Battelle
The Business of Innovation

HVAC Economizers 101

Section #5

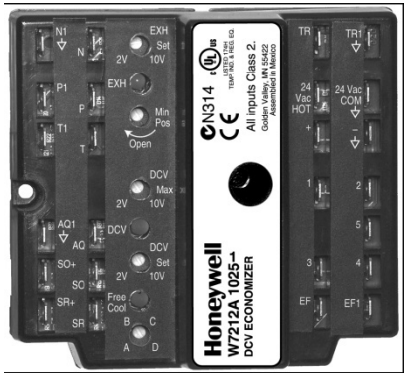
Typical Economizer Controls on Rooftop Units that Utilize Honeywell Controls

Section #5-Typical Economizer Controls on Rooftop Units Utilizing Honeywell Controls

- Dampers (not shown)
- Damper actuator
- MAT/DAT sensors
- Solid state controller
- OAT/RAT sensors
- Dry bulb
- Enthalpy

Actuator M7414

Temperature Sensor C7046C



Controller W7212

Enthalpy Sensor C7400A

(Honeywell shown, often basis of OEM RTU brands, out there for 20+ years)

Source: Honeywell Controls

Honeywell W7459 Economizer and Associated Control Components

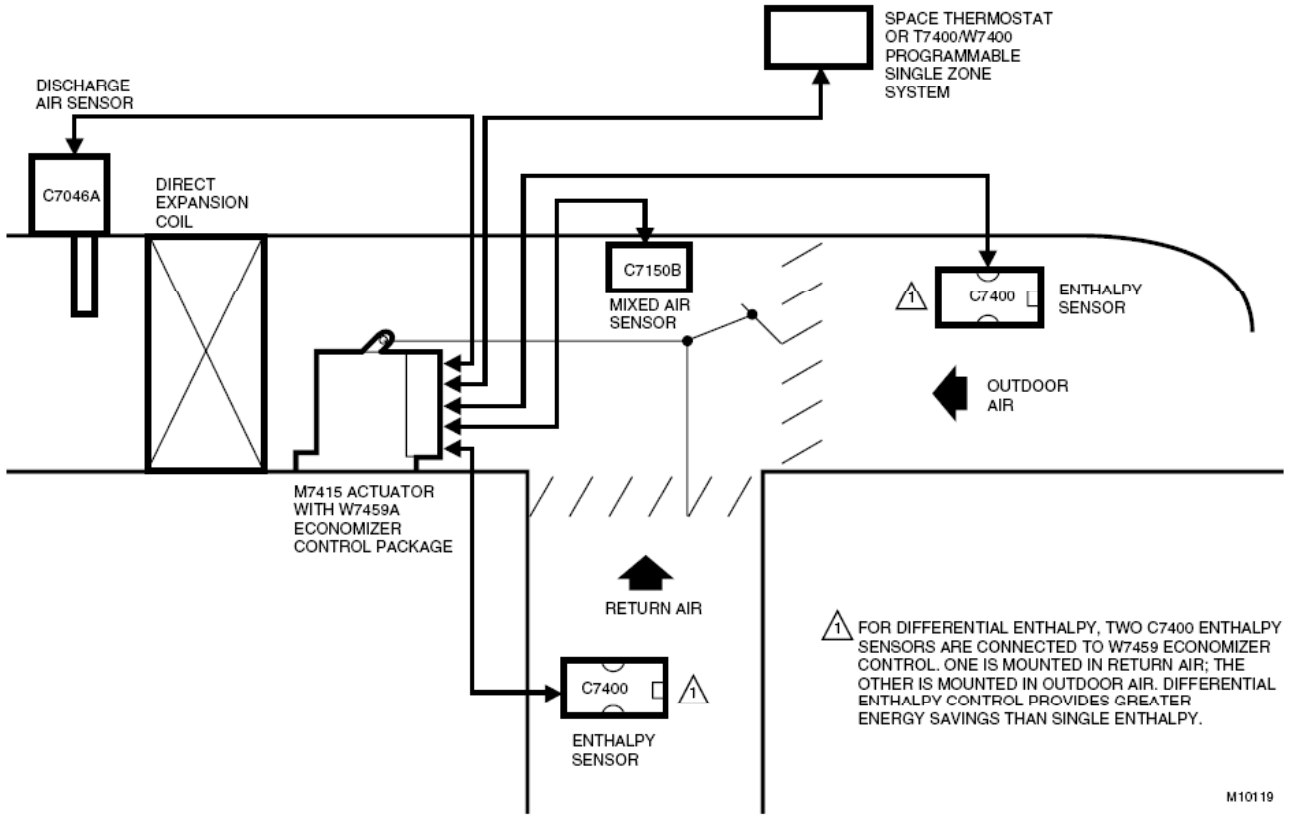


Fig. 3. Location of C7400 Outdoor and Return Air Sensors, C7150 Mixed Air Sensor, and C7046 Discharge Air Sensor in a W7459 Economizer System.

Basic Economizer Cycle Sequence Typical for Honeywell with only 1 stg. Cooling

(For typical packaged RTU with DX mechanical cooling)

On a First Call for Cooling From Commercial Thermostat (Y1)

- Controller signal is routed to the economizer logic module.

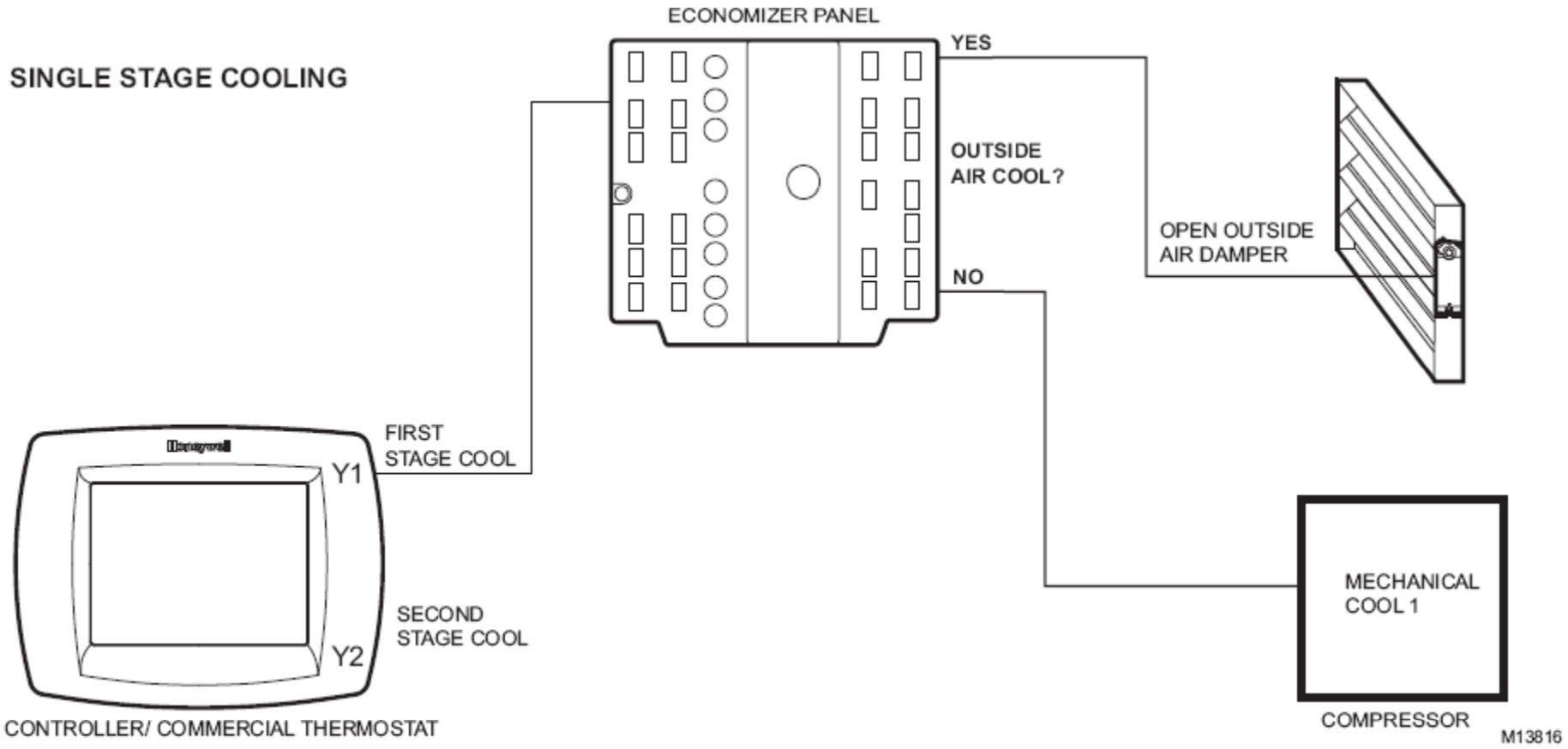
IF THE OUTDOOR AIR IS SUITABLE FOR FREE COOLING:

- Actuator modulates the outdoor damper open until the room temperature is cool enough to satisfy the call for cooling and maintain the desired set point. When the mixed or discharge air is between 50 and 55 °F, the actuator will hold the damper position. When the mixed or supply air goes below 50°F, the damper is modulated towards closed. When the mixed or supply air goes above 56°F, the damper is modulated towards open.

