

# PROFESSIONAL REFERENCE GUIDE GEMTECH

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## **GEMTECH THERMOSTATS FOR HVAC (heat, ventilation, air conditioning)**

A thermostat is an electronic switch much like a light switch, i.e., the switch is either on (contacts closed) or off (contacts open). In a thermostat this is done several ways.

1. The old mercury thermostats use a vial of mercury. When the vial is tipped one way, the mercury closes two contacts at that end by touching them both. When the vial is tipped the other way, it opens those two contacts. The vial of mercury is connected to a bi metal spring that reacts to temperature tipping the vial back and forth. The use of mercury is no longer acceptable, but there are many still in use. Dispose of mercury very carefully as it is extremely dangerous. Call your local recycler to find a disposal station.
2. Some mechanical thermostats use a bi metal device that causes the two contacts to touch or open depending on temperature.
3. Modern electronic thermostats use what is called a magnetic latching relay. This is a device that has two contacts that close when a coil on the relay is pulsed with a voltage. To open it, a second coil is pulsed and the contacts open. The voltage pulses are generated by the electronics inside the thermostat. The electronics is what makes thermostats different from each other. The purpose of most thermostats is to close two contacts to turn on the function and to open them to turn off the function.

There are 3 main methods of switching heating systems on and off, Gas Millivolt, 24VAC and 115/230VAC.

1. The Gas millivolt system requires the thermostats to switch only about 750Mv (3/4 volt) to turn on and off the gas heat.
2. The 24VAC systems require the thermostat to switch 24VAC. All thermostats will easily switch these two systems on and off. This is the most popular.
3. The 115VAC or 230VAC is generally used for electric baseboard, wall heaters or ceiling heat. **This takes a special “LINE VOLTAGE” Thermostat.**

If the old thermostat has 2 or 4 large, stiff wires, coming out of a plastic or metal box in the wall, it is likely the system is 115/230VAC, and must use a line voltage thermostat. Connecting line voltage to a 24VAC thermostat is dangerous and will severely damage the thermostat. Always shut off power before replacing a thermostat.

Standards for identifying low voltage thermostat wiring were set in 1972 by the National Electrical Manufacturers Association (NEMA). These standards set down what letters to be used for what function in thermostats. Though many thermostats adhere to those standards, some older thermostats do not. Below is a wiring chart to help compare wiring letters in most systems. As we discuss various HVAC systems, we will be using the NEMA standard letters for our thermostats. Refer to this chart when replacing old thermostats that do not have the same letters as the Gemtech thermostats.

## VERY IMPORTANT NOTICE!!

**BEFORE REMOVING WIRES FROM THE OLD THERMOSTAT, LOOK AT THE LETTERS NEXT TO EACH WIRE AND MARK THE WIRES WITH THE SUPPLIED LETTERS. USE THE CHART BELOW TO CROSS REFERENCE. ANY WIRES THAT WERE NOT CONNECTED TO THE OLD THERMOSTAT OR NOT USED ON THE NEW THERMOSTAT SHOULD BE TAPED OFF AND PUSHED BACK INTO THE WALL.**

**THERE IS NO COLOR CODE FOR THERMOSTAT WIRES THOUGH THE COLOR OF THE WIRE MAY MATCH THE LETTER OF THE WIRE, THE COLORS THEMSELVES SHOULD NOT BE CONSIDERED.**

OLD THERMOSTAT    NEW THERMOSTAT (NEMA standard)    DESCRIPTION

R, or RH, or 4, or V                      RC and RH (leave jumper)                      Power wire (pwr)

FOR a, b, c POWER WIRING BELOW, REMOVE THE RC TO RH JUMPER WIRE

a. RH and R	RH to RH and R to RC	RH = Pwr heat and R= pwr cool
b. 4 and R	4 to RH and R to RC	4 =Pwr heat and R = pwr cool
c. RH and RC	RH to RH and RC to RC	RH = Pwr heat and RC = Pwr cool
W or H	W	Heat return
Y or M	Y	Cool return (compressor)
G or F	G	Fan return
C or X	C	AC power for the thermostat
W2 or H2	W2	2 <sup>nd</sup> stage of heat
Y2	do not connect	2 <sup>nd</sup> stage of cool (not available)

### ADDITIONAL WIRES FOR HEAT PUMPS

W2	W2	Heat pump Aux heat
E	W2	Emergency heat
O	O	Damper or Changeover (Pwr in cool)
or	or	<b>Do not connect both O and B!</b>
B	B	Damper or Changeover (Pwr in heat)

**On a heat pump, if O and B are both present, connect O to O and tape off B.**

### ZONED HOT WATER MOTOR VALVES

5 or R	RH	Power wire
4 or W or NO	W	Turn Valve on
6 or Y or NC	A	Turn Valve off

### ZONED HOT WATER SOLENOID VALVES

R	RH	power
Y or B or NO	W	Turn Valve off
W or NC	A	Turn Valve on

## HEAT PUMPS

To better understand heat pumps, go to a drawing at: [www.dhclimatecontrol.com/hp.htm](http://www.dhclimatecontrol.com/hp.htm)

Heat pumps are a unique method of heating. Essentially it is an air conditioner (A/C) in reverse. An A/C pumps heat out of the house into an **outside air exchanger** and into the outside air. A heat pump uses very similar equipment and pumps heat from the outside air into the house. The heat pump has a “reversing valve” to go from COOL to HEAT. An AIR CONDITIONER gets less efficient in cooling a house as the outside air gets hotter. Similarly, the HEAT PUMP gets less efficient as the outside air gets colder.

### AUXILIARY HEAT (for heat pumps)

In moderate to cold climates, the heat pump cannot keep the house warm if the outside air gets too cold. So most air exchange heat pumps have an additional heat source called AUXILIARY heat and is often electric heat strips but can be other sources of heat like gas. This auxiliary heat comes on to help bring the house temperature up quicker and/or provide heat when the heat pump can no longer keep up (outside temp. below 30 to 35F). Most heat pump thermostats have an emergency (**emer**) switch or button to allow the auxiliary heat be the primary heat if the heat pump quits.

All Gemtech thermostats work with heat pumps without aux heat. To determine if you need a thermostat for a heat pump with aux heat, the following may be helpful:

1. Does your old thermostat have 2 or more mercury bulbs?
2. Does your old thermostat have an EMER switch position or button?
3. Is there a wire going to a letter E on the old thermostat?
4. Is there a wire going to a letter W2 on the old thermostat?
5. Is there a wire going to a letter B or a letter O on the old thermostat?
6. In addition to the above, is there also a wire going to a letter X?

If any of the above fit your installation, you probably have a heat pump with auxiliary heat and need a particular Gemtech thermostat. To be sure it is a heat pump, look at the tags on the outside air exchanger. Somewhere it may say heat pump. If you need help deciding what thermostat you may need, please call us at 1 888 515-2585 before you decide.

Some heat pumps do not need auxiliary heat if they are used in warm climates and/or if instead of using air heat exchangers, they can use ground or water (wells) heat exchanging. Ground and well temperatures stay very constant (typically 60F) so make excellent heat exchanger medium for pulling out heat (for heating a house), or dumping in heat (for cooling a house). Most Gemtech thermostats can be used on heat pumps without auxiliary heat.

**GEMTECH THERMOSTATS ARE COMPATIBLE WITH MOST HVAC'S**

OIL, GAS, PROPANE, ELECTRIC, HOT WATER, ZONED HEATING/COOLING, and HEAT PUMPS with or without auxiliary heat. Gemtech thermostats are not compatible with 2 stage compressor heating or cooling.

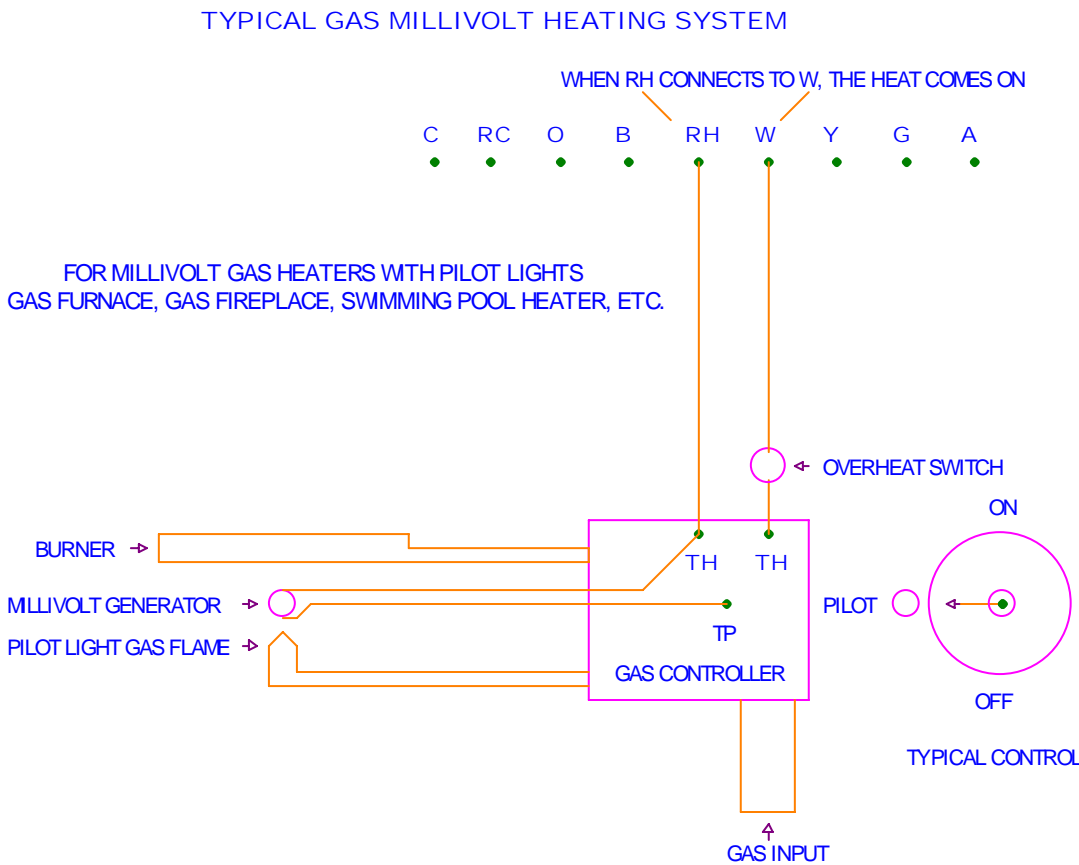
(See the SELECTION CHART on this web site)

The following drawings will help explain how the thermostat's switch operates the HVAC systems. The letters at the top of each diagram are on the Gemtech thermostats back plate.

