Titus Installation Manual

IOM-MBC-00 08-30-04

Mixing Box Control Systems
Installation, Operation, and Maintenance Manual

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Introduction

This document provides installation, operation, and maintenance information for the mixing box control systems.

General

The following information is to be used by the installer as a guide. Since each installation is unique unto itself, only general topics are covered. The order in which topics are presented may not be required by the actual installation.

This guide is not intended to supersede or circumvent any applicable national, state, or local codes.

The installation is to be performed only by individuals whose experience meets or exceeds the requirements of the work involved.

The installer MUST read the entire contents of this guide and develop a thorough understanding before beginning installation.

Due to a continuing program of product research, Titus reserves the right to discontinue or change without notice, any or all specifications or designs without incurring obligations.

Safety

Titus requests the following information be read and understood prior to installation.

The installation and/or servicing of comfort conditioning equipment can be hazardous due to system pressures and electrical devices.

Caution: Only trained and qualified personnel should perform service and/or installation.

Observe all precautions and warnings in the product data or attached to the unit.

Follow all safety codes. Wear eye protection and gloves. Have a fire extinguisher readily available.

Caution: Disconnect all power supplies before accessing equipment.

Disconnecting more than one power supply may be required to de-energize some equipment.

DANGER

ELECTRIC SHOCK CAN CAUSE DEATH.

Caution: Read these instructions carefully. Failure to follow them could result in damage to the product or cause a hazardous condition.

- Check the ratings given in the instructions and on the product to ensure the product is suitable for your application.
- Only trained and qualified personnel should perform service and/or installation.
- After installation is complete, checkout product operation as provided within this document.

Inspection

Thoroughly inspect all packages upon receipt. Ensure carton(s) have not been dropped, crushed or punctured. Inspect all contents for damage. If damage is found, immediately file a claim with the delivering carrier.

Titus

605 Shiloh Road • Plano, Texas 75074 • 972-212-4800

Mixing Box Control Systems

Titus offers two types of mixing box control system packages, they are:

- Three-Position Control System.
- Modulating Control System.

The following segments discuss each system and its components in detail, with the exception of the ball joints and pushrods. The setup shown in Figure 1 is logic module connected to a damper motor in a dedicated arrangement.

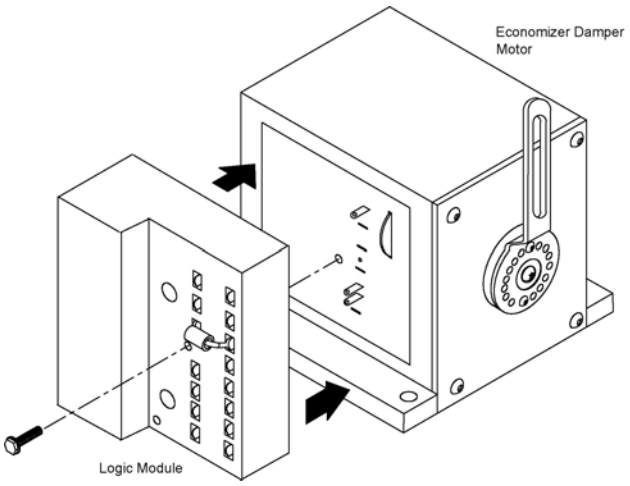


Figure 1. Dedicated Logic Module and Damper Motor Arrangement

Integrated Economizer System Operation

The purpose of an economizer is to use outdoor air for cooling, whenever possible, to reduce compressor operation. An economizer control system includes a cooling thermostat and a solid-state enthalpy changeover sensor. This allows it to respond to both dry bulb temperature and humidity, allowing the use of outdoor air temperatures for free cooling when humidity is low.

The economizer functions as a first stage of cooling and provides maximum economy during the cooling cycle. The economizer is automatically locked out during heating by holding the outdoor air damper at the minimum position setting.

On a call for cooling by the space thermostat, the system operates as follows:

When the sensed enthalpy of the outdoor air is below the set point, the outdoor air damper is modulated open (and return air damper is modulated closed) to maintain between 50 and 56º Fahrenheit at the mixed/discharge air sensor. The second stage cooling uses the mechanical cooling during the economizer operation.

When the sensed enthalpy of the outdoor air is above the set point, the outdoor air damper closes to its minimum position. On a call for cooling from the space thermostat brings on mechanical cooling.

During the unoccupied period, the damper motor will spring return the outdoor air damper to full closed position.

Diagnostic Equipment

In addition to either control system package, the following diagnostic equipment (supplied by others) may be beneficial to the installation, verification, and/or troubleshooting processes.

- 1.2k ohm checkout resistor
- Remote minimum position potentiometer
- Minimum position potentiometer
- Remote bulb control for low ambient lockout
- Board for panel mounting logic module

Three-Position Control System

Components list of the three-position control system is as follows:

Table 1. Package Contents

Part Code	Description	Quantity
M8405A	Three-position Damper Motor	1
W7459C	Logic module	1
C7400A	Solid state enthalpy sensor	1
27518	Ball joints	2
27520E	18-inch pushrods	2

Three-position Damper Motor – M8405A

Spring-return, 25-inch/pound damper motor (actuator) provides three-position control of economizer systems or ventilation dampers. Spring returns motor shaft to normal position on power interruption. The following figure depicts a damper motor.

> ***Note**: Damper motors may be referred to as actuators.*

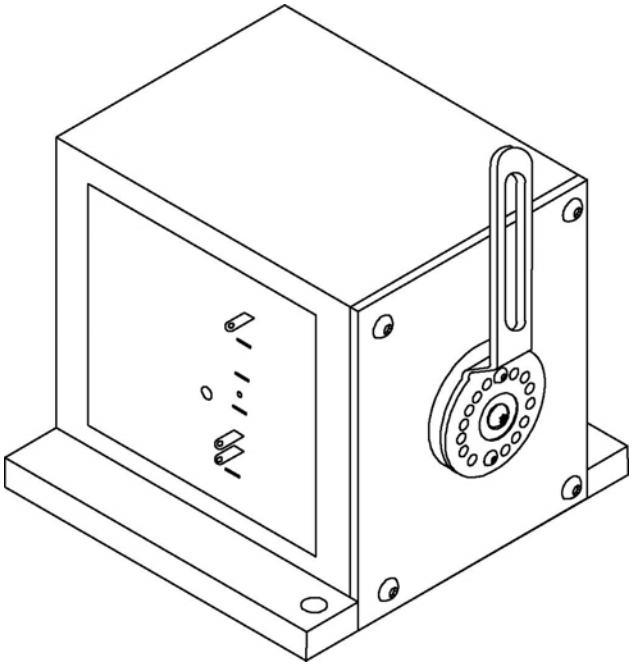


Figure 2. Three-Position Damper Motor

Operation Ratings

The following table highlights operational information.

