

# HEAT-TIMER

## INSTALLATION/OPERATING INSTRUCTIONS

# HEAT-TROL Elite Series

## HWE Multi-Stage

### Hot Water Reset Control For Multiple Boilers with Heating and DHW Pumps

#### How the HWE Multi-Stage operates...

The HWE Multi-Stage (MSTG) establishes ambient comfort by varying the temperature of the heating system's circulating hot water in response to changes in the outdoor temperature. In addition, it provides an outdoor temperature based start/stop, setback capability, heating system pump control, and domestic hot water (DHW) pump control.

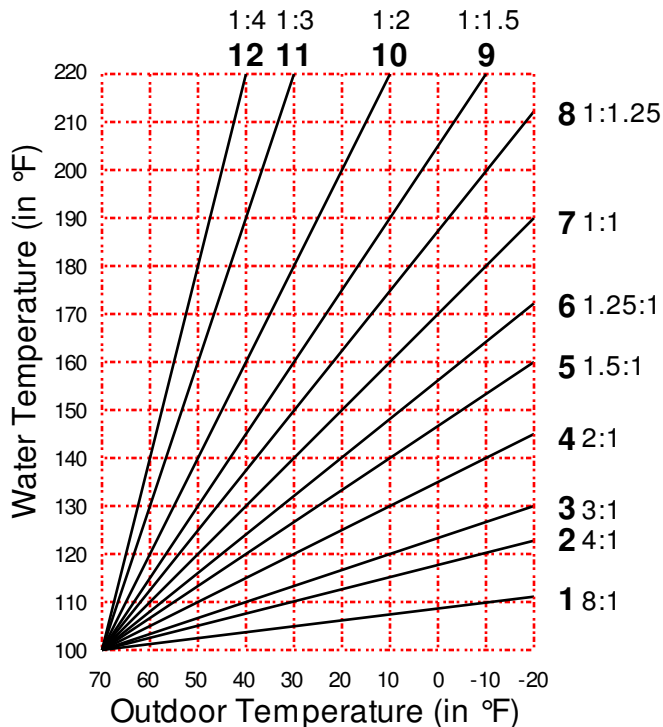
Two sensors are used, one to monitor the outdoor temperature, and one to monitor the temperature of the circulating hot water in the heating system. When the outdoor temperature falls to the outdoor cutoff setting, the heating system is activated and the hot water temperature is increased proportionally to meet the need for more heat. Should it get warmer outdoors, the hot water temperature is automatically lowered by the control. If the outdoor temperature continues to rise to the outdoor cutoff setting then the heating system is turned off.

Because of many physical characteristics, and the type of radiation, ie. baseboard or radiant, heat loss varies. In one building, a 1-degree temperature change outdoors may require a change of 1 degree in heating water temperature; for another it may require a change of 2, 3, or even 4 degrees in order to gain the desired comfort level. This is known as the reset ratio. The middle chart shows the wide range of reset ratios available for the MSTG. The installer fits the MSTG to a

specific building by adjusting the reset ratio curve. With a curve of **4** (2:1 reset ratio) a 2-degree change in outdoor temperature will change the circulating hot water temperature by 1 degree; at an **11** curve (1:3 reset ratio) an outdoor change of 1 degree will change the water temperature by 3 degrees. Most buildings with baseboard radiation require a curve of **6**, **7**, or **8**. Radiant heat applications usually require a lower curve.

Optional features include:

- An external thermostat input which can be connected to a new or existing thermostat or switch to shut the heating system down when the thermostat is satisfied or heat isn't required
- A domestic hot water input for systems where an indirect tank provides DHW. During a DHW call, the MSTG will maintain a constant 180°F set point. The DHW pump will be enabled whenever there is a call for DHW. The heating system pump can be programmed to turn off during the first hour of a DHW call.
- A built-in or external setback to provide lower water temperatures when the building is unoccupied or tenants are asleep.



The MSTG can control up to four boiler stages directly with automatic lead stage rotation. The boilers can be on/off or lo/hi/lo. If additional stages are required, the MSTG can be connected to the Heat-Timer SEQ-6 or SEQ-12.

# INSTALLATION

## MOUNTING THE CONTROLLER

- Locate the MSTG in a convenient location near the boilers to be controlled.
- Mount the MSTG away from excessive heat or cold. Ambient operating temperature is from 20 to 120°F.
- The surface must be flat and strong enough to hold the weight of the control.
- Leave 12" of clearance under the enclosure to allow access to the bottom knockouts (KO).
- Remove the three recessed screws which attach the lower cover to the MSTG. When the cover is removed, the terminal strip and the two vertical mounting slots on the sides of the enclosure are visible.
- Mount the enclosure by screwing it to the flat surface using the two horizontal mounting slots in the top flange and the two vertical mounting slots.