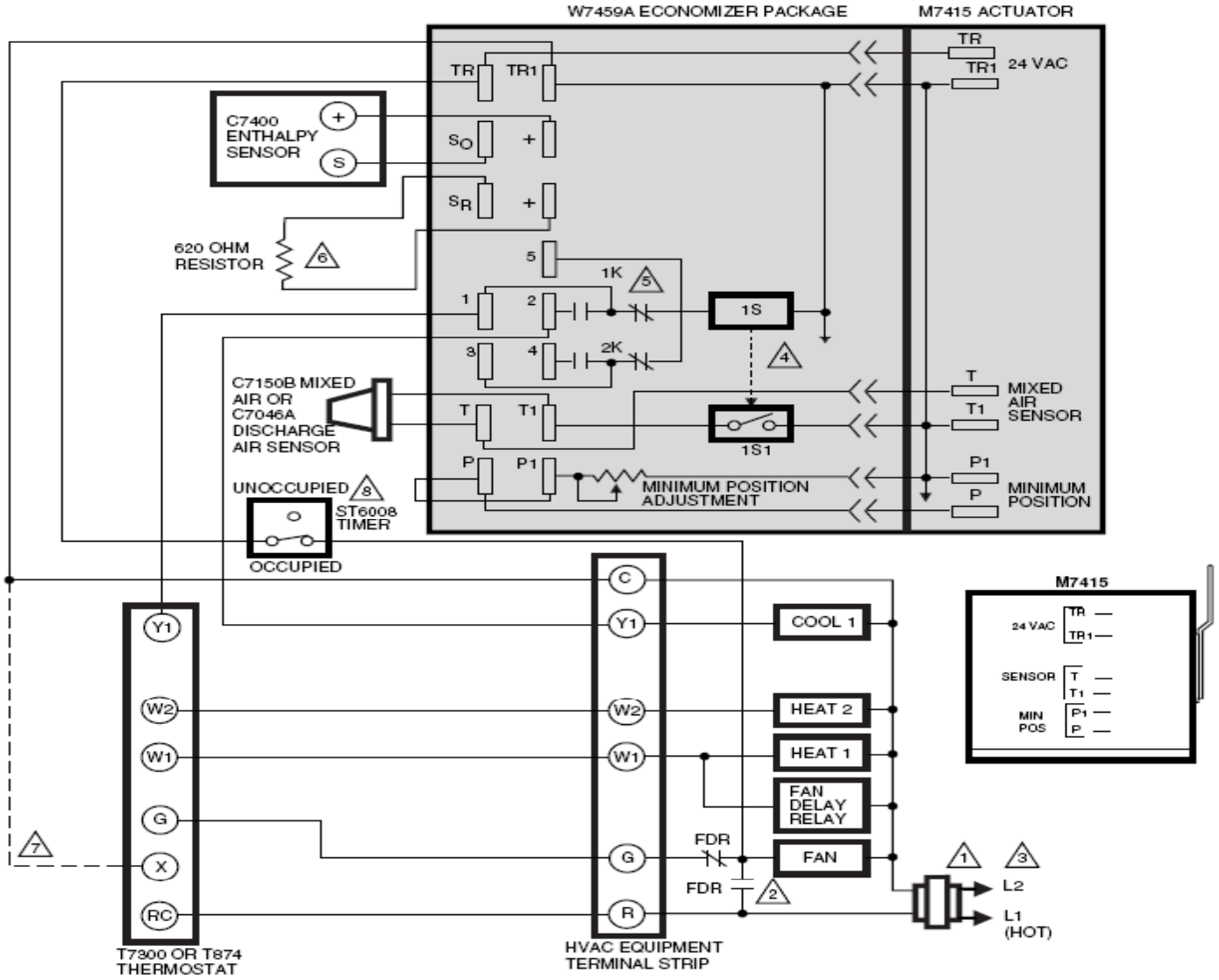
IF THE OUTDOOR AIR IS NOT SUITABLE FOR FREE COOLING:

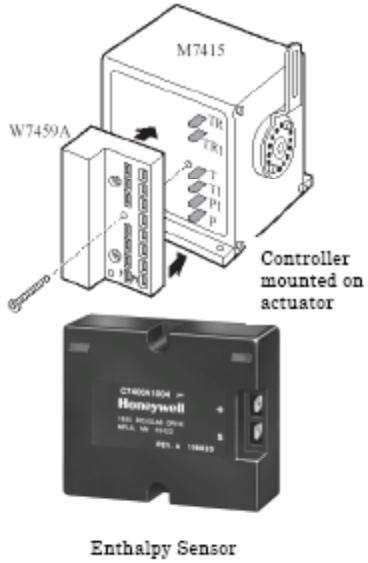
- The first stage of the cooling compressor is turned on and the dampers are set to minimum for occupancy requirements.

Basic Economizer Cycle Sequence
Typical for Honeywell with one stage Cooling
(For typical packaged RTU with DX mechanical cooling)



Economizer Control Diagram for One Stage Cooling





Basic Economizer Cycle Sequence Typical for Honeywell With Two Stage Cooling with Economizer