Table 2. Operating Ratings

Operation	Rating
Synchronous	Normally closed
Power VA	7
Timing (sec.)	90
Stroke	90 degrees, opens counter-clockwise as viewed from power end.
Application	Three-position, with adjustable minimum position control
Timing	90 seconds
Voltage and frequency	24 Vac, 50/60 hertz
Maximum operating torque	25-inch/pound (2.8N-M)
Ambient temperature rating	-25° to +125° Fahrenheit (-32° to +52° Celsius) at 25 percent duty cycle.
Shaft	Single-ended drive with crank arm supplied.
Approximate dimensions	4.5 inches (114 millimeter) high; 5 inches (127 millimeters) wide, and 5.188 inches (132 millimeter) deep.

Component recognized by Underwriters Laboratories, Inc.

Installation

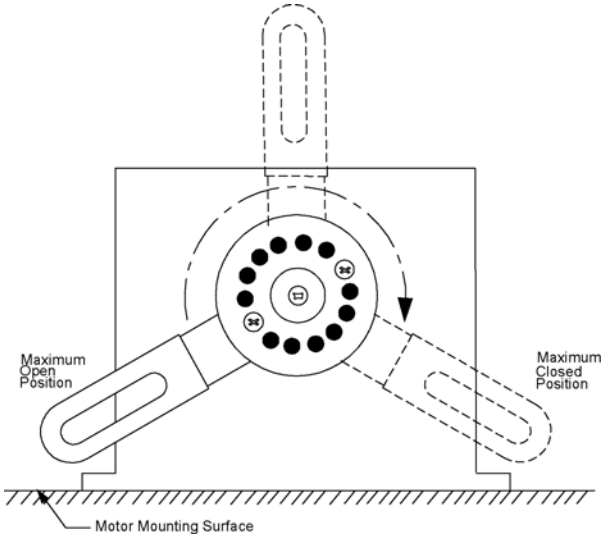
When planning the installation, allow ample clearance for maintenance and service. Ensure the location is protected from rain and snow. The following steps provide basic instructions to install a damper motor.

1. Position damper motor on mixing box where mounting is desired.

   ***Note**: Motor placement may restrict crank arm rotation. Position motor to allow widest range of crank arm rotation, see Figure 3.*

2. Use the damper motor holes as guides and drill four holes into mixing box.

3. Secure the damper motor to mixing box using four screws. Figure 4 shows a typical damper motor to mixing box installation.



***Note**: Possible 90 degree arm rotation, based on motor positioning.*

Figure 3. Crank Arm Rotation Limits

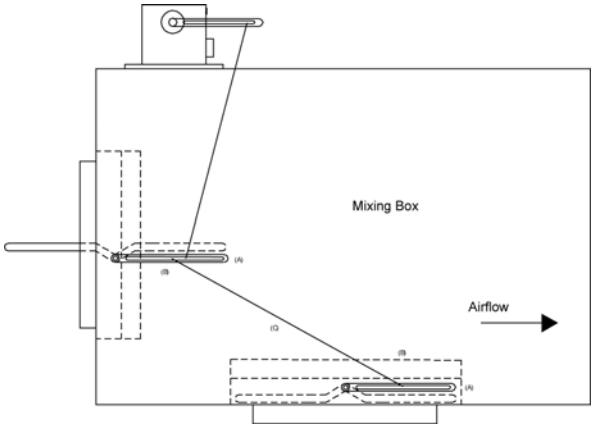


Figure 4. Typical Damper Motor to Mixing Box Installation

Settings and Adjustments

1. Connect 24 Vac to motor at terminals T and X (Terminal D is not connected).
2. Adjust thumbwheel on motor for desired minimum position.

Operation

A single-pole, single-throw (SPST) low-voltage controller is used to control the three-position Damper Motor.

- **Fully open** – when controller provides 24 Vac to D and T, motor is energized and drives fully open.
- **Fully closed** – when power is removed from terminals T and D, and the motor spring returns to the fully closed position.
- **Mid-position** – when controller provides 24 Vac to T and X, motor is energized and drives to the adjustable mid-position (minimum position).

An adjustable minimum position can be reached from either the fully closed or fully open position. From fully closed, the motor drives open to the minimum position; from fully open the motor spring returns to the minimum position.

Verification

Operate the motor through its complete open-close stroke. If necessary, release one of the previously tightened linkage connections to prevent damage. Check for proper operation, ensuring the linkage does not bind and the motor travels smoothly throughout its fully open and full closed positions. This motor checkout ensures:

1. The motor operates the load.
2. The motor responds properly to the controller.
3. There is no binding of the linkage or motor stalling at any point of travel.

If motor does not operate properly, check for proper voltage or mechanical binding in linkage or damper.

If questions arise regarding this product, contact your distributor or Titus representative.

Logic Module – W7459C

The logic module provides control for the damper motor. Use the enthalpy set point of the logic module to select air temperature and humidity suitable for free cooling. Figure 5 depicts the logic module.

Remote Minimum Position Control

Remote control of the outdoor air dampers can be used, if temporary additional ventilation is required. The potentiometer in the logic module – W7459 controls the minimum position of the dampers.

Operation

Table 4 provides operational information.

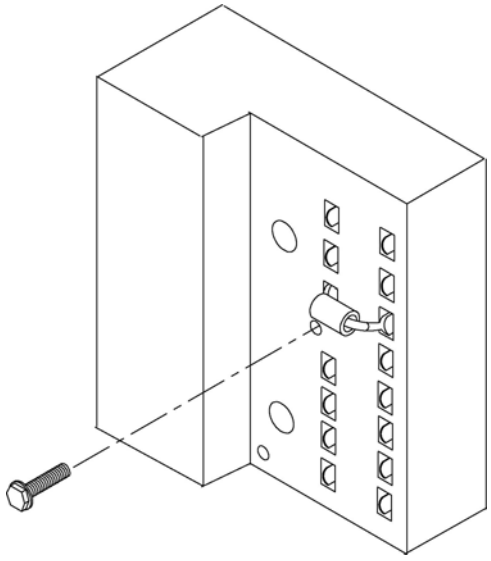


Figure 5. Three-Position Logic Module

Table 4. Operational Ratings

Operation	Rating
Operating ambient temperature	25º Fahrenheit t_p to +125º Fahrenheit (32 to +52º Celsius)
Humidity	5 to 95 percent relative humidity
Input voltage	24 Vac, 50/60 hertz
Relay contact rating at 24 Vac	1.5 A run, 3.5 A inrush
Application	Use with three-position Damper Motor - M8405A
Discharge air temperature input	Single-pole, single-throw (spst)
Minimum position potentiometer adjustment	None (Minimum position adjustment is built into Damper Motor M8405)
Terminals for remote minimum damper position	None
Output relays	2 single-pole, dual-throw (spdt)

Installation

The logic module mounts on the side of the three-position damper motor (M8405A). When planning the installation, allow enough clearance for maintenance and service. Ensure the location is protected from rain and snow.

1. Align logic module to prongs of the Damper Motor.
2. Press logic module and Damper Motor together.
3. Secure logic module to damper motor using the supplied mounting screw.

Settings and Adjustments

The minimum position potentiometer keeps the outdoor air damper from closing completely during system operation to provide ventilation. Figure 6 shows potentiometer adjustment slots. Use a screwdriver to make adjustments.

1. Connect 24 Vac at terminals TR and X (D is not connected).
2. Adjust thumbwheel on motor for desired minimum position.

