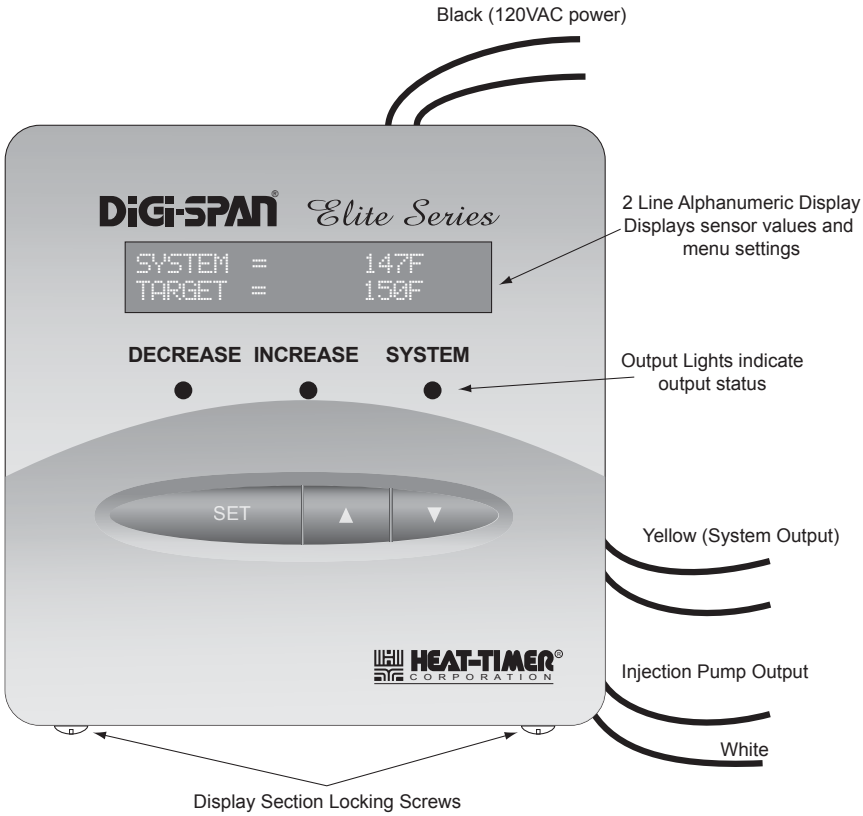
HEAT-TIMER®

INSTALLATION AND OPERATION INSTRUCTIONS

DIGI-SPAN® *Elite Series*

VSP DIGI-ELITE
Variable Speed Pump Control

Injection Pump Control for Hydronic Heating in Outdoor Reset or Set Point Applications



The DIGI-SPAN VSP *Elite* establishes ambient comfort by varying the temperature of the Secondary Loop's circulating hot water in response to changes in the loop temperature. The temperature of the heating water is controlled by regulating the speed of a pump which injects water from a hot Boiler Loop (Primary Loop) into a cooler heating loop (Secondary Loop). As the speed of the pump increases, more hot water is sent into the Secondary Loop resulting into warmer water temperature.

The VSP *Elite* can be used as an outdoor reset control. The VSP can also be used as a set point control. In this mode of operation, the VSP will control the injection pump speed to hold a constant temperature (determined by the user) in the Secondary Loop. In addition, it provides an outdoor temperature based cutoff and system pump control.

Three new features have been added to this control. A customized reset ratio curve for specialized buildings , a manual pump speed control to manually adjust the pump speed based on a well balanced system, and a minimum pump speed adjustment to allow for pump operation at all heating levels.

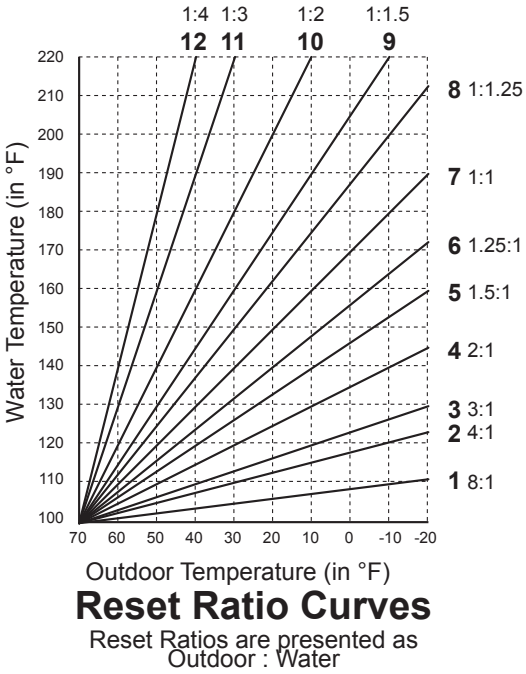
⚠ WARNING

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 code. The installer must verify proper operation and correct any safety problems related to the installation of this Heat-Timer control.

This control must be installed by a licensed electrician.

