INSTALLATION INSTRUCTIONS

COOL-FREE RESIDENTIAL ECONOMIZER

The ***Cool-Free*** economizer system is designed to be installed in the attic of a home to provide cooling to the home utilizing outside air when the outside air total heat temperature (sensible and latent) is lower than the inside air total heat temperature. The ***Cool-Free*** is shipped with all the controls (except for the thermostat) required for the application. These include a damper motor, logic module, outside and inside air sensor, and a discharge air sensor. All ductwork is field supplied.

Check the correct number of parts. See the list below

1 - Rough-in Box
1 - Rough-in Collar Mounted on Box
1 - Economizer
1 - Outside Air Enthalpy Control

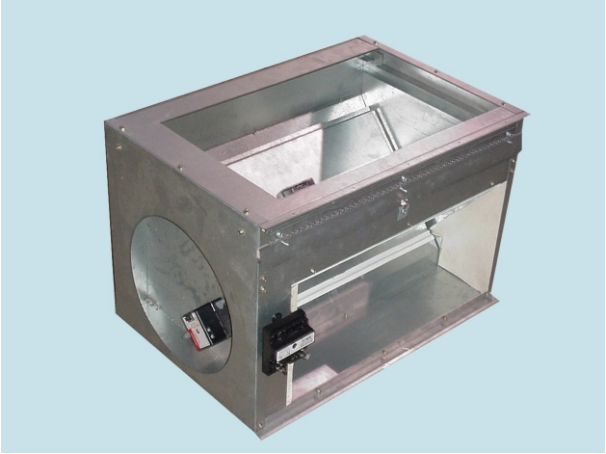


Figure 1 - Economizer

Sequence of Operation

When the thermostat senses a cooling requirement in the home, the system checks to see if the outside air is cooler (total heat) than the inside air (total heat). If the total heat of the outside air is higher than the inside air, the air conditioning compressor is energized, resulting in normal air conditioning operation. If the total heat of the outside air is cooler than the total heat of the inside air, then the ***Cool-Free*** damper opens, which results in outside air cooling the home. If the second stage of the thermostat senses more cooling required, then the compressor is energized. This results in cooling the outside air with refrigerated air. This is desirable because the air is cooler than the inside air, resulting in satisfying the cooling load quicker. However, if the outside air is cold, then the air conditioner coil could freeze. The discharge sensor will close the damper to mix room air and outside air to prevent this from happening.

Internal building pressure is relieved through an aluminum blade back draft damper.

The ***Cool-Free*** system can be used with a programmable thermostat to provide comfort when it is required. This prevents over cooling the home and running the air handler when no one is home.

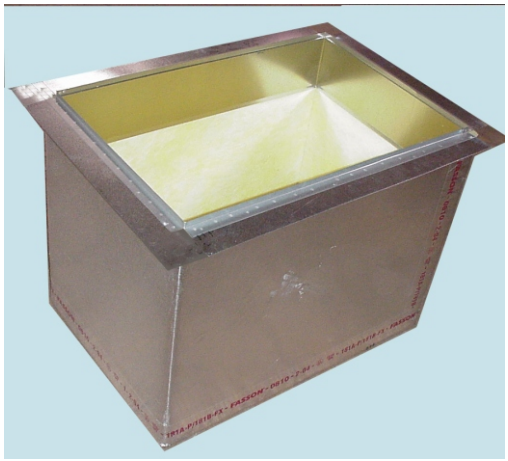


Figure 2 - Rough-In Box

Note:
Location of sensor if not continuous fan.

