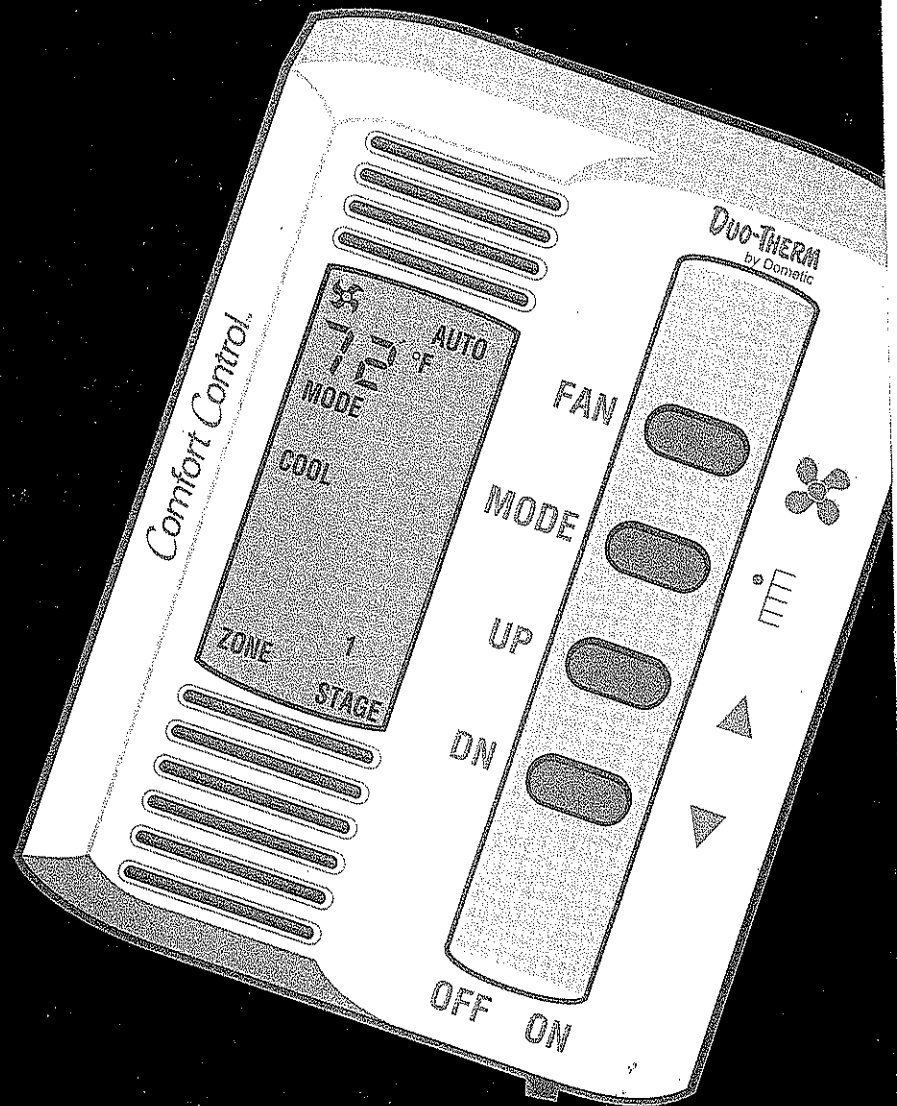


DUO-THERM® *Comfort Control*™



User's Guide

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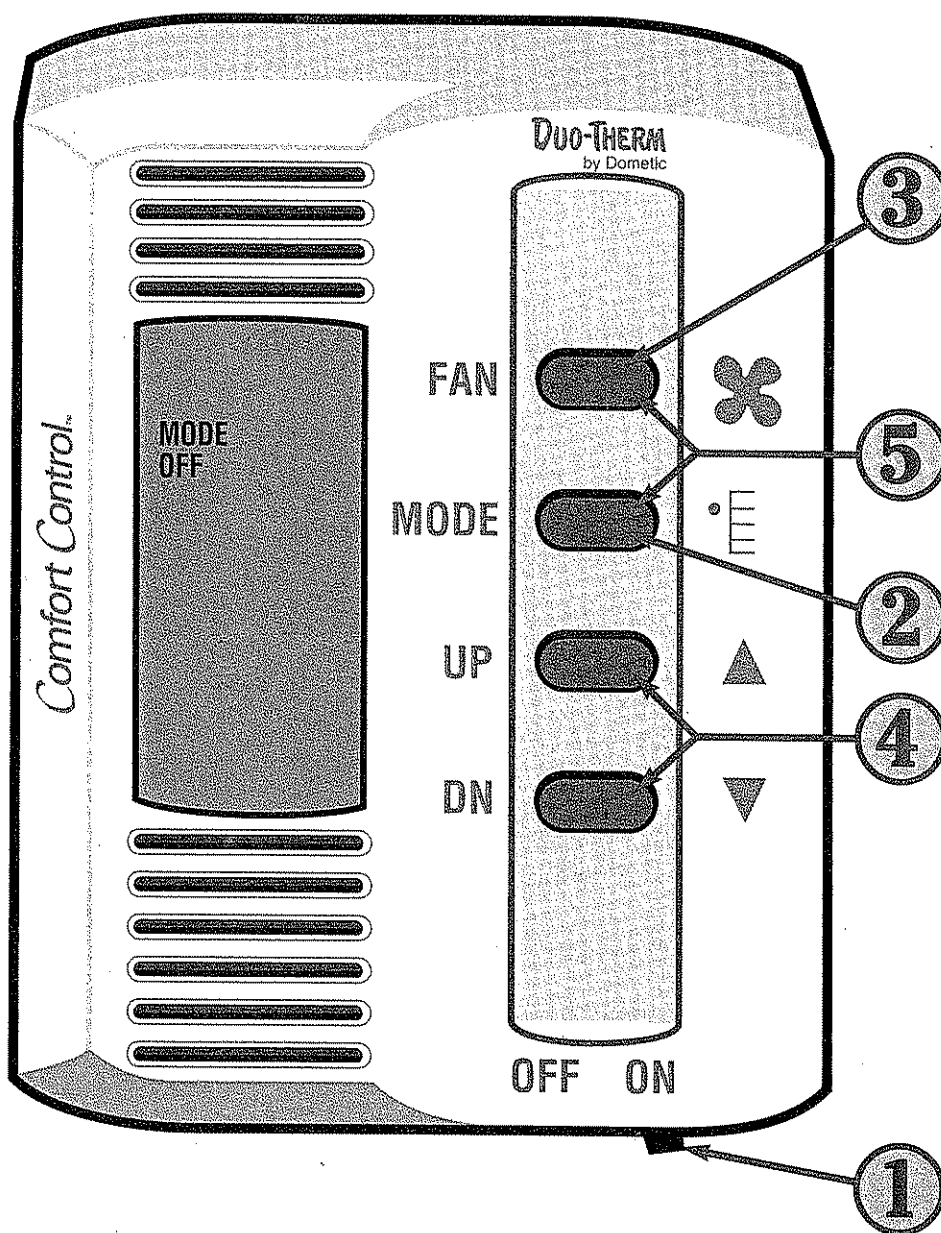
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STARTING THE COMFC

NOTE: The basic steps for normal operation of your Comfort Control system are covered in this User's Guide. If you encounter difficulty or want more information about your system, refer to the Operating Instructions manual.



PORT CONTROL SYSTEM

Step One: Move power switch to ON

Step Two: Press MODE button to select function. (COOL*, FURNACE, FAN ONLY, etc.)

Step Three: Press FAN button to select fan speed or automatic operation.

Step Four: Press UP or DN button to set your desired temperature for the zone

Step Five: If your vehicle contains more than one ZONE, depress FAN and MODE simultaneously to select zone 2, and repeat procedures from step 2 above. Repeat entire procedure for each additional zone.

Step Six: If your vehicle has 2 roof top air conditioners utilizing a 50 amp power cord, some restrictions may apply. When only 30 amps are available, you most likely will have to turn off one of the two air conditioners to prevent tripping the circuit breaker. Refer to Step Five, then Step Two, for shutting off the air conditioner in your selected zone.

* There is an approximate 2-minute time delay after selecting cooling function for refrigerant compressor to start.

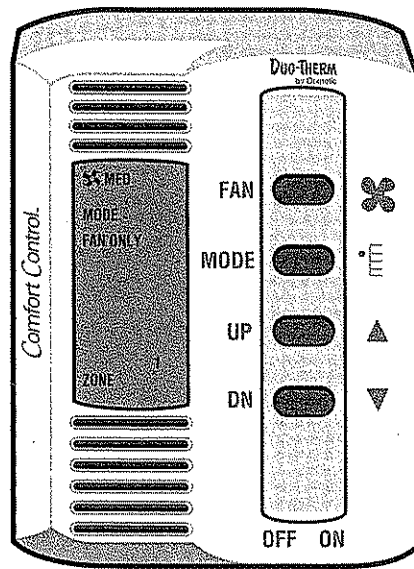
SHUTDOWN

If you turn the Comfort Control off, or if there is a power interruption for any reason, the system will resume operation on the last settings when power returns.

**SEE BACK PAGE FOR FAN ONLY
AND HEAT PUMP OPERATION**

Fan Only Mode of Operation

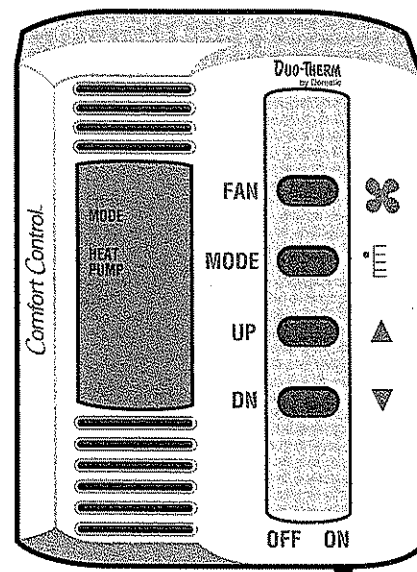
1. Place the power switch to ON by moving the lever to the right.
2. Depress and release the MODE button until FAN ONLY indicator is illuminated.
3. Depress and release the FAN push-button until desired speed (LOW, MED, HIGH, AUTO) is illuminated. If your vehicle is equipped with a heat pump or basement air conditioner system, your choice for fan speeds will be (LOW, HIGH, AUTO).
4. If your vehicle contains more than one zone, depress FAN & MODE simultaneously to select ZONE 2. Repeat the above procedure to set each zone.



Heat Pump Operation

To set heating temperatures for vehicles equipped with Duo-Therm basement or rooftop Heat Pumps:

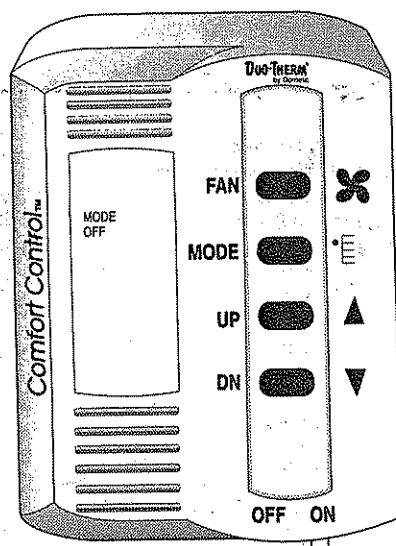
1. Press the MODE button until HEAT PUMP appears on the LCD display.
2. Press the FAN button to select the desired speed or AUTO.
3. Press the UP or DN button until the desired temperature is displayed. The compressor will start in approximately 2 minutes to begin the heating process.
4. If your vehicle has more than one zone, press FAN and MODE buttons simultaneously to select ZONE 2. Repeat the above procedure to set each zone.



For more information, refer to the Operating Instructions.

DUO-THERM®
by Dometic

COMFORT CONTROL CENTER™ Part No. 3106463.007



This Comfort Control Center will provide your cooling and heating requirements regardless of your vehicle size.

OPERATING INSTRUCTIONS

**Comfort
Control Center™**
Part No. 3106463.007

USA
SERVICE OFFICE
The Dometic Corp.
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(219) 463-4858

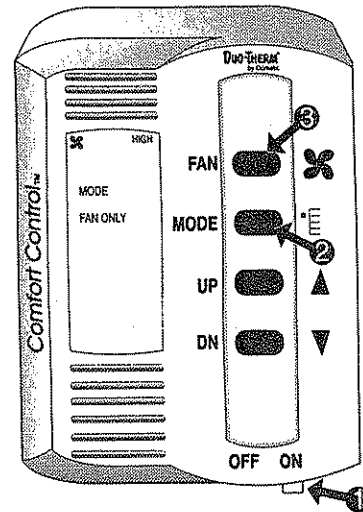
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OPERATING YOUR DUO-THERM COMFORT CONTROL CENTER

The Comfort Control Center allows you the freedom of controlling your vehicle's temperature to provide you with a comfortable environment to enjoy your life-style. With just a few simple steps, you can control which mode of operation you will use, the vehicle temperature and the fan speeds.

A. FAN ONLY MODE OF OPERATION

1. Begin by placing the power switch on the lower right hand edge of the Control Center on the **ON** position. To do this, simply move the lever to the right.
2. Momentarily depress and release the **MODE** push-button until the **FAN ONLY** indicator on the Liquid Crystal Display (LCD) is illuminated.
3. Momentarily depress and release the **FAN** push-button until the desired fan speed indicator (**LOW**, **MED**, **HIGH**, **AUTO**) is illuminated. If your vehicle is equipped with a heat pump or a dual basement air conditioning system, your selection choice will be **LOW**, **HIGH** or **AUTO**.
4. After approximately 5 seconds, the selected fan speed will come on. The **MODE** and **FAN** speed you have selected will remain shown in the LCD area of the Control Center until you change your selection.
5. If your vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from step two above. Repeat entire procedure for each additional zone.

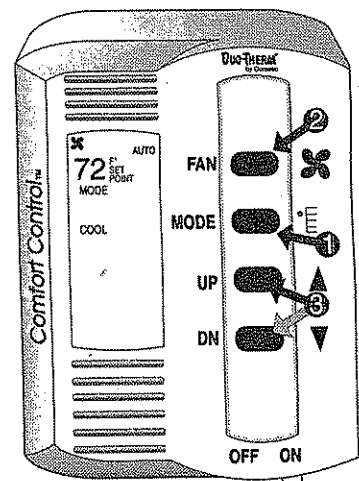


B. COOLING MODE OPERATION

(To set cooling temperatures and fan speeds on Duo-Therm Air Conditioners & the cooling mode of Duo-Therm Heat Pumps)

1. Momentarily depress and release the **MODE** push-button until the **COOL** indicator on the LCD is illuminated.
2. Depress and release the **FAN** push-button to select your desired fan speed.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. After a delay of approximately 2 minutes the air conditioner's compressor will come on and the cooling process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for cooling, the compressor will restart in approximately two minutes. At this point, the fan will either:
 - a. continue to operate in the single selected fan speed or,
 - b. cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.

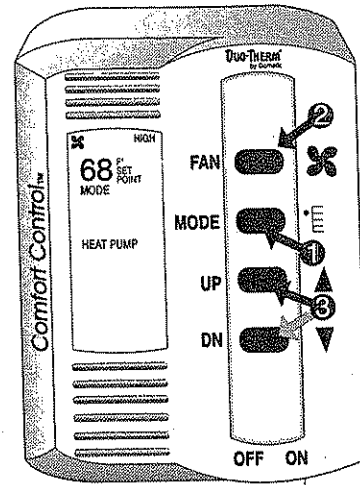
5. If your vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1. Repeat entire procedure for each additional zone.



C. HEAT PUMP OPERATION

(To set heating temperatures for vehicles equipped with a Duo-Therm rooftop or basement heat pump. To operate cooling mode with a heat pump, see "B. Cooling Mode Operation", Page 3.)

1. Momentarily depress and release the **MODE** push-button until the **HEAT PUMP** indicator on the LCD is illuminated.
2. If you have not previously set your fan speed, you may do so by depressing and releasing the **FAN** push-button to select.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. After a delay of approximately 2 minutes the heat pump's compressor will come on and the heating process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for heating, the compressor will restart in approximately two minutes. At this point, the fan will either:
 - a. continue to operate in the single selected fan speed or,
 - b. cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.
5. If your vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



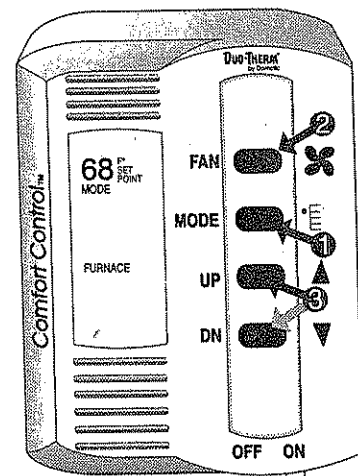
NOTE:

See Page 7, Items F & G for additional Special Heat Pump Features.

D. FURNACE MODE OPERATION

(If your vehicle is equipped with a gas furnace connected to the Comfort Control Center)

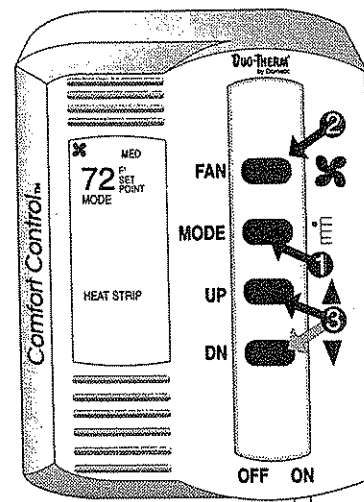
1. Momentarily depress and release the **MODE** push-button until the **FURNACE** indicator on the LCD is illuminated.
2. The A/C fan does not operate in the **FURNACE** mode.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. Your Duo-Therm air conditioning system will not operate when the Comfort Control System is in the **FURNACE** mode. For cooling, change the **MODE** to **COOL**.
5. If your vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



E. HEAT STRIP MODE OPERATION

(For Duo-Therm air conditioners with an electric heat strip)

1. Momentarily depress and release the **MODE** push-button until the **HEAT STRIP** indicator on the LCD is illuminated.
2. The fan will operate in **LOW**, **MED** or **AUTO**. You will not be able to select **HIGH** speed when in the **HEAT STRIP** mode. Depress and release the **FAN** push-button to select desired speed.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. The electric heat strip will cycle **ON** and **OFF** per the temperature **SET-POINT** displayed. The fan will either:
 - a. continue to operate in the selected fan speed or,
 - b. cycle **OFF** and **ON** with the heat strip if the **AUTO** fan speed has been selected.
5. If your vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



COMFORT CONTROL CENTER SPECIAL CONTROL FEATURES

A. AUTO FAN

When **AUTO FAN** is selected, the fan speed will be determined by the mode you are in.

1. **COOL MODE** – In the **COOL** mode, which is the air conditioning mode, the fan will automatically select the speed depending upon the difference between the temperature **SET-POINT** and the room temperature.

When that difference is:

8° or more	The fan will operate on HIGH
4° to 8°	The fan will operate on MED
4° or below	The fan will operate on LOW

2. **COOL OR HEAT PUMP MODE** – If your vehicle is equipped with a Duo-Therm Heat Pump or Dual Basement Air Conditioner, the fan will automatically select the fan speed depending upon the difference between the temperature **SET-POINT** and the room temperature.

When the difference is:

Greater than 4°	– The fan operates on HIGH
4° or less	– The fan operates on LOW

3. **HEAT STRIP MODE** – When **HEAT STRIP** mode is selected, the fan will automatically run in the **LOW** speed.

4. **FAN ONLY MODE** – In the **FAN ONLY** mode, the fan automatically runs in the **LOW** speed.

B. REFRIGERANT COMPRESSOR TIME DELAY

A time delay of approximately two minutes occurs any time the compressor is required to begin the cooling or heat pump cycle.

C. POWER INTERRUPTION

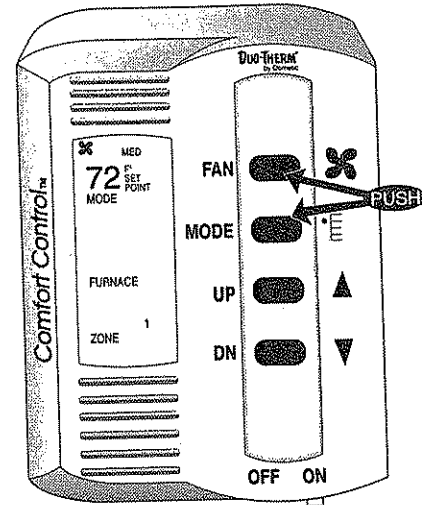
In the event that power to the air conditioner or control is interrupted, the system will restart with the same settings you have previously set.

D. ZONE CONTROL

Your Duo-Therm Control Center will operate cooling and heating appliances which your vehicle manufacturer has designed to heat or cool different areas (**ZONES**) of your RV. The Comfort Control Center will

(D. Zone Control continued)

advise you if your vehicle has multiple **ZONES**, by showing **ZONE 1, 2 3** or **4** illuminated in the LCD read-out. In the event your vehicle has multiple zones designed, you have the freedom of selecting the **MODE** of operation for each zone independently. To change from one zone to another, simultaneously depress the **FAN** and **MODE** push-buttons. Each time you depress and release these push-buttons, the indicator will change the zone data displayed. To program each zone, simply repeat the programming steps shown in the operation section of this manual. Please note: The Comfort Control Center will prevent operating **FURNACE** and **COOL** or **FURNACE** and **HEAT PUMP** at the same time.

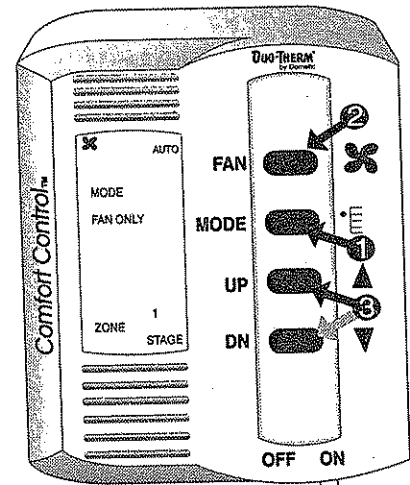


E. STAGE CONTROL OPERATION

If your vehicle is equipped with a Duo-Therm Dual Basement Air Conditioner or a Dual Basement Heat Pump, you have an air conditioning system that is designed to optimize comfort and running efficiencies. (Two units wired in series within one compartment). This is accomplished as long as the required electrical power is available, by providing an on-demand secondary stage of operation. (NOTE: The primary stage will continue to operate even if there isn't enough electrical power available to run the second stage.) The Comfort Control Center simplifies this operation by allowing you to set the primary temperature set-point and the differential temperature set-point which activates the secondary stage. After turning on your Comfort Control Center, perform the following steps to set and activate the stage control operation.

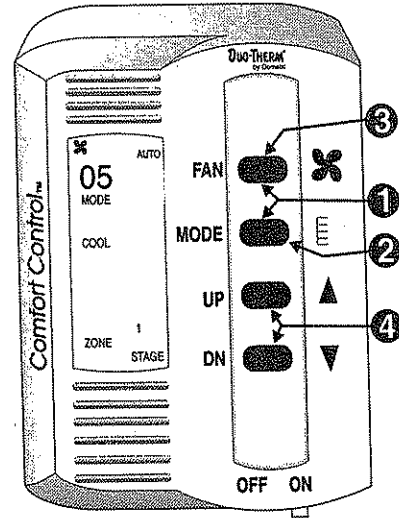
- 1) Momentarily depress the **MODE** push-button until the desired mode of operation is selected. (**FAN ONLY, COOL, HEAT PUMP**)
- 2) Momentarily depress the **FAN** or **FURNACE** push-button until the desired fan speed indicator is illuminated (**LOW, HIGH, AUTO**)
- 3) Momentarily depress the **UP** and **DN** push-button until the desired room temperature set-point is displayed.

This completes the set-up for the primary stage of your Dual Basement Air Conditioner or Dual Basement Heat Pump. Next, you will set-up the secondary stage (Page 7).



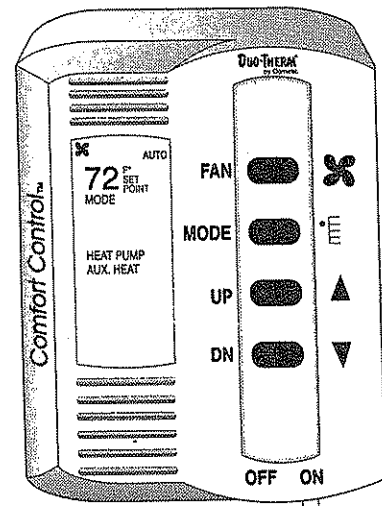
TO SET UP THE SECONDARY STAGE:

- 1) Simultaneously depress and release the **FAN** and **MODE** push-buttons until the **STAGE** indicator on the LCD is illuminated.
- 2) Momentarily depress the **MODE** push-button until the desired mode of operation for the second stage is selected. (**FAN ONLY**, **COOL**, **HEAT PUMP**). Normally, the mode of operation is the same as the primary stage.
- 3) Momentarily depress the **FAN** push-button until the desired fan speed indicator is illuminated. (**LOW**, **HIGH**, **AUTO**)
- 4) Momentarily depress the **UP** or **DN** push-button to set the desired differential temperature set-point (0°F to 10°F). The secondary stage will run once the actual room temperature reaches the differential temperature set-point. **Example:** Desired room temperature set-point for the primary stage in the **COOL** **MODE** is set at 72°F; differential temperature set-point is set at 5°F. The secondary stage will activate when the actual room temperature reaches 77°F (72°F + 5°F), and will continue to operate until the room once again becomes 72°F.



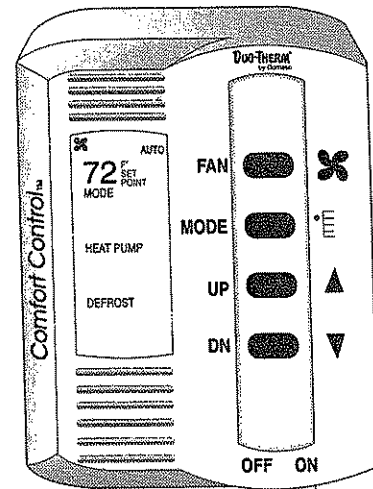
F. AUX. HEAT

When in the **HEAT PUMP** mode, if the outside ambient temperature is measured to be below 24°F, the control will automatically select the **FURNACE** operation. When this happens, the **AUX. HEAT** and the **HEAT PUMP** indicators on the LCD will illuminate. Once the outside ambient temperature is measured above 34°F, the control will return to the **HEAT PUMP** operation. If your vehicle does not contain a furnace, and you have a Duo-Therm Heat Pump, once the outside ambient temperature goes below 24°F, the system will shut down until the outside temperature reaches 34°F, at which time the Heat Pump will resume operation.



G. DEFROST CYCLE

This cycle is active during **HEAT PUMP** operation and allows the heat pump to operate down to 24°F. When the outside ambient temperature is less than 42°F and greater than 24°F, a defrost timing cycle will begin. The defrost timing cycle will allow operation of the heat pump for 40 minutes. The fan will then be shut off, the refrigerant flow reversed and run for 4-1/2 minutes, this is the **DEFROST** cycle. The refrigerant flow will then be returned to normal and, after a 30 second delay will continue until the temperature is greater than 42°F or until the temperature becomes less than 24°F, at which time the furnace will activate. (See **AUX. HEAT**). During the defrost cycle, the **DEFROST** indicator on the LCD shall be illuminated.



GENERAL INFORMATION

A. The ability of the air conditioner to maintain the desired inside temperature depends on the heat gain of the RV. Some preventative measures taken by the occupants of the RV can reduce the heat gain and improve the performance of the air conditioner. During extremely high outdoor temperatures, the heat gain of the vehicle may be reduced by:

1. Parking the RV in a shaded area.
2. Using window shades (blinds and/or curtains).
3. Keeping windows and doors shut or minimizing usage.
4. Avoiding the use of heat producing appliances.

Starting the air conditioner early in the morning and giving it a "head start" on the expected high outdoor ambient will greatly improve its ability to maintain the desired indoor temperature.

B. The manufacturer of this air conditioner will not be responsible for damage caused by condensed moisture on ceilings or other surfaces. Air contains moisture and this moisture tends to condense on cold surfaces. When air enters the RV, condensed moisture may appear on the ceiling, windows, metal parts, etc. The air conditioner removes this moisture from the air during normal operation. Keeping doors and windows closed when this air conditioner is in operation will minimize condensed moisture on cold surfaces.

C. This equipment must be serviced by qualified personnel and some states require these people to be licensed.

MAINTENANCE

AIR FILTER: Periodically remove the return air filter. Wash the filter with soap and warm water; let dry and then reinstall or replace as required.

NOTE: Never run the air conditioner without the return air filter in place. This may plug the unit evaporator coil with dirt and may substantially affect the performance of the unit.

Comfort Control Center™: Clean the Comfort Control Center™ with a moist, soft cloth. **DO NOT** use solvents for cleaning.

SERVICE

If your unit fails to operate or operates improperly, check the following before calling your service center.

- A. If your RV is connected to a motor generator, check to be sure the motor generator is running and producing power.
- B. If the RV is connected to a power supply by a land line, check to be sure the line is sized properly to run air conditioner load and it is plugged into the power supply.
- C. Check your 115VAC fuse or circuit breaker to see if it is open.
- D. Check your 12VDC fuse or circuit breaker to see if it is open.
- E. After the above checks, call your local service center for further help. This unit must be serviced by qualified service personnel only.

When calling for service, always give the following:

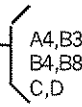
- A. Air Conditioner Model Number and Serial Number found on Rating Plate located on the Base Pan of the air conditioner.
- B. Electronic Control Kit Part Number and Serial Number found on Rating Plate located on the side of the Kit.

RETURN AIR GRILLE MUST BE REMOVED FROM THE RETURN AIR COVER TO VIEW THESE RATING PLATES.

This program will address the most common system problems associated with the Duo-Therm Comfort Control Center supplied by The Dometic Corporation. Our intent is to provide you with a guideline of checks to make, should you encounter one of the following symptoms.