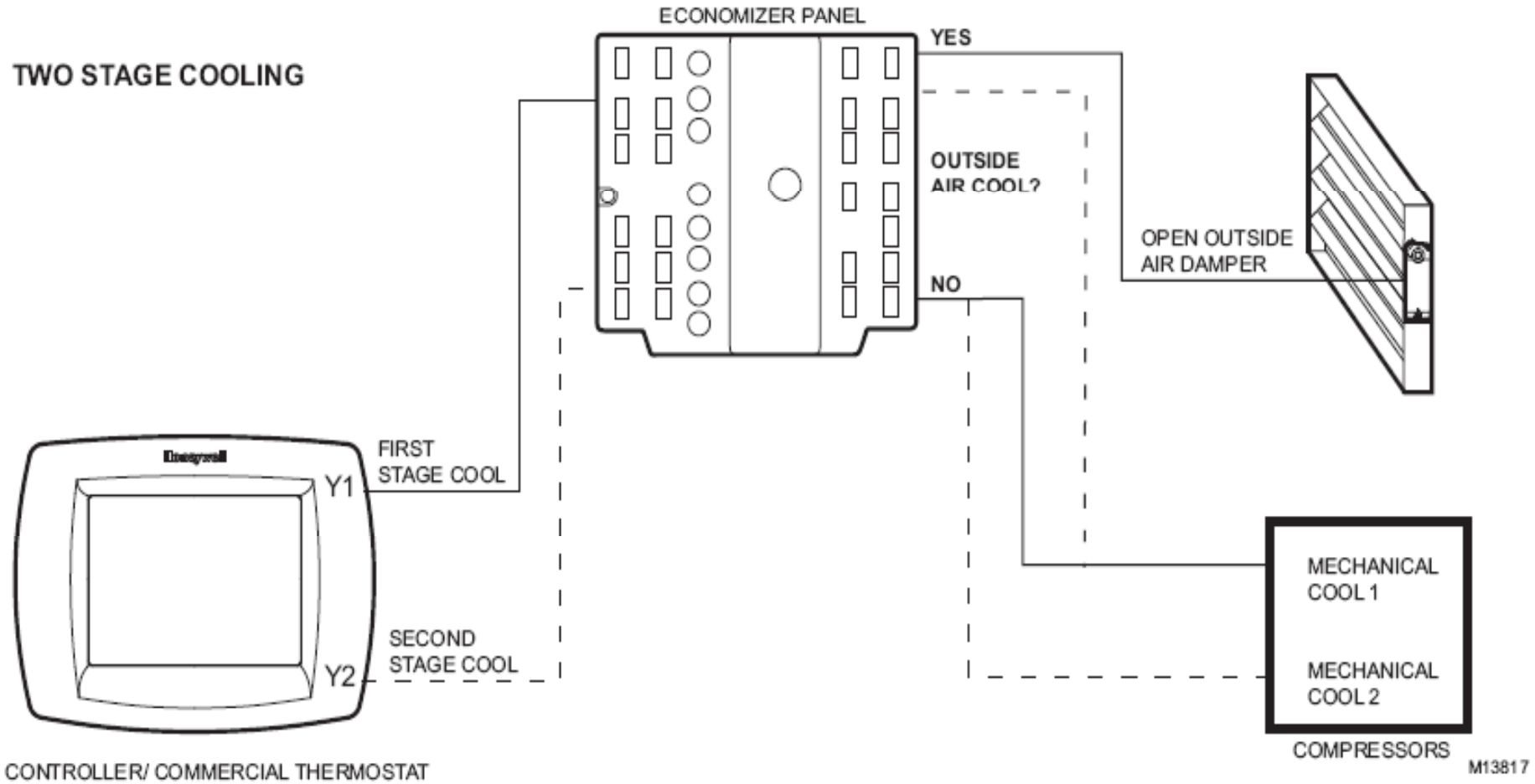
On a Call for Single Stage Cooling

- Controller signal is routed to the economizer logic module to maintain space temperature using outside air for free cooling.

On a Call for Second Stage Cooling

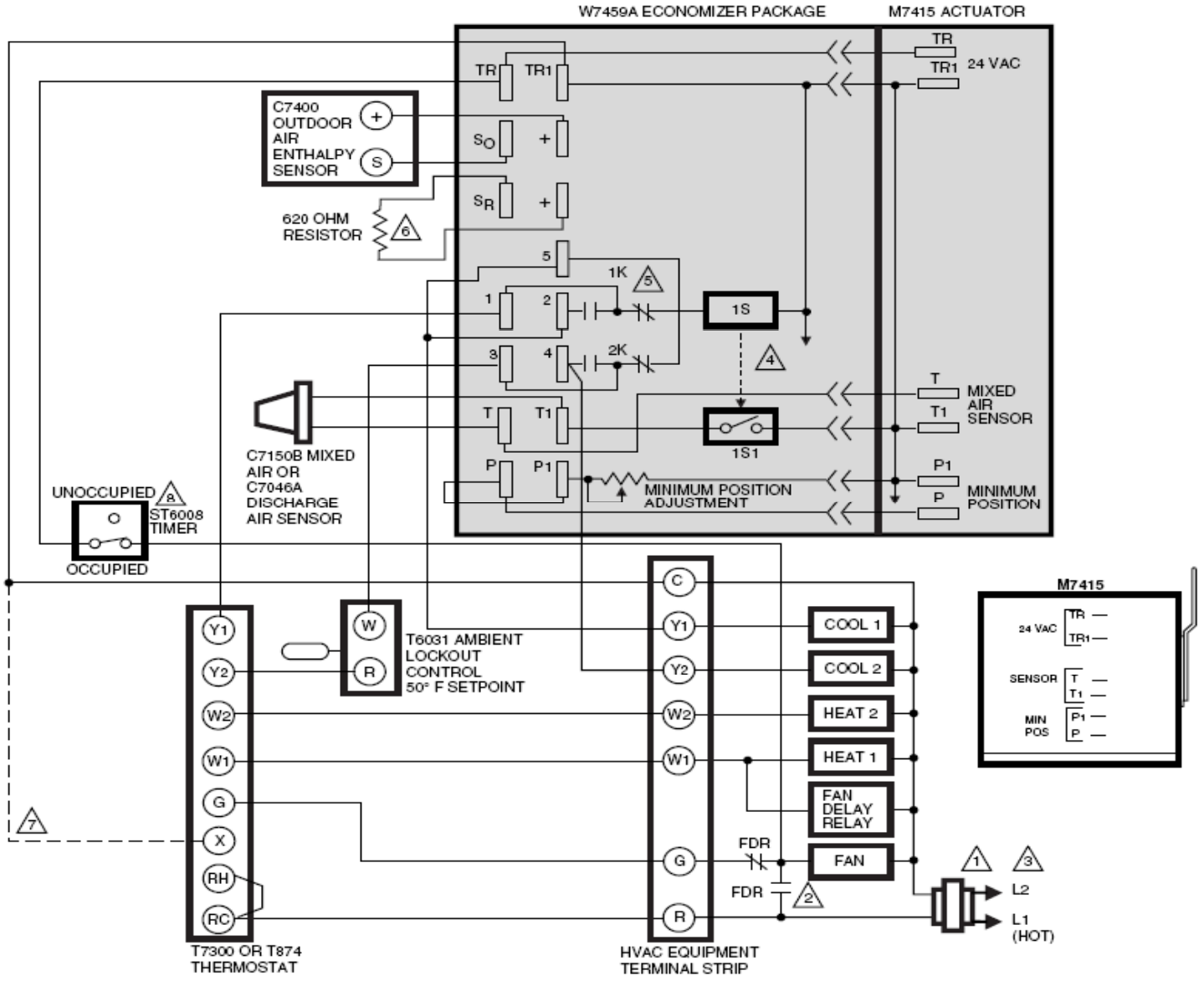
- **If the outdoor air is suitable for free cooling and the outside are dampers are open,** The economizer logic turns on the first stage of mechanical cooling for the second stage of cooling required by the commercial thermostat.
- **If the outdoor air is not suitable for free cooling,** The dampers are set to minimum for occupancy requirements, the first stage cooling compressor is on, and the logic module turns on the second stage of mechanical cooling if available.
- **NOTE:** A commercial thermostat with a minimum of two stages of cooling is required. The first stage must be available for economizing if outside air is suitable.

Basic Operation of Honeywell Thermostat and Controls for Two Stage Cooling with Outside Air Economizer