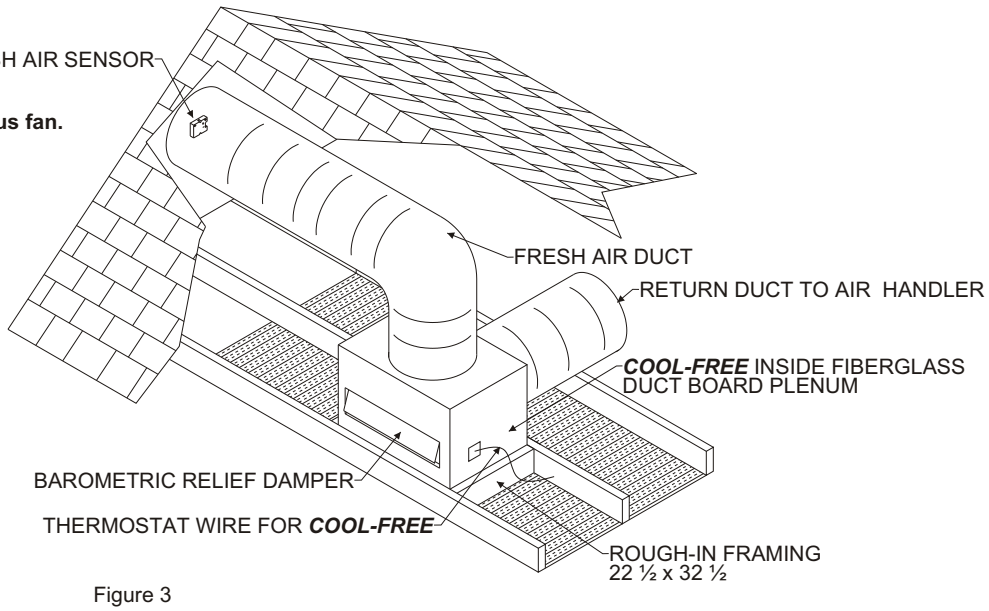


Figure 3

INSTALLATION INSTRUCTIONS

COOL-FREE
RESIDENTIAL ECONOMIZER

Mounting Location

The ***Cool-Free*** economizer should be mounted in a location that meets the following.

Ceiling Mount

A- Accessible to mounting the required ductwork. Duct from economizer to air handler and from economizer to fresh air supply.

B- In an area with access for filter maintenance. Field supplied filter grill and filter.

Other types of installations are possible but will have the same requirements as above.

Installation

Step 1- Install the framing for the fiberglass duct board plenum as shown in Figure 4. The hole for plenum must be 22 ½ x 32 ½.

Step 2- Mount the fiberglass duct board plenum by putting it through the framing making sure the metal collar is facing the conditioned space. Then secure the plenum by fastening flanges of collar to wood framing with no less than three 16p nails on all four sides (field supplied).

Step 3- Cut the openings for the ductwork going to the air handler and the fresh air supply. The fresh air always comes out the top. The return duct going to the air handler can go to either side of the plenum. **Note:** Be sure to cut the return and barometric openings on the correct sides of the plenum. Also cut the opening for barometric relief damper. Make sure to stay within the available area of the plenum as shown in Figure 5, 6 and 7.

Step 4- Install the fresh air and return air ductwork by attaching it to the plenum (duct collars are field supplied). This allows the economizer to be installed at a later date.

Important: Be sure the economizer is oriented in the correct position. The filter should be facing the air handler and the barometric damper facing away from air handler.

Step 5- Place the economizer below the plenum to be sure it is oriented so that the filter rack is facing the air handler. Determine motor side of economizer and its location in reference to the plenum. Cut a small access on the motor side of plenum. Route 18 gauge thermostat wire (wire field supplied) through access down to the floor and into motor end of economizer. Now route wire through bushing by logic module to terminal block to be wired later.

All economizer controls are mounted and tested from the factory except for mixed air sensor, which is mounted in the air handler.

Step 6- Raise the economizer up into the plenum, be sure to pull excess wire through the bushing as the economizer is raised. Once the economizer has been raised up into position. Economizer is in position when it measures 4" from face of plenum collar. Secure economizer in place with ten #10 - 16 x ½" self tapping screws provided with the unit. See Figure 9.

