setting on damper dial is correct (N.O. or N.C.).
 - TITUS II—Check thermostat and damper compatibility selectors, verify that settings are as marked on the label.
- Remove the caps from the tees in the HI and LO tubes (red and green stripe). Connect a manometer gauge to both tees (gauge with a 0 to 2 inch scale is recommended).
- Refer to the calibration curve for the size terminal being serviced (Page 8). From the curve read the differential pressure across the sensor for the required airflow.
- For instructions to readjust the control refer to:
 - TITUS I See page 3.
 - TITUS IIA See page 4-5.
 - TITUS II See page 6-7.
 - For dual duct terminals, see document PNEU-DD-IOM.
 - Quick-Check. See page 2.
- After the flow rates are adjusted:
 - Replace the thermostat connection to the controller.
 - Remove the gauge and replace the caps on the tees.
 - Replace the optional controller cover.

MODEL NO: PESV	SIZE: 08
TOTAL CFM: 600	VP: .410
TITUS II NO RA COOL	
MIN. CFM: 160	VP: .030
FACTORY NO:XXXXX	ITEM: 1

Figure 3. Controller Label

Quick-Check Procedure for TITUS I, II, and IIA Controllers

Preparing for Calibration

1. Disconnect the actuator tube (yellow stripe) from controller Port B.
2. Connect squeeze bulb with 0 to 25 PSI gauge to the actuator.
3. Connect 0 to 25 PSI gauge to controller Port B (Figure 4).

A. Direct Acting Cooling or Reverse Acting Heating

1. Apply zero PSI to thermostat Port T.
2. Read the differential pressure for the desired Minimum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
3. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
4. Adjust the LO knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
5. Read the differential pressure for the desired Maximum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
6. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
7. Adjust the HI knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
8. Remove gauges and reconnect actuator to controller Port B.

NOTE: If the actuator fails to respond, see Guide to Service Procedures.

B. Reverse Acting Cooling or Direct Acting Heating

For TITUS I Controllers

1. Apply zero PSI to thermostat Port T.
2. Read the differential pressure for the desired Maximum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
3. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
4. Adjust the HI knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
5. Read the differential pressure for the desired Minimum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
6. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
7. Adjust the LO knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
8. Remove gauges and reconnect actuator to controller Port B.

NOTE: If the actuator fails to respond, see Guide to Service Procedures.

For TITUS II Controllers

1. Apply 15 to 25 PSI to thermostat Port T.
2. Read the differential pressure for the desired Minimum CFM from the calibration curve corresponding to the inlet size of the terminal being

calibrated (Page 8).

3. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
4. Adjust the LO knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
5. Read the differential pressure of the desired Maximum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
6. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
7. Adjust the HI knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
8. Remove gauges and reconnect actuator to controller Port B.

NOTE: If the actuator fails to respond, see Guide to Service Procedures.

For TITUS IIA Controllers

1. Apply zero PSI to thermostat Port T.
2. Read the differential pressure for the desired Maximum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
3. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
4. Adjust the LO knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
5. Read the differential pressure for the desired Minimum CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
6. Pump the squeeze bulb until the desired differential pressure is read on the manometer gauge.
7. Adjust the HI knob on the face of the controller until the gauge on Port B reads $7.5 \text{ PSI} \pm 1.0 \text{ PSI}$.
8. Remove gauges and reconnect actuator to controller Port B.

NOTE: If the actuator fails to respond see Guide to Service Procedures.