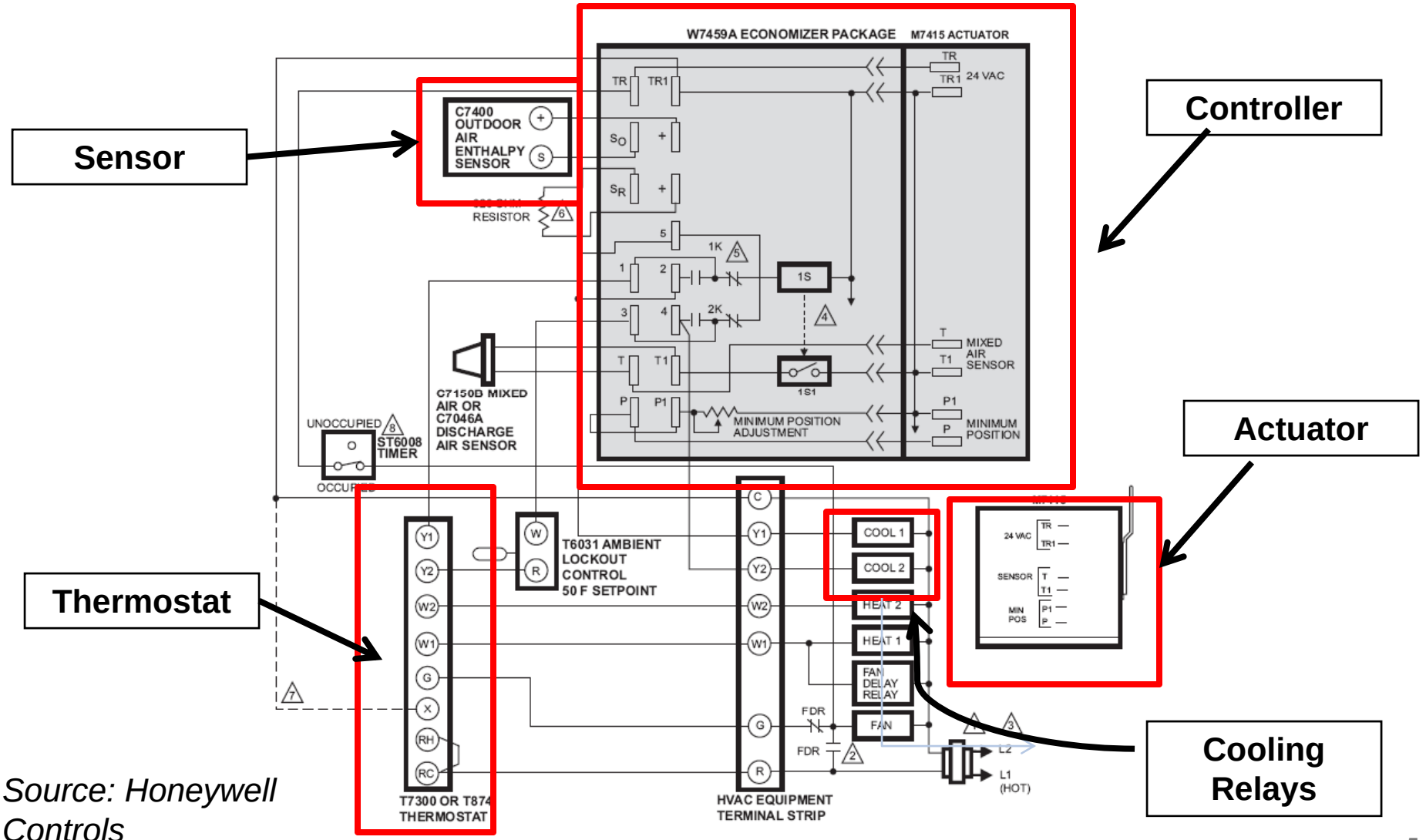


Source: Honeywell Controls

Economizer Control Diagram for Two Stage Cooling



Troubleshooting Factory Schematics Requires Identifying Sensors, Thermostats, Controllers, Relays, and Actuators



Source: Honeywell Controls

ECONOMIZER Checkout Sheet (sample)

ECONOMIZER INFORMATION						
	Sensor Type (EM or SS/ DB or, h)*	**Where Placed**	**As found conditions** (temp and RH (if enthalpy))	**Output** (DC Volts, mA, kΩ-- enter expected and actual values) **Book**	**Actual**	**Adjusted output** Cleaned? Replaced? Enter C or R
Outside Air						
Mixed Air Temp						
Discharge Air Temp						
Return						
* EM=electromechanical, SS=solid state, DB= dry bulb, h=enthalpy (total energy)						
Control Logic (check choices & circle settings. If DIPs, convert to temperature (if known). For differential, record as-found changeover POT setting. Change if not on D.)	As Found Final	____Changeover (A, B, C, D, DIP settings, Snap Disk) T if DIP_____ ____ Differential (outside & return air sensors wired) POT _____ ____Changeover (A, B, C, D, DIP settings, Snap Disk) T if DIP_____ ____ Differential (outside & return air sensors wired) POT _____				

Source: PSE

Economizer Checkout Results
(Summarize repairs and replacements)

Upon your arrival, was economizer fully functional? If not, briefly describe problem(s):	Yes____ No____
Sensor output was checked (enter values above)	Yes____ No____
The outside air damper moves to full open without catching or binding	Yes____ No____
The outside air damper moves to minimum setting without catching or binding	Yes____ No____
Type of relief air: ___ barometric damper ___ mechanically powered exhaust ___ none	
Controller operation was checked	Yes____ No____
Economizer changeover was adjusted to match climate conditions at A, B, C, or D ? If not, explain why not:	Yes____ No____
Should demand controlled ventilation (DCV) be added?	Yes____ No____
If (DCV) was added, was min. air set to 5% of system flow?	Yes____ No____

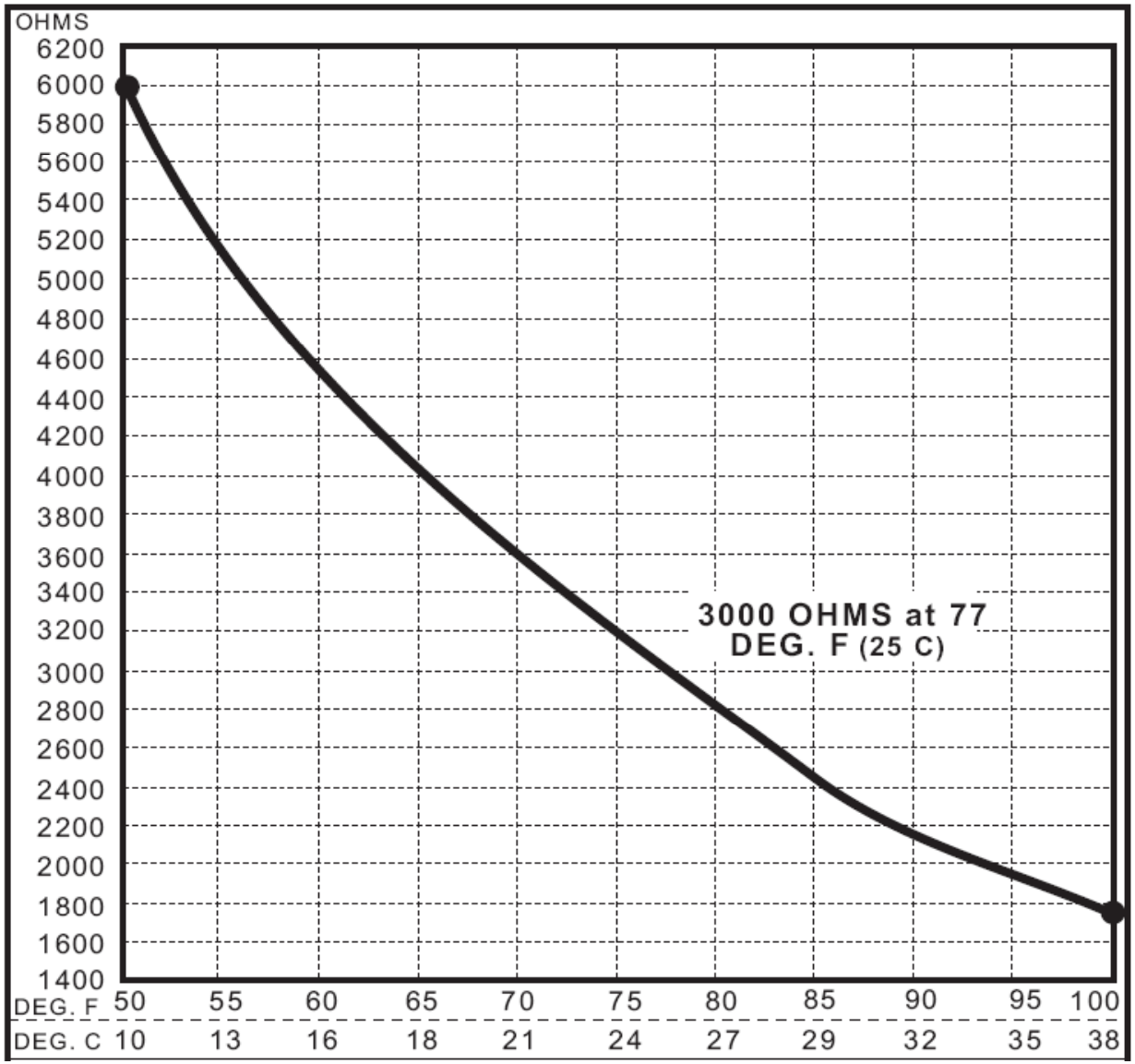
Honeywell W7459 Checkout and Setup Procedures

- Verify all sensors are reading correctly. (See next 3 slides for more details on sensor checkout.)
- Generate a call for cooling.
- Adjust A-B-C-D setting to “D” **(Humid Climates)**
  - For changeover control, economizer should be disabled and outside air damper at minimum if outside air conditions are greater than 55°F (dry bulb) or between 20 and 22 Btu/lb (enthalpy).
- Adjust A-B-C-D setting to “A” **(Dry Climates)**
  - For changeover control, economizer should be enabled and outside air damper modulate full open if outside air conditions are less than 85°F (dry bulb) or between 23 and 32 Btu/lb (enthalpy).
- For differential control strategy, economizer will only be enabled when outside air temperature is less than return temperature.