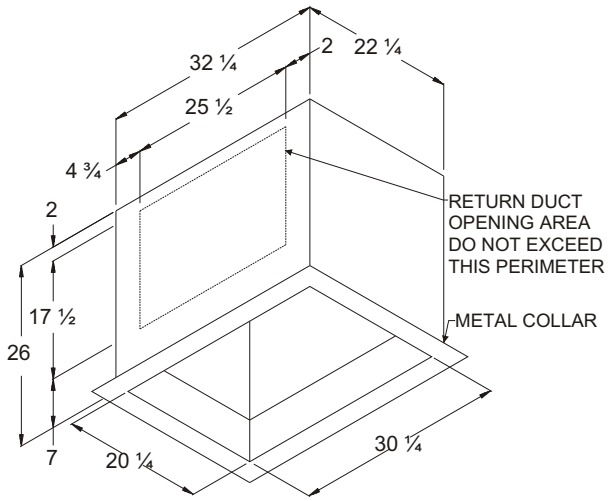


Figure 4

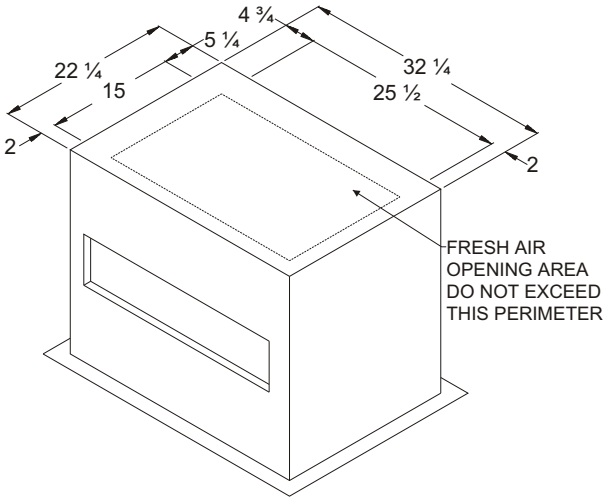


Figure 5

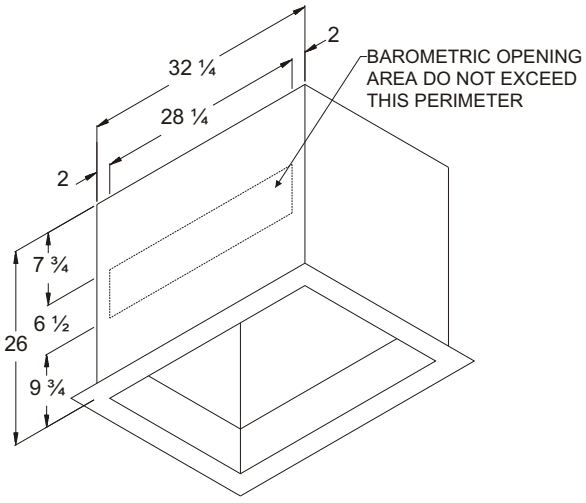


Figure 6

INSTALLATION INSTRUCTIONS

COOL-FREE RESIDENTIAL ECONOMIZER

Seal all air leaks with silicone caulk around the outer return face of economizer before going to the next step.

Return Air Filter Grill and Modification

Step 7- Mount field supplied return air filter grill (standard 20" x 30"). The grill needs to be modified to allow the filter to install in the economizer filter rack and allow the hinged filter access to open and for filter maintenance. Secure grill when modifications are completed.

Step 8- Install the 20" x 30" x 1" filter (field supplied) into filter rack of the economizer. Close hinged filter access and secure by closing the clip. Now that the filter has been installed close the return air filter grill and secure.

Wiring

Step 1- Install outside air enthalpy control at outside air opening and connect 2 wires (field supplied) to 3(+) and 4(So) on the terminal strip and + and So on the sensor.

Step 2- Install discharge air sensor downstream of the evaporator coil and connect 2 wires (field supplied) to 8 and 9 on the terminal strip. This sensor prevents air leaving the evaporator coil from being below 55°F.

Step 3- Install a 2-stage thermostat (field supplied) and connect low voltage wires to air handling unit and terminal block as follows

A- Y1- (thermostat) 1st stage cooling connect to #5 on terminal strip. When outside air is cooler, the ***Cool-Free*** brings in outside air to cool the home when cooling is required.

B- Y2 - (thermostat) 2nd stage cooling connect to #7 on terminal strip. When the outside air is cooler than the inside, but is not cool enough to match the cooling requirement, Y2 is energized to provide compressor operation and ***Cool-Free*** operation.

C- G - (air handler) blower signal connect to #2 on terminal strip. ***Cool-Free*** only operates when the blower is energized.

D- Y1 - (air handler) 1st stage cooling connect to #6 on terminal strip.

E- C - (air handler) 24 volt common connect to #1 on terminal strip.

Maintenance

The only maintenance needed on your ***Cool-Free*** System is to keep the filter clean. It is recommended that you service the filter every 30-45 days to help our system perform efficiently. The economizer damper motor is sealed and lubricated for life.