Wiring

Disconnect power supply before connecting wiring to prevent electrical shock or equipment. All wiring must comply with applicable local codes, ordinances, and regulations. See Figure 7 for wiring diagram depicting the three-position control system.

Solid-State Enthalpy Sensor - C7400A

The solid-state enthalpy sensor – the C7400A has a solid-state element that senses temperature and humidity. It combines solid-state enthalpy changeover control, minimum damper position potentiometer and compressor staging relays.

The solid-state enthalpy sensor – C7400A when used with the Solid State Economizer Logic Module – W7459 and three-position damper motor – M8405 helps to position outdoor and return air dampers in economizer systems. Figure 8 depicts the solid-state enthalpy sensor.

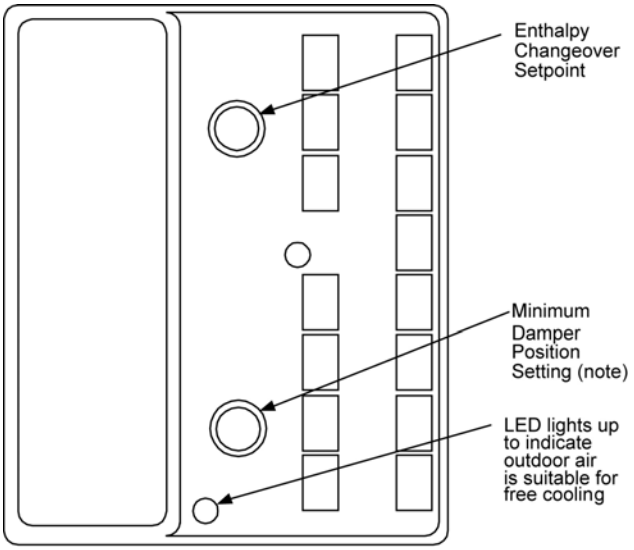
Use for enthalpy control as follows:

- One sensor in outdoor air for single enthalpy control.
- Two sensors, one in return air and one in outdoor air, for differential enthalpy control. **Contact a Titus representative, if specifications call for differential enthalpy control.**

The enthalpy set point of the logic module selects the air temperature and humidity suitable for free cooling.

Operational Ratings

Table 6 highlights operational ratings.



Note: Minimum damper position adjustment is present on W7459A and B models only

Figure 6. Enthalpy Set Point Potentiometer (Three-Position System)

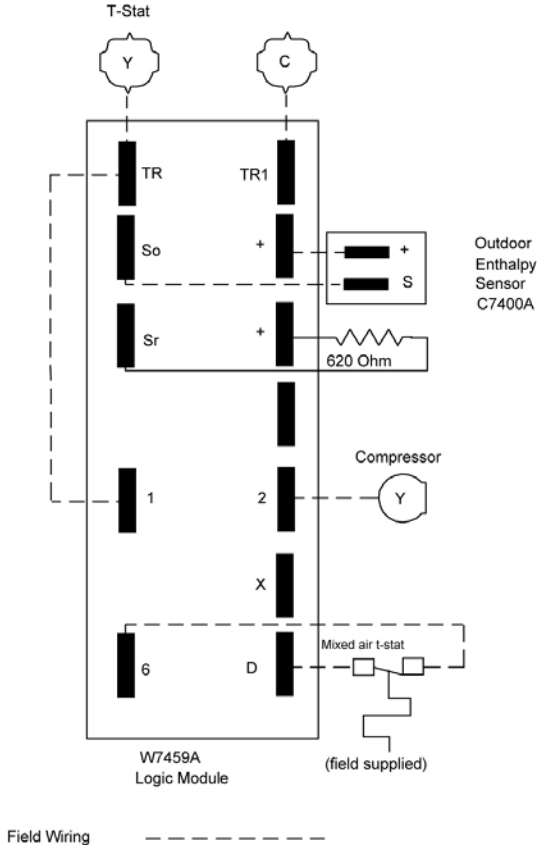


Figure 7. Three-position Control System Circuit

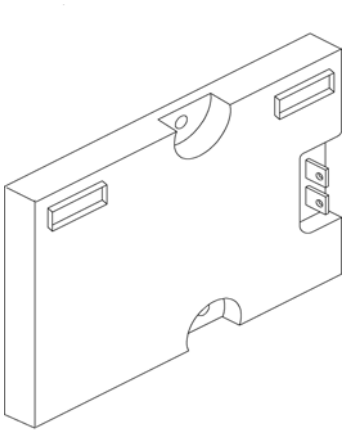


Figure 8. Solid-State Enthalpy Sensor

Table 6. Operating Ratings

Specific	Description
Case	Duct-mounted
Temperature Sensing Element:	Thermistor
Output Signal	4 to 20 mA current signal; increases from 4 to 20 mA as enthalpy decreases
Operating ambient temperature	-40 to 125° Fahrenheit (-40 to +52° Celsius)
Shipping temperature rating:	-40 to 150° Fahrenheit (-40 to +66° Celsius)
Maximum power consumption	0.45 Vac
Maximum supply voltage	18 to 24 Vdc
Electrical connection	Two ¼-inch quick-connect terminals

Listed by Underwriters Laboratories Inc.

Location and Mounting

The sensor mounts in any position up to 200 feet (61 meters) away from the logic module – W7459C and may be used for the following operational circumstances.

- **Proportional damper control**: Attach the logic module to the Damper Motor's side.
- **Outdoor air sensing**: Mount in any orientation where it is exposed to freely circulating air, but is protected from rain, snow, and direct sunlight.
- **Return air sensing**: For differential enthalpy control, a second C7400A enthalpy sensor can be connected to the W7459 and mounted in the return air duct.

  ***Note**: Contact your Titus representative if specifications call for differential enthalpy control.*

Verification and Troubleshooting

The following table provides the actions and responses to verify the installation of W7459C logic module installed on an M8405 Actuator.

DANGER

DISCONNECT POWER SUPPLY BEFORE CONNECTING WIRING TO PREVENT ELECTRICAL SHOCK OR EQUIPMENT DAMAGE

Caution: Exercise care when adjusting the enthalpy changeover and minimum damper position control. Use a small screwdriver for these adjustments. Excessive force may damage the controls.

Perform verification and troubleshooting steps in order.

Table 7. Three-Position Control Verification and Troubleshooting

Action		Response
A.	**Power**	
1.	Disconnect power at terminals TR and TR1.	
2.	Disconnect wires from terminals 6, X and D.	
3.	Jumper TR and 1.	
4.	Jumper 6 and D.	
5.	If connected, remove C7400A enthalpy sensor from terminals S_O and +. Factory-installed 620-ohm resistor should be connected to S_R and +.	
6.	Apply 24 Vac power to terminals TR and TR1.	LED should be off. Motor is in closed position.
7.	Disconnect factory-installed 620-ohm resistor from terminals S_R and +.	LED should be on. Motor drives toward open.
B.	**Enthalpy Simulation**	
1.	To simulate high and low enthalpy (single enthalpy sensor)).	
2.	Reconnect factory-installed 620-ohm resistor across terminals S_R and +.	
3.	Connect 1.2k ohm checkout resistor across terminals S_O and +.	