SYMPTOM	CAUSE	REFER TO	STEP
<u>COMFORT CONTROL CENTER SECTION:</u>			
1. Turn to "ON" – No display.	Reset DC Volts Cable Assembly Fuse AC Power Module Board Comfort Control Center	1 4 5.2 5.15 5.14 5.1	M
2. Turn to "ON" – Has display, improper operation.	Operation Reset Configuration Wiring AC Power Module Board Comfort Control Center	1 1 2 3.3 5.14 5.1	M
3. Multiple Units: One unit operates and improper operation on other unit(s).	Operation Reset Configuration Wiring AC Power Module Board Comfort Control Center	1 1 2 3.3 5.14 5.1	M
<u>ROOF MOUNTED AIR CONDITIONER SECTION:</u>			
1. Unit does not run: No fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	A A1,A2,A3 B1,B2,B3, B7,B8,C,D
2. Fan operates: Compressor will not come on (does not "hum")	Operation Cable Assembly Cold Control Compressor AC Power Module Board Comfort Control Center	1 5.2 5.10 5.7 5.14 5.1	
3. Fan Operates: Compressor tries to start, cycles "OFF" and "Hums" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Cold Control Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	

SYMPTOM	CAUSE	REFER TO	STEP
(Roof Mounted Air Conditioner Sec. continued)			
4. Fan operates: compressor runs for a short while, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Overload Protector Compressor Refrigerant System	6.1 6.2 6.3 5.8 5.7 8.1	A
5. Compressor runs, no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	
6. Fan runs, but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	A
7. Air distribution box unit: Evaporator freezes.	Operation Cold Control Air Flow Obstruction Low Charge Capillary Tube Blockage Evaporator Blockage	1 5.10 6.2 8.1 8.2 8.2	
8. Duct in ceiling unit: Evaporator freezes.	Operation Cold Control Air Flow Obstruction Air Distribution System Low Charge Capillary Tube Blockage Evaporator Blockage	1 5.10 6.2 6.3 8.1 8.2 8.2	A
9. Air distribution box unit: Insufficient cooling, compressor runs constantly.	Air Flow Obstruction Heat Gain/Heat Loss Refrigerant System Compressor	6.2 7.1 8.1 5.7	
10. Duct in ceiling unit: Insufficient cooling, compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	A

SYMPTOM	CAUSE	REFER TO	STEP
(Roof Mounted Air Conditioner Sec. continued)			
11. Air distribution box unit: Insufficient cooling with reduced air output.	Air Flow Obstruction Blower Wheel	6.2 7.4	A
12. Duct in ceiling unit: Insufficient cooling with reduced air output.	Air flow Obstruction Air Distribution System Blower Wheel	6.2 6.3 7.4	
13. Excessive cooling.	Remote sensor AC Power Module Board Comfort Control Center	5.13 5.14 5.1	A
14. Noisy Operation.	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	
<u>ROOF MOUNTED HEAT PUMP SECTION:</u>			
1. Unit does not run: No fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	 A4,B3, B4,B8 C,D
2. Fan operates: Compressor will not come on (does not "hum").	Operation Cable Assembly Compressor AC Power Module Board Comfort Control Center	1 5.2 5.7 5.14 5.1	B
3. Fan operates: Compressor tries to start, cycles "OFF" and "hums" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	B
4. Fan operates; compressor runs for a short time, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Compressor Refrigerant System	6.1 6.2 5.8 5.7 8.1	

SYMPTOM	CAUSE	REFER TO	STEP
(Roof Mounted Heat Pump Sec. continued)			
5. Compressor runs, no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	B
6. Fan runs, but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	B
7. Air distribution box unit: Inside coil freezes.	Operation Air Flow Obstruction Low Charge Capillary Tube Blockage Reversing Valve	1 6.2 8.1 8.2 5.9	
8. Duct in ceiling unit: Inside coil freezes.	Operation Air Flow Obstruction Air Distribution System Low Charge Capillary Tube Blockage Reversing Valve	1 6.2 6.3 8.1 8.2 5.9	A
9. Air Distribution Box Unit: Insufficient cooling or heating, compressor runs constantly.	Air Flow Obstruction Heat Gain/Heat Loss Refrigerant System Compressor	6.2 7.1 8.1 5.7	
10. Duct in ceiling unit: Insufficient cooling or heating, compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	A
11. Air distribution box unit: Insufficient cooling or heating with reduced air output.	Air Flow Obstruction Blower Wheel	6.2 7.4	
12. Duct in ceiling unit: Insufficient cooling or heating with reduced air output.	Air Flow Obstruction Air Distribution System Blower Wheel	6.2 6.3 7.4	A
13. Excessive cooling or heating.	Remote Sensor AC Power Module Comfort Control Center	5.13 5.14 5.1	B

SYMPTOM	CAUSE	REFER TO	STEP
(Roof Mounted Heat Pump Sec. continued)			
14. Unit operation in wrong mode (cool instead of heat pump or reversed)	Operation Ambient Sensor Reversing Valve Comfort Control Center	1 5.12 5.9 5.1	
15. Noisy Operation	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	
<u>BASEMENT (SINGLE COMPRESSOR)</u> <u>AIR CONDITIONER SECTION:</u>			
1. Unit does not run; no fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	A5,B5,C,D
2. Fan operates; compressor will not come on (does not "hum")	Operation Cable Assembly Compressor AC Power Module Board Comfort Control Center	1 5.2 5.7 5.14 5.1	C
3. Fan operates; compressor tries to start, cycles "OFF" and "hum" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	
4. Fan operates; compressor runs for a short time, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Overload Protector Compressor Refrigerant System	6.1 6.2 6.3 5.8 5.7 8.1	B

SYMPTOM	CAUSE	REFER TO	STEP
<u>(Basement [Single Compressor] A/C Sec. continued)</u>			
5. Compressor runs, no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	C
6. Fan runs, but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	C
7. Evaporator freezes.	Operation Air Flow Obstruction Low Charge Capillary Tube Blockage Evaporator Blockage	1 6.2 8.1 8.2 8.2	
8. Insufficient cooling, compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	B
9. Insufficient cooling with reduced air output.	Air Flow Obstruction Blower Wheel Air Distribution System	6.2 7.4 6.3	B
10. Excessive cooling.	Remote Sensor AC Power Module Board Comfort Control Center	5.13 5.14 5.1	C
11. Noisy operation.	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	
<u>BASEMENT (SINGLE COMPRESSOR) HEAT PUMP SECTION:</u>			
1. Unit does not run; no fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	A6,B6,C,D D

SYMPTOM	CAUSE	REFER TO	STEP
(Basement [Single Compressor] H/P Sec. continued)			
2. Fan operates; compressor will not come on (does not "hum")	Operation Cable Assembly Compressor AC Power Module Board Comfort Control Center	1 5.2 5.7 5.14 5.1	D
3. Fan operates; compressor tries to start, cycles "OFF" and "hums" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	
4. Fan operates; compressor runs for a short while, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Overload Protector Compressor Refrigerant System	6.1 6.2 6.3 5.8 5.7 8.1	B
5. Compressor runs; no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	D
6. Fan runs; but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	D
7. Inside coil freezes.	Operation Air Flow Obstruction Air Distribution System Low Charge Capillary Tube Blockage Reversing Valve	1 6.2 6.3 8.2 8.2 5.9	B
8. Insufficient cooling or heating; compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	B

SYMPTOM	CAUSE	REFER TO	STEP
(Basement [Single Compressor] H/P Sec. continued)			
9. Insufficient cooling or heating with reduced air output.	Air Flow Obstruction Air Distribution System Blower Wheel	6.2 6.3 7.4	B
10. Excessive cooling or heating.	Remote Sensor AC Power Module Board Comfort Control Center	5.13 5.14 5.1	D
11. Unit operates in wrong mode (cool instead of heat pump or reversed)	Operation Ambient Sensor Reversing Valve Comfort Control Center	1 5.12 5.9 5.1	
12. Noisy operation.	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	
BASEMENT (DUAL COMPRESSOR) AIR CONDITIONER SECTION:			
1. Unit does not run; no fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	A7 E
2. Fan operates; compressor will not come "ON" (does not "hum")	Operation Cable Assembly Compressor AC Power Module Board Comfort Control Center	1 5.2 5.7 5.14 5.1	 E
3. Fan operates; compressor tries to start, cycles "OFF" and "hums" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	

SYMPTOM	CAUSE	REFER TO	STEP
(Basement [Dual Compressor] A/C Sec. continued)			
4. Fan operates; compressor runs for a short while, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Overload Protector Compressor Refrigerant System	6.1 6.2 6.3 5.8 5.7 8.1	C
5. Compressor runs, no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	E
6. Fan runs, but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	E
7. Evaporator freezes.	Operation Air Flow Obstruction Air Distribution System Low Charge Capillary Blockage Evaporator Blockage	1 6.2 6.3 8.1 8.2 8.2	
8. Insufficient cooling; compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	C
9. Insufficient cooling with reduced air output.	Air Flow Obstruction Air Distribution System Blower Wheel	6.2 6.3 7.4	C
10. Excessive cooling.	Remote Sensor AC Power Module Board Comfort Control Center	5.13 5.14 5.1	E
11. Noisy operation.	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	

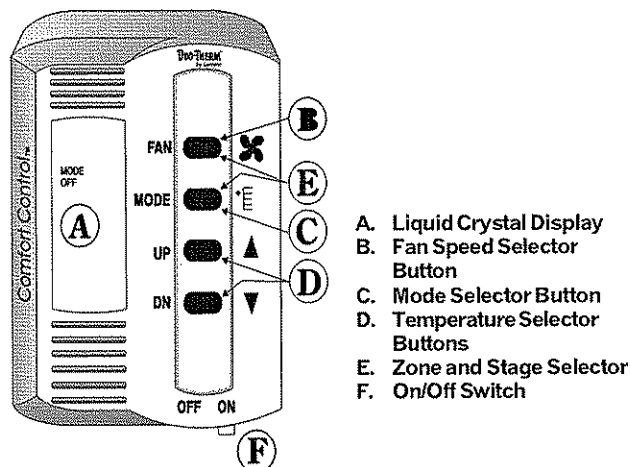
SYMPTOM	CAUSE	REFER TO	STEP
<u>BASEMENT (DUAL COMPRESSOR) HEAT PUMP SECTION:</u>			
1. Unit does not run; no fan, no compressor.	Configuration Operation AC Voltage DC Voltage Breaker Fuse Cable Assembly Comfort Control Center AC Power Module Board	2 1 3.1 4 3.2 5.15 5.2 5.1 5.14	A8 E
2. Fan operates; compressor will not come on (does not "hum")	Operation Cable Assembly Compressor AC Power Module Board Comfort Control Center	1 5.2 5.7 5.14 5.1	 E 5.1
3. Fan operation; compressor tries to start, cycles "OFF" and "hums" again, or blows circuit breaker.	AC Voltage PTCR Start or Run Capacitor Overload Protector Compressor	3.1 5.6 5.5 & 5.4 5.8 5.7	 5.7
4. Fan operates; compressor runs for a short while, cycles "OFF", cycles back "ON".	Short Cycle Air Flow Obstruction Air Distribution System Overload Protector Compressor Refrigerant System	6.1 6.2 6.3 5.8 5.7 8.1	 C 8.1
5. Compressor runs; no fan.	Wiring Run Capacitor Motor AC Power Module Board Comfort Control Center	3.3 5.4 5.3 5.14 5.1	 E 5.1
6. Fan runs; but not on all speeds.	Wiring Motor Cable Assembly AC Power Module Board Comfort Control Center	3.3 5.3 5.2 5.14 5.1	 E 5.1
7. Inside coil freezes.	Operation Air Flow Obstruction Air Distribution System Low Charge Capillary Tube Blockage Reversing Valve	1 6.2 6.3 8.1 8.2 5.9	 C 5.9

SYMPTOM	CAUSE	REFER TO	STEP
<u>(Basement [Dual Compressor] H/P Sec. continued)</u>			
8. Insufficient cooling or heating; compressor runs constantly.	Air Flow Obstruction Air Distribution System Heat Gain/Heat Loss Refrigerant System Compressor	6.2 6.3 7.1 8.1 5.7	C
9. Insufficient cooling or heating with reduced air output.	Air Flow Obstruction Air Distribution System Blower Wheel	6.2 6.3 7.4	C
10. Excessive cooling or heating.	Remote Sensor AC Power Module Comfort Control Center	5.13 5.14 5.1	E
11. Unit operates in wrong mode (cool instead of heat pump or reversed)	Operation Ambient Sensor Reversing Valve Comfort Control Center	1 5.12 5.9 5.1	
12. Noisy Operation.	Loose Parts Fan Blades Hitting Tubing Vibration	7.2 7.4 7.3	

SECTION 1 OPERATION

The recreational vehicle manufacturer has equipped the vehicle with Duo-Therm's Comfort Control Center™. The Comfort Control Center has been designed for you to easily operate all the air conditioning and gas heating appliances found in your vehicle from one location.

In order to familiarize yourself with the operation of the Comfort Control Center, the following diagram along with the accompanying text will explain all the functional characteristics of the system.



A. LIQUID CRYSTAL DISPLAY – The Comfort Control Center is equipped with a liquid crystal display (LCD) that identifies the mode of operation, the temperature set-point, the zone identification and the fan speed. The Comfort Control Center is designed to accept and control many varied air conditioning and gas heating appliances. When you begin to first operate the Comfort Control Center, you will see that the LCD readout will only show the options available based on the appliances installed on your vehicle. An incandescent light will illuminate the LCD area when a selector button is pushed for easy reading at all times.

B. FAN SPEEDS – Possible available fan speeds are: **LOW, MEDIUM, HIGH** and **AUTO**. To select the desired fan speed, momentarily depress the **FAN** push button. You will need to continue to depress and release the **FAN** button until the desired fan speed is shown in the LCD readout area of the Comfort Control Center.

C. MODE SELECTOR BUTTON – Modes of operation available are: **OFF, FAN ONLY, COOL, HEAT PUMP, FURNACE** and **HEAT STRIP**. Remember, the LCD readout will only show the options available based on the appliances installed on your vehicle. To select the mode of operation, momentarily depress the **MODE** push-button. You will need to continue to depress and release the button until the desired mode is shown in the LCD readout area on the Comfort Control Center.

To determine the Comfort Control Center options available to you, depress and release the **MODE** push-button until it goes through all selections.

D. TEMPERATURE SELECTOR BUTTONS – The temperature Set-point range is from 40° to 99° Fahrenheit. Determination of Fahrenheit or Celsius standard is done at the time of your manufacturer's installation of the Climate Control Center. To set the temperature at your comfort level, simply depress and release the **UP** or **DN** push-button until the desired temperature is shown in the LCD readout area of the Comfort Control Center.

E. ZONE AND STAGE SELECTOR BUTTONS – A **ZONE** is also established at the time of installation of the Comfort Control Center. If you have one air conditioner, you will have one **ZONE**. If the vehicle has more than one cooling system, depending on the manufacturing installation, you may have 2, 3 or 4 **ZONES**. Zones are defined and preset by the manufacturer. A zone is an area of cooling/heating which is controlled independently within that area, and regulated at the Comfort Control Center. A typical example of a two zone application would be a vehicle with two air conditioning systems, one in the front area (living room, kitchen) and one in the back section (bedroom and bath). The front area could be established as **ZONE1** and the back section **ZONE2**. You can select the desired temperature and fan speeds for each zone independently, thereby keeping your bedroom cooler than the front portion of the vehicle. To determine the number of established zones in the vehicle, simultaneously depress the **FAN** and **MODE** push-buttons. Zone 1 will be the first Zone to appear in the LCD readout. Continue to depress and release these buttons until you see Zone 1 reappear.

If the vehicle has a dual basement air conditioner or dual heat pump system, the word **STAGE** will be illuminated. Both of these units operate in two different stages, and the word **STAGE** will show when the second stage operation has been selected. To select the second stage, simultaneously depress the **FAN** and **MODE** push-buttons.

- F. **ON/OFF SWITCH**—The ON/OFF switch is located on the lower right hand edge of the Comfort Control Center. Move the lever from side to side to change status.

GENERAL INFORMATION

- A. The ability of the air conditioner to maintain the desired inside temperature depends on the heat gain of the RV. Some preventative measures taken by the occupants of the RV can reduce the heat gain and improve the performance of the air conditioner. During extremely high outdoor temperatures, the heat gain of the vehicle may be reduced by:

1. Parking the RV in a shaded area.
2. Using window shades (blinds and/or curtains).
3. Keeping windows and doors shut or minimizing usage.
4. Avoiding the use of heat producing appliances.

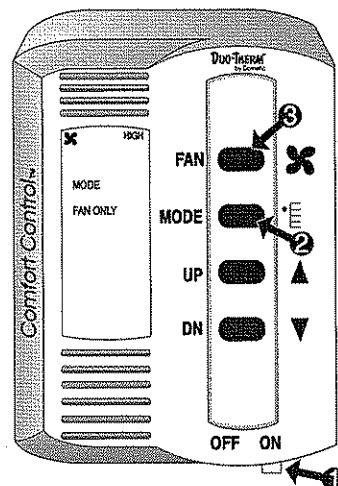
Starting the air conditioner early in the morning and giving it a "head start" on the expected high outdoor ambient will greatly improve its ability to maintain the desired indoor temperature.

- B. The manufacturer of this air conditioner will not be responsible for damage caused by condensed moisture on ceilings or other surfaces. Air contains moisture and this moisture tends to condense on cold surfaces. When air enters the RV, condensed moisture may appear on the ceiling, windows, metal parts, etc. The air conditioner removes this moisture from the air during normal operation. Keeping doors and windows closed when this air conditioner is in operation will minimize condensed moisture on cold surfaces.
- C. This equipment must be serviced by qualified personnel and some states require these people to be licensed.

A. FAN ONLY MODE OF OPERATION

1. Begin by placing the power switch on the lower right hand edge of the Control Center on the **ON** position. To do this, simply move the lever to the right.
2. Momentarily depress and release the **MODE** push-button until the **FAN ONLY** indicator on the Liquid Crystal Display (LCD) is illuminated.
3. Momentarily depress and release the **FAN** push-button until the desired fan speed indicator (**LOW**, **MED**, **HIGH**, **AUTO**) is illuminated. If your vehicle is equipped with a heat pump or a dual basement air conditioning system, your selection choice will be **LOW**, **HIGH** or **AUTO**.

4. After approximately 5 seconds, the selected fan speed will come on. The **MODE** and **FAN** speed you have selected will remain shown in the LCD area of the Control Center until you change your selection.
5. If the vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from step two above. Repeat entire procedure for each additional zone.

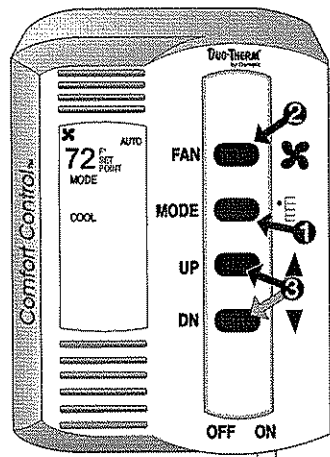


B. COOLING MODE OPERATION

(To set cooling temperatures and fan speeds on Duo-Therm Air Conditioners & the cooling mode of Duo-Therm Heat Pumps)

1. Momentarily depress and release the **MODE** push-button until the **COOL** indicator on the LCD is illuminated.
2. Depress and release the **FAN** push-button to select your desired fan speed.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. After a delay of approximately 2 minutes the air conditioner's compressor will come on and the cooling process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for cooling, the compressor will restart in approximately two minutes. At this point, the fan will either:
 - a. continue to operate in the single selected fan speed or,
 - b. cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.

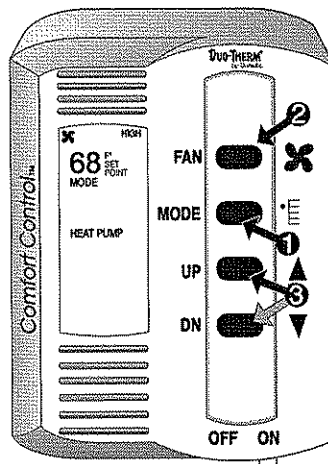
- If the vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1. Repeat entire procedure for each additional zone. NOTE: If set point is too low, the inside coil could freeze up.



C. HEAT PUMP OPERATION

(To set heating temperatures for vehicles equipped with a Duo-Therm rooftop or basement heat pump. To operate cooling mode with a heat pump, see "B. Cooling Mode Operation".)

- Momentarily depress and release the **MODE** push-button until the **HEAT PUMP** indicator on the LCD is illuminated.
- If you have not previously set your fan speed, you may do so by depressing and releasing the **FAN** push-button to select.
- Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
- After a delay of approximately 2 minutes the heat pump's compressor will come on and the heating process will begin. Once the room temperature reaches the selected **SET-POINT**, the compressor will cycle off. Once the Comfort Control Center senses the need for heating, the compressor will restart in approximately two minutes. At this point, the fan will either:
 - continue to operate in the single selected fan speed or,
 - cycle **OFF** and **ON** with the compressor if the **AUTO** fan speed has been selected.
- If the vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



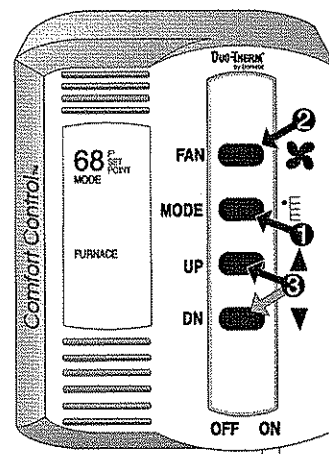
NOTE: See Sections K & L for additional Special Heat Pump Features.

D. FURNACE MODE OPERATION

(If the vehicle is equipped with a gas furnace connected to the Comfort Control Center)

- Momentarily depress and release the **MODE** push-button until the **FURNACE** indicator on the LCD is illuminated.
- The A/C fan does not operate in the **FURNACE** mode.
- Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the desired temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
- The Duo-Therm air conditioning system will not operate when the Comfort Control System is in the **FURNACE** mode. For cooling, change the **MODE** to **COOL**.
- If the vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.

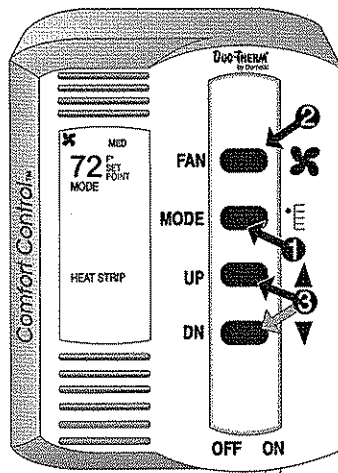
NOTE: When furnace mode is selected in any Zone, all air conditioner or heat pump units will terminate operation.



E. HEAT STRIP MODE OPERATION

(For Duo-Therm air conditioners with an electric heat strip)

1. Momentarily depress and release the **MODE** push-button until the **HEAT STRIP** indicator on the LCD is illuminated.
2. The fan will operate in **LOW**, **MED** or **AUTO**. You will not be able to select **HIGH** speed when in the **HEAT STRIP** mode. Depress and release the **FAN** push-button to select desired speed.
3. Depress and release the **UP** push-button to increase the temperature or the **DN** push-button to decrease the temperature. The final selected **SET-POINT** will be displayed in the LCD area of the Comfort Control Center.
4. The electric heat strip will cycle **ON** and **OFF** per the temperature **SET-POINT** displayed. The fan will either:
 - a. continue to operate in the selected fan speed or,
 - b. cycle **OFF** and **ON** with the heat strip if the **AUTO** fan speed has been selected.
5. If the vehicle contains more than one **ZONE**, depress the **FAN** and **MODE** push-buttons simultaneously to select **ZONE 2**, and repeat procedures from Step 1 above. Repeat entire procedure for each additional zone.



F. AUTO FAN

When **AUTO FAN** is selected, the fan speed will be determined by the mode you are in.

COOL MODE – In the **COOL** mode, which is the air conditioning mode, the fan will automatically select the speed depending upon the difference between the temperature **SET-POINT** and the room temperature.

When that difference is:

8° or more	The fan will operate on HIGH
4° to 8°	The fan will operate on MED
4° or below	The fan will operate on LOW

COOL OR HEAT PUMP MODE – If the vehicle is equipped with a Duo-Therm Heat Pump or Dual Basement Air Conditioner, the fan will automatically select the fan speed depending upon the difference between the temperature **SET-POINT** and the room temperature.

When the difference is:

Greater than 4°	– The fan operates on HIGH
4° or less	– The fan operates on LOW

HEAT STRIP MODE – When **HEAT STRIP** mode is selected, the fan will automatically run in the **LOW** speed.

FAN ONLY MODE – In the **FAN ONLY** mode, the fan automatically runs in the **LOW** speed.

G. REFRIGERANT COMPRESSOR TIME DELAY

A time delay of approximately two minutes occurs any time the compressor is required to begin the cooling or heat pump cycle.

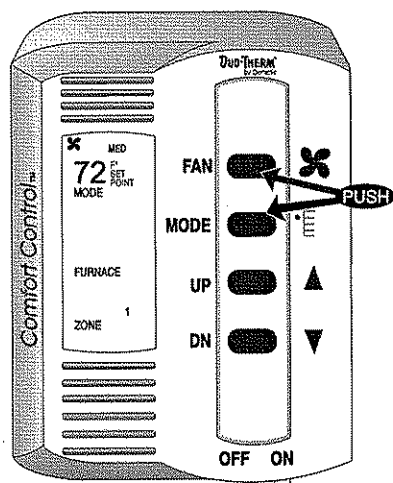
H. POWER INTERRUPTION

In the event that power to the air conditioner or control is interrupted, the system will restart with the same settings you have previously set.

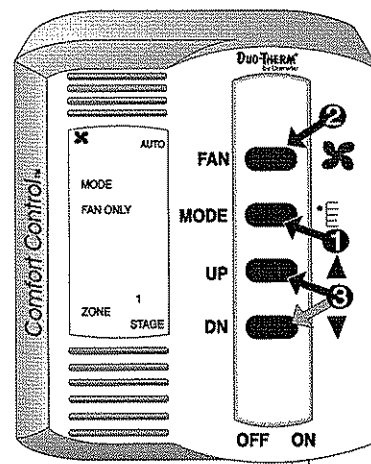
I. ZONE CONTROL

The Duo-Therm Control Center will operate cooling and heating appliances which the vehicle manufacturer has designed to heat or cool different areas (**ZONES**) of your RV. The Comfort Control Center will advise you if the vehicle has multiple **ZONES**, by showing **ZONE 1**, **2**, **3** or **4** illuminated in the LCD readout. In the event the vehicle has multiple zones

designed, you have the freedom of selecting the **MODE** of operation for each zone independently. To change from one zone to another, simultaneously depress the **FAN** and **MODE** push-buttons. Each time you depress and release these push-buttons, the indicator will change the zone data displayed. To program each zone, simply repeat the programming steps shown in the operation section of this manual. Please note: The Comfort Control Center will prevent operating **FURNACE** and **COOL** or **FURNACE** and **HEAT PUMP** at the same time.



- 2) Momentarily depress the **FAN** push-button until the desired fan speed indicator is illuminated (**LOW, HIGH, AUTO**)
- 3) Momentarily depress the **UP** and **DN** push-button until the desired room temperature set-point is displayed.



This completes the setup for the primary stage of the Dual Basement Air Conditioner or Dual Basement Heat Pump. Next, you will setup the secondary stage.

J. STAGE CONTROL OPERATION

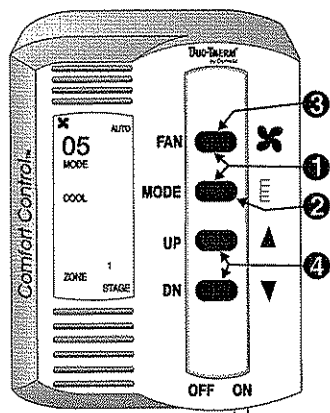
If the vehicle is equipped with a Duo-Therm Dual Basement Air Conditioner or a Dual Basement Heat Pump, you have an air conditioning system that is designed to optimize comfort and running efficiencies. (Two units wired in series within one compartment). This is accomplished as long as the required electrical power is available, by providing an on-demand secondary stage of operation. (NOTE: The primary stage will continue to operate even if there isn't enough electrical power available to run the second stage.) The Comfort Control Center simplifies this operation by allowing you to set the primary temperature set-point and the differential temperature set-point which activates the secondary stage. After turning on your Comfort Control Center, perform the following steps to set and activate the stage control operation.

- 1) Momentarily depress the **MODE** push-button until the desired mode of operation is selected. (**FAN ONLY, COOL, HEAT PUMP**)

TO SET UP THE SECONDARY STAGE:

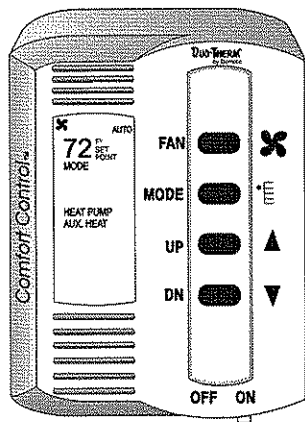
- 1) Simultaneously depress and release the **FAN** and **MODE** push-buttons until the STAGE indicator on the LCD is illuminated.
- 2) Momentarily depress the **MODE** push-button until the desired mode of operation for the second stage is selected. (**FAN ONLY, COOL, HEAT PUMP**). Normally, the mode of operation is the same as the primary stage.
- 3) Momentarily depress the **FAN** push-button until the desired fan speed indicator is illuminated. (**LOW, HIGH, AUTO**)
- 4) Momentarily depress the **UP** or **DN** push-button to set the desired differential temperature set-point (0°F to 10°F). The secondary stage will run once the actual room temperature reaches the differential temperature set-point. **Example:** Desired room temperature set-point for the primary stage in the **COOL MODE** is set at 72°F; differential temperature set-

point is set at 5°F. The secondary stage will activate when the actual room temperature reaches 77°F (72°F + 5°F), and will continue to operate until the room once again becomes 72°F.



K. AUX. HEAT

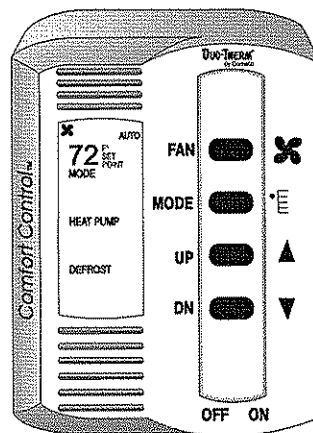
When in the **HEAT PUMP** mode, if the outside ambient temperature is measured to be below 24°F, the control will automatically select the **FURNACE** operation. When this happens, the **AUX. HEAT** and the **HEAT PUMP** indicators on the LCD will illuminate. Once the outside ambient temperature is measured above 34°F, the control will return to the **HEAT PUMP** operation. If your vehicle does not contain a furnace, and you have a Duo-Therm Heat Pump, once the outside ambient temperature goes below 24°F, the system will shut down until the outside temperature reaches 34°F, at which time the Heat Pump will resume operation.



L. DEFROST CYCLE

This cycle is active during **HEAT PUMP** operation and allows the heat pump to operate down to 24°F. When the outside ambient temperature is less than 42°F and

greater than 24°F, a defrost timing cycle will begin. The defrost timing cycle will allow operation of the heat pump for 40 minutes. The fan will then be shut off, the refrigerant flow reversed and run for 4-1/2 minutes, this is the **DEFROST** cycle. The refrigerant flow will then be returned to normal and, after a 30 second delay will continue until the temperature is greater than 42°F or until the temperature becomes less than 24°F, at which time the furnace will activate. (See **AUX. HEAT**). During the defrost cycle, the **DEFROST** indicator on the LCD shall be illuminated.



M. RESET

If the Comfort Control Center is not operational, inadequate data or no functions occur, reset the Comfort Control Center to factory setting. When a reset procedure is done, all previous program memory is removed. The factory setting of 72°F for cooling mode and 68°F for heating modes are entered.

To initiate a RESET, do the following in the order listed:

- 1) Turn control on to ensure annunciator data and light are present. If data and light are present, continue to next step. If data and light are not present, see Sec. 5.1.
- 2) Depress **MODE** switch to activate annunciator light.
- 3) Simultaneously depress the bottom two buttons (temperature UP and DOWN) and hold.
- 4) While holding these buttons down, depress the **MODE** button once and release.
- 5) Release the two buttons previously held down.
- 6) Depress the **MODE** button once again.
- 7) At this time the light should extinguish, and the mode should register "OFF". If not, repeat Steps 2 through 6.
- 8) Retest system ensuring that all functions are present and operational.

SECTION 2 CONFIGURATION

The Comfort Control Center configuration relates to setting the Dip switches and particular components (remote temperature sensor, cold [freeze] control and ambient sensor) that can be plugged into the AC power module board according to the type of unit and accessories included.