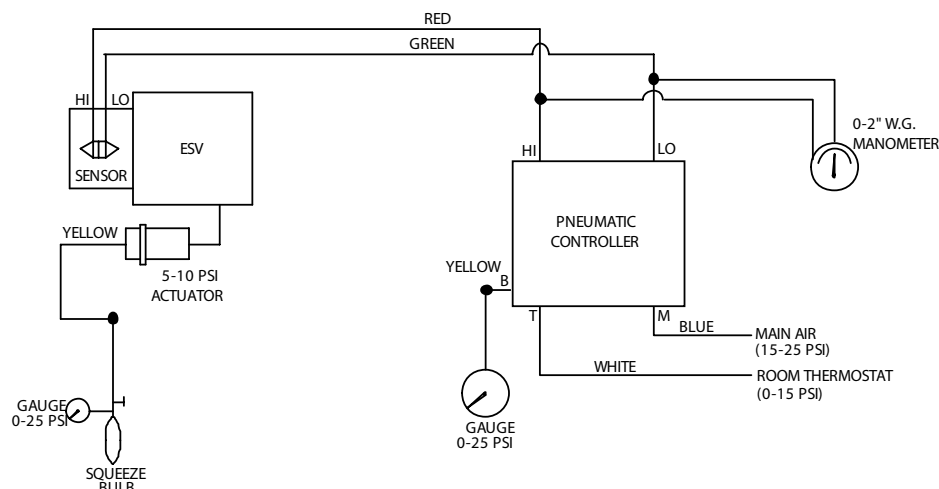


Figure 4. Controller Setup

Calibration Procedure for TITUS I Controller

A. Direct Acting (Beige). (N.O.)

1. Adjusting minimum air flow:
 - a. Apply zero PSI signal to Port T on the controller.
 - b. If the minimum CFM equals zero, the damper should assume a closed position (observe the indicator on the end of the damper shaft). If not, adjust LO knob on the controller until the compressed air drives the damper closed.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the desired CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
 - d. Adjust the LO knob until the desired differential pressure is read on the manometer gauge. Allow several seconds for the controls to react to system pressure and stabilize.
2. Adjusting maximum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.

- b. Refer again to the calibration curve (Page 8) to determine the differential pressure necessary for the required maximum CFM.
- c. Adjust the HI knob on the controller until the manometer gauge reads the required differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedure.

B. Reverse Acting (Gray). (N.C.)

1. Adjusting maximum air flow:
 - a. Apply zero PSI signal to Port T on the controller.
 - b. Refer to calibration chart (Page 8). Read the differential pressure for the desired maximum CFM from the curve corresponding to the inlet size of the terminal being calibrated.
 - c. Adjust the HI knob on the controller until the desired differential pressure is read on

the manometer gauge. Allow several seconds for the controls to react to the system and stabilize.

2. Adjusting minimum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.
 - b. If minimum CFM equals zero, the damper should assume a closed position (observe indicator on the end of the damper shaft). If not, adjust the LO knob until the damper closes.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the required CFM from the curve (Page 8).
 - d. Adjust the LO knob on the controller until the manometer gauge reads the desired differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedures.

Table 1.

Thermostat Action	Color	Low Port Signal	High Port Signal
Direct	Beige	Y	X
Reverse	Grey	X	Y

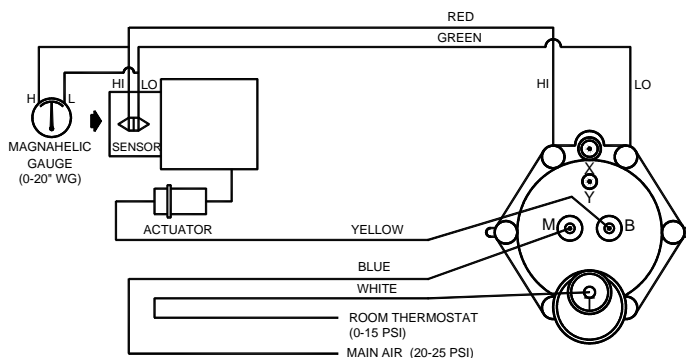
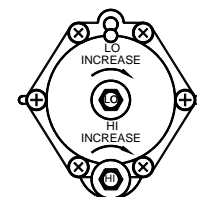
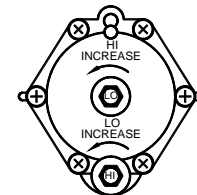


Figure 5. Titus I Controller



DIRECT ACTING CONTROLLER
BEIGE



REVERSE ACTING CONTROLLER
GRAY

Calibration Procedure for TITUS II Controller

A. Direct Acting Cooling or Reverse Acting Heating.

1. Adjusting minimum air flow:
 - a. Apply zero PSI signal to Port T on the controller.
 - b. If the minimum CFM equals zero, the damper should drive to a closed position with compressed air (observe the indicator on the end of the damper shaft). If not, adjust the LO knob on the controller until the damper is closed.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the desired CFM from the calibration curve corresponding to the inlet size of the terminal being calibrated (Page 8).
 - d. Adjust the LO knob until the desired differential pressure is read on the manometer gauge. Allow several seconds for the controls to react to the system pressure and stabilize.

Note: Air flow must be going across the inlet probe.

2. Adjusting maximum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.

- b. Refer again to the calibration curve (Page 8) to determine the differential pressure necessary for the required CFM.
- c. Adjust the HI knob on the controller until the manometer gauge reads the required differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedures.