Action		Response
4.	Turn enthalpy set potentiometer to “A”.	LED should be on, indicating low enthalpy. Motor drives toward open.
5.	Turn enthalpy set point potentiometer to “D”.	LED should be off, indicating high enthalpy. Motor spring returns to fully closed position.
6.	Disconnect the 1.2k ohm checkout resistor.	
C.	**Sensor**	
1.	Reconnect the + lead of outdoor enthalpy sensor to the + terminal of W7459.	
2.	Connect a DC multi-meter or voltmeter between terminals S_O of the W7459 and terminal S of the enthalpy sensor. (Positive meter lead to terminal S of enthalpy sensor.)	Multi-meter or voltmeter should indicate between 3 and 25 mA, if sensor is operating properly. If multi-meter or voltmeter indicates zero, the sensor may be wired backwards.
3.	If using differential enthalpy, the return air enthalpy sensor may be checked by connecting a DC multi-meter or voltmeter between terminal S_R of the W7459 and terminal S of the return air enthalpy sensor. (Position meter lead to terminal S of return air enthalpy sensor.	Multi-meter or voltmeter should indicate between 3 and 25 mA, if sensor is operating properly. If multi-meter or voltmeter indicates zero, the sensor may be wired backwards.

Modulating Control System

Package contents of the modulating (enthalpy) system are as follows:

Table 8. Modulating (Enthalpy) System Package

Part Code	Description	Quantity
M7415A	Modulating damper motor	1
W7459A	Logic module	1
C7400A	Solid state enthalpy sensor	1
C7150B	Sensor	1
27518	Ball joints	2
27520E	18-inch pushrods	2

Modulating Damper Motor – M7415A

Spring-return, 25-inch/pound damper motor provides modulating control of economizer systems or ventilation dampers. Spring returns motor shaft to normal position on power interruption. Figure 9 depicts a damper motor.

Operation

Tables 9 and 10 provide operating ratings and motor performance respectively.

A single Damper Motor – M7415 accepts the thermistor sensor input from the air temperature sensor, mounted in the discharge or mixed air duct. See Figure 10.

During the occupied period, on a call for cooling, when the outdoor air temperature is low, the damper motor – M7415 modulates to maintain between 50 and 56° Fahrenheit at the thermistor.

If the mixed or discharge air temperature is above 56° Fahrenheit, the damper motor opens to admit additional outdoor air until the temperature returns to between 50 and 56° Fahrenheit. If the mixed or discharge air temperature is below 50° Fahrenheit, the damper motor modulates close, shutting the outdoor air damper until the temperature returns to between 50 and 56° Fahrenheit. During the occupied period, the damper will not close past the minimum position.

If the fully open damper motor cannot satisfy the space demand, mechanical cooling is sequenced on.

During the unoccupied period, the damper motor overrides the minimum position setting and drives fully closed. On a loss of power, the damper spring returns to a fully closed position.

When in heating operation, outdoor air temperature or enthalpy conditions are high, economizer operation is locked out, and the damper motor is held at minimum position.

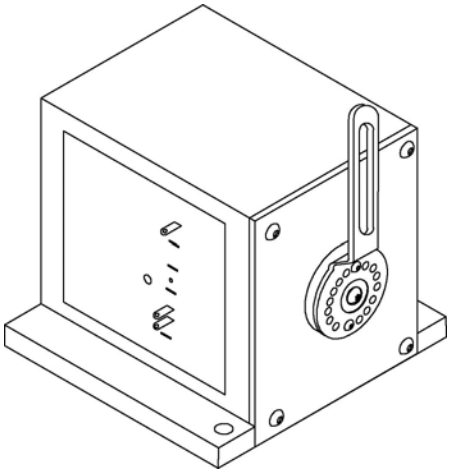


Figure 9. Fully Modulating Damper Motor

Table 9. Operation Ratings

Specification	Performance
Stroke	Fixed 90 degrees, opens counter-clockwise as viewed from power end.
Timing	90 seconds
Voltage and frequency	24 Vac, 50/60 hertz
Maximum operating torque	25 inch/pound (2.8N-M)
Ambient temperature rating	-25° to +125° Fahrenheit (-32° to +52° Celsius) at 25 percent duty cycle.
Synchronous	Normally closed.
Power VA	8
Application	Modulating, use with thermistor mixed-air or discharge sensor (C7150B)
Shaft	Single-ended drive with crank arm supplied.
Approximate dimensions	4.5 inches (114 millimeter) high; 5 inches (127 millimeters) wide, and 5.188 inches (132 millimeter) deep.

Component recognized by Underwriters Laboratories, Inc.