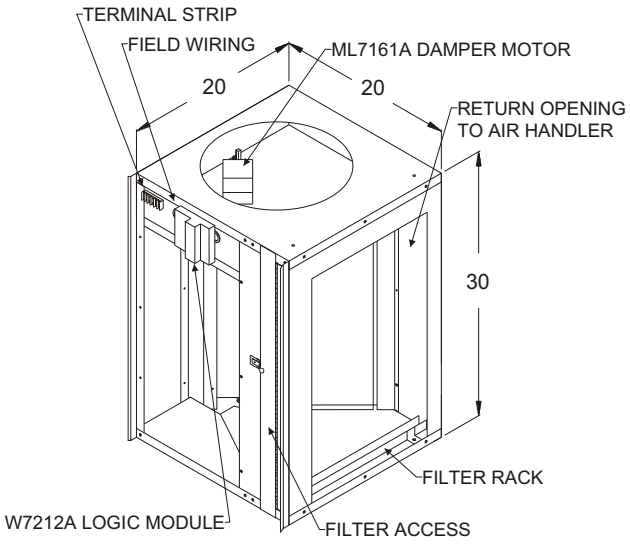


Figure 7

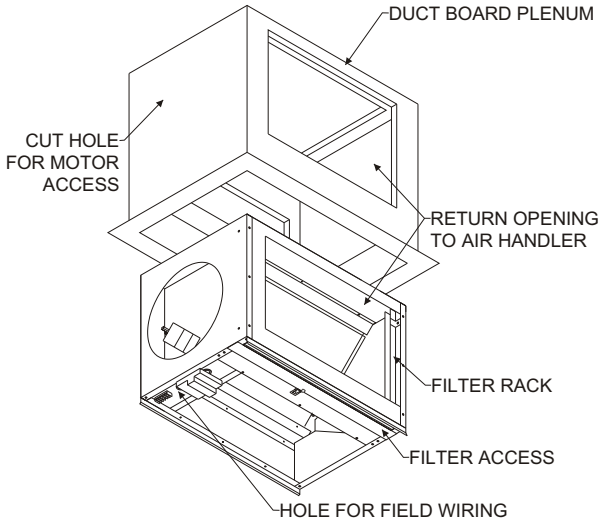


Figure 8

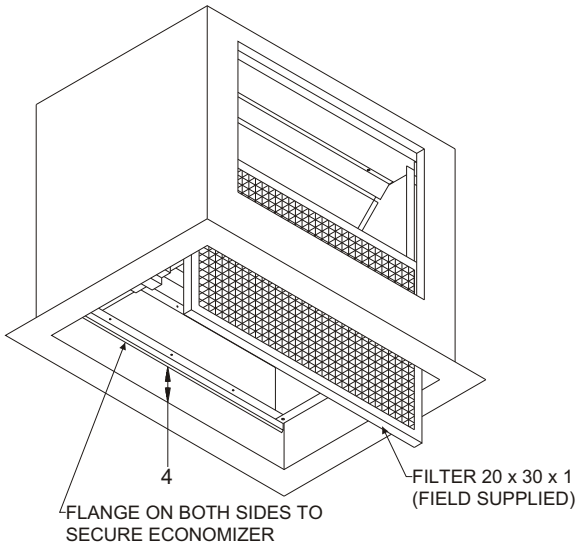


Figure 9

HARNESS DETAIL

E# = WIRE END DESIGNATION
E2 STUD #6 18 Ga. Wire
E3 Female ¼ Quick Disc.
E4 Male ¼ Quick Disc. Insul
E6 Wire Nut Size 73B