## WIRING THE POWER INPUTS

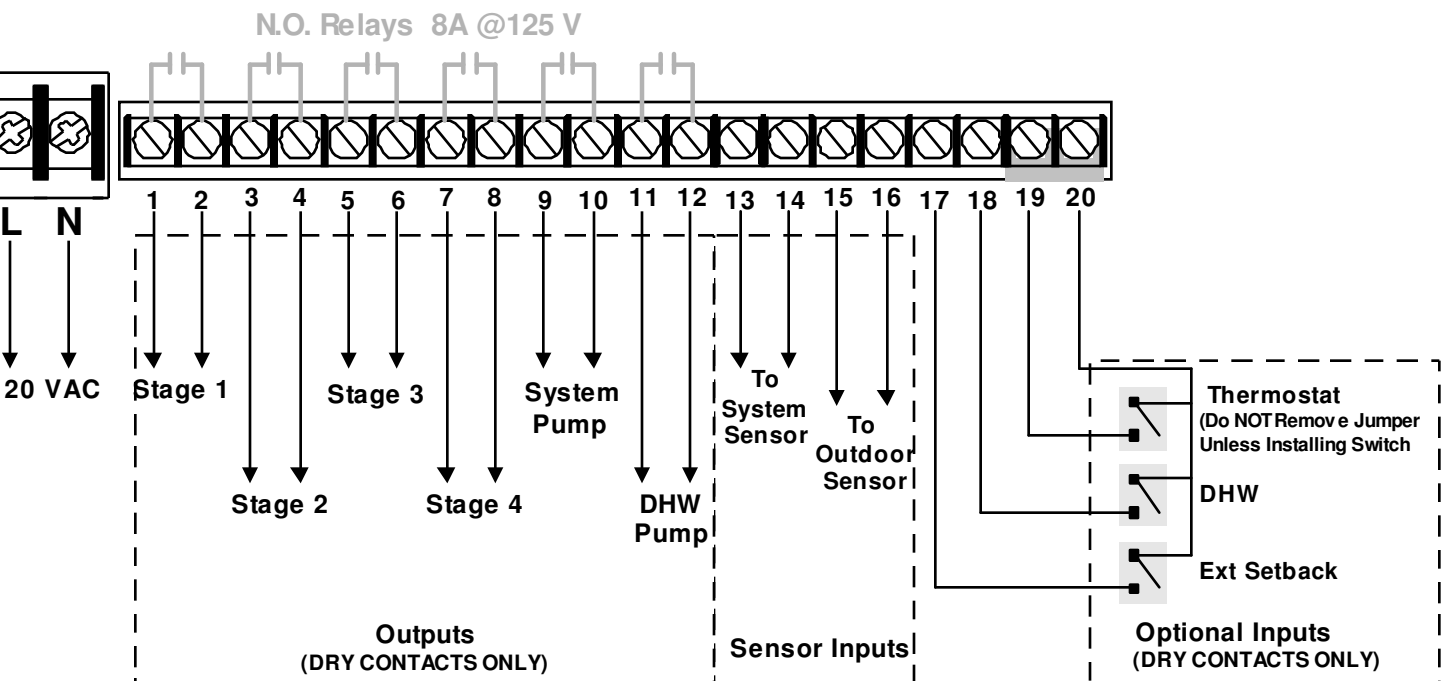
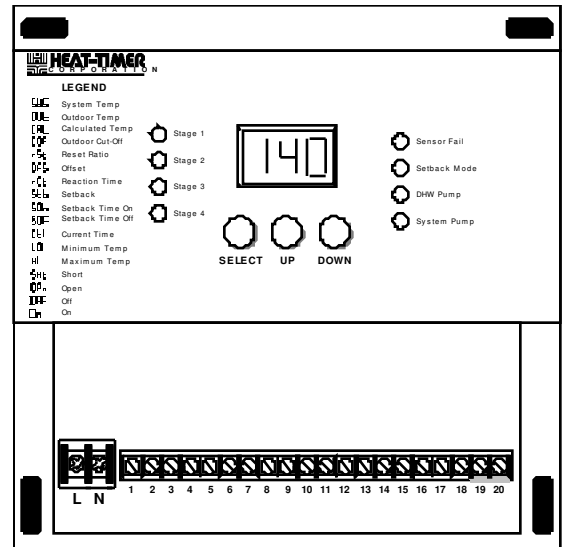
- Bring 120VAC line voltage through the left-hand bottom KO of the MSTG.
- Attach 120VAC to the left-hand terminal strip marked *L* and *N*.
- If possible, provide a dedicated circuit breaker for the MSTG. Never connect the MSTG on a circuit breaker connected to high inductance devices such as relays, contactors, pumps, fans, or motors.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 wiring.

## INSTALL THE HEATING SYSTEM SENSOR

- The MSTG heating system sensor is designed to be installed in a 3/8" ID well.
- Locate the sensor in the common header, where it will register the output of all the boiler stages and before any takeoffs.
- The sensor wires can be extended up to 500 feet by splicing with 18 gauge shielded wire.
- Do not run sensor wire in conduit with line voltage.
- The sensor has no polarity. Connect one of the sensor wires to the terminal marked *13*.
- Connect the other sensor wire and the shield to the terminal marked *14*.

## INSTALL THE OUTDOOR SENSOR

- Locate the outdoor sensor in the shade on the north side of the building.



- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources.
- The sensor should be mounted at least 4 inches away from the building wall and approximately 10 feet above ground level.
- The sensor wires can be extended up to 500 feet by splicing with 18 gauge shielded wire.
- Do not run sensor wire in conduit with line voltage.
- The sensor has no polarity. Connect either sensor wire to the terminal marked 15.
- Connect the other sensor wire and the shield to the front terminal marked 16.

### WIRING THE THERMOSTAT or REMOTE SHUTDOWN INPUT (Optional)

- If the Thermostat terminals (19&20) are open, the MSTG will not energize the boiler Stage outputs (except on a DHW call) or the Heating System Pump output.
- The MSTG is shipped with a jumper across the Thermostat terminals. **DO NOT** remove this jumper unless you replace it with a dry contact switch which closes when heat is required in the building. This type of contact is usually provided by a thermostat.
- When the Thermostat terminals are opened, the Stage outputs will immediately open to disable all the boiler stages. If there is an active Heating System Pump output, it will remain energized for three minutes to remove heat from the boiler stages, and then also turn off.
- The Thermostat signal must be a dry contact only. No voltage can be placed across terminals 19&20.
- Bring the two wires from the dry contact thermostat or remote shutdown switch to the terminals marked 19&20.

