

W859F Economizer Control Packages

W859F Economizer Control Packages are used with any Series 91 Modutrol IV Motor (M91XX) to modulate the outdoor and return air dampers for most economical operation of an economizer ventilation system.



- Combines functions of (1) proportional mixed air temperature controller, (2) outside air changeover controller, (3) minimum position potentiometer, and (4) air conditioning compressor lockout in one package. (Some functions are not available on all models.)
- W859F can be connected to operate from the cooling thermostat to provide a totally integrated control system that locks out the economizer in the heating season.
- W859F is used with an H205A Enthalpy Control to provide maximum economy in high humidity areas.
- W859F includes leadwires for wiring remote potentiometer and remote minimum position switch.
- 24 Vac power supply only.
- Housed in die-cast aluminum case that mounts on a 203977A Adapter Bracket, in place of the Modutrol IV Motor cover.
- Color-coded leadwires.
- Weatherproof, screw-on caps prevent accidental changing of control adjustments. NEMA 3 weatherproofed when 4074EUB Economizer Weather Kit is installed and motor is in an upright position.
- Hook provided for hanging device on side of Modutrol IV Motor while connecting wiring.

CONTENTS

<i>Specifications</i>	<i>2</i>
<i>Ordering Information</i>	<i>2</i>
<i>Installation</i>	<i>3</i>
<i>Optional Applications</i>	<i>6</i>
<i>Settings and Adjustments</i>	<i>11</i>
<i>Operation and Checkout</i>	<i>13</i>

Specifications

IMPORTANT: *The specifications given in this publication do not include normal manufacturing tolerances. Therefore, an individual unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions and some minor differences in performance can be expected if those conditions are changed.*

MODELS:

W859F1005 Economizer Control Package with compressor lockout switch.

W859F1013, W859F1021 Economizer Control Package with leadwires for wiring enthalpy control, remote potentiometer and minimum position switch. Two spdt relays controlled by external enthalpy control provide outdoor air changeover and compressor lock-out.

FOR USE WITH: M91XX Modutrol IV Motors with internal balancing relays.

ELECTRICAL RATING: Input Voltage: 24 Vac.

TEMPERATURE RATINGS:

Temperature Control Range: 0° F to 100° F [-18° C to +38° C].

Maximum Operating Ambient Temperature: 125° F [51° C].

Maximum Duct Temperature: 125° F [51° C].

APPROXIMATE WEIGHT: 6-1/2 lb [3 kg].

DIMENSIONS in. [mm]: 5-13/16 [148] long, 4-1/8 [105] wide, 3-11/32 [85] deep (increases overall height of Modutrol IV Motor to 10-5/8 [273]). (Does not include height of 220738A Adapter Bracket.)

MIXED AIR TEMPERATURE CONTROLLER:

Control Range: 0° F to 100° F [-18° C to +38° C].

Maximum Ambient Operating Temperature: 125° F [51° C].

Throttling Range: 10° F [6° C].

Potentiometer Resistance: 135 ohms.

(W859F1005 AND W859F1013 ONLY):

Sensing Element: 12 ft [3.7 m] long, averaging, liquid filled.

Capillary Length: 10 ft [3 m].

(W859F1021 ONLY):

Sensing Element: Remote bulb with 10 ft [3m] capillary.

OUTSIDE AIR CHANGEOVER CONTROLLER

(W859F1005 ONLY):

Control Range: 0° F to 100° F [-18° C to +38° C].

Maximum Ambient Operating Temperature: 125° F [51° C].

Differential: 2° F [1° C].

Sensing Element: Remote bulb, liquid filled.

Capillary Length: 5 ft [1.5m].

MINIMUM POSITION POTENTIOMETER:

Resistance: 150 ohms.

Minimum Setting: 0 to 50 percent of motor stroke.

COMPRESSOR LOCKOUT:

Operation: Spst switch (W859F1005) or relay contacts (W859F1013, W859F1021) make R to W (black/red lead to black/yellow lead) on temperature rise above outside air changeover controller setpoint; make R to B (black/red lead to black/blue lead) on temperature fall below outside air changeover controller setpoint.

Differential: 3° F [1.5° C].

Contact Ratings:

1 ampere at 24 Vac (Class II circuits).

ACCESSORIES:

203977A Adapter Bracket (adapts W859F to Modutrol IV Motor).

107324A Bulb Holder to support the outside air sensing bulb in the air duct.

314439 Mounting Clips to mount the mixed air control averaging element in the duct.

113665 Grommet to secure capillary tubing in duct hole.

S963 Manual Potentiometer to provide remote control of damper position.

W950 Status Panel to provide system indicator lights and manual potentiometer to adjust damper position.

4074EUB Economizer Weather Kit

R8225A Fan Relay to provide manual control of mini-

Ordering Information

When purchasing replacement and modernization products from your wholesaler or distributor, refer to the price sheets for complete ordering number, or specify—

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 Home and Building Control Sales Office (check white pages of your phone directory).
2. Home and Building Control Customer Satisfaction
Honeywell Inc., 1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Limitée, 740 Ellesmere Road, Scarborough, Ontario M1P 2V9. International Sales and Service offices in all principal cities of the world.

mum outside air during heating and for use in an automatic economizer system.
T675 Thermostat to provide automatic control of minimum outside air during heating or automatic control of night setback.
T872 Multistage Thermostat for use in an automatic

economizer system to regulate space temperature; with a Q672B Subbase to provide a remote manual changeover switch.
H205A/H705A Enthalpy Control.
118837 Protective Screw-on Cap for replacement of lost or misplaced cap.

Installation

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings and description given on the product 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

1. Disconnect power before installation to prevent electrical shock or equipment damage.
2. On multitap models, insulate all unused transformer leads separately to prevent danger of electrical shock or equipment damage.
2. Never turn the motor shaft by hand or with a wrench to prevent damage to the motor.
3. Always conduct a thorough checkout when installation is complete.

IMPORTANT: *Avoid sharp bends or kinks in the capillary tubing that reduce the efficiency of the controller. Carefully coil excess capillary tubing and place it directly beside the W859F. Assure that the capillary will not interfere with the operation of the damper linkage.*

NOTE: Before installing the economizer control package, make sure the Modutrol IV Motor and linkage are installed according to instructions packed with the devices.

LOCATION AND MOUNTING

W859F Case

Mount the W859F Economizer Control Package on top of any M91XX Modutrol IV Motor or M944, M945 Modutrol III Motor having an internal balance relay. The W859F mounts in place of the original wiring box cover. When planning the installation, allow enough clearance for maintenance and service. Include height allowance for the 203977A Adapter Bracket used with the Modutrol IV Motors.

The W859F is weatherproof when used with a weatherproof motor, 4074EUB Economizer Weather Kit and

weatherproof conduit fittings. It may be installed outdoors if the range of the ambient temperature is within the rating of the motor. The screw-on caps over the control adjustments must be in place to maintain the weatherproof characteristics of the package.

After the motor is mounted with the power supply wiring running to it, mount the W859F on the motor as follows:

1. Remove the four screws securing the original motor wiring box cover and remove the cover.
2. Mount the 203977A Adapter Bracket in place of the cover (Modutrol IV Motors only).
3. Hang the W859F on the top of the motor or on the bracket so that the minimum position potentiometer is closest to the power end of the motor (same end as the nameplate).
4. Make W859F wiring connections. (See Wiring and Optional Applications sections.)
5. When the wiring is completed, fit the W859F on top of the motor or bracket and secure with the four screws provided.

REMOTE SENSING ELEMENTS

Mixed Air Temperature Controller

NOTE: If the mixed air temperature controller has a bulb type element, install as outlined for outdoor air changeover control.

The proportional mixed air temperature controller has a 12 foot [3.7 meter] active averaging element at the end of 10 feet [3 meters] of capillary tubing. The element, which is mounted in the mixed air duct, must be supported so that it is distributed evenly across the entire height and width of the duct. It may be fastened to perforated strap iron as shown in Fig. 1 or mounted with clips (part no. 314439) as shown in Fig. 2.