NO HARNESS

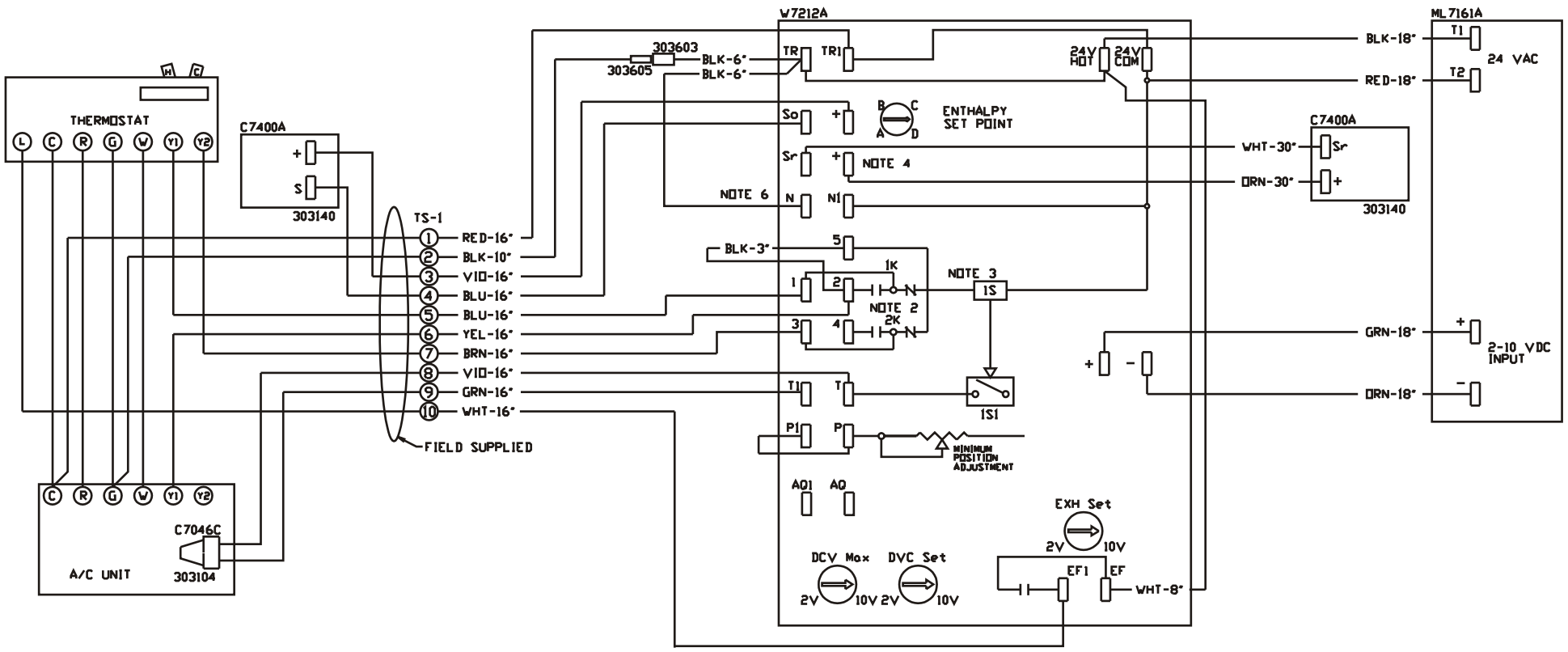
COMPONENT CODE

Economizer

TS-1	Economizer Terminal Strip
C7400A	Fresh Air Sensor
ML7161A	Damper Actuator
C7046C	Mixed Air Sensor
W7212A	Logic Module
C7400A	Return Air Sensor

WIRE COLOR CODE

BLK	Black	BLU	Blue
BRN	Brown	GRN	Green
ORN	Orange	RED	Red
VIO	Violet	WHT	White
YEL	Yellow		



Notes:

1. Unit wiring shown as reference only. Check unit wiring for actual unit wiring.
2. Relays 1K and 2K actuate when the Outdoor Air Enthalpy is higher than the Return Air Enthalpy.
3. 1S is an electronic switch which closes when powered by a 24 VAC input.
4. C7400 Differential Enthalpy Sensor is added.
5. Y2 must be energized for the compressor to operate.
6. "N" terminal used for occupied mode. Remove jumper when night setback control utilized. 24v must be applied for occupied mode operation

Cool-Free Residential
Modulating Economizer

Rooftop Systems, Inc.
2405 McIver Lane
Carrollton, Texas 75006
Phone (972) 247-7447
Fax (972) 243-0940

Date: February 3, 2005
Supercedes: 11-10-04
Drawn by:
Unit # 01-424-01D
Diagram# 0142401DW

W7212
Economizer Logic Modules
For Ventilation Control

Operation

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

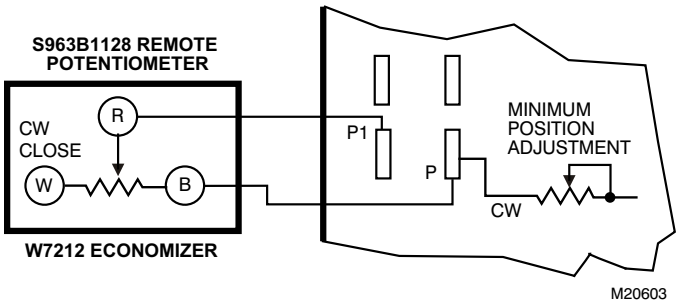
When wired as shown in **Figure 7**, the logic module responds to the cooling thermostat signal. This system uses C7400 Solid State Enthalpy Changeover Sensor(s) or C7650 Dry Bulb Temperature Sensor(s). The C7400 responds to both dry bulb temperature and humidity, allowing use of outdoor air at higher 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.