**CAUTION** Do not remove the factory installed Thermostat jumper without installing a dry contact switch which closes when heat is required.

### WIRING THE DHW INPUT (Optional)

- If the DHW terminals (18&20) are connected, the MSTG will recognize a DHW call. During a DHW call, the control will hold a 180°F set point, the DHW Pump output will be active, and the Heating System Pump can be selected to turn off. This allows an indirect DHW tank to heat up quickly.
- The DHW signal is normally provided by an aquastat in the DHW tank.
- The DHW signal must be a dry contact only. No voltage can be placed across terminals 18&20.
- Bring the two wires from the dry contact to the terminals marked 18&20.

### WIRING THE EXTERNAL SETBACK (Optional)

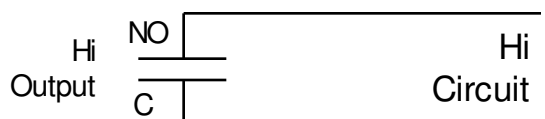
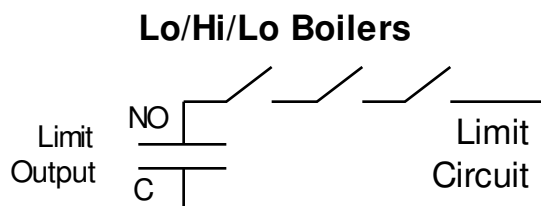
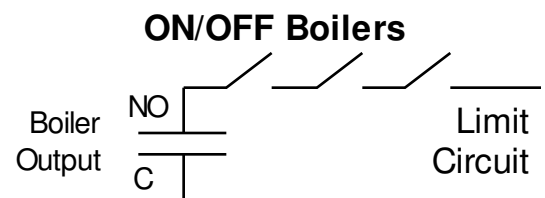
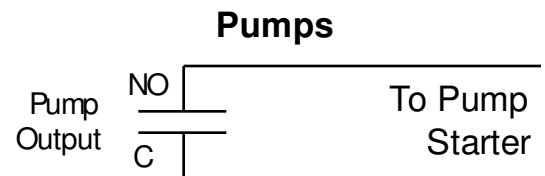
- Setback provides a lower temperature for the heating water during times when the building is unoccupied or tenants are sleeping.
- The MSTG has a built-in Setback timer with one setback period per day. However, if additional Setback times are required, or if the Setback times change from day to day, the MSTG can be connected to an external clock or other switch which provides a dry contact closure when the MSTG should be in the Setback.
- When the Ext Setback to Common terminals (17&20) are connected, the MSTG will hold the lower Setback temperature. The amount of Setback is adjustable (see pg. 9).
- The Ext Setback signal must be a dry contact only. No voltage can be placed across terminals 17&20.
- Bring the two wires from the dry contact to the terminals marked 17&20.

### WIRING THE PUMP OUTPUTS

- The pairs of output terminals 9&10 for the Heating System Pump and 11&12 for the DHW provide a dry contact closure only. They do not source any power.
- They are connected internally to a N.O. relay which is rated at 8 Amp max.
- The total of all outputs, including all boiler stages and the pumps must not exceed 15A.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 wiring.
- Connect terminals 9&10 to the Heating System Pump starter.
- Connect terminals 11&12 to the DHW Pump starter.

### WIRING THE STAGE OUTPUTS

- The pairs of Stage output terminals, 1&2, 3&4, 5&6, and 7&8 provide a dry contact closure only. They do not source any power.
- They are connected internally to a N.O. relay which is rated at 8 Amp max.



	Boiler Type	1 On/Off	2 On/Off	3 On/Off	4 On/Off	1 Lo/Hi	2 Lo/Hi
<b>Terminals</b>							
1&2	Limit	Limit	Limit	Limit	Limit	Limit	Limit
3&4		Limit	Limit	Limit	Limit	Hi Fire	Hi Fire
5&6			Limit	Limit	Limit		Limit
7&8					Limit		Hi Fire

- The total of all outputs, including all boiler stages and the pumps must not exceed 15A.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 wiring.

### On/Off Boiler

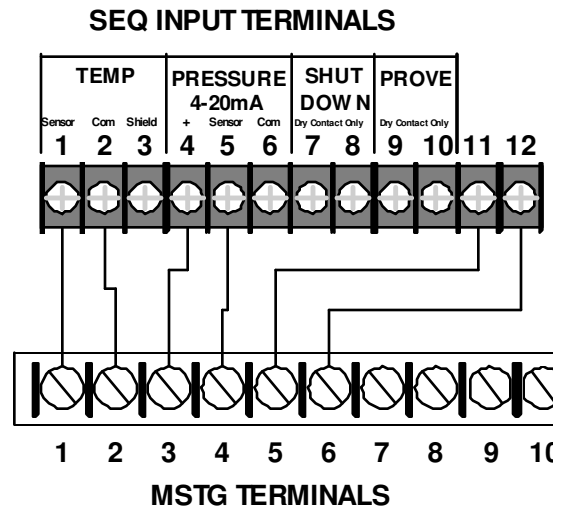
- Each boiler has one relay and one pair of Stage contacts associated with it.
- See chart above to determine the correct wiring for your installation.
- Wire the N.O. relay contacts in series with the boiler's limit circuit.