NOTE: If the configuration of the Dip switches and plug-in components are not correct, the air conditioner or heat pump could operate erratically or not operate at all.

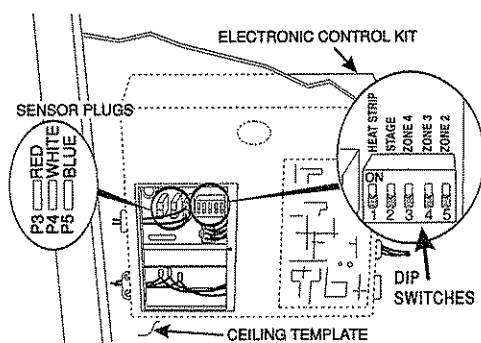
⚠ CAUTION

Improper configuration could cause damage to components of the system.

We recommend the configuration be done at the time of installation by the installer.

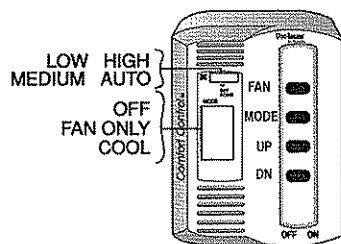
To check the configuration, first locate the Electronic Control Kit on roof-mounted units or the Electronic Control Box on basement mounted units. Next remove any cover or covers for access to Dip switches and Sensor Plugs (P3, P4 and P5). Both are located on the AC Power Module Board. All Dip switches are in the "OFF" position at the time of manufacture of the appliance.

NOTE: The only exceptions are Models 620315.XXX, 39424.XXX and 39224.XXX.



If the configuration is not correct, turn Comfort Control Center OFF before changing the configuration.

ONE ROOFTOP AIR CONDITIONER



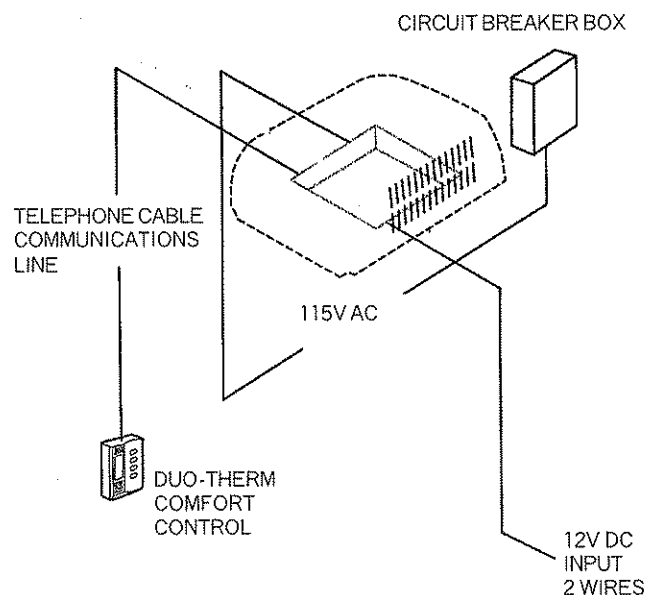
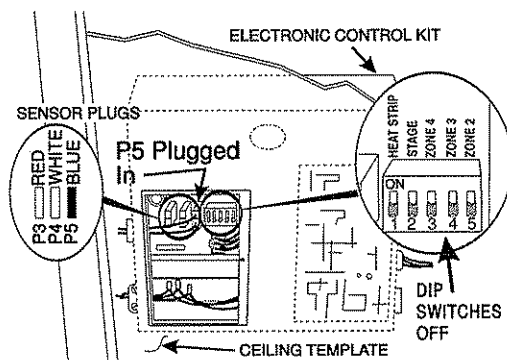
A. ONE COMFORT ZONE

1) ONE ROOFTOP AIR CONDITIONER

To configure one rooftop air conditioner, all Dip switches are to "OFF" position and the cold (freeze) control is plugged into P5 (blue) connector. 115VAC, 12VDC and the telephone cable communications line is properly connected to the air conditioner electronic control box. NOTE: if a remote sensor is used, it must be plugged into the P4 (white) connector.

⚠ CAUTION

Improper connections can cause component damage.



Typical installation for one comfort zone with rooftop air. Comfort control may serve as a room temperature sensor, or a remote sensor may be used.

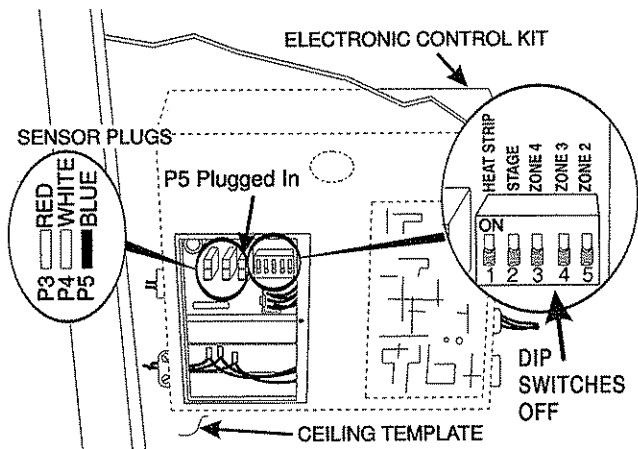
2. ONE ROOFTOP AIR CONDITIONER PLUS ONE GAS FURNACE

To configure one rooftop air conditioner plus one gas furnace, all Dip switches are "OFF" and the freeze control is plugged into the proper connector (blue) 115VAC, 12VDC. Two thermostat wires from the furnace and telephone cable communications line are properly connected to the air conditioner electronic control box.

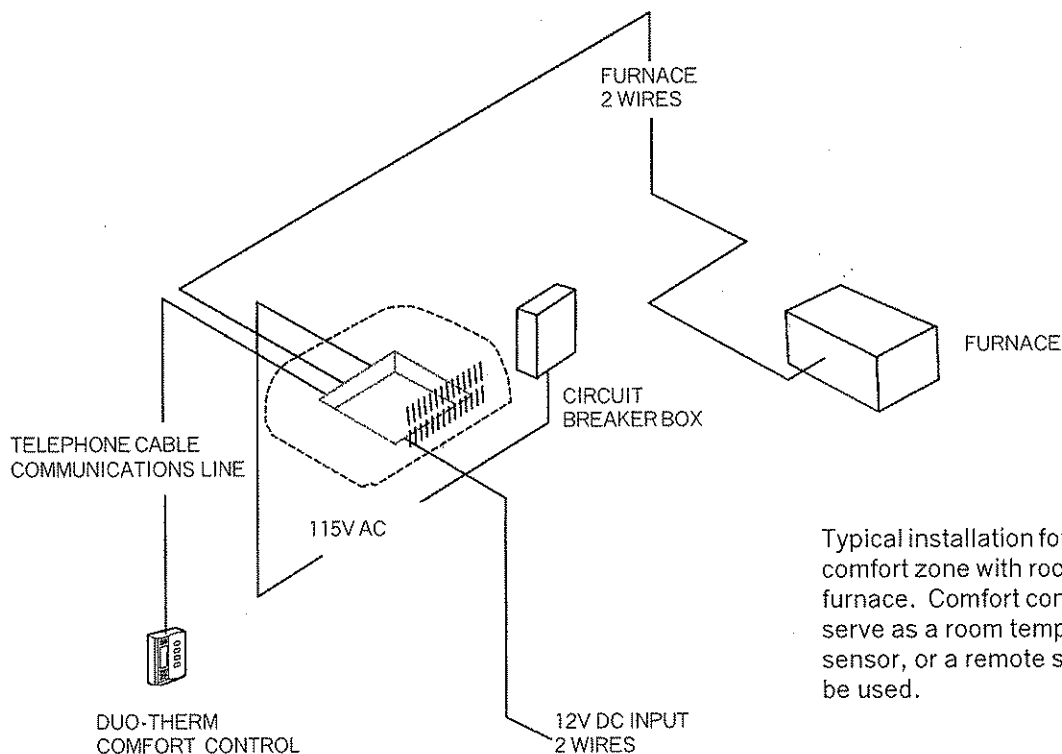
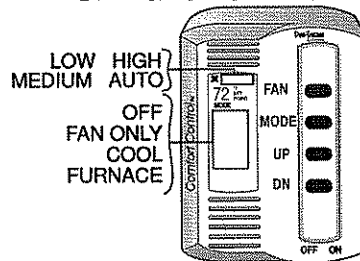
NOTE: If a remote sensor is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



ONE ROOFTOP AIR CONDITIONER + ONE GAS FURNACE



Typical installation for one comfort zone with rooftop air and furnace. Comfort control may serve as a room temperature sensor, or a remote sensor may be used.

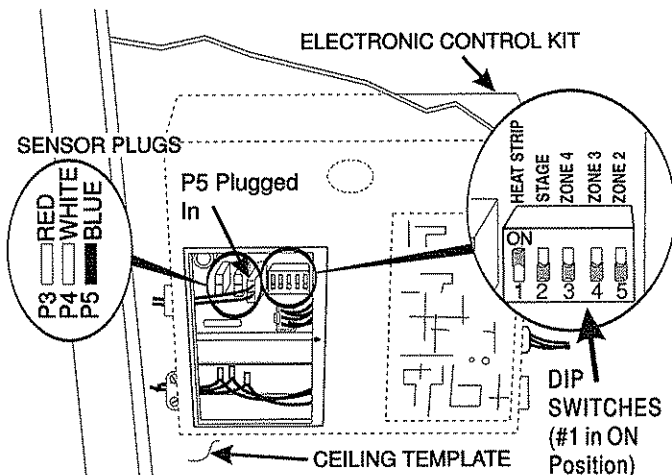
3. ONE ROOFTOP AIR CONDITIONER WITH HEAT STRIP PLUS ONE GAS FURNACE

To configure one rooftop air conditioner with heat strip plus one gas furnace, turn heat strip (#1) Dip switch to ON and all other Dip switches to OFF. The freeze control is plugged into the proper connector (blue). 115VAC, 12VDC, two thermostat wires from the furnace and telephone cable communications line are properly connected to the air conditioner electronic control box.

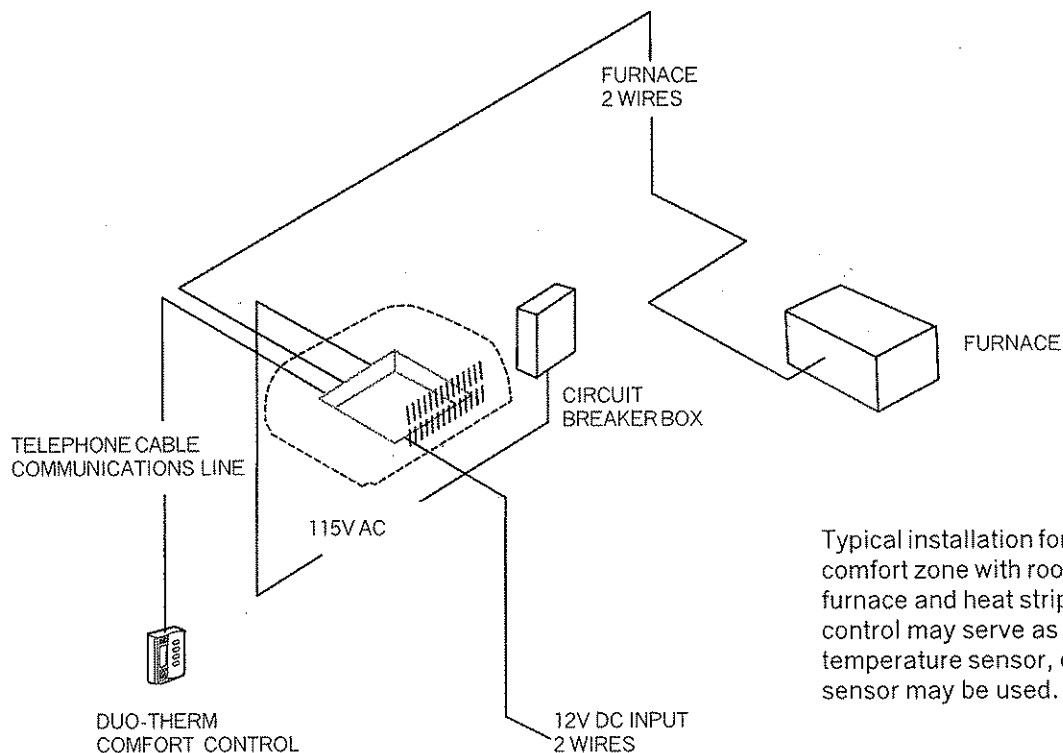
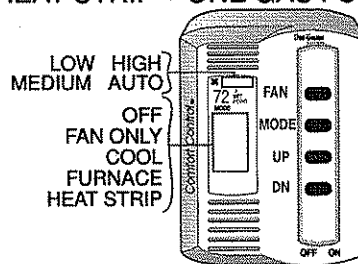
NOTE: If a remote sensor is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



ONE ROOFTOP AIR CONDITIONER with HEAT STRIP + ONE GAS FURNACE



Typical installation for one comfort zone with rooftop air, furnace and heat strip. Comfort control may serve as a room temperature sensor, or a remote sensor may be used.

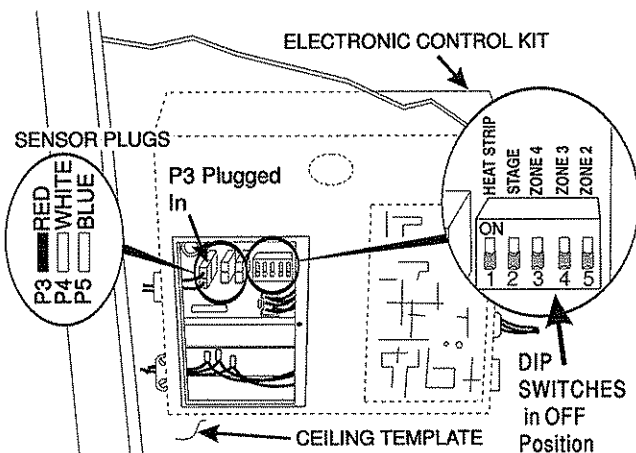
4. ONE ROOFTOP HEAT PUMP PLUS ONE GAS FURNACE

To configure one rooftop heat pump plus one gas furnace, all Dip switches are OFF. The freeze control is NOT used. The blue connector must stay open (P5). The ambient sensor is plugged into the proper connector (red). 115VAC, 12VDC, two thermostat wires from the furnace and telephone cable communications line are properly connected to the heat pump electronic control box.

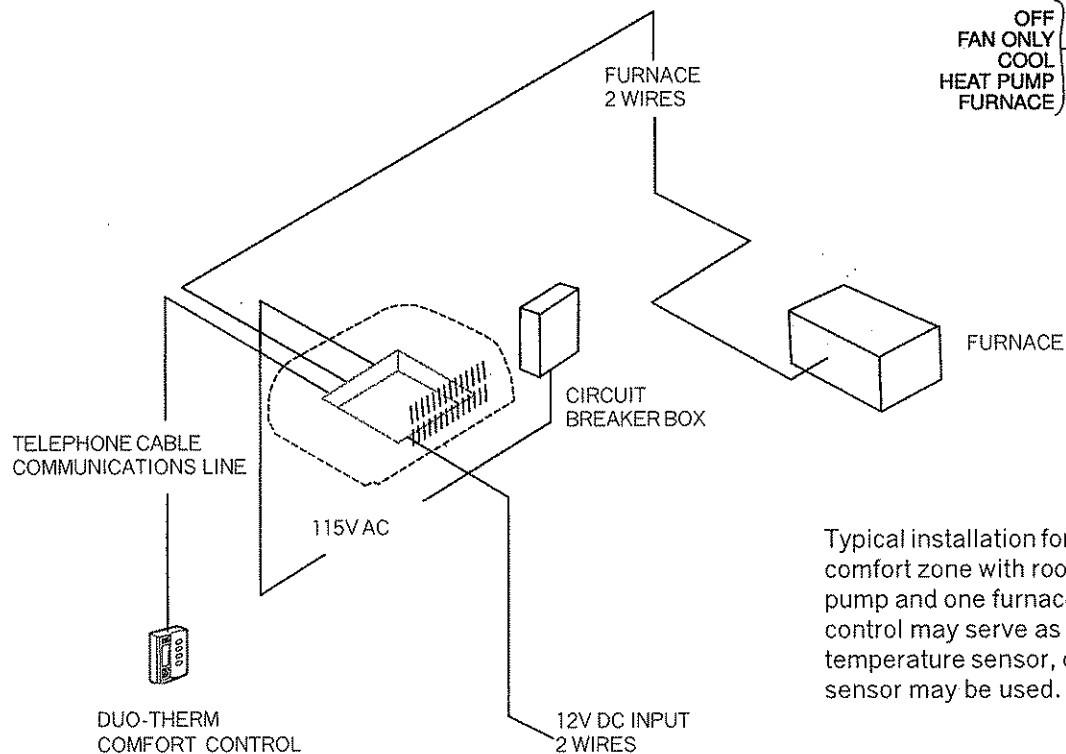
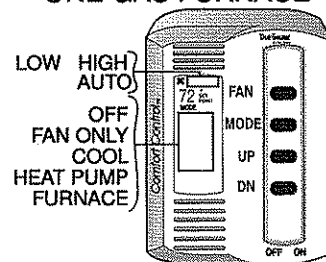
NOTE: If a remote sensor is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



ONE ROOFTOP HEAT PUMP + ONE GAS FURNACE



Typical installation for one comfort zone with rooftop heat pump and one furnace. Comfort control may serve as a room temperature sensor, or a remote sensor may be used.

NOTE: If a remote sensor is used, it must be plugged into the P4 (white) connector.

CAUTION
Improper connections can cause component damage.



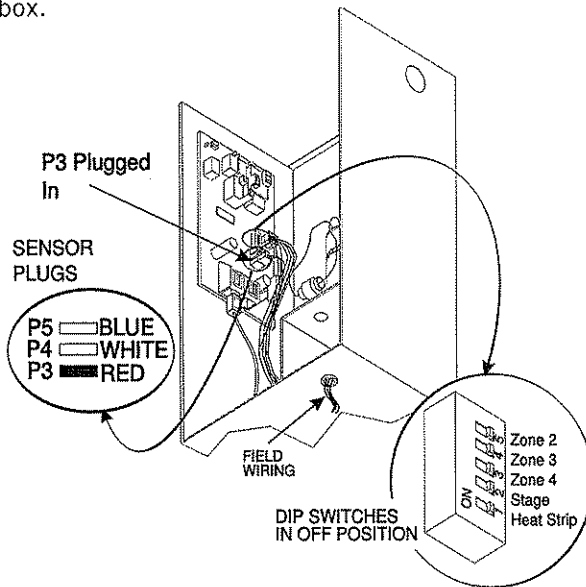
6. ONE BASEMENT HEAT PUMP PLUS ONE GAS FURNACE

To configure one basement heat pump plus one gas furnace, all Dip switches are OFF. The ambient sensor is plugged into the proper connector (red). 115VAC, 12VDC, two thermostat wires from the furnace and telephone cable communications line are properly connected to the AC power module in the unit's electrical box.

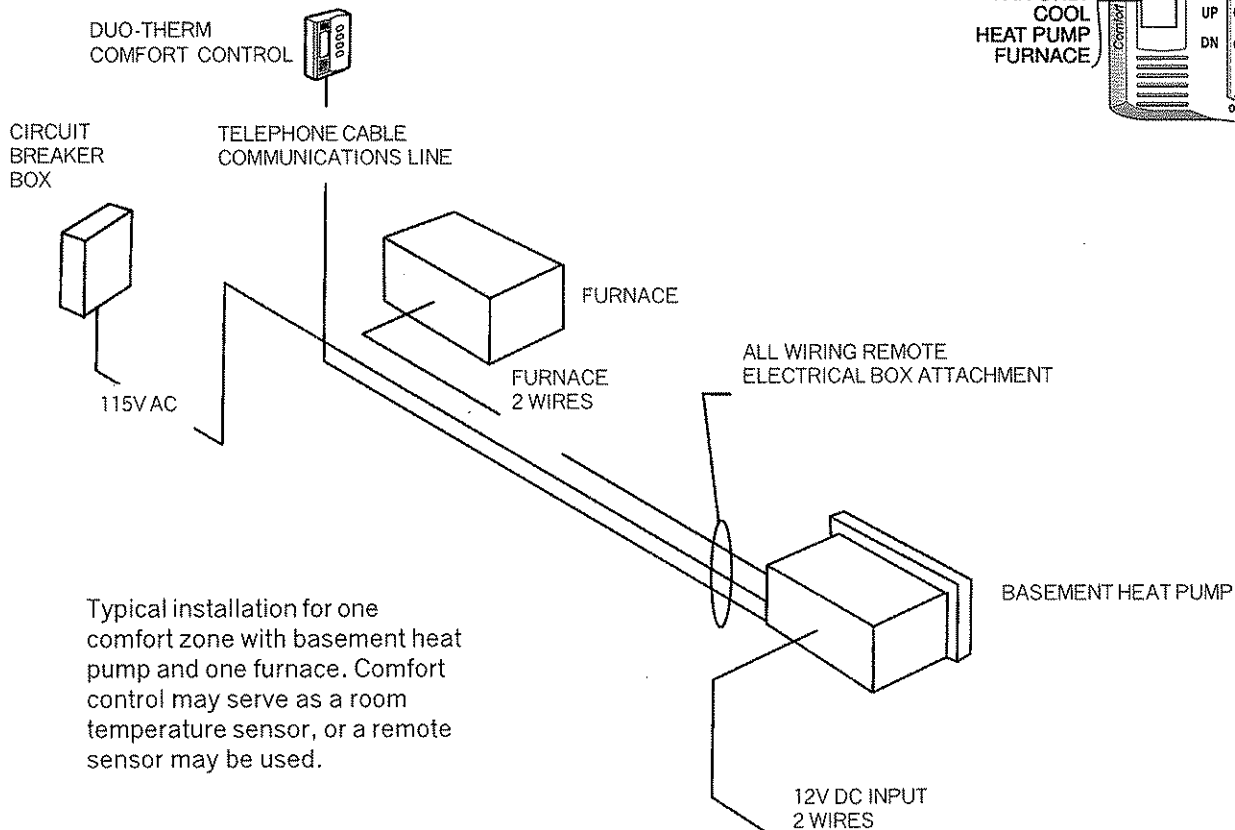
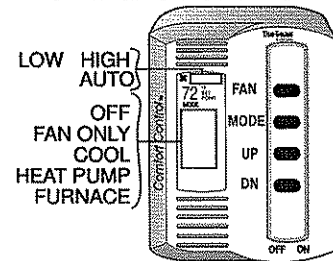
NOTE: If a remote sensor is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



ONE BASEMENT HEAT PUMP + ONE GAS FURNACE



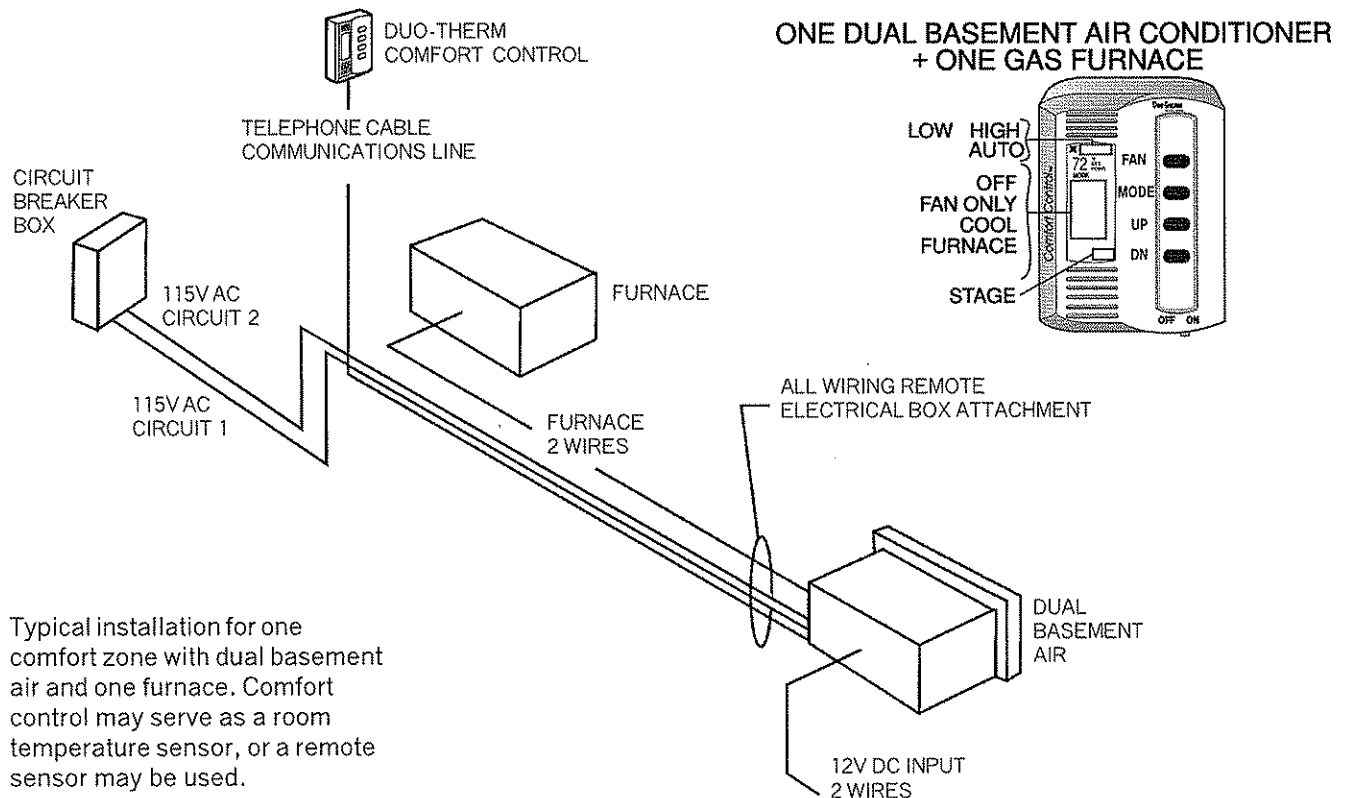
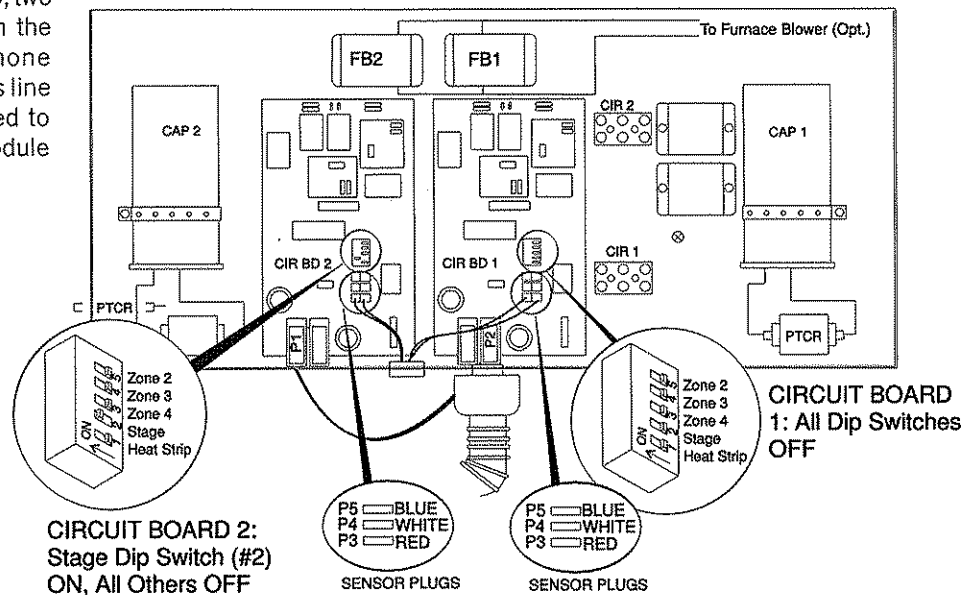
7. ONE DUAL BASEMENT AIR CONDITIONER PLUS ONE GAS FURNACE

To configure one dual basement air conditioner plus one gas furnace, the STAGE Dip switch on AC power module for Circuit 2 must be turned to ON. All other Dip switches are OFF on both AC power modules. 115VAC (Circuit 1 and Circuit 2) are connected properly to CIR 1 and CIR 2 terminal blocks; 12VDC, two thermostat wires from the furnace and telephone cable communications line are properly connected to Circuit 1, AC power module in the electrical box.

NOTE: If a remote sensor(s) is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



8. ONE DUAL BASEMENT HEAT PUMP PLUS ONE GAS FURNACE

To configure one dual basement heat pump plus one gas furnace, the STAGE Dip switch on AC power module for Circuit 2 must be turned to ON. All other Dip switches are OFF on both AC power modules. Two (2) ambient sensors (one per AC power module), are plugged into the proper connector (red) on each AC power module. 115VAC (Circuit 1 and Circuit 2) are connected properly to CIR 1 and CIR 2 terminal blocks; 12VDC, two thermostat wires from the furnace and telephone cable communications line are

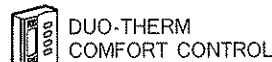
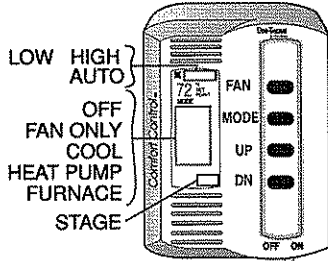
properly connected to Circuit 1 AC power module in the electrical box.

NOTE: If a remote sensor(s) is used, it must be plugged into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.

ONE DUAL BASEMENT HEAT PUMP + ONE GAS FURNACE



TELEPHONE CABLE
COMMUNICATIONS LINE

CIRCUIT
BREAKER
BOX

115V AC
CIRCUIT 2

115V AC
CIRCUIT 1

FURNACE

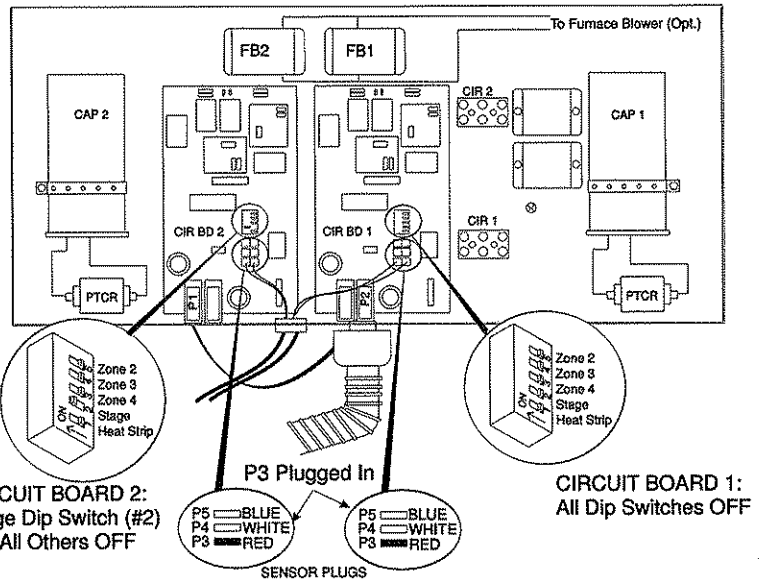
FURNACE
2 WIRES

ALL WIRING REMOTE
ELECTRICAL BOX ATTACHMENT

DUAL
BASEMENT
HEAT PUMP

12V DC INPUT
2 WIRES

Typical installation for one comfort zone with dual basement heat pump and one furnace. Comfort control may serve as a room temperature sensor, or a remote sensor may be used.