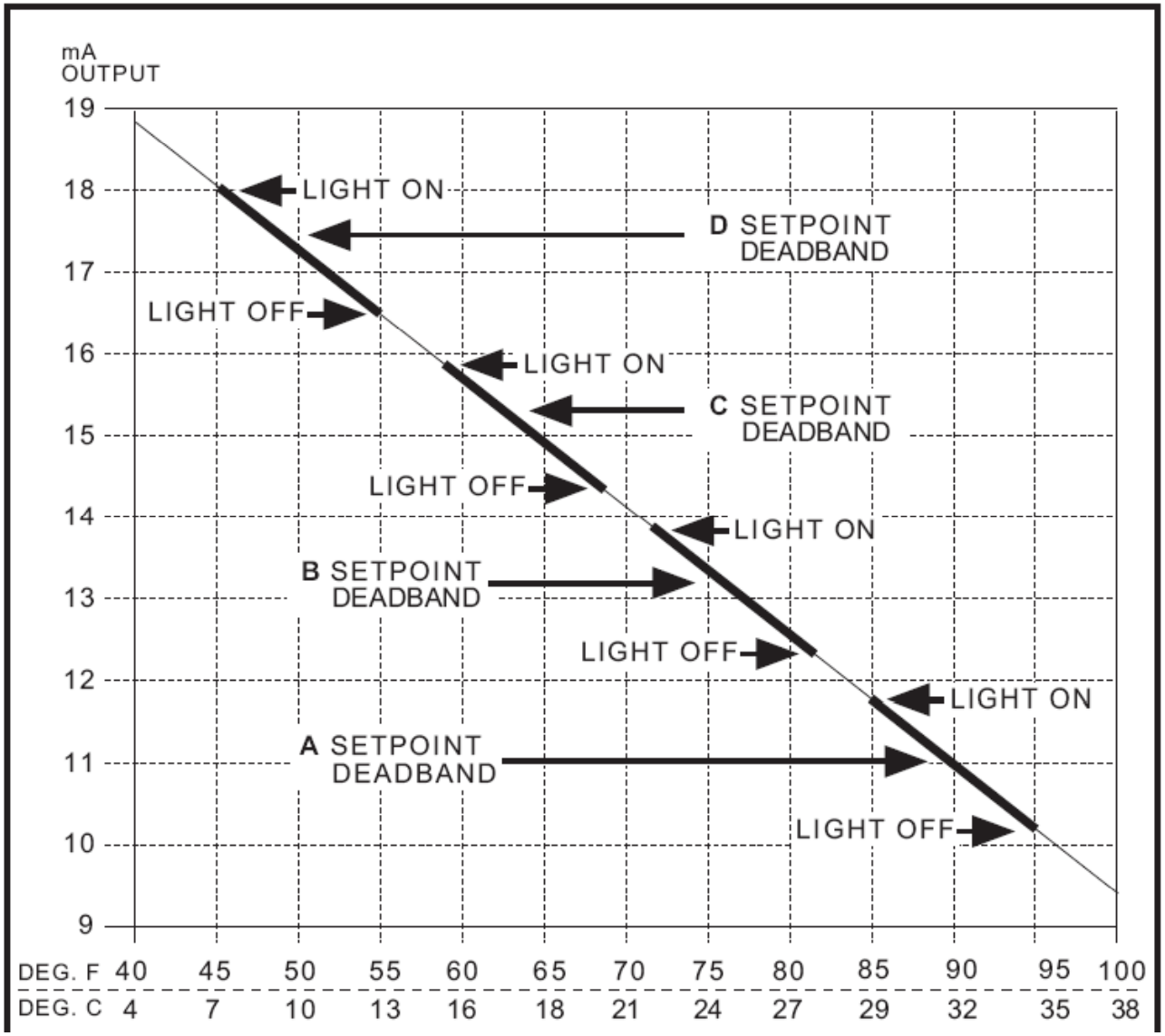
Honeywell W7459 Sensor Signal and Checkout

- Analog temperature sensors typically:
  - Produce a milliamp or resistance signal; check with a DMM in mA or Ω (ohms). See next slide.
  - Measure sensor output and current temperature and compare each value with manufacturer's published data; checked with a DMM in Ω (ohms) at a known temperature.
- Thermostats simply change state at specific temperatures
  - Compare existing temperature to point when thermostat changes state; checked with a DMM in continuity mode, as a switch closure.
- Snap Discs change state only
  - They cannot be adjusted or verified with any degree of accuracy.
  - They typically change state between 60°F and 65°F, which is a fixed setting at the factory; checked with a DMM in continuity mode, as a switch closure at design temperatures.

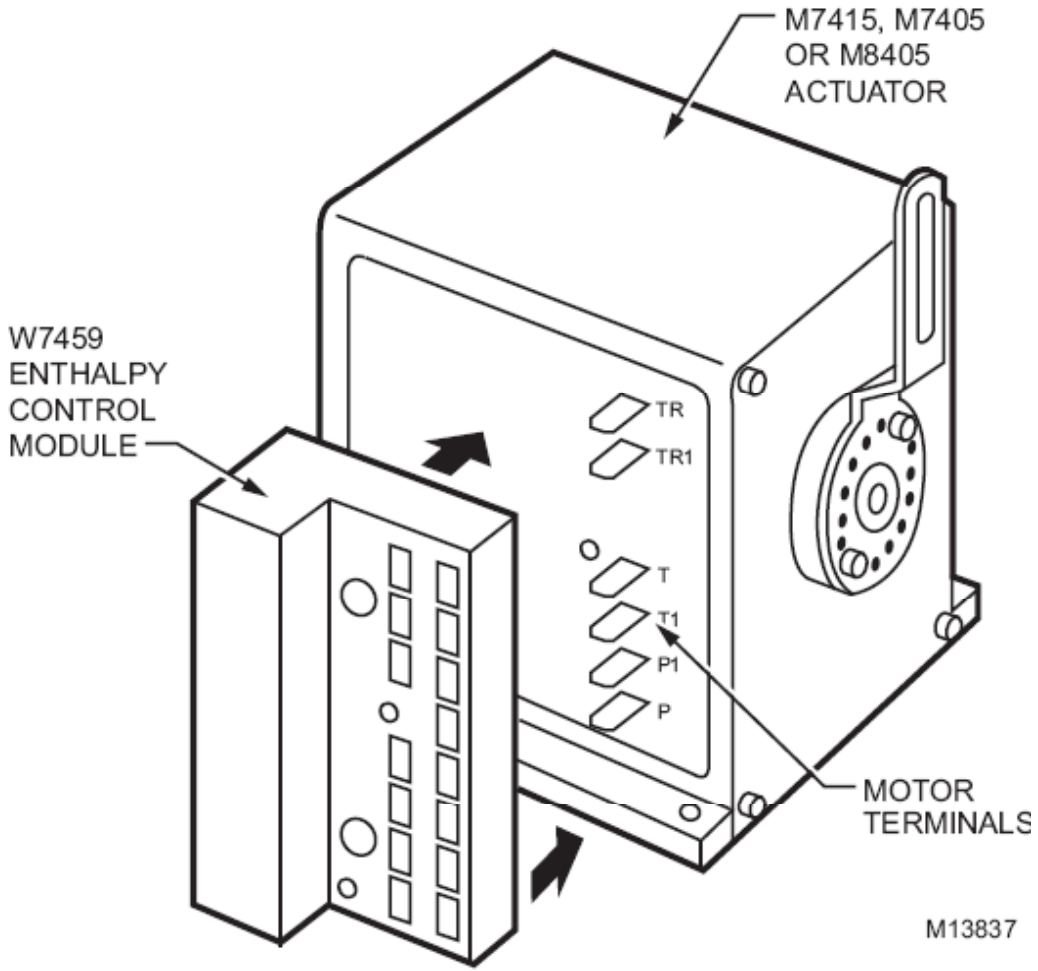
Honeywell C7150 and C7046 Analog Temperature Sensor Checkout Chart (ohms/°F)