### 2-Stage (Lo/Hi/Lo) Boilers

- Each boiler has two relays and two pairs of Stage contacts associated with it.
- Check the chart above to determine the correct wiring for your installation.
- Connect the Limit N.O. relay contacts in series with the boiler's limit circuit.
- Connect the Hi Fire N.O. relay contacts to the Hi control circuit.

### WIRING TO A SEQ6/6P/12

- The MSTG can be connected to a Heat-Timer SEQ-6/6P/12 to expand the number of output stages.
- The SEQ-12 can control up to 12 On/Off boilers, 6 Lo/Hi boilers, 4 3-stage boilers, or 3 4-stage boilers.
- The SEQ-6P provides control for both boilers and individual boiler pumps. The SEQ-6P can control up to 6 On/Off boilers with pumps, 4 Lo/Hi boilers with pumps, 3 3-stage boilers with pumps, or 2 4-stage boilers with pumps.
- Connect MSTG terminals 1&2 to the SEQ-6/6P/12 terminals 1 and 2.
- Connect MSTG terminals 3&4 to the SEQ-6/6P/12 terminals 4 and 5.
- Connect MSTG terminals 5&6 to the SEQ-6/6P/12 terminals 11 and 12.



### INITIAL CONTROL START-UP

- Whenever the MSTG is powered up, it will display the software version number and then the current operating modes. Each display will remain on the screen approximately 5 seconds. If the operating modes are correct, there is no need to make any adjustments.
- Once the operating modes have been set for a particular application, they will be retained in memory and will not need to be reset.
- Note that if you do change an operating mode, you will need to reset all the settings (shown on the chart pg. 7).
- An operating mode can only be changed when it is being displayed in the start-up sequence. To restart the sequence it is necessary to remove power to the MSTG and then power it again.
- Set the operating parameters as described in sequence below:

#### °F or °C - Fahrenheit or Celsius Temperature Operation Default is °F

- If the display shows °F then the MSTG will operate in Fahrenheit degrees.
- If the display shows °C then the MSTG will operate in Celsius degrees.
- To change the temperature operation, hold down the *SELECT* button while pushing either the *UP* or *DOWN* button to toggle between the displays of °F and °C.
- When the correct temperature operation is selected, release the buttons and wait approximately 5 seconds.

#### dnO or d\_P- DHW selection Default is dnO

- If the display shows *dnO* then the MSTG will operate with NO DHW Priority. This means the status of the Heating System Pump

## WARNING

**This Heat-Timer control is strictly an operating control; it should never be used as a primary limit or safety control. All equipment must have its own certified limit and safety controls required by local codes. The installer must verify proper operation and correct any safety problems prior to the installation of this Heat-Timer control.**

will not change when there is a DHW call. If the Heating System Pump was not running, based on the outdoor temperature and Thermostat input, the Heating System Pump will remain off. If the Heating System Pump was running, it will continue to run, and 180°F water will be circulated through the heating loop.

- If the display shows *d\_P* then the Heating System Pump will be disabled for the first hour of a DHW call. This allows the DHW tank to be satisfied more quickly. If the DHW is not satisfied after an hour, the Heating System Pump will resume its normal operation based on the outdoor temperature and Thermostat input.
- To change the DHW Priority selection, hold down the *SELECT* button while pushing either the *UP* or *DOWN* button to toggle between the displays of no priority (*dnO*) and priority (*d\_P*).
- When the correct priority mode is selected, release the buttons and wait approximately 5 seconds.

**Programmed Operating Mode** Default is P00

- The Programmed Operating mode must be set correctly for the MSTG to function properly. Carefully check the chart below to determine the correct Programmed Operating mode for your specific installation and lead/lag requirements.
- To change the Programmed Offset mode, hold down the *SELECT* button while pushing either the *UP* or *DOWN* button to move through the Programmed Operating modes.
- When the correct mode is selected, release the buttons and wait approximately 5 seconds.

**DEFAULT SETTINGS**

**Settings shown in instructions have been selected by Heat-Timer and will provide proper operation for many installations.**

- The MSTG comes equipped with default settings which are a good starting point for most installations.
- After the start-up routine has completed, the display will show the system water temperature.
- To display the other settings (see chart on pg. 7), repeatedly press the *SELECT* button.

# Boilers	Boiler Type	Rotation	Programmed Mode
4	On/Off	None Boiler 1 is always the lead stage.	P00
3			P01
2			P02
1			P12
4	On/Off	First On/First Off The first stage activated on a call for heat will be the first stage turned off when the heat demand is satisfied.	P04
3			P05
2			P06
4	On/Off	Lead Stage Rotates Every 24 Hours On powerup, Boiler 1 is lead. At midnight, Boiler 2 becomes lead. lead continues to rotate through the active stages every 24 hours.	P08
3			P09
2			P10
2	Lo/Hi	None Boiler 1 is always the lead stage.	P03
1			P13
2	Lo/Hi	First On/First Off The first stage activated on a call for heat will be the first stage turned off when the heat demand is satisfied.	P07
2	Lo/Hi	Lead Stage Rotates Every 24 Hours On powerup, Boiler 1 is lead. At midnight, Boiler 2 becomes lead. lead continues to rotate through the active stages every 24 hours.	P11
Up to 12 Boilers	MSTG Connected to SEQ6/6P/12 The SEQ6/6P/12 expands the number of boiler stages which can be controlled by the MSTG.		P14