CIRCUIT BOARD 2:
Stage Dip Switch (#2)
ON, All Others OFF

CIRCUIT BOARD 1:
All Dip Switches OFF

B. TWO COMFORT ZONES

1. TWO ROOFTOP AIR CONDITIONERS PLUS ONE GAS FURNACE

To configure two rooftop air conditioners plus one gas furnace, **ZONES** need to be established. For explanation purposes the front unit will be ZONE 1 and the rear unit will be ZONE 2. ZONES can be arranged per the customer's wishes.

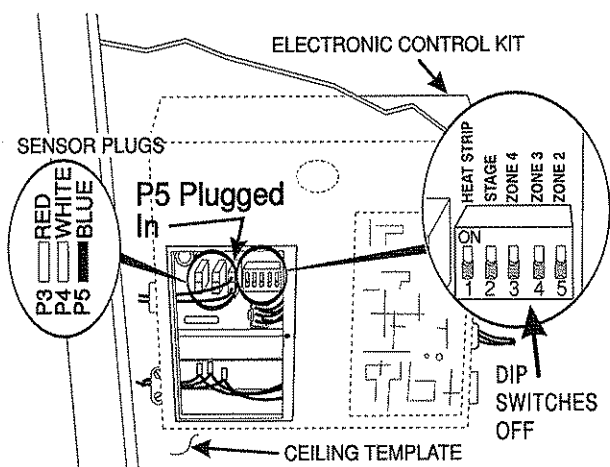
EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

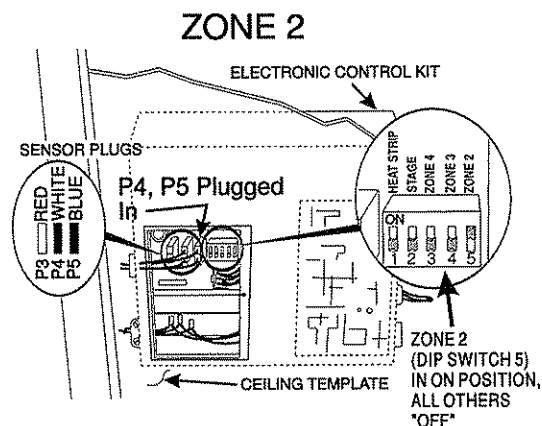
Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes, the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

ZONE 1 configuration should have all Dip switches in the OFF position, and the cold (freeze) control plugged into P5 (blue) connector on the AC power module. (Refer to Figure "ZONE 1")



ZONE 2 configuration should have Dip switch 5 (ZONE 2) in the ON position and all other Dip switches in the OFF position. The cold (freeze) control should be plugged into P5 (blue) connector and the remote sensor plugged into P4 (white) connector on the AC power module. (Refer to Figure "ZONE 2")



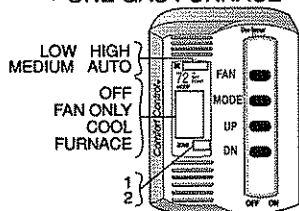
NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

CAUTION

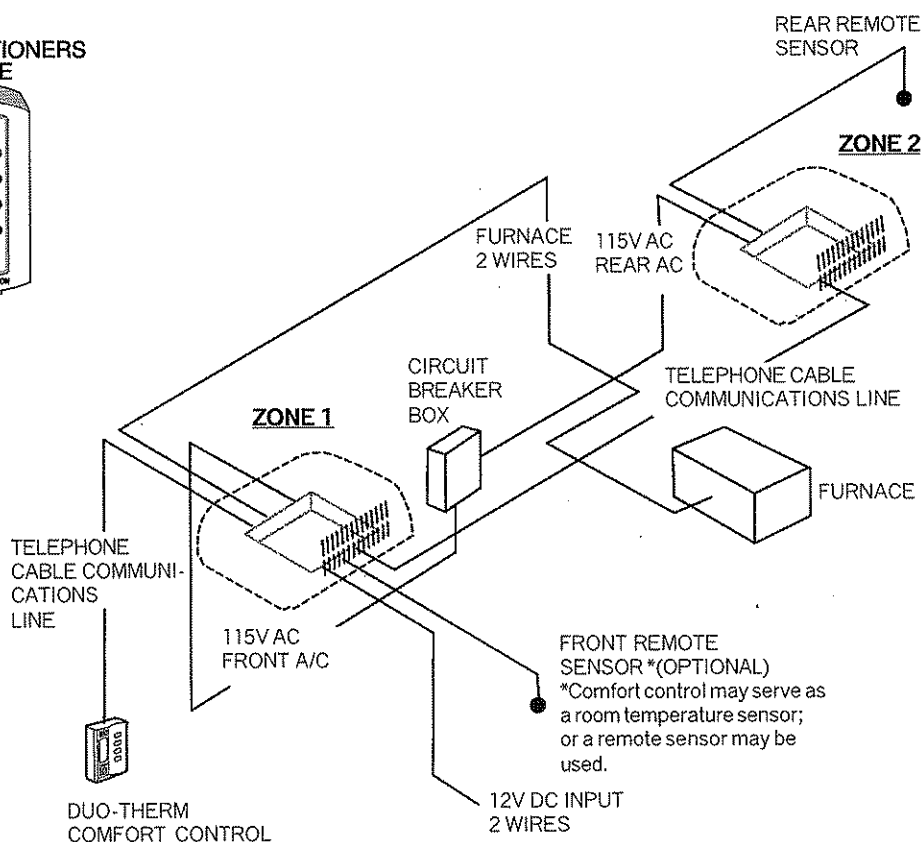
Improper connections can cause component damage.

(Refer to Illustration on next page)

**TWO ROOFTOP AIR CONDITIONERS
+ ONE GAS FURNACE**



Typical installation for two comfort zones with two rooftop airs and one furnace. Two remote sensors may be used.



(B. Two Comfort Zones, continued)

2. TWO ROOFTOP AIR CONDITIONERS WITH HEAT STRIP PLUS ONE FURNACE

To configure two rooftop air conditioners with heat strip plus one gas furnace, **ZONES** need to be established. For explanation purposes the front air conditioner will be ZONE 1 and the rear air conditioner will be ZONE 2. ZONES can be arranged per the customer's wishes.

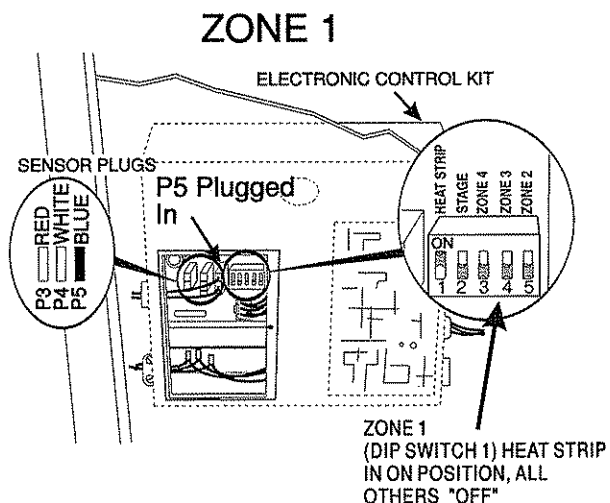
EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

ZONE 1 configuration should have Dip switch 1 (heat strip) to ON position and all other Dip switches to OFF position. The cold (freeze) control should be plugged into P5 (blue) connector on the AC power module. (Refer to Figure "ZONE 1")

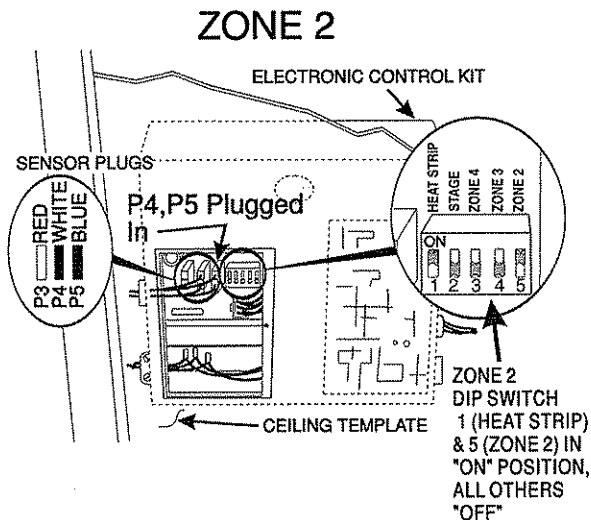


ZONE 2 configuration should have Dip switch 1 (heat strip) and 5 (ZONE 2) to ON position. The cold (freeze) control should be plugged into P5 (blue) connector and remote sensor plugged into P4 (white) connector on the AC power module. (Refer to Figure "ZONE 2")

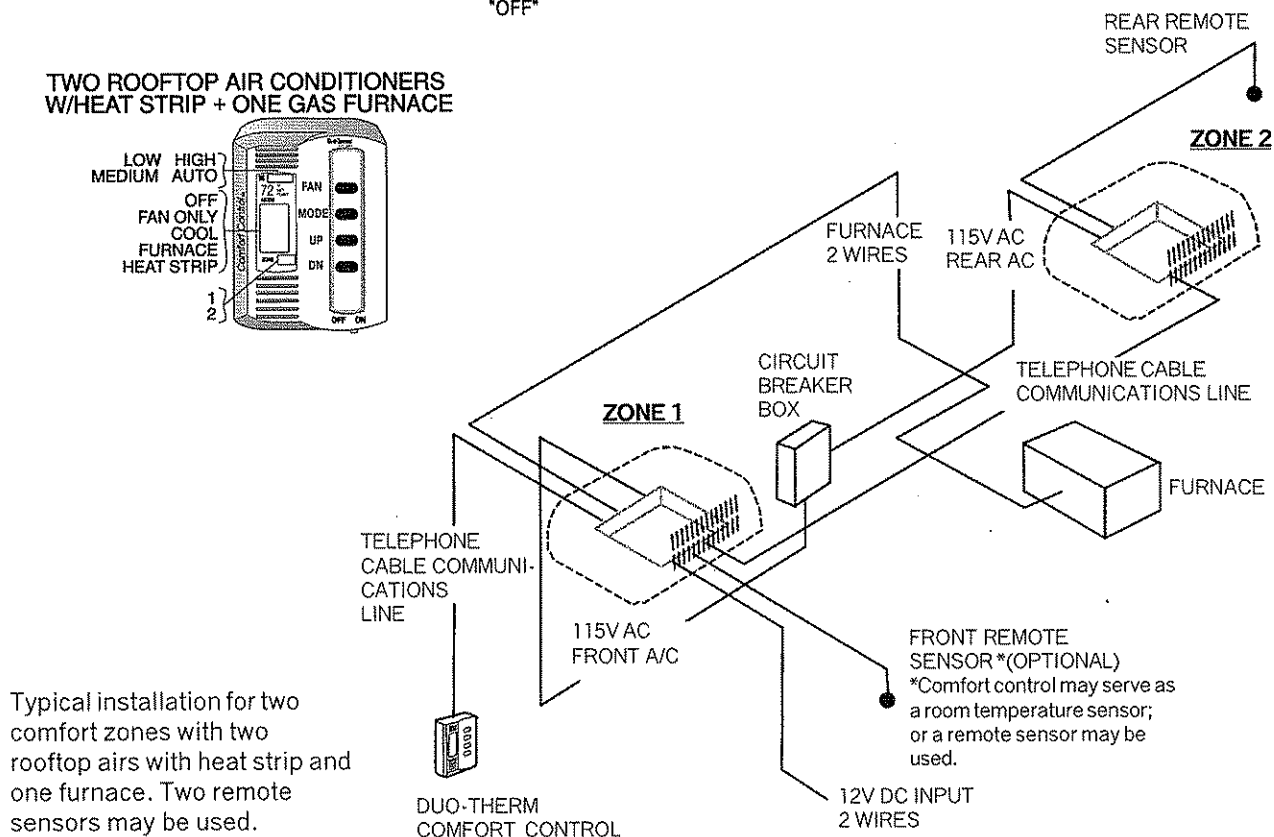
NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



**TWO ROOFTOP AIR CONDITIONERS
W/HEAT STRIP + ONE GAS FURNACE**



3. ONE ROOFTOP AIR CONDITIONER PLUS ONE ROOFTOP HEAT PUMP PLUS ONE GAS FURNACE

To configure one rooftop air conditioner plus one rooftop heat pump plus one gas furnace, ZONES need to be established. For explanation purposes the front unit will be a heat pump on ZONE 1. The rear unit will be an air conditioner on ZONE 2. Zones can be arranged per the customer's wishes.

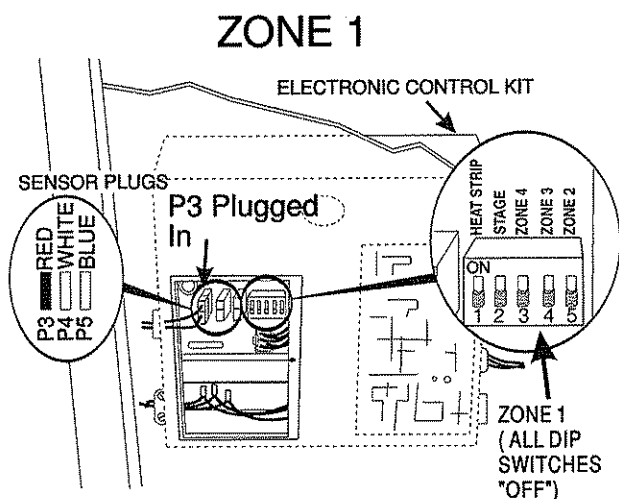
EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

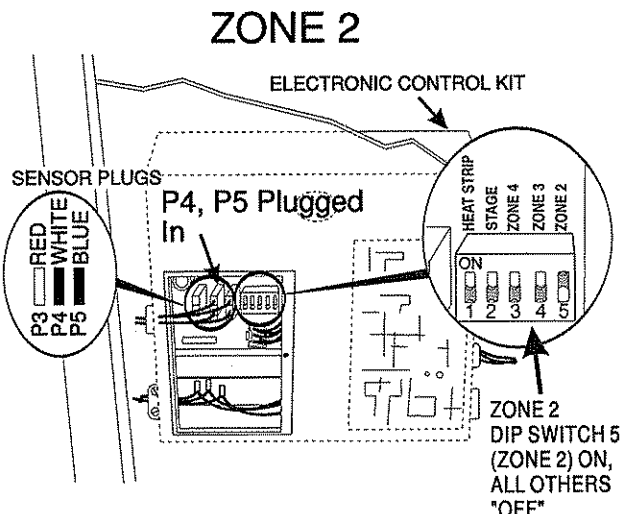
Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

ZONE 1 (Heat Pump) configuration should have all Dip switches to OFF position. The cold (freeze) control is NOT used. The P5 (blue) connector must stay open. The ambient sensor must be plugged into the P3 (red) connector on the AC power module. (Refer to Figure "ZONE 1")



ZONE 2 (Air Conditioner) configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. The cold (freeze) control should be plugged into P5 (blue) connector and remote sensor plugged into P4 (white) connector on the AC power module. (Refer to Figure "ZONE 2")

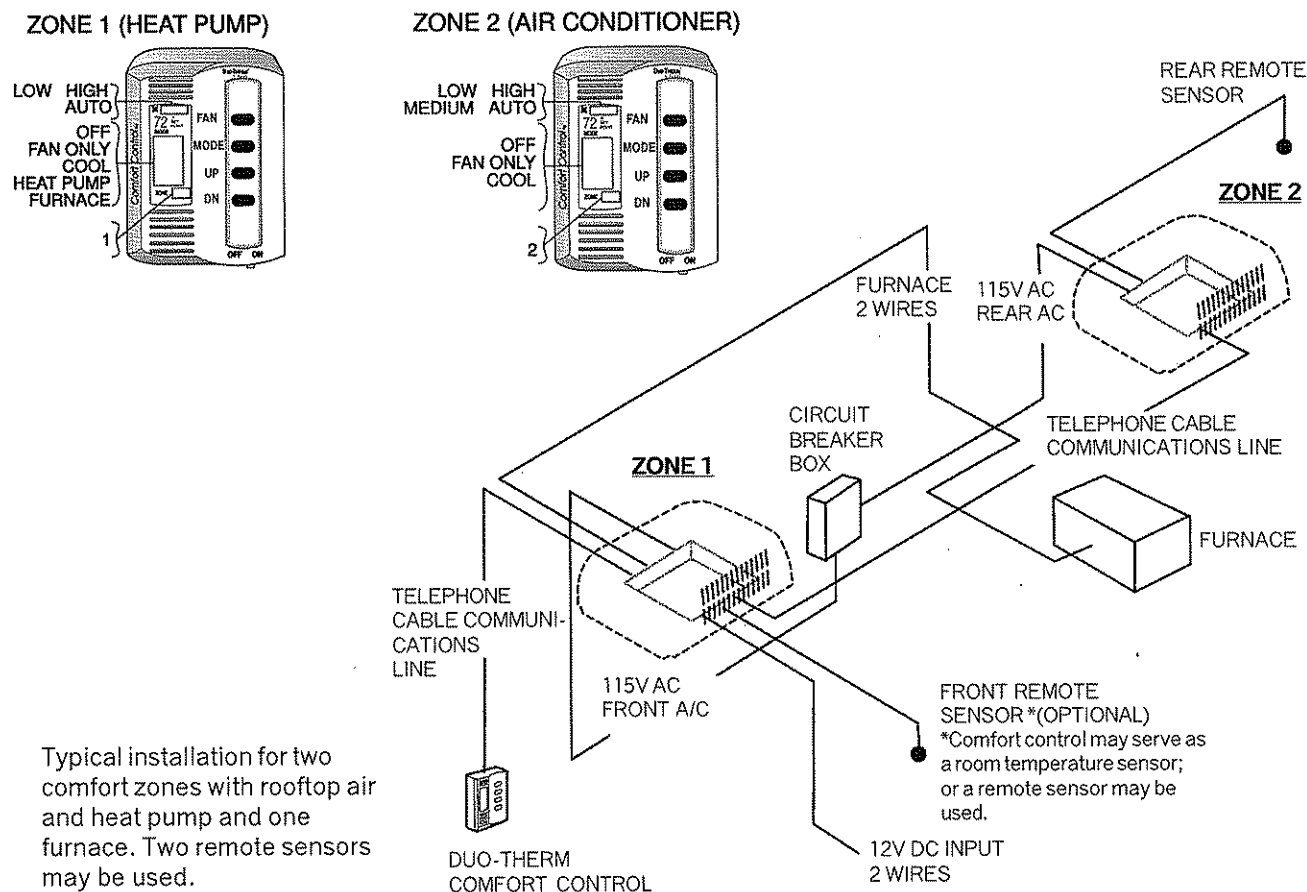


NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.

(Refer to diagram on top of Page 31)



4. TWO ROOFTOP HEAT PUMPS PLUS ONE GAS FURNACE

To configure two rooftop heat pumps plus one gas furnace, ZONES need to be established. For explanation purposes, the front unit will be ZONE 1 and the rear unit will be ZONE 2. Zones can be arranged per the customer's wishes.

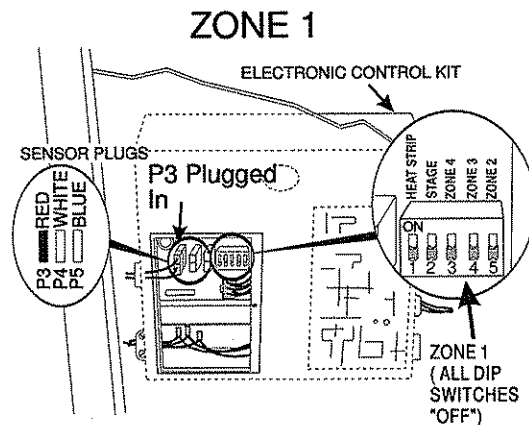
EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

ZONE 1 configuration should have all Dip switches to OFF position. The cold (freeze) control is NOT used. The P5 (blue) connector must stay open. The ambient sensor must be plugged into the P3 (red) connector on the AC power module. (Refer to Figure "ZONE 1")

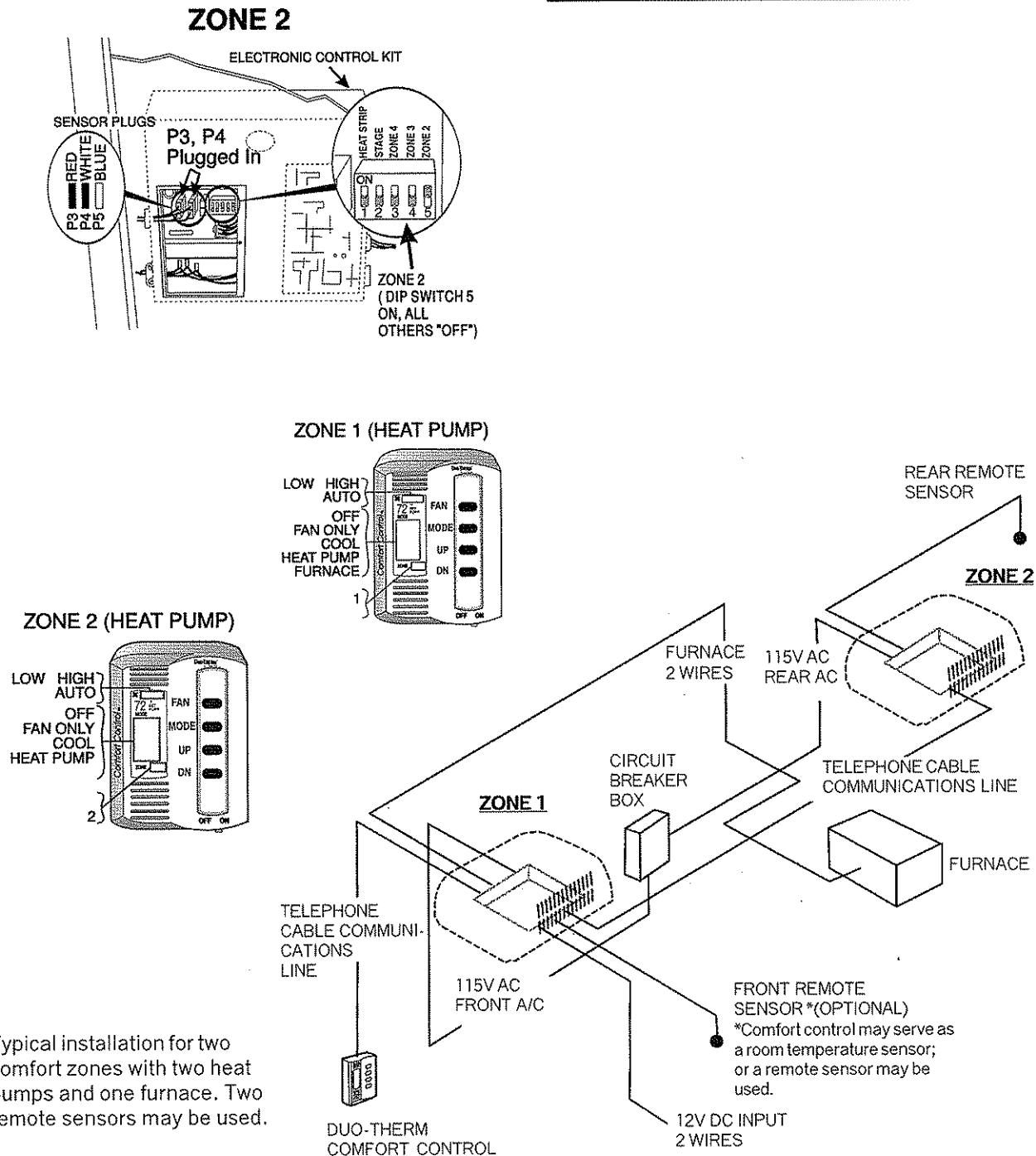


ZONE 2 configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. The cold (freeze) control is NOT used. The P5 (blue) connector must stay open. The ambient sensor must be plugged into the P3 (red) connector on the AC power module. (Refer to Figure "ZONE 2")

NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

! CAUTION

Improper connections can cause component damage.



5. TWO BASEMENT AIR CONDITIONERS PLUS ONE GAS FURNACE

To configure two basement air conditioners plus one gas furnace, ZONES need to be established. For explanation purposes, the front unit will be ZONE 1, and the rear unit will be ZONE 2. Zones can be arranged per the customer's wishes.

EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

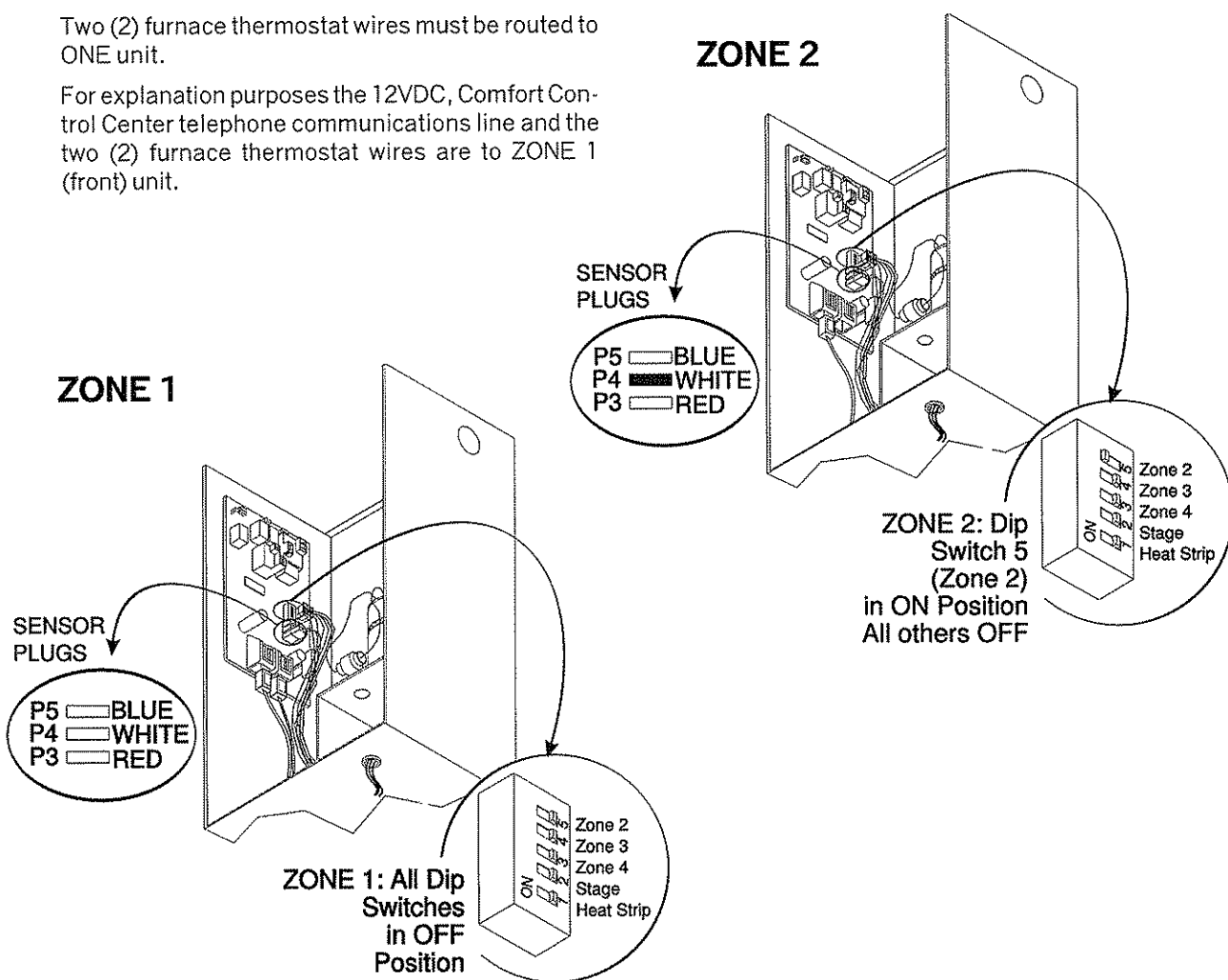
ZONE 1 configuration should have all Dip switches to OFF position. (Refer to Figure "ZONE 1")

ZONE 2 configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. (Refer to Figure "ZONE 2")

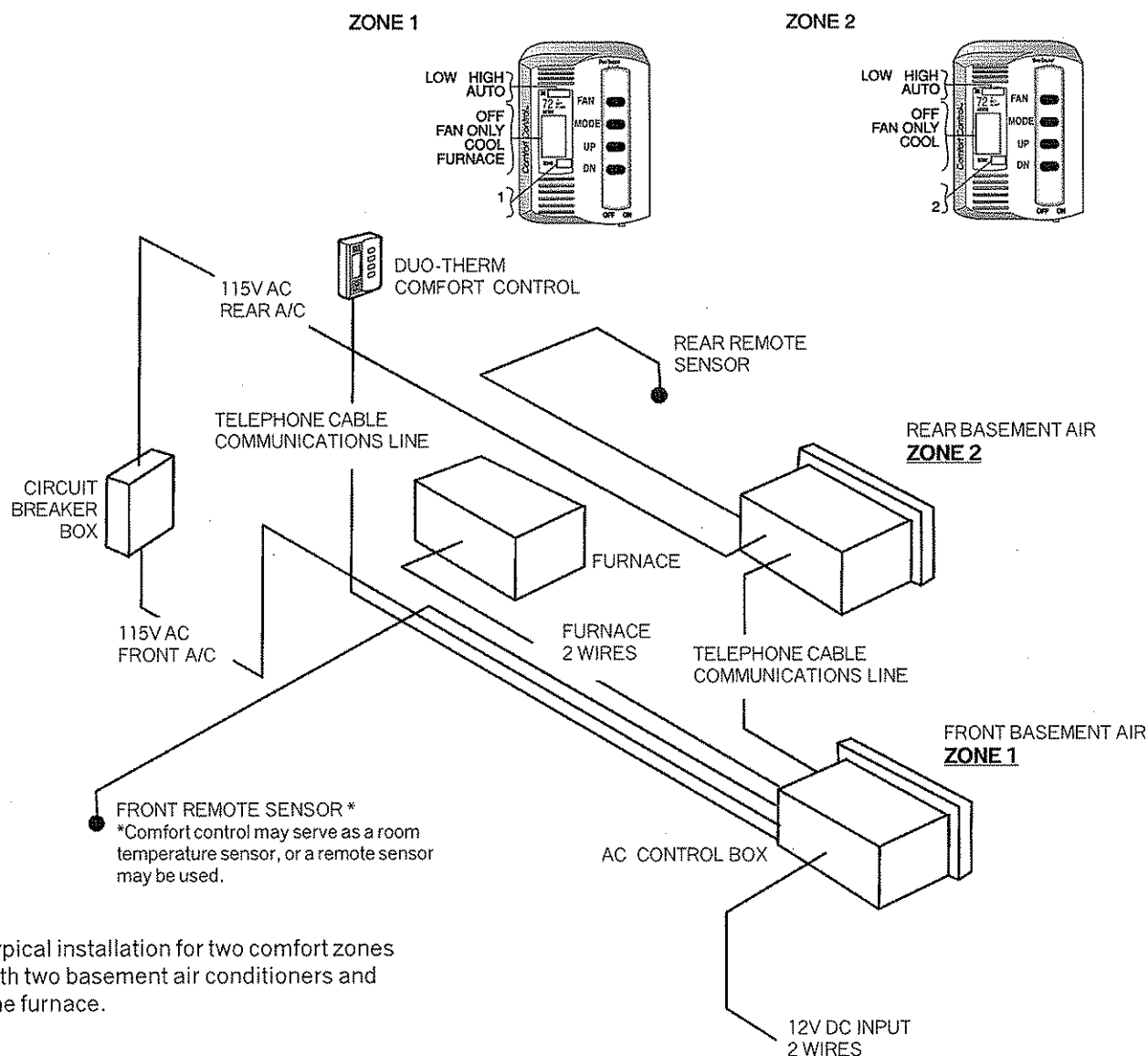
NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

CAUTION

Improper connections can cause component damage.