Note:

When module is operating in Occupied mode, the minimum position is defined by the potentiometer. When the module is operating in Unoccupied mode, the minimum position is fully closed.

The logic module can operate as either a basic free cooling controller, or it can incorporate additional functions. **Table 1** details the input/output (I/O) logic of the module.



Optional S963B1128 Remote Potentiometer used with W7212 for remote damper control

Table 1 - W7212 Economizer I/O Logic

Inputs					Outputs			
DCV	Enthalpy[a]		Y1[b]	Y1[b]	Damper		Compressor	
	Outdoor	Return			Occupied	Unoccupied	1	2
Below Set (DCV LED Off)	High (Free Cooling LED off)	Low	On	On	Minimum position	Closed	On	On
			On	Off			On	Off
	Low (Free Cooling LED on)	High	On	On	Modulating[c] (min. position to full-open)	Modulating[c] (closed to full-open)	On	Off
			On	Off			Off	Off
Above Set (DCV LED On)	High (Free Cooling LED off)	Low	On	On	Modulating[d] (min. position to DCV maximum)	Modulating[d] (closed to DCV maximum)	On	On
			On	Off			On	Off
	Low (Free Cooling LED on)	High	On	On	Modulating[e]	Modulating[f]	On	Off
			On	Off			Off	Off

[a] For single enthalpy control, the module compares outdoor enthalpy to the ABCD setpoint.

[b] If both stages of cooling are off, the system is off and the damper is at:
- Minimum position if DCV is below setpoint and system is Occupied (24 Vac across N and N1 terminals).
- Closed if DCV is below setpoint and system is Unoccupied (no voltage across N and N1 terminals).
- Modulating if DCV is above setpoint.

[c] Modulation is based on the mixed air sensor signal.

[d] Modulation is based on the DCV signal.

[e] Modulation, 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).

[f] Modulation, based on the greater of DCV and mixed air sensor signals, between closed and either maximum position (DCV) or fully open (mixed air signal).

Note:

DCV and Free Cooling have setpoints and LED indications.

Settings And Adjustments

Potentiometers with screwdriver adjustment slots, located on device face, provide adjustments for several parameters (see **Figure 5** for locations on device):

— DCV setpoint.
— Minimum damper position.
— Maximum damper position.
— Enthalpy changeover.
— Exhaust setpoint.

Demand Control Ventilation Setpoint

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

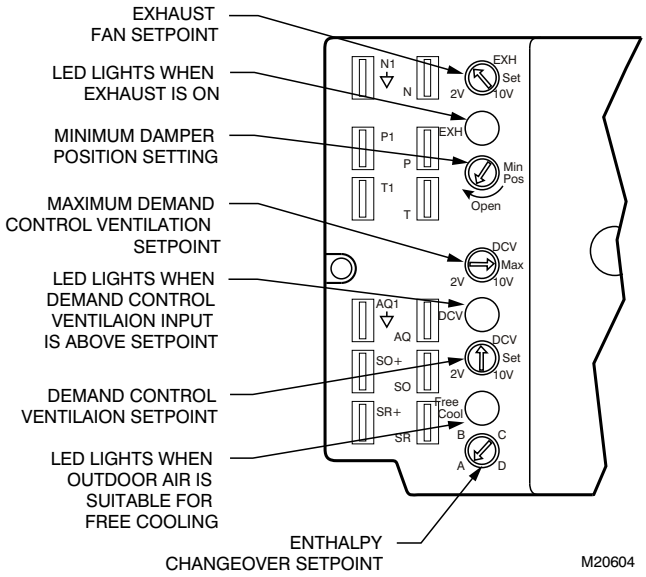


Figure - 5 Potentiometer and LED locations.

