

## Solid State Economizer System

(CONSISTING OF: C7046C DISCHARGE AIR SENSOR **OR** C7150B MIXED AIR SENSOR, C7400A SOLID STATE ENTHALPY SENSOR **OR** C7650A SOLID STATE TEMPERATURE SENSOR, M7415 **OR** M8405 DAMPER ACTUATORS **OR** MODULATING DIRECT COUPLED ACTUATORS (MS7505), T6031H THERMOSTAT AND W7459 **OR** W7212 SOLID STATE ECONOMIZER LOGIC MODULE)

### PRODUCT DATA



### FEATURES

*C7046C Discharge Air Sensors have probe lengths of 8 in. (203 mm) and nominal sensor resistance of 3000 ohms at 77°F (25°C).*

- No setting or calibration required.
- Solid state components not affected by dust or dirt.
- Fast reacting.
- Rugged aluminum insertion probe.

*C7150B Mixed Air Sensor is used with the W7212/W7459 Economizer Module to sense mixed or discharged air in roof-top packaged air conditioning equipment.*

- No setting or calibration required.

*C7400A Solid State Enthalpy Sensor and C7650A Solid State Temperature Sensors are used with the W7212/W7459 Solid State Economizer Logic Module to sense outdoor and return air enthalpy or temperature.*

- **C7400A senses and combines temperature and humidity (enthalpy) of outdoor air (heat index).**
- **C7650A senses temperature only.**
- **When enthalpy/temperature of outdoor air increases, the outdoor air damper closes to a preset minimum position.**
- **When enthalpy/temperature of outdoor air is low, the outdoor air damper opens to reduce the building cooling load.**
- **Additional economizer savings are achieved when two C7400A Solid State Enthalpy Sensors are connected to one Logic Module for differential enthalpy changeover control.**

### APPLICATION

The Solid State Economizer System provides an economical method of providing cooling air by incorporating outdoor air in the first stage of cooling in heating, ventilating and air conditioning (HVAC) systems. The Solid State Economizer System consists of the C7046C Discharge Air Sensor **or** C7150B Mixed Air Sensor, C7400A Solid State Enthalpy Sensor **or** C7650A Solid State Temperature Sensor, M7415 **or** M8405 Damper Actuators **or** Modulating Direct Coupled Actuators (MS7505), T6031H Thermostat and W7212 **or** W7459A,C Solid State Economizer Logic Module.

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*M7415 and M8405 Damper Actuators are 25 lb-in. spring return damper actuators that provide modulating or three-position control of economizer systems on HVAC equipment.*

- **M7415 Damper Actuator provides modulating control of economizer dampers from a thermistor mixed-air or discharge sensor to maintain 56°F (13°C) air temperature.**
- **M8405A Damper Actuator provides three-position control: closed, adjustable mid-position, and open.**
- **W7459 logic modules may plug directly onto the M7415.**
- **High impact, glass-fiber reinforced, plastic case is rugged, lightweight and corrosion resistant.**

*M7215 Damper Motors provide 25 lb-in. torque with spring return and 2–10 Vdc modulating control of economizer systems on HVAC equipment.*

- **M7215 Damper Motors provide modulating control of economizer dampers from a 2–10 Vdc controller.**
- **W7212 logic module may plug directly onto the M7215.**

*T6031H Thermostat acts as changeover thermostat.*

- **Switches enclosed to resist effects of dust and moisture.**
- **Warmer–Cooler temperature scale.**
- **Sensing bulb installed in return air flow.**

*W7459A,C Solid State Economizer Logic Module used with C7400 Solid State Enthalpy Sensors and M7415 or M8405 Damper Actuators to proportion outdoor and return air dampers for economizer control in commercial HVAC equipment.*

- **Combine functions of solid state enthalpy changeover control, minimum damper position potentiometer (W7459A) and compressor staging relays.**
- **Optional differential enthalpy control provides greater economizer savings than single enthalpy control by selecting the most economical air for cooling.**
- **W7459A mounts on M7415 Damper Actuator and accepts inputs from C7150B Mixed Air Sensors, C7400 Solid State Enthalpy Sensors, C7046C Discharge Air Sensor, and optional remote minimum damper position potentiometer.**

- **W7459C mounts on M8405A Damper Actuator and accepts inputs from single pole single throw (spst) mixed or discharge air control and C7400 Solid State Enthalpy Sensors.**
- **Packages are designed to operate from the cooling space thermostat to provide a totally integrated control system.**
- **Enthalpy setpoint (A,B,C,D) located on W7459 Solid State Economizer Logic Module is used to select combination of air temperature and humidity that is suitable for free cooling.**
- **W7459A include built-in adjustable minimum damper position potentiometer that controls the amount of outdoor air admitted to meet minimum ventilation requirements; includes terminals for connecting optional remote minimum position potentiometer.**
- **LED on W7459 indicates free cooling is available when there is a call for cooling from the thermostat.**

*W7212A economizer logic module used with C7400 enthalpy sensors, M7215 or MS7505 damper actuators and C7232 CO<sub>2</sub> sensors to proportion outdoor and return air dampers from economizer and demand control ventilation in commercial HVAC equipment.*

- **Operates from thermostat and DCV sensor to provide a totally integrated control system.**
- **Combines minimum and DCV maximum damper position potentiometers with compressor staging.**
- **Solid state enthalpy or dry bulb changeover control.**
- **Terminals included for switching between Occupied and Unoccupied operation.**
- **Maximum economizer savings is achieved with two (2) C7400 enthalpy sensors, one (1) W7212 economizer logic module, and one (1) C7232 CO<sub>2</sub> sensor using differential enthalpy changeover and Demand Control Ventilation (DCV).**
- **LED indicates when free cooling is available.**
- **LED indicates when module is in DCV mode.**
- **LED indicates when exhaust fan contact is closed.**
- **W7213 is used with heat pump B terminal.**
- **W7214 is used with heat pump O terminal.**

## ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care  
1885 Douglas Drive North  
Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.

International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

### MS7505 Spring Return Direct Coupled Actuator

The MS7505 Series Spring Return Direct Coupled Actuators (DCA) are control actuators that provide proportioning control for valves and dampers. They accept a voltage signal from an economizer to position a damper or valve at any chosen point between fully open and fully closed.

- Control for air damper applications with up to 12.5 sq ft assuming 3.5 in.-lb per sq ft of damper area, velocity independent.
- Brushless DC submotor with electronic stall protection.
- Patented self-centering shaft adapter.
- Access cover to facilitate connectivity.
- Metal housing with mechanical end limits.
- Field-installable auxiliary switches.
- Spring return direction field-selectable.
- Hub includes position indicator.

## SPECIFICATIONS

### IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, these units may not exactly match the specifications listed. Also, these products are tested and calibrated under closely controlled conditions and some minor differences in performance can be expected if these conditions are changed.

### Models:

Specifications for each model are listed separately.

### C7046 Discharge Air Sensors

Intended for use as a discharge sensor in rooftop applications.

#### Sensing Element:

Carbon type, thermistor-resistor element.

#### Performance Characteristics:

Reaction Time Constant with Air Approach Velocity of 8.33 ft/sec (2.54 m/sec): 60 seconds.

#### Resistance/Temperature (NTC):

Nominal Resistance: 3000 ohms at 77°F (24°C). Nominal Sensitivity: 70 ohms per degree F (124 ohms per degree C) at midrange.

#### Mounting Arrangement:

Integral mounting flange that requires two no. 8 screws (not provided).

#### Maximum Ambient Temperature:

250°F (121°C).

#### Operating Temperature Range:

40°F to 150°F (4°C to 66°C).

#### Wiring Connections:

6 in. (152 mm) leadwires.

#### Dimensions:

See Fig. 1.

### C7150B Mixed Air Sensor

Used to sense mixed air in rooftop packaged air conditioning equipment.

#### Resistance/Temperature (NTC):

Nominal Resistance: 3000 ohms at 77°F (24°C). Nominal Sensitivity: 70 ohms per degree F (124 ohms per degree C) at midrange.

#### Maximum Ambient Temperature:

250°F (121°C).

#### Operating Temperature Range:

-40°F to +110°F (-40°C to +44°C).

#### Dimensions:

See Fig. 2.

### C7400A Solid State Enthalpy Sensor/C7650A Solid State Temperature Sensor

Senses enthalpy or temperature of outdoor and return air.

#### Temperature Sensing Element:

Thermistor.

#### Output Signal:

4 to 20 mA current signal; increases from 4 mA to 20 mA as enthalpy decreases.

#### Ambient Operating Temperature Range:

-40°F to +125°F (-40°C to +52°C).

#### Approval:

Underwriters Laboratories Inc. Flammability Rating: UL94-5V.

#### Dimensions:

See Fig. 3.

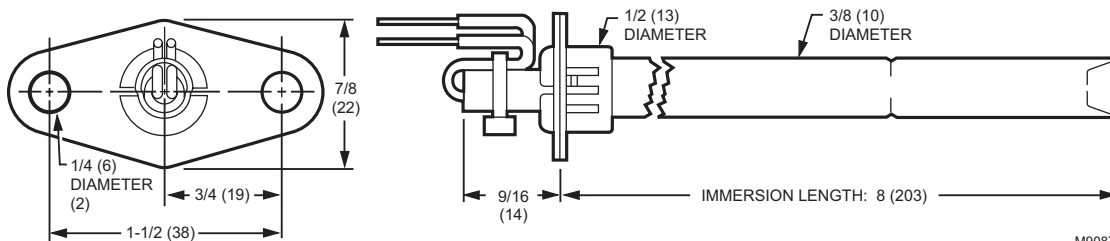
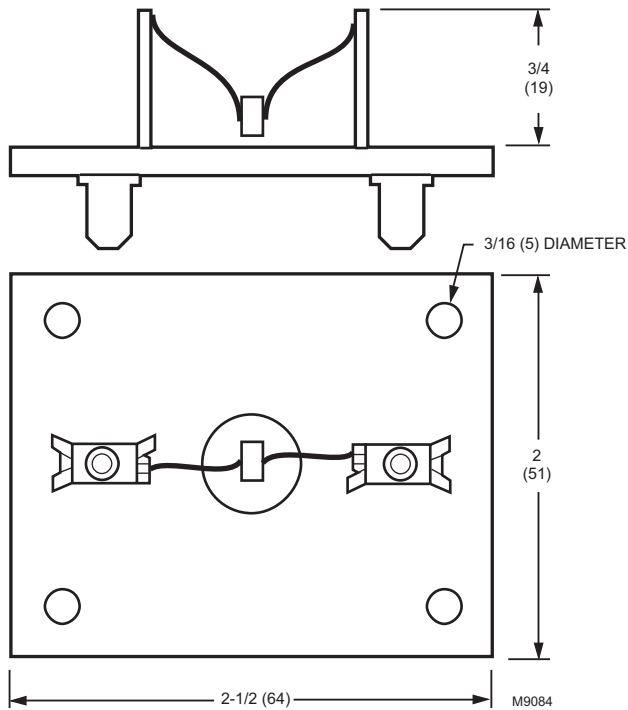
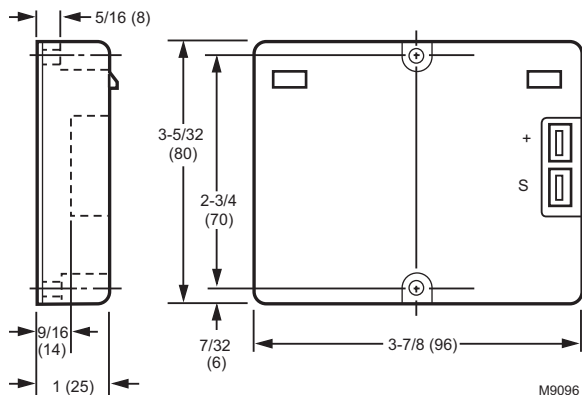


Fig. 1. Approximate dimensions of C7046C Air Temperature Sensor in in. (mm).



**Fig. 2. Approximate dimensions of C7150B Mixed/Discharge Air Sensor in in. (mm).**



**Fig. 3. Approximate dimensions of C7400A Solid State Enthalpy Sensor/C7650A Solid State Temperature Sensor in in. (mm).**

**M7415A, M8405A Damper Actuators**

Provides control of economizer systems on HVAC equipment.

**Actuator Rotation:**

Closed position is the limit of clockwise rotation; open position is the limit of counterclockwise rotation as viewed from the shaft end of the motor.

**Auxiliary Switch Rating (M8405A only):**

24 Vac, 20 VA inrush, 20 VA run.

**Terminal Connections:**

1/4 in. (6 mm) male quick connect terminals mounted on actuator. Terminal arrangement is dependent on actuator model.

**Ambient Operating Temperature Range:**

-40°F to +125°F (-40°C to +52°C).

**Voltage and Timing:**

See Table 1.

**Dimensions:**

See Fig. 4.

**Shaft:**

Single-ended drive shaft with crank arm supplied.

**Flammability Rating:**

Underwriters Laboratories Inc. UL94-5V.

**Approval:**

Underwriters Laboratories Inc. Component Recognized: File No. E4436, Guide No. XAPX2, Vol. 9, Section 1, 7-25-83.

**SPECIFICATIONS: M7215**

**Models:** ML7215: 25 lb-in. (2.8 Nm) torque, foot-mounted spring-return damper motor with 2-10 Vdc feedback signal. Accepts 2-10 Vdc control signal.

**Dimensions:** See Fig. 4.

**Electrical Ratings:**

Supply Voltage: 24 ±6 Vac 50/60 Hz.

Power Consumption: 24 Vac, 60 Hz: 8.7 VA. 24 Vac, 50 Hz: 8.4 VA.

**Torque:**

Lift and Hold: 25 lb-in. (2.8 Nm). Spring Return: 25 lb-in. (2.8 Nm). Breakaway: 40 lb-in. (4.5 Nm).

**IMPORTANT**

*Never use motor continuously at the breakaway torque rating.*

**NOTE:** Breakaway torque available to overcome occasional large loads such as a seized damper.

**Stroke:**

Travel: 90°.

**Timing:**

Driving: 86 ±5 seconds.

Spring Return: 13 ±5 seconds.

**Motor Rotation (Viewed From Shaft End):**

Closed Position: Limit of clockwise rotation.

Open Position: Limit of counterclockwise rotation.

Crank Arm Rotation Limits: See Fig. 8.

Shipped with shaft in closed position.

**Ambient Ratings:**

Temperature:

Operating: -25°F to +125°F (-32°C to +52°C).

Storage: -30°F to +150°F (-34°C to +66°C).

Humidity: 5 to 95 percent RH, noncondensing.

**Terminal Connections:** 1/4 in. (6 mm) quick-connect terminals mounted on motor.

**Shaft:** Single-ended drive shaft with crank arm supplied.

**Reliability:**

Full-Stroke Cycles: 60,000. Repositions: 1,500,000.

**Approvals:**

Underwriters Laboratory Inc.: Flammability Rating: UL94-5V.  
Component Recognized: File No. E4436, Guide No. XAPX2, Vol. 9, Section 1, 7-25-83.

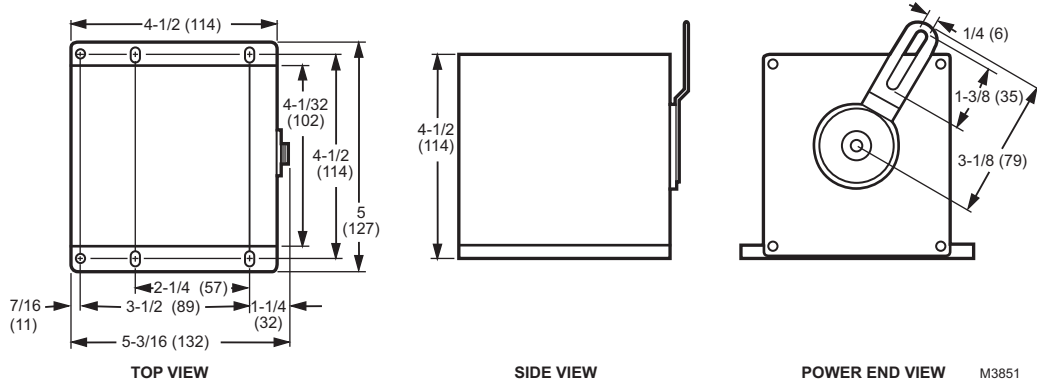


Fig. 4. M7215, M7415A, and M8405A Damper Motor dimensions in in. (mm).

Table 1. M7415A/M7405A Actuator Specifications.