B. Reverse Acting Cooling and Direct Acting Heating.

1. Adjusting minimum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.
 - b. If the minimum CFM equals zero, the damper should assume a closed position (observe the indicator on the end of the damper shaft). If not, adjust LO knob on the controller until the damper closes.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the desired CFM from the calibration curve

- d. Adjust the LO knob until the desired differential pressure is read on the manometer gauge. Allow controls to react to the system and stabilize.
2. Adjusting maximum air flow:
 - a. Apply zero signal to Port T on the controller.
 - b. Refer again to the calibration curve (Page 8) to determine the differential pressure necessary for the required maximum CFM.
 - c. Adjust the HI knob on the controller until the manometer gauge reads the required differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedures.

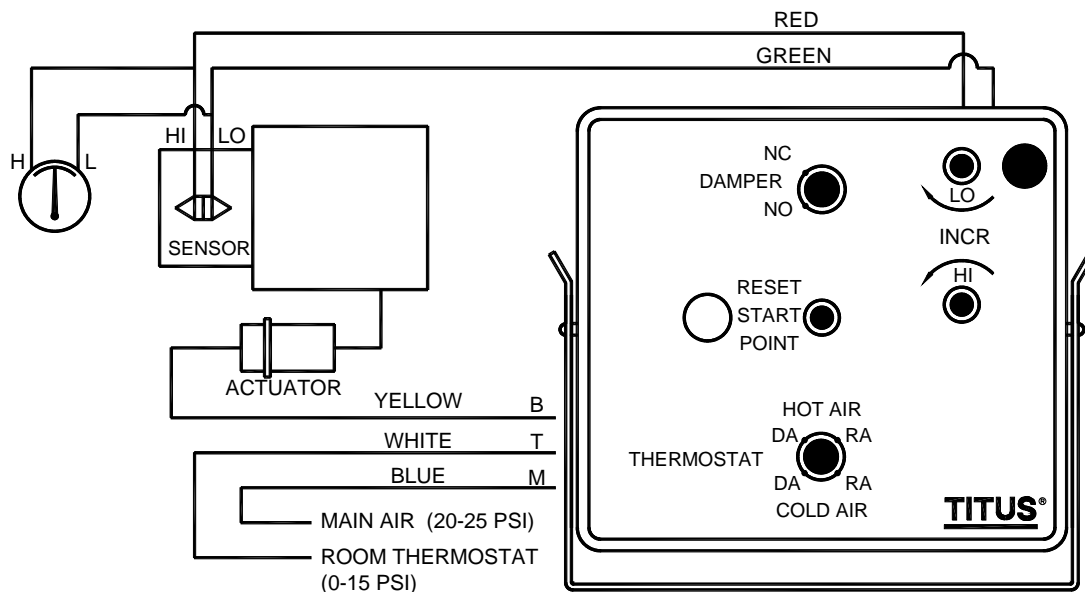


Figure 6. Titus II Controller

CONTROLLER

Reset Start Point Instructions for the TITUS II Controller

Setup Procedure

1. Confirm the setting on the Thermostat adjustment Switch for TITUS II controls.
2. Confirm the setting on the Damper Switch.
3. Disconnect the red HI and green LO lines from the controller.
4. Detach the white thermostat line from Port T on the controller. Attach a squeeze bulb with 0 to 25 PSI gauge to Port T.
5. Remove the yellow motor line from Port B on the controller. Attach a 0 to 25 PSI gauge to Port B.

3. Use the Squeeze-Bulb to set the thermostat pressure to 8 PSI or (whatever PSI the desired setpoint should be).
4. Adjust the Reset-Start-Point knob until the gauge on Port B reads: (Note 1)

4-5 PSI for normally open terminals
[or]
10-11 PSI for normally closed terminals.

5. SEE NOTE 2.

3. Use the Squeeze-Bulb to set thermostat to desired start-point PSI.
4. Adjust the Reset-Start-Point knob until the gauge on Port B reads: (Note 1)

4-5 PSI for normally open terminals
[or]
10-11 PSI for normally closed terminals.

5. SEE NOTE 2.

NOTE 1: Pressures shown are for 5-10 PSI actuators. For other spring ranges adjust readings accordingly.

NOTE 2: Reconnect Red-Green-Yellow-White tubes to their proper control terminals. Recalibrate Min./Max. CFM settings in accordance with procedures shown in the proper Installation Manual.