A grommet (part no. 113665) is inserted into a hole on the duct wall. The required length of element is pushed through this grommet and fastened inside the duct.

Outside Air Changeover Controller (W859F1005)

The outside air temperature is sensed by a remote bulb element at the end of five feet [1.5 meters] of capillary tubing. Locate the sensing bulb where duct air of average temperature can circulate freely around it. Avoid mounting the bulb close to hot pipes, cooling coils, and other places where temperatures are not representative of outdoor air.

Fig. 1—Averaging element mounted with perforated strap iron.

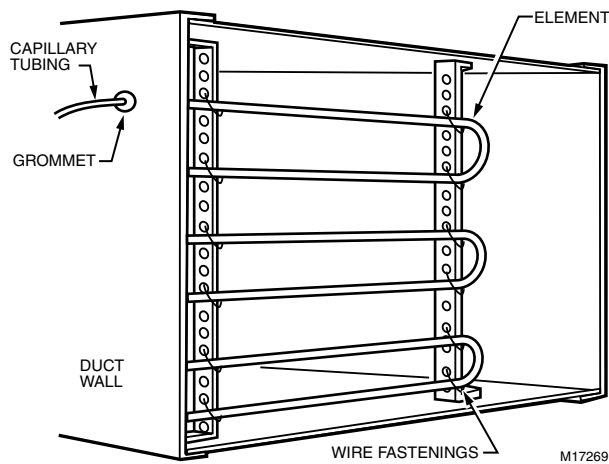


Fig. 2—Averaging element mounted with 314439 Clips.

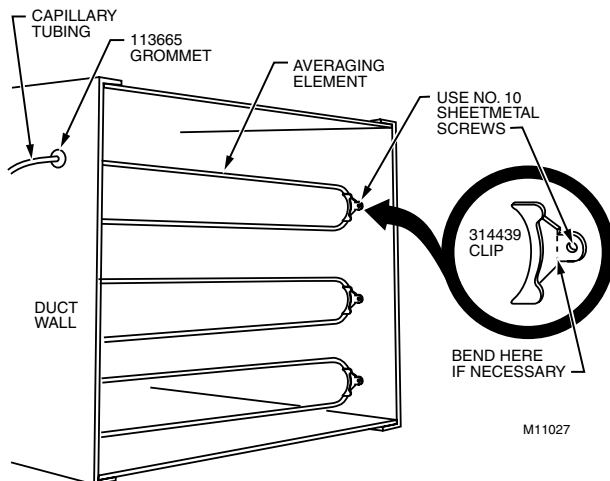
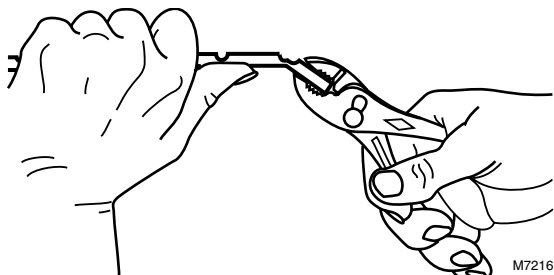


Fig. 3—Shortening the bulb holder.



To support the bulb in the duct, use part number 107324A Accessory Bulb Holder. Proceed with the installation as follows:

1. Drill a 3/4 in [19 mm] hole in the duct wall to admit the sensing bulb and the holder (Fig. 5).
2. Using the holder as a template, mark and drill holes for the bulb holder mounting screws (Fig. 5).
3. Break off the bulb holder to the desired length (Fig. 3).

NOTE: Make holder long enough to hold sensing bulb in freely circulating air, away from the duct wall.

4. Place capillary tubing in bulb holder channel, and pinch top edges of holder together at each segment, as shown in Fig. 4.
5. Insert bulb and holder into controlled area through hole, as shown in Fig. 5.
6. Fasten bulb holder to duct wall using screws furnished, as shown in Fig. 5.

Fig. 4—Inserting capillary tubing in bulb holder.

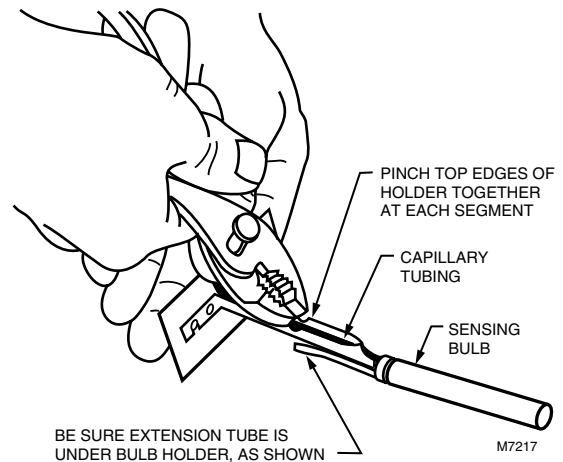
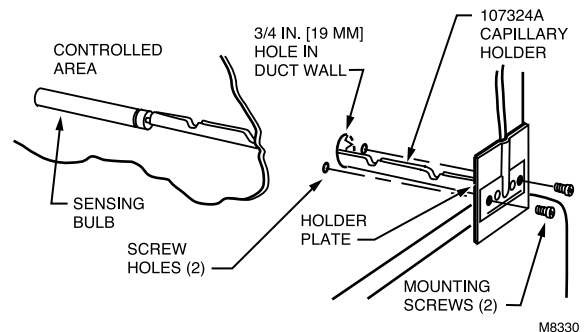


Fig. 5—Inserting sensing bulb and holder into duct.



WIRING

All wiring must comply with applicable local codes, ordinances, and regulations. The voltage and frequency of the power supply must match that marked on the Modutrol Motor. If a Modutrol Motor with multitap transformer is used, select leads to match the power supply. W859F

Economizer Control Packages are rated at 24-volts and have no power supply leads.

Internal schematics are shown in Figs. 6 and 7. On some W859F models, extra leadwires are provided for system options. If no optional applications are used, let the leads remain connected as shipped.

Fig. 6—W859F1013,1021 internal schematic and connections to Modutrol IV Motor and H205A/H705A Enthalpy Controller. See Fig. 19 for totally integrated economizer system.