(Refer to Diagram on top of Page 34)



6. TWO BASEMENT HEAT PUMPS PLUS ONE GAS FURNACE

To configure two basement air heat pumps plus one gas furnace, ZONES need to be established. For explanation purposes, the front unit will be ZONE 1, and the rear unit will be ZONE 2. Zones can be arranged per the customer's wishes.

EACH unit must have 115VAC. Only one unit requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit.

Another telephone communications line must be between the two units.

Two (2) furnace thermostat wires must be routed to ONE unit.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires are to ZONE 1 (front) unit.

ZONE 1 configuration should have all Dip switches to OFF position. The ambient sensor should be plugged into P3 (red) connector. (Refer to Figure "ZONE 1", Page 35)

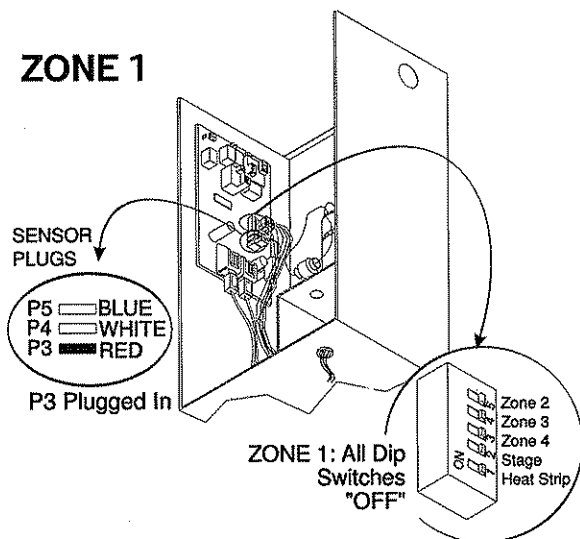
ZONE 2 configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. The ambient sensor should be plugged into P3 (red) connector. The remote sensor should be plugged into P4 (white) connector. (Refer to Figure "ZONE 2")

NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

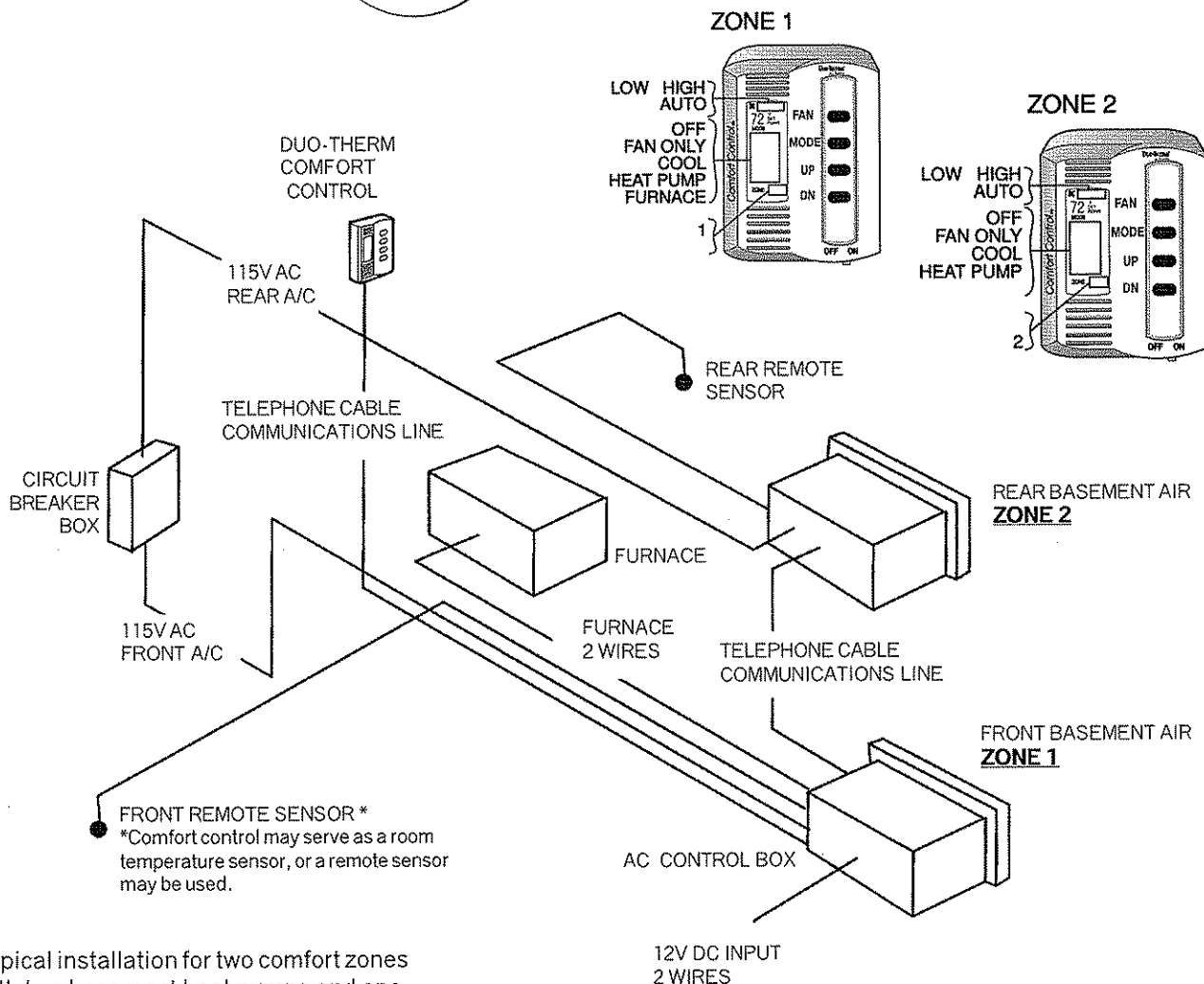
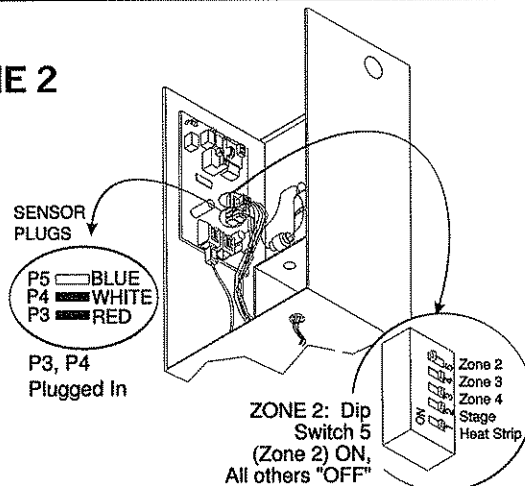
CAUTION

Improper connections can cause component damage.

ZONE 1



ZONE 2



Typical installation for two comfort zones with two basement heat pumps and one furnace.

7. TWO ROOFTOP AIR CONDITIONERS PLUS TWO GAS FURNACES

To configure two rooftop air conditioners plus two gas furnaces, ZONES need to be established. For explanation purposes, the front air conditioner and one furnace will be Zone 1, and the rear air conditioner and one furnace will be Zone 2. Zones can be arranged per the customer's wishes.

EACH air conditioner must have 115VAC. Only one air conditioner requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE air conditioner only.

Another telephone communications line must be between the two air conditioners.

Two (2) furnace thermostat wires must be between front furnace and front air conditioner. Two (2) furnace thermostat wires must be between rear furnace and rear air conditioner.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires from front furnace are to ZONE 1 (front) air conditioner.

The two (2) furnace thermostat wires from rear furnace are to Zone 2 (rear) air conditioner.

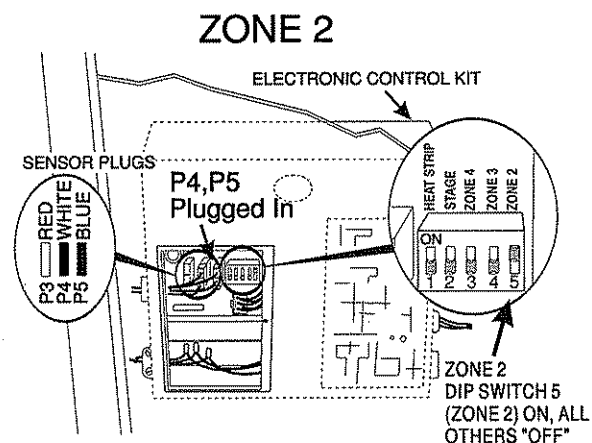
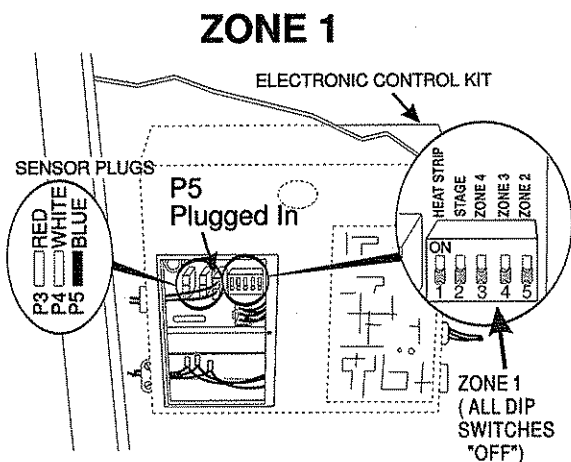
ZONE 1 configuration should have all Dip switches to OFF position and the cold (freeze) control plugged into P5 (blue) connector. (Refer to Figure "ZONE 1")

ZONE 2 configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. The cold (freeze) control should be plugged into P5 (blue) connector. The remote sensor (if used) must be plugged into P4 (white) connector. (Refer to Figure "ZONE 2")

NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

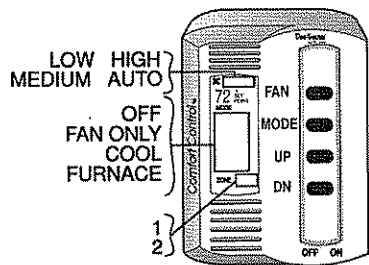
CAUTION

Improper connections can cause component damage.

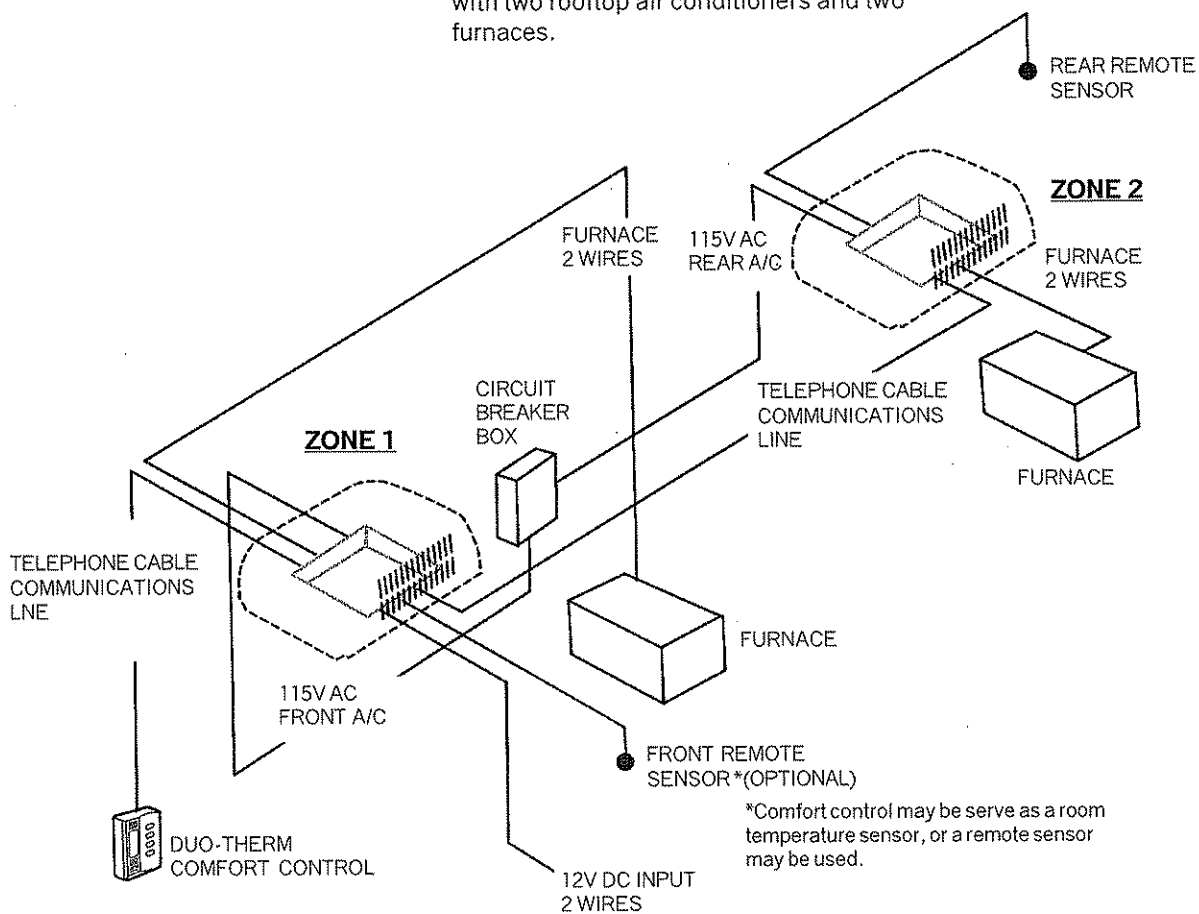


(Refer to Diagram on top of Page 37)

ZONE 1 & ZONE 2



Typical installation for two comfort zones with two rooftop air conditioners and two furnaces.



8. ONE ROOFTOP HEAT PUMP PLUS ONE ROOFTOP AIR CONDITIONER PLUS TWO GAS FURNACES

To configure one rooftop heat pump plus one rooftop air conditioner plus two gas furnaces, ZONES need to be established. For explanation purposes, the front unit (heat pump) and one furnace will be Zone 1; and the rear unit (air conditioner) and one furnace will be Zone 2. Zones can be arranged per the customer's wishes.

EACH air conditioner must have 115VAC. Only one air conditioner requires 12VDC. Telephone communications line must be between the Comfort Control Center and ONE unit only.

Another telephone communications line must be between the two units.

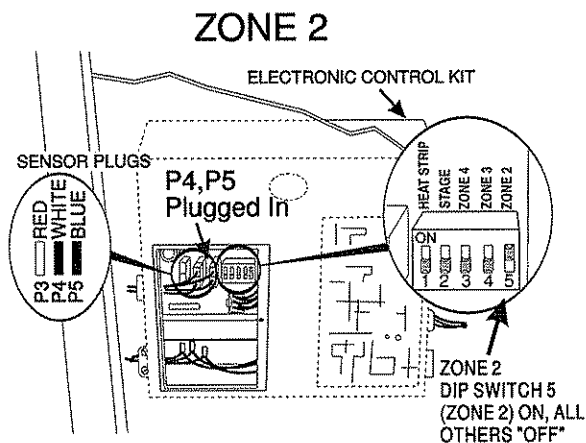
Two (2) furnace thermostat wires must be between front unit and front furnace. Two (2) furnace thermostat wires must be between rear unit and rear furnace.

For explanation purposes the 12VDC, Comfort Control Center telephone communications line and the two (2) furnace thermostat wires from front furnace are to ZONE 1 (front) unit.

The two (2) furnace thermostat wires from rear furnace are to Zone 2 (rear) unit.

ZONE 1 (heat pump) configuration should have all Dip switches to OFF position. The cold (freeze) control is NOT used and P5 (blue) connector should remain open. The ambient sensor should be connect into P3 (red) connector. (Refer to Figure "ZONE 1")

ZONE 2 (air conditioner) configuration should have Dip switch 5 (ZONE 2) to ON position and all other Dip switches to OFF position. The cold (freeze) control should be plugged into P5 (blue) connector. The remote sensor (if used) must be plugged into P4 (white) connector. (Refer to Figure "ZONE 2")

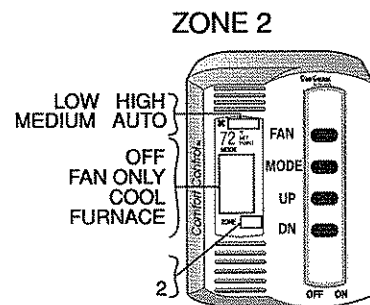
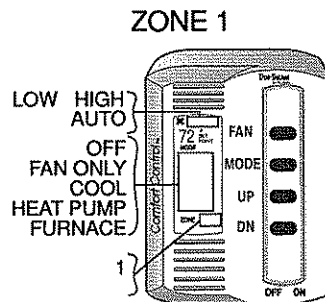
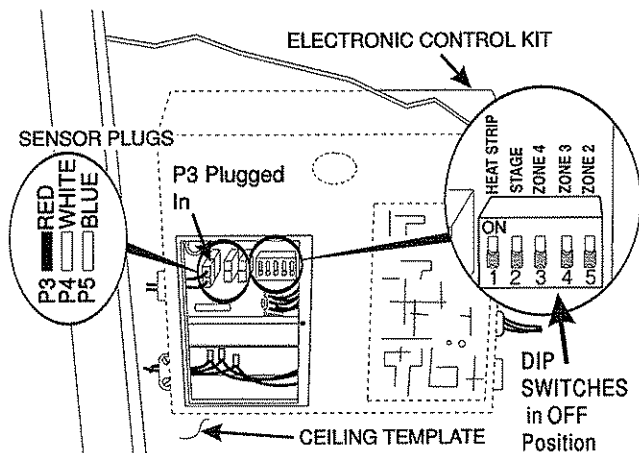


NOTE: If a remote sensor(s) is used, it must be connected into the P4 (white) connector.

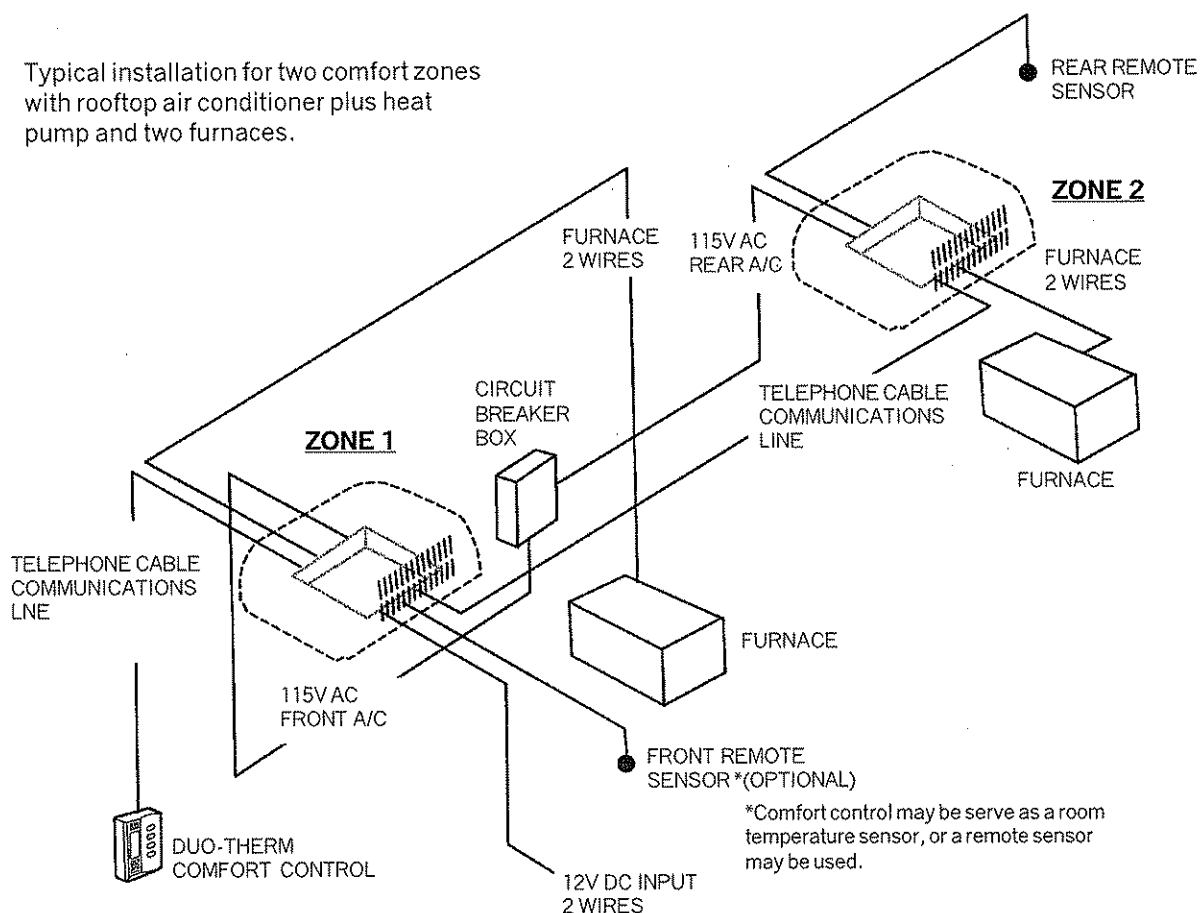
CAUTION

Improper connections can cause component damage.

ZONE 1



Typical installation for two comfort zones with rooftop air conditioner plus heat pump and two furnaces.



C. THREE COMFORT ZONES

To configure three units, ZONES need to be established. Refer to Section 2A and 2B for Zone 1 and Zone 2 configuration.

115V AC must be to ZONE 3 unit. A telephone communication line must be between ZONE 2 and ZONE 3 units.

Configure ZONE 3 unit the same as other **like** units, **EXCEPT** for the Dip Switches. Dip Switch 4 (ZONE 3) to ON position, and all other Dip Switches to OFF position.

D. FOUR COMFORT ZONES

To configure four units, ZONES need to be established. Refer to Section 2A, 2B and 2C for Zone 1, Zone 2 and Zone 3 configuration.

115V AC must be to ZONE 4 unit. A telephone communication line must be between ZONE 3 and ZONE 4 units.

Configure ZONE 4 unit the same as other **like** units, **EXCEPT** for the Dip Switches. Dip Switch 3 (ZONE 4) to ON position, and all other Dip Switches to OFF position.

SECTION 3

AC VOLTAGE REQUIREMENTS

3.1 AC VOLTAGE

The unit is a 115V AC, 60 Hz. appliance. The proper operation range is between 103 volts and 126.5 volts. The voltage reading should be taken at the unit power supply leads. One test should be performed when the unit is turned OFF and another with it under a load. If the voltage is not within the proper operating range, it must be corrected before operating the heat pump.

⚠ WARNING

THIS IS AN ENERGIZED CIRCUIT. SHOCK CAN OCCUR IF NOT TESTED PROPERLY. TESTING TO BE DONE BY A QUALIFIED SERVICE TECHNICIAN.

Check for proper AC volts at the connections at the unit's electronic control box on roof mounted units and at the connections at the electric box on basement units.

The dual units (Models 39224 and 39424) have two AC volt circuits to them. Verify that Circuit 1 is wired into CIR 1 terminal block, and Circuit 2 is wired into CIR 2 terminal block. (See Sec. 3.3). Check for proper AC volts at each terminal block.

3.2 BREAKER

⚠ WARNING

MAKE SURE THAT THE POWER SUPPLY TO THE UNIT IS DISCONNECTED BEFORE PERFORMING ANY WORK ON THE UNIT TO AVOID THE POSSIBILITY OF SHOCK INJURY OR DAMAGE TO THE EQUIPMENT.

The unit circuit is to be protected by a time delay fuse or HACR (heating, air conditioner, refrigerator) breaker. By taking an amp reading at the unit AC voltage supply line, you can determine if the breaker is tripping prematurely. Place a clamp-on type ammeter around the black wire from the breaker going to the unit. Turn on the unit and record amp draw. If the breaker trips before the rated amperage, replace the breaker.

3.3 WIRING

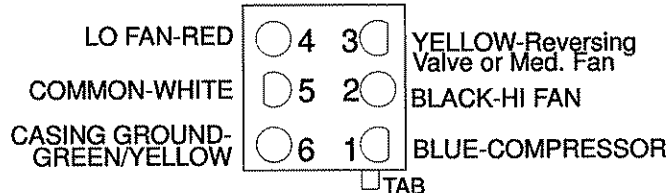
⚠ WARNING

MAKE SURE THAT THE POWER SUPPLY TO THE UNIT IS DISCONNECTED BEFORE PERFORMING ANY WORK ON THE UNIT TO AVOID THE POSSIBILITY OF SHOCK INJURY OR DAMAGE TO THE EQUIPMENT.

With the line circuit breaker turned OFF, check to see if the unit is wired correctly. Each unit is supplied with a wiring diagram. Check all wires for proper location and tight connections. If you have difficulty in reading wiring diagrams or schematics, please enroll in an electricity course at your local school or college.

NOTE: BE SURE TO USE THE WIRING DIAGRAM FOR THE SPECIFIC MODEL OF UNIT YOU ARE DIAGNOSING.

On rooftop units there is a 6-pin connector. Verify that all wires are tight in this connector.

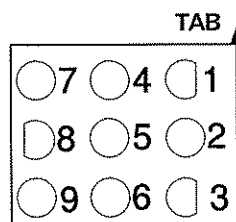


MODELS		CIRCUIT PROTECTION
39125 (Basement)		15 amp T.D. Fuse or 15 amp HACR Breaker
39325 (Basement)		20 amp T.D. Fuse or 20 amp HACR Breaker
39224 (Basement)	Circuit 1	15 amp T.D. Fuse or 15 amp HACR Breaker
	Circuit 2	15 amp T.D. Fuse or 15 amp HACR Breaker
39424 (Basement)	Circuit 1	15 amp T.D. Fuse or 15 amp HACR Breaker
	Circuit 2	15 amp T.D. Fuse or 15 amp HACR Breaker
All Rooftop Units		20 amp T.D. Fuse or 20 amp HACR Breaker

On some basement units there are two 9-pin connectors.
Verify all wires are tight in each connector.