- A setting can only be adjusted when it is being displayed.
- Use the *UP* and *DOWN* buttons to adjust the setting.
- The display will always revert back to the actual system water temperature after 30 seconds.
- The default Outdoor Cutoff (COF) is 60°F. When the outdoor temperature sensor reads above the Outdoor Cutoff, the MSTG will not give heat, except on a DHW call.
- The default Reset Ratio (rSt) is curve 7 or 1:1 (see chart on first page). This ratio should be a good starting point for applications with baseboard or radiators. If the application has radiant heat, a lower numbered reset ratio curve should be selected.
- The default Offset (OFS) is 0°. This means the system target temperature will be 100°F at an outdoor temperature of 70°F as shown on the reset curves on the front page.
- The default Reaction Time (rCt) is 2 minutes. This means the minimum run-time for any boiler stage is at least one minute.
- The default Setback (Stb) is 20°F. When either the internal Setback clock or the Ext Setback input is active, the temperature of the heating water will be reduced by 20°F.
- The default values for the Setback Time On (SOn) and Setback Time Off (SOF) are both 12 noon. This disables the internal Setback Clock feature. The setback times are shown in 24 hour time, so 12 noon is displayed as 12.00.
- The default Minimum Temp (LO) is 70°F. This is the minimum water temperature the MSTG will circulate. When there is a call for heat, the MSTG will compute the temperature of the water to circulate based on the outdoor temperature, Reset Ratio, and Offset. It will then either use the Minimum Temp or the calculated temperature, whichever is higher. The Minimum Temp should be set to the minimum water temperature recommended by the boiler's manufacturer.
- The default Maximum Temp (HI) is 160°F. This is the maximum water temperature the MSTG will circulate. In the case of radiant heat, contact the tubing and flooring manufacturers to determine the correct value for the maximum water temperature. For most installations with radiators, the Maximum Temp can be set to the highest value, 200°F.

## **CAUTION**

Set the Minimum Temp to the minimum water temperature specified by the boiler's manufacturer. Failure to do so may shorten the life of the boiler.

## **WARNING**

**Excessive heat can cause substantial property damage in certain installations. It is the responsibility of the installer to determine the correct maximum water temperature which can be safely circulated through a specific installation. Additionally, the Heat-Timer control can not be used as a limit control. Separate high limit controls must be installed to prevent property damage.**

## DISPLAY CHART AND ADJUSTMENTS

Press Center Button	DISPLAY	Press and hold either the UP or DOWN button to adjust the value
Once*	<b>OUT</b> Outdoor	The temperature value measured by the Outdoor Sensor. If the sensor is not connected, the display will show OPN. If shorted, it will show SHT.
Twice*	<b>CAL</b> Calculated	This is the water temperature the MSTG will control boilers to hold. It is based on outdoor temperature, Reset Ratio, Offset, Setback, Minimum, and Maximum values.
3 Times	<b>COF</b> Outdoor Cutoff	When the outdoor temperature falls below the Outdoor Cutoff setting, the MSTG will not give heat. When the outdoor temperature is above the Outdoor Cutoff, the Calculated value will be OFF and no stages will be activated. The Outdoor Cutoff is adjustable from 40 to 100 °F, and ON.
4 Times	<b>RSE</b> Reset Ratio	The Reset Ratio controls the amount of heat which enters the heating system based on the outdoor temperature. A higher numbered Reset Ratio will result in a higher Calculated water temperature. See the chart on the first page for the reset curves. The Reset Ratio is adjustable from 1 to 12.
5 Times	<b>OFF</b> Offset	The Offset moves the Reset Ratio curves vertically up or down. For example, changing the offset from 0 to -10 will decrease the water temperature 10° regardless of outdoor temperature or the Reset Ratio curve selected. The Offset is adjustable from -40 to 40 °F.
6 Times	<b>RCT</b> Reaction Time	The Reaction Time sets the minimum run-time for any boiler stage. It is adjustable from half a minute to ten minutes in 30 second increments.
7 Times	<b>SEB</b> Setback	The Setback controls the number of degrees the water temperature will be lower when either the internal Setback clock or Ext Setback input is active. The Setback is adjustable from 0 to 40 °F.
8 Times	<b>SON</b> Setback Time ON	The water temperature will be reduced by the amount of the Setback (above) starting at the Setback Time ON. The time is shown in 24 hour mode.
9 Times	<b>SOF</b> Setback Time OFF	The water temperature will return to its normally calculated value starting at the Setback Time OFF. The time is shown in 24 hour mode.
10 Times	<b>CTI</b> Current Time	The current time shown in 24 hour mode.
11 Times	<b>LD</b> Minimum Temp	This is the lowest temperature heating water the MSTG will circulate through the heating system. It should be set according to the boiler manufacturer's specifications. The temperature is adjustable from 70 to 170 °F or the Maximum Temp, whichever is lower.
12 Times	<b>HI</b> Maximum Temp	This is the highest temperature heating water the MSTG will circulate through the heating system. It should be set according to the tubing or floor manufacturer's specification. The temperature is adjustable from the Minimum Temp or 100 °F whichever is higher, to 200 °F.
13 Times*	<b>SYS</b> Default	The MSTG returns to the default display of system water temperature as measured by the System Sensor. If the sensor is not connected, the display will show OPN. If shorted, it will show SHT.

\* The sensor readings and Calculated temperature can not be adjusted with the UP and DOWN buttons.