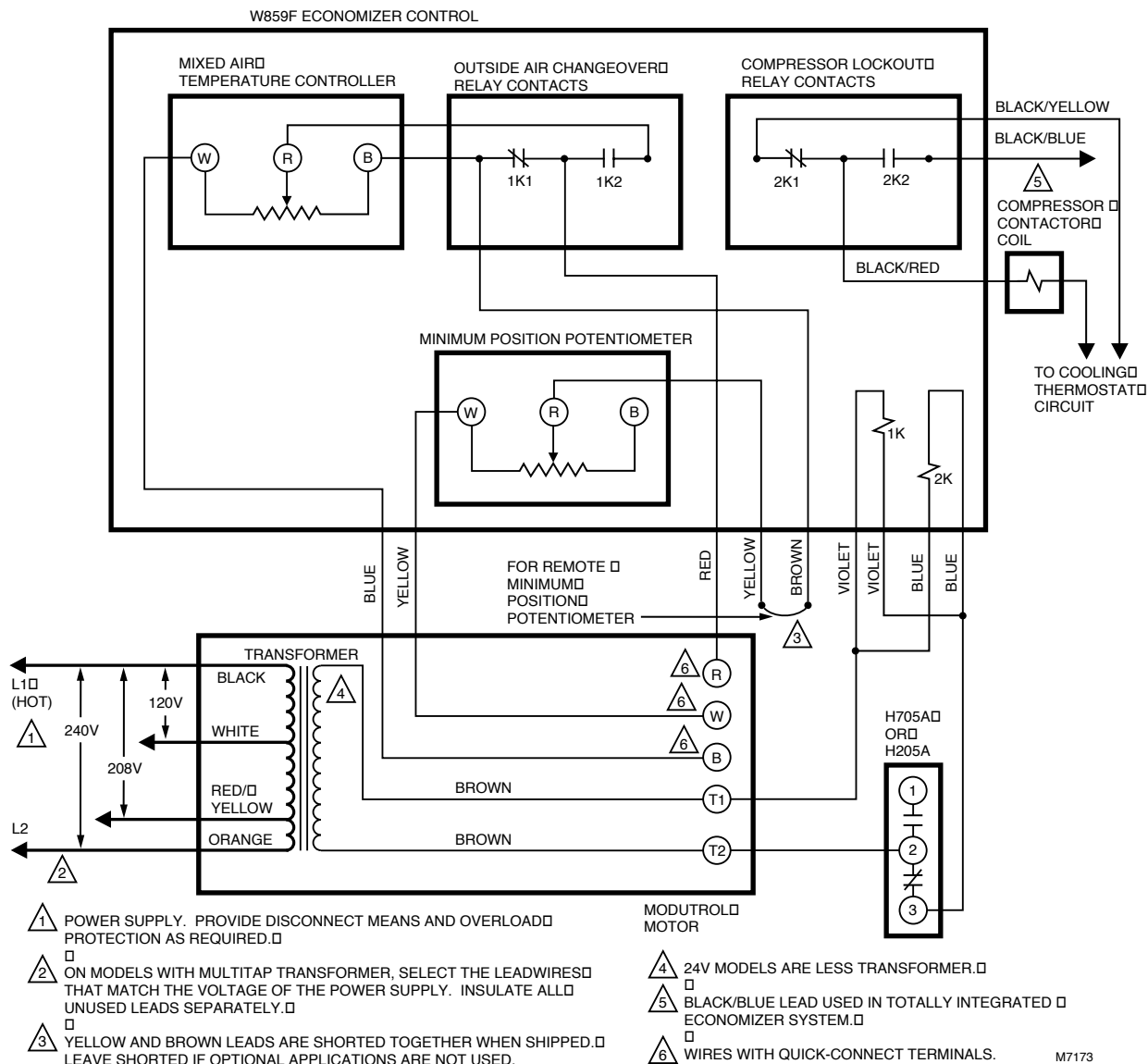
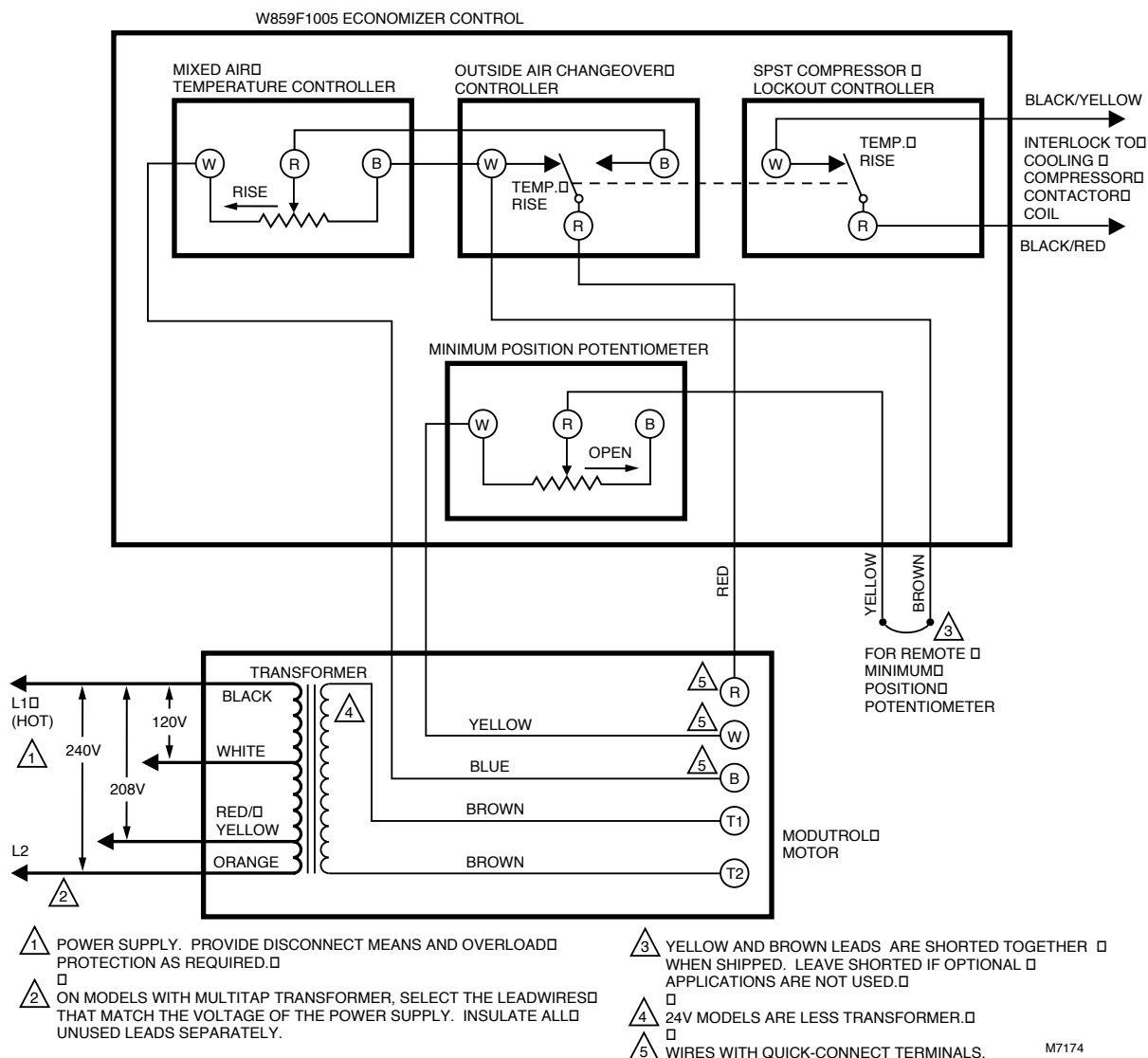


Fig. 7—W859F1005 internal schematic and Modutrol IV Motor connections.



Optional Applications

Refer to Figs. 6 and 7 for internal circuits and connections to Modutrol IV Motors. The wiring diagrams in the following descriptions show only the leadwires and connections to external accessories.

VENTILATION SYSTEMS

Remote Minimum Position Control

Remote control of the outdoor air dampers is desirable where temporary additional ventilation may be required, such as in cocktail lounges, conference rooms, stores, and

factories. The potentiometer in the W859F controls the minimum position of the dampers. The addition of a remote manual potentiometer, such as the S963 or Q209F, allows the occupants to open the damper beyond the minimum position for additional ventilation. Connect the potentiometer as shown in Fig. 8 for the W859F1005, and as shown in Fig. 9 for the W859F1013 and 1021.

Fig. 8—Adding a remote minimum position potentiometer to the W859F1005.

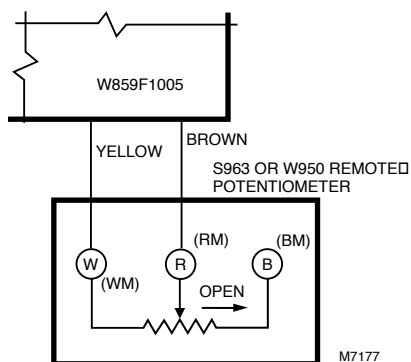
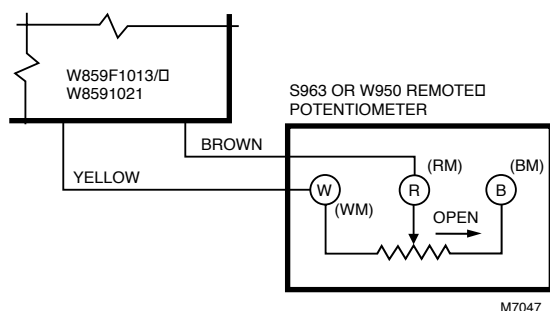


Fig. 9—Adding a remote minimum position potentiometer to the W859F1013,1021.