To Adjust the Start Point

Direct-Acting Thermostats:

1. Apply zero PSI to thermostat Port T.
2. Adjust the LO knob on the face of the controller until the gauge on Port B reads:

2 PSI for normally closed terminals
[or]
15 PSI for normally open terminals.

2 PSI for normally closed terminals
[or]
15 PSI for normally open terminals.

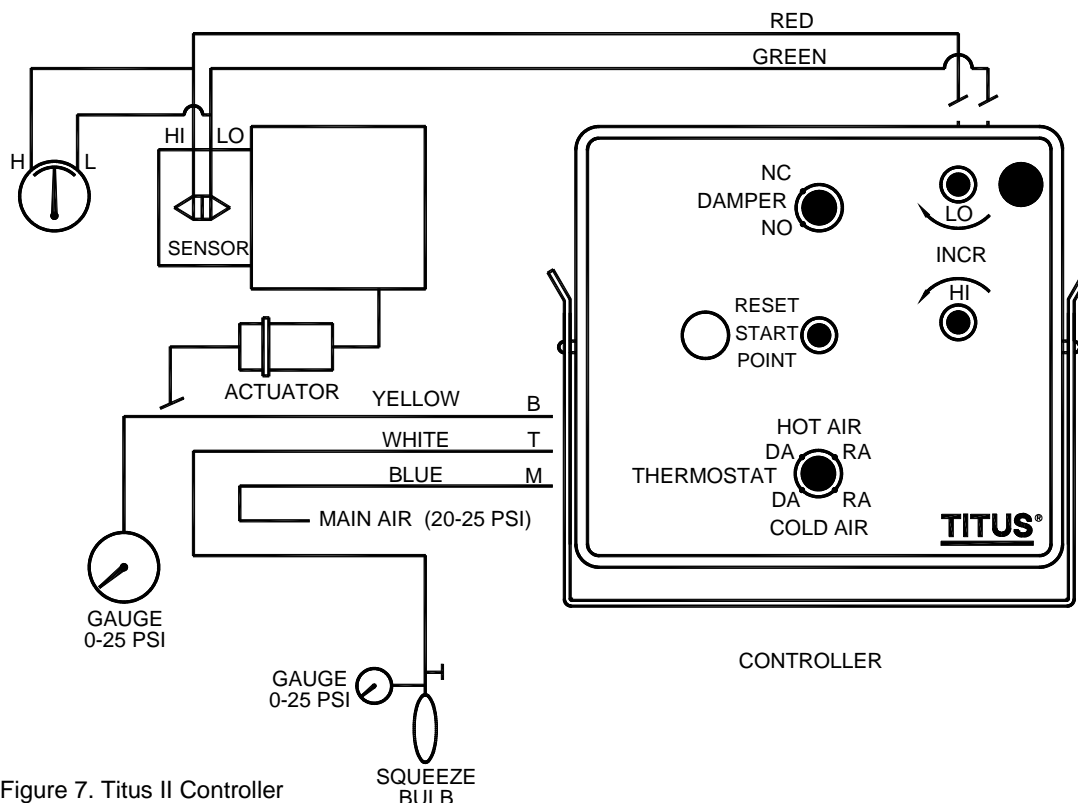


Figure 7. Titus II Controller

Calibration Procedure for TITUS IIA Controller

A. Direct Acting Cooling or Reverse Acting Heating.

1. Adjusting minimum air flow:
 - a. Apply zero PSI signal to Port T on the controller.
 - b. If the minimum CFM equals zero, the damper should assume a closed position (observe the indicator on the end of the damper shaft). If not, adjust the LO STAT knob on the controller until the damper is closed.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the desired CFM from the calibration curve corresponding to the inlet size of the terminal being calibrate (Page 8).
 - d. Adjust the LO STAT knob until the desired differential pressure is read on the manometer gauge. Allow several seconds for the controls to react to the system pressure and stabilize.
2. Adjusting maximum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.

- b. Refer again to the calibration curve (Page 8).
- c. Adjust the HI STAT knob on the controller until the manometer gauge reads the required differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedures.

B. Reverse Acting Cooling or Direct Acting Heating

1. Adjusting maximum air flow:
 - a. Apply zero PSI signal to Port T on the controller.
 - b. Refer to the calibration chart (Page 8). Read the differential pressure for the desired maximum CFM from the curve corresponding to the inlet size of the terminal being calibrated.
 - c. Adjust the LO STAT knob on the controller until the desired differential pressure is read on the manometer gauge. Allow several seconds for the controls to react to the system and stabilize.

2. Adjusting minimum air flow:
 - a. Apply 15-25 PSI signal to Port T on the controller.
 - b. If the minimum CFM equals zero, the damper should assume a closed position (observe indicator on the end of the damper shaft). If not, adjust the HI STAT knob until the damper closes.
 - c. If a non-zero minimum CFM is required, read the differential pressure for the required CFM from the curve (Page 8).
 - d. Adjust the HI STAT knob on the controller until the manometer gauge reads the desired differential pressure from the curve.