TERM 1- Compressor (C)
TERM 2- Compressor (R)
TERM 3- Compressor (S)
TERM 4- Common (motor)
TERM 5- Capacitor (motor)

TERM 6- Hi Fan (motor)
TERM 7- Lo Fan (motor)
TERM 8- Reversing Valve
TERM 9- Reversing Valve

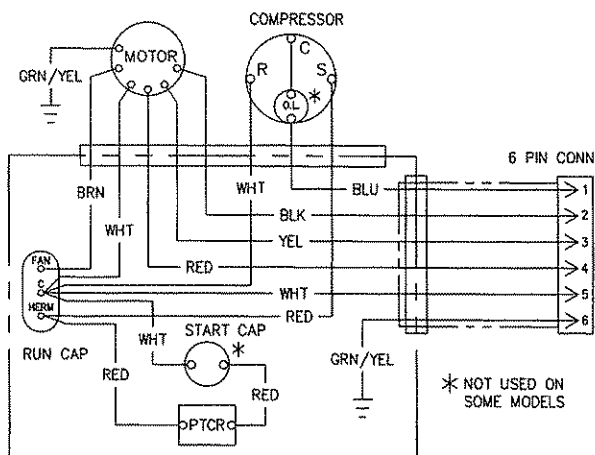


CIRCUIT 1
1 - Black
2 - White
3 - Red
4 - White
5 - Brown
6 - Black
7 - Red
8 - Violet
9 - Violet

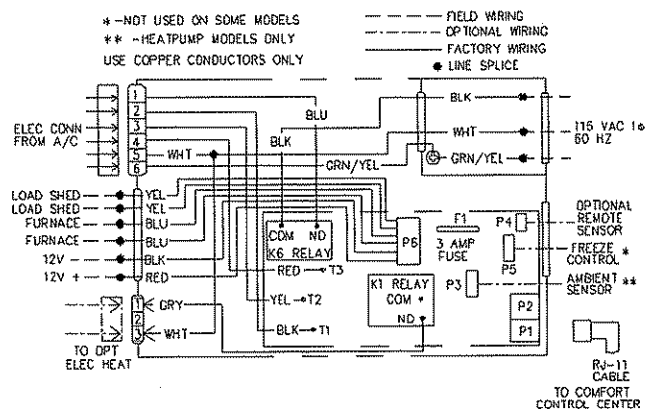
CIRCUIT 2
1 - Orange
2 - Gray
3 - Brown
4 - White
5 - Brown
6 - Black
7 - Red
8 - Open
9 - Open

TYPICAL WIRING DIAGRAMS FOR ROOF TOP UNITS

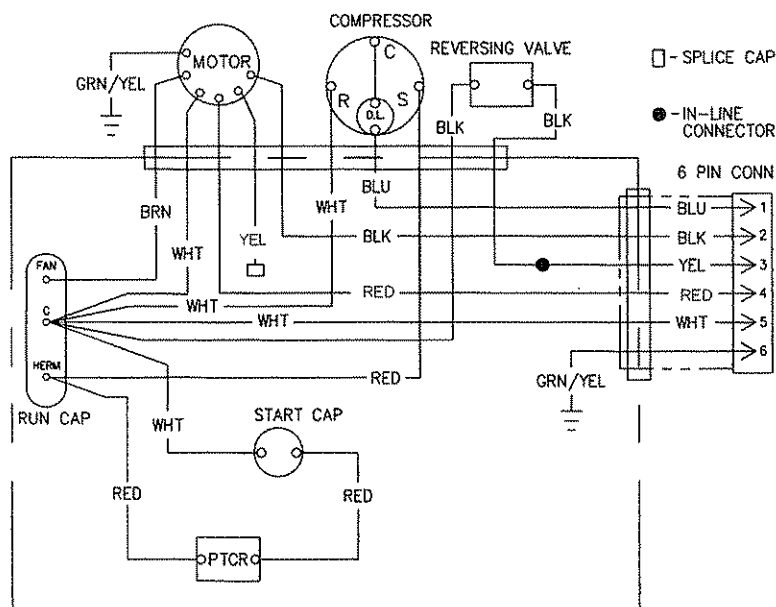
AIR CONDITIONER



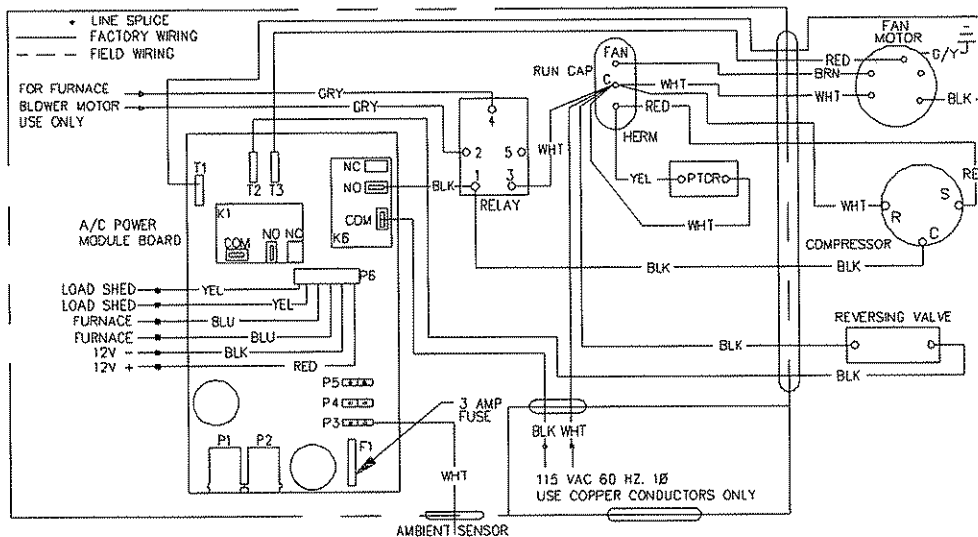
ELECTRONIC CONTROL KIT



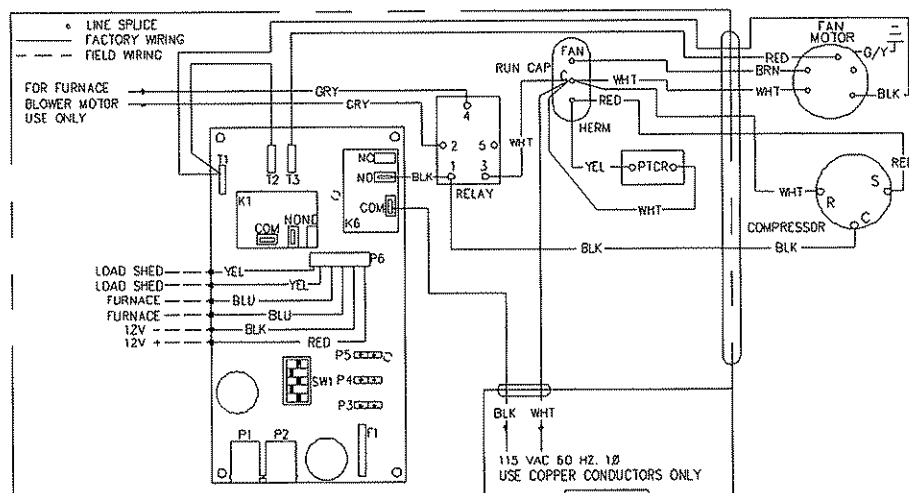
HEAT PUMP



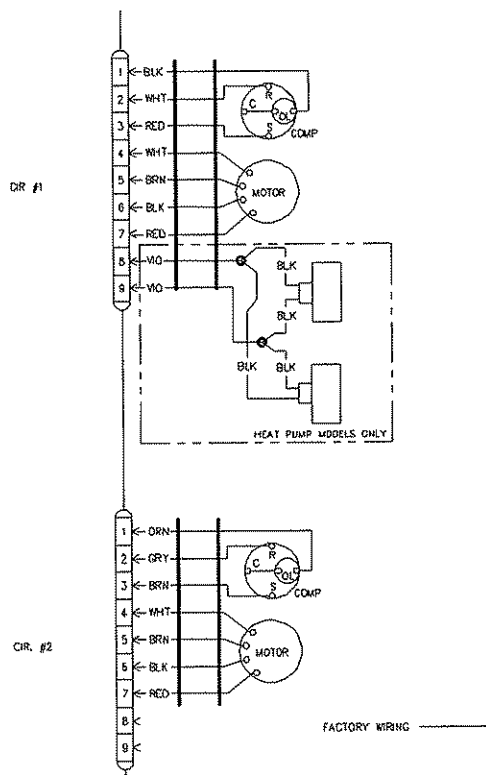
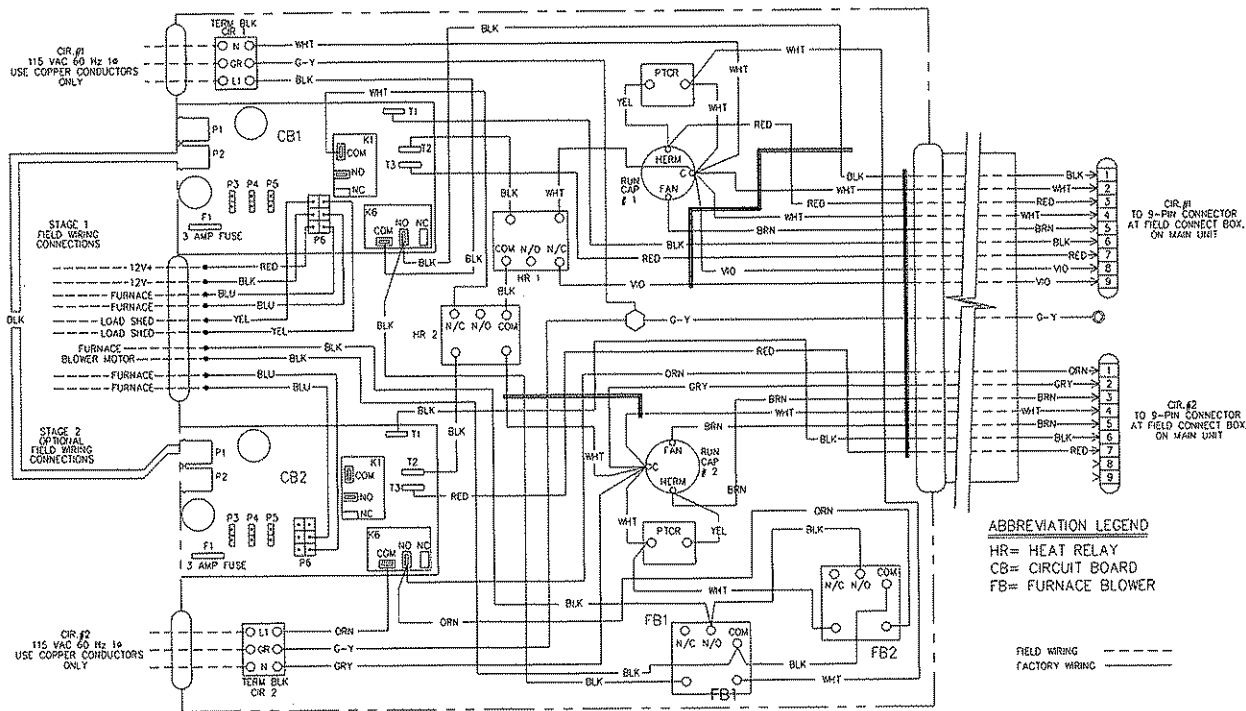
TYPICAL WIRING DIAGRAM FOR SINGLE BASEMENT HEAT PUMP



TYPICAL WIRING DIAGRAM FOR SINGLE BASEMENT AIR CONDITIONER



TYPICAL WIRING DIAGRAM FOR DUAL BASEMENT



SECTION 4

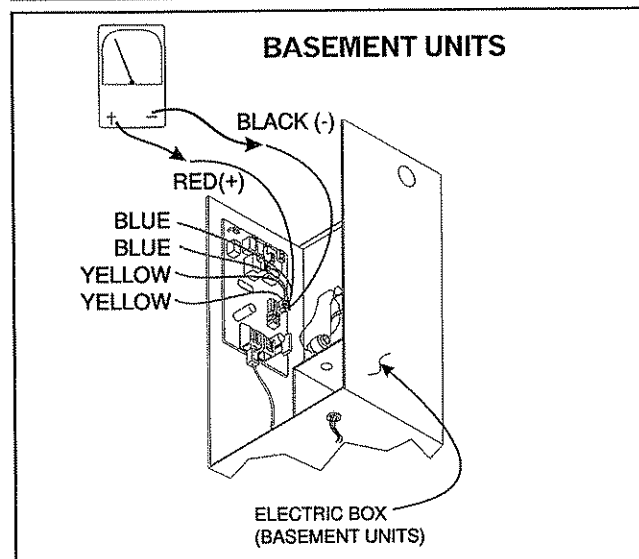
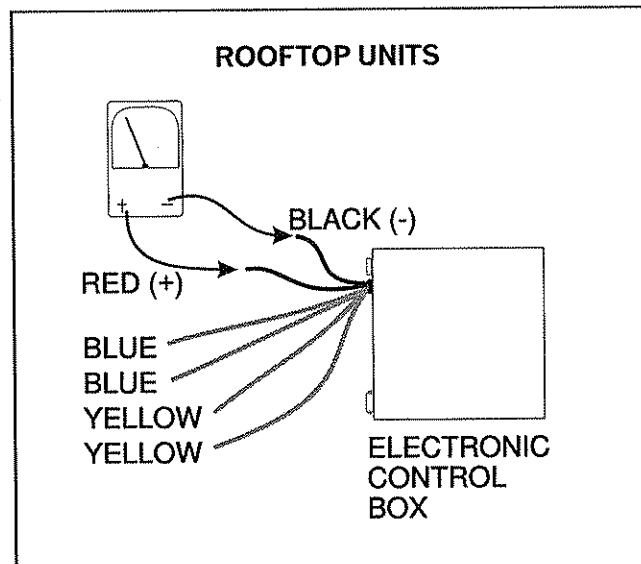
DC VOLT REQUIREMENTS

A DC volt supply is required for operation of the Comfort Control Center. The operating range is 10 to 30 volts DC. If DC volts are outside of the operating range, you could experience improper or erratic operation.

⚠ CAUTION

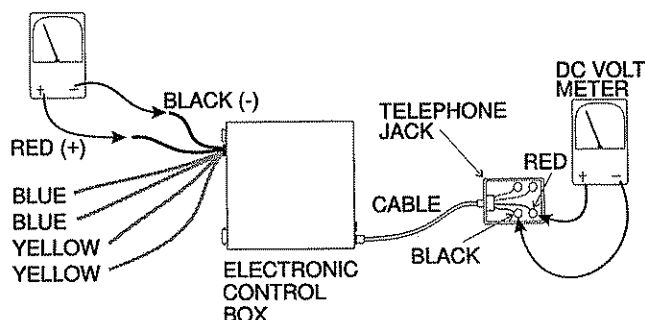
DC VOLTS IN EXCESS OF 30 VOLTS CAN CAUSE DAMAGE TO THE COMPONENTS OF THE SYSTEM.

To check DC volts, first check the incoming DC volts between red (+) positive, and black (—) negative, at the connections on the electronic control box on rooftop units; or at the connections at the electric box on basement units.



Next check the output DC volts from the AC power module. This can be done by using a short telephone communications line. One end plugged into one of the RJ11 connectors on the AC power module and the other end plugged into a standard telephone jack. Next measure the DC volts between red (+) and black (—). If volts are more at this check, AC ripple is on the incoming DC source. Be sure DC volts are less than 30.

The AC power module has a filter within the circuitry to filter any AC ripple and will increase DC volts if AC ripple is present.



SECTION 5

COMPONENTS

5.1 COMFORT CONTROL CENTER □

The comfort control center is the component that makes all decisions for operation depending on the system and the accessories connected to it.

NOTE: The PAL tester with the air conditioner Comfort Control Center Data Capture Module attached will test the integrity and circuitry of the Comfort Control Center.

If the system is to be used **WITHOUT** a **Remote Temperature Sensor**, the proper location of the **Comfort Control Center** is very important to ensure that it will provide a comfortable RV temperature. Observe the following rules when selecting a location:

- Locate the Comfort Control Center 54" above the floor.
- Install the Comfort Control Center on a partition, not on an outside wall.
- NEVER** expose it to direct heat from lamps, sun or other heat producing items.
- Avoid locations close to doors that lead outside, windows or adjoining outside walls.
- Avoid locations close to supply registers and the air from them.

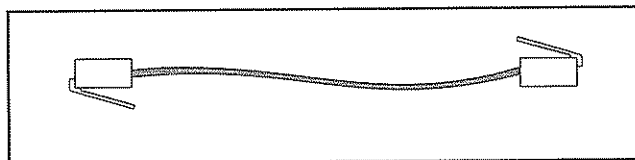
If the system is to be used **WITH** a **Remote Temperature Sensor** in **ALL** zones, the Comfort Control Center may be mounted anywhere that is convenient in the coach. Try to avoid hard to see areas.

To check the Comfort Control Center, first verify the ON/OFF switch is in the ON position. Next, verify DC volts (10 to 30) and polarity are correct (see Sec. 4). Then do a reset procedure (see Sec. 1M). If the Comfort Control Center still does not illuminate when depressing any selector button or the liquid crystal display does not read (see Sec. 1), replace it. If the correct function does not show on the liquid crystal display, verify configuration is correct (see Sec. 2) before replacing the Comfort Control Center.

5.2 CABLE ASSEMBLY

A flat telephone extension cable must be routed from the unit to the Comfort Control Center. It must be 26 gauge, stranded copper wire, four (4) conductor (yellow, green, red and black). The cable must be terminated with a four (4) position telephone RJ-11 connector.

NOTE: DO NOT USE A PRE-MADE TELEPHONE EXTENSION CABLE. THE POLARITY OF THE CONNECTORS IS REVERSED AND WILL CAUSE A FAILURE OF THE SYSTEM.



The cable assembly should be made in the following manner:

Cut the modular cable to the desired length. When cutting, make sure ends are cut straight, not diagonally. Next, use an RJ11 connector crimping tool.

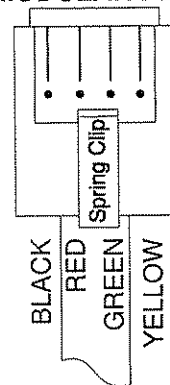
Use the stripper section of the tool's blade to remove the outer insulation from each end of the cable. Be careful not to remove or break the colored insulation on the inner conductors.

NOTE: Fully insert the cable into the stripper slot, holding cable in one hand and tool in the other hand. Squeeze down on tool and pull away. This will remove the correct amount of outer insulation for insertion into RJ-11 modular plug.

Now you are ready to insert the prepared cable into the RJ-11 modular plug. When inserting cable into plug, you **MUST** be sure that the black wire is on your left as you look at the top of the plug (with the spring clip facing you) and that the conductors are flush with the tip of the plug and touching the small teeth-like gold conductors. Insert the RJ-11 modular plug with the cable into the tool's cavity, squeeze down to the STOP and hold for a few seconds. This completes connections for one end of the cable. To prepare the other end of the cable, repeat this procedure.

NOTE: Be sure polarity is the same on each plug. Example: Black on left (viewing plug from top, spring clip side).

TOP VIEW OF RJ-11 MODULAR PLUG



5.3 BLOWER MOTOR

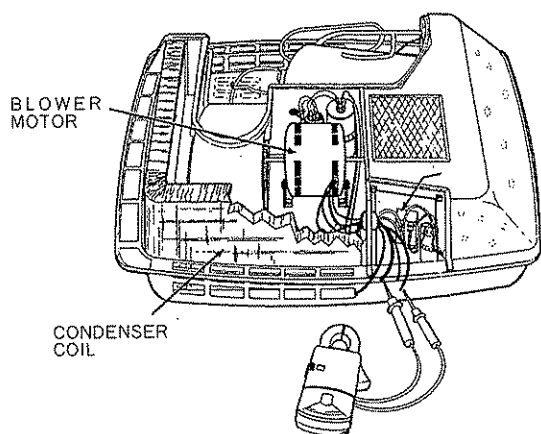
A. ROOFTOP UNITS

To check the motor, turn the unit circuit breaker to OFF. With an AC volt meter, verify that the circuit has no AC volts. On most units, the wires from the motor connect directly into a 6 or 9-pin connector. The motor leads are white (common), black (high), red (low) and yellow (medium). Some units are 2-speed. If you are checking a 2-speed system, disregard the yellow wire. Set your VOM to the ohms scale. You will perform a continuity test. Check for continuity between the white wire and each of the other wires.

LO FAN-RED	4	3	YELLOW-MED. FAN
COMMON-WHITE	5	2	BLACK-HI FAN
CASING GROUND- GREEN/YELLOW	6	1	BLUE-COMPRESSOR
		TAB	

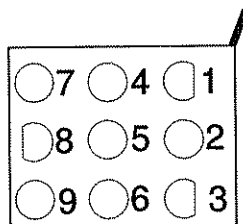
Lack of continuity between the white wire and any of the other wires indicates an open circuit and requires that the motor be changed. Next, check for continuity between each wire and the green/yellow wire. If you get continuity, you have a grounded motor and it must be replaced.

On Models 620315 and 630215, the motor leads do not go into a connector. On these units, disconnect the wires from the AC power module and do the previous tests between the motor leads.



B. BASEMENT UNITS

To check the motor, turn the unit circuit breaker or breakers to OFF. With an AC volt meter, verify that the circuit has no AC volts. On units with one compressor, the wires from the motor connect to the AC power module. On units with two compressors (dual), the wires from the motor connect to a 9-pin connector. The motor leads are white (common-Terminal 4), black (high-Terminal 6) and red (low-Terminal 7). Set your VOM to the ohms scale. You will perform a continuity test. Check for continuity between the white wire and each of the other wires.



CIRCUIT 1	CIRCUIT 2
1 - Black	1 - Orange
2 - White	2 - Gray
3 - Red	3 - Brown
4 - White	4 - White
5 - Brown	5 - Brown
6 - Black	6 - Black
7 - Red	7 - Red
8 - Violet	8 - Open
9 - Violet	9 - Open

Lack of continuity between the white wire and any of the other wires indicates an open circuit and requires that the motor be changed. Next, check for continuity between each wire and the green/yellow wire. If you get continuity, you have a grounded motor and it must be replaced.

On units with one compressor, the motor leads do not go into a connector. These models are 39125 and 39335. On these units, disconnect the wires from the AC power module and perform the above tests between the motor leads.

5.4 RUN CAPACITOR

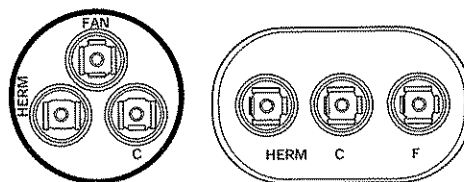
The run capacitor may be one of two different kinds: Either a single capacitor for the fan or compressor, or a combination capacitor for both the fan and the compressor.

The run capacitor should be checked with a capacitor tester. Follow the tester manufacturer's testing procedures. If one is not available, an ohm meter may be used. Only use a dial-type meter. Most digital meters will not do a proper test. Turn the air conditioner circuit breaker OFF. Verify there are not AC volts to the unit before doing any tests.

WARNING

THERE MAY BE A CHARGE ON THE CAPACITOR UNTIL DISCHARGED.

The run capacitor must be manually discharged. Using an AC voltmeter set at the 500 volt scale or higher, connect meter leads to the terminals of the capacitor. After discharging the capacitor, disconnect the wires to the capacitor. Next, set the dial-type VOM meter to the highest ohm scale and connect the probes to the capacitor terminals. The reading should rapidly move toward continuity and slowly return to infinity. You should reverse the leads and repeat the procedure. If there is no reading, or a prolonged reading, replace the run capacitor. The combination run capacitor has three terminals. The terminals are marked "F", "C" and "HERM". To check the combination run capacitor, follow the discharge procedures above. Again, make sure you test from "C" (common) to "F" (fan), and "C" (common) to "HERM" (compressor).



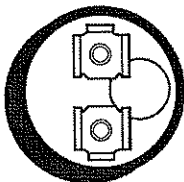
5.5 START CAPACITOR

The start capacitor should be checked with a capacitor tester. Follow the tester manufacturer's testing procedures. If one is not available, an ohm meter may be used. Use a dial-type meter ONLY, most digital meters will not do a proper test. Turn the unit's circuit breaker OFF. Verify there is no AC volts to the unit before doing any tests.

WARNING

THERE MAY BE A CHARGE ON THE CAPACITOR UNTIL DISCHARGED.

The start capacitor must be manually discharged. Using an AC voltmeter set at the 500 volt scale or higher, connect meter leads to the terminals of the capacitor. Next, disconnect the wires to the capacitor. Set the dial-type VOM to the highest ohm scale and connect the probes to the capacitor terminals. The reading should rapidly move toward continuity and slowly return to infinity. Next, you should reverse the leads and repeat the procedure. If there is no reading or a prolonged reading, replace the start capacitor.



5.6 PTCR DEVICE

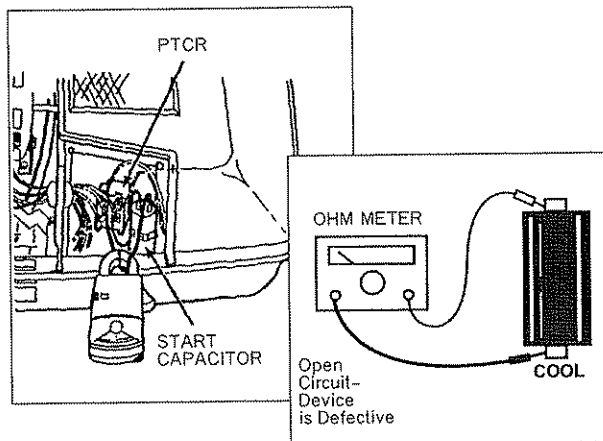
The positive temperature coefficient resistor, or PTCR, has replaced the compressor start relay and the start capacitor, on some models. It should be checked in two different ways:

The first check that should be made is continuity. Turn the air conditioner circuit breaker to OFF. Disconnect the PTCR from the circuit. Check for continuity. If there is no continuity, replace the PTCR.

⚠ WARNING

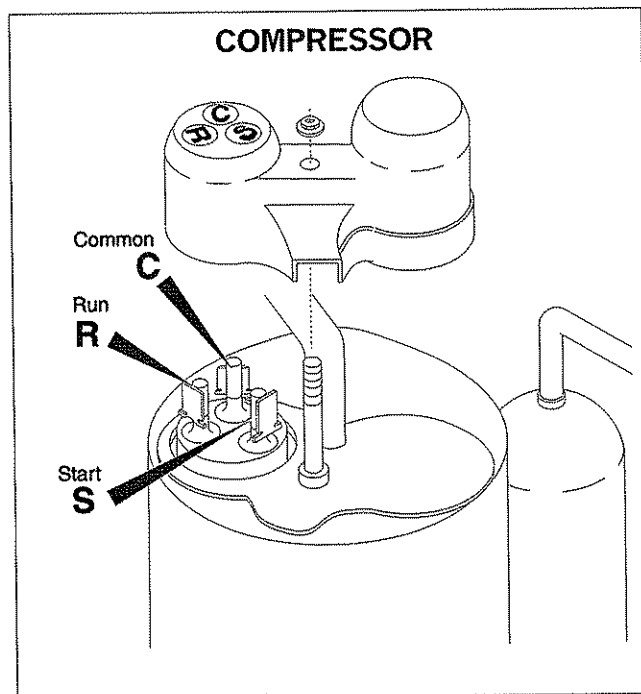
THIS IS AN ENERGIZED CIRCUIT. SHOCK CAN OCCUR IF NOT TESTED PROPERLY. TESTING TO BE DONE BY A QUALIFIED SERVICE TECHNICIAN.

The second check to take is an amperage reading. Clamp an ammeter around the wire from the PTCR to the capacitor. Turn the air conditioner circuit breaker to ON and start the air conditioner. When the compressor starts, there will be an amperage reading for approximately one second or less. If there is no reading, or if there is a prolonged reading, the PTCR or start relay is faulty and must be replaced.



5.7 COMPRESSOR

To check compressor, turn the air conditioner circuit breaker to OFF. Disconnect the wires from the COMMON, START and RUN terminals. With the VOM set on the ohms scale, check for continuity between all three terminals. Lack of continuity between any of the terminals indicates faulty windings in the compressor, and the compressor should be replaced. Next, scrape some paint off the casing of the compressor and check for continuity between each terminal and the casing. If a reading is obtained, the windings are shorted to the casing and the compressor must be replaced.



5.8 OVERLOAD PROTECTOR

An overload protector is a component that will open the AC volt circuit to the compressor if the compressor overheats due to an electrical problem. Some compressors have the overload protector built inside the compressor. This type, if defective, requires a complete compressor replacement.

Most compressors have the overload protector mounted on the exterior of the compressor casing. To check this type of protector, turn the air conditioner circuit breaker OFF. Make sure that the overload is at ambient temperature and measure continuity across its terminals. If open, it should be replaced. A weak overload protector in the electrical system will cause the compressor to start and stop rapidly or short-cycle. This situation would be difficult to test. An exact replacement overload protector should be used whenever a replacement is required.

5.9 REVERSING VALVE

The reversing valve is the heart of a heat pump. It directs refrigerant flow to the coils to achieve proper direction of flow that allows the same system to supply heated or cooled air to enter the inside atmosphere of the structure according to occupants' desires.

The reversing valve's solenoid can be energized in either HEAT or COOL mode of operation. Most Duo-Therm Heat Pumps have the solenoid energized in the COOL mode of operation. The Dual (Model 39424) has the solenoid energized in the HEAT mode of operation.

One way to check the reversing valve is to feel the refrigerant line at the top of the inside coil. In the COOL mode, this line will be cool or cold to the touch. In the HEAT mode, this line will be warm or hot to the touch. If you do not achieve these results, direction of refrigerant flow is not correct.

The ohms resistance of the reversing valve solenoid coil is approximately 465 ohms plus or minus (\pm) 10%.

On Model 39424, verify AC volts are to the solenoid coil when in HEAT mode. If AC volts are NOT present, verify wiring is correct and the 9-pin terminal connector is proper; and connection is completed through it. Next, verify AC power module board is correct. If AC volts is present and refrigerant flow is not proper, the reversing valve assembly needs to be replaced.

On all other models verify AC volts is to the solenoid coil when in COOL mode. If AC volts are NOT present, verify wiring is correct and the 6-pin terminal connector is proper; and connection is completed through it. Next, verify AC power module board is correct. If AC volts are present and refrigerant flow is not proper, the reversing valve assembly needs to be replaced.

5.10 COLD (FREEZE) CONTROL (Low Temperature Protection Device)

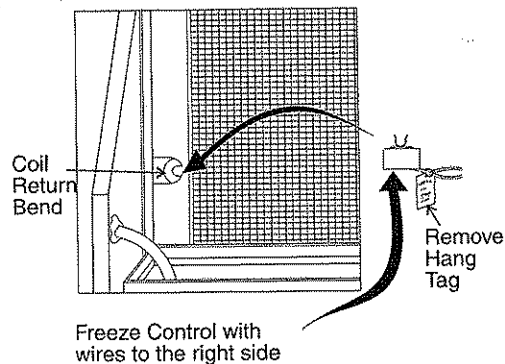
The cold (freeze) control is used on rooftop air conditioners ONLY. If it is used with rooftop heat pumps, it can cause premature shutoff of the compressor.

The cold (freeze) control is a normally open type (no continuity).

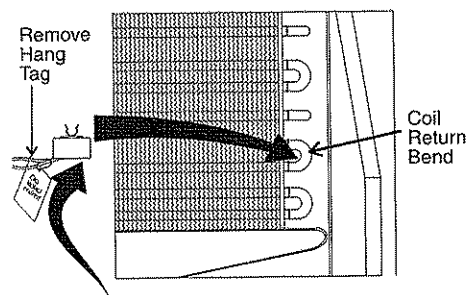
When the refrigerant line the cold control is attached to reaches below freezing temperatures, it will close (continuity). When the temperature of the line reaches approximately 65° to 70°F., it will open (no continuity). Verify temperature of the refrigerant line before changing.

NOTE: A defective switch can cause a cycle problem with the unit.

579 & 595 FREEZE CONTROL



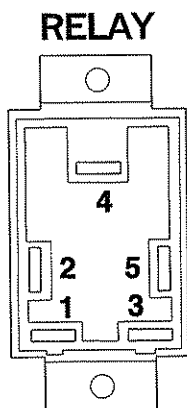
600 & 630 FREEZE CONTROL



5.11 RELAY, 2 POLE

The relay is used on basement air conditioner Model 39125 and Basement heat pump Model 39335 ONLY. The relay has five (5) terminals. **It is used to complete a circuit to the furnace.**

Terminals 1 and 3 are the coil terminals. When the coil (terminals 1 and 3) is not energized (no power to terminals 1 and 3), continuity should exist between terminals 4 to 5; and no continuity between terminals 2 to 4.



When the coil (terminals 1 and 3) is energized (power to terminals 1 and 3), continuity should exist between terminals 2 to 4 and no continuity between terminals 4 to 5. This relay is used to energize the furnace blower any time the compressor is energized. This circuit has been added to enhance both the cooling and heating operation.

NOTE: This circuit will not work with all furnaces. Before using this circuit, check with the furnace manufacturer for proper wire connection to the furnace. Other components may or may not be required. Read and follow the instructions provided with the furnace.

INSTRUCTIONS FOR FURNACE CONNECTIONS:



THE FOLLOWING FURNACE CONNECTION INSTRUCTIONS ONLY PERTAIN TO ONE SPECIFIC FURNACE MANUFACTURER, AND MAY NOT APPLY TO YOUR INSTALLATION.

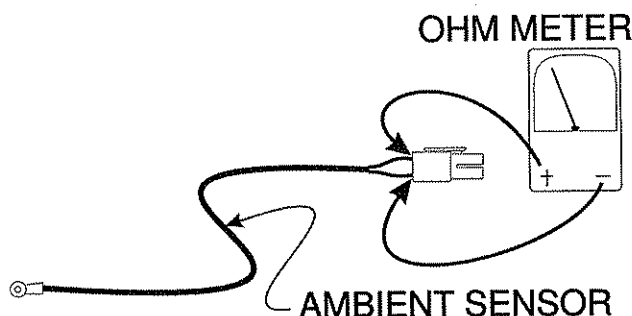
Run a 12 volt DC positive lead to one of the gray wires in the unit electrical box and secure with an approved connector.

Run a second lead from the furnace blower motor or terminal board to the remaining gray lead in the unit electrical box. Secure with an approved connector.

5.12 AMBIENT SENSOR

The ambient sensor is the outside air temperature sensor and is used on heat pump units only. This component allows the heat pump to operate down to 24°F.

To check the ambient sensor, first measure outside temperature surround the sensor. This is called "ambient". Next, unplug the ambient sensor (red plug) from the AC power module board. Now do an ohms test on the wire side of the plug.



For the specific ambient (outside) temperature listed below, you should have the following readings:

At Ambient Temperature of:	You Should Have Ohms Reading of:
55°F	11667
60°F	10212
65°F	8959
70°F	7876
75°F	6939
80°F	6126
85°F	5418
90°F	4802
95°F	4264
100°F	3793

NOTE: Any ohms reading has a tolerance of plus or minus (\pm) 10% to be a good component. **A very precise and accurate ohm meter must be used before condemning the sensor.**

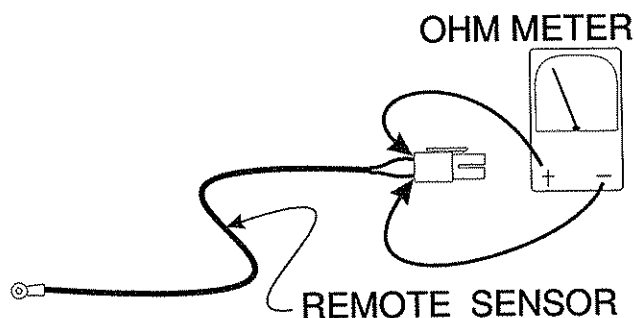
5.13 REMOTE SENSOR

The remote sensor is the temperature sensor that allows the unit for that zone to cycle ON and OFF by temperature. Normally, a remote sensor is used for each unit or zone. A remote sensor is optional for Zone 1, or a single unit installation.