When complete control of the damper position is desired from the remote manual potentiometer, turn the potentiometer on the W859F to the fully closed position.

If outdoor air is necessary to satisfy code requirements, set the potentiometer in the W859F to the required minimum position. The remote potentiometer can still operate the outdoor dampers beyond the minimum position.

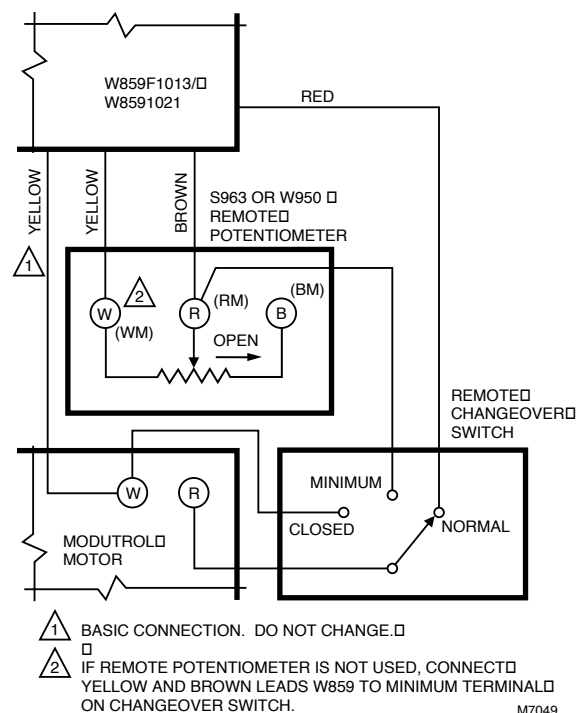
Minimum Outdoor Air During Heating

Considerable fuel savings can be realized during the heating season by restricting the outdoor air added to the system to the minimum required for ventilation. This is done by closing the outdoor air dampers to the minimum position when the system is in the heating mode or when outdoor temperature is low enough for the building to require heat.

Manual Changeover Switch

A remote changeover switch may be used on the W859F1013 or W859F1021 Economizer Control Package to bypass the outside air changeover controller in order to move the outside air dampers to minimum position or to close them completely. Wire a single pole, triple throw

Fig. 10—Adding manual remote changeover switch to W859F1013 or W859F1021. Spdt switch may be used if night setback is not required.



switch as shown in Fig. 10. If the remote minimum position potentiometer is not used, wire the yellow and brown leadwires to the minimum terminal of the switch.

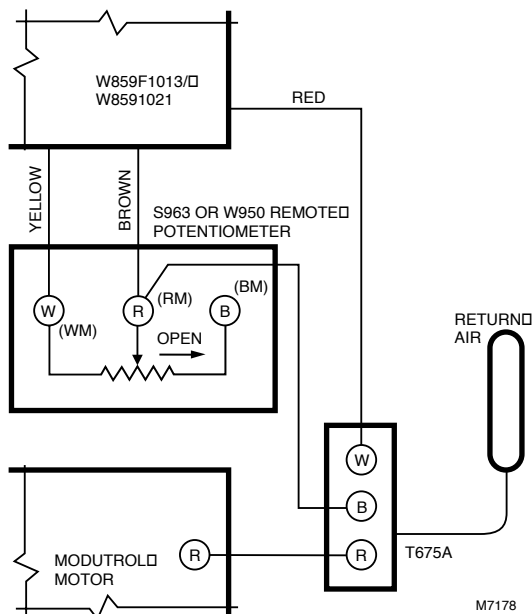
When the outdoor temperature drops and heating is required, place the switch in the minimum position. The outdoor air dampers are then driven to the minimum position set on the W859F potentiometer (or the remote potentiometer, if used).

When the switch is moved to the CLOSED position, the motor drives the outdoor air damper to the fully closed position. This provides additional fuel economy during periods the building is unoccupied and ventilation air is not required.

Automatic Changeover Thermostat

For automatic changeover control on W859F1013 or W859F1021, wire T675A Thermostat as shown in Fig. 11. If a remote minimum position potentiometer is not used, leave the yellow and brown leadwires connected together and connect them to the B terminal of the thermostat. Locate the sensing bulb element of the thermostat to sense outdoor air temperature.

Fig. 11—Adding automatic remote changeover thermostat to W859F1013, W859F1021. See Fig. 15 or 16 for adding night setback when changeover thermostat is used.



Adjust the setpoint of the thermostat to a temperature at which heating would normally be required; this would be 40° F to 50° F [5° C to 13° C] depending on climate and type of building. When the outdoor air temperature falls below the setpoint, the T675A Thermostat drives the outdoor air dampers to the minimum position set on the W859F potentiometer (or the remote potentiometer, if used).

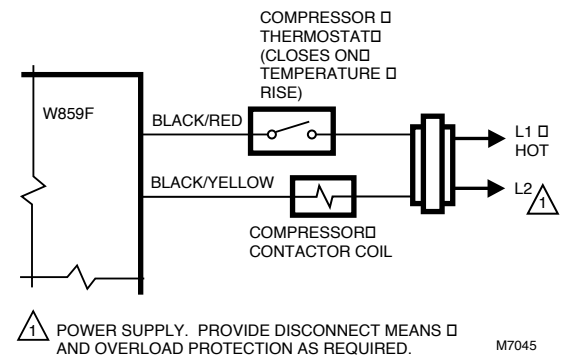
AIR CONDITIONING SYSTEMS

Compressor Lockout

On cool days and during intermediate seasons, the air conditioning compressor may be locked out until the outdoor temperature rises above the changeover controller setpoint. This feature is required to help protect some compressors during light load conditions—in mild weather. It also reduces unnecessary compressor operation and extends equipment life, thus increasing air conditioning economy. The compressor lockout feature included in the W859F eliminates the possibility of conflicting setpoints, which can occur if individual lockout and changeover controls are used.

For compressor lockout on W859F1005, connect as shown in Fig. 12. When the outdoor air temperature rises to the changeover controller setpoint, the lockout switch will close and allow the compressor to start if mechanical cooling is required.

Fig. 12—Method of providing compressor lockout when W859F1005 is used.



On W859F1013/W859F1021, lockout is accomplished through the H205A or H705A Enthalpy Controller and the cooling thermostat. See Fig. 6. On these models, the economizer operates only when the enthalpy of the outdoor air is below the H205A/H705A setpoint and the thermostat is calling for cooling. Mechanical cooling is locked out during economizer operation. If the enthalpy of the outdoor air rises above the H205A/H705A setpoint, the economizer closes to minimum position and the cooling compressor operates when the thermostat calls for cooling. When wired as shown in Fig. 19, a second-stage cooling compressor will operate on a call from the second stage of the thermostat, if the outdoor air enthalpy is above the H205A/H705A setpoint.

Night Setback

Outdoor air is not required for ventilation when the building is unoccupied. Therefore, the W859F Economizer can be used to close the outdoor air dampers completely. This results in additional economy by preventing any cold outdoor air from being added to the system.

In buildings that are unoccupied at night, the heating system is usually switched to a night thermostat (a T6051, for example) that maintains the building space at a lower temperature to conserve fuel.

Manual Control

For manual control, wire an S547 switch as shown in Fig. 13. If an M91X5 Spring Return Modutrol IV Motor is used, the switch may be wired as shown in Fig. 14. Label the switch DAY-NIGHT or OCCUPIED-UNOCCUPIED. The switch is closed in the DAY or OCCUPIED position. At the end of the day, place the switch in the NIGHT or UNOCCUPIED position. The motor will drive the outdoor air damper closed. If wired as shown in Fig. 14, the motor will be de-energized; spring return will drive the outdoor air damper closed. In the morning, place the switch in the DAY or OCCUPIED position to energize the motor and allow the outdoor air damper to open.

The manual changeover switch shown in Fig. 10 also provides night setback when W859F1013 or W859F1021 is used.