NOTE: If actuator fails to respond, see Guide to Service Procedures.

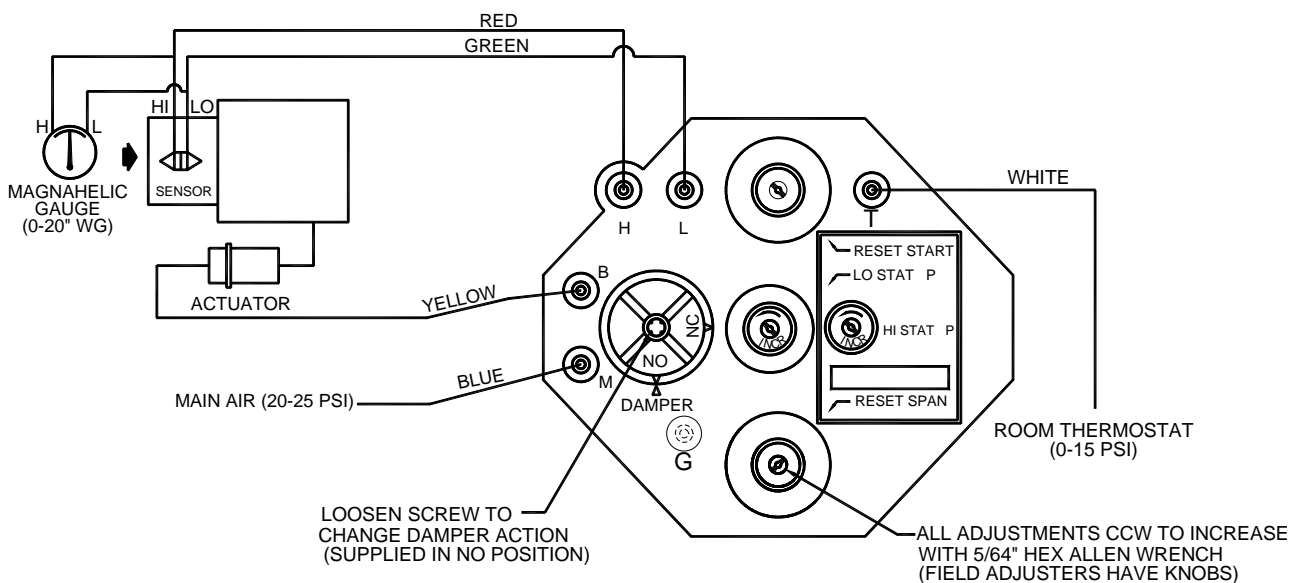


Figure 8. Titus IIA Controller

Reset Start Point Instructions for the TITUS IIA Controller

Setup Procedure

1. Confirm the setting on the Thermostat adjustment Switch for TITUS IIA controls.
2. Confirm the setting on the Damper Switch.
3. Disconnect the red HI and green LO lines from the controller.
4. Detach the white thermostat line from Port T on the controller. Attach a squeeze bulb with 0 to 25 PSI gauge to Port T.
5. Remove the yellow motor line from Port B on the controller. Attach a 0 to 25 PSI gauge to Port B.

To Adjust the Start Point

Direct-Acting Thermostats:

1. Apply zero PSI to thermostat Port T.
2. Adjust the LO knob on the face of the controller until the gauge on Port B reads:

2 PSI for normally closed terminals
[or]
15 PSI for normally open terminals.

3. Use the Squeeze-Bulb to set the thermostat pressure to 8 PSI or (whatever PSI the desired setpoint should be).
4. Adjust the Reset-Start-Point knob until the gauge on Port B reads: (Note 1)

4-5 PSI for normally open terminals
[or]
10-11 PSI for normally closed terminals.

5. SEE NOTE 2

Reverse-Acting Thermostats:

1. Apply 15 PSI to thermostat Port T.
2. Adjust the LO knob on the face of the controller until the gauge on Port B reads:

2 PSI for normally closed terminals
[or]
15 PSI for normally open terminals.

3. Use the Squeeze-Bulb to set thermostat to desired start-point PSI.
4. Adjust the Reset-Start-Point knob until the gauge on Port B reads: (Note 1)

10-11 PSI for normally open terminals
[or]
4-5 PSI for normally closed terminals.

5. SEE NOTE 2.

NOTE 1: Pressures shown are for 5-10 PSI actuators. For other spring ranges adjust readings accordingly.

NOTE 2: Reconnect Red-Green-Yellow-White tubes to their proper control terminals. Recalibrate Min./Max CFM settings in accordance with procedures shown in the proper Installation Manual.