Ensure that the compressor is operational by:

- Placing mode switch to cool.
- Lower temperature setting to start compressor operation (approx. 2 min. time delay)
- Once compressor is operational adjust setting up to shut down compressor system.

Locate sensor attached to zone being tested. Using a hair dryer or other heat producing air device, GRADUALLY heat up the area surrounding the thermistor. **Ensure that device does not place excessive heat on plastic cover.** If compressor system comes on, sensor is operational. If the compressor does not come on, re-verify connections at air conditioner. If the system is still not operational, unplug sensor from unit and verify its cable by checking the ohms.



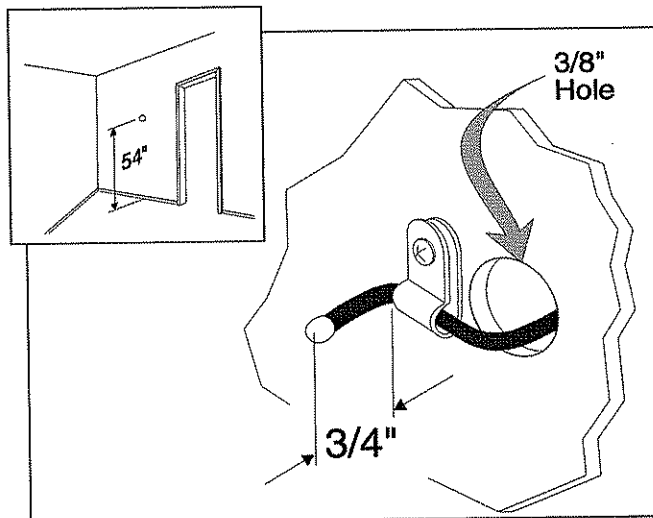
For the specific temperature surrounding the sensor, the ohms readings should be as follows:

A room Temperature of:	You Should Have Ohms Reading of:
55°F	11667
60°F	10212
65°F	8959
70°F	7876
75°F	6939
80°F	6126
85°F	5418
90°F	4802
95°F	4264
100°F	3793

NOTE: Any ohms reading has a tolerance of plus or minus (\pm) 10% to be a good component. **A very precise and accurate ohm meter must be used before condemning the sensor.**

The proper location of the Remote Sensor is very important to ensure that a comfortable RV temperature is maintained. Observe the following rules when selecting a location.

- Locate the Remote Sensor 54" above the floor. Install the Remote Sensor on a partition, not on an outside wall.



- **NEVER** expose it to direct heat from lamps, sun or other heat producing items.
- Avoid locations close to doors that lead outside, windows or adjoining outside walls.
- Avoid locations close to cold air supply registers.
- Avoid area with air stagnation such as under cupboards.

Improper location can cause improper operation of the unit, such as repeated on/off cycle.

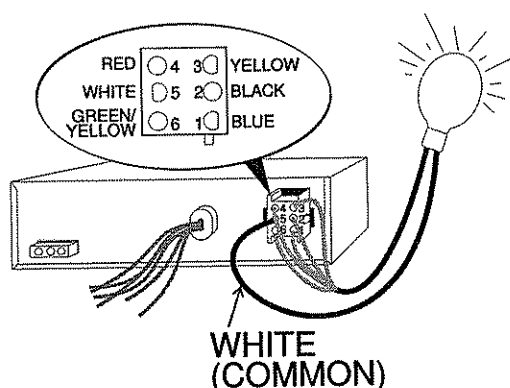
5.14 AC POWER MODULE BOARD

The AC power module board consists of relays, Dip switches, plug receptacles and other components. If any one of these are defective, the complete AC power module board must be replaced. The 3-amp fuse is the only replaceable component. See Sec. 5.15 for fuse diagnosis.

The board is a signal receiver and completes AC volt circuits according to what signal it receives. Before diagnosing the AC power module, verify Configuration (sec. 2), Operation (Sec. 1), Comfort Control Center (Sec. 5.1), DC volts are within operation range (Sec. 4) and 115 volts AC is supplied to the AC power module board.

A. ROOFTOP AIR CONDITIONERS

To verify circuits are being completed by the AC power module board, you would first disconnect the 6-pin plug connector from the electric kit.



Using a 115 volt incandescent bulb, check from terminal 5 (white-common) to the other terminals to determine if a particular circuit is completed through the board. If the circuit is completed, the light will illuminate.

Terminal 1 is blue wire and is the compressor circuit
Terminal 2 is black wire and is High Fan circuit
Terminal 3 is yellow wire and is Medium Fan circuit
Terminal 4 is red wire and is Low Fan circuit
Terminal 5 is white wire and is Common 115 V
Terminal 6 is Green/Yellow wire and is casing ground

NOTE: DO NOT use a voltmeter to do these checks as it will give erroneous readings.

If the circuit is completed and that component is not operating, the problem is in the rooftop unit or the connection is not being completed through the connector.

B. ROOFTOP HEAT PUMP

To verify circuits are being completed by the AC power module board you would first disconnect the 6-plug connector from the electric kit. (Refer to the above illustration)

Using a 115 volt incandescent bulb, check from terminal 5 (white-common) to the other terminals to determine if a particular circuit is completed through the board. If the circuit is completed, the light will illuminate.

Terminal 1 is blue wire and is the compressor circuit
Terminal 2 is black wire and is High Fan circuit
Terminal 3 is yellow wire and is reversing valve circuit.

This circuit is energized in cooling mode and not energized in the heat pump mode.

Terminal 4 is red wire and is Low Fan circuit
Terminal 5 is white wire and is Common 115 V
Terminal 6 is Green/Yellow wire and is casing ground

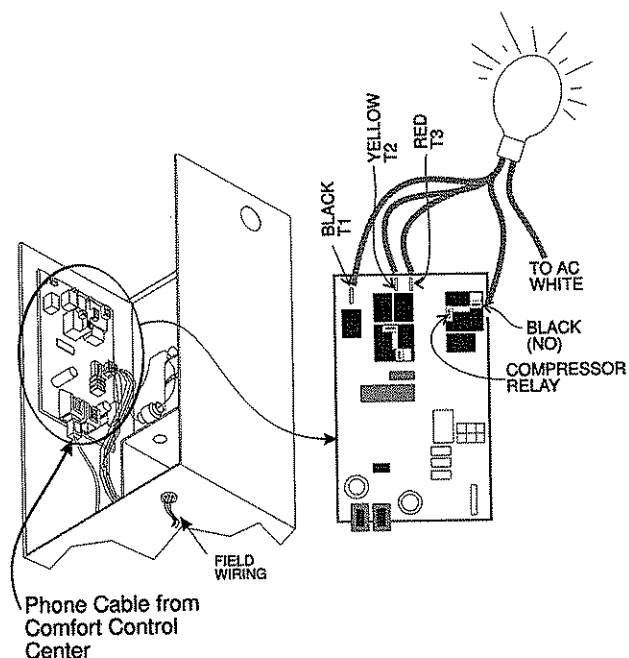
NOTE: DO NOT use a voltmeter to do these checks as it will give erroneous readings.

If the circuit is completed and that component is not operating, the problem is in the rooftop unit or the connection is not being completed through the connector.

It is possible to make the above checks on the board, if necessary.

C. SINGLE BASEMENT AIR CONDITIONER

To verify circuits are being completed by the AC power



module board, you would first remove the electric box cover and locate the AC power module board.

Using a 115 volt incandescent bulb, check from AC white (common) of incoming 115V AC; one lead from incandescent bulb, the other lead from incandescent bulb to the terminals listed below to determine if a particular circuit is completed through the board. If the circuit is completed, the light will illuminate.

NO on compressor relay is black wire and is compressor circuit.

Terminal T1 is black wire and is High Fan circuit

Terminal T2 is jumpered to T1 terminal

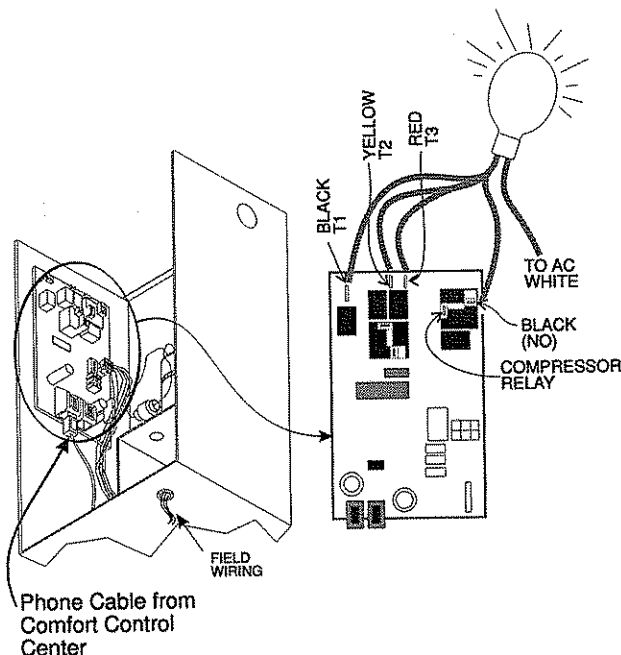
Terminal T3 is red wire and is Low Fan circuit

NOTE: DO NOT use a voltmeter to do these checks as it will give erroneous readings.

If the circuit is completed and that component is not operating, the problem is in the wiring to the component or the component.

D. SINGLE BASEMENT HEAT PUMP

To verify circuits are being completed by the AC power module board, you would first remove the electric box cover and locate the AC power module board.



Using a 115 volt incandescent bulb, check from AC white (common) of incoming 115V AC; one lead from incandescent bulb and the other lead from incandescent bulb to the terminals listed below to determine if a particular circuit is completed through the board. If the circuit is completed, the light will illuminate.

NO on compressor relay is black wire and is compressor circuit.

Terminal T1 is black wire and is High Fan circuit

Terminal T2 is black wire and is Reversing Valve circuit. This circuit is energized in cooling mode and NOT energized in the Heat Pump mode.

Terminal T3 is red wire and is Low Fan circuit.

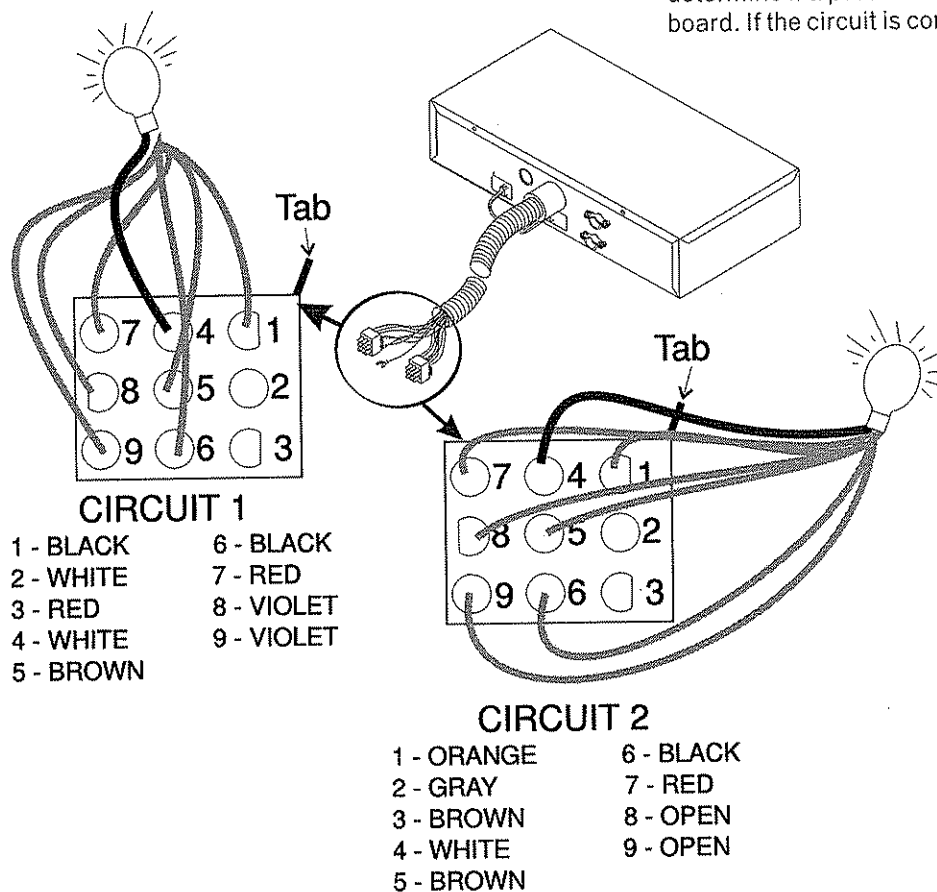
NOTE: DO NOT use a voltmeter to do these checks as it will give erroneous readings.

If the circuit is completed and that component is not operating, the problem is in the wiring to the component or the component.

E. DUAL BASEMENT AIR CONDITIONER AND HEAT PUMP

To verify circuits are being completed by the AC power module board you would first disconnect the two 9-pin connectors that connect the electric kit to the unit.

Using a 115V incandescent bulb check from terminal 4, white wire (115V common) to the other terminals to determine if a particular circuit is completed through the board. If the circuit is completed, the light will illuminate.



CIRCUIT 1:

Terminal 1 is black wire and is compressor circuit
Terminal 2 is white wire and is run circuit to compressor. **DO NOT TEST.**

Terminal 3 is red wire and is start circuit to compressor. **DO NOT TEST.**

Terminal 4 is white wire and is 115V common
Terminal 5 is brown wire and is fan capacitor circuit to fan motor. **DO NOT TEST.**

Terminal 6 is black wire and is high fan circuit
Terminal 7 is red wire and is low fan circuit
Terminal 8 is violet wire and is 115V common
Terminal 9 is violet wire and is reversing valve circuit.
This circuit is energized in heat pump mode only.

NOTE: DO NOT use a volt meter to do these checks as it will give erroneous readings.

CIRCUIT 2:

Terminal 1 is orange wire and is compressor circuit
Terminal 2 is gray wire and run circuit to compressor.

DO NOT TEST.
Terminal 3 is brown wire and is start circuit to compressor. **DO NOT TEST.**

Terminal 4 is white wire and is 115V common
Terminal 5 is brown wire and is fan capacitor circuit to fan motor. **DO NOT TEST.**

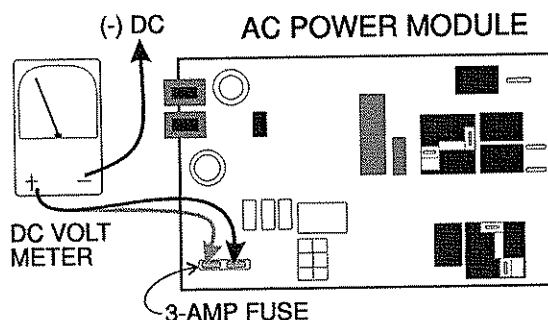
Terminal 6 is black wire and is high fan circuit.
Terminal 7 is red wire and is low fan circuit
Terminals 8 & 9 are open.

NOTE: The Circuit 2 AC power module board is the one that is staged and will have a delay from the Circuit 1 system. Verify that Circuit 2 should be operating before start of diagnosis.

NOTE: DO NOT use a volt meter to do these checks as it will give erroneous readings.

5.15 FUSE

A 3-amp DC fuse is installed in the AC power module board to protect the system from shorts or overload created by disconnecting or reconnecting components when DC volts are to the system.



One test is to remove the fuse and do a continuity test. No continuity requires the fuse be replaced. Continuity means the fuse is good. Another test can be done without removing the fuse. Use a DC volt meter to check between ground or negative (-) DC to each side of fuse. If there is voltage on each side, the fuse is good. If there is voltage on one side only, the fuse is defective and requires replacement.

5.16 ELECTRIC HEATER ASSEMBLY

The electric heater assembly is an optional component for most rooftop air conditioners; however it is standard equipment for Model 620315. It is not used with any heat pump unit.

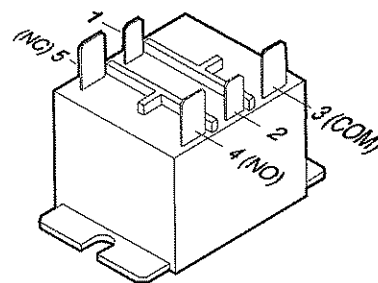
To check the heater limit switch, check for continuity across the limit switch terminals with the limit switch at ambient temperature. If you have an open limit switch (no continuity), replace it.

5.17 RELAY (T91/120V)

The relay is used on basement air conditioner Model 39224 and basement heat pump Model 39424 ONLY.

The relay has five terminals. Two terminals are not identified; they are the coil terminals. When the coil is not energized (no power to the coil terminals), continuity should exist between COM to NC and no continuity between COM to NO.

When the coil is energized (power to the coil terminals), continuity should exist between COM to NO and no continuity between COM to NC.



There are four relays use in Models 39224 and 39424. Two are used in the reversing valve circuit and are designated as HR (heat relay) on the wiring diagram. Two are used in the furnace blower circuit and are designated a FB (furnace blower) on the wiring diagram.

The FB (furnace blower) relays were installed for an **ADDITIONAL FEATURE**; to provide a circuit for the furnace blower motor to enhance both the cooling and heating operation.

NOTE: This circuit will not work with all furnaces.

Before using this circuit, check with the furnace manufacturer for proper wire connection to the furnace. Other components may or may not be required. Read and follow the instructions provided with the furnace.

INSTRUCTIONS FOR FURNACE CONNECTIONS:

! WARNING

THE FOLLOWING FURNACE CONNECTION INSTRUCTIONS ONLY PERTAIN TO ONE SPECIFIC FURNACE MANUFACTURER, AND MAY NOT APPLY TO YOUR INSTALLATION.

Run a 12 volt DC positive lead to one of the gray wires in the unit electrical box and secure with an approved connector.

Run a second lead from the furnace blower motor or terminal board to the remaining gray lead in the unit electrical box. Secure with an approved connector.

SECTION 6
AIR FLOW

6.1 SHORT CYCLE

A. AIR DISTRIBUTION BOX INSTALLATIONS

Short cycle is caused by cold air being drawn back into the intake side of the air conditioner before it is mixed with the warmer room air. This may cause the evaporator coil to freeze up, causing the cold control to open the circuit to the compressor.

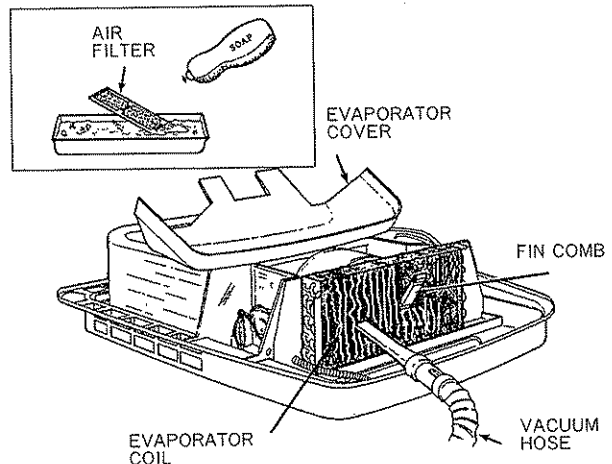
Two possible causes of this condition are the air box and the discharge duct. If the air box is not sealed tightly against the ceiling, it will allow cold air to cross over into the return air portion of the air box. Also, if the discharge duct is not installed properly, it can allow cold air to cross over into the return portion of the air conditioner. Make sure you have the correct discharge duct for the thickness of the roof. Seal all problem areas as necessary. You may need to use tape to seal the discharge duct. Also, make sure the discharge louvers are not restricted.

B. DUCTED INSTALLATIONS

Short cycle could be caused by air being circulated directly on the remote sensor. Make sure you do not have a register too close to the remote sensor. Verify the duct connection at the unit is not leaking into the return air. Seal all problem areas.

6.2 AIR FLOW OBSTRUCTION

The coils and filters must be kept clean. Obstructions reduce the amount of air passing through the coils. Dirt acts as an insulator reducing the heat transfer across the fins. Turn the air conditioner circuit breaker to OFF. Brush the fins with a soft bristle brush, and vacuum up the residue. The filters should be cleaned in a soap solution and rinsed in clean water. Air-dry the filters before reinstalling; a wet filter can cause insufficient cooling or freeze-up.



6.3 AIR DISTRIBUTION SYSTEM

A. ROOFTOP UNITS

SIZING & DESIGN

The installer of this air conditioner system must design the air distribution system for his particular application. Several requirements for this system **MUST** be met for the air conditioner to operate properly. These requirements are as follows:

Roof cavity thickness must be between 2.00" to 5.50" . This distance is measured between roof and ceiling surface.

The total cross-sectional discharge area of outlet ducts from the plenum area under the air conditioner must be as follows:

1. 579 & 600 Series 17.5 sq.in.
2. 591, 595 & 630 Series 21.0 sq. in.

Duct Sizing Requirements as Follows:

	MIN.	MAX.
Duct Depth (591/595/630 Series)	1-1/2"	2-1/4"
(579/600 Series)	1-1/4"	2-1/4"
Duct Width	7.00"	—
Total Duct Length	12 ft.	36 ft.
Duct Length (short run)	1/3 Total Length	

Register Requirements as Follows:

	MIN.	MAX.
Distance from Duct End	5"	8"
Distance from End of Elbow	15"	—
Distance between Registers	24"	—
Total Number Required/AC	4	8
Number required per Run/AC	2	—
Free Area per Register	14 sq. in.	—

The duct material must meet or exceed any agency or RVIA Standard that may be in existence at the time the RV is produced.

⚠ CAUTION

IT IS THE RESPONSIBILITY OF THE INSTALLER OF THIS SYSTEM TO ENSURE THE DUCTWORK WILL NOT COLLAPSE OR BEN DURING OR AFTER THE INSTALLATION.

All discharge air ducts must be properly insulated to prevent condensation from forming on their surfaces or adjacent surfaces during operation of the air conditioner or heat pump. This insulation must be R-7 minimum.

Ducts and their joints must be sealed to prevent condensation from forming on adjacent surfaces during operation of the air conditioner.

NOTE

THE DOMETIC CORPORATION WILL NOT BE HELD LIABLE FOR ROOF STRUCTURAL OR CEILING DAMAGE DUE TO IMPROPERLY INSULATED OR SEALED DUCTWORK.

Return air opening must have 40 sq. in. minimum free area including the filter.

Return air to the air conditioner must be filtered to prevent dirt accumulation on air conditioner cooling surface.

Total System Pressure must be between the following:
0.55 to 0.90 in. W.C. for 579 Series
0.40 to 1.10 in. W.C. for 591, 595 & 630
0.12 to 0.65 in W.C. for 600 Series

This is determined with the air conditioner blower operation on high speed and return air filter and grille in place.

INSTALLATION

The Dometic Corporation recommends the basic configuration shown below for installing this Air Conditioner System. We have found by testing, that this configuration works best in most applications of this Air Conditioner System.

It is the responsibility of the Installer of this System to review each RV floor plan and determine the following:

- A. Duct size
- B. Duct layout
- C. Register size
- D. Register locations
- E. Thermostat location.

These items must be determined in conjunction with the Air Distribution System Sizing and Design Requirements listed.

ALTERNATE CONFIGURATIONS AND METHODS MAY BE USED WHICH STILL ALLOW THE AIR CONDITIONER TO OPERATE PROPERLY. HOWEVER, THESE ALTERNATE CONFIGURATIONS AND METHODS MUST BE APPROVED BY THE DOMETIC CORPORATION IN WRITING.

The following instructions are based upon the use of Dometic Return Air Kit. The electronic control kit has mounting bolts supplied for use with this Kit.

Before preparing the ceiling opening, the type of system options must be decided upon. If a remote sensor is to be used, provision must be made for it. If the load shed option (Energy Management System feature) is to be used, wires must be run from the load shed control to the Dometic A/C. If a furnace is to be connected, wires must be run from the furnace to the Dometic A/C. **Read all of the following instructions before beginning the installation.**

ROOF AND CEILING OPENING PREPARATION

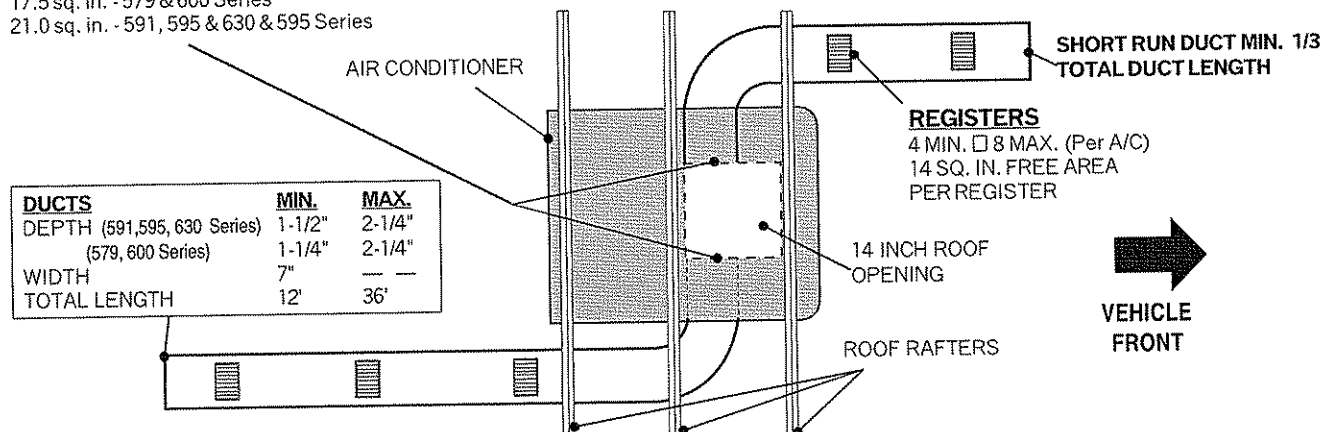
- 1) A 14" x 14" opening must be cut through the roof and ceiling of the RV. This opening must be located between the roof and reinforcing members.

! WARNING

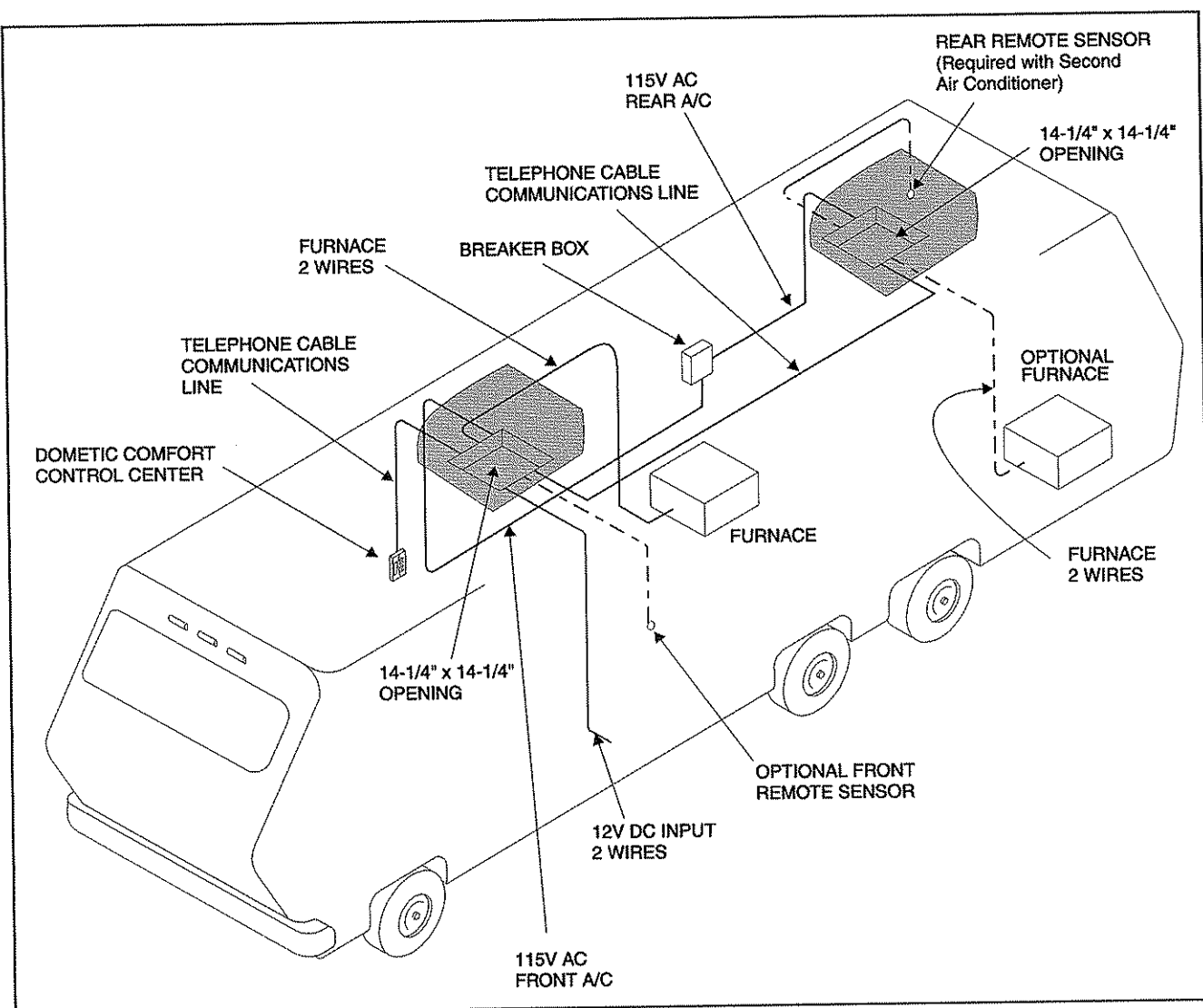
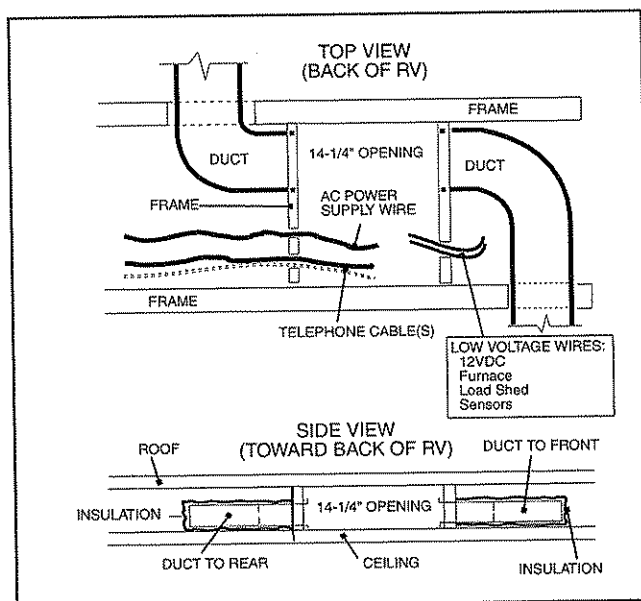
THERE MAY BE ELECTRICAL WIRING BETWEEN THE ROOF AND THE CEILING. DISCONNECT ALL POWER SUPPLIES AND THE POSITIVE (+) TERMINAL FROM THE SUPPLY BATTERY. FAILURE TO FOLLOW THIS INSTRUCTION MAY CREATE A SHOCK HAZARD.