Model Number	Voltage (Vac) 50/60 Hz	Power (Vac)		Timing (sec) <sup>a</sup>	Stroke (°)	Torque		Open Rotation (Shaft End View)	Spring Return (Shaft End View)
		(Drive)	(Hold)			(lb-in.)	(Nm)		
M7415A <sup>b,c</sup>	24	8	5	90	90	25	2.8	CCW	CW
M8405A <sup>b,d</sup>	24	7	3	90	90	25	2.8	CCW	CW
M7415B <sup>b,c</sup>	24	8	5	90	90	25	2.8	CW	CCW
M7215A <sup>b,c</sup>	24	8	5	90	90	25	2.8	CCW	CW
MS7505 <sup>a,b,c,e</sup>	24	13	5	90	90	44	5	CW/CCW	CW/CCW

<sup>a</sup> Timing with 60 Hz power.

<sup>b</sup> Spring return.

<sup>c</sup> Modulating.

<sup>d</sup> Three-position with field adjustable minimum position control.

<sup>e</sup> Mounts directly on damper shaft.

**T6031H Thermostat**

A standard spdt switch, without a case, that acts as a changeover thermostat.

**Electrical Rating:**

0.25A at 1/4V to 12 Vdc inductive load.

**Control Range, Element Temperature and Differential:**

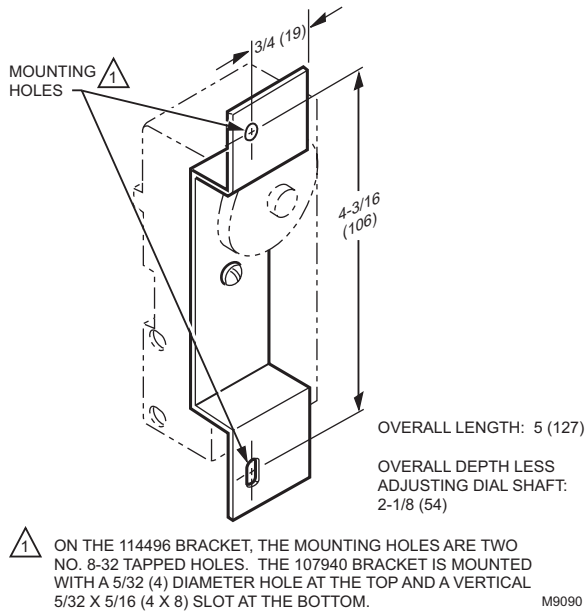
See Table 2.

**Approval:**

Underwriters Laboratories Inc. Listed:  
File E4436, Vol. 4, Guide No. XAPX2.

**Dimensions:**

See Fig. 5.



**Fig. 5. Approximate dimensions of back mounting bracket for T6031H in in. (mm).**

**W7459A,C Solid State Economizer Logic Module**

Used with C7400 Sensor or C7650A Sensor and M7415 or M8405 Actuator to proportion outdoor and return air dampers for economizer control in commercial HVAC equipment.

**Electrical Ratings:**

Input Voltage: 24 Vac, 50/60 Hz.  
 Power Consumption: 5.5 VA.  
 Relay Contact Rating at 24 Vac: 1.5A run, 3.5A inrush.

**Temperature Ratings:**

-25°F to +125°F (-32°C to +52°C).

**Approval:**

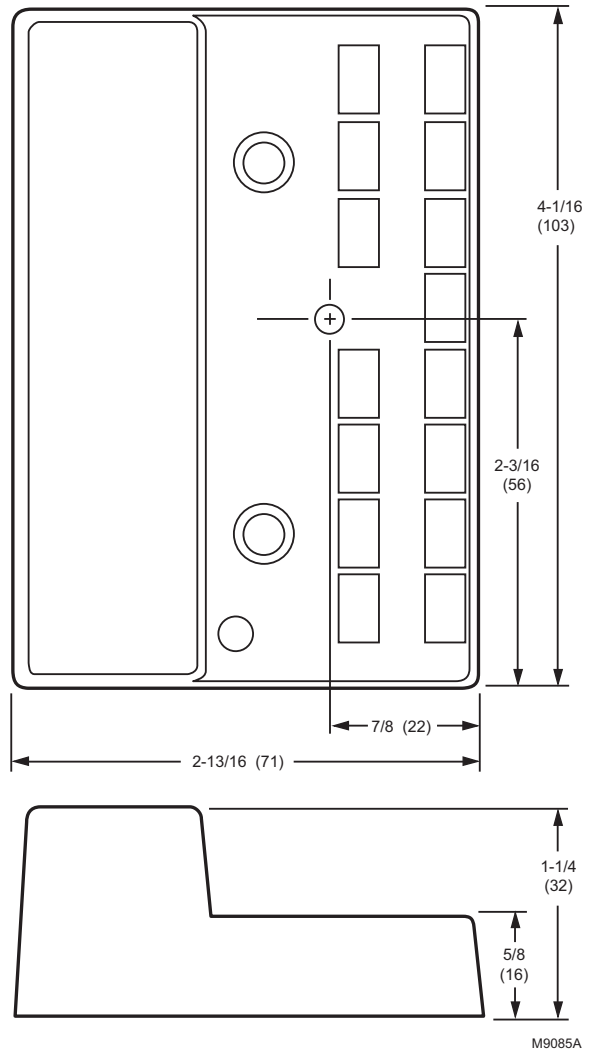
Underwriters Laboratories Inc.: Flammability Rating: UL94V-5V.

**Specifications:**

See Table 3.

**Dimensions:**

See Fig. 6.



**Fig. 6. Approximate dimensions of W7459 Solid State Economizer Logic Module in in. (mm).**

**SPECIFICATIONS: W7212A LOGIC MODULE**

**Models:** W7212A, W7213A, W7214A Logic Modules: for use with any Honeywell 2-10 Vdc actuator; includes DCV input; adjustable exhaust fan setpoint.

**NOTES:**

- All models include a minimum damper position potentiometer, and setpoints for: occupied/unoccupied control, DCV operation, and DCV maximum.
- Occupied/Unoccupied overrides minimum damper position setting when building is unoccupied.

**Dimensions:** See Fig. 7.

**Electrical Ratings:**

Input Voltage: 24 Vac ±20%; 50/60 Hz (Class 2). Nominal Power Consumption (at 24 Vac, 60 Hz): 11.5 VA.  
 Relay Contact Rating at 30 Vac (maximum power from class 2 input only): 1.5A run, 3.5A inrush.

**IMPORTANT**

All inputs and outputs must be 24 Vac Class 2.

**Ambient Ratings:**

Temperature: -40°F to +149°F (-40°C to +65°C). Humidity: 5 to 95 percent RH (noncondensing).

**Inputs:**

Enthalpy (C7400)  
 Dry Bulb Temperature (C7650)  
 Discharge Air (C7046)  
 Mixed Air (C7150)  
 DCV Sensor (C7232): 0/2-10 Vdc control signal;  
 100K ohm input impedance.

**Outputs:**

Actuator Signal: 2-10 Vdc. Minimum Actuator Impedance: 1K ohm.  
 Exhaust Fan: Contact closure.  
 24 Vac Out: 25 VA maximum.

**Approvals:**

Underwriters Laboratories Inc.: UL873 listed.  
 Flammability Rating: UL94-5VB.  
 Plenum Rated.  
 CE.  
 C-tick.

**Accessories:**

4074EJM Bag Assembly. Consists of: Checkout jumper, 620 ohm, 1.2K ohm, 5.6K ohm, and 6.8K ohm checkout resistors.  
 C7046A Discharge Air Temperature Sensor. C7150B Mixed Air Temperature Sensor.  
 C7232A,B Carbon Dioxide Sensors.

C7400 Solid State Enthalpy Sensor.  
 C7650 Dry Bulb Temperature Sensor.  
 S963B1128 Remote Potentiometer to provide remote control of damper minimum position.  
 ST6008 Energy Management Timer for occupied/unoccupied control.

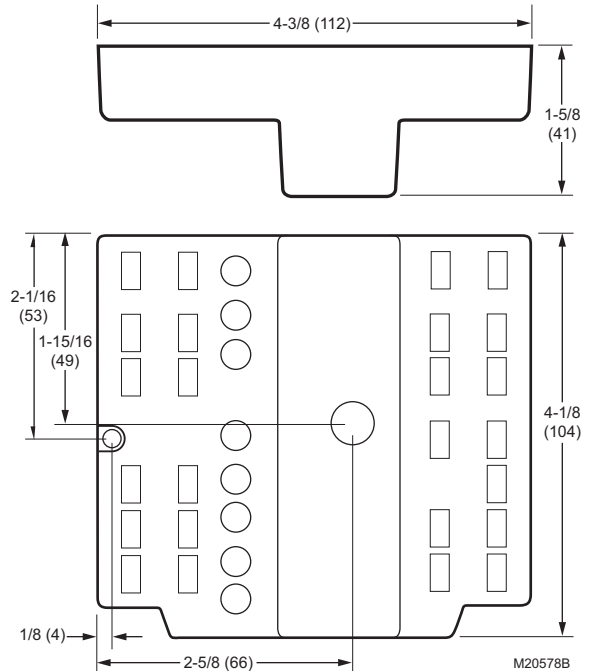


Fig. 7. Logic module dimensions in in. (mm).

Table 2. T6031H Thermostat Specifications.

Model Number	Control Range		Max Element Temperature		Differential		Type of Mounting	Capillary Length		Bulb Size	
	°F	°C	°F	°C	°F	°C		ft	m	in.	mm
T6031H	0° to 95°	-18° to +35°	150°	66°	3°	2°	Back	2	0.6	3/8 x 3-1/2	10 x 89

Table 3. W7459A,C,D Specifications.

Model	For Use with Actuator	Discharge Air Temperature Input	Minimum Position Potentiometer Adjustment	Terminals for Remote Minimum Damper Position	Output Relays
W7459A	M7415	Thermistor Sensor	Yes	Yes	2 spdt
W7459C	M8405	Spst control	No. Minimum position adjustment is built into M8405 Actuator	No	2 spdt
W7212A	M7215 MS7505	Thermistor sensor	Yes	Yes	2 spdt

**INSTALLATION: M7215, M7415, M8405**

**When Installing this Product...**

1. Read instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings and description given in the specifications to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.

4. After installation is complete, check out product operation as provided in these instructions.



**CAUTION**

**Electrical Shock or Equipment Damage Hazard.**  
 Can shock individuals or short equipment circuitry.  
 Disconnect power supply before installation.

## CAUTION

**Personal Injury Hazard.**  
**Spring-return assembly can release.**  
 Leave end covers attached to the motor.

## Location and Mounting

Locate motor as close as possible to the equipment to be controlled. Refer to Fig. 4 for mounting dimensions.

1. Mount motor with the shaft horizontal to ensure maximum life.

NOTE: Operation in other positions is possible when required by the application.

2. Remove crank arm (secured with two screws) from the motor hub.

### IMPORTANT

*Position crank arm on hub so it does not strike motor mounting surface during any portion of full stroke. See Fig. 8.*

3. Reposition the crank arm to accommodate specific damper requirements.

NOTE: Crank arm position is adjustable in eight degree increments.

4. Reconnect crank arm to the motor hub.
5. If there is an excess length of linkage rod, cut it to size. Make necessary minor adjustments until desired operation is obtained.
6. Tighten all nuts and set screws.

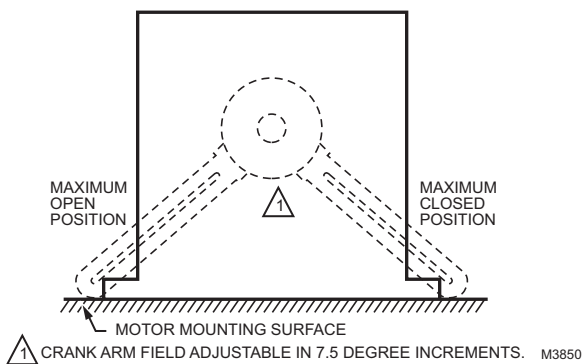


Fig. 8. Limits of crank arm rotation.

## WIRING: M7215, M7415, M8405

All wiring must comply with applicable codes and ordinances. Refer to Fig. 9 for typical hookup.

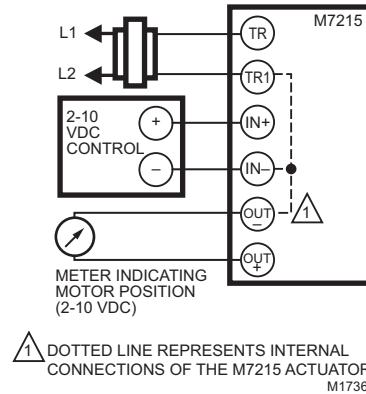


Fig. 9. Typical M7215 wiring.

## C7046C Discharge Air Temperature Sensor

The sensor assembly consists of an aluminum sensor probe (element housed internally) with attached flange that can be mounted on a flat duct or plenum surface, or in a 2 in. by 4 in. (51 by 102 mm) junction box, using two no. 8 screws. Connections to the sensor are made through two 6 in. (152 mm) leadwires.

### Location

Locate the sensor in the air duct or plenum where it can sample average air temperature. Avoid locations where air stratification can cause sensing errors.

### Mounting

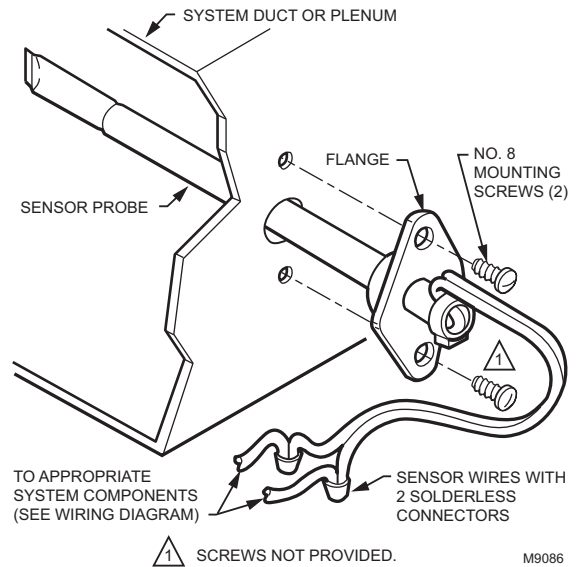
To mount the C7046C Sensor on a flat duct or plenum surface (see Fig. 10):

1. Cut a 1/2 in. (13 mm) hole in the duct or plenum surface at the desired location.
2. Insert the sensor probe into the duct or plenum hole until the flange rests against the duct or plenum wall.
3. If necessary, use the flange as a template to mark and drill two holes for no. 8 mounting screws.
4. Fasten the sensor to the duct or plenum surface with the two no. 8 sheet metal screws (not provided).

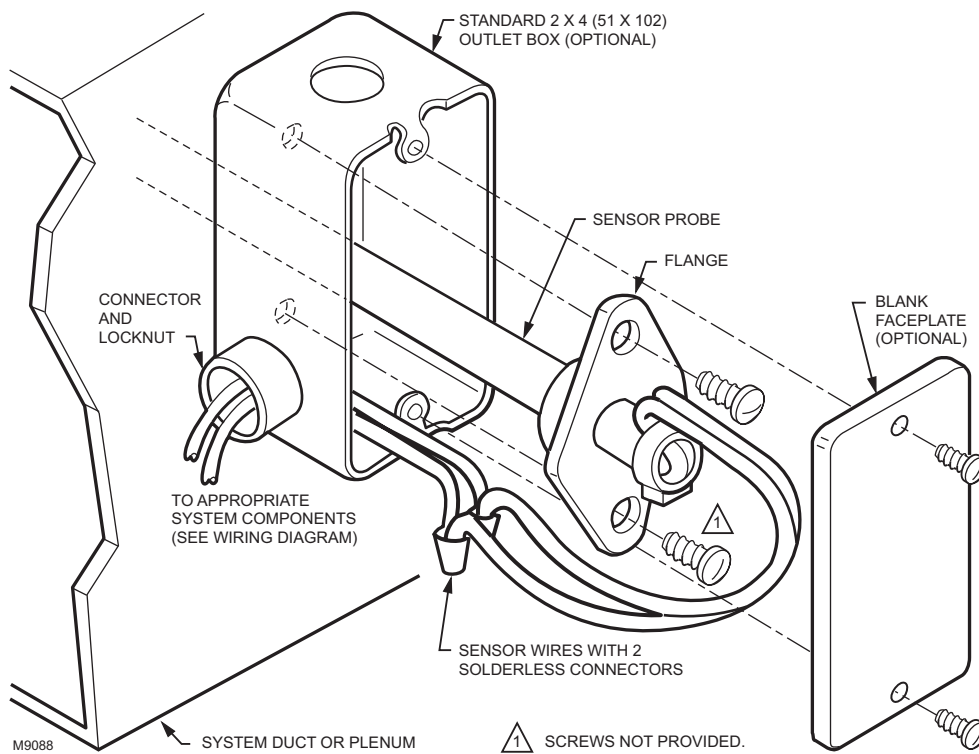


To mount the C7046C Sensor in a junction box (see Fig. 11):

1. Cut a 1/2 in. (13 mm) hole in the duct or plenum surface at the desired location.
2. Remove the center rear knockout from the junction box and insert the sensor probe through the knockout with the flange flat against the junction box.
3. Using the flange as a template, mark and drill two holes in the junction box and the duct or plenum surface for no. 8 mounting screws.
4. Insert the sensor probe through both the junction box knockout and the 1/2 in. (13 mm) hole drilled in the duct or plenum and fasten the junction box and sensor to the duct or plenum surface with the two no. 8 sheet metal screws (not provided).