# OPERATION

## DISPLAY SETTINGS

### Calculated water temperature

#### Center button pressed twice

- This is the water temperature the MSTG will control the boiler stages to hold. It is based on outdoor temperature, Offset, Reset Ratio, and Setback values (described in the following sections).
- The Calculated temperature is the average temperature the MSTG will maintain. The system temperature can be expected to fluctuate above and below the Calculated value. The size of the fluctuation depends on several factors including the size of the boiler stages, the load variation, and the Reaction Time setting.
- The Calculated water temperature can not be less than the Minimum Temp setting.
- The Calculated water temperature can not be greater than the Maximum Temp setting, with the exception that a DHW call will hold a set point of 180°F, even if that exceeds the Maximum Temp.
- If the outdoor temperature is above the Outdoor Cutoff setting or the Thermostat input is open, the MSTG will not activate the boiler Stage outputs or the Heating System Pump output. The main display and the Calculated display will show *OFF* to indicate this condition.
- If the Outdoor sensor is reading a fault condition, the boiler Stage outputs and the Heating System Pump output will be activated. The Calculated display will show *ON* to indicate this condition.
- If the Heating System Sensor has a fault, the boiler Stage outputs and Heating System Pump output will be off if the outdoor temperature is above the Outdoor Cutoff or the Thermostat input is open. If the outdoor temperature is below the Outdoor Cutoff, the boiler Stage outputs and the Heating System Pump output will be activated. The Calculated display will show *ON* to indicate this condition.
- The Calculated temperature is based on all the settings described above. The value can not be changed by pressing the *UP* or *DOWN* button while it is displayed.

### Outdoor Cutoff Default is 60°F

#### Center button pressed 3 times

- The Outdoor Cutoff sets at what outdoor temperature the MSTG will activate the heating system.
- When the outdoor temperature is above the Outdoor Cutoff setting, the MSTG will not give heat. The main display and the Calculated water temperature will read *OFF* to indicate this condition.
- The Outdoor Cutoff has a built in 2°F differential.
- When the outdoor temperature drops below the Outdoor Cutoff setting minus the 2°F differential, the MSTG will compute the Calculated water temperature and control the boiler stages to hold that temperature.
- If the building is too cold before the heating system is activated, raise the Outdoor Cutoff temperature.
- The Outdoor Cutoff temperature can be set from 40 to 100°F or ON.

### Reset Ratio Default is 7

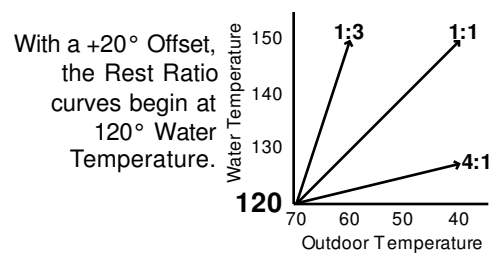
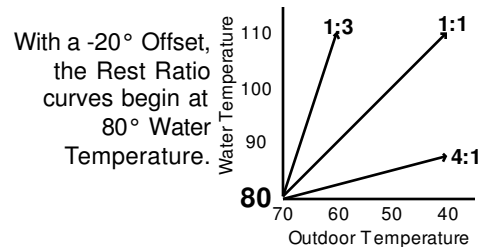
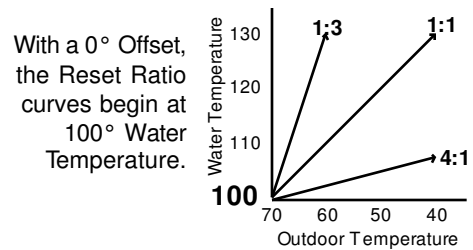
#### Center button pressed 4 times

- The Reset Ratio controls how much heat will be input to the system based on outdoor temperature. The Reset Ratios are shown as Outdoor Temperature:Water Temperature.
- A 1:1 Reset Ratio signifies for each degree it gets colder outside, the Calculated water temperature will increase 1 degree.
- The other Reset Ratios are shown on the first page.
- The Reset Ratio curves start at 70°F. At 70°F the MSTG will require 100°F water. Note that 70°F is not the outdoor temperature where the MSTG will begin giving heat. That point is determined by the Outdoor Cutoff. Also note the 100°F starting point can be changed by adjusting the Offset as shown on the opposite page.
- For new installations with standard baseboard heating, begin with a Reset Ratio curve of 7.
- For new installations with radiant heat, begin with a Reset Ratio curve of 4 or 5.
- Adjust the Reset Ratio curves in cold weather. If the ambient indoor temperatures are cold in the cold weather, pick the next higher Reset Ratio (that is, go from 7 to 8). If the ambient building temperatures are warm in the cold weather, pick the next lower Reset Ratio.
- After adjusting the Reset Ratio curve, wait at least 24 hours before making another adjustment.
- The Reset Ratio can be set from 1 to 12.

## Offset Default is 0°F

### Center button pressed 5 times

- The Offset value moves the starting point of the Reset Ratio curves as shown on the side charts.
- Therefore, any change made to the Offset will immediately change the value of the Calculated water temperature by the same amount (unless the new value is below the Minimum or above the Maximum Temp).
- For example, if the Calculated water temperature were 140°F based on the specific outdoor temperature and Reset Ratio, then increasing the Offset from 0°F to 10°F would increase the Calculated water temperature to 150°F.
- In a new installation, start with an Offset value of 0°.
- Adjust the Offset value in mild weather. If the ambient indoor temperatures are warm in the warm weather, decrease the Offset. If the ambient building temperatures are cold in the mild weather, increase the Offset.
- The rule of thumb for baseboard radiation is to change the Offset by 4° for every degree you wish to change the ambient temperature. For radiant heat applications, change the Offset by 1° or 2° for every degree you wish to change the building temperature.
- The Offset can be set from -40 to 40°F.