Honeywell Temperature Sensor C7650 Checkout Chart (mA/°F)



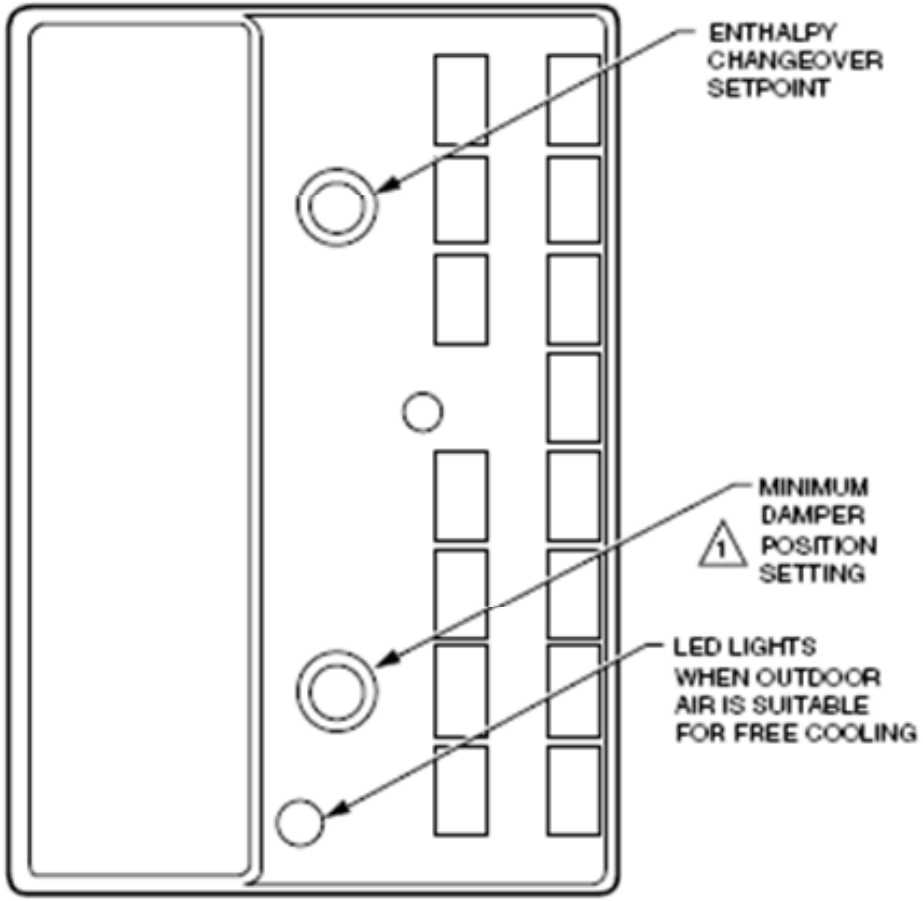
The W7459 is used in conjunction with a Honeywell actuator (M7415) and sensors to control outdoor and return air dampers free cooling using outside air. It is designed to be installed directly on the actuator.



Honeywell W7459 Economizer Control

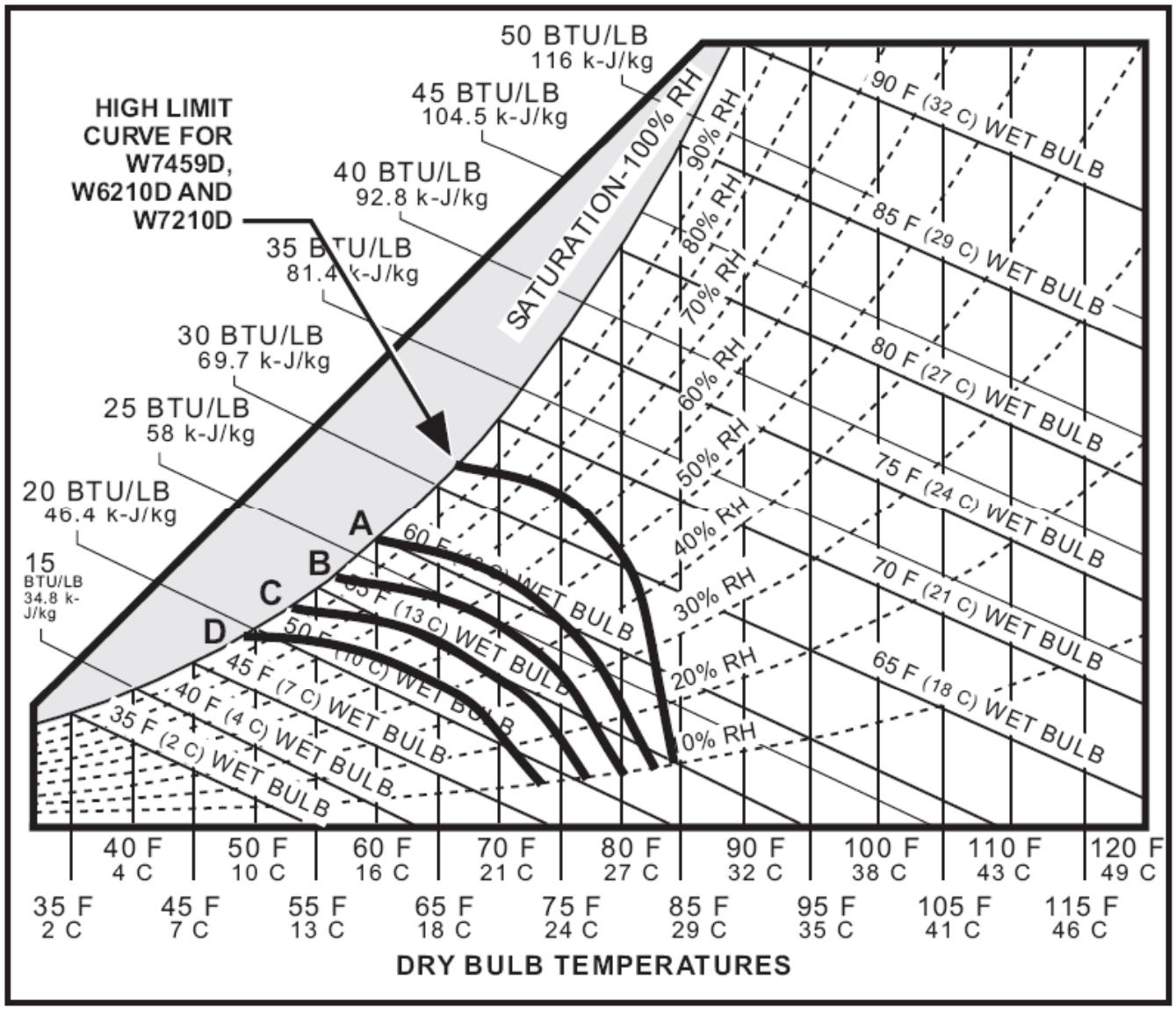
SETTINGS AND ADJUSTMENTS

Potentiometers with screwdriver adjustment slots, located on face of device, provide adjustments for minimum damper position and enthalpy changeover.