**Fig. 10. Mounting C7046C Air Temperature Sensor on duct or plenum.**



**Fig. 11. Mounting C7046C Discharge Air Temperature Sensor in junction box.**

## Wiring



### CAUTION

**Can Cause Electrical Shock or Equipment Damage.** Disconnect the power supply before connecting the wiring.

Make sure wiring complies with applicable local codes, ordinances and regulations.

Connect low voltage wiring from the sensor to the appropriate system component terminals using solderless connectors as shown in Fig. 10 and 11.

**IMPORTANT**

Failure to follow these wiring practices can introduce electrical interference (noise) that can cause erratic system operation:

- a. Keep wiring at least one foot away from large inductive loads such as motors, line starters, lighting ballasts, and large power distribution panels.
- b. Shielded cable is required in installations where these guidelines cannot be met.
- c. Ground shield only to grounded controller case.
- d. Make good physical wiring connections to ensure good electrical connections.
- e. Make sure that building earth ground connections are not intermittent or missing.
- f. Mount sensor only in recommended environment.

**MS7505 Damper Actuators**

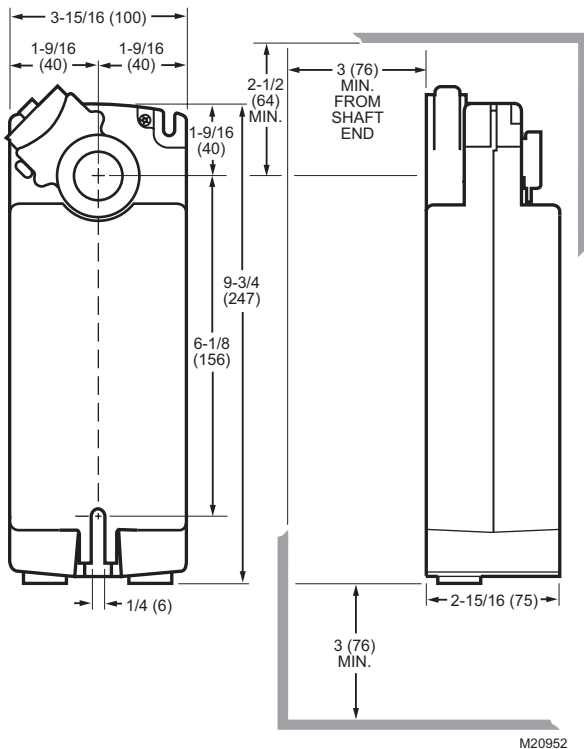
**Location and Mounting**

**LOCATION**

Locate the actuator as close as possible to the equipment to be controlled. Refer to Fig. 12 for mounting dimensions.

**Wiring**

Disconnect power supply before connecting wiring to prevent electrical shock or equipment damage. All wiring must comply with applicable local codes and ordinances.



**Fig. 12. MS7505 Dimensions Diagram.**

**Dimensions, Approximate** 9.72 in. high x 3.94 in. wide x 2.95 in. deep (247 mm high x 100 mm wide x 75 mm deep)

**Fail Safe Mode** Spring Return

**Electrical Connections** Enclosed screw terminal strip (22 to 14 AWG) (Enclosed screw terminal strip [0.324 to 2.08 sq mm])

**Frequency** 60 Hz

**Manual operation** Manual Crank

**Spring Return Direction** By orientation

**Rotational Stroke** 95 ±3 degrees

**Rotational Stroke Adjustment** Mechanically limited 5 degree increments

**Shaft Adapter Type** Self-centering clamping

**Compatible Damper Shafts** 3/8 to 1.06 round or 3/8 to 11/16 square (10 to 27 round or 10 to 18 square)

**Mounting** Direct Coupled

**External Auxiliary Switches Available** Yes

**Rated Torque** (44 lb-in. (5 Nm)

**Maximum Stall Torque** 75 lb-in. (8.5 Nm)

**Spring Return Torque** 44 lb-in. (5 Nm)

**Maximum Noise Rating, Holding (dBA @ 1m)** 20 (no audible noise)

**Maximum Noise Rating, Driving (dBA @ 1m)** 40

**Environmental Rating** NEMA2

**Ambient Temperature Range** -40°F to +140°F (-40°C to +60°C)

**Storage Temperature Range** -40°F to +158°F (-40°C to +70°C)

**Operating Humidity Range (% RH)** 5 to 95% RH, non-condensing

**Materials** Aluminum housing, Plenum rated plastic access cover

**Weight** 6 lb (2.72 kg)

**Approvals:** CE: 89/336/ECC, 73/23/EEC

**C-Tick** N314

**Canadian Underwriters Laboratories, Inc.** cUL C22.2 No. 24-93

**Underwriters Laboratories, Inc.** UL873, Plenum Rated  
**Includes** Mounting Bracket, Self-Centering Shaft Adapter, 3mm crank

**T6031H THERMOSTAT**

**Location and Mounting**

The T6031H Thermostat mounts either vertically or horizontally on a wall or panel. Locate the remote bulb as far from the controller as capillary tubing allows.

**Mounting Sensing Elements**

T6031H: Install the bulb in the return airflow where air of average temperature can circulate around it.

**IMPORTANT**

*Do not overtighten clamps to the point of distorting the sensor bulb because overtightening causes a significant shift in bulb calibration.*

**Mounting Thermostat**

Mount the thermostat using the back mounting plate as shown in Fig. 5.

## Wiring



### CAUTION

**Can Cause Electrical Shock or Equipment Damage.**  
Disconnect power supply before connecting wiring.

Disconnect the power supply before connecting wiring to prevent electrical shock and equipment damage. All wiring must comply with applicable local codes and ordinances.

Refer to Fig. 13 and the wiring diagrams furnished with the system equipment to complete the wiring.

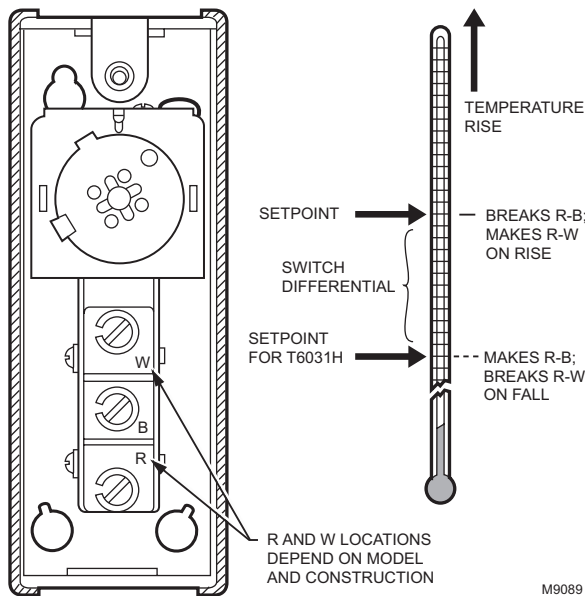


Fig. 13. T6031H switch terminal arrangement and switching.

## W7459A,C AND W7212 Solid State Economizer Logic Module

### Location and Mounting W7459 Economizer Logic Module

Mount the W7459 Economizer Logic Module on the side of the M7415 or M8405 Damper Actuator. When planning the installation, allow enough clearance for maintenance and service. Install the W7459 Economizer Logic Module where it is protected from rain and snow. One mounting screw is supplied to secure the W7459 to the actuator (after the actuator is mounted). See Fig. 14.

### Location and Mounting W7212

The logic modules mount on an M7215 or a sheet metal duct or panel. When planning the installation, allow enough clearance for maintenance and service (see Fig. 15 and 16 for

dimensions). Mount device in a location protected from rain, snow and direct sunlight. Secure device to sheet metal using the two supplied mounting screws.



### CAUTION

**Equipment Damage Hazard.**  
**Mounting screws longer than 5/8 in. can damage internal motor components.**  
When mounting the module to an M7215 use only the included #6 5/8 in. thread-forming screw.

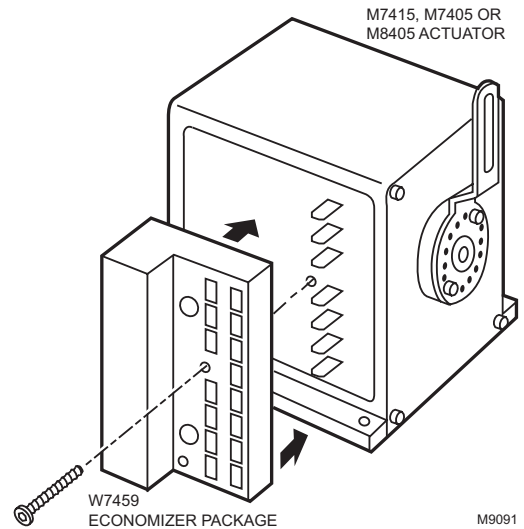


Fig. 14. Mounting W7459 on M7415 or M8405 Damper Actuator.

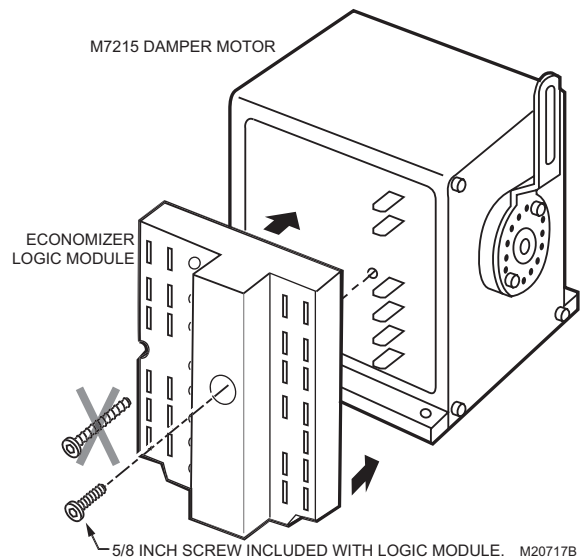
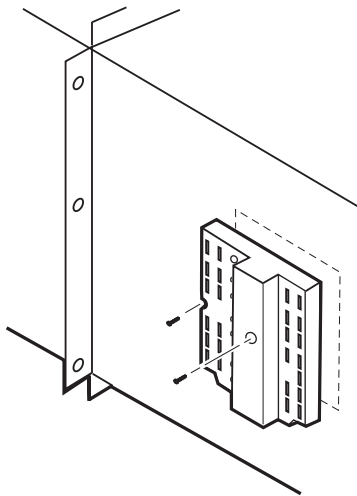


Fig. 15. Direct mounting of module.



M20601

Fig. 16. Mounting the W7212 module on sheet metal.

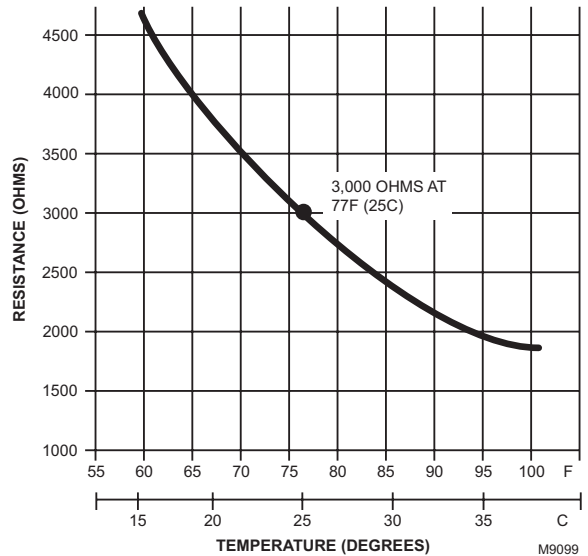


Fig. 17. C7046C and C7150B Air Temperature Sensors resistance versus temperature.

## C7400 Enthalpy Sensor and C7650A Temperature Sensor Location and Mounting

**Outdoor air sensing:** Mount the C7400 Enthalpy Sensor or C7650A Temperature Sensor 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 or temperature control, a second C7400 Enthalpy Sensor or C7650A Temperature Sensor is connected to the W7459 or W7212. Mount the second sensor in the return air duct as far as possible from the outdoor air sensor.

## Wiring



### CAUTION

**Can Cause Electrical Shock or Equipment Damage.**  
Disconnect power supply before connecting wiring.

Disconnect the power supply before connecting wiring to prevent electrical shock or equipment damage. All wiring must comply with applicable local codes, ordinances and regulations.

## OPERATION AND CHECKOUT

### C7046C (Discharge) and C7150B (Mixed) Air Sensors

The C7046C discharge air sensor is applied following the coils in the supply air to the conditioned space. The C7150B mixed air sensor is mounted in the mixing box, where the “best” combination of outdoor and return air temperature can be measured. Use either a discharge or a mixed air sensor to provide input to the economizer module through T and T1 Terminals.

### C7400A Solid State Enthalpy Sensor

The C7400A Solid State Enthalpy Sensor is used with a solid state economizer control and damper actuator to proportion an outdoor air damper in a ventilation system.

Figure 18 is a partial psychrometric chart with single C7400A Sensor and W7459A Economizer Logic Module performance curves. The curves illustrate the reset in the temperature control point due to changes in relative humidity.

The enthalpy control setpoint A,B,C or D combines temperature and humidity conditions, resulting in the control curve shown in Fig. 18. When the enthalpy or outdoor air is below (left of) the appropriate curve, the outdoor air damper can proportion open on a call for cooling. If outdoor air enthalpy rises above (to the right of) the control curve, the outdoor air damper closes to the minimum position.

For differential enthalpy, turn the control setpoint to D (fully clockwise). If outdoor air enthalpy is lower than return air enthalpy, the outdoor air damper proportions open on a call for cooling.

If outdoor air is higher enthalpy than return air enthalpy, the outdoor air damper closes to minimum position. Differential enthalpy control provides energy savings and increased comfort by using the air with the lowest enthalpy.

If outdoor air enthalpy and return air enthalpy are equal, the outdoor air damper proportions open on a call for cooling.

The relationship between the C7400A Sensor output current and relative humidity is shown in Fig. 19.

### C7650A Solid State Temperature Sensor

The C7650A Solid State Temperature Sensor is used with a solid state economizer control and damper actuator to proportion an outdoor air damper in a ventilation system.

When outdoor air temperature is higher than return air temperature, the outdoor air damper closes to the minimum position. When the outdoor air temperature and the return air temperature are equal, the outdoor air damper proportions open on a call for cooling.

The relationship between the C7650A Sensor output current and the air temperature is shown in Fig. 20.