## Reaction Time Default is 2.0 minutes

### Center button pressed 6 times

- The Reaction Time controls the minimum run time for any boiler stage.
- When a boiler Stage output has been added, it can not be turned off, nor can another boiler Stage output be activated, until at least half the Reaction Time has elapsed.
- The Reaction Time must be at least as long as the time it takes for a newly activated Stage to start affecting the system temperature. If the Reaction Time is shorter, the MSTG may activate additional Stages before it can see the impact of each Stage.
- If the system tends to fluctuate rapidly above and below the Calculated temperature, the Reaction Time may be too short.
- If the system tends to remain always below the Calculated Temp, the Reaction Time may be too long.
- When making a change to the Reaction Time, wait at least 5 reaction times before making another change. The system will need time to settle out.
- The Reaction Time can be set from half a minute (0.5) to ten minutes (10.0).

## Setback Default 20°F

### Center button pressed 7 times

- The MSTG has two heat levels: Normal Mode which is used when a building is occupied and people are active; and Setback Mode which holds a lower ambient temperature and is used when a building is unoccupied, or people are sleeping.
- The Setback Mode can be activated by the internal Setback Clock (settings described below) or by a dry contact closure across the Ext Setback terminals (see pg. 3).
- When the MSTG enters the Setback Mode the Calculated temperature will be lowered by the number of degrees set by this Setback setting.
- When in Setback Mode, the MSTG will first compute the Calculated water temperature using the outside temperature, Reset Ratio, and Offset. Then the MSTG will subtract the value of the Setback. This will be the Calculated temperature (as long as it is higher than the Minimum Temp).
- The rule of thumb for baseboard radiation is to set the Setback 4° for every degree you wish to lower the building temperature. For example, if you want the building to be 5° cooler at night, set the Night Setback for -20°.
- For radiant heat applications, set the Night Setback 1° or 2° for every degree you wish to lower the building temperature.

## Setback Time On Default 12 noon

### Center button pressed 8 times

- The Setback Time On determines when the MSTG will enter the Setback Mode based on its internal clock.
- The internal Setback Clock reports time in 24 hour mode. The time will be shown as HOURS.MINUTES. For example, 8:00 am would be shown as 08.00 and 11:30 pm would be shown as 23.30.
- To adjust the Setback Time On, press the *SELECT* button 8 times.
- The current Setback Time On will be shown. The hours will be flashing.
- Use the *UP* and *DOWN* buttons to select the desired hour setting and then press the *SELECT* button to save it.

- Now the minutes will be flashing.
- Use the *UP* and *DOWN* button to select the desired minute setting and then press the *SELECT* button to save it.

**Setback Time Off** Default 12 noon

**Center button pressed 9 times**

- The Setback Time Off determines when the MSTG will return to the Normal Mode based on its internal clock.
- To adjust the Setback Time Off, press the *SELECT* button 9 times and follow the procedure in *Setback Time On* to set the hours and minutes.

**Current Time**

**Center button pressed 10 times**

- The Current Time must be set correctly if the internal Setback Clock is used. If it is not set correctly, the Setback will not begin and end at the expected times.
- To adjust the Current Time, press the *SELECT* button 10 times and follow the procedure in *Setback Time On* to set the hours and minutes.

**Minimum Temp** Default 70°F

**Center button pressed 11 times**

- The Minimum Temp value is the minimum water temperature the MSTG will circulate.
- When there is a call for heat, the MSTG will compute the temperature of the water to circulate based on the outdoor temperature, Reset Ratio, Offset, and Setback, as described in the previous sections.
- After this, the MSTG will compare the newly computed water temperature to the Minimum Temp. The MSTG will use either the computed value or the Minimum Temp value, whichever is **HIGHER**.
- The Minimum Temp should be set to the minimum water temperature recommended by the boiler's manufacturer.

**CAUTION**

Set the Minimum Temp to the minimum water temperature specified by the boiler's manufacturer. Failure to do so may shorten the life of the boiler.

**Maximum Temp** Default 160°F

**Center button pressed 12 times**





- The Maximum Temp value is the maximum water temperature the MSTG will circulate.
- When there is a call for heat, the MSTG will compute the temperature of the water to circulate based on the outdoor temperature, Reset Ratio, Offset, and Setback, as described in the previous sections.
- After this, the MSTG will compare this newly computed water temperature to the Maximum Temp. The MSTG will use either the computed value or the Maximum Temp value, whichever is **LOWER**.

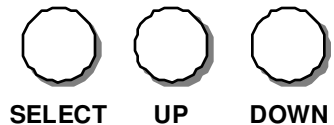
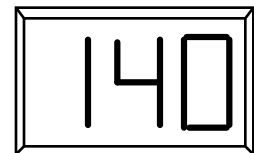
**WARNING**

**Excessive heat can cause substantial property damage in certain installations. It is the responsibility of the installer to determine the correct maximum water temperature which can be safely circulated through a specific installation. Additionally, the Heat-Timer control can not be used as a limit control. Separate high limit controls must be installed to prevent property damage.**

**STAGE LIGHTS**

- The four red Stage Lights indicate when an output Stage relay is energized.
- The red light marked *Stage 1* will be on when output terminals 1&2 are energized and off when they are open.
- The red light marked *Stage 2* will be on when output terminals 3&4 are energized and off when they are open.
- The red light marked *Stage 3* will be on when output terminals 5&6 are energized and off when they are open.
- The red light marked *Stage 4* will be on when output terminals 7&8 are energized and off when they are open.