Two sensors are used for outdoor reset, one to monitor the outdoor temperature, and one to monitor the Secondary Loop circulating hot water temperature. When the outdoor temperature falls below outdoor cutoff setting, the heating system is activated and the Secondary Loop hot water temperature is increased proportionally to satisfy the load. 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 automatically turned off.

Because of the many different physical characteristics of buildings, and the type of radiation, i.e., baseboard or radiant, the 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 VSP *Elite*.



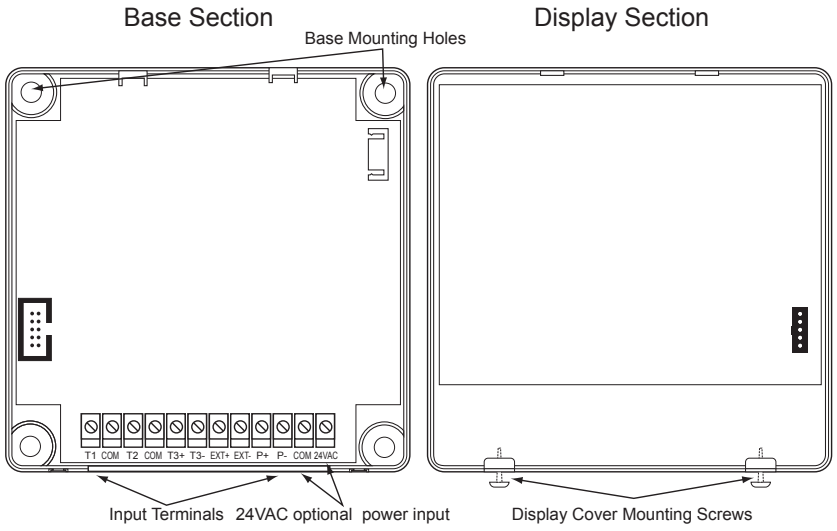
Reset Ratio Curves

Reset Ratios are presented as Outdoor : Water

The installer fits the VSP *Elite* to a specific building by adjusting the Reset Ratio curve. With curve 4 (2:1 reset ratio) a 2-degree change in outdoor temperature will change the circulating hot water temperature by 1 degree; at curve 11 (1:3 reset ratio) an outdoor change of 1 degree will change the water temperature by 3 degrees. Most buildings with baseboard radiation require curve 6, 7, or 8. Radiant heat applications usually require a lower curve. Another, is a Setback input that will switch the heating system to a lower set point determined by the Set Back setting.

Type of Radiation in Building	Reset Ratio	Offset
Radiators (Steel & Cast Iron)	1.00 (O) : 1.00 (S)	0˚F
Baseboard (Finned copper tube& Cast Iron)	1.00 (O) : 1.00 (S)	0˚F
Radiant (High Mass/Concrete)	4.00 (O) : 1.00 (S)	-10˚F
Radiant (Low Mass/Joists)	2.00 (O) : 1.00 (S)	-10˚F
Fan Coils & Air Handlers	1.00 (O) : 1.00 (S)	20˚F

The Boiler Return water sensor and well are provided to avoid thermal shock to the boiler and, therefore, to help prolong boiler life. If the sensor registers that the boiler return water is colder than 120°F, the VSP *Elite* immediately lowers the temperature of the circulating heating water to reduce the load on the boiler, allowing the return water temperature to rise.

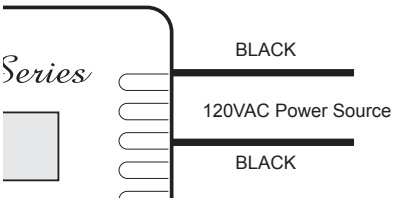


Mounting the Controller

- The VSP *Elite* is designed to mount on a 1900 (4”x4”) deep electrical box.
- If additional room is needed for wiring use the extension skirt provided in the box.
- Place the VSP *Elite* in a convenient location near the unit to be controlled.
- Mount the VSP *Elite* indoors and away from excessive heat or cold.
- Partially unscrew the Display Cover Mounting screws. This allows for its removal.
- Lifting the Display Section away from the base will unplug it from the Base section.
- Proceed with the power and output wiring instructions.
- Use the screws provided to mount the VSP *Elite* to the 1900 box or the extension skirt.
- Mount Display Section back to the Base Section. Tighten the Display Cover Mounting Screws.

Wiring

120VAC Power Wiring

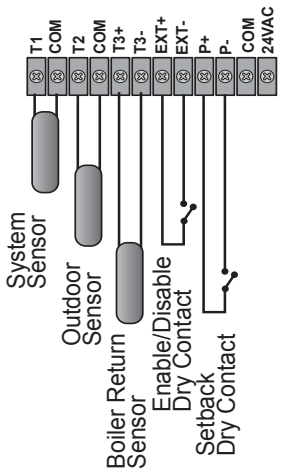


Wiring Power Input

The VSP *Elite* is designed to accept 120VAC using the two Black wires. Heat-Timer recommends the installation of a Surge Suppressor and a Power Switch before the Power Line connection for safety and ease of service.

- Attach line voltage, 120VAC, to the two Black wires extending from the back of the VSP *Elite*. Remember to use the power line from a different source than the equipment being controlled.