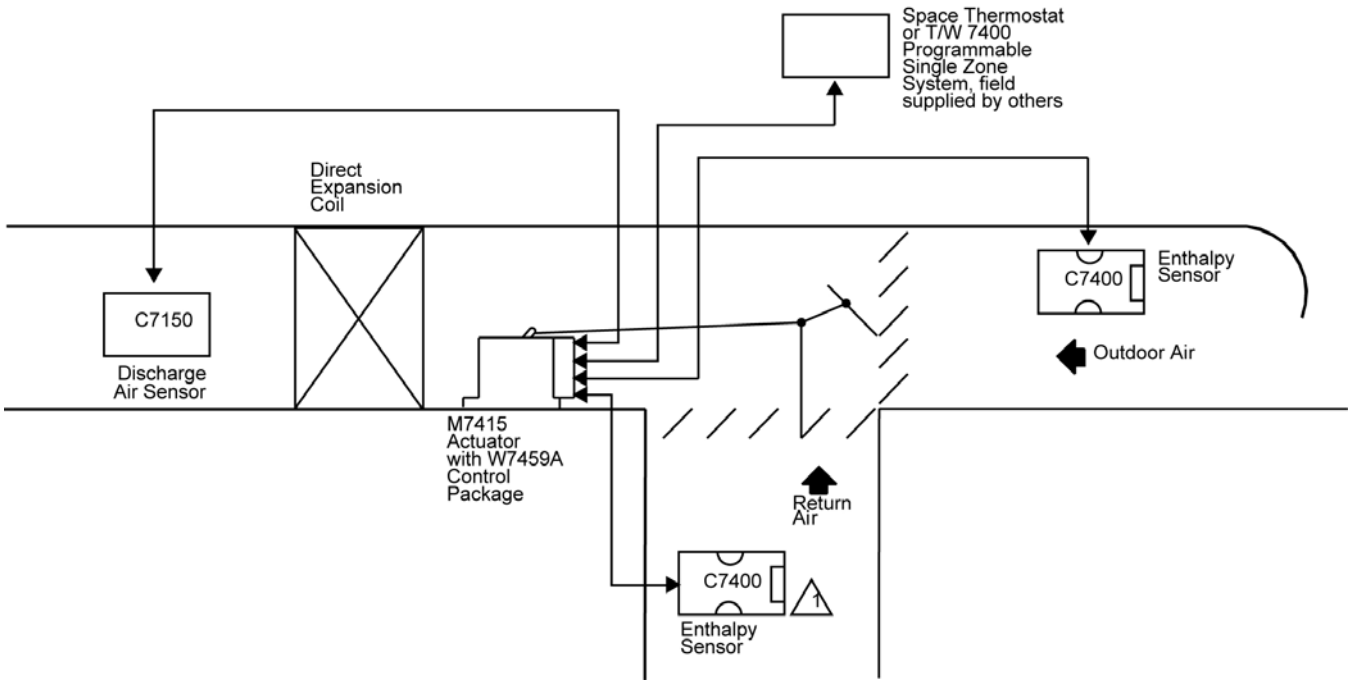


Figure 10. Economizer Control System Schematic

Installation

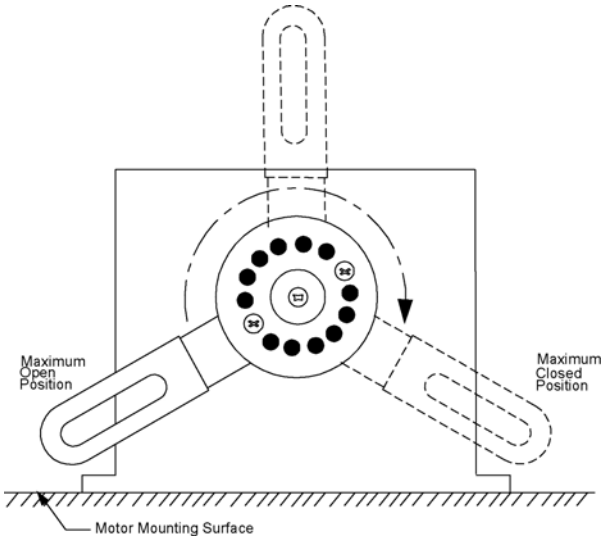
When planning the installation, allow ample clearance for maintenance and service. Ensure the location is protected from rain and snow. The following steps provide basic instructions to install a damper motor.

1. Position damper motor on mixing box where mounting is desired. Figure 11 shows possible crank arm rotation.
2. Use the damper motor holes as guides and drill four holes into mixing box.
3. Secure the damper motor to mixing box using four screws. Figure 12 shows a typical damper motor to mixing box installation.

Settings and Adjustments

Once installed, review system requirements and settings. Then make necessary adjustments using the following information.

1. Run motor to fully closed position and disconnect 24 Vac from terminals TR and TR1.
2. Connect minimum position potentiometer to terminals P and P1 (T and T1 are disconnected).
3. Reconnect 24 Vac to terminals TR and TR1 and adjust potentiometer for desired minimum position.



***Note**: Possible 90 degree arm rotation, based on motor positioning.*

Figure 11. Crank Arm Rotation Limits

4. When an actuator mounted minimum position potentiometer is used and a remote potentiometer is NOT connected in series, utilize jumper terminals P and P1 on the minimum position potentiometer.

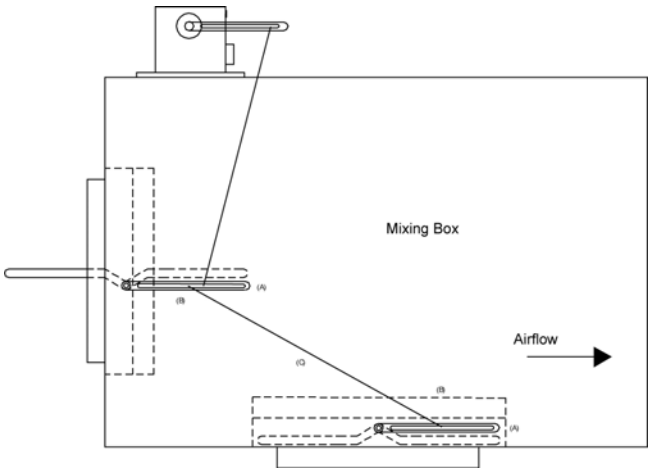


Figure 12. Typical Damper Motor to Mixing Box Installation

Verification

Operate the motor through its complete open-close stroke. If necessary, release one of the previously tightened linkage connections to prevent damage. Check for proper operation, making sure that the linkage does not bind and that the motor travels smoothly throughout its fully open and fully closed positions. This motor checkout ensures:

- The motor operates the load.
- The motor responds properly to the controller.
- There is no binding of the linkage or motor stalling at any point of travel.

If motor does not operate properly, check for proper voltage or mechanical binding in linkage or damper.

If questions arise regarding this product, contact your distributor or Titus representative.

Logic Module – W7459A

The logic module provides the operation control to the Damper Motor. Use the enthalpy set point of the logic module to select air temperature and humidity suitable for free cooling. Figure 13 depicts the logic module.

Remote Minimum Position Control

Remote control of the outdoor air dampers is desirable when temporary additional ventilation may be required. The potentiometer in the logic module controls the minimum position of the dampers.

Operation

Tables 11 and 12 provide operating rating and specific information.

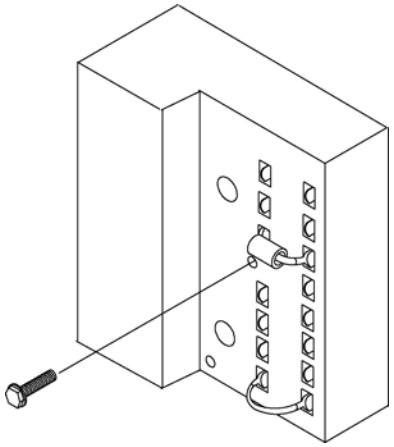


Figure 13. Fully Modulating Logic Module

Table 11. Operational Ratings

Operation	Rating
Operating ambient temperature	25º Fahrenheit t_p to +125º Fahrenheit (32 to +52º Celsius)
Humidity	5 to 95 percent relative humidity
Input voltage	24 Vac, 50/60 hertz
Relay contact rating at 24 Vac	1.5 A run, 3.5 A inrush
Discharge air temperature input	Single-pole, single-throw (spst)
Minimum position potentiometer adjustment	None (Minimum position adjustment is built into damper motor M7415A)
Terminals for remote minimum damper position	None
Output relays	2 Single-pole, double-throw (spdt)
Application	To be used with • Solid-state enthalpy sensor C7400A • Modulating damper motor M7415A

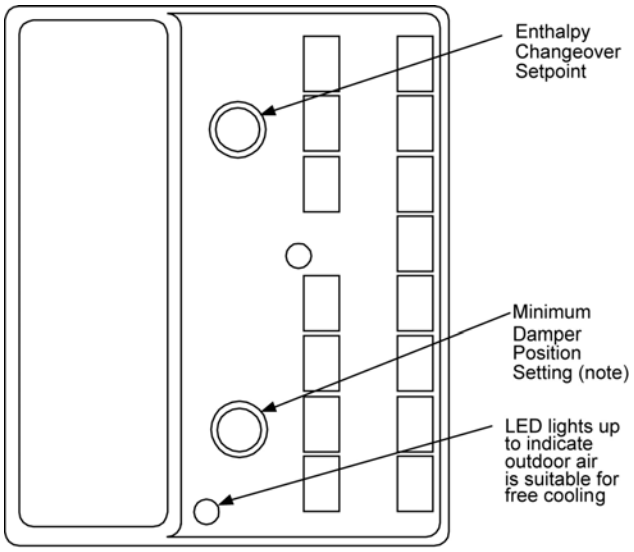
Installation

The logic module mounts on the side of the Modulating Damper Motor (W7415A). When planning the installation, allow ample clearance for maintenance and service. Ensure the location is protected from rain and snow.