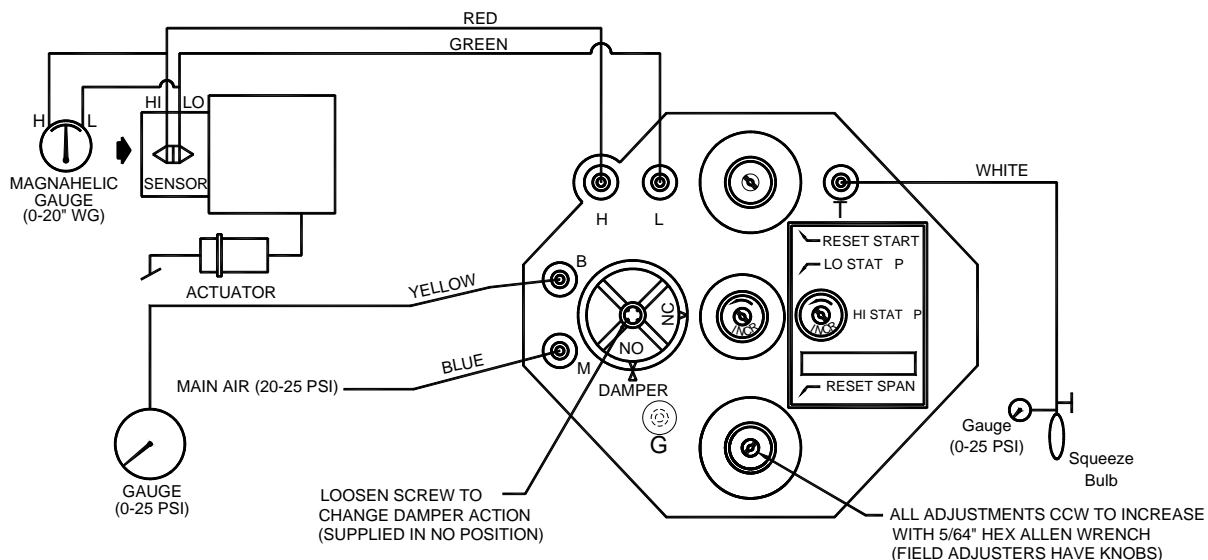


Figure 9. Titus II Controller

AeroCross™ Multi-Point Inlet Sensor

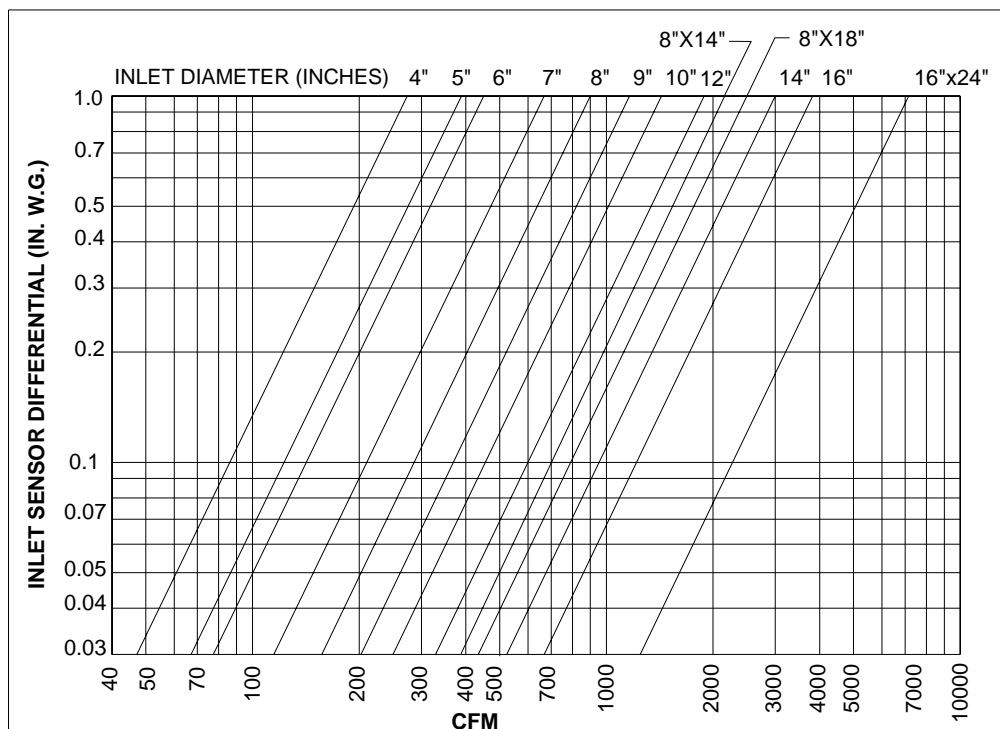


Table 2. AeroCross™ K-Factors

Terminal Size	K-Factor (CFM)
04	273
05	390
06	448
07	667
08	904
09	1167
10	1436
12	1891
14	3015
16	3839
8x14	2106
8x18	2498
40(16x24)	7176