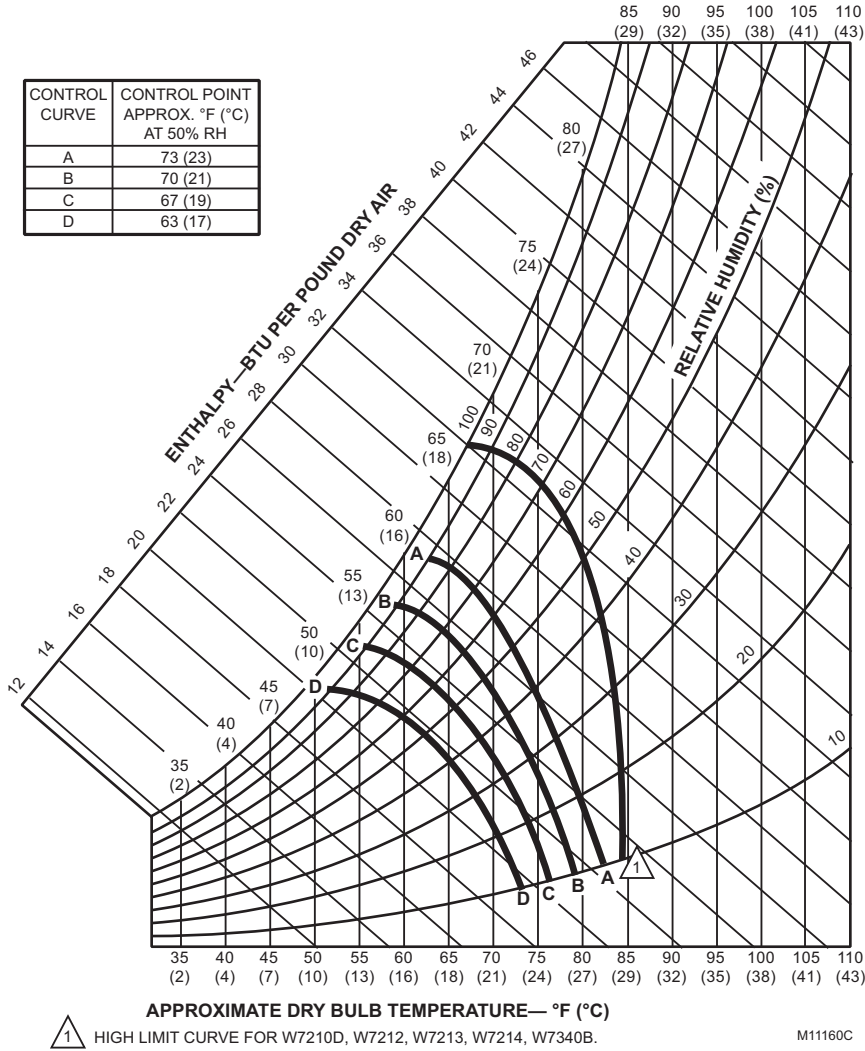


Fig. 18. Partial psychrometric chart with single C7400A Solid State Enthalpy Sensor and W7212 or W7459 Solid State Economizer Logic Module performance curves.

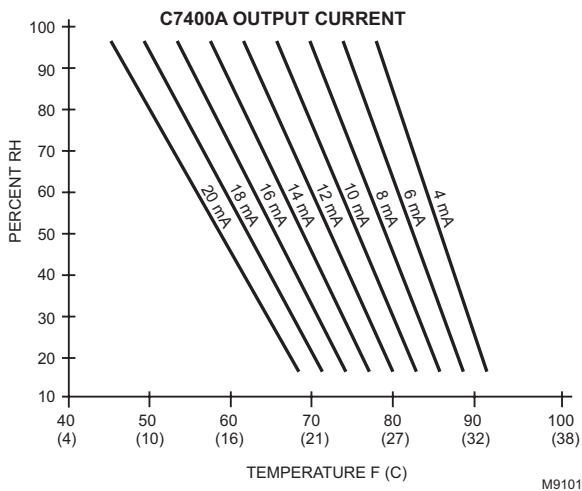


Fig. 19. C7400A Sensor output current vs. relative humidity.

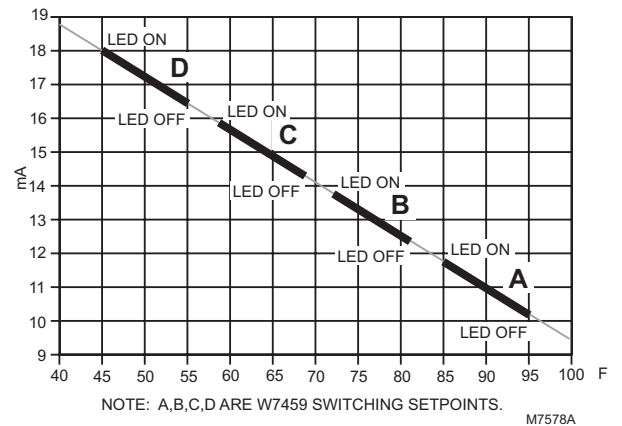


Fig. 20. C7650A Solid State Temperature Sensor output current vs. temperature.

## M7415 Damper Actuator

Single M7415 Damper Actuator accepts thermistor sensor input from a C7046A or a C7150B Mixed Air Sensor mounted in discharge or mixed air duct. See Fig. 27.

During the occupied period, on a call for cooling, when outdoor air temperature or enthalpy conditions are low, the M7415 Actuator proportions to maintain between 50°F (10°C) and 56°F (13°C) at the thermistor sensor.

If the mixed or discharge temperature is above 56°F (13°C), the M7415 Actuator opens to admit additional outdoor air until the temperature returns to the 50°F (10°C) to 56°F (13°C) range. If the mixed or discharge air temperature is below 50°F (10°C), the actuator proportions closed, shutting the outdoor air damper until the temperature returns to the 50°F (10°C) to 56°F (13°C) range. During the occupied period, the actuator does not close past the 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 overrides the minimum position setting and drives fully closed. On a loss of power, the actuator spring-returns fully closed.

If terminals P and P1 are jumpered, the M7415 drives fully open; however, if terminals P and P1 are left open, the M7415 drives fully closed. The M7415 minimum position adjustment drives the motor open when the resistance across P and P1 is minimal. Increasing the amount of resistance across these terminals drives the actuator closed.

## M8405 Damper Actuator

An spst low-voltage controller is used to control the M8405 Actuator as follows:

- a. Fully open—when the controller circuit closes to provide 24 Vac to terminals D and T, the actuator is energized and runs fully open.
- b. Fully closed—when the controller circuit opens, power is removed from terminals D and T, and the actuator spring-returns to the fully closed position.
- c. Mid-position—when the controller circuit closes to provide 24 Vac to terminals T and X, the actuator is energized to run to the adjustable mid-position (minimum position).

Adjustable minimum position can be reached from either the fully closed or fully open position. From fully closed, the actuator drives open to the minimum position; from fully open, the actuator spring-returns to minimum position.

## W7459A,C Solid State Economizer Logic Module

The purpose of an economizer is to use outdoor air for cooling whenever possible, to reduce air conditioner compressor operation. The W7459 Economizer System, when wired as shown in Fig. 27, responds to a signal from the cooling thermostat. This system uses a C7400 Enthalpy Sensor or a C7650A Temperature Sensor. It responds to both dry bulb temperature and humidity, allowing the use of outdoor air at higher temperatures for free cooling when the humidity is low.

The economizer functions as a true first stage of cooling and provides maximum fuel economy during the cooling cycle. The economizer is automatically locked out during heating. It holds 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 enthalpy or temperature of the outdoor air is below the setpoint, the outdoor air damper is proportioned open (and the return air damper is proportioned closed) to maintain between 50°F and 56°F (10°C and 13°C) at the mixed/discharge air sensor. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat.

When the enthalpy or temperature of the outdoor air is above the setpoint, the outdoor air damper closes to its minimum position. A call for cooling from the space thermostat turns on the mechanical cooling.

During the unoccupied period, the M7415 Damper Actuator spring-returns the outdoor air damper to the fully closed position.

## W7212A Economizer Logic Module

W7212A economizer logic module used with C7400 enthalpy sensors, M7215 or MS7505 damper actuators and C7232 CO<sub>2</sub> sensors to proportion outdoor and return air dampers from economizer and demand control ventilation in commercial HVAC equipment.

## W7212A Optional Applications

### HEAT PUMP CHANGEOVER (W7213, W7214 ONLY)

In heat pump applications, the controller must have control of the changeover valve. To provide the logic module with the information necessary for proper information, there must be a connection to the logic module O/B terminal. This terminal alerts the logic module as to when the system operates in cooling (the only time the economizer is used).

### W7213 (CHANGEOVER TERMINAL B)

Connect the B terminal according to the following details:

- 24V power to B: System is in heating mode.
- No power to B: System is in cooling mode.

### W7214 (CHANGEOVER TERMINAL O)

Connect the O terminal according to the following details:

- 24V power to O: System is in cooling mode.
- No power to O: System is in heating mode.

## SETTINGS AND ADJUSTMENTS

### Adjusting Minimum Damper Position

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

## M7415 and M8405 Damper Actuators Adjusting Minimum Position (Ventilation)

The M7415 Damper Actuator is adjusted for desired minimum position using a Q709 Actuator Mounted Minimum Position Potentiometer and/or a remote S963B1136 Manual Potentiometer. The M8405 Damper Actuator has an integral thumbwheel for minimum position adjustment.

### M7415 Minimum Position Adjustment

1. Run actuator 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 the potentiometer for the desired minimum position.
4. When the Q709 Actuator Mounted Minimum Position Potentiometer is used and a remote potentiometer is not connected in series, jumper terminals P and P1 on the Q709A.

### M8405 Minimum Position Adjustment

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

## Discharge Air Temperature Setpoint Adjustment—M7415 Only

This temperature range can be adjusted either up or down by wiring a resistor in series (to increase the setpoint) or in parallel (to decrease the setpoint) with the C7150B, depending on the application. See Fig. 21 and 22 for explanation.

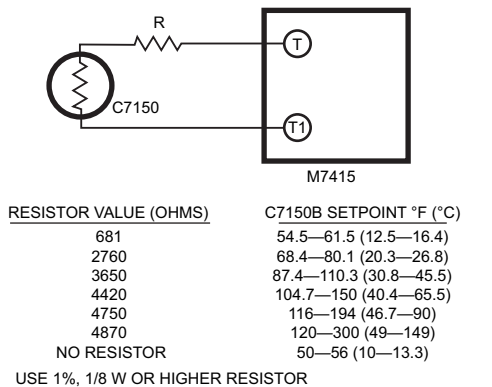


Fig. 21. Increasing C7150B setpoint.

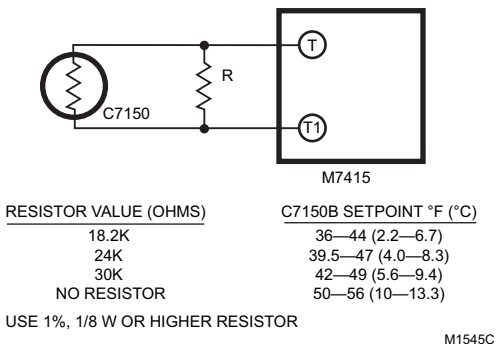


Fig. 22. Decreasing C7150B setpoint.

## W7459A,C Solid State Economizer Logic Module

Two potentiometers with small screwdriver slots for adjustment are located on the face of the module.

### Minimum Position Adjustment

#### W7459A ECONOMIZER LOGIC MODULE

1. Make sure the factory-installed jumper is in place across terminals P and P1 (terminals T and T1 are disconnected).
2. Connect 24 Vac at terminals TR and TR1 and adjust the potentiometer on the face of the W7459A with a small screwdriver for desired minimum position.

#### W7459C ECONOMIZER LOGIC MODULE

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

## Enthalpy Changeover Setpoint

Single enthalpy: the enthalpy changeover setpoint is set to return the outdoor air damper to the minimum position when the enthalpy rises above its setpoint. The enthalpy setpoint scale markings, located on the W7459, are A, B, C, D; see Fig. 18 for the corresponding control point. The factory-installed 620-ohm jumper must be in place across terminals + and S<sub>R</sub>.

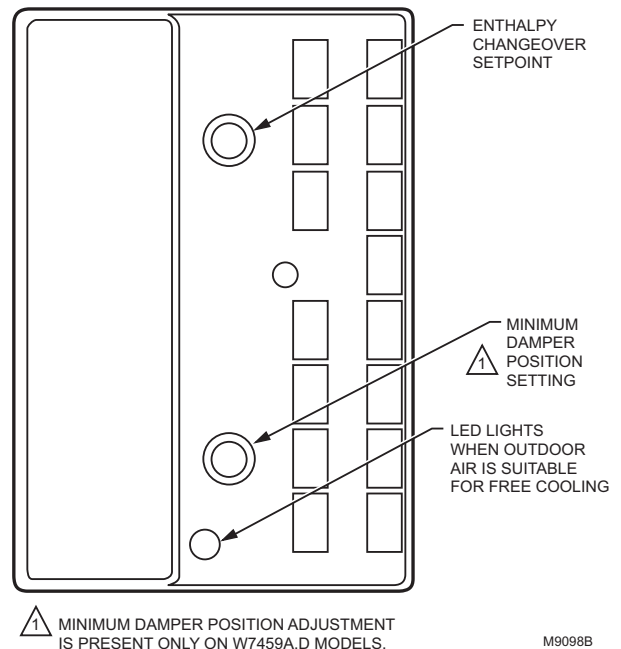


Fig. 23. Location of enthalpy setpoint potentiometer, minimum position potentiometer and LED.

## Differential Enthalpy Changeover Setting

(USE THIS OPTION ONLY WITH TWO-STAGE COOLING THERMOSTATS.)

Differential enthalpy control uses two C7400 Enthalpy Sensors or two C7650A Temperature Sensors connected to one W7459 Solid State Economizer Logic Module.

The setpoint scale markings, located on the W7459, are A,B,C and D. Turn the setpoint potentiometer fully clockwise to the D setting. The economizer selects the air that has lower enthalpy or temperature for cooling; for example, if outdoor air has lower enthalpy or temperature than return air, the outdoor air damper is opened to bring in outdoor air for free cooling.

**Remote Minimum Position Control**

Remote control of outdoor air dampers is desirable when requiring temporary additional ventilation. The addition of a S963B1128 Remote Potentiometer allows occupants to open or close the dampers beyond minimum position for modified ventilation.

**SEQUENCE OF OPERATION**

**Economizer Sequence of Operation**

**(WITH AND WITHOUT DIFFERENTIAL ENTHALPY)**

The economizer operating sequence for both the modulating and the three-position control systems are identical when the outdoor enthalpy temperature is above the mixed air setpoint of 55°F (13°C). The operating sequence for both, using a standard two-stage thermostat is:

1. The first stage of the thermostat signals a need for cooling.
2. The W7459 Solid State Economizer Logic Module begins to make decisions regarding the unit/ economizer operation.

3.
  - a. On the standard (non-differential) economizers, the logic module checks the outdoor air C7400 Enthalpy Sensor or C7650 Temperature Sensor to determine if the enthalpy or temperature is below the setpoint.
  - b. On the differential economizers, the logic module checks to determine if the outdoor air temperature is below the return air temperature.
4. If the logic module uses the outside air for cooling, the mixed air sensor prevents the entering air from going below 50°F (10°C).
  - a. On the modulating system, the control closes the outside air damper and opens the return air damper to mix the outside air and return air to maintain 50°–55°F (10°–13°C).
  - b. On the three-position system, the mixed air sensor switch opens, closing the fresh air damper until the mixed air sensor temperature returns above 55°F (13°C), closing the switch and re-opening the outside air damper.
5.
  - a. If the logic module senses that the outside air is not suitable for cooling, the air conditioning unit compressor is energized and the space is cooled with refrigerated air.
  - b. On the two-stage thermostat, the economizer is the first stage if the outside air temperature is suitable for cooling. The compressor on the unit is energized if the second stage of the thermostat is energized, thereby creating an integrated economizer.
6. Refer to Table 4 for further information on outside air damper positions.

**Table 4. Outdoor air damper positions.**

Outside Temperature <sup>1</sup>	Standard Economizer Damper Position		Return Temperature <sup>1</sup>	Differential Enthalpy Damper Position	
	Modulating <sup>2</sup>	3-Position <sup>2</sup>		Modulating <sup>2,3</sup>	3-Position <sup>2,3</sup>
80	Closed	Closed	80	Closed	Closed
			85	Open	Open
75	Closed	Closed	75	Closed	Closed
			80	Open	Open
70	Open	Open	75	Open	Open
65	Open	Open			
60	Open	Open	75	Open	Open
55	Open	Open	75	Open	Open
54 and down	Modulating	Opening/Closing	75	Modulating	Opening/Closing

<sup>1</sup> Standard economizer position based on enthalpy control set on the A setting and 50% relative humidity.

<sup>2</sup> Closed position is either the minimum position or fully closed, depending on the job setting.

<sup>3</sup> Opening/closing is dependent on the mixed air temperature.



## OPERATION: W7212

The purpose of the economizer is to use outdoor air for cooling, whenever possible, to reduce compressor operation.

Power at the N terminal determines the Occupied/Unoccupied setting:

- W7212:
  - **24 Vac (Occupied).**
  - **No power (Unoccupied).**
- W7213,W7214:
  - **W7213 (CHANGEOVER TERMINAL B)**
    - 24V power to B: System is in heating mode.
    - No power to B: System is in cooling mode.
  - **W7214 (CHANGEOVER TERMINAL O)**
    - 24V power to O: System is in cooling mode.
    - No power to O: System is in heating mode.

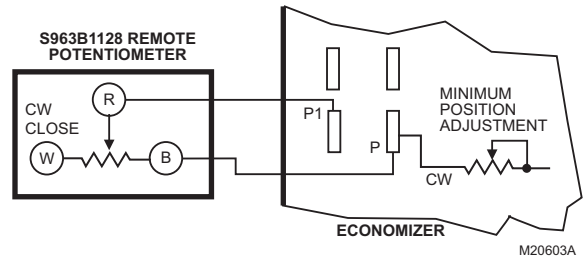
**NOTE:** When module is operating in Occupied mode, the minimum position is defined by the potentiometer. When the module is operating in Unoccupied mode, and there is no call for cooling, the damper drives fully closed.