Adjusting Minimum and Maximum Positions

The minimum position potentiometer maintains the minimum outdoor air flow into the building during occupied period. 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. Setting the DCV maximum position of the damper prevents the introduction of large amounts of hot or cold air into the space.

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, it overrides the DCV maximum position potentiometer.
- If mixed air temperature drops to 45°F, the mixed air sensor overrides the DCV and closes the damper to minimum position 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, as required by local codes, to enter the building.

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. Ensure that either the factory-installed jumper is in place across terminals P and P1 or, of remote damper position is required, that it is wired according to Figure 4 and turned fully clockwise.
4. Connect 24 Vac across terminals TR and TR1.
5. 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.

Equation 1:
Formula to aid minimum position adjustment.

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

Where:

T_O = Outdoor air temperature
OA = Percent of outdoor air
T_R = Return air temperature
RA = Percent of return air
T_M = Resulting mixed air temperature

Important:

This procedure requires use of a quality thermometer capable of reading to 0.5°F [0.25°C].

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?

$(0.1 \times 60^oF) + (0.9 \times 75^oF) = 6.0^oF + 67.5^oF = 73.5^oF$

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

1. Disconnect mixed air sensor from terminals T and T1 and short terminals T and T1.
2. Connect a jumper between terminals AQ and SO+.
3. Connect 24 Vac across terminals TR and TR1.
4. Adjust the potentiometer on the face of the device with a screwdriver for desired maximum position.

Enthalpy Changeover

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 **Figure 6** for the corresponding control point. The factory-installed 620-ohm jumper must be in place across terminals SR and SR+.

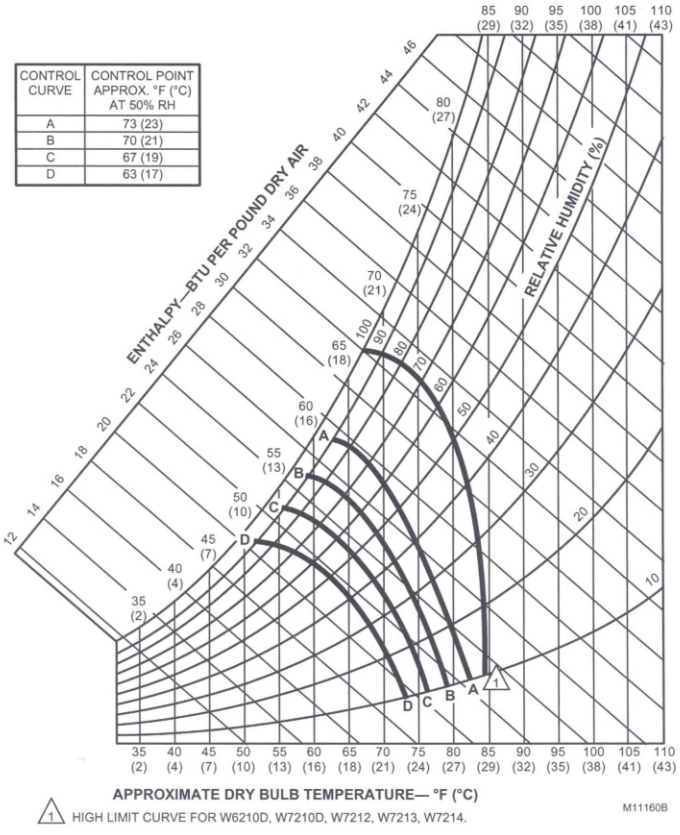
Differential Enthalpy Changeover Setting

Differential enthalpy control uses two C7400 Enthalpy Sensors connected to one logic module. The logic module compares outdoor air to return air instead of to a setpoint as it does for single enthalpy.

Note:

Turn the 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 outdoor air damper opens 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.

Note:

EF and EF1 are dry contacts only. An external line voltage contactor is required to operate the exhaust fan.

Adjustable Exhaust Setpoint

These logic modules have an adjustable setpoint. This potentiometer allows the installer to set the exhaust setpoint at an actual damper position percentage open from fully closed.