$$CFM = K \sqrt{P}$$

$$P = \left(\frac{CFM}{K} \right)^2$$

Figure 10. AeroCross™ Sensor Calibration Curves

Original Titus Multi-Point Inlet Sensor (for use with units shipped before April 1, 2002)

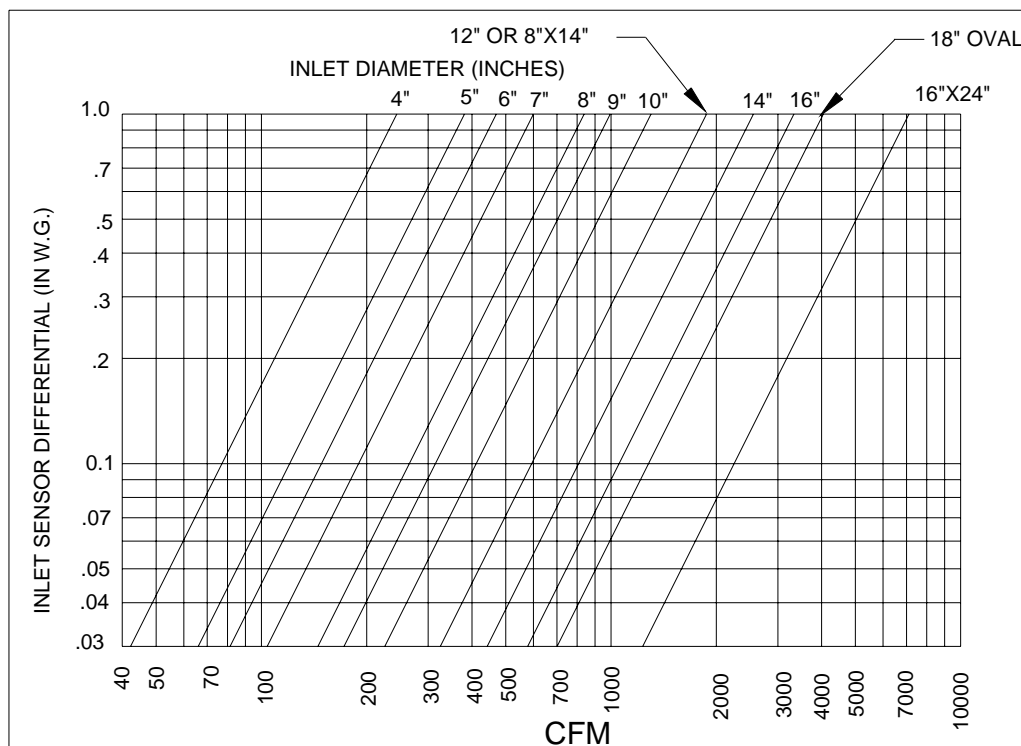


Table 3. Original Sensor K-Factors

Terminal Size	K-Factor (CFM)
04	269
05	404
06	474
07	625
08	881
09	1094
10	1371
12	1931
14	2795
16	3677
40(16x24)	7784