W7459 Enthalpy Economizer Control Settings = A,B,C, or D

Control Curve	Control Point (Approximate Temperature at 50% Humidity)
A	73°F (23°C)
B	70°F (21°C)
C	67°F (19°C)
D	63°F (17°C)
Knob turned to D	For Differential Enthalpy (2 Sensor)

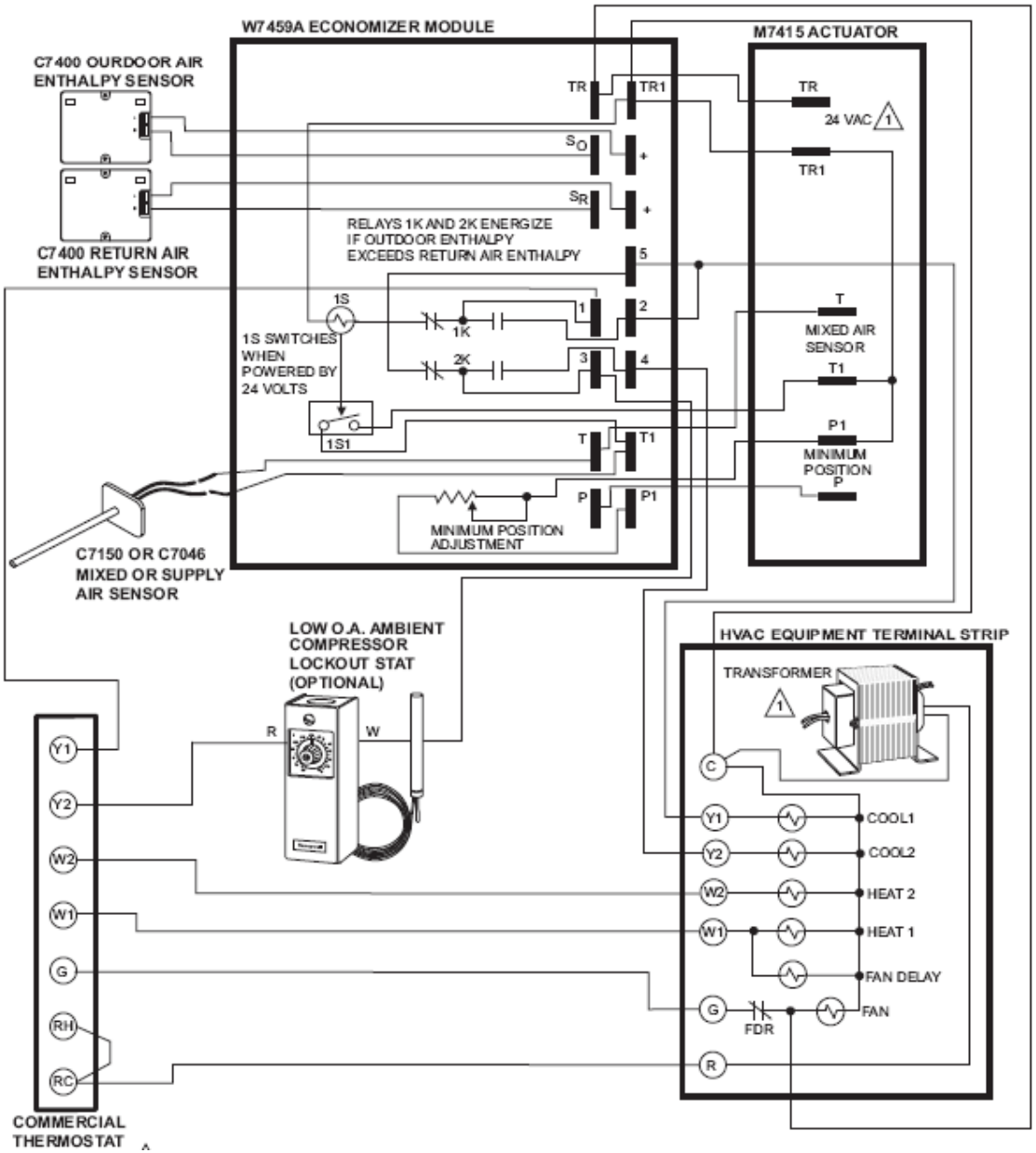


Adjusting Minimum Damper Position for Honeywell W7459A

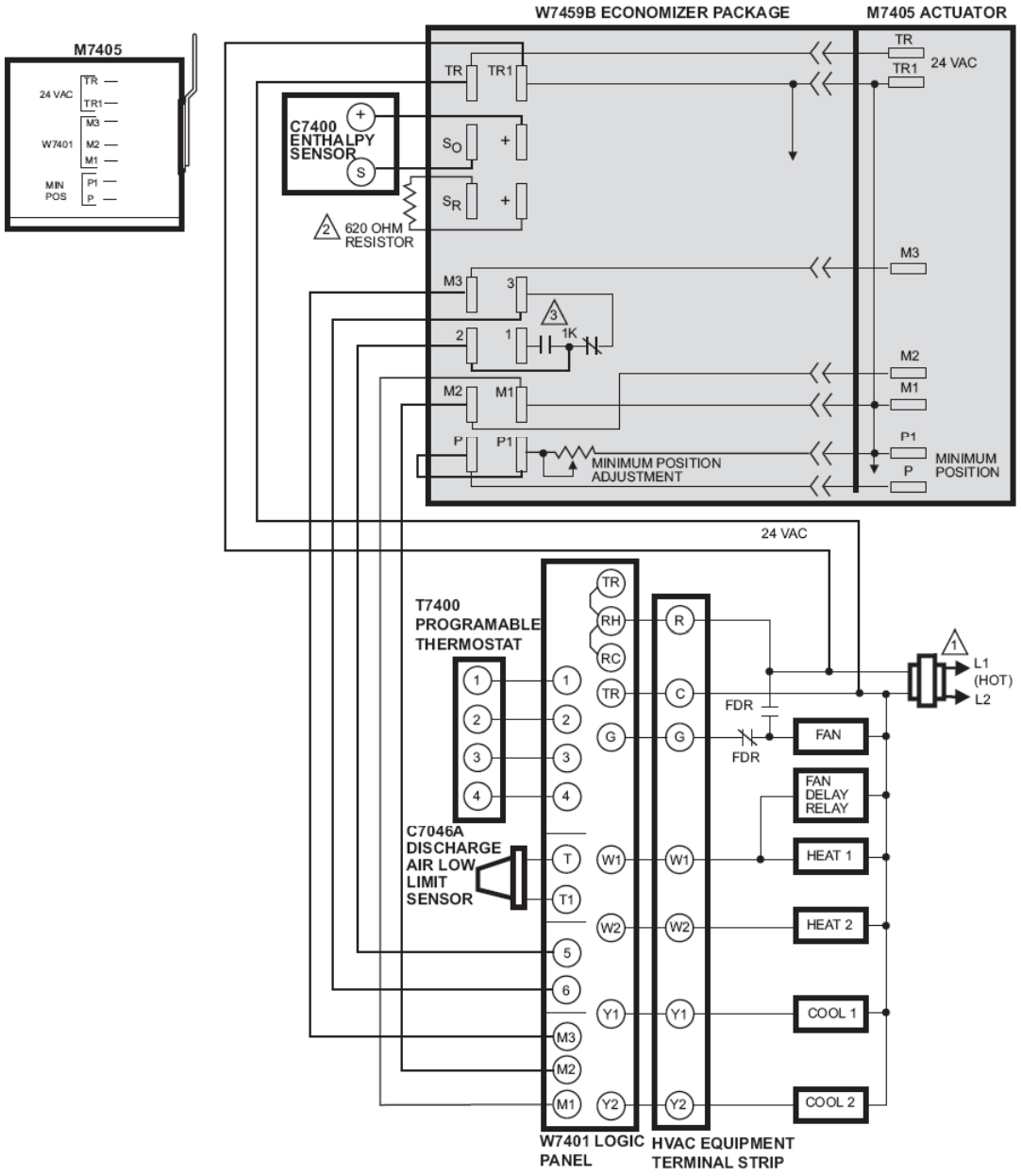
- Note: The W7459A uses inputs from mixed or discharge air temperature sensors.
- Minimum Position Adjustment - Minimum position potentiometer keeps outdoor air damper from closing completely during system operation to provide ventilation.

1. Disconnect mixed air sensor from terminals T and T1.
2. Make sure either factory-installed jumper is in place across terminals P and P1 or if remote damper positioner is required, that it is wired according to Honeywell instructions and turned fully clockwise. See Figure on next slide.
3. Connect 24 Vac across terminals TR and TR1.
4. Adjust potentiometer on face of W7459A with screwdriver to desired minimum position.
5. Note: Check actual percentage of OSA by utilizing % charts or formulas, discussed later.