When wired as shown in Fig. 28–33, the logic module responds to the cooling thermostat signal. The system uses C7400 Solid State Enthalpy Changeover Sensor(s) or C7650

Dry Bulb Temperature Sensor(s). The C7400 responds to both dry bulb temperature and humidity, allowing use of outdoor air at higher temperatures for free cooling when humidity is low. The C7650 responds only to dry bulb temperature; use only in dry, arid climates.

The logic module functions as a true first stage of cooling providing maximum energy economy during the cooling cycle. It automatically locks out free cooling during heating; holding the outdoor air damper at the minimum position setting.

The logic module can operate as either a basic free cooling controller, or it can incorporate additional functions. Table 5 details the input/output (I/O) logic of the module.



**Fig. 24. S963B1128 Remote Potentiometer used with logic module for remote damper control.**

**Table 5. W7212 Economizer I/O Logic.**

Demand Control Ventilation (DCV)	INPUTS				OUTPUTS				
	Enthalpy <sup>a</sup>		Y1	Y2	Compressor		N Terminal <sup>b</sup>		
	Outdoor	Return			Stage 1	Stage 2	Occupied <sup>b</sup>	Unoccupied <sup>b</sup>	
								Damper	
Below set (DCV LED Off)	High (Free Cooling LED Off)	Low	On	On	On	On	Minimum position	Closed	
			On	Off	On	Off			
			Off	Off	Off	Off			
	Low (Free Cooling LED On)	High	On	On	On	Off	Modulating <sup>c</sup> (between min. position and full-open)	Modulating <sup>c</sup> (between closed and full-open)	
			On	Off	Off	Off			
			Off	Off	Off	Off			
Above set (DCV LED On)	High (Free Cooling LED Off)	Low	On	On	On	On	Modulating <sup>d</sup> (between min. position and DCV maximum)	Modulating <sup>d</sup> (between closed and DCV maximum)	
			On	Off	On	Off			
			Off	Off	Off	Off			
	Low (Free Cooling LED On)	High	On	On	On	Off	Modulating <sup>e</sup>	Modulating <sup>f</sup>	
			On	Off	Off	Off			
			Off	Off	Off	Off			

<sup>a</sup> For single enthalpy control, the module compares outdoor enthalpy to the ABCD setpoint.

<sup>b</sup> Power at N terminal determines Occupied/Unoccupied setting:

- W7212: 24 Vac (Occupied), no power (Unoccupied).
- W7213,W7214: No power (Occupied), 24 Vac (Unoccupied).

<sup>c</sup> Modulation is based on the mixed air sensor signal.

<sup>d</sup> Modulation is based on the DCV signal.

<sup>e</sup> Modulation is based on the greater of DCV and mixed air sensor signals, between minimum position and either maximum position (DCV) or fully open (mixed air signal).

<sup>f</sup> Modulation is based on the greater of DCV and mixed air sensor signals, between closed and either maximum position (DCV) or fully open (mixed air signal).

NOTES:

- DCV and Free Cooling have setpoints and LED indications.
- For models with a B terminal (W7213):  
No power to B: cooling mode, free cool enabled. Module follows logic detailed above.  
24V power to B: heating mode, free cool disabled. Actuator drives to minimum position (closed when Unoccupied).
- For models with an O terminal (W7214):  
24V power to O: cooling mode, free cool enabled. Module follows logic detailed above.  
No power to O: heating mode, free cool disabled. Actuator drives to minimum position (closed when Unoccupied).

## SETTINGS AND ADJUSTMENTS: W7212

### CAUTION

**Equipment Damage Hazard.**  
**Excessive force can damage potentiometer controls.**

Use a small screwdriver when adjusting enthalpy changeover and minimum damper position controls.

Potentiometers with small screwdriver adjustment slots, located on device face, provide adjustments for several parameters (see Fig. 25 for locations on device):

- DCV setpoint.
- Minimum damper position.
- DCV maximum damper position.
- Enthalpy changeover.
- Exhaust setpoint.

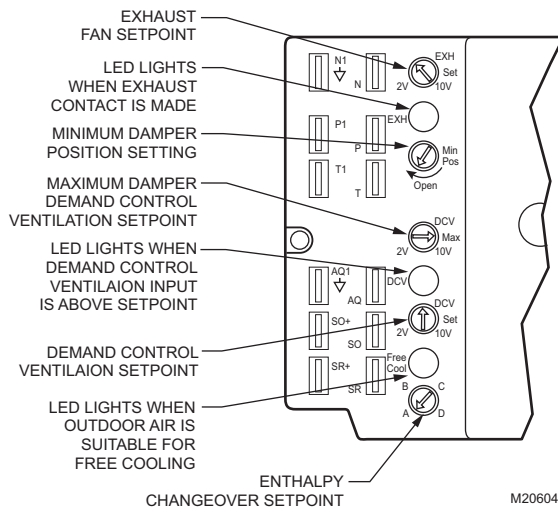


Fig. 25. Potentiometer and LED locations (W7212 shown).

### Demand Control Ventilation Setpoint

The logic module modulates the outdoor damper to provide ventilation based on the 0/2-10 Vdc DCV. With no cooling signal, the DCV overrides the outdoor air damper when ventilation requires additional outdoor air.

### Adjusting Minimum and Maximum Positions

The minimum position potentiometer maintains the minimum outdoor air flow into the building during the occupied period. The minimum position allows for the building effluents. The DCV maximum position potentiometer allows the installer to

limit the amount of outdoor air flow into the building when the DCV overrides the mixed air sensor and allows the proper ventilation based on occupancy. Setting the DCV maximum position of the damper prevents the introduction of large amounts of hot or cold air into the space by preventing the dampers from opening 100%. Set the DCV maximum position at the maximum design occupancy.

### IMPORTANT

*With the DCV maximum position set below the minimum position, the minimum position overrides the maximum position (negating most DCV functions of the logic module, as the damper cannot move).*

NOTES:

- When the mixed air sensor takes control based on an increased requirement for cooling, it overrides the DCV maximum position potentiometer and can drive the damper full-open.
- If the mixed air temperature drops to 45°F, the mixed air sensor overrides the DCV and fully closes the damper to protect from freezing the hot or chilled water coils. Control returns to normal once the mixed air temperature rises to 48°F.

### Minimum Position Adjustment

For detailed assistance in minimum position selection reference the Economizer Application Guide (form 63-8594) Ventilation section. The following provides basic guidelines for minimum position selection and adjustment:

### IMPORTANT

- Adjust the minimum position potentiometer to allow the minimum amount of outdoor air for building effluents, as required by local codes, to enter the building.
- This procedure requires use of a quality thermometer capable of reading to 0.5°F (0.25°C).

NOTE: Make minimum position adjustments with at least a 10°F (6°C) temperature difference between outdoor and return air.

1. Calculate the appropriate mixed air temperature. See Equation 1.
2. Disconnect mixed air sensor from terminals T and T1.
3. Place a jumper across terminals T and T1.
4. Ensure that either the factory-installed jumper is in place across terminals P and P1 or, if remote damper position is required, that it is wired according to Fig. 24 and turned fully clockwise.
5. Connect 24 Vac across terminals TR and TR1.
6. Carefully adjust the potentiometer on the face of the device with a small screwdriver until the mixed air temperature reaches the calculated value.

NOTE: Ensure that the sensed air is well-mixed.

- If all minimum and maximum position adjustments are complete, remove the T-T1 jumper and reconnect the mixed air sensor.

**EQUATION 1. FORMULA TO AID MINIMUM POSITION ADJUSTMENT.**

$$(T_O \times OA) + (T_R \times RA) = T_M$$

Where:

- T<sub>O</sub> = Outdoor air temperature
- OA = Percent of outdoor air
- T<sub>R</sub> = Return air temperature
- RA = Percent of return air
- T<sub>M</sub> = Resulting mixed air temperature

NOTE: The following sample calculation uses only Fahrenheit temperature.

EXAMPLE: Assume local codes require 10% outdoor air during occupied conditions, outdoor air is 60°F and return air is 75°F. Under these conditions, what is the temperature of the mixed air?

$$(0.1 \times 60^\circ\text{F}) + (0.9 \times 75^\circ\text{F}) = 6.0^\circ\text{F} + 67.5^\circ\text{F} = 73.5^\circ\text{F}$$

Mixed air will be 73.5°F when OA is 60°F and RA is 75°F with 10 percent outdoor air entering the building.

**DCV Maximum Position Adjustment**

- Disconnect mixed air sensor from terminals T and T1 and short terminals T and T1.
- Connect a jumper between terminals AQ and AQ1.
- Connect 24 Vac across terminals TR and TR1.
- Adjust the potentiometer on the face of the device with a small screwdriver for desired maximum position.
- If all minimum and maximum position adjustments are complete, remove the T-T1 jumper and reconnect the mixed air sensor.

**Enthalpy Changeover Setpoint**

**Outdoor Enthalpy Changeover Setpoint (Single Enthalpy)**

The outdoor enthalpy changeover setpoint returns the outdoor air damper to minimum position when enthalpy rises above its setpoint. Enthalpy setpoint scale markings, located in the device, are A, B, C and D. See Fig. 18 for the corresponding control point. The factory-installed 620-ohm jumper must be in place across terminals SR and SR+. Temperature and humidity points to the left of the selected curve will allow the dampers to open for free cooling.

**Differential Enthalpy Changeover Setting**

Differential enthalpy control uses two C7400 Enthalpy Sensors connected to one logic module. The logic module compares outdoor air to return air.

NOTE: Turn the enthalpy setpoint potentiometer fully clockwise to the D setting.

The logic module selects the lower enthalpy air (return or outdoor) for cooling. For example, when outdoor air has lower enthalpy than return air, the module calls to open the outdoor air damper to bring in outdoor air for free cooling.

**Exhaust Setpoint**

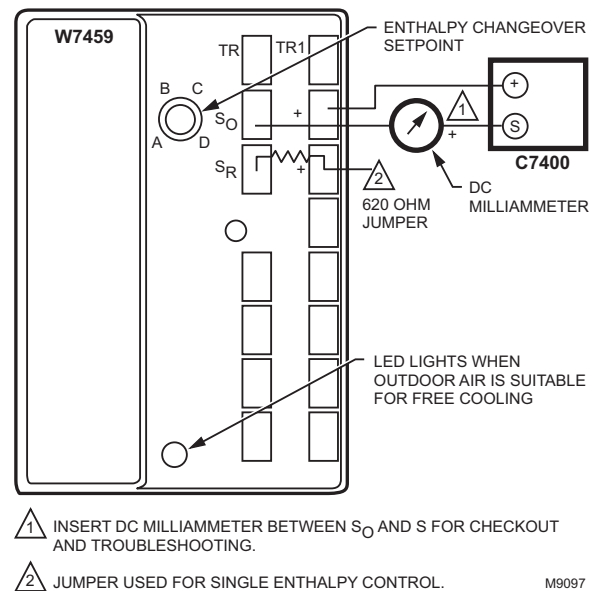
The exhaust setpoint determines when the exhaust fan runs based on damper position. When the exhaust fan call is made, the module provides a 60 ±30 second delay before exhaust fan activation. This delay allows the damper to reach the appropriate position to avoid unnecessary fan overload.

NOTES:

- EF and EF1 are 24V dry contacts only. An external line voltage contactor is required to operate the exhaust fan.
- When the exhaust fan is deactivated the EF and EF1 contacts open immediately.

**CHECKOUT AND TROUBLESHOOTING**

Tables 6 through 10 provide step-by-step economizer checkout and troubleshooting steps. See Fig. 23 and 25 for enthalpy setpoint potentiometer, minimum position potentiometer and LED locations.



**Fig. 26. Meter location for checkout and troubleshooting.**

SOLID STATE ECONOMIZER SYSTEM

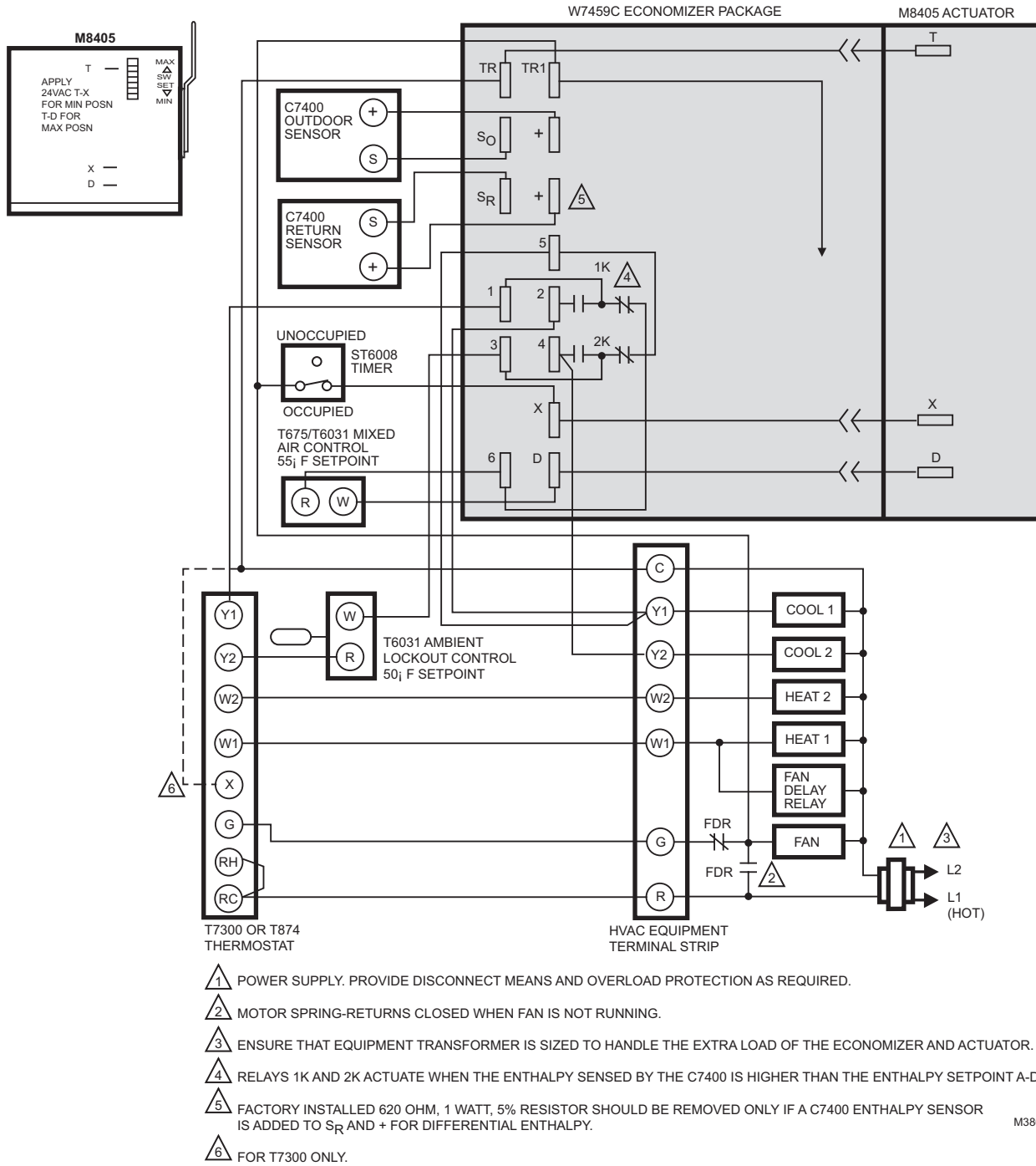
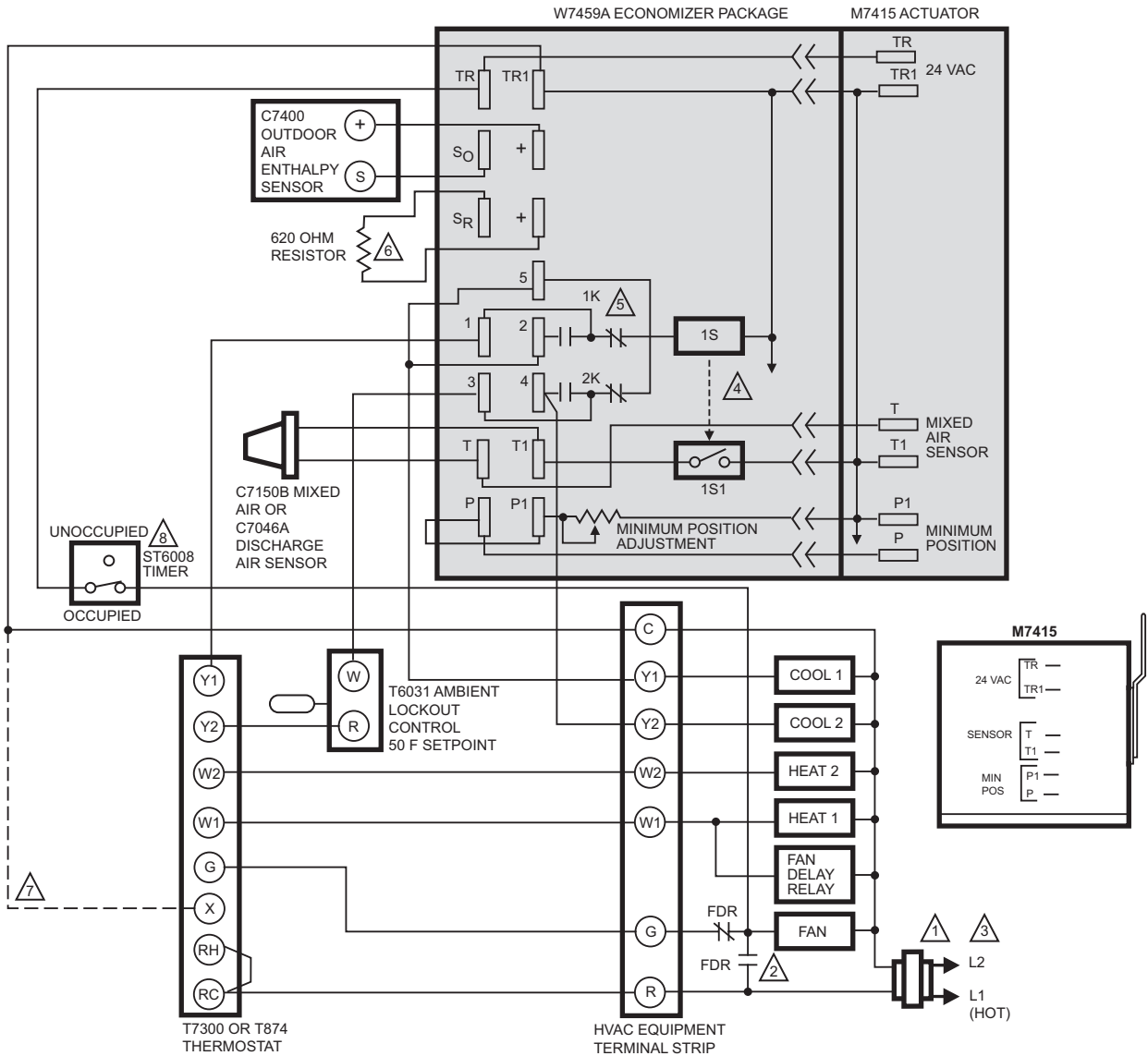