The following information and diagrams may be helpful in determining your system and your wiring. Pg. 5 through Pg. 17.

**GAS MILLIVOLT HEAT ONLY 2 WIRE**

Below is a typical Gas Millivolt system. When the thermostat's relay (switch) connects RH to W, the heat comes on. If the heating system already has a thermostat connected, use the same two wires that were on the old thermostat. When there are just two wires, there is no polarity, i.e., either wire can go to RH or W.

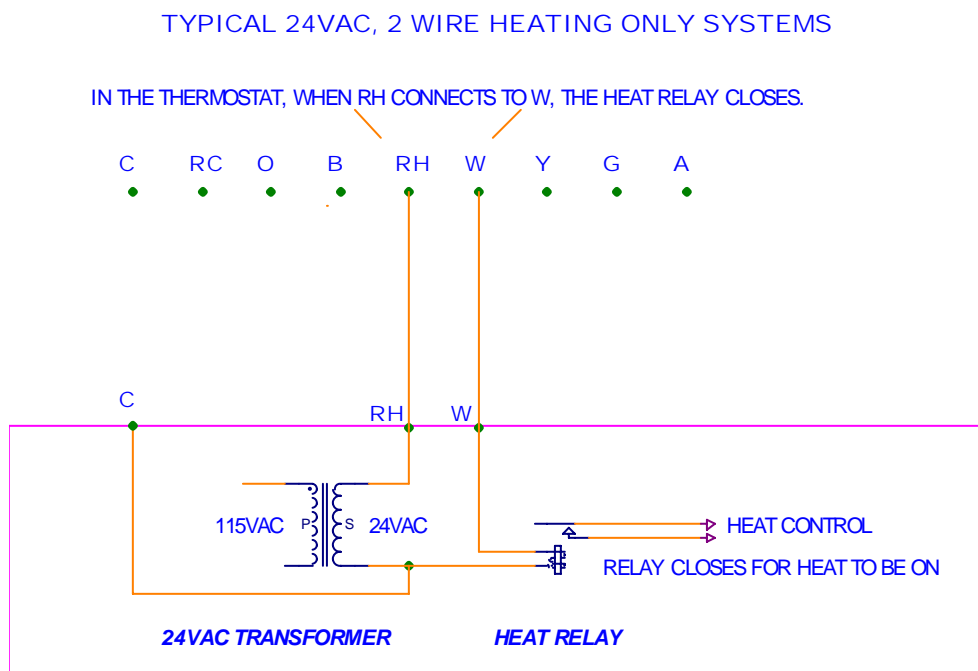


## LOW VOLTAGE 24VAC HEAT ONLY 2 WIRE

The drawing below is a typical heating system using 24VAC. The heating system has a transformer that generates 24VAC to operate the furnace low voltage thermostat controlled system. The 24VAC is not an electrical hazard. It can use much smaller wire than line voltage systems, and does not need an electrical box in the wall.

When terminals RH and W are connected together by the thermostats relay (switch), the 24VAC (RH) connects to the furnace relay (W) and the heat comes on. When the relay opens the contacts, the heat goes off. This relay is operated by the thermostats computer which follows your programming commands. Some heating systems immediately come on. Some take a few seconds. With just two wires, the heating systems fan is controlled by the furnace, not by the thermostat. With only two wires, there is no polarity, ie, either wire can go to RH or W.

The “C” wire is always available in a 24VAC system as it is the side of the 24VAC heat transformer that goes to the relay. Most HVAC techs can find this point and run a wire to the thermostat. For more information, refer to POWER page 20.



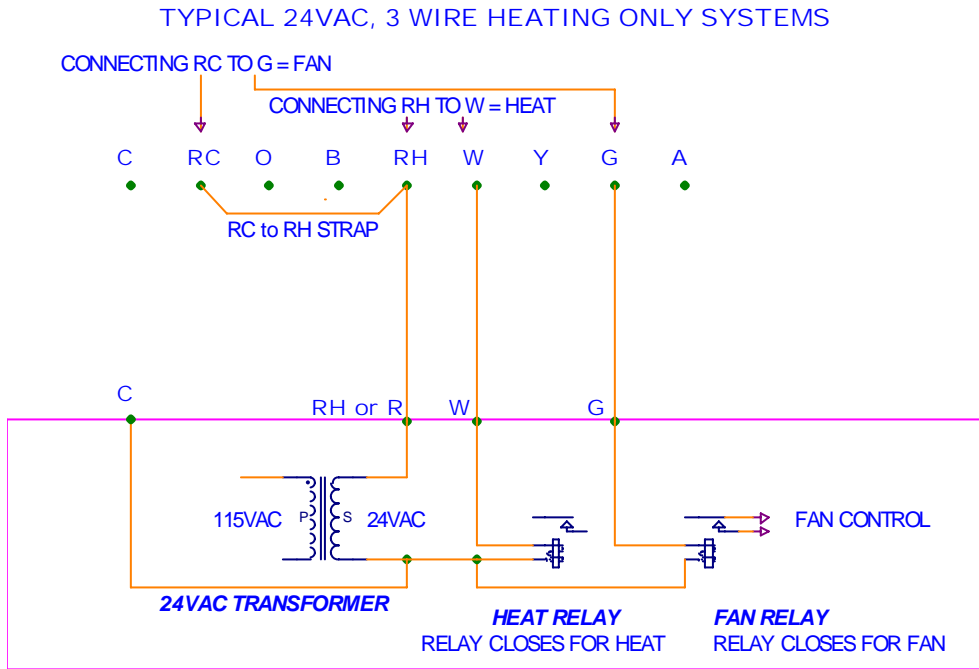
### 24VAC HEAT and air handler's FAN 3 WIRE

The drawing below is a 24VAC, three wire heat control system controlling both HEAT and FAN. The 24VAC provides power to the HEAT CONTROL relay and the FAN CONTROL relay through the thermostat.

Most heating systems control the fan so the air is not circulated until the air is heated in the furnace. The G wire allows the thermostat to control the fan under two conditions.

The thermostats FAN switch. In AUTO, the furnace controls the fan. When switched to ON, the FAN stays on all the time.

Most electric furnaces do not have any fan control and must have the thermostat turn on the fan whenever the electric furnace is turned on. This is necessary to circulate the warmed air into the house and keeps the electric elements from overheating. See pg 22.



#### THE GAS/ELECTRIC JUMPER (fan control)

There is a GAS/ELECT jumper on the back of the thermostat which is normally left in the GAS position. This allows the heating system to control the fan. I recommend changing it to the ELEC position for most electric heating systems. For more information on this option see the FAN CONTROL page 22.

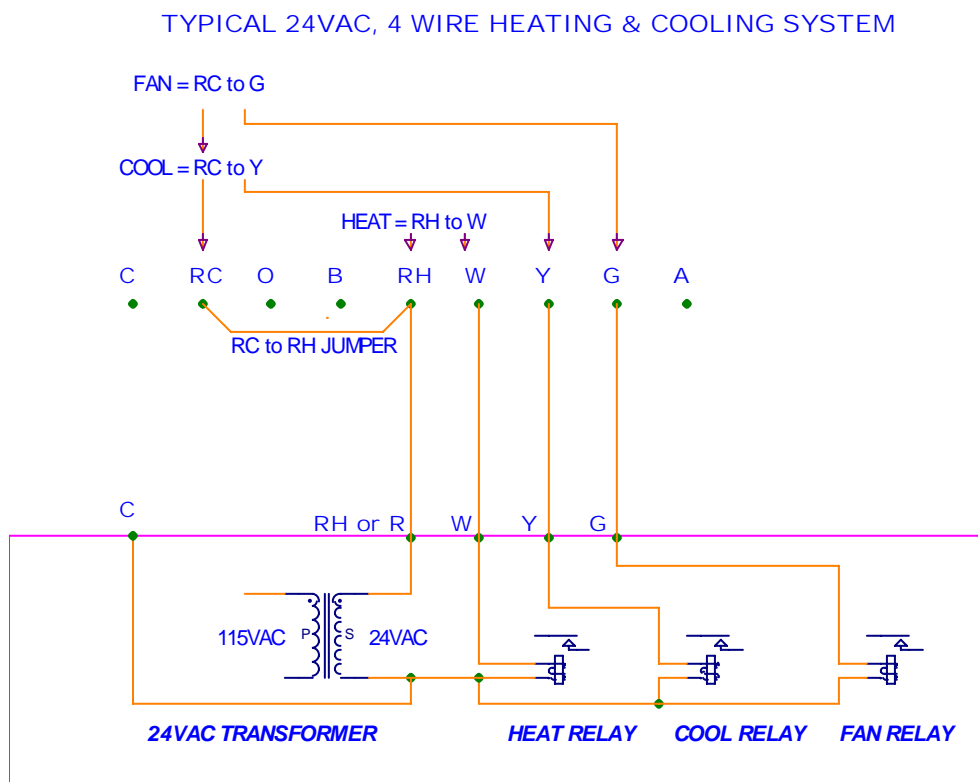
### 24VAC HEAT, FAN and COOL 4 WIRE (non heat pump)

The drawing below is a standard 24VAC, 4 wire heating and cooling control system. (not a heat pump). The 24VAC provides power to the HEAT CONTROL relay, the FAN CONTROL relay and the COOLING CONTROL (A/C compressor) relay through the thermostat as a function of its mode switch and programming.