1. Align logic module to prongs of the Damper Motor and press module and motor together.
2. Secure logic module to damper motor using the supplied mounting screw.

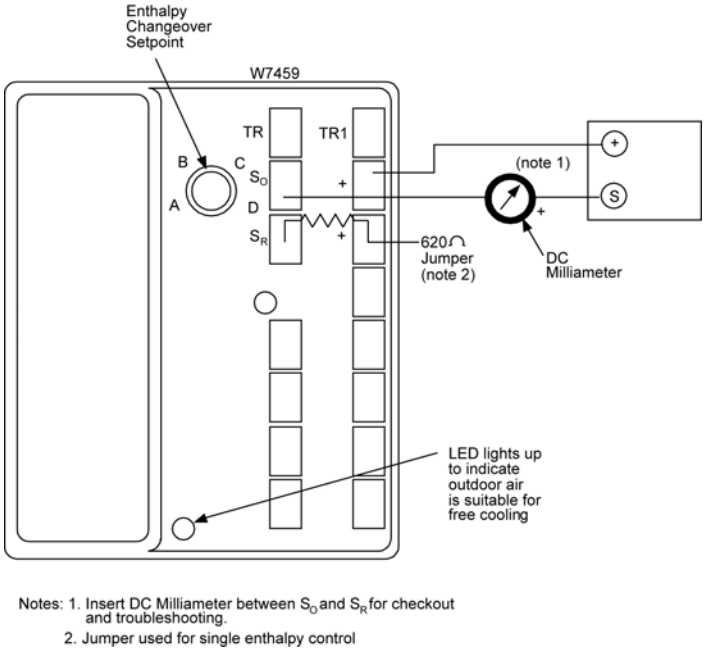
Settings and Adjustments

The face of the logic module has two potentiometers with slots for adjustment. Use a slotted screwdriver to adjust the potentiometers. Figures 14 and 15 show potentiometer adjustment slots.



Note: Minimum damper position adjustment is present on W7459A and B models only

Figure 14. Enthalpy Set Point Potentiometer Location



Notes: 1. Insert DC Milliameter between S_O and S_R for checkout and troubleshooting.
2. Jumper used for single enthalpy control

Figure 15. Meter Location for Verification and Troubleshooting

Minimum Damper Position

The minimum position potentiometer keeps the outdoor air damper from closing completely during system operation to provide ventilation.

1. Ensure the factory-installed jumper is in place across terminals P and P1 (T and T1 are disconnected).
2. If remote control of dampers is desired, connect the remote potentiometer and turn it fully clockwise before adjusting the minimum position. See Figure 14.
3. Connect 24 Vac at terminal TR and TR1 and adjust the potentiometer on the logic module face with a screwdriver for desired minimum position.

Wiring

Disconnect power supply before connecting wiring to prevent electrical shock or equipment. All wiring must comply with applicable local codes, ordinances, and regulations. Figure 16 shows a modulating circuit.

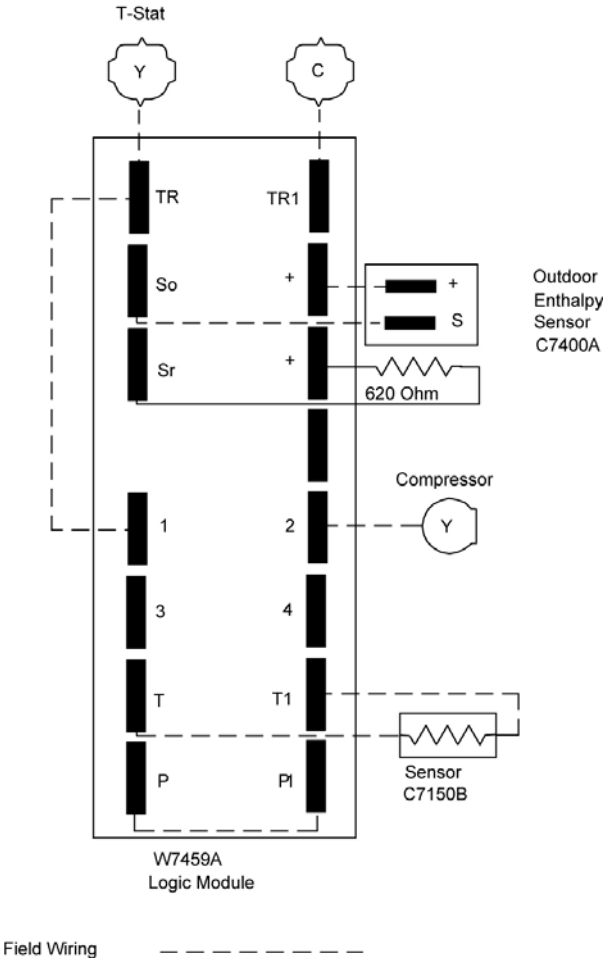


Figure 16. Modulating Control Circuit

Solid-State Enthalpy Sensor - C7400A

Use the Solid State Enthalpy Sensor – C7400A and Solid State Logic Module W7459A with Modulating Damper Motor - M7415 to proportion outdoor and return air dampers in economizer systems.

C7400A solid-state element senses temperature and humidity. Sensor mounts in any position up to 200 feet (61 meters) away from the W7459. Use one sensor in outdoor air for single enthalpy control. Use two sensors, one in return air and one in outdoor air, for differential enthalpy control. W7459A attaches to the damper motor's side for proportional control of damper. Combines solid-state enthalpy changeover control, minimum damper position potentiometer and compressor staging relays. To select air temperature and humidity suitable for free cooling, use enthalpy set point on W7459.

Table 13 and 14 list application operational specifics, respectively. Figure 17 depicts a solid-state enthalpy sensor.

Table 13. Application Specifics

Application	Comment
Sensor Used With	C7400A
For use with actuator	M7415
Discharge Air Temperature Input	Thermistor sensor C7150B or C7046
Minimum Position Potentiometer Adjustment	YES
Terminals for Remote Minimum Damper Position	YES
Output Relays	2 spdt

Table 14. Operating Specifics

Specific	Description
Case	Duct-mounted
Temperature Sensing Element:	Thermistor
Output Signal	4-20 mA current signal; increases from 4 mA to 20 mA as enthalpy decreases
Operating ambient temperature	-40 to 125° Fahrenheit (-40 to +52° Celsius)
Shipping temperature rating:	-40 to 150° Fahrenheit (-40 to +66° Celsius)
Maximum power consumption	0.45 Vac
Maximum supply voltage	18 to 24 Vdc
Electrical connection	Two ¼-inch quick-connect terminals

Listed by Underwriters Laboratories Inc.