Fig. 27. M8405A Damper Actuator used in two-stage cooling system with differential enthalpy changeover and W7459C Economizer.

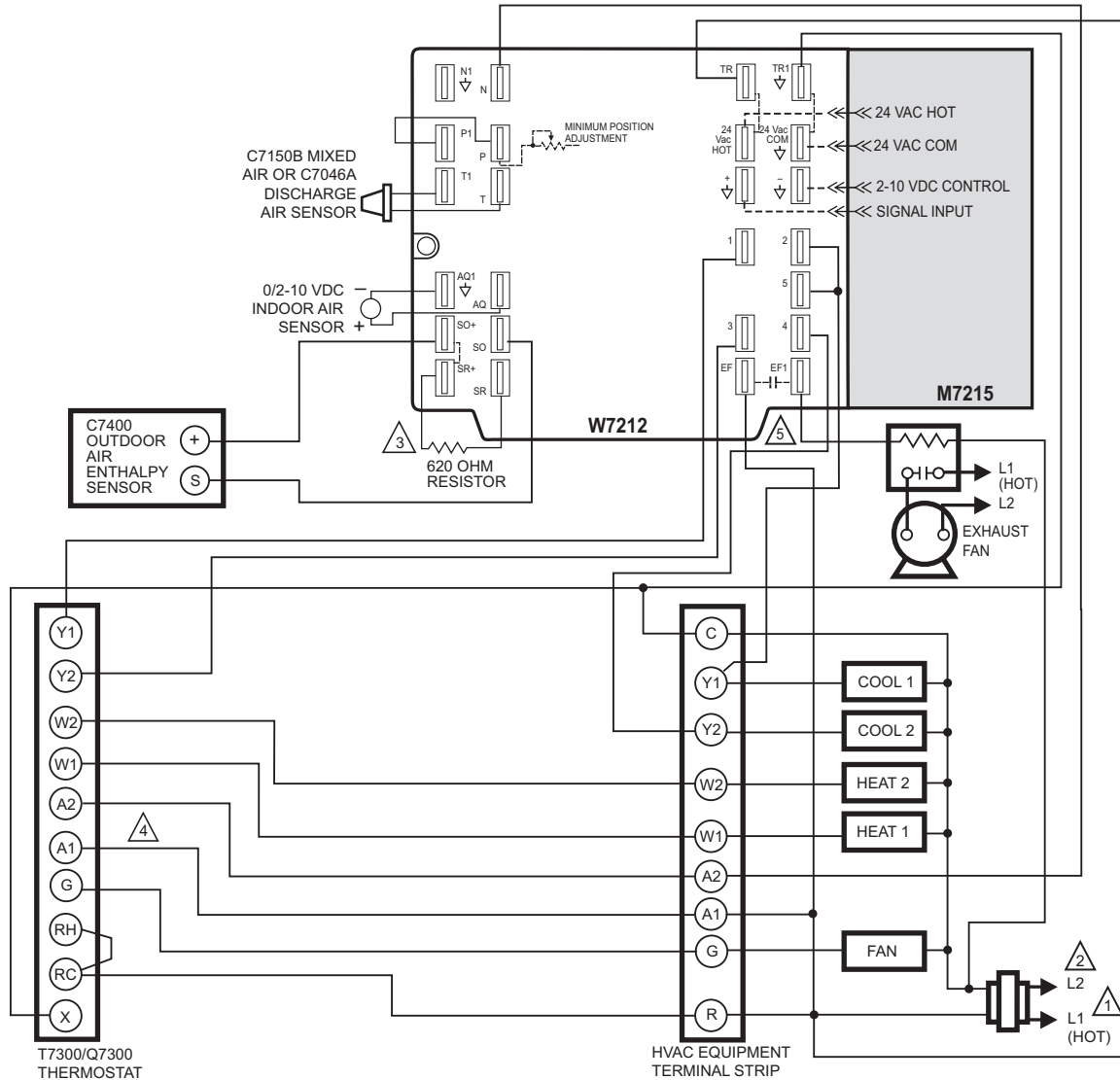


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 MOTOR SPRING-RETURNS CLOSED WHEN FAN IS NOT RUNNING.
- 3 ENSURE THAT EQUIPMENT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR.
- 4 1S IS AN ELECTRONIC SWITCH THAT CLOSURES WHEN POWERED BY A 24 VAC INPUT.
- 5 RELAYS 1K AND 2K ACTUATE WHEN THE ENTHALPY SENSED BY THE C7400 IS HIGHER THAN THE ENTHALPY SETPOINT A-D.
- 6 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD BE REMOVED ONLY IF A C7400 ENTHALPY SENSOR IS ADDED TO S<sub>R</sub> AND + FOR DIFFERENTIAL ENTHALPY.
- 7 FOR T7300 ONLY.
- 8 WITH T7300, USE CONTACTS A<sub>1</sub> AND A<sub>2</sub> INSTEAD OF S7005 TIMER.

M10115A

Fig. 28. W7459A/C7400 used in two-stage cooling system with single enthalpy changeover and with M7415 Actuator.

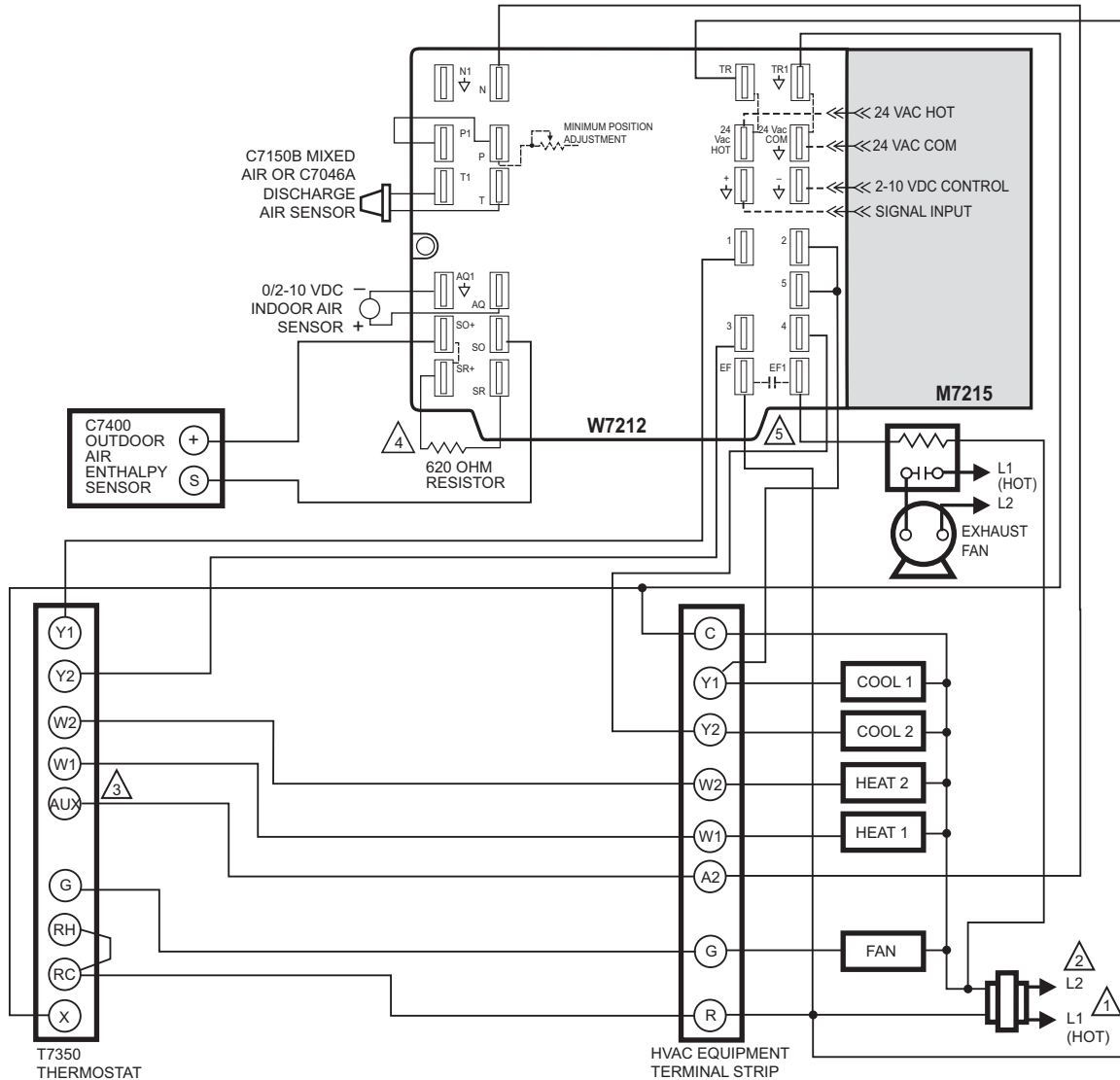
SOLID STATE ECONOMIZER SYSTEM



- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 ENSURE THAT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR. USE THE SAME TRANSFORMER FOR T7300 AND ECONOMIZER.
- 3 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD NOT BE REMOVED. DIFFERENTIAL ENTHALPY NOT RECOMMENDED FOR USE WITH SINGLE-STAGE COOLING SYSTEMS OR SINGLE-STAGE COOLING THERMOSTATS.
- 4 T7300 TERMINALS A1 AND A2 ARE CONNECTED WHEN THERMOSTAT IS IN THE OCCUPIED MODE.
- 5 EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.

M20716D

Fig. 29. W7212 used with M7215 Damper Motor and T7300 Thermostat.

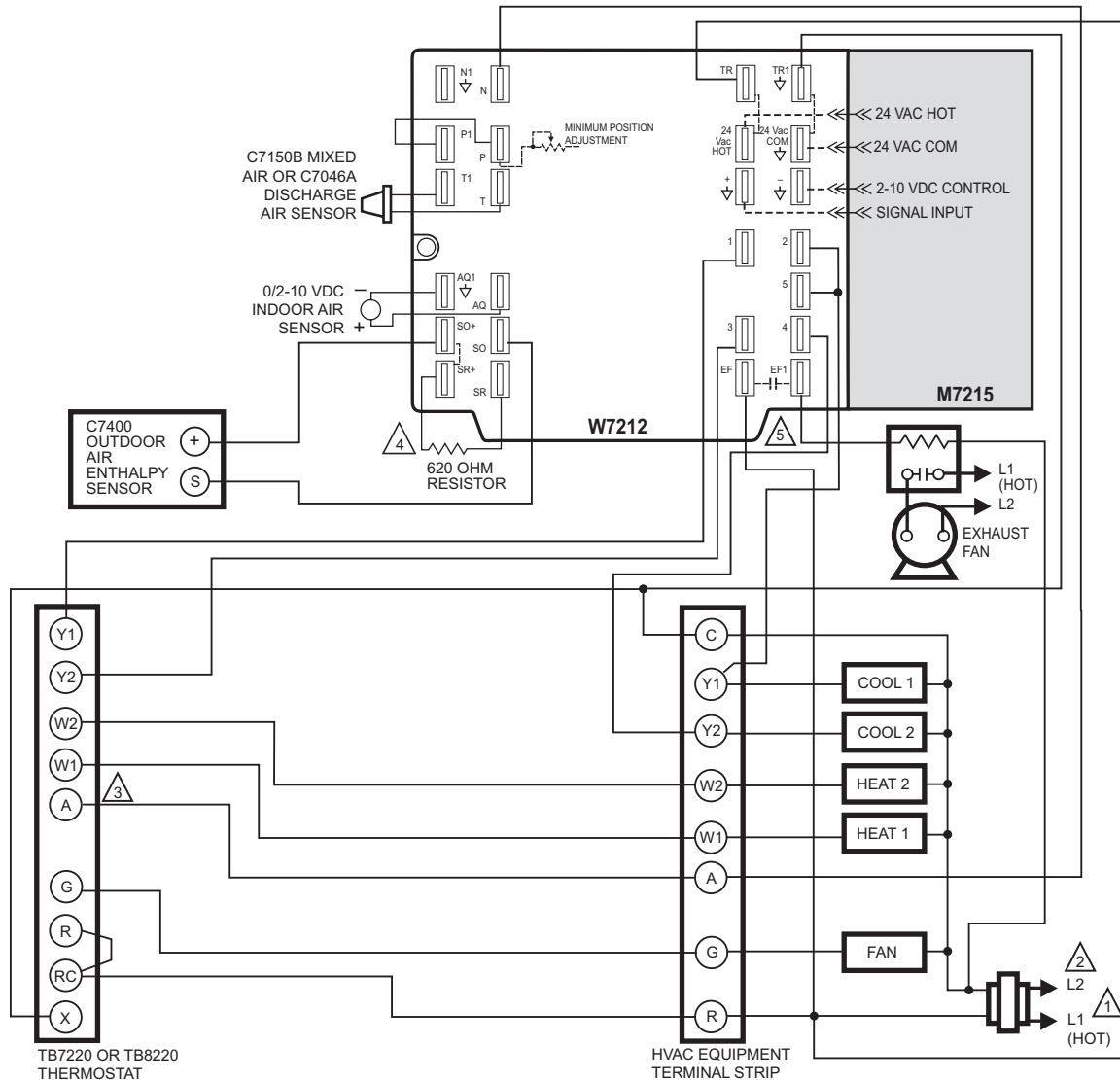


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 ENSURE THAT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR. THE SAME TRANSFORMER CAN BE USED FOR THE THERMOSTAT AND ACTUATOR.
- 3 IF SEPARATE HEATING AND COOLING TRANSFORMERS ARE USED, REMOVE JUMPER AT THERMOSTAT. T7350 - TERMINAL "AUX" IS POWERED BY THE HEATING TRANSFORMER (RH). IF POWERING THE ECONOMIZER TERMINAL "N" WITH THE THERMOSTAT TERMINAL "AUX", BE SURE THE ECONOMIZER IS POWERED BY THE SAME TRANSFORMER AS TERMINAL "AUX". IF NOT, USE AN ISOLATION RELAY TO POWER "N".
- 4 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD NOT BE REMOVED. DIFFERENTIAL ENTHALPY NOT RECOMMENDED FOR USE WITH SINGLE-STAGE COOLING SYSTEMS OR SINGLE-STAGE COOLING THERMOSTATS.
- 5 EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.