Wiring Input Terminals



System (T1, COM) Sensor Installation

- Place the System sensor in the Secondary Loop past the pump where it will register the temperature of the loop before any takeoffs.
- Insert the Brass Tube sensor provided (HT #904250-00) into a ⅜" ID ½" NPT immersion well (HT #904011-00).
- The sensor wires can be extended up to 500' using a shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)). Do not ground the shield at the sensor but at the control using the *COM* terminal.
- Do not run sensor wires in conduit with line voltage wiring.

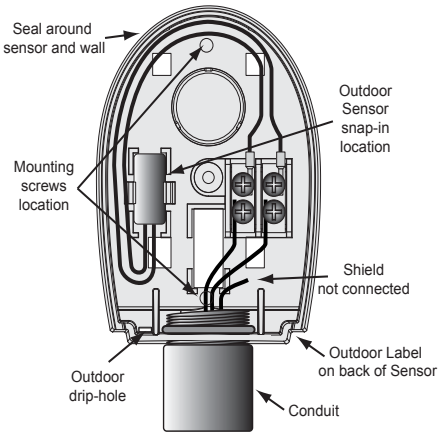
Boiler Return Sensor Installation (T3+, T3-)

- The provided Boiler Return Sensor is designed to be installed in the provided ⅜" ID immersion well.
- The sensor should be located where it will register the correct return from all loops to boiler.
- The sensor wires can be extended up to 500' by splicing it with shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- The sensor has no polarity. Connect either sensor wire to the front terminal marked *T3*±. Connect the other sensor wire and the shield to the front terminal marked *T3*-. Do not ground the shield at the sensor.
- Do not run sensor wires in conduit with line voltage wiring.

Outdoor Sensor Installation (T2, COM)

- The Outdoor Sensor must be used when Outdoor Reset is selected as the Control Mode from the Startup menu. However, in Set Point mode, the Outdoor Sensor is optional. When connected in that mode, it will be used as an input for the Outdoor Cutoff only.
- Only use the Heat-Timer outdoor sensor provided (HT# 904220-00).
- Place the 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 heat or cool sources.
- The sensor should be mounted approximately 10' feet above ground level.
- Adhere the Outdoor Label provided to the back of the sensor base.
- Use the Enclosure Base bottom knockout for the conduit. Use the conduit locknut to hold the conduit and enclosure base together. Screw the cover to the base.
- If screws are used to affix the enclosure to the wall, make sure to seal around the sensor and wall except from the bottom.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- Cut the shield and do not connect it at the sensor end. Only connect it at the control end using the outdoor terminal marked *COM*.
- Do not run sensor wires in conduit with line voltage wiring.

Outdoor Sensor



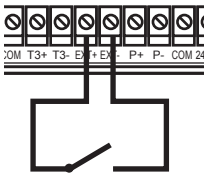
⚠ ALERT

Determining the proper location for the Outdoor Sensor is very important. The VSP will base the heat on the outdoor temperature information it receives from this location. If the sensor is in the sun, or covered with ice, its reading will be different from the actual Outdoor temperature (O).

Wiring the Enable/Disable (EXT+, EXT-)

- The *EXT*± terminals can be used to enable or disable the system by connecting it to a thermostat, external control, or a switch. It accepts dry contact input only. No voltage can be placed across these terminals.
- If no thermostat or control is connected to the *EXT*± terminals, leave the jumper supplied as a contact to the terminals. The VSP *Elite* will not provide heat unless the *EXT*± terminals are closed/shorted.

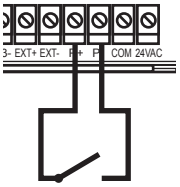
Enable/Disable Wiring



Wiring the Setback/Boost (P+, P-)

- The Setback feature can be used to provide a lower temperature Set Point when less heat is required.
- A typical use for Setback is to provide less system temperature during the night or on the weekends, but heat is still required.
- The Setback is activated by closing/shorting the *P*± terminals using an external timer.
- The Setback can accept only dry-contact input. No voltage can be placed across these terminals.

Setback/Boost Wiring



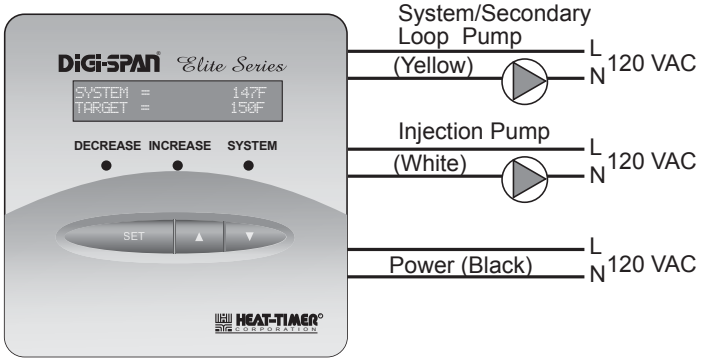
Wiring Outputs

Wire Colors and Output