Fig. 13—Using a low voltage manual spst switch to provide night setback.

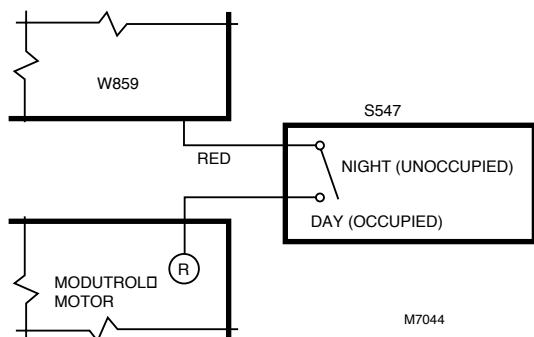
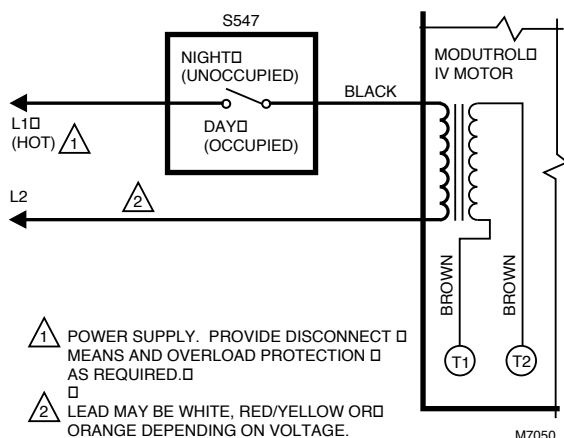


Fig. 14—A line voltage manual spst switch may be used to provide night setback when the M91X5 Spring Return Modutrol IV Motor is used.



Automatic Control

For automatic night setback, connect the normally closed contacts of a time clock (such as the S659) as shown in Fig. 15 (low voltage wiring) or Fig. 16 (line voltage wiring—requires M91X5 Spring Return Motor). When the timer contacts open, the motor will drive the outdoor air damper to the closed position. If wired as shown in Fig. 16, the motor will be de-energized; spring return will drive the outdoor air damper closed.

Morning Warm-up

Morning warm-up is used in conjunction with automatic night setback to provide added fuel economy. It is intended to raise space temperature to occupied conditions as soon as possible with minimal fuel.

Fig. 15—Using a time clock in the low voltage motor control circuit to provide automatic night setback.

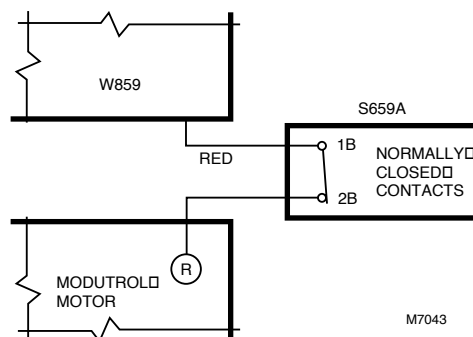
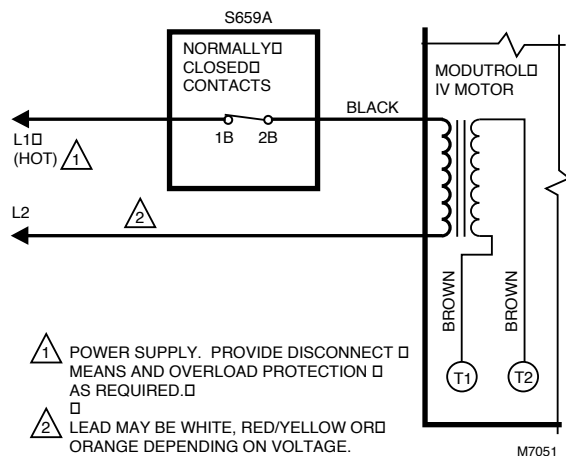


Fig. 16—A line voltage time clock may be used to provide night setback when the M91X5 Spring Return Motor is used.



When night setback is used, the nighttime space temperature is controlled at about 60° F [16° C]. In the morning, a timer switches from the night thermostat to the normal space thermostat to raise the space temperature to the daytime setting. Without the morning warm-up feature, the damper motor is energized to admit outdoor air. The addition of outdoor air during the warm-up period slows the process and uses extra fuel.

With the W859F, a warm-up thermostat can be added to keep the outdoor air dampers closed until the return air temperature reaches its setpoint 68° F to 70° F [20° C to 21° C]. This allows the building to warm up before any outdoor air is brought in.

Wire a T675A as shown in Fig. 17 (low voltage wiring) or Fig. 18 (line voltage wiring—requires M91X5 Spring Return Motor). Locate the controller sensing bulb in the return air duct.

Fig. 17—Adding a T675A in the low voltage motor control circuit to provide morning warm-up in conjunction with automatic night setback.

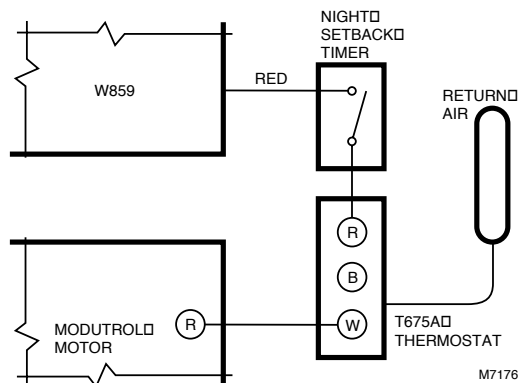
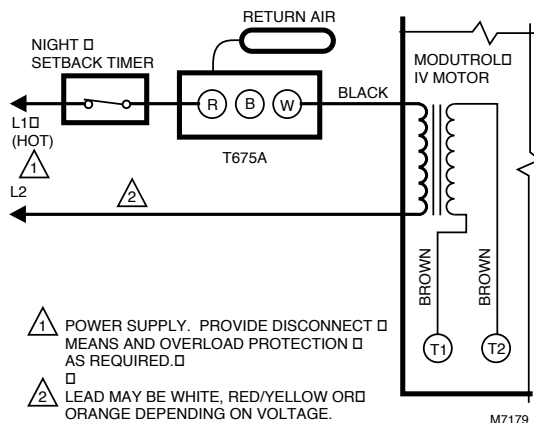


Fig. 18—Adding a T675A in the power supply line to the W859F to provide morning warm-up in conjunction with automatic night setback.



Adjust the setpoint of the warm-up thermostat (68° F to 70° F [20° C to 21° C]) to keep the outdoor air damper closed while the building is warming up from the night setback temperature. When the return air temperature exceeds the setpoint of the thermostat, the economizer system is energized and the outdoor air damper can open. It is not necessary to bypass this feature during cooling because the return air temperature is higher than the setting of the thermostat.

TOTALLY INTEGRATED ECONOMIZER SYSTEM

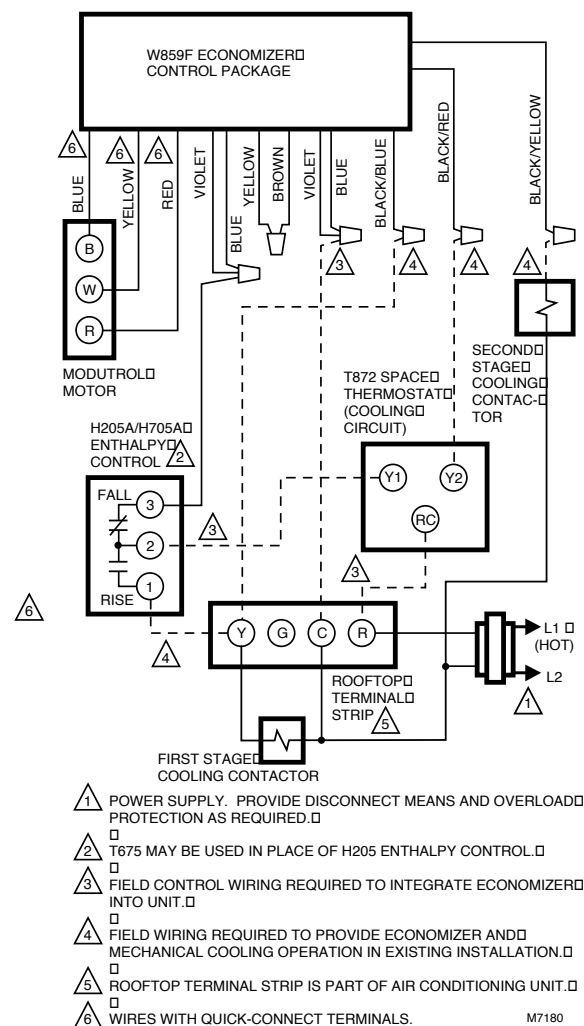
Maximum operating economy with minimum equipment expenditure can be realized by operating the W859F economizer system in response to a signal from the cooling thermostat. The changeover controller in this system is a remote-mounted H205A or H705A Enthalpy Controller. It responds to both dry bulb temperature and humidity, allowing the use of outdoor air at a higher temperature for free cooling when the humidity is low.