$$CFM = K \sqrt{P}$$

$$P = \left(\frac{CFM}{K} \right)^2$$

Figure 11. Original Sensor Calibration Curves

Guide to Service Procedures

Actuator will not stroke. (Generally any setting of the damper compatibility selector on the face of the controller).	<ol style="list-style-type: none"> 1. Leak in the control line between the controller and the actuator. 2. Leak in the actuator. 3. Insufficient main air supply pressure. 4. Faulty controller. 5. Pneumatic thermostat and main air line connections are reversed at the controller. 6. Control lines from the sensor to the controller are reversed. 	<ol style="list-style-type: none"> 1. Repair the leak. 2. Apply 15-25 PSI air from the main air supply to the actuator. The actuator should stroke. Pinch the air supply line. If the actuator retracts, it is leaking. Replace the actuator and contact your TITUS distributor. 3. The controller must receive compressed air from the main supply at 15-25 PSI. Be sure all connections are as shown in Figure 9. 4. If the controller appears to be faulty, contact your Titus distributor. 5. See Figure 9. The Thermostat must be connected to Port T and the main air to Port M. 6. See Figure 9. Make the connections as shown.
Actuator will not stroke. (Normally open setting of the damper compatibility selector on the face of the controller.)	<ol style="list-style-type: none"> 1-6 as above. 7. Rubber caps on HI or both balancing tees are missing. 8. HI control line or the HI passage of the sensor is plugged. 9. Damper compatibility selector on the face of the controller is set wrong. 10. Low differential pressure at the sensor. 	<ol style="list-style-type: none"> 1-6 as above. 7. Replace the caps on the balancing tees. 8. Clean out the passage or control line 9. Set the damper compatibility selector to match the action of the damper. 10. Increase the air flow rate to the terminal inlet if necessary.
Actuator will not stroke. (Normally closed setting of the damper compatibility selector on the face of the controller).	<ol style="list-style-type: none"> 1-6 as above. 7. Rubber cap on the LO balancing tee is missing. 8. LO control line or the LO passage in the sensor is plugged. 	<ol style="list-style-type: none"> 1-6. As above. 7. Replace the cap 8. Clean out the passage or control line.
Actuator remains fully stroked at all times. (Normally open setting of the damper compatibility selector on the face of the controller).	<ol style="list-style-type: none"> 1. Faulty controller. 2. Rubber cap on the LO balancing tee is missing. 3. LO control line or the LO passage of the sensor is plugged. 	<ol style="list-style-type: none"> 1. If the controller appears to be faulty, contact your Titus products distributor. 2. Replace the cap. 3. Clean out the passage or control line.
Actuator remains fully stroked at all times. (Normally closed setting of the damper compatibility selector on the face of the controller).	<ol style="list-style-type: none"> 1. Faulty controller. 2. Control lines from the sensor to the controller are reversed. 3. Rubber caps on HI or both balancing tees are missing. 4. HI control line or the HI passage of the sensor is plugged. 5. Damper compatibility selector on the face of the controller is set wrong. 6. Low differential pressure at the sensor. 	<ol style="list-style-type: none"> 1. If the controller appears to be faulty, contact your Titus products distributor. 2. See Figure 9. Make the connections as shown. 3. Replace the caps on the balancing tees. 4. Clean out the passage or control line. 5. Set the damper compatibility selector to match the action of the damper. 6. Increase the air flow rate to the terminal inlet if necessary.
Inaccurate or erratic air flow control.	<ol style="list-style-type: none"> 1. Poor inlet duct connection. 2. Leakage in the duct work. 3. Assembly mounted in a non-level position or upside down. 4. Controller adjustment dials are not set correctly. 5. Low velocity pressure in the inlet duct. 6. Thermostat compatibility selector on the face of the controller is set wrong. 7. Thermostat is out of calibration. 	<ol style="list-style-type: none"> 1. Check inlet duct for blockage or kinks. 2. Repair the leakage. 3. Control must be horizontal ± 10 degrees. 4. See "Adjusting the Minimum and Maximum Air flow". 5. Increase the air flow rate to the terminal inlet if necessary. 6. Set the thermostat compatibility selector to match the action of the thermostat. 7. Turn the thermostat adjusting dial through its full travel. The air pressure signal delivered by the thermostat to Port T on the back of the controller must vary from 0 to main air supply pressure (15-25 PSI). If this pressure range is not correct, recalibrate the thermostat or consult your Titus products distributor.

Replacement Parts

Actuators

Krueter MCP-8031 (5-10PSI)	10058501
Johnson D-3062 (5-10PSI)	10058601

Actuator Crank Arms

Krueter	30192002
Johnson	30192006

Actuator Mounting Plate-RH/LH

70560301

Controllers

Titus I DA (Beige)	10015001
Titus I RA (Gray)	10015101
Titus II	70500001
Titus IIA	10065001

Room Thermostats

Std. DA one pipe	10182203
Std. RA one pipe	10182204
Std. DA two pipe	10182201
Std. RA two pipe	10182202
Restrictor Tee (.005)	41410174
Restrictor Inline (.0063)	41410164

Pneumatic Controller Mounting Bracket

Titus I	70267002
Titus II, IIA, III	70382901

Controller Box

Enclosure (Titus II, IIA, III)	70073401
Cover (Titus II, IIA, III)	70073501
Enclosure Titus I	70267201
Cover Titus I	70267101

AeroCross™ Flow Sensor

4", 5"	3151520001
6"	3151520002
7"	3151520003
8"	3151520004
9"	3151520005
10"	3151520006
12"	3151520007
14"	3151520008
16"	3151520009