Minimum Outside Air Requirements for a Cool Free Economizer when used with a Honeywell TH8320U1008 Thermostat

Outside Air CFM Required per Hour with Continuous Blower Operation			
Home Square Feet	Quantity Bedrooms		
	3	4	5
2,000	50	58	65
2,500	55	63	70
3,000	60	68	75
3,500	65	73	80
4,000	70	78	85
4,500	75	83	90
5,000	80	88	95
5,500	85	93	100
6,000	90	98	105

"Circulation" Mode on Thermostat Outside Air CFM Required per Hour Blower is Energized 35% of Time			
Home Square Feet	Quantity Bedrooms		
	3	4	5
2,000	143	164	186
2,500	157	179	200
3,000	171	193	214
3,500	186	207	229
4,000	200	221	243
4,500	214	236	257
5,000	229	250	271
5,500	243	264	286
6,000	257	279	300

Note:

1. During installed thermostat setup, set fan code (#180) to = "1". This will energize the "G" terminal on the thermostat during the heating operation to provide minimum outside air.
2. During thermostat setup, set System Type code (#170) to = "8" for 2 heat / 2 cool operation.

STEP BY STEP MODULATING ECONOMIZER CHECKOUT & TROUBLE SHOOTING

OUTSIDE ENTHALPY BELOW SET POINT	
Condition on Logic Module Should Be	**Conditions Not Met**
1. Red "LED" Illuminated	1. Jumper terminals {So} and {+}. If the "LED" glows the Module is okay. Check 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 Motor.
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 will 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" should not be illuminated. If there is continuity and the "LED" does glow, then the module is defective.
5. Continuity on Terminals: {3} and {5}	5. If there is continuity on terminals {3} and {5} then the internal switch "1S" is correctly energized. Damper motor should be in a modulating mode.
6. Motor does not operate with all above conditions correct. Second Stage	6. Jumper the Mixed Air Sensor, {T} and {T1}. If the Motor begins to operate, then check the wiring to the Sensor. If it is correct, then the temperature is below the sensor set point, or it is defective. If the Motor does not operate, and the wiring is correct, and the temperature is above the sensor set point, then the motor is bad.
7. 24 Vac to Terminals: {3} and {TR1}	7. Verify that you have a 2-Stage thermostat. Check for a "call" for a second stage cooling. If there is not 24 VAC on {3} and {TR1} check wiring from "Y2" on the thermostat to module.
8. 24 Vac to Terminals: {5} and {TR1}	8. If {5} and {TR1} does not have 24 VAC then the internal switch "1S" is not in the correct position assuming {3} and {TR1} has 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 {5} to "Y2" on the unit low voltage terminal board.

OUTSIDE ENTHALPY ABOVE SET POINT	
Condition on Logic Module Should Be	**Conditions Not Met**
1. Red "LED" Not Illuminated	1. If the "LED" glows the Module "thinks" it is in the Economizer mode. Verify the conditions are above the enthalpy set point. Check note 2. Check wiring to Enthalpy Control for a short from {S0} 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 Motor. {X} and {TR} provide power for minimum position.
3. 24 Vac to Terminals: {1} and {TR}	3. Verify there is a "call" for cooling from the thermostat. Without a call for cooling the compressor will not be in the normal A/C mode.
4. 24 Vac to Terminals: {2} and {TR}	4. If there is not 24 VAC on {2} and {TR} then the internal contacts are not set correctly. Remove the {So} wire from the module. If there is 24 volts to {2} and {TR} then the enthalpy control is bad or the {So} and {+} wiring is shorted together. If no voltage to {2} and {TR} then the module is bad.
5. Continuity on Terminals: {1} and {2} {3} and {4}	5. If there is not a continuity for {1} to {2} then 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} then the red "LED" should not be illuminated. If there is continuity and the LED does glow, then the module is defective. If there is continuity on terminals {3} and {5} then the internal contacts are correctly energized. Damper motor should be in the Economizer mode.
6. Compressor does not operate with all above conditions correct. Second Stage	6. Check the wiring from {2} to "Y1" on the unit low voltage control board. Verify that there is not 24 VAC to "Y1" and "C" on the unit.
7. 24 Vac to Terminals: {3} and {TR}	7. Verify that you have a 2-Stage thermostat. Check for a "call" for a second stage cooling. If there is not 24 VAC on {3} and {TR} check wiring from "Y2" on the thermostat to module.
8. 24 Vac to Terminals: {5} and {TR}	8. If {4} and {TR} does not have 24 VAC then the internal switch "1S" is not in the correct position if {3} and {TR} has 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 {4} to "Y2" on the unit low voltage terminal board.

{ } Terminals on the Logic Module.
[ ] Low Voltage input from unit or thermostat