Honeywell W7459A



Honeywell W7459A

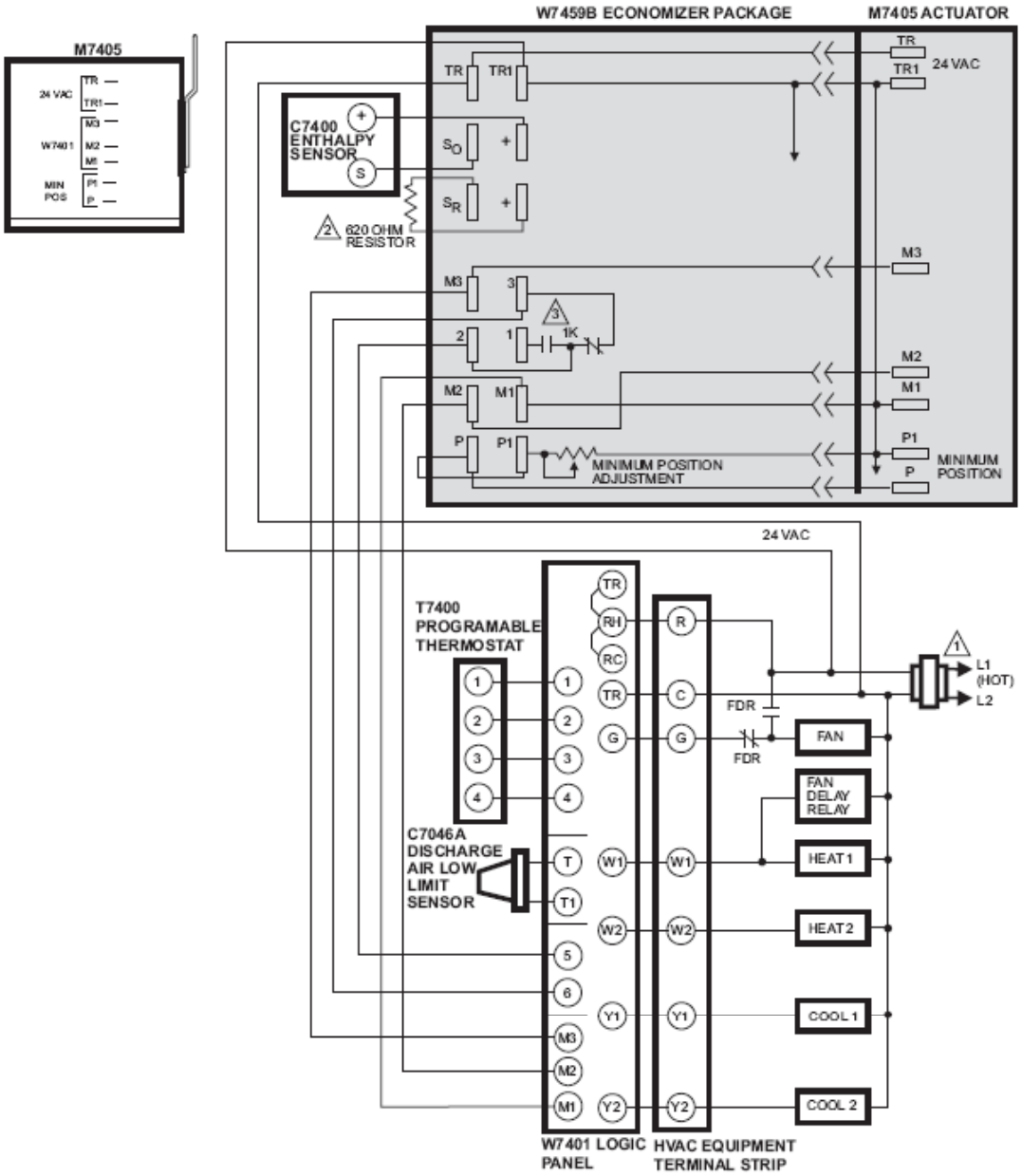


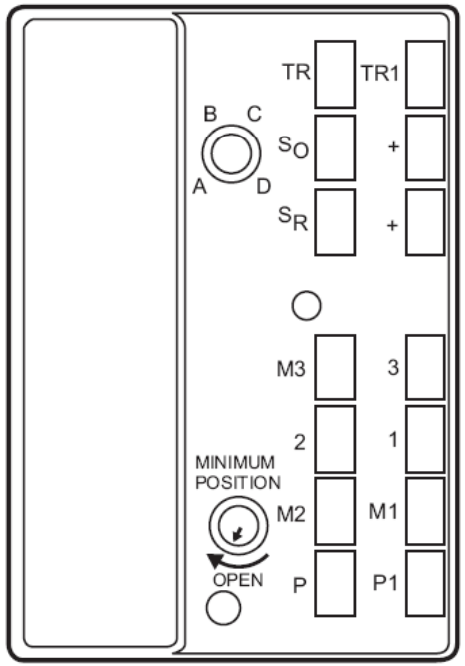
Adjusting Minimum Damper Position for Honeywell W7459B

- Note: The W7459B is designed for use with a W7401 Logic Panel or a Honeywell Legacy direct digital controller.

1. Make sure either the factory-installed jumper is in place across terminals P and P1 or if remote damper positioner is required, it is wired according to Honeywell instructions, and turned fully clockwise. See figure on next page.
2. Connect jumper across terminals M1 and M3.
3. IMPORTANT: Do not contact or connect jumper to M2. If M2 is jumpered to M1, the motor will not respond to the controller.
4. Connect 24 Vac across terminals TR and TR1.
5. Adjust potentiometer on face of W7459B with screwdriver to desired minimum position.

Honeywell W7459B





Checkout and Troubleshooting W7459

	Checkout Procedure	Proper Response
1.	a. Disconnect power at TR and TR1.	—
	b. Disconnect Jumper P to P1.	
	c. Jumper TR to 1.	
	d. Jumper T1 to T.	
	e. If connected, remove C7400 Solid State Enthalpy Sensor from terminals S_O and +. Ensure factory-installed 620 ohm resistor is connected to terminals S_R and +.	LED is off.
	f. Apply power (24 Vac) to terminals TR and TR1.	Motor is in closed position.
2.	a. Disconnect factory-installed 620 ohm resistor from terminals S_R and +.	LED turns on (on A model only, for D model, go to step 3). Motor drives toward open.
3.	a. To simulate high and low enthalpy (single enthalpy sensor), reconnect factory-installed 620 ohm resistor from terminals S_R and +. Connect 1.2K ohm 4074EJM Checkout Resistor across terminals S_O and +.	—
	b. Turn enthalpy setpoint potentiometer to "A".	LED turns on, indicating low enthalpy. Motor drives toward open.
	c. Turn enthalpy setpoint potentiometer to "D".	LED turns off, indicating high enthalpy. Motor drives toward closed.
	d. Disconnect the 1.2K ohm checkout resistor.	—
4.	a. To verify sensor operation, reconnect the + lead of outdoor enthalpy sensor to the + terminal of W7459.	
	b. Connect a DC milliammeter between terminal S_O of the W7459A and terminal S of the enthalpy sensor. See Fig. 14 (positive meter lead to terminal S of the enthalpy sensor).	Milliammeter indication is between 3 and 25 mA if sensor is operating properly. If milliammeter indicates zero, the sensor may be wired backward.
	c. When using differential enthalpy, check the return air enthalpy sensor by connecting a DC milliammeter between terminal S_R of the W7459A and terminal S of the return air enthalpy sensor. (Positive meter lead to terminal S of the enthalpy sensor.)	Milliammeter indication is between 3 and 25 mA if sensor is operating properly. If milliammeter indicates zero, the sensor may be wired backward.

Exercise #5
(Provide Answers below on notes page)

1. T or F When wired properly, the 1st stage of cooling must go through the economizer controller circuit prior to energizing the compressor.
2. T or F When differential enthalpy is utilized, one sensor is in the outside air and one sensor is in the mixed air.
3. T or F When the enthalpy sensor is set at “D”, the unit is set to the minimum level for humid climates.
4. T or F To simulate high and low enthalpy settings, two resistors are needed: a 62O Ω and 1.2 kΩ.
5. T or F A milliamp reading of 3 to 25 mA is the expected reading to check the differential enthalpy sensor.