When wired as shown in Fig. 19, the economizer functions as a true first stage of cooling and provides maximum fuel economy during the heating cycle. The economizer is automatically locked out during heating. During the cooling cycle, the system operates as follows.

When the enthalpy of the outdoor air is below setpoint, the H205A/H705A is made through terminals 2 and 3. On a call for cooling by the space thermostat, the 1K and 2K relays in the W859F are energized, contacts 1K1 and 2K1 open, and 1K2 and 2K2 close. The outdoor air damper is modulated by the mixed air temperature controller. During economizer operation, the mechanical cooling is operated by stage 2 cooling on the space thermostat. See Fig. 19.

When the enthalpy of the outdoor air is above the H205A/H705A setpoint, terminals 2 and 3 break and relays 1K and 2K drop out. The outdoor air damper closes to its minimum position. If the space thermostat is calling for cooling, the compressor starts.

Fig. 19—W859F enthalpy economizer system connected to function as a true first stage of cooling.



Settings and Adjustments

NOTE: To adjust settings, remove the protective screw-on cap and use a screwdriver to turn the inner dial to the desired setting. Be sure to replace the screw-on caps to maintain weatherproof characteristics.

Proportional Mixed Air Temperature Controller

The proportional mixed air temperature controller, labeled MIXED AIR, is set to maintain a mixed air temperature that is satisfactory for cooling the building. See Table 1 for recommended settings.

TABLE 1—RECOMMENDED SETTINGS^a ON W859F FOR MAXIMUM ECONOMY.

Region	Mixed Air		OA Changeover	
	° F	° C	° F	° C
Southeast	60° F	16° C	70° F	21° C
South-Central	60° F	16° C	70° F	21° C
Southwest	55° F	13° C	70° F	21° C
West	55° F	13° C	70° F	21° C
North-Central	55° F	13° C	70° F	21° C
Northeast	55° F	13° C	70° F	21° C

^a These settings apply for most applications.

Outside Air Changeover Controller

When the temperature rises above its setpoint, the outside air changeover controller in the W859F1005, labeled O.A. CHANGEOVER, is set to return the outside air dampers to the minimum position. The compressor lock-out switch simultaneously allows the air conditioning compressor to take over the cooling of the building. See Table 1 for recommended settings.

The changeover function in the W859F1013/W859F1021 is controlled by the H205A/H705A Enthalpy Controller. Refer to instructions for the H205A/H705A to determine the correct enthalpy controller settings for various areas of the country.

Accessory Controllers

Suggested settings for accessory controllers are indicated in the descriptions of optional applications where they are used.

Minimum Position Potentiometer

The minimum position potentiometer keeps the outdoor air damper from closing completely during system operation to provide ventilation air. To adjust the minimum position potentiometer, set the outdoor air changeover controller below the outside temperature. The outdoor air damper will close to minimum position.

Remove the black protective screw-on cap from the shaft of the potentiometer. Using a screwdriver, adjust the potentiometer to provide the desired minimum position of the outside air dampers. A typical setting allows 10 to 25 percent outside air.

ENERGY MANAGEMENT ECONOMIZER SYSTEM INSTALLATION SPECIFICATIONS

1. Each air condition unit shall include an Energy Management Economizer System consisting of the basic controls listed in Table 2.

TABLE 2—BASIC CONTROLS.

Electromechanical			
Space Thermostat	Damper Motor	Changeover Control	Logic Panel
T872 ^a	M91X5	H205A/H705A	
T872 ^a	W899G	H205A/H705A	
Solid State			
T7047	M71X5	H205A/H705A	W945
T7047	M71X5	H205A/H705A	W936

^a Two stage cooling thermostat.

2. The controls in Table 2 shall operate a Honeywell D640 (see Fig. 20) or equivalent low leakage damper (leakage not to exceed three percent). The dampers shall be linked so the outdoor damper closes tightly when the return damper is fully open. The return air damper shall close tightly when the outdoor air damper is open. The outdoor damper shall open 45 to 50 angular degrees as the spring return motor operates through full stroke (open).

3. The minimum position of the outdoor air dampers shall be adjusted to allow the minimum amount of fresh air, as required by local codes, to enter the building. (Use the procedure outlined below to make the adjustment.)

Fig. 20—Use a low leakage damper such as the D640 with leakage not exceeding three percent.



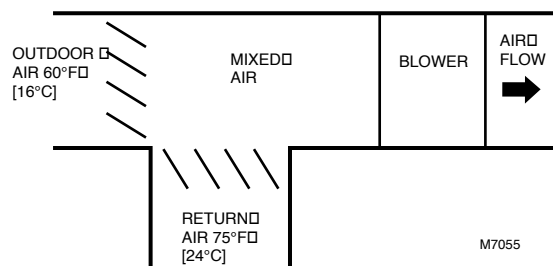
NOTE: This adjustment can be made only when there is at least a 10° F [6° C] temperature difference between outdoor air and return air. The following sample calculation is made using only Fahrenheit temperature.

EXAMPLE: Assume local codes require 10 percent outdoor air during occupied conditions, outdoor air is 60° F and return air is 75° F. See Fig. 21. Under these conditions, what is the temperature of the mixed air when 10 percent outdoor air is allowed to enter the building?

$$\begin{aligned} 10 \text{ percent Outdoor Air (OA)} &= 0.1 \times 60^\circ \text{ F} \\ (\text{OA temperature}) &= 6.0^\circ \text{ F} \\ 90 \text{ percent Return Air (RA)} &= 0.9 \times 75^\circ \text{ F} = \underline{67.5^\circ \text{ F}} \\ &73.5^\circ \text{ F} \end{aligned}$$

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.

Fig. 21—Adjust minimum position of the outdoor air damper.



Adjust the minimum position potentiometer until the mixed air temperature, as calculated above [73.5° F], is reached. Take care to assure the thermometer is sensing air that is well mixed.

NOTE: A quality thermometer capable of reading to 0.5° F [0.25° C] must be used. When minimum position adjustments are being made with electromechanical systems, turn the mixed air controller to the highest setting.

4. With the outdoor air damper fully open, the blower and/or fans shall be capable of bringing in 100 percent outdoor air. A powered exhaust system or barometric dampers may be necessary to relieve positive pressure in the building.

5. The economizer must contain an H205A/H705A Enthalpy Changeover Control to sense temperature and humidity of outdoor air. The H205A/H705A shall be set

between the A and B setpoints.