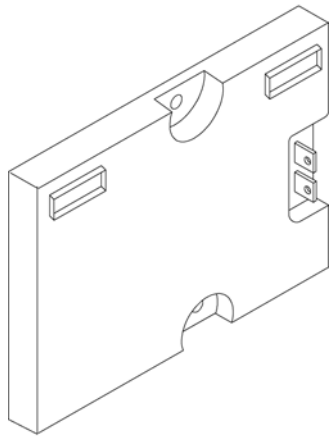


Figure 17. Solid-State Enthalpy Sensor

Location and Mounting

Outdoor air sensing: The Enthalpy Sensor may be mounted in any orientation where it is exposed to freely circulating air, but protected from rain, snow, and direct sunlight.

Return air sensing: For differential enthalpy control, a second C7400A enthalpy sensor is connected to the W7459. It is mounted in the return air duct. **Contact Titus if specifications call for differential enthalpy control.**

Air Temperature Sensor – C7150B

Use the air temperature sensor – C7150B and the single-zone system – W973 with the damper motor – M7415A to sense mixed or discharge air in rooftop packaged air conditioning equipment. See Figure 18.

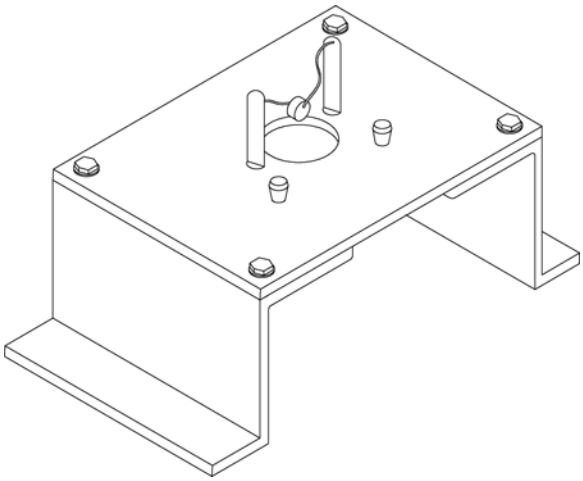


Figure 18. Air Temperature Sensor

The sensor consists of thermistor sensor element used in ventilation duct systems. Negative temperature coefficient (NTC) causes the resistance to decrease as the sampled air temperature increases. This resistance change is used to control the W973 and W7415A. Setting and calibration not required.

Operation

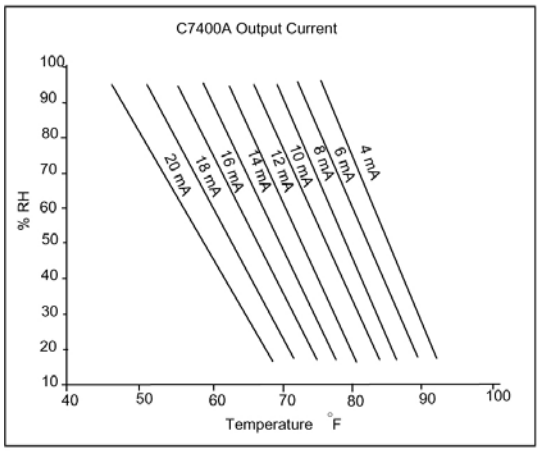
Table 15 highlights operational ratings of the air temperature sensor.

Enthalpy Changeover Set Point

With single enthalpy the enthalpy changeover set point is set to return the outdoor air damper to minimum position when the enthalpy rises above its set point. The enthalpy set point scale markings, located on W7459, are A, B, C, and D in Figure 20.

Table 15. Operation Ratings

Specification	Performance
Maximum ambient temperature	250º Fahrenheit (125º Celsius)
Operating temperature range	-30 to 150º Fahrenheit (-34 to 65º Celsius)
Resistance/ Temperature (NTC)	300 ohms at 77º Fahrenheit (25º Celsius)
Resistance sensitivity per degree at midrange	70 ohms per degree Fahrenheit
Electrical connections	¼-inch quick-connect terminals



Control Curve	Control Point (approx. deg.) at 50% RH
A	73 [23]
B	70 [21]
C	67 [19]
D	63 [17]

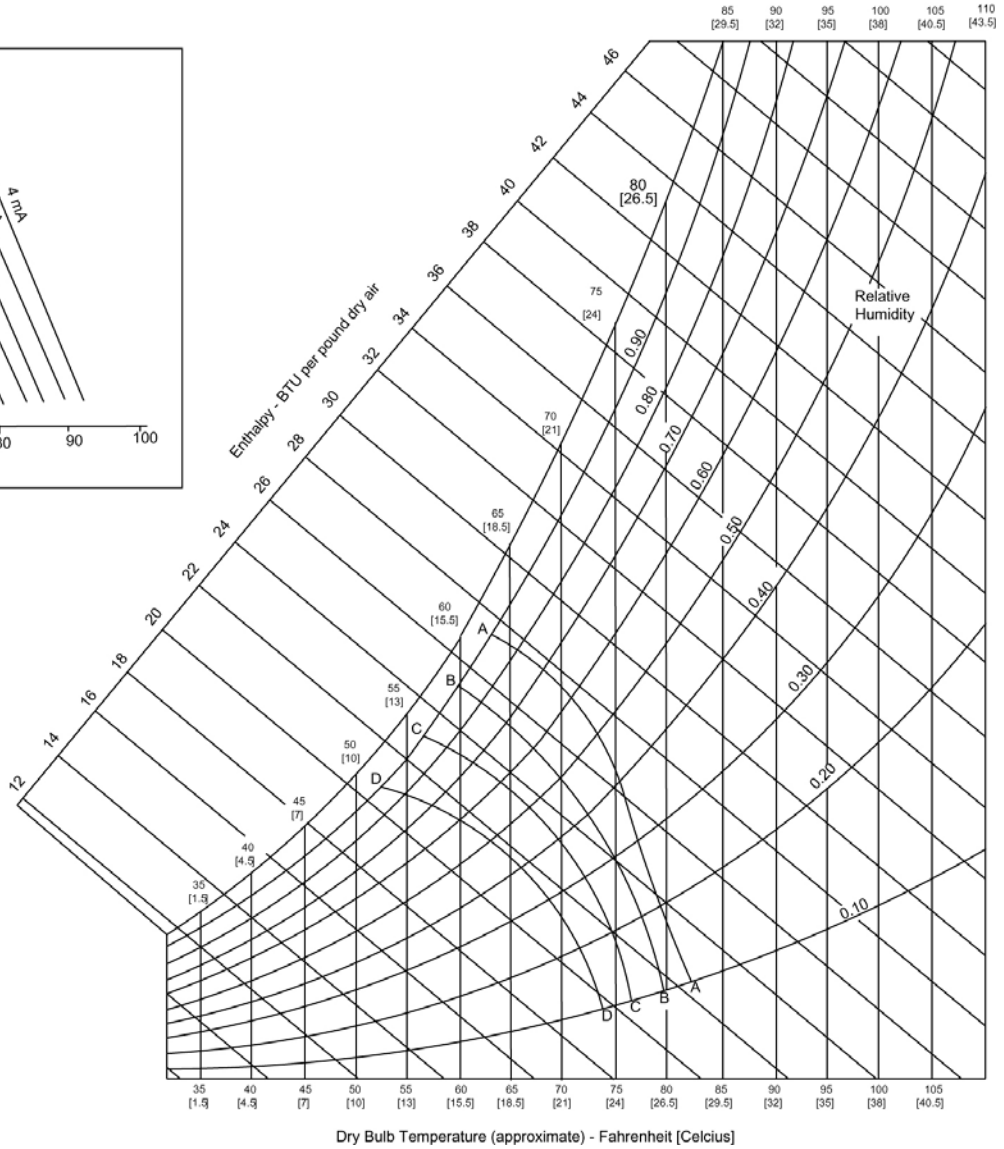


Figure 20. Performance Characteristics for Enthalpy Changeover Settings A, B, C, and D

See Figure 20 for the corresponding control point. The factory-installed 620 ohm jumper must be in place across terminals + and S_R.