With the thermostats mode switch in the HEAT position, the heating functions are the same as in the 3 wire heating system.

When the thermostats mode switch is in the COOL position, the thermostat turns on the air conditioner's cooling compressor and the air handler circulating fan at the same time. Some AC units also control the fan and leave it on for a few minutes after the thermostat has turned off the compressor. This is to clear out "residual" cool air from the system.

Note the RC (power cool) and RH (power heat) terminals are connected together. This is because in a 4 wire heating and cooling system, there is a single 24VAC power transformer for both the heat and cool.



FOR FOUR WIRE, FORCED AIR, 24VAC HEATING AND COOLING SYSTEM  
GAS, OIL, ELECTRIC, HOT WATER, ETC.

## 24VAC HEAT PUMP WITHOUT AUXILIARY HEAT 4 WIRE

The drawing below is a heat pump without auxiliary heat. This is useful with an air heat exchanger (outside unit) in mild climates like Florida and parts of Arizona. It is not very efficient much below 35F. Most areas require a heat pump with auxiliary (generally electric) heat to supplement the heat pump in cold weather. If the heat exchanger is in the ground or in a well (hydro), it is very efficient and auxiliary heat is not necessary. Some high rise apartments and condos circulate water through the building, warm in winter and cool in summer. This does not require auxiliary heat. NOTE: Often this system requires a line voltage thermostat. For information on this, call Gemtech @ 1-954-957-4160

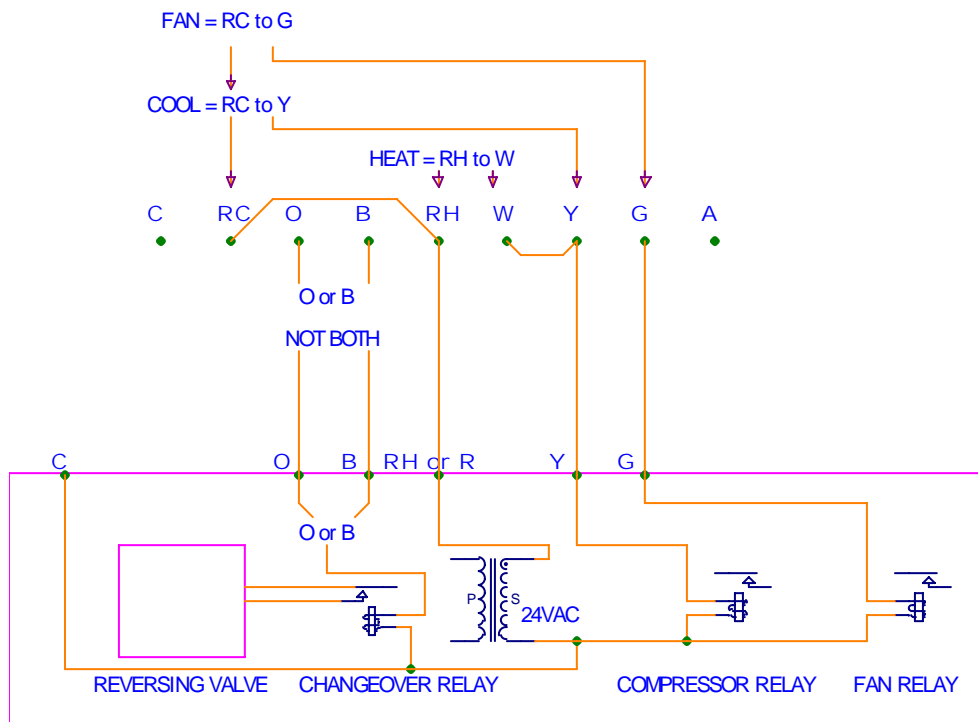
Notice the thermostats W (heat) and Y (cool) are connected together. This is because the compressor is used when the thermostat calls for heating (W) or cooling (Y). The terminals O or B control the changeover relay which determines if it will be heating or cooling.

**In a heat pump, never connect both O and B or damage may result. See wiring pg 3.**

NOTE: Some heat pumps use other letters for the changeover. Florida Heat Pump Co. uses the letter W on the old thermostat instead of O. (Connect their W to the stats O)

For more information about heat pumps go to: [www.dhclimatecontrol.com/hp.htm](http://www.dhclimatecontrol.com/hp.htm)

TYPICAL 24VAC, HEAT PUMP WITHOUT AUXILIARY HEAT



FOUR WIRE, FORCED AIR, 24VAC, HEATING AND COOLING HEAT PUMP

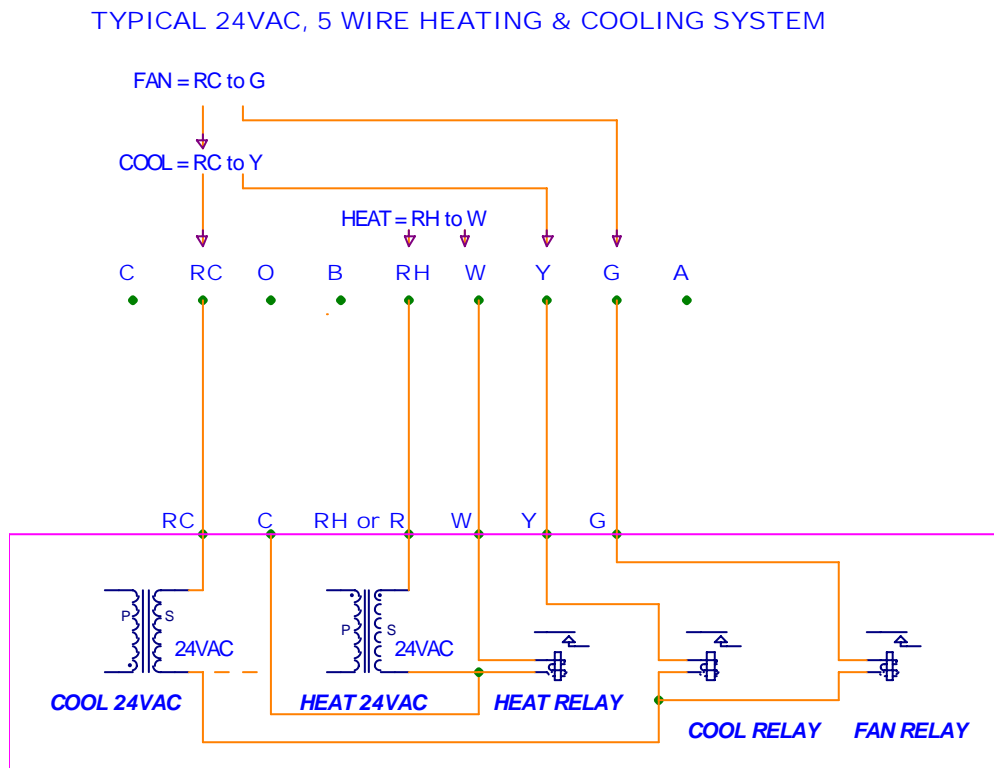
### 24VAC HEAT, FAN and COOL 5 wire (with separate heat & cool power)

The drawing below is a standard 24VAC, 5 wire heat and cool controls system. Some times, the heating and cooling systems have their own separate 24VAC power so there are two power sources, RC (cool and fan) and RH (heat).

The 24VAC HEAT transformer provides power to just the HEAT relay. The 24VAC COOL transformer provides power to the FAN relay and the COOL (compressor) relay.

**When there are two power sources, the strap between RC and RH must be removed or damage may occur! The RC wire and the RH wire must never touch each other. It is important for the customer to turn off his power before he disconnects the old thermostat!**

The 5 wire heating and cooling functions are the same as the 3 and 4 wire drawings. Note when there are two transformers, the C wire comes off of the HEAT transformer.



FOR FIVE WIRE, FORCED AIR, 24VAC HEATING AND COOLING SYSTEM  
GAS, OIL, ELECTRIC, HOT WATER, ETC.

## **24VAC HEAT PUMP WITH AUXILIARY HEAT 5 WIRE**

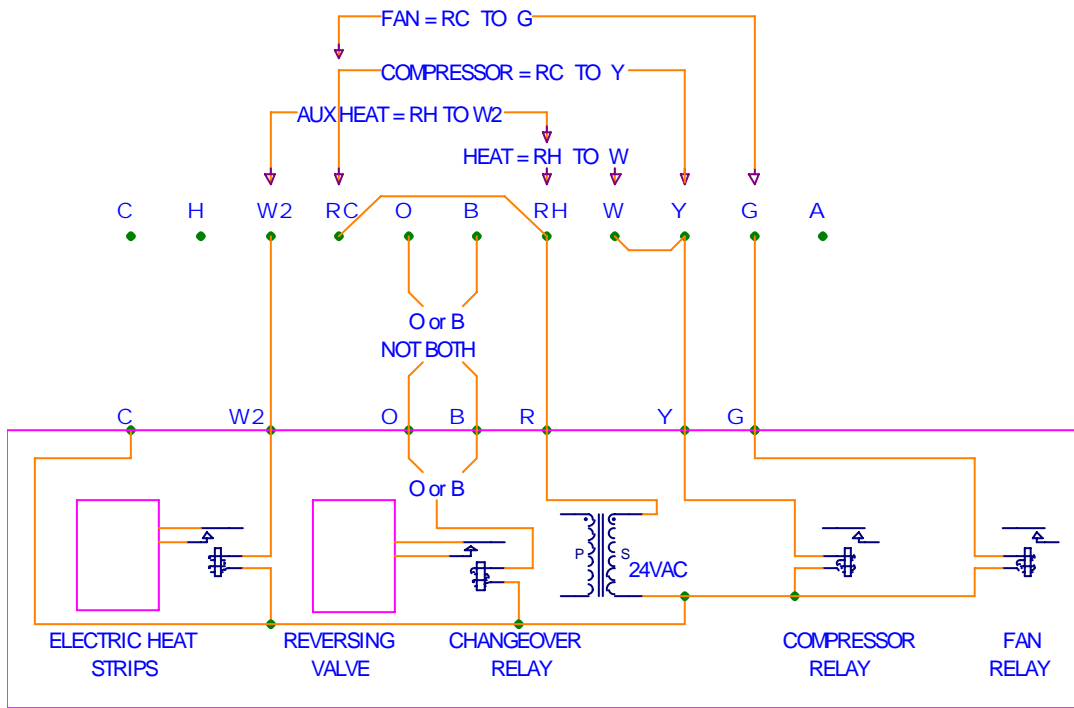
The drawing below is a heat pump with auxiliary heat. The auxiliary heat is usually electric heat strips mounted in the air handler (fan). This type of system is typically used where there is no natural gas available in cool to cold climates.

The auxiliary electric heat comes on to help bring the house temperature up faster, and to supplement the heat pump when the outside temperature is cold (approx. 35F or below). When the outside temperature gets to low, the heat pump can frost up and quit working. Most heat pump thermostats turn the auxiliary electric heat on when the target temperature gets 2F or more above the room temperature. The electric heat strips use much more electricity than the heat pump.

**The Gemtech thermostats for heat pumps with AUX heat must have the GAS/ELECT jumper in the ELECT position (fan comes on with the AUX heat).**

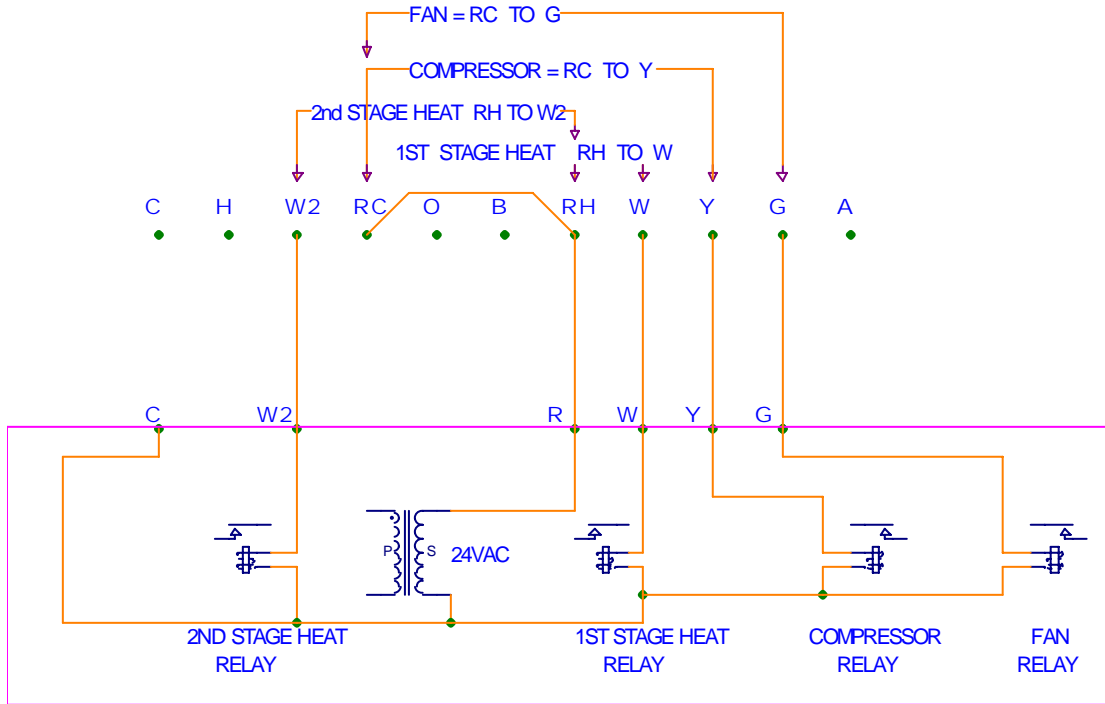
The auxiliary heat is also used in an emergency if the heat pump quits or just can't keep up. When the thermostat is switched to EMER, the heat pump is shut off and only the AUX heat is used.

TYPICAL 24VAC, HEAT PUMP WITH AUXILIARY HEAT



**24VAC TWO STAGE HEAT AND SINGLE STAGE OF COOL 5 WIRE**

The drawing below is the wiring of a typical two stage heating system and not a heat pump. When heat is requested by the thermostat, the first stage comes on and if the room temperature is not up to the target temperature within 15 minutes, the Gemtech thermostat turns on the 2<sup>nd</sup> stage of heat which also increases the fan speed. When the target temperature is reached, the heat shuts off. After that the 1<sup>st</sup> stage generally can maintain the room temperature which is more efficient and quieter.



FIVE WIRE, FORCED AIR, 24VAC, 2 STAGE OF HEATING AND SINGLE STAGE OF COOLING  
 SYSTEM COULD HAVE 6 WIRES IF THE HVAC SYSTEM HAS SEPERATE RH AND RC

## 24VAC ZONED FORCED AIR HEATING AND COOLING 6 WIRE (main)

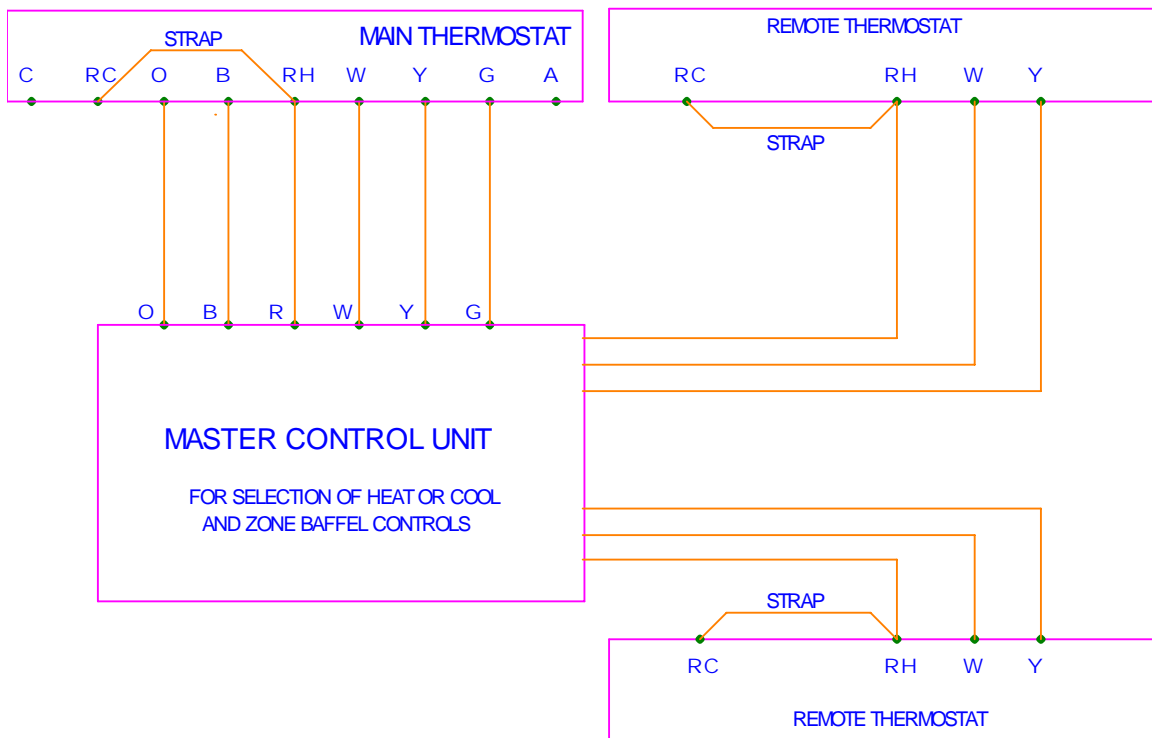
The drawing below is a forced air, zoned, heating and cooling system with remote thermostats for different areas. The master control unit opens and closes baffles in the forced air system to open an area or close an area for either heating or cooling. This allows different areas of the house to be at different temperatures as a function of the areas own thermostat using a single HVAC system.

The selection of HEATING or COOLING is made by the master controller. If the customer wishes to use programmable thermostats at the remotes, they must remember to switch the remotes from HEAT to COOL whenever they switch the main thermostat from HEAT to COOL. This is because the heating and cooling programs are different.

Some forced air zoned systems master controllers use both B and O for changing from HEAT to COOL and some use just one of the letters, B or O. Be sure it is a forced air zoned system before connecting both O and B.

Some of the names of forced air zoned heating are Durazone, Trol-a-temp.

ZONE FORCED AIR HEATING AND COOLING (such as Trol-a-temp)



**NOTE: Be sure your system is not a heat pump before connecting O and B. Connecting both O and B in a heat pump, can cause damage to the HVAC system.**

**ZONE HOT WATER HEATING SYSTEMS (3 wires to thermostat)**

The drawing below is a zoned hot water system that uses a 3 wire thermostat control system to open and close a motor driven valve.

**NOTE: If a hot water system has just two wires, connect it as a standard 2 wire heating system between RH and W. Pg.6.**

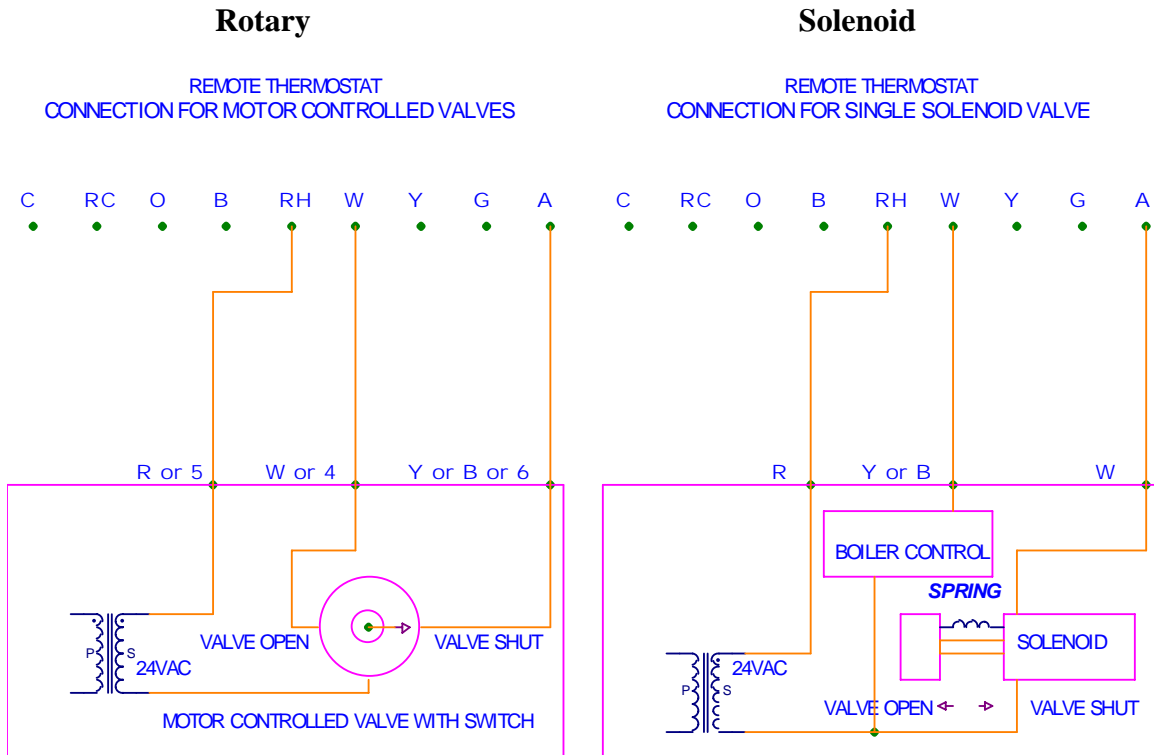
**ROTARY VALVE**

NOTE: If your Gemtech thermostat does not have an A terminal, call the Gemtech help line at 1-954-917-4160 for further information and help.

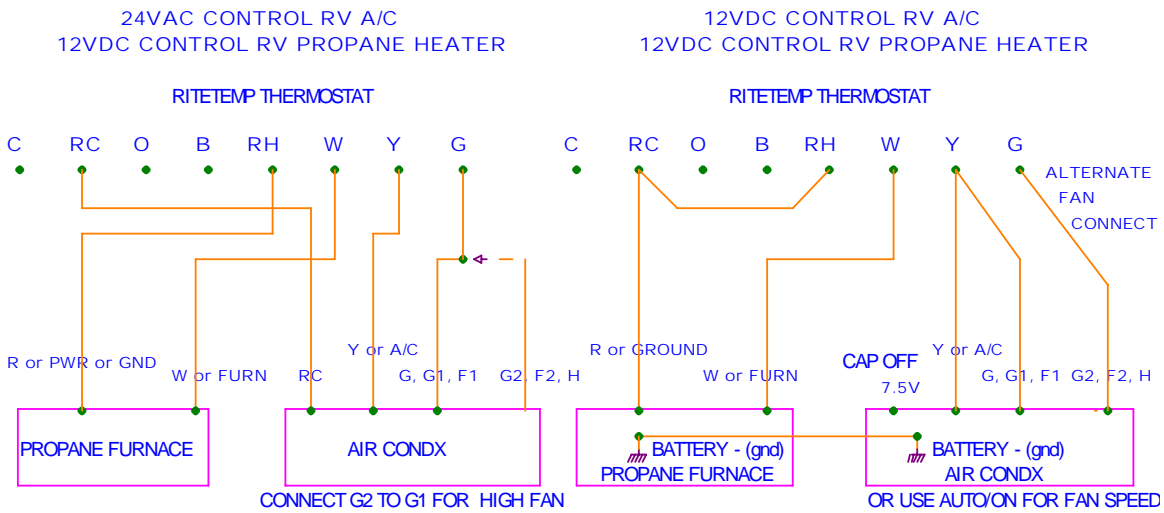
When the thermostat requests heat, RH connects to W and the motor controlled valve opens. When the thermostat requests the heat go off, the RH to W connection opens and the RH to A connects and closes the valve. Each valve has a switch to turn the boiler on and off so the boiler can be turned on by any zones rotary switch.

**SOLENOID VALVES (note reverse wiring from rotary connections)**

When heat is not requested, RH is connected to A and holds the solenoid valve in the OFF position. When heat is requested, RH disconnects from A which lets the solenoid go and its spring opens the valve. At the same time, RH connects to W and turns on the boiler. Any zone's thermostat can turn on the boiler.



## RV's, 2 speed fan's, and Swamp Coolers



All RV air conditioners run on 115VAC and the RV must be connected to AC power for the air conditioner to operate. No Air Conditioning test can be done without AC power.

The diagram on the left is for a typical 12VDC propane furnace and an RV air conditioner that uses separate control power. It is often easy to identify the propane furnace wires as they generally come to the thermostat on a separate 2 wire cable. Connecting these two wires together, will power the furnace. Be sure the RC/RH jumper is out as you do not want to mix 24VAC and 12VDC.

The diagram on the right uses a common control system for both the A/C and the propane furnace so the RC and RH jumper must remain connected. There may be a terminal on the old thermostat marked 7.5V, cap that off as we do not use it.

### TWO SPEED FAN CONNECTION for RV's and SWAMP COOLERS

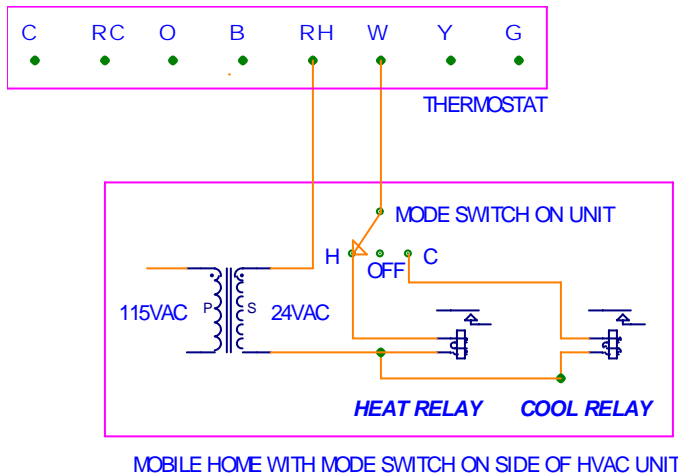
Swamp coolers connect like any A/C system, ie, RC, Y, and G (sometimes also G2). If there is a two speed A/C fan, connect just the G fan wire to the thermostat's G terminal for low, or both fan wires (G and G2) to the thermostat's G terminal for high.

If the customer wishes to have a switch for high fan, in most cases, he can use the ALTERNATE FAN CONNECT drawing above and **remove the GAS/ELECT jumper.** Connect the G1 and the Y wire to the Y terminal. Connect the G2 wire to the G terminal. Now the FAN switch AUTO is LOW fan, and the FAN switch ON is HIGH fan. **You must remove the GAS/ELECTRIC jumper in the thermostat for the alternate fan connection!**

## MOBILE HOME

Some mobile homes have a 2 wire thermostat for heating and cooling. The HEAT/OFF/COOL switch is on the side of the HVAC system. Typically in this case, connect the two wires going to the thermostat to RH and W.

**Leave the thermostat always in HEAT, do not switch the thermostat to cool!**



### TESTING FOR HVAC SYSTEM WITH REVERSING MODE SWITCH IN UNIT

To test for this type of system, put the HEAT/OFF/COOL switch on the side of the HVAC system in the HEAT position. Then connect the two wires going to the thermostat in the HEAT position. The heat should come on. Disconnect the two wires going to the thermostat and the heat should go off.

Now put the HEAT/OFF/COOL switch on the side of the HVAC system in the COOL mode. Leave the two wires going to the thermostat disconnected and the COOL should come on. Then connect the two wires going to the thermostat and the COOL should go off. Notice that cool is the reverse of heat as is the thermostat function, ie, raising the target temperature turns on heat but turns off cool. When this is true, it indicates the reversal of the HEAT/COOL function is taken care of in the HVAC system with its switch and typically uses a thermostat that has no HEAT/OFF/COOL switching therefore if the replacement thermostat has a mode switch, it must be always left in the HEAT position. Recommend non-programmable thermostats.

**Switch the HVAC mode switch to OFF before connecting the thermostat.**

### TESTING FOR HVAC WITH NON-REVERSING MODE SWITCH IN UNIT.

If during testing, you find connecting the two thermostat wires in HEAT turns on the HEAT, and also connecting the two thermostat wires in COOL turns on COOL, then the HVAC systems switch is not taking care of the reversal and the thermostat must be wired with one wire to RH/RC and the other to W/Y. Now when the HVAC mode switch is changed from HEAT to COOL, the thermostat switch would also have to be switched from HEAT to COOL.

## LINE VOLTAGE THERMOSTATS

These are typically used for baseboard, wall, ceiling and floor heating systems

The drawings below show the connection for typical line voltage thermostats. These are special thermostats that can switch high voltage (115/230VAC) and high current (16 amps).

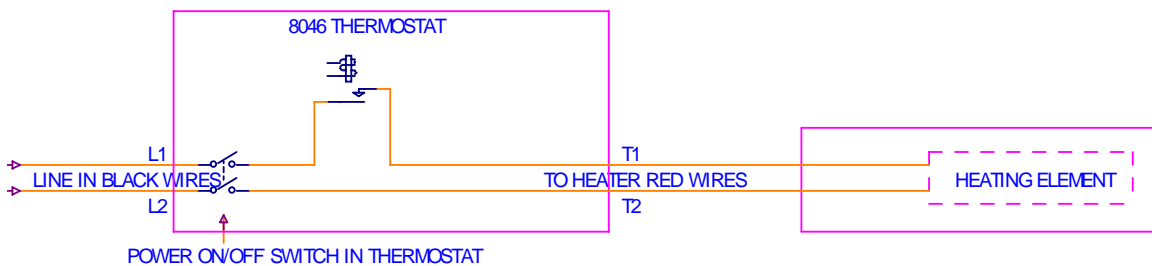
**NOTE: Line voltage is very dangerous and the power to the heating system should be shut off before changing the thermostat!**

To identify if you have a line voltage thermostat, they will have 2 or 4 large wires coming out of the thermostat and be connected to 2 or 4 large wires coming out of a metal or plastic wiring box. The wires will typically be connected with large wire nuts.

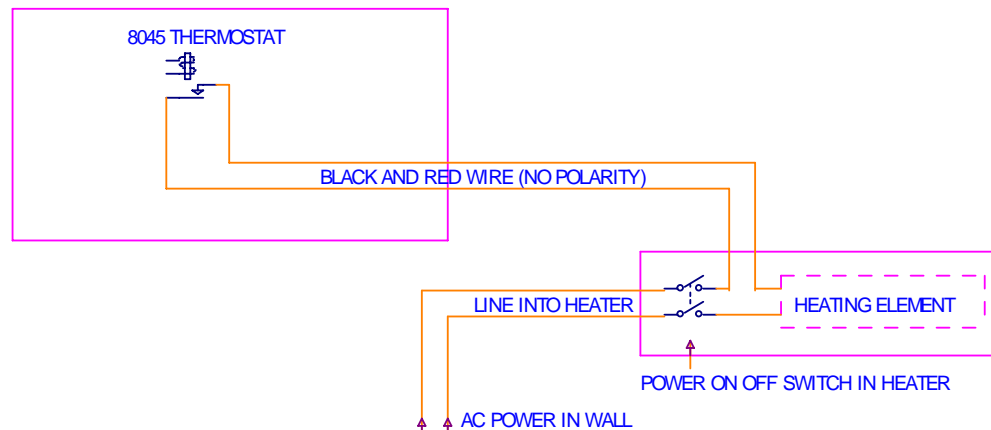
The SINGLE POLE type will only have two large wires coming out of the thermostat and the POWER ON/OFF switch will be at the heater.

The DOUBLE POLE type will have 4 large wires coming out of the thermostat, with the ON/OFF switch on the thermostat.

LINE VOLTAGE DOUBLE POLE THERMOSTAT CONFIGURATION



LINE VOLTAGE SINGLE POLE THERMOSTAT CONFIGURATION



## CONTROLLING HUMIDITY (Using a Gemtech thermostat equipped with a built in humidistat).

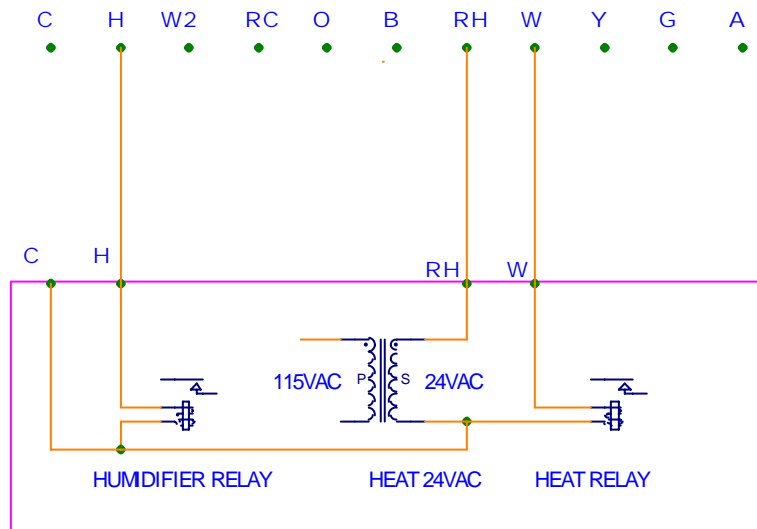
### HUMIDIFIER

NOTE: If your Gemtech thermostat has a built in humidistat (with an H terminal), and your heating system has a built in humidifier, connect it as below.

The thermostat can control a humidifier as part of any heating system if the humidifiers 24VAC control system is the same as the heating system as shown below.

If you have a humidifier and wish this thermostat to control it, connect the humidifier control wire to the H terminal on the new Gemtech thermostat. The MIN (minimum) humidity setting on the thermostat will now turn the humidifier on and off as a function of the humidity level in your home. The thermostat will automatically turn on the air handler fan when the humidifier is turned on. It only operates in the HEAT mode only and operates with the heat running or off to maintain your selected humidity level.

### HUMIDIFIER CONNECTION WITH THE HEATING SIDE OF ANY HVAC SYSTEM



The drawing is simplified for clarity. Other functions may be in use like fan and cool.

To de-humidify, using a Gemtech thermostat, see the operation manual of a Gemtech thermostat with a built in humidistat. You must have air conditioning to de-humidify.

## CONNECTING AN EXTERNAL HUMIDISTAT FOR HUMIDIFYING

(Any Gemtech thermostat for heating)

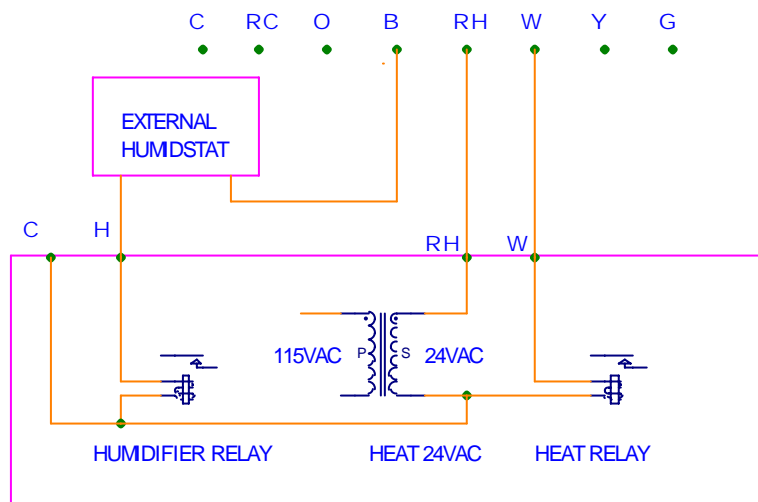
If you have an existing humidifier, with an external humidistat, and wish it to be active only when the thermostat is switched to HEAT, connect the power wire (R) from your humidistat to the B terminal of the thermostat.

When the mode switch is put in HEAT, the B terminal is powered from the RH terminal, which will power the external humidistat. The humidistat will then operate independent of the thermostat settings. When the thermostat is switched to OFF or COOL, the external humidistat will be off.

If you wish the external humidistat to be active only when the heat is running, connect its power terminal to W instead of B.

If you wish the external humidistat to be always active, connect its power terminal to RH instead of B or W. It will then operate independent of the thermostat's mode switch.

### HUMIDIFIER CONNECTION WITH AN EXISTING EXTERNAL HUMIDISTAT FOR ANY 24VAC HVAC SYSTEM



The drawing is simplified for clarity. Other functions may be in use like fan and cool.

Go to next page for de-humidifying connections.

## CONNECTING AN EXISTING HUMIDISTAT FOR DE-HUMIDIFYING

(Any Gemtech thermostat that has cooling)

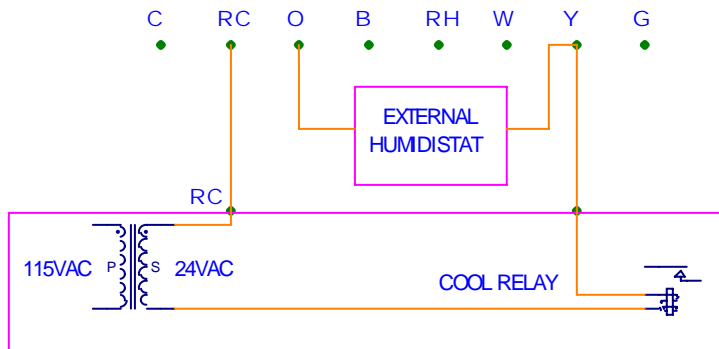
NOTE: The power to the external humidifier should come from the thermostats O terminal which is powered only in the cool mode so the HEAT and the A/C cannot be on at the same time

If you have an external humidistat you wish to use with a Gemtech thermostat, it can be connected two ways.

**PARALLEL:** So the air conditioning can be turned on by either the humidistat with high humidity, or by the thermostat with high temperature.

### DE-HUMIDIFIER CONNECTION WITH AN EXISTING EXTERNAL HUMIDISTAT

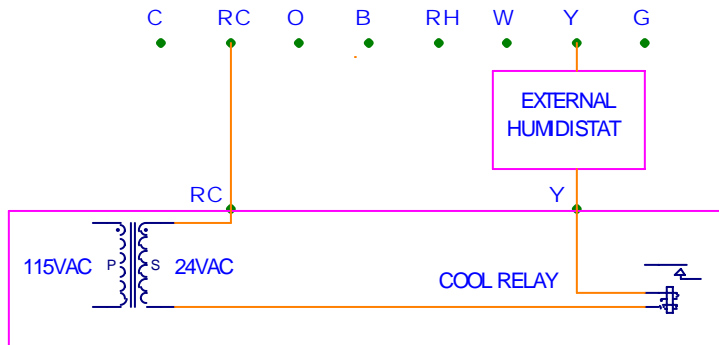
PARALLEL: EITHER HIGH TEMPERATURE OR HUMIDITY WILL TURN ON THE AIR CONDITIONER  
FOR ANY 24VAC HVAC SYSTEM



2. **SERIES** so the air conditioning will come on only with high humidity and high temperature.

### DE-HUMIDIFIER CONNECTION WITH AN EXISTING EXTERNAL HUMIDISTAT

SERIES: BOTH TEMPERATURE AND HUMIDITY MUST BE HIGH TO TURN ON THE AIR COND. X  
FOR ANY 24VAC HVAC SYSTEM



The drawings are simplified for clarity. Other functions may be in use like heat and fan.

## THERMOSTAT POWER

### BATTERIES

Gemtech thermostats are powered from 2AA batteries. The life of the batteries is typically between 1 and 2 years depending on how often the backlight is used (on the units with backlights).

**DO NOT ATTEMPT TO USE RECHARGEABLE BATTERIES**, they will not run Gemtech thermostats.

If the batteries die, the thermostat will quit operating. The LOW BATTERY icon will come on for several weeks before this happens. When changing batteries do it quickly (30 seconds) or you may lose your time and custom program settings. The thermostat will still function and default to the built in Energy Star program, but would still need to have the day and time re-set. All manual functions will continue to work.

### 24VAC POWER

**Gemtech thermostats switching power specs are: 0 to 30V, AC or DC, 2 amps max.**

The thermostat can also use the 24VAC power if available. One side of the 24VAC is the power wire at the thermostat going to the RH terminal. The other side of the 24VAC is called the “C” wire and if available at the thermostat, can be connected to the thermostat C terminal. This will allow the thermostat to get its power from the furnace so the battery life will about double. Thermostats with a backlight will have the backlight also be powered from the 24VAC power.

The batteries are still necessary to retain the thermostat's custom programs and other settings if the AC power to the furnace is interrupted. Using the 24VAC (C wire), the thermostat will continue to run if the batteries die. The C wire is shown in all of the heat connection drawings. Mechanical thermostats had no need for the C wire so often it is not at the thermostat. If there is an unused wire in the wall, an HVAC tech can connect it for you or run another wire. You can also use an external 24VAC power adapter as explained below.

### **GEMTECH THERMOSTATS WITH REMOTE CONTROL (require C wire)**

The Gemtech thermostats with remote control must have the 24VAC for the remote's receiver inside the thermostat to work. The remote receiver in the thermostat requires power and would substantially reduce battery life so cannot run on the batteries.

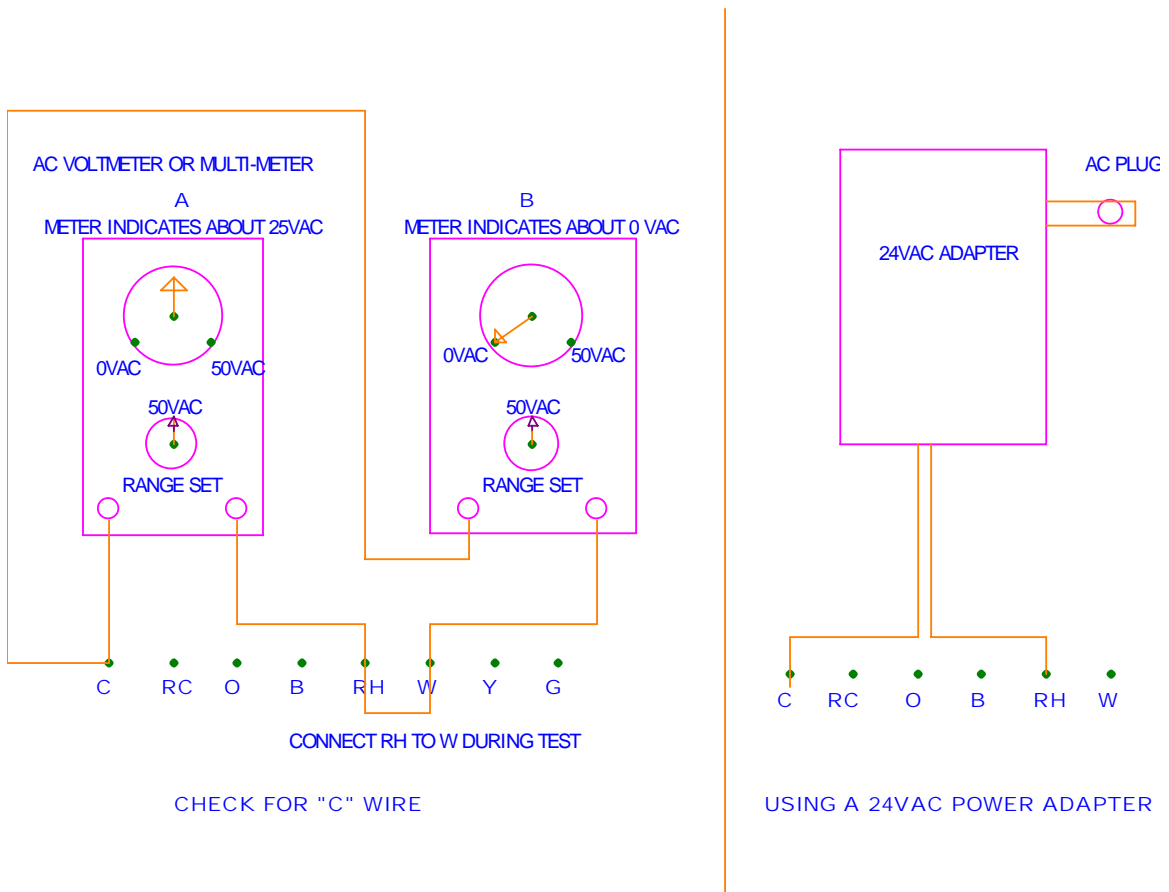
If the C wire is not readily available, a 24VAC plug-in power adapter may be used by connecting its wires to the thermostat's terminals RH and C. There is no polarity of the two wires so either wire can go to either terminal. The Radio Shack Cat No. 273-1690 adapter can be used. Cut off its connector and connect the two wires to RH and C. See the POWER ADAPTER drawing below.

## THERMOSTAT POWER CONTINUED

If you have a wire you think is the C wire, a test is to measure the AC voltage as follows:

1. Connect the RH and W terminals with a piece of wire or a paper clip. Doing this turns on the heat.
2. Between the proposed C wire and the RH wire terminal should be about 24 to 28VAC with the heat on. DRAWING A.
3. Between the proposed C wire and the W wire terminal should be close to 0 volts AC with the heat on. DRAWING B.

**Note: The measurement is AC volts, not DC volts. Use an AC volt meter on the 50V or 100VAC range scale.**



## FAN CONTROL (gas/elect jumper in thermostat)

### HEATING

Most forced air heating systems that use gas, oil, or boiler, have their own fan control. When the heating system is hot enough, inside the furnace, a “stack” fan control (upper limit) turns on the fan. When the house is up to temperature, the thermostat shuts off the burner, the stack cools down, and the furnace’s fan control (lower limit) shuts off the fan. These limits switches control the fan when the thermostats gas/elect jumper selector is in GAS.

Electric heating systems can also have fan control as above but often do not and rely on the thermostat to turn the fan on and off with the electric heat. Electric heat should not be turned on without air circulating over the heater elements.

**For electric furnaces and heat pumps, the thermostats fan control jumper selector (gas/elect) should initially be set in the ELECT position!**

To see if an electric furnace has its own fan control, leave the GAS/ELEC in GAS, turn on the heat, and switch the thermostats fan switch from AUTO to ON. Wait about 1 minute and turn the thermostats fan switch back to AUTO. If the fan stays on, the furnace has its own fan control so leave the jumper in GAS. If the fan goes off when switched to AUTO, the furnace does not have fan control so put the thermostat in the ELECT position. When in doubt, put the jumper in the ELEC position.

**NOTE: The jumper must be in the ELECT position when using a Gemtech thermostat on a heat pump particularly with electric auxiliary heat.**

### COOLING

Most air conditioners (AC) do not have internal fan control and require the thermostat to turn the fan on and off with the compressor. Your thermostat does this as long as the GAS/ELECT jumper is in either GAS or ELECT. Newer AC systems control the fan separate from the thermostat. These newer units turn the fan on with the compressor, and then leave the fan running for a while after the compressor has shut off. This is more efficient by clearing out the residual cool air after the compressor has shut off.

If your AC or fan will not shut off when the room temperature is below the target, your AC may have fan control and you may have to shut off the thermostats fan control by removing the GAS/ELECT jumper. Sometimes there is an incompatibility when two controls systems are both trying to control the fan. **If you remove the GAS/ELECT jumper, be sure the fan does run when the AC comes on!**

### MANUAL

The AUTO/ON switch on your thermostat allows you to turn on the FAN manually by switching to ON. The fan will run continuously if the switch is left in ON. This will keep your house a more even temperature and if you have a good clean air filter system, will reduce dust and smells.

## GENERAL INFORMATION

### SWING

Swing is the temperature difference between where a system comes on and then goes off. **EXAMPLE:** The thermostat is set at HEAT, a target temperature set at 70F, and the swing number set at 3 (+/-1F). The heat would typically come on at 71 and go off at 69. Most Gemtech thermostats have the ability to set the swing. Below is a swing chart. The lower number gives a higher comfort level as the room temperature is more constant and the HVAC system will cycle more often. The higher number is more efficient and the HVAC system will cycle less often.

1= .33F      2= .67F      3=1F                      4=1.33F      5=1.67F      6=2F

### ANTICIPATORS

Mechanical thermostats use anticipators. This is a resistive device that heats up when the thermostat has turned on the heat. The anticipator gets warm; heating the thermostat so that it will shut off the heating system earlier than it would have without the anticipator. This is done because there is a delay in the reaction of the thermostat's temperature sensor spring due to the thermal mass of the mechanism. The typical swing in a mechanical thermostat can be wide and get wider with age.

### ELECTRONIC THERMOSTATS ACCURACY

Electronic thermostats typically use temperature sensing devices called thermistors which are very small, with almost no thermal mass. These devices track the air temperature very well so no anticipator is necessary. Gemtech thermostats are specified and checked at +/- 1F. The ROOM TEMPERATURE measured by the thermostat is a function of the room, wall, and radiant temperatures near the thermostat. For better accuracy, fill the hole in the wall with insulation so the thermostat's room temperature will not be affected by air flow in the wall. This is particularly important if the thermostat is on an outside wall. When you are installing a thermostat, the room temperature will initially read high because the case has been warmed by your hands. It may take several hours for the thermostat to stabilize to room temperature. If your new thermostat does not match your old thermostat, the error is probably a combination of the two thermostats' accuracy.

Most Gemtech thermostats allow you to change or "calibrate" the room temperature to match another device, or to set it for a comfort level in a different room.

### SHORT CYCLE COMPRESSOR DELAY

All Gemtech thermostats with COOL capability have a build in approx 5 minute delay from the time a compressor turns off until the thermostat will turn it back on. This is to prevent compressor stall. This delay is not present if the thermostat is turned from COOL to OFF and back to COOL and is not present in case of AC power interruption.

## TROUBLE SHOOTING

The thermostat simply connects the wires coming to the thermostat together as needed to control a given function. The thermostat uses an isolated relay that makes these connections. The thermostat does not have, or generate any power, it simply switches the power (RC and RH) coming to the thermostat to the appropriate return wires.

If some or all thermostat functions are not working, a good test is to try to run that function without the thermostat. Take the thermostat off the back plate and make the following checks.

### HEAT CHECK

RH is power for the heat and W is the heat return wire. Connecting RH to W with a wire or paper clip (used as a wire) should turn the heat on in either 24VAC or GAS millivolt systems. If the heat does not come on, the problem is in the heating system.

### FAN CHECK

RC is used as power for the fan and G is the fan return wire. Connecting RC to G should turn the fan on. If it does not the problem is in the fan system.

### COMPRESSOR CHECK

RC is used as power for the cooling compressor and Y is the compressors return wire. Connecting RC to Y should turn on the cooling compressor (outside unit).

**WARNING:** When checking the compressor, DO NOT shut it off and right back on. After it has been on and then off, wait for 5 minutes before turning it on again to prevent compressor stall.

### 24VAC POWER CHECK

In the 24VAC systems, if nothing works, the 24VAC power may be off. This can be because of lack of main power to the heating system (check breakers), or a blown fuse on the 24VAC line.

To check for the 24VAC power, use an AC voltmeter and set it to the 50 or 100 **AC volts** range. Remove the thermostat from the wall and measure between the RH and the W terminals on the thermostats back plate. There should be 24 to 28VAC. If not, measure the voltage between the RC and the Y. Again, there should be 24 to 28VAC. If there is no voltage, check your AC breakers, your 24VAC fuse, and any resets on your furnace. You may need to call an HVAC tech to find your power problem. Most furnaces will not run with the furnace panels removed.

### **TEST: 4 WIRE NORMAL HVAC or 4 WIRE HEAT PUMP**

The procedure below assumes there was heat with the old thermostat.

If the old thermostat has 4 wires (typically R, W, Y, G) it is probably a normal heating system but could be a heat pump without auxiliary heat. If possible, look for the words HEAT PUMP on the outside compressor or on the air handler in the house. If it is a heat pump, connect the W wire to the O terminal. If it cannot be determined, use the following procedure. The 4<sup>th</sup> wire may be marked something besides W. The brand name FLORIDA HEAT PUMPS use the letter W for the O change over wire.

1. Connect the R (power) wire to both the G (fan return) wire and the W (heat return) wire. If the heat comes on, put the W wire on the W terminal and the G wire on the G terminal. It is not a heat pump. If it is electric heat, put the thermostats GAS/ELEC selector on ELEC.
2. If the heat does not come on, the system may be a heat pump. Disconnect the W.
3. Connect the G (fan return) wire and the Y (compressor return) wire together. Then connect the R (power) wire to the junction of G and Y. The outside compressor unit should run.
4. Let it run for a few minutes and see if the air coming from the register is warm or cold. If it is warm, it is a heat pump so connect the wires to the thermostat as follows: R wire to terminals RH and RC (jumper), Y wire to terminals Y and W (jumper), G wire to G terminal, and W wire to O terminal (changeover). If the air is cold, connect the thermostat as above but with the W on the thermostats B terminal (other changeover).
5. NOTE: The air out of a heat pump is warm not hot as with gas or oil.

### **TESTING FOR SHORT CYCLING (heat cycling on and off)**

If your heating system sounds like it is cycling on and off too often, first try increasing your SWING setting on your thermostat. If that does not help, the problem could be your heating system's stack switches or stack settings that control the fan.

To check this, change your thermostats fan switch from AUTO to ON. This leaves the fan always running. Now check your furnace to see if it is coming on and off.

Another check is to remove the thermostat from the wall. With a piece of wire or an un-wound paper clip, connect the RH terminal to the W terminal on the back plate. This will turn on and hold on your heat as long as RH is connected to W. If it still short cycles, the problem is in the furnace.

### **TESTING FOR LONG CYCLING (Furnace or AC runs almost continuously)**

If your HVAC system is running continuously and the room temperature is not changing, the problem may be the HVAC system cannot keep up with the heating or cooling settings because of outside temperature extremes. All the thermostat does is turn on and off the system as per the target temperature vs the room temperature. If the room temperature never gets to, or crosses the target setting, the thermostat is not going to shut the HVAC off. Also, check your air handler filters, as dirty filters make a big difference.

HEAT: Lower your target temperature 5F below your room temperature, the furnace should shut off in a few minutes which indicates the thermostat is working.

COOL: Raise your target temperature 5F above your room temperature, the cool should shut off in a few minutes which indicates the thermostat is working.

### **FAN NOT RUNNING**

In COOL, if the fan comes when the thermostat fan switch is moved to ON, but the fan does not come on when the compressor starts, check to see if the GAS/ELEC jumper is missing. It must be in one of the two positions (gas or elect) for the thermostat to control the fan.

### **THERMOSTAT RANDOMLY RESETS**

If your electronic thermostat randomly resets back to its original settings and time, it may be caused by radio frequency interference (RFI) or RF noise. This can occur from many sources but is more prevalent in gas furnaces with spark igniters. If this occurs, the RFI can be reduced and/or eliminated by adding an RF chock on the leads going from the furnace to the thermostat. This is very easy to do.

The Radio Shack ferrite data line filter cat # 273-105 is a clip on device that goes around all the wires going to the thermostat. It is best to put it at the furnace end if easy to get to, but may also be used on the wires at the thermostat end. In some cases, one at each end is even better. If the wires are too large for that filter, the Radio Shack snap on RF chock cat #273-104 may be used.

### **B WIRE (Additional information)**

In some systems built by Trane, the B wire may actually be the common or C and can be used to power the thermostat and extend the battery life. To find out, use the C wire test procedure under POWER pg. 21. If both the O wire and the B wire are present on a heat pump, never accidentally connect the B wire to the RC or RH terminals, as that may short out the 24VAC transformer. It is always best to shut off the HVAC power before working on the thermostat.

## PROGRAMMING ACROSS MIDNIGHT

When programming Gemtech programmable thermostats, the period 1 (morn) start from after 12:00AM and go to period 4 (nite) 11:45PM. If you wish to have the night set back after 11:45PM, start your programming by using period 1 (morn) for your night set back, period 2 (day) would then be your wake up, etc.

## SAFETY

Always shut off the power before disconnecting wires on a thermostat. In some cases if wires touch each other, damage could be caused to the HVAC systems 24VAC power.

Never connect the C wire to any other wire as you may short the 24VAC transformer.

If you have wires from the HVAC system that connect to RC and RH, never let these wires touch each other. Also, if you have both RC and RH wires, be sure to remove the jumper wire between RC and RH before connecting any wires.

Before you install the thermostat on the back plate, be sure the wires connected to the back plate do not stick up above the screw terminals. They should not touch the back of the thermostat.

**If you have a line voltage system, shut off the power at the breaker box before working or replacing the thermostat!** The 115VAC or 220VAC is lethal, be very careful. Be sure you have a line voltage thermostat. Connecting a line voltage thermostat to a low voltage 23VAC thermostat is dangerous and will damage the thermostat. All line voltage thermostats have large wires coming out of the thermostat and connect to large wires in an AC box with large wire nuts.

### **8082C PROGRAMMING LIMITATIONS (because of AUTO function)**

The programming has two limitations.

1. The periods times set in HEAT will be the same in the COOL program. The COOL program times cannot be independently set.
2. The COOL program cannot be set any closer than 3F above the HEAT program at each period.

When lowering the programmed COOL temperature, it will stop 3F above HEAT. When raising the programmed HEAT temperature, it will “push” the programmed COOL temperature up to keep it 3F above the HEAT. HEAT takes precedence.

Both of these limitations are necessary because the 8082C has the AUTO mode available. The AUTO mode allows the thermostat to switch from HEATING to COOLING on demand. Programmed HEAT and COOL times are generally set the same, and the programmed COOL temperature is generally more that 3F above the HEAT program.

## GENERAL INFORMATION

### TIME/TEMP BLINKING

Some Gemtech thermostats displays blink between the TIME of day, and the ROOM TEMPERATURE. This blink cannot be stopped as it gives both pieces of information in as large a display as possible.

### BACK LIGHTING

All of the 8082, 8085, 8050 models have back lights. See the SELECTION CHART on this web site.

### T-FACTOR

The (delta sign) T-FACTOR on the 8085C and 8082C means the change in room temperature setting when you “calibrate” the room temperature to your liking. When you change the room temperature with the “calibration” function, the display shows you both the new room temperature and the T-FACTOR which is how much you changed the room temperature display.

### DIFFERENTIA

The “differentia” on the 8085C and the 8082C is only used in the PUMP mode and has no affect in the NORM mode.

When the room temperature is below the target temperature by 5F or more, the expensive AUXILIARY heat and the cheaper PUMP heat both run. As the room temperature comes up, at some point, the AUXILIARY heat will go off and leave just the PUMP heat running to bring the room temperature up to the target temperature. The point where the AUXILIARY heat shuts off is determined by the “differentia” jumper setting. The differentia number is the number of degrees F below the target temperature that the AUXILIARY heat shuts off. The best setting for a mild climate is 4F so the heat pump is doing most of the heating. In a cold climate, 2 is the best setting because the heat pump may not be able to keep up and or may quit in severely cold climates.

### RESET

The thermostats reset button should be pushed after initially putting in the batteries. It should also be pushed if any set up is changed using the little black jumpers or the switches on the back of the thermostats. All of these functional changes (except gas/elect) will not occur unless the unit is reset after the change.