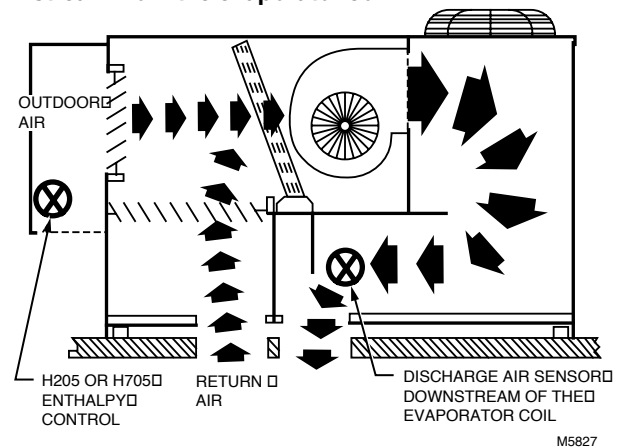
6. The air conditioning unit shall be equipped with an S659 Timer that locks out mechanical cooling and blower operation during unoccupied conditions.

For additional savings in the heating season, the timer shall energize a night setback thermostat or circuit and operate the blower only during a call for heat.

A morning warm-up thermostat can also be installed in the return air to keep the outdoor air dampers closed during the warm-up period after night shutdown.

7. The mixed air sensor setting shall be between 58° F and 60° F [15° C and 16° C]. For optimum control, the mixed air sensor shall be mounted downstream from the evaporator coil. See Fig. 22.

Fig. 22—Place the mixed air sensor downstream from the evaporator coil.



8. The air conditioning unit, equipped with the W859F/H205A/H705A, shall include a two-stage cooling T872 Thermostat. The thermostat shall be set at 68° F [20° C] in winter and no lower than 75° F [24° C] in summer. An air conditioning unit with a single compressor will operate the economizer or the compressor (depending on outdoor air conditions) from the Y1 contacts as the first stage of cooling. The Y2 contacts (second stage cooling) bypass the changeover control and operate the mechanical cooling.

An air-conditioning unit with two compressors will operate the economizer or compressor number 1 from the Y1 contacts. That is, when Y1 contacts call for cooling, the economizer cycle will operate if outdoor air is available for free cooling. If Y1 contacts call for cooling and outdoor air is not suitable for cooling, compressor number 1 will operate. The Y2 contacts will operate the second compressor as the second stage of cooling.

Operation and Checkout

SYSTEM DESCRIPTION AND BASIC OPERATION

A typical commercial air conditioning system is shown in Fig. 23. The economizer package is the set of dampers, economizer control and actuator, and outdoor air hood shown on the upper left side. The thermostat is located in the space to be controlled and the numbered boxes represent alternate control sensor locations.

The economizer provides its greatest benefit during the portion of the year when cooling is required and the outside air is cool and dry enough to provide cooling. At other times, the economizer provides minimum outside air (ventilation) requirements. As building design has improved, the amount of outside air entering the building is reduced (cutting heat loss to and heat gain from the outside environment), increasing concern over the health of the building occupants. As a result, many building codes now include a requirement that a minimum amount of outside air be introduced into the building when the building is occupied. In recent years, the ventilation problem, known as the “sick building syndrome,” has gained widespread visibility. To prevent this, the amount of undesirable airborne elements in the building is decreased by introducing additional outside air using the outside air damper. At times, an air-to-air heat exchanger is installed in the outdoor air intake. This air-to-air heat exchanger is used to reduce energy costs required to condition the ventilating air. In addition, the air-to-air heat exchanger can reduce the heating costs during the heating season by warming colder air brought into the building for ventilation.

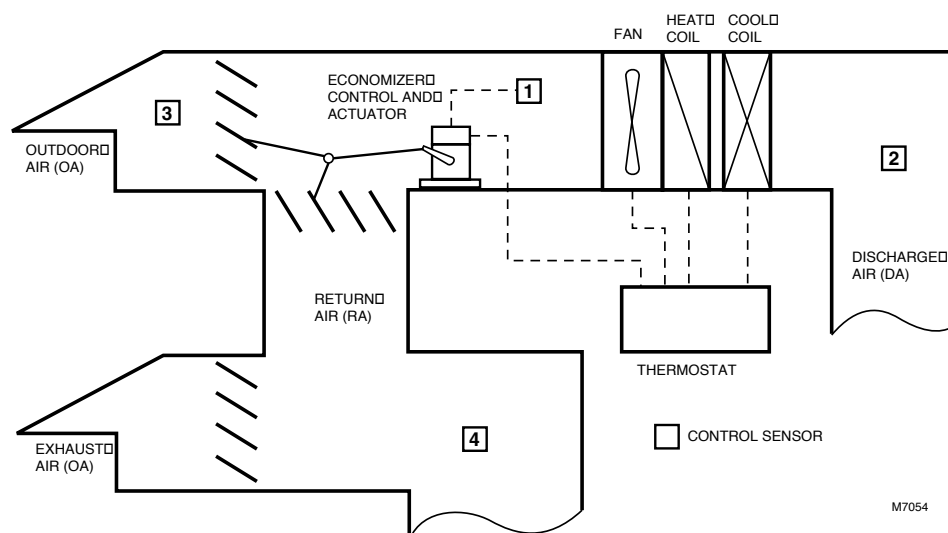
The economizer cycle closes the outside air damper when no air is required, opens to minimum position when ventilation is desired, and modulates the outdoor air damper when there is a call for cooling and outdoor air is suitable for *free* cooling.

During the unoccupied time, the economizer is not powered and the actuator, usually a spring return type, returns the outside damper to the fully closed position. At the same time, the return air damper is opened to the fully open position, allowing the air to circulate. In the case of an economizer control integrated into a control package, spring return on loss of power might be replaced with a signal to close, which is a control signal that closes the damper by running the motor to the fully closed position.

During the occupied time, the economizer is powered and the actuator opens the outside air damper to the minimum position set in the economizer control package. The provision for outside air, called *minimum outside air*, is controlled in an economizer by the minimum position potentiometer. Be sure to follow the local ordinances regarding minimum outside air.

Remaining in the occupied mode, but with a call for heat, no change in outdoor air damper position occurs. If the damper were to open while the air is being mechanically heated, the end result would be an increase in energy cost to provide heated air to the controlled space. On a call for cooling, the economizer control package decides whether to use outside air for *free* cooling, or to run the mechanical cooling (compressor) to maintain the required temperature in the building. This decision is made by an enthalpy sensor or enthalpy control. The typical location for such an outdoor enthalpy sensor is sensor 3; see Fig. 23. If differential enthalpy is used, the return air enthalpy sensor is positioned as sensor 4; see Fig. 23. If outside air is chosen, the actuator is allowed to modulate based on sensor input, either from a mixed air temperature sensor (sensor 1, Fig. 23) or a discharge air temperature sensor (sensor 2, Fig. 23).

Fig. 23—Typical air conditioning system and economizer package block diagram.



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W859F Operation Example

See the block diagram operation of the economizer (Fig. 23) for the operation of the economizer control itself. Fig. 24 is a schematic for a representative W859F Economizer System. Note the addition of the cooling compressor contactors and the thermostat. Heating control is not shown because operation is limited to minimum position when in the heating mode.