Single M7415 actuator accepts the thermistor sensor input from C7150B mounted in discharge or mixed air duct. See Figure 10.

During the occupied period, on a call for cooling, when outdoor air temperature or enthalpy conditions are low, the M7415 economizer actuator will proportion to maintain between 50-56º Fahrenheit at thermistor sensor.

If the mixed or discharge air temperature is above 56º Fahrenheit, M7415 actuator will open to admit additional outdoor air until the temperature returns to the 50 to 56º Fahrenheit range. During the occupied period, the actuator will not close past minimum position.

If the fully open M7415 actuator cannot satisfy the space demand, mechanical cooling is sequenced on.

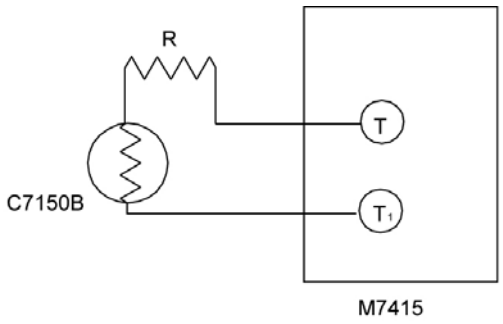
During the unoccupied period, the M7415 actuator will override minimum position setting and drive fully closed. On a loss of power, the actuator will spring return fully closed.

When in heating operation, or outdoor air temperature or enthalpy conditions are high, economizer operation is locked out, and M7415 actuator is held at minimum position.

Discharge Air Temperature Setpoint Adjustment

The air temperature sensor – C7150B maintains the discharge or mixed air duct temperature between 50 and 56º Fahrenheit. If the mixed air discharge temperature is outside the 50 to 56º Fahrenheit range, the damper motor will proportion open or closed until the temperature returns to the 50 to 56º Fahrenheit.

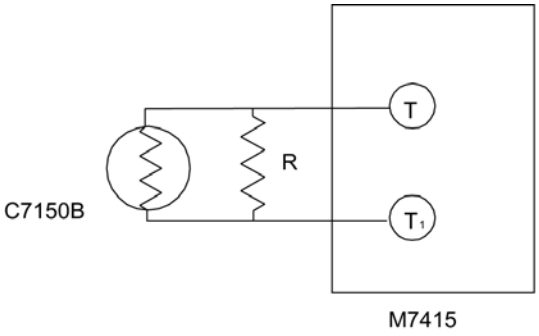
This temperature range can be adjusted either up or down by wiring a resistor in series or parallel with the C7150B depending on the application. Refer to Figures 21 and 22 for details.



Resistor Value	C7150B Setpoint
681 Ω	54.5 °F to 61.5 °F
2760 Ω	68.4 °F to 80.1 °F
3650 Ω	87.4 °F to 110.3 °F
4420 Ω	104.7 °F to 150 °F
4750 Ω	116 °F to 194 °F
4870 Ω	120 °F to 300 °F

Use 1%, 1/8 W or higher resistor

Figure 21. Increasing the Air Temperature Sensor Setpoint



Resistor Value	C7150B Setpoint
18.2K Ω	36 °F to 44 °F
24K Ω	39.5 °F to 47 °F
30K Ω	42 °F to 49 °F

Use 1%, 1/8 W or higher resistor

Figure 22. Decreasing the Air Temperature Sensor Setpoint

Verification and Troubleshooting

The following table provides the actions and responses to verify the installation of W7459A installed on an M7415 Actuator.

DANGER

DISCONNECT POWER SUPPLY BEFORE CONNECTING WIRING TO PREVENT ELECTRICAL SHOCK OR EQUIPMENT DAMAGE

Caution: Exercise care when adjusting the enthalpy changeover and minimum damper position control. Use a small screwdriver for these adjustments. Excessive force may damage the controls.

Perform verification and troubleshooting steps in order.

Table 16. Modulating Control Verification and Troubleshooting

Action		Response
A.	**Power**	
1.	Disconnect power at terminals TR and TR1.	
2.	Disconnect jumper across P and P1.	
3.	Jumper TR and 1.	
4.	Jumper T1 to T.	
5.	If connect, remove C7400A Enthalpy Sensor from terminals S_O and +.	
6.	Verify Factory-installed 620 ohm resistor is connected to S_R and +.	
7.	Apply 24 Vac power to terminals TR and TR1	LED should be off. Motor is in closed position.
8.	Disconnect factory-installed 620 ohm resistor from terminals S_R and +.	LED should be on, indicating low enthalpy. Motor drives toward open.
B.	**Enthalpy Simulation**	
1.	Reconnect factory-installed 620-ohm resistor across terminals S_R and +.	
2.	Connect 1.2k ohm checkout resistor across terminals S_O and +.	
3.	Set enthalpy set point potentiometer to “A”.	LED should come on, indicating low enthalpy. Motor drives toward open.
4.	Set enthalpy set point potentiometer to “D”.	LED should go off, indicating high enthalpy. Motor drives toward closed.
C.	**Sensor**	
1.	Reconnect the + lead of outdoor enthalpy sensor to the + terminal of W7459.	
2.	Connect a DC multi-meter or voltmeter between terminals S_O of the W7459 and terminal S of the enthalpy sensor. (Positive meter lead to terminal S of enthalpy sensor.)	Multi-meter or voltmeter should indicate between 3 and 25 mA, if sensor is operating properly. If multi-meter or voltmeter indicates zero, the sensor may be wired backwards.
3.	If using differential enthalpy, the return air enthalpy sensor may be checked by connecting a DC multi-meter or voltmeter between terminal S_R of the W7459 and terminal S of the return air enthalpy sensor. (Position meter lead to terminal S of return air enthalpy sensor.	Multi-meter or voltmeter should indicate between 3 and 25 mA, if sensor is operating properly. If multi-meter or voltmeter indicates zero, the sensor may be wired backwards.

Abbreviations

The following table lists the abbreviations found within this document.

Abbrev.	Term
A	Ampere
BTU	British Thermal Units
DC	Direct Current
LED	Light Emitting Diode
mA	Milliampere
NTC	Negative temperature coefficient
RH	Relative Humidity
spdt	Single-pole, double -throw
spst	Single-pole, single-throw
Vac	Volts Alternating Current
Vdc	Volts Direct Current