- 2) Mark a 14" x 14" square on the roof and carefully cut the opening.
- 3) Using the roof opening as a guide, cut the matching hole in the ceiling.
- 4) The opening created must be framed to provide adequate support and prevent air from being drawn from the roof cavity. Lumber 3/4" or more in thickness must be used. Remember to provide an entrance hole for power supplies, furnace wiring, 4-conductor telephone cable, remote sensing and load shed options as desired.
- 5) The 14" opening is part of the return air system of the Air Conditioner and must be finished in accordance with NFPA Standard 501C Section 2.7.
- 6) Route a copper 12 AWG, with ground, 115 VAC supply line from the fuse or circuit breaker box to the roof opening.
 - a. This supply line must be located in the front portion of the 14" opening.
 - b. The power supply **MUST** be on a separate Time Delay Fuse or HACR Circuit Breaker.
 - c. Make sure at least 15" of supply wire extends into the roof opening. This ensures easy connection at the Junction Box.
- 7) Route a dedicated 12 VDC supply line (18-22 AWG) from the RV's Converter or Battery to the roof opening.
 - a. This supply line must be located in the front portion of the 14" opening.
 - b. Make sure that at least 15" of supply wire extends into the roof opening.
 - c. **In a multiple zone installation, this wiring is required in only one of the 14" openings.**
- 8) If a **Remote Temperature Sensor** is to be used, the connector end must be routed to the roof opening of the system which it will control. Make sure that at least 15" of the sensor cable extends into the roof opening.
- 9) If a furnace is to be controlled by the system, the two furnace thermostat leads must be routed to the roof opening of the air conditioner that will control it. Make sure at least 15" of the furnace thermostat wires extend into the roof opening.
- 10) If an Energy Management System- EMS (load shed) is to be used with the control, two wires must be routed to the roof opening of the zone to be managed. The signal required for this function is a normally open relay contact. When the EMS calls for the compressor to shut off, the relay contacts should close. Make sure that at least 15" of the EMS wires extend into the roof opening.

TOTAL OUTLET
AIR AREA MINIMUM:
17.5 sq. in. - 579 & 600 Series
21.0 sq. in. - 591, 595 & 630 & 595 Series



- 11) Route a 4-conductor telephone cable from the **Comfort Control Center™** mounting position into the 14" roof opening. Make sure that at least 15" of the wire extends into the roof opening and 6" extend from the wall at the mounting position of the **Comfort Control Center™**.
- 12) In the event that other A/C's are to be installed (additional zones) an additional 4-conductor telephone cable must be routed to the **other A/C's**. Make sure that at least 15" of the wire extends into each of the roof openings. See FIG. 3.



B. BASEMENT UNITS MODELS 39335 AND 39125

OUTDOOR SECTION:

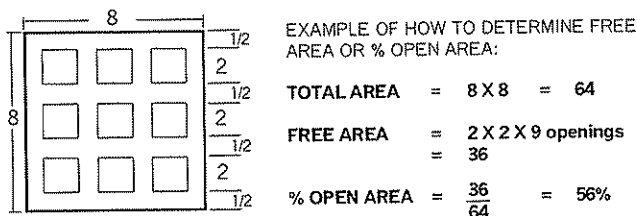
The condenser coil is designed to have a fresh supply of air. If skirting is installed, allow a 15" x 22" opening (330 square inches) for supply air and a 15" x 22" opening (330 square inches) for discharge air. Use the cross flow method for good air circulation.

⚠ CAUTION

DO NOT TOTALLY ENCLOSE THE UNDERSIDE OF THE UNIT. AIR CIRCULATION PREVENTS HEAT FROM BUILDING UNDER UNIT AND YOUR SYSTEM WILL PERFORM AS DESIGNED.

The condenser section is a "blow-through" type. When the face of the coil is positioned behind a louvered or other type of restrictive opening, the **FREE AREA** of the opening must be **at least 260 square inches**.

FREE AREA — is the opening that remains in a grill or louvered panel after the restrictions are taken away. For example, an opening of 10 x 20 inches has 200 square inches. When this opening is covered with a grill that is 56 percent open, the **FREE AREA** is (200 x .56), 112 square inches.



Expanded and perforated metal grills in general vary from 30 percent to 60 percent open. Be certain that **260 square inches** of **FREE AREA** is available to the face of the condenser.

NOTE: Service access must always be supplied either as clearance or as a defined access panel.

MOUNTING

Vibration eliminators are supplied to prevent the transmittance of vibration into the living area.

The air conditioning unit may be attached to rails beneath the vehicle, attached to the frame, or mounted directly to the floor of some vehicles.

Unit should be mounted with a tilt toward the rear (condenser) a half-bubble using a level. Unit rear should be 1/4" lower than the front.

SERVICE ACCESS

Be sure **NOT** to block the inlet or discharge air, or service access, when mounting.

INDOOR SECTION

CLEARANCES

The minimum clearances to the evaporator are zero inches to the bottom, top, left and right sides. Access to the electrical connections and drain connection must be provided when making the installation.

⚠ CAUTION

Be sure to allow sufficient room to service the electrical components.

INLET AIR

The evaporator section must have free access to room air. **A minimum of 180 square inches** of **FREE AREA** opening is required. Where the return air must be provided through louvers or mesh screen, the **FREE AREA** percentage of the material used shall be taken into consideration when making this determination. An example of how to determine **FREE AREA** is included under **"2. OUTDOOR SECTION"**.

GRILLS AND REGISTERS:

NOTE: The return air grill must have the same square surface as the coil face (15"H x 17"L).

For each air conditioning system, there must be a return grill to bring cabin air back into the unit. There must also be at least four discharge grills per unit.

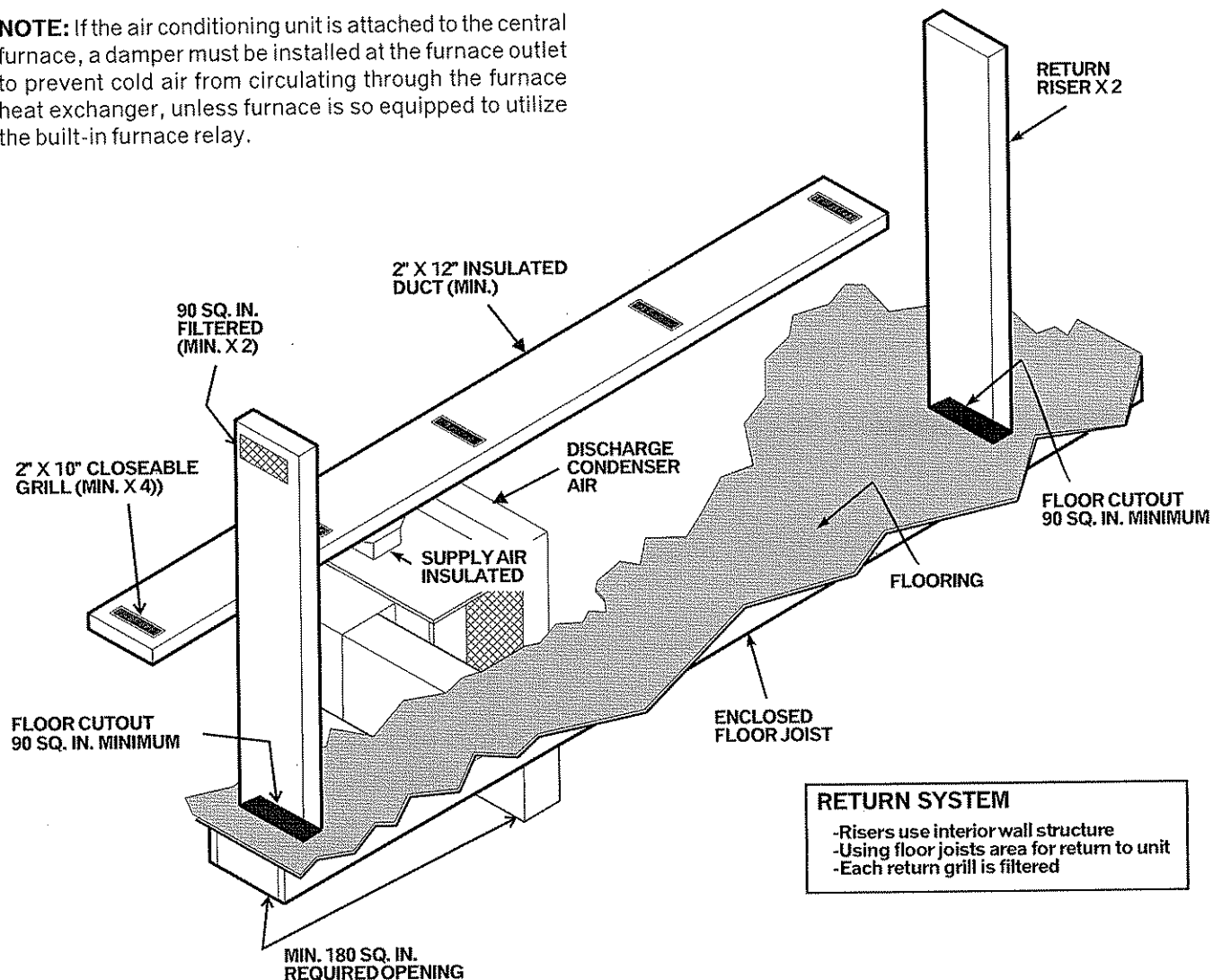
Each return air grille must be filtered and accessible for cleaning or replacement.

OUTLET AIR

The central air conditioning unit is designed to use a discharge air duct with a static pressure of .10 to .25 inches water column. Proper duct size is necessary to maintain proper air flow without loss of static pressure and provide good air circulation.

All air handling ducts must be properly insulated to prevent condensation forming on their surface during operation. A vapor barrier must also be supplied on the outer surface of the insulation to prevent moisture from traveling through the insulation and condensing on the cold ductwork.

NOTE: If the air conditioning unit is attached to the central furnace, a damper must be installed at the furnace outlet to prevent cold air from circulating through the furnace heat exchanger, unless furnace is so equipped to utilize the built-in furnace relay.



C. BASEMENT UNITS MODELS 39224 AND 39424

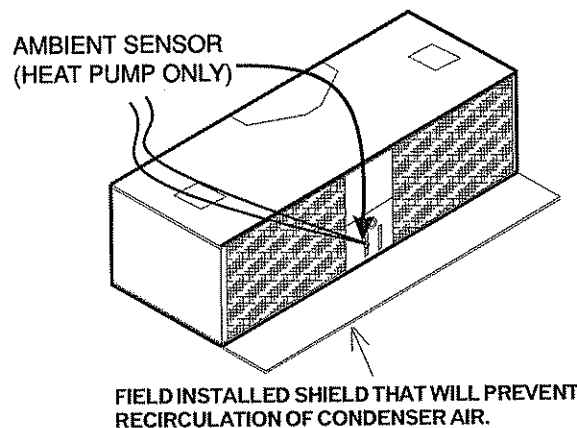
CONDENSER SECTION:

SUPPLY AIR

The inlet of the condenser coil should be positioned so that it draws air from outside the vehicle. **SPECIAL CARE MUST BE TAKEN TO PREVENT THE DISCHARGE AIR FROM RECIRCULATING TO THE INLET OF THE CONDENSER COIL.** Shields should be added to ensure fresh air supply.

! WARNING

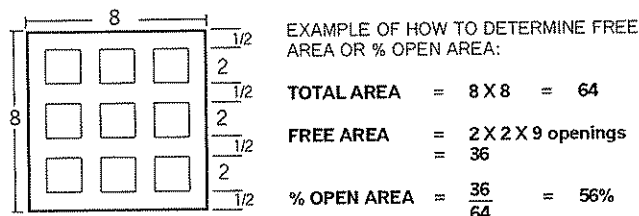
DO NOT INSTALL THE CONDENSER WHERE THE FAN WILL DRAW AIR FROM THE EXHAUST OF THE VEHICLE, A MOTOR GENERATOR SET, TRANSMISSION, ROAD HEAT OR ANY OTHER HEAT PRODUCING SOURCE.



The condenser section is a "draw-through" type. When the face of the coil is positioned behind a louvered or other type of restrictive opening, the FREE AREA of the opening must be **at least 460 square inches.**

FREE AREA — is the opening that remains in a grill or louvered panel after the restrictions are taken away. For example, an opening of 10 x 20 inches has 200 square inches. When this opening is covered with a grill that is 56 percent open, the FREE AREA is (200 x .56), 112 square inches.

Expanded and perforated metal grills in general vary from 30 percent to 60 percent open. Be certain that **460 square inches** of FREE AREA is available to the face of the condenser.



NOTE: Service access must always be supplied either as clearance or as a defined access panel.

CLEARANCES

The air conditioning unit clearances depend on:

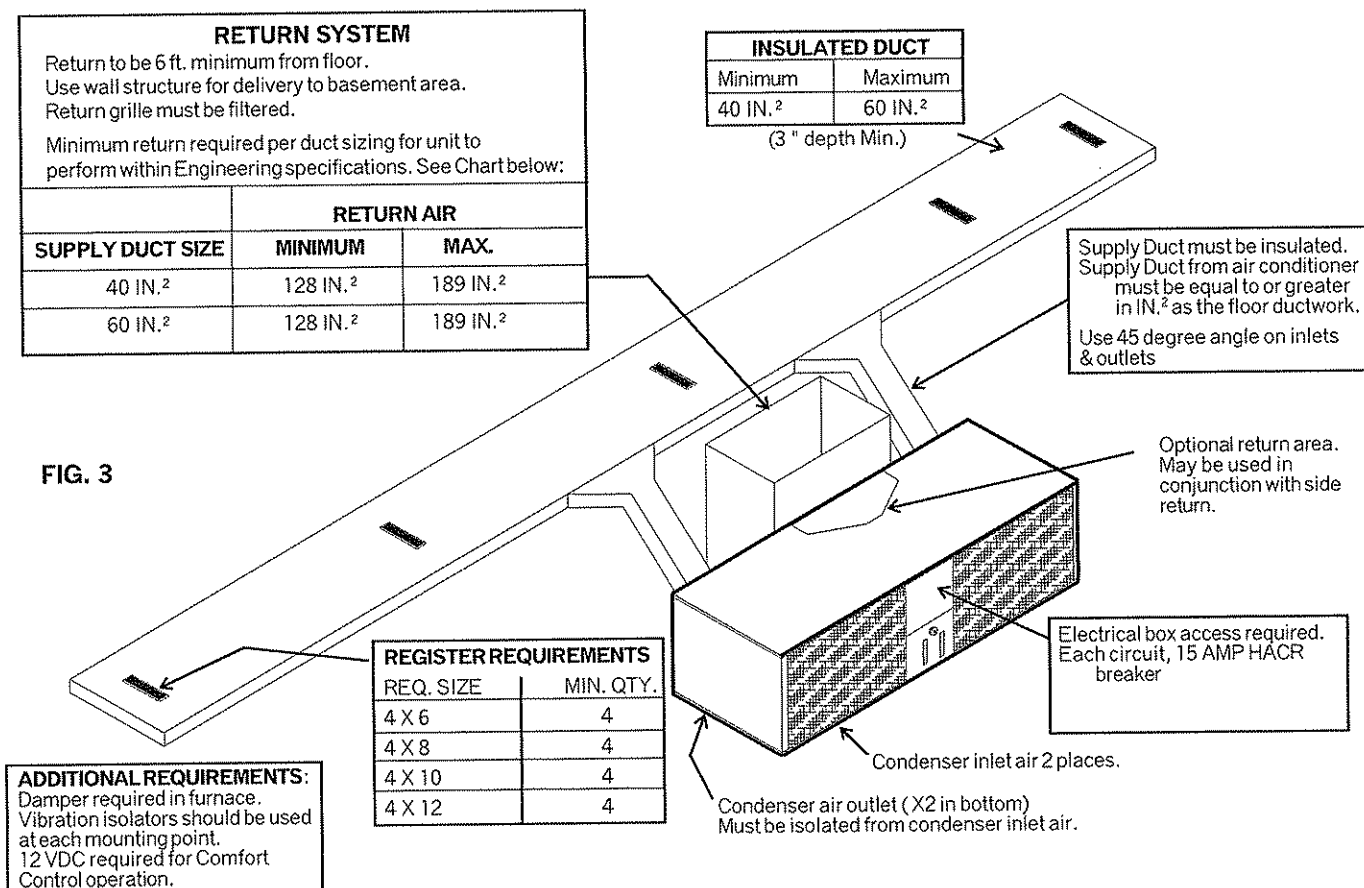
1. Inlet air access used;
2. Discharge air duct arrangement;
3. Return air duct;
4. Storage compartment location and design.

A one (1) inch clearance is required on three (3) sides of the air conditioner if the top return is used. When using the side access for return, please allow a minimum of eight (8) inches for the return air duct. Access to the electrical connections must be provided when making the installation.

EVAPORATION SECTION

INLET AIR

The evaporation section must have free access to room air. A minimum of 128 square inches of FREE AREA opening is required. Where the return air must be provided through louvers or mesh screen, the FREE AREA percentage of the material used shall be taken into consideration when making this determination. An example of how to determine FREE AREA is included under "CONDENSER SECTION".



GRILLS

NOTE: The return air grill must have the same square surface as the return air duct.

- 1) For each air conditioning system, there must be a return grill to bring cabin air back into the unit. There must also be at least four discharge grills per unit.
- 2) Return grills must be mounted in front of the evaporator. If this is not possible, make sure there is nothing blocking the air flow from the grill to the evaporator.
- 3) The unit must have a return filter between the grill and the unit. This filter must be accessible for periodic cleaning.

OUTLET AIR

The air diffusion system, supplied by the installer, must be sized to maintain a static pressure at the blower outlet between .4 and 1.2 inches water column.

All air handling ducts must be properly insulated to prevent condensation forming on their surface during operation. A vapor barrier must also be supplied on the outer surface of the insulation to prevent moisture from traveling through the insulation and condensing on the cold ductwork.

SECTION 7 OTHER

7.1 HEAT GAIN

HEAT GAIN can be caused by several factors: A hot, humid and sunny day; a large number of people in the coach; frequent opening of the door; excessive showering and cooking, etc.

Other factors to be taken into consideration as possible heat gain causes are the size of the air conditioner relative to the size of the coach; the "R" factor of insulation; and the size and placement of windows.

7.2 LOOSE PARTS

Loose parts can cause the air conditioner to operate noisily. Check for any loose bolts, any component rubbing against its housing, or any plastic parts which might be cracked. Repair or replace parts as necessary to correct any noise problems.

7.3 TUBING VIBRATION

If any of the copper tubing is rubbing against itself or any other part, verify that the proper tubing has been installed. Duo-Therm air conditioners are designed to avoid this problem if the correct tubing is used. Replace or position tubing as necessary.

7.4 CONDENSER OR BLOWER FAN

The blower motor will have either a squirrel-cage or blade-type fan attached to it. Turn the air conditioner circuit breaker to OFF. Adjust the component to make sure it is not rubbing against the bulkhead. If it is a blade-type fan, the blades should be half through the opening for proper operation. Replace the blade fan or squirrel-cage if necessary.

SECTION 8 SEALED SYSTEM

8.1 RECHARGING

NOTE: The *Clean Air Act* of 1990 set guidelines in regard to recapturing or disposition of refrigerants. Check with local authorities for proper handling or evacuation of refrigerants.

NOTE: DO NOT attempt to check high and low side pressures below 75° ambient (outside) temperature.

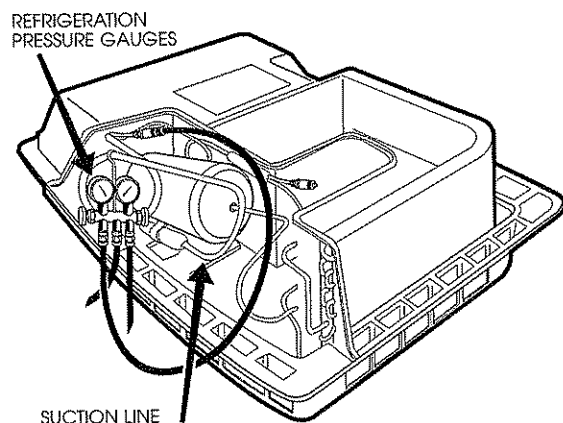
The equipment items needed to properly evacuate and recharge a sealed system are: a piercing type clamp-on saddle valve; a braze-on processing valve; a core removal tool; a process tube fitting; a set of compound gauges; a vacuum pump; equipment to weigh a precise amount of refrigerant; R-22 refrigerant; gas welding equipment; a R-22 refrigerant leak detector and recapturing or recycling equipment. **If you have not been properly trained in sealed system repairs, do not attempt this procedure.**

NOTE: This is not a thorough sealed system repair training program. For additional information or training, you may want to attend a basic air conditioning course at your local college.

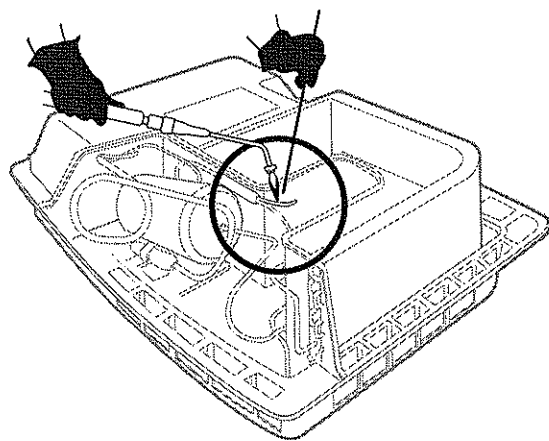
To drain the R-22 refrigerant, attach a clamp-on saddle valve on the low side process tube. If the air conditioner does not have a low side process tube, attach a saddle valve at the point where you will add a process tube.

Slowly drain the R-22 refrigerant by using recapturing or recycling equipment. Do not leave the clamp-on saddle valve on the unit as it will cause leaks.

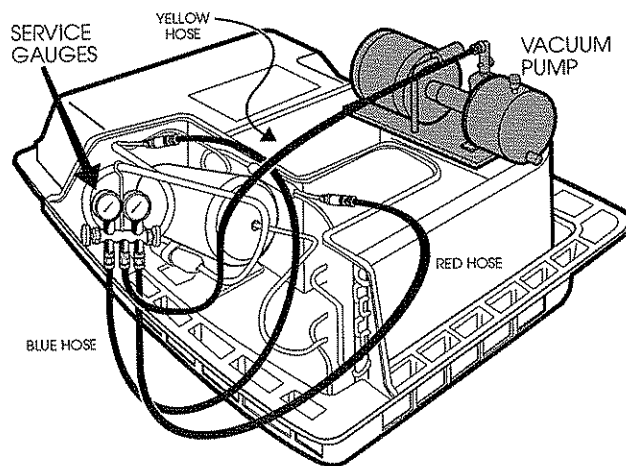
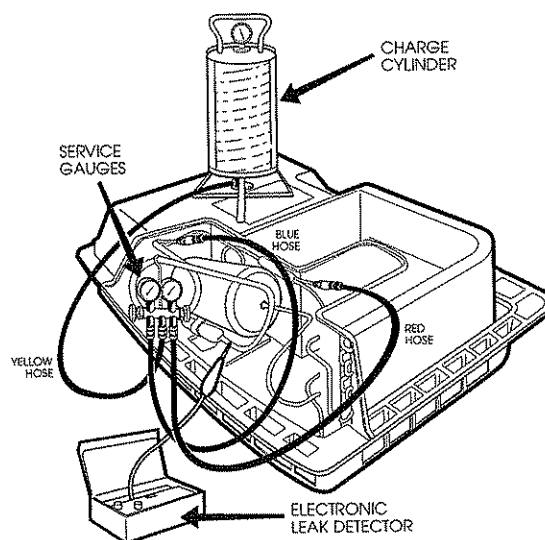
If you are going to use the braze-on processing valve, once the refrigerant has been drained, use a tubing cutter and cut the tube near the end. Do this on both the low and high side processing tubes.



Next weld the process tube in place. We recommend using a brazing material which melts between 950° and 1450° Fahrenheit, and contains a minimum of 2% silver, and 5% to 10% phosphorous. This type of brazing material does not require the use of a flux to join copper to copper. If you are using the weld on the process valve, be sure the valve core is removed before any heat is applied. Connect the blue colored low pressure line of the com-



pound gauges to the charging port on the low side pressure tubing. Next, connect the red colored high pressure line of the compound gauges to the charging port on the high side pressure tubing.



Next, connect the yellow colored line of the compound gauges to the charging cylinder and add 2 or more ounces of R-22 refrigerant to the sealed system and check all weld joints for leaks. Allow the refrigerant to stay in the system for at least 10 minutes. If a leak is detected, drain the system and repair the leak before you proceed.

When you are certain the system is sealed, drain any refrigerant from the system and connect the yellow common line of the compound gauges to the vacuum pump.

Open the pressure relief valve on the vacuum pump. This allows the major contaminants from the sealed system to escape into the atmosphere rather than enter the oil in the vacuum pump.

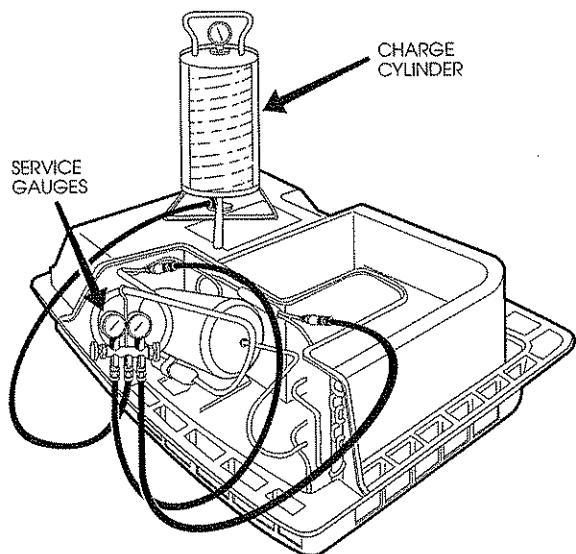
Both the low and high side valves on the compound gauge set should be opened and the vacuum pump turned on.

After five minutes, close the pressure relief valve on the vacuum pump. Check the blue gauge after running the vacuum pump for 10 minutes. A vacuum reading of zero to 10 inches would indicate a leak in the system or the hose connections. Check all hose connections for tightness. If the low side gauge does not change, there is a leak in the sealed system. Locate the leak and correct it before proceeding.

If the blue low side gauge is well below 10 inches of vacuum, continue the evacuation for at least 40 to 45 minutes or until **you have a dry system**.

At this time there should be a good, deep evacuation, or dry atmosphere inside the sealed system. Close both the low and high side valves on the compound gauge set and turn off the vacuum pump.

Disconnect the yellow colored hose at the vacuum pump and connect it to the bottom port or connection on the charging cylinder. Open the valve on the cylinder.



For the correct amount of R-22 refrigerant charge, check the data plate of the air conditioner you are working on. To compensate for the red liquid line, on the gauge set (approx. 30—36 inches long), add one ounce to the data plate amount. You are now ready to do a weighted charge.

The air conditioner charge is critical and must be exact for proper cooling. The proper charge is noted on the data plate of the unit.

Allow the refrigerant charge to equalize by waiting 10 minutes before starting the system. After 10 minutes, do a cooling performance test to determine whether the problem was in the amount of charge or within the components of the system.

Now the blue low side and the red high side lines should be disconnected. Make sure that the air conditioner connection is sealed before removing the lines. The process tube can be pinched off in two places; the charging port cut off, and the end of the tube brazed for a hermetically sealed system.

8.2 SEALED SYSTEM PROBLEMS

One mechanical problem you may encounter is refrigerant flow restriction. There are two types of restrictions, high side and low side. The basics to use to determine a restriction are amp draw and pressure. This check will only work above 75°F.

To determine the high side pressure, add 32 degrees to your ambient temperature. Find that temperature on the chart on Page 27. The pressure listed to the right of the temperature should be your correct high side pressure, plus or minus 7 PSIG. For the low side pressure, divide the high side pressure by four. This will be the low side pressure, plus or minus 3 PSIG.

High side restriction will cause higher than normal amp draw, drastically higher than normal high side pressures, and slightly higher than normal low side pressures.

Low side restriction will cause lower than normal amp draw, drastically lower than normal low side pressures and slightly lower than normal high side pressures.

A restriction that would not follow these basic conditions is a liquid line restriction, which is in the high side of the air conditioner. It will give the same results as a low side restriction.

The most common restriction is the capillary tube or tubes. If there is a restriction in the liquid line, there will be a temperature drop from one side of the restriction to the other side.

In the case of a capillary tube restriction, one tube would be normal (warm to the touch) and the restricted tube would be cool or cold to the touch, and could even sweat if operated long enough.

A restriction would cause a temperature drop at the point of the restriction. A buildup of frost or sweat could be evident if operated long enough.

Refrigerant leaks can occur from an improper weld, a broken line or other damage. Compressor oil will often be noticeable at the location of major leaks.

Replace any parts that are found to be bad. Whenever a component is replaced in the sealed system, or the system has been opened to the atmosphere, a good, deep evacuation and an exact weighted charge is required.

REFRIGERANT VAPOR PRESSURES (PSIG)

Temp. Deg. F.	Pressure PSIG R-22	Temp. Deg. F.	Pressure PSIG R-22	Temp. Deg. F.	Pressure PSIG R-22	Temp. Deg. F.	Pressure PSIG R-22
20	43.0	57	96.1	94	179.1	131	300.7
21	44.1	58	97.9	95	181.8	132	304.6
22	45.3	59	99.8	96	184.6	133	308.6
23	46.4	60	101.6	97	187.4	134	312.6
24	47.6	61	103.5	98	190.2	135	316.6
25	48.8	62	105.4	99	193.0	136	320.7
26	50.0	63	107.3	100	195.9	137	324.8
27	51.2	64	109.3	101	198.8	138	328.9
28	52.4	65	111.2	102	201.8	139	333.1
29	53.6	66	113.2	103	204.7	140	337.3
30	54.9	67	115.2	104	207.7	141	341.5
31	56.2	68	117.3	105	210.3	142	345.8
32	57.5	69	119.4	106	213.8	143	350.1
33	58.8	70	121.4	107	216.9	144	354.5
34	60.1	71	122.5	108	220.0	145	358.9
35	61.5	72	125.7	109	223.2	146	363.4
36	62.8	73	127.8	110	226.4	147	367.8
37	64.2	74	130.0	111	229.6	148	372.4
38	65.6	75	132.2	112	232.8	149	376.9
39	67.1	76	134.5	113	236.1	150	381.5
40	68.5	77	136.7	114	239.4	151	386.2
41	70.0	78	139.0	115	242.7	152	390.9
42	71.5	79	141.3	116	246.1	153	395.6
43	73.0	80	143.6	117	249.5	154	400.4
44	74.5	81	146.0	118	253.0	155	405.2
45	76.0	82	148.4	119	256.4	156	410.0
46	77.6	83	150.8	120	259.9	157	414.9
47	79.2	84	153.2	121	263.5	158	419.9
48	80.0	85	155.7	122	267.0	159	424.8
49	82.4	86	158.2	123	270.6	160	429.9
50	84.0	87	160.7	124	274.3	161	434.9
51	85.7	88	163.2	125	278.0	162	440.1
52	87.4	89	165.8	126	281.7	163	445.2
53	89.1	90	168.4	127	285.4	164	450.4
54	90.8	91	171.0	128	289.2	165	455.7
55	92.6	92	173.7	129	293.0		
56	94.3	93	176.4	130	296.8		