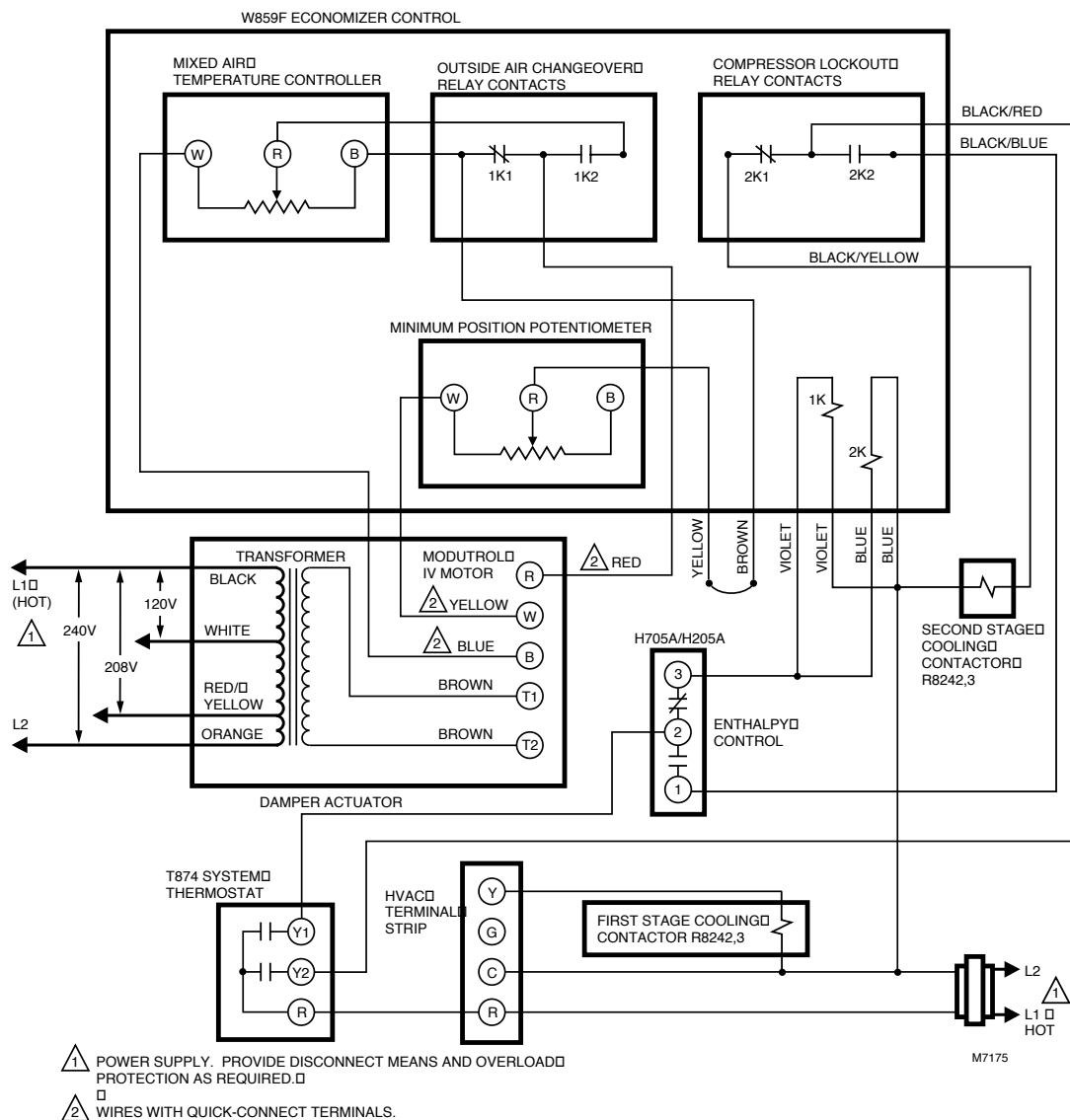
All the elements discussed in the System Description and Basic Operation can be identified in Fig. 24. The damper actuator shown is a Series 90 Modutrol IV Motor. The changeover control is an H205A or H705A, normally located at Sensor 3 in Fig. 23. The transformer, minimum position potentiometer and mixed air temperature controller are labeled and located in the W859F. Relays 1K and 2K and the contacts for changeover and compressor lockout

are also located in the W859F. The W859F is mounted on top of the wiring box of the Modutrol IV Motor. The system thermostat shown in Fig. 24 is a two stage cool thermostat, labeled T874, and is located in the controlled space. This thermostat was chosen for ease of description. The transformer located in the lower right side of Fig. 24 and the 1st Stage and 2nd Stage Cooling Contactors are located in the rooftop equipment, not inside the W859F or Modutrol IV Motor.

UNOCCUPIED MODE

During the time period when the space is occupied, the transformer in the upper left side of Fig. 24 is powered. During the time period when the space is not occupied, the transformer is not powered. When the transformer is not powered, the motor will spring return closed, causing the

Fig. 24—Typical W859F Economizer wiring diagram.



outside air damper to close. The control of power to this transformer may be obtained via a time clock, a manual switch, or a switch built into the thermostat or main controller. In each case, the objective is to close the outside air damper when the space is not occupied.

OCCUPIED MODE

When power is applied to the transformer, the Modutrol IV Motor will open to the minimum position set on the Minimum Position Potentiometer. This assumes the thermostat is not calling for cooling, the contacts are in the position shown in Fig. 24, and the Minimum Position Potentiometer is set for the correct outside air requirement.

When System Thermostat contact Y1 closes on a call for stage 1 cooling, the circuit to energize relays 1K and 2K is completed through terminals 2 and 3 of H205A/H705A. This causes contacts 1K1 to open and 1K2 to close and the motor modulates the damper in response to the Mixed Air Temperature Controller. At the same time, contact 2K1 opens and contact 2K2 closes, locking out the second stage cooling contactor. The first stage cooling contactor is now enabled. Y2 contacts will close when the outside air is insufficient to cool the space. This second stage call is routed to the first stage of mechanical cooling via contact 2K2 in the economizer.

If the outdoor enthalpy is not acceptable for *free* cooling, the contacts in the H205A/H705A close between terminals 1 and 2, and open between terminals 2 and 3. In this case, a Y1 call for cooling at the T874 Thermostat will be directed to the first stage cooling contactor via the H205A/H705A (through shorted contacts 1 and 2). In addition, a Y2 call for cooling will be directed to the second stage cooling contactor via contact 2K1 in the economizer. This is due to the compressor lockout contacts 2K1 remaining closed when relay coils 1K and 2K are not powered.

Heating operation is not shown, but assumes the economizer is powered during the occupied period and not powered during the unoccupied period. This keeps the outdoor air open to minimum position as required by the minimum position potentiometer.

OPERATION

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

When the outside air temperature (W859F1005) or enthalpy (W859F1013 or W859F1021) is below the control setpoint, the outside air damper is modulated by the mixed air temperature controller. The return and outside air dampers are adjusted to maintain mixed air temperature controller setpoint.

When the outside air temperature (W859F1005) or enthalpy (W859F1013 or W859F1021) rises above the setpoint, the changeover control is made to switch the mixed air temperature controller out of the circuit and close the damper to its minimum position. Simultaneously, on W859F1005, the compressor lockout switch is made to allow the compressor motor to operate.

The W859F1013 or W859F1021 (wired as shown in Fig. 19) is energized by the space thermostat. The economizer will operate only on a call for cooling and, therefore, will be held at minimum position during heating. This enables the economizer to function as a true first stage of cooling and provide maximum fuel economy during the heating cycle.

CHECKOUT

When installation is complete, check the entire system for proper operation. The checkout procedure is intended to assure:

- The controls in the W859F operate properly.
- The motor operates properly.
- The dampers perform as intended without binding.
- The air conditioning system is locked out below changeover temperature.

NOTE: To adjust settings during checkout procedure, remove the protective screw-on caps. Use a screwdriver to turn the inner dials to the checkout settings.

With the system power on and the fan running, set the outside changeover control (W859F1005) below the outside air temperature. If the W859F1013 or W859F1021 is used, disconnect one lead from terminal 2 at the *enthalpy control*. Turn the minimum position potentiometer to fully open (fully clockwise) to run the motor to the 50 percent open position. Turn the minimum position potentiometer fully closed (fully counterclockwise); the damper should close completely. Check to make sure the air conditioner compressor can be turned on. Leave the minimum position potentiometer in this position and reconnect the wire on the W859F1013 or W859F1021.

Set the outside air changeover control (W859F1005) above the outside air temperature. If *the W859F1013 or W859F1021 is used, jumper terminals 2 and 3 on the H205A/H705A*. Adjust the proportional mixed air temperature controller to the low end of its range. The outside air dampers should open and the return air dampers should close. Adjust the mixed air controller to the high end of its range. The outside air dampers should close and the return air dampers should open. At the same time, make sure the compressor is locked out of the system. *Remove the H205A/H705A jumper.*

Before leaving the installation, be sure to return all controls to the recommended settings. Replace screw-on caps to maintain weatherproof characteristics.

CALIBRATION

The W859F was carefully checked before leaving the factory and requires no further calibration.

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