M13657

Fig. 30. W7212 used with M7215 Damper Motor and T7350 Thermostat.

SOLID STATE ECONOMIZER SYSTEM

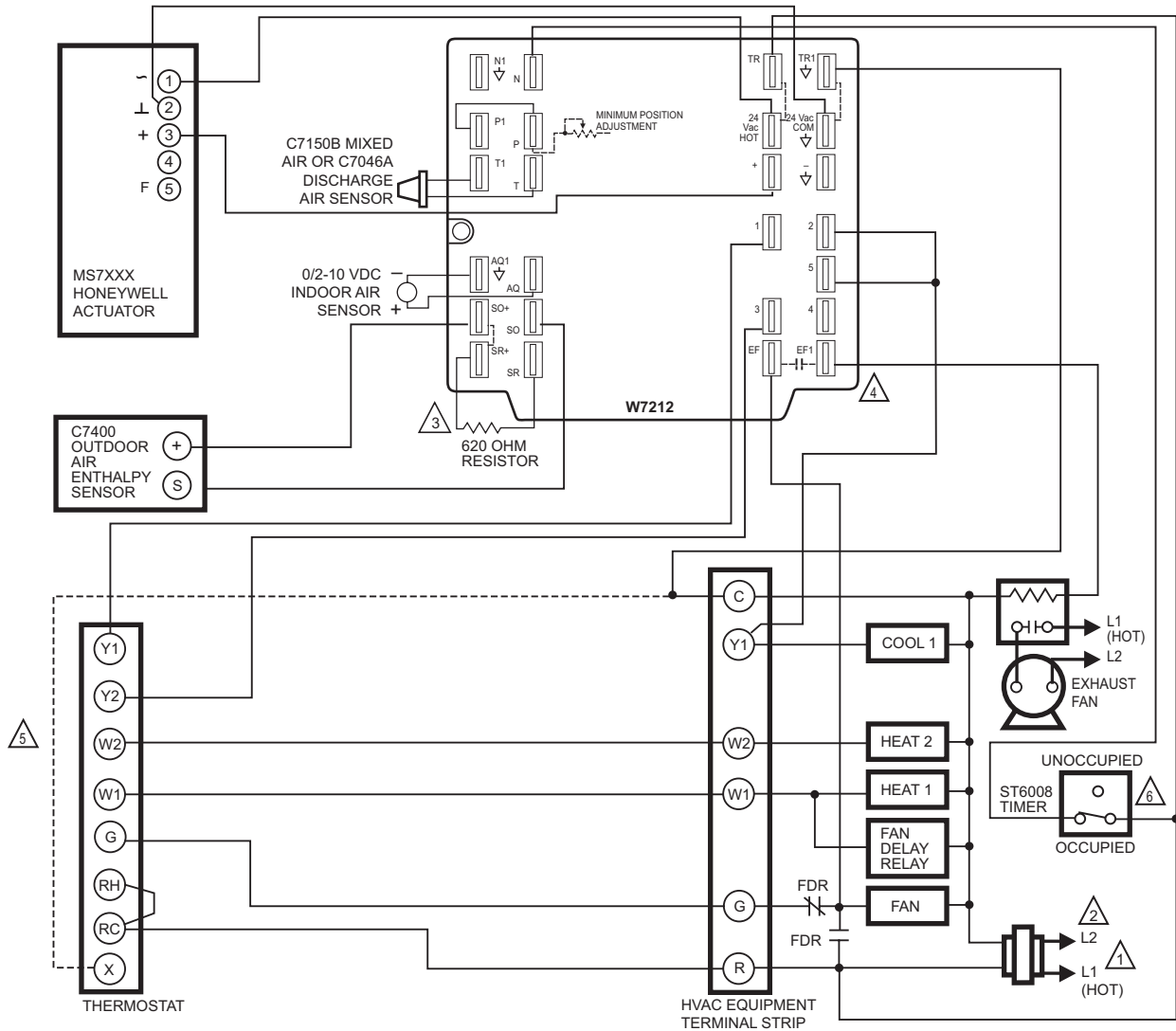


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 ENSURE THAT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR. THE SAME TRANSFORMER CAN BE USED FOR THE THERMOSTAT AND ACTUATOR.
- 3 IF SEPARATE HEATING AND COOLING TRANSFORMERS ARE USED, REMOVE JUMPER AT THERMOSTAT.  
TB7220 - TERMINAL "A" IS POWERED BY THE COOLING TRANSFORMER (RC).  
TB8220 - TERMINAL "A" IS POWERED BY THE HEATING TRANSFORMER (R).  
IF POWERING THE ECONOMIZER TERMINAL "N" WITH THE THERMOSTAT TERMINAL "A", BE SURE THE ECONOMIZER IS POWERED BY THE SAME TRANSFORMER AS TERMINAL "A". IF NOT, USE AN ISOLATION RELAY TO POWER "N".
- 4 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD NOT BE REMOVED. DIFFERENTIAL ENTHALPY NOT RECOMMENDED FOR USE WITH SINGLE-STAGE COOLING SYSTEMS OR SINGLE-STAGE COOLING THERMOSTATS.
- 5 EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.

M13658

**Fig. 31. W7212 used with M7215 Damper Motor and TB7220 or TB8220 Thermostats.**



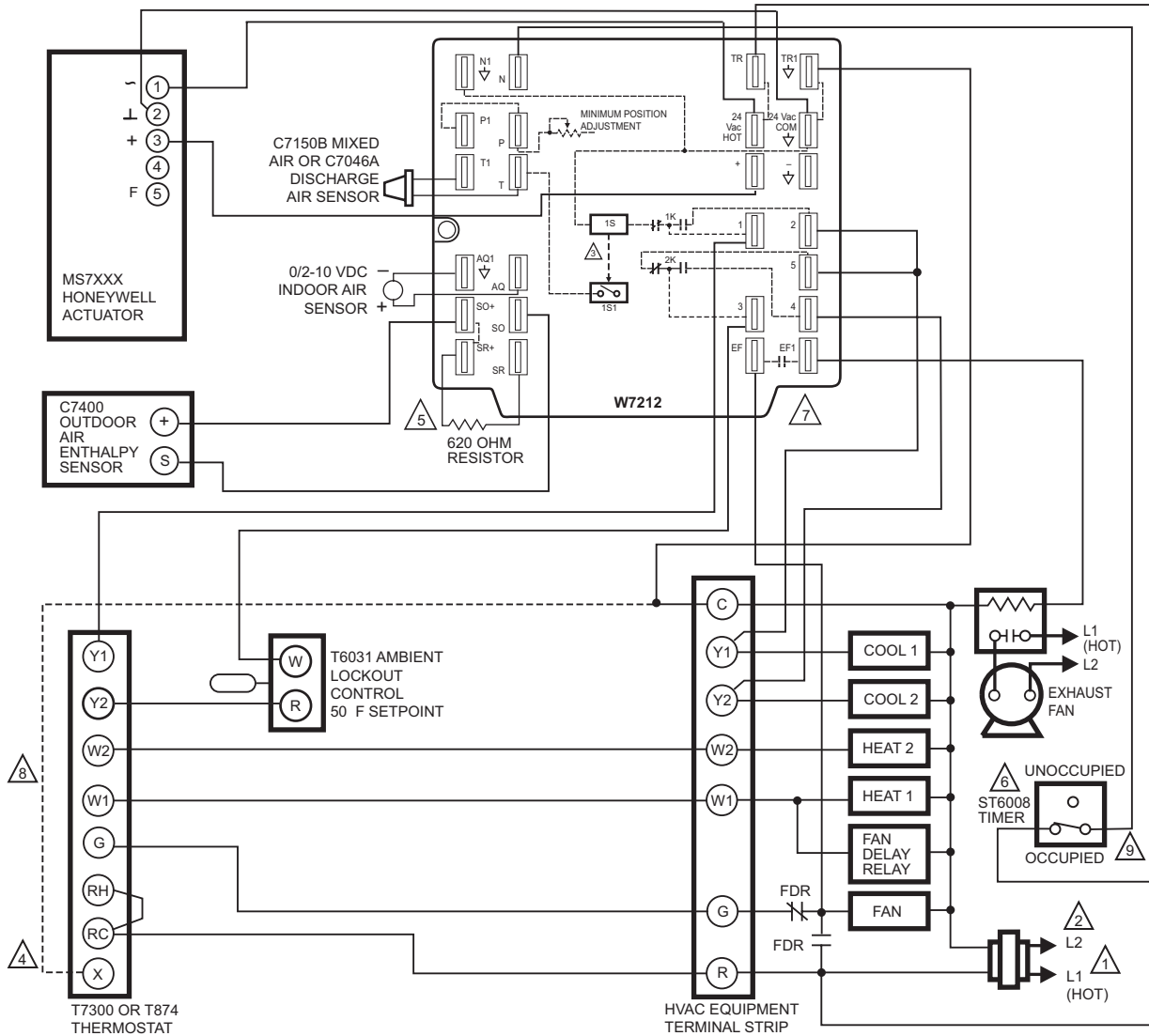


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 ENSURE THAT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR.
- 3 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD NOT BE REMOVED. DIFFERENTIAL ENTHALPY NOT RECOMMENDED FOR USE WITH SINGLE-STAGE COOLING SYSTEMS OR SINGLE-STAGE COOLING THERMOSTATS.
- 4 EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.
- 5 SEE WIRING DIAGRAMS FOR T7350 AND TB7220/TB8220.
- 6 TIME CLOCK IS AN OPTION TO USING OCCUPIED CONTACTS ON THE THERMOSTAT.

M24219

**Fig. 32. W7212A used in single-stage cooling system with single enthalpy changeover and Honeywell actuator and time clock for occupancy.**

SOLID STATE ECONOMIZER SYSTEM



- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 ENSURE THAT TRANSFORMER IS SIZED TO HANDLE THE EXTRA LOAD OF THE ECONOMIZER AND ACTUATOR.
- 3 1S IS AN ELECTRONIC SWITCH THAT CLOSSES WHEN POWERED BY A 24 VAC INPUT.
- 4 FOR T7300 ONLY
- 5 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD BE REMOVED ONLY WHEN A C7400 ENTHALPY SENSOR IS ADDED TO SR AND SR+ FOR DIFFERENTIAL ENTHALPY.
- 6 USE THE FOLLOWING CONTACTS INSTEAD OF TIMER FOR T7300, USE A1 AND A2 TERMINALS. FOR T7350 USE AUX TERMINAL. FOR TB7220 OR TB8220 USE A TERMINAL THE TERMINALS ARE CONNECTED WHEN THERMOSTAT IS IN THE OCCUPIED MODE.
- 7 EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.
- 8 SEE WIRING DIAGRAMS FOR T7350 AND TB7220/TB8220.
- 9 TIME CLOCK IS AN OPTION TO USING OCCUPIED CONTACTS ON THE THERMOSTAT.

M24220

Fig. 33. W7212A used in two-stage cooling system with Honeywell Series 72 Actuator and time clock for occupancy.

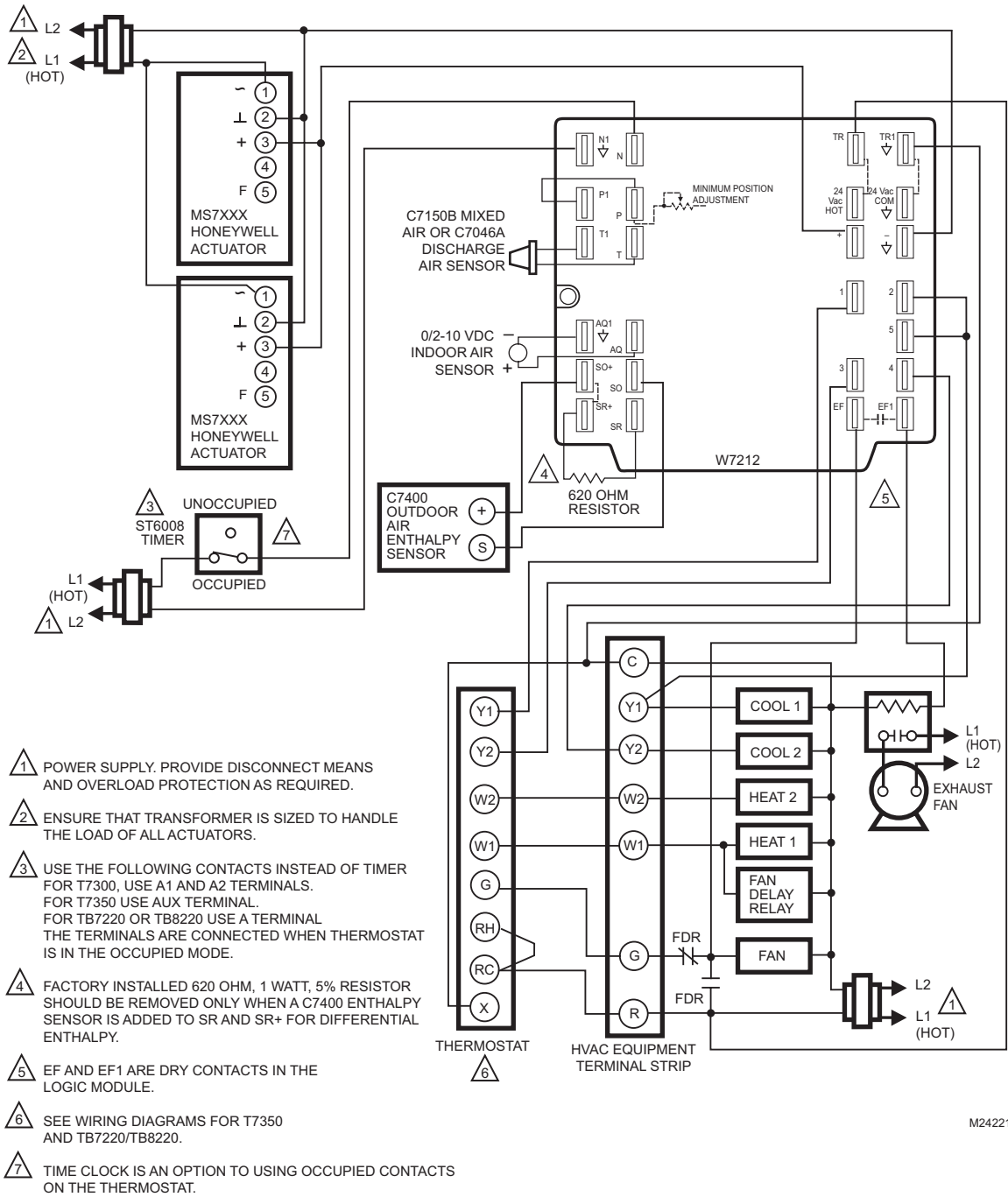
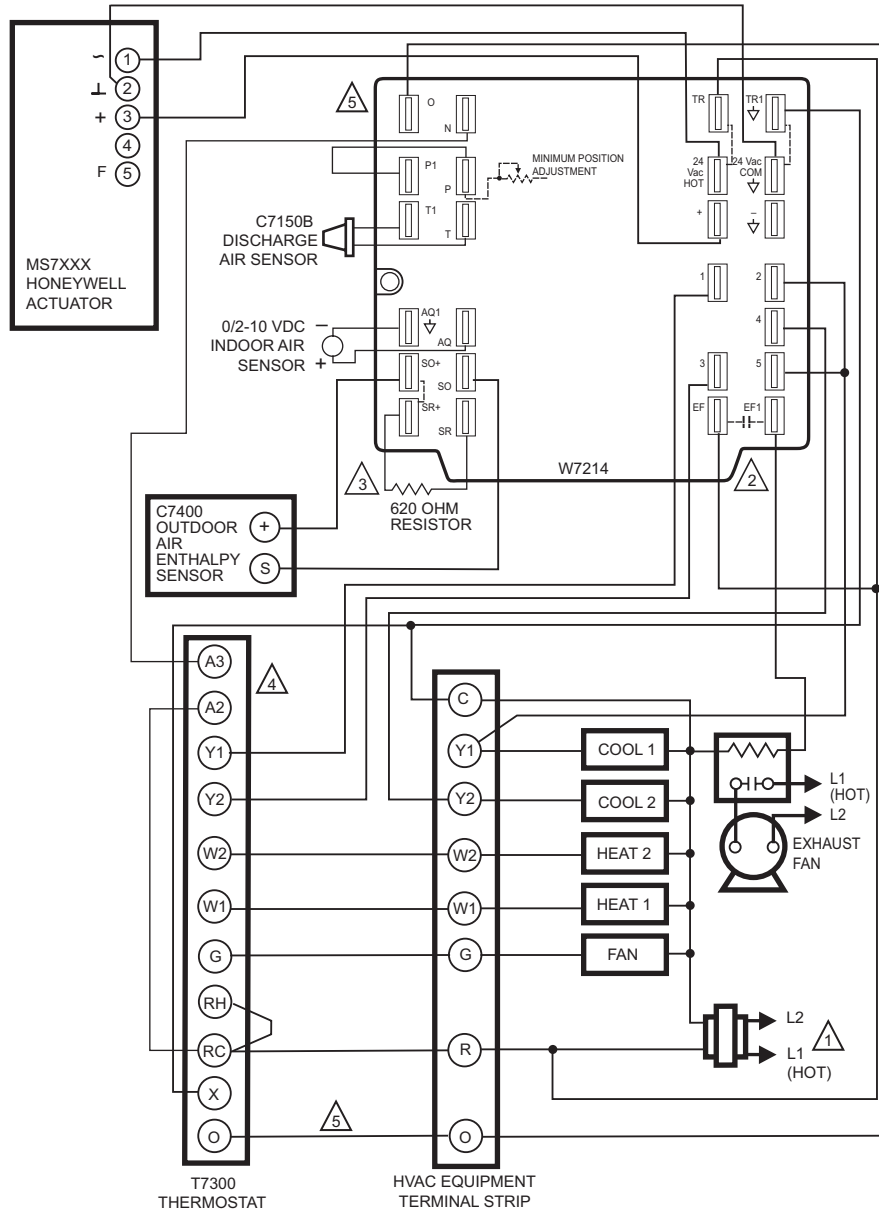


Fig. 34. W7212 controlling parallel-wired Honeywell Series 72 Actuators and time clock for occupancy.



- ① POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- ② EF AND EF1 ARE DRY CONTACTS IN THE LOGIC MODULE.
- ③ FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR SHOULD BE REMOVED ONLY WHEN A C7400 ENTHALPY SENSOR IS ADDED TO SR AND SR+ FOR DIFFERENTIAL ENTHALPY.
- ④ T7300 TERMINALS A2 AND A3 ARE CONNECTED WHEN THERMOSTAT IS IN THE UNOCCUPIED MODE. SEE WIRING DIAGRAMS FOR T7350 AND TB7220/TB8220.
- ⑤ W7213: B TERMINAL  
W7214: O TERMINAL

M24222

**Fig. 35. W7213, W7214 controlling heat pump system.**

**Table 6. Troubleshooting modulating economizer—outdoor enthalpy above setpoint.**

<b>Condition on Logic Module <i>Should Be</i></b>	<b>Condition Not Met</b>
1. Red LED not lighted.	1. If the LED glows, the Logic Module recognizes conditions are good for free cooling. Verify that conditions are above the enthalpy setpoint, see Note 2. Check wiring to Enthalpy Control for a short from {SO} and {+}.
2. 24 Vac to terminals {TR} and {TR1}.	2. Check the wiring from [G] and [C] on the unit low voltage terminal strip. {TR} and {TR1} power the actuator.
3. 24 Vac to terminals {1} and {TR1}.	3. Verify that there is a call for cooling from the thermostat. Without a call for cooling, the compressor can not be in the normal air conditioning mode.
4. 24 Vac to terminals {2} and {TR1}.	4. If 24 Vac is not on {2} and {TR1}, the internal switch is not set correctly. Remove the {SO} wire from the module. If 24 Vac is on {2} and {TR1}, the enthalpy control is bad or the {SO} and {+} wires are shorted together. If no voltage to {2} and {TR1}, the module is bad.
5. Continuity on terminals {1} and {2}, {3} and {4}.	5. If there is not continuity for terminals {1} and {2}, the internal switch is not in the correct position and the module is defective. If there is continuity from terminals {1} and {2}, the red LED should not be lighted. If there is continuity on terminals {3} and {4}, the internal switch is correctly energized. The damper actuator should be in a min. position.
6. Compressor does not operate with all above conditions correct.	6. Check the wiring from {2} to Y1 on the unit low voltage control board. If the LED is not lighted, check 24 Vac from {2} to Y1.
<b>Second Stage</b>	
7. 24 Vac to terminals {3} and {TR1}.	7. Verify that you have a two-stage thermostat. Check for a call for a second stage cooling. If 24 Vac is not on {3} and {TR1}, check wiring from Y2 on the thermostat to the module.
8. 24 Vac to terminals {4} and {TR1}.	8. If {4} and {TR1} do not have 24 Vac, and {3} and {TR1} have 24 Vac, the internal switch is not in the correct position. The module is defective.
9. Compressor does not operate with second stage conditions met.	9. If all other functions are correct, check wiring from {4} to Y2 on the unit low voltage terminal board.

**Table 7. Troubleshooting modulating economizer—outdoor enthalpy below setpoint.**

<b>Condition on Logic Module <i>Should Be</i></b>	<b>Conditions Not Met</b>
1. Red LED lighted.	1. Jumper terminals {SO} and {+}. If the LED lights, the module is okay, see Note 2. Check wiring to enthalpy control.
2. 24 Vac to terminals {TR} and {TR1}.	2. Check the wiring from [G] and [C] on the unit low voltage terminal strip. {TR} and {TR1} power the actuator.
3. 24 Vac to terminals {1} and {TR1}.	3. Verify there is a call for cooling from the thermostat. Without a call for cooling, the motor can not be in the economizer mode.
4. No continuity on terminals {1} and {2}.	4. If there is continuity from terminals {1} and {2}, the red LED should not be lighted. If there is continuity and the LED glows, the module is defective.
5. Continuity on terminals {3} and {5}.	5. If there is continuity on terminals {3} and {5}, the internal switch is correctly energized. Damper motor should be in a modulating mode.
6. Motor does not operate with all above conditions met.	6. Jumper the mixed air sensor terminals {T} and {T1}. If the motor begins to operate, check the wiring to the sensor. If correct, the temperature is below the sensor setpoint or it is defective. If the motor does not operate, and the wiring is correct and the temperature is above the sensor setpoint, the motor is bad.
<b>Second Stage</b>	
7. 24 Vac to terminals {3} and {TR1}.	7. Verify that you have a two-stage thermostat. Check for a call for a second stage cooling. If 24 Vac is not on terminals {3} and {TR1}, check wiring from terminal Y2 on the thermostat to the module.
8. 24 Vac to terminals {5} and {TR1}.	8. If terminals {5} and {TR1} do not have 24 Vac, the internal switch is not in the correct position, assuming that terminals {3} and {TR1} have 24 Vac. The module is defective.
9. Compressor does not operate with second stage conditions met.	9. If all other functions are correct, check the wiring from terminal {5} to Y2 on the unit low voltage terminal board.

**Table 8. Troubleshooting three-position economizer—outdoor enthalpy above setpoint.**

<b>Condition on Logic Module <i>Should Be</i></b>	<b>Conditions Not Met</b>
1. Red LED not lighted.	1. If the LED glows, the module is in the economizer mode. Verify the conditions are above the enthalpy setpoint, see Note 2. Check wiring to Enthalpy Control for a short from {SO} and {+}.
2. 24 Vac to terminals {TR} and {TR1}, {X} and {TR}.	2. Check the wiring from [G] and [C] on the unit low voltage terminal strip. {TR} and {TR1} power the actuator. {X} and {TR} provide power for minimum position.
3. 24 Vac to terminals {1} and {TR}.	3. Verify that there is a call for cooling from the thermostat. Without a call for cooling the compressor can not be in the normal air conditioning mode.
4. 24 Vac to terminals {2} and {TR}.	4. If 24 Vac is not on {2} and {TR}, the internal contacts are not set correctly. Remove the {SO} wire from the module. If 24 Vac is on {2} and {TR}, the enthalpy control is bad or the {SO} and + wiring are shorted together. If no voltage to {2} and {TR}, the module is bad.
5. Continuity on terminals {1} and {2}, {3} and {4}.	5. If there is not continuity for {1} to {2}, the internal contacts are not in the correct position, and either the module or the enthalpy control is defective. If there is continuity from terminals {1} and {2}, the red LED should not be lighted. If there is continuity and the LED glows, the module is defective. If there is continuity on terminals {3} and {4}, the internal contacts are correctly energized. Damper motor should be in the min. position.
6. Compressor does not operate with all above conditions correct.	6. Check the wiring from {2} to Y1 on the unit low voltage control board. Verify that there are not 24 Vac to Y1 and C on the unit.
<b>Second Stage</b>	
7. 24 Vac to terminals {3} and {TR}.	7. Verify that the thermostat is two-stage. Check for a call for a second stage cooling. If there are not 24 Vac on {3} and {TR}, check wiring from Y2 on the thermostat to the module.
8. 24 Vac to terminals {5} and {TR}.	8. If {5} and {TR} do not have 24 Vac and {3} and {TR} have 24 Vac, the internal switch 1S is not in the correct position. The module is defective.
9. Compressor does not operate with second stage conditions met.	9. If all other functions are correct, check the wiring from {5} to Y2 on the unit low voltage terminal board.

**Table 9. Troubleshooting three position economizer—outdoor enthalpy below setpoint.**

<b>Condition on Logic Module <i>Should Be</i></b>	<b>Conditions Not Met</b>
1. Red LED lighted.	1. Jumper terminals {SO} and {+}. If the LED glows, the module is okay, see Note 2. Check wiring to enthalpy control.
2. 24 Vac to terminals {TR} and {TR1}.	2. Check the wiring from [G] and [C] on the unit low voltage terminal strip. {TR} and {TR1} power the actuator.
3. 24 Vac to terminals {1} and {TR1}.	3. Verify there is a call for cooling from the thermostat. Without a call for cooling, the motor can not be in the economizer mode.
4. No continuity on terminals {1} and {2}.	4. If there is continuity from terminals {1} and {2}, then the red LED cannot be lighted. If there is continuity and the LED glows, the module is defective.
5. Continuity on terminals {3} and {5}.	5. If there is continuity on terminals {3} and {5}, the internal switch 1S is correctly energized. Damper motor should be in a modulating mode.
6. Motor does not operate with all above conditions met.	6. Jumper the mixed air sensor terminals {6} and {D}. If the motor begins to operate, check the wiring to the sensor. If it is correct, the temperature is below the sensor setpoint or the sensor is defective. If the motor does not operate, the wiring is correct, and the temperature is above the sensor setpoint, the motor is bad.
<b>Second Stage</b>	
7. 24 Vac to terminals {3} and {TR}.	7. Verify that the thermostat is two-stage. Check for a call for a second stage cooling. If 24 Vac is not on {3} and {TR}, check wiring from Y2 on the thermostat to the module.
8. 24 Vac to terminals {5} and {TR}.	8. If {5} and {TR} do not have 24 Vac, and {3} and {TR} do have 24 Vac, then the internal switch 1S is not in the correct position. The module is defective.
9. Compressor does not operate with second stage conditions met.	9. If all other functions are correct, check the wiring from {5} to Y2 on the unit low voltage terminal board.

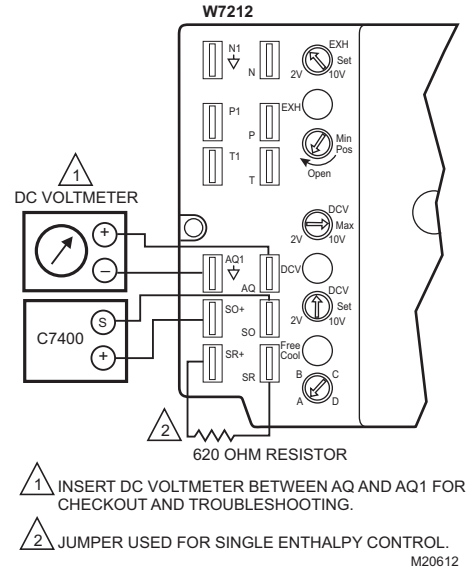
# CHECKOUT AND TROUBLESHOOTING: W7212

Checkout requires a 9V battery, 620 ohm, 1.2K ohm, 5.6K ohm, and 6.8K ohm resistors. Use Table 10 and Fig. 36 for checkout.



## CAUTION

**Equipment Damage Hazard.**  
**Excessive force can damage potentiometer controls.**  
 Use a small screwdriver when adjusting enthalpy changeover and minimum damper position controls.



**Fig. 36. Meter location for checkout and troubleshooting (W7212 shown).**

**Table 10. Checkout for W7212, W7213, W7214 Economizers Connected to Honeywell Actuator.**

Step	Checkout Procedure	Proper Response
1.	<b>CHECKOUT PREPARATION</b>	
	Disconnect power at TR and TR1.	All LED are off; Exhaust Fan contacts are open.
	Disconnect devices at P and P1.	
	Jumper P to P1.	
	Place 5.6K ohm resistor across T and T1.	
	Jumper TR to 1.	
	<i>W7212 only:</i> Jumper TR to N.	
	If connected, remove C7400 Enthalpy Sensor from terminals S <sub>O</sub> and +.	
	Connect 1.2K ohm 4074EJM Checkout Resistor across terminals S <sub>O</sub> and +.	
	Put 620 ohm resistor across S <sub>R</sub> and +.	
	Set minimum position, DCV setpoint, and Exhaust potentiometers fully CCW.	
	Turn DCV maximum position potentiometer fully CW.	
Set enthalpy potentiometer to D.		
Apply power (24 Vac) to terminals TR and TR1.		
2.	<b>DIFFERENTIAL ENTHALPY</b>	
	Execute step one, Checkout Preparation.	—
	Place 620 ohm resistor across S <sub>O</sub> and +.	—
	Place 1.2K ohm resistor across S <sub>R</sub> and +.	Free cool LED turns on.
	Remove 620 ohm resistor from S <sub>O</sub> and +.	Free cool LED turns off.
3.	<b>SINGLE ENTHALPY</b>	
	Execute step one, Checkout Preparation.	—
	Set enthalpy potentiometer to A (fully CCW).	Free cool LED turns on.
	Set enthalpy potentiometer to D (fully CW).	Free cool LED turns off.

**Table 10. Checkout for W7212, W7213, W7214 Economizers Connected to Honeywell Actuator. (Continued)**

Step	Checkout Procedure	Proper Response
4.	DCV AND EXHAUST	
	Execute step one, Checkout Preparation.	—
	Ensure terminals AQ and AQ1 are open.	LED for both DCV and Exhaust should be off. Actuator drives fully closed.
	Connect 9V battery positive to AQ and negative to AQ1.	LED for both DCV and Exhaust turn on. Actuator drives to between 81 and 85 degrees open.
	Turn Exhaust potentiometer CW until Exhaust LED turns off.	Exhaust LED turns off with potentiometer approximately 90 percent CW. Actuator remains in position.
	Turn DCV setpoint potentiometer CW.	DCV LED turns off with potentiometer at approximately 9V. Actuator drives fully closed.
	Turn DCV setpoint potentiometer CCW until Exhaust LED turns on.	Exhaust contacts close 30-90 seconds after Exhaust LED turns on.
	Turn DCV setpoint potentiometer CW.	Exhaust LED turns off with potentiometer indication at approximately 9V.
5.	MINIMUM AND MAXIMUM POSITION	
	Execute step one, Checkout Preparation.	—
	Connect 9V battery positive to AQ and negative to AQ1.	DCV LED turns on. Actuator drives to between 81 and 85 degrees open.
	Turn DCV maximum position potentiometer to midpoint.	Actuator drives to between 18 and 72 degrees open.
	Turn DCV maximum position potentiometer to fully CCW.	Actuator drives fully closed.
	Turn minimum position potentiometer to midpoint.	Actuator drives to between 18 and 72 degrees open.
	Turn minimum position potentiometer fully CW.	Actuator drives fully open.
	W7212: Remove jumper from TR and N.	Actuator drives fully closed.
6.	MIXED AIR INPUT	
	Execute step one, Checkout Preparation.	—
	Set enthalpy potentiometer to A.	Free cool LED turns on. Actuator drives to between 18 and 72 degrees open.
	Remove 5.6K ohm resistor and jumper from T and T1.	Actuator drives fully open.
7.	HEAT PUMP INPUT - W7213, W7214 ONLY	
	Execute step one, Checkout Preparation.	—
	Set enthalpy potentiometer to A.	Free cool LED turns on. Actuator drives to between 18 and 72 degrees open.
	W7213: Jumper TR to B. W7214: Remove jumper from TR and O.	Free cool LED turns off. Actuator drives fully closed

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