-  Stage 1
-  Stage 2
-  Stage 3
-  Stage 4



## OTHER INDICATOR LIGHTS

### Sensor Fail

- The red *Sensor Fail* light will come on when either the Heating System sensor or the Outdoor sensor is open or shorted.
- If the Heating System sensor is open, the default display will read *OPN*. If the Heating System sensor is shorted, the default display will read *SHt*.
- If the fault is with the Outdoor sensor, push the *SELECT* button once to show if the Outdoor sensor is open or shorted.
- Note that on an outdoor sensor fault, the Heating System pump will be active, as indicated by the *System Pump* light.

### Setback Mode

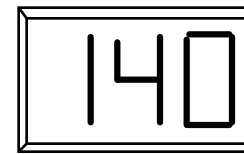
- The red *Setback Mode* light will come on when the MSTG is holding the lower Setback water temperature.
- Either the Ext Setback (see pg. 3) or the internal Setback Clock (see pg. 9) will put the MSTG in Setback mode, and the light will be active.

### DHW Pump

- The red *DHW Pump* light will come on when the Domestic Hot Water input is active and the DHW Pump output is energized.

### System Pump

- The red *System Pump* light will be on whenever the Heating System Pump output is energized and the MSTG is controlling the boiler stages to provide ambient heat (see below).



- Sensor Fail
- Setback Mode
- DHW Pump
- System Pump

## HEATING SYSTEM PUMP OPERATION

- The Heating System Pump output is designed to continuously circulate the heating water whenever heat is required, although it may be selected to be turned off during the first hour of a DHW call (see pg. 4).
- The Heating System Pump relay will energize whenever the outdoor temperature is below the Outdoor Cutoff temperature, the Thermostat input is closed, and there is no priority DHW call.
- When either the outdoor temperature rises above the Outdoor Cutoff, or the Thermostat input is opened, the Heating System Pump will run on for three additional minutes after the call for heat ends. This removes heat from the boiler stages. However, if the Heating System Pump is disabled due to a DHW call, there will be no run on.
- If the Heating System Pump output has not been activated for 7 days (as might occur in the summer), the relay will be energized for 15 seconds to exercise the pump.

## DHW PUMP OPERATION

- The DHW pump output is provided for systems with an indirect hot water heater.
- The DHW Pump output will continuously circulate 180°F boiler water through a domestic tank when there is a DHW call (connected across the *DHW* and *COM* terminals).

# TROUBLESHOOTING

## No Display or Display of 888

Check the power to the MSTG. The MSTG requires 120VAC power to the *L* and *N* terminals. Turn the power off and back on to restore the display.

## Display flashing

The Outdoor sensor has a fault. Follow the steps below.

## System or Outdoor Display shows OPN

Check that the wires from the sensor are continuous to the MSTG. Then follow the procedure for Incorrect Temperature Display.

## System or Outdoor Display shows SHT

The MSTG sees a short across the input terminals. Remove the wires from the input terminals. The display should change to read *OPN*. If it doesn't, the MSTG may be damaged.

## System or Outdoor Display shows an Incorrect Temperature

Remove the wires from the input terminals. The display should change to read *OPN*. If it doesn't, the MSTG may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the chart at right. If it doesn't, the sensor may be damaged.

## No Heat - System Pump light off

Check the outdoor temperature and Outdoor Cutoff readings. If the outdoor temperature is above the Outdoor Cutoff, the MSTG will not give heat. Then check the Thermostat input. If terminals *19&20* are not jumped together, the MSTG will not give heat.

## No Heat - System Pump light on

Remove any connections across terminals *9&10* for the Heating System Pump. Test for continuity across the terminals. If the terminals *9&10* are continuous, the MSTG is calling for the Heating System Pump to run. Check the pump to determine why it is not circulating.

## No Heat - System Pump Running - Stage lights off

Check if the displayed System Water temperature is close to the Calculated water temperature. During mild weather it is possible for all boiler stages to be off for a prolonged period of time while the Calculated temperature is still maintained.

## No Heat - System Pump Running - Stage lights on

Remove any wires from the pair of terminals connected to active stage light (for Stage 1: Terminals *1&2*, Stage 2: Terminals *3&4*, Stage 3: Terminals *5&6*, Stage 4: Terminals *7&8*). Test for continuity across the terminal pair. If the terminal pair are continuous, the MSTG is calling for that boiler stage to be firing. Check the boiler to determine why it is not firing.

## No Heat - DHW Pump light on

The MSTG is registering a call for DHW. If the DHW Priority (*d\_P*) is set, the Heating System Pump will not run during the first hour of a DHW call. Generally the DHW will be satisfied before a drop in ambient temperature is noticeable. If the DHW load is large, change the Priority setting to none (*dnO*); this will allow the Heating System Pump to circulate heating water while the DHW tank is being satisfied.

## Cold DHW - DHW Pump light on

Check if the System Water temperature display is approximately 180°F. If it is cooler, follow the procedure to check the Stage output described in *No Heat-System Pump Running - Stage lights ON*. If the System Water temperature is hot, remove any connections to the pair of DHW pump terminals, *11&12*. Check for continuity across the terminal pair. If terminals *11&12* are continuous, the MSTG is calling for the DHW pump to run. Check the pump to determine why it is not circulating.

TEMPERATURE (in degrees F)	Value (in Ohms)
0	42683
10	31215
20	23089
25	19939
30	17264
35	14985
40	13040
45	11374
50	9944
55	8714
60	7653
70	5941
80	4649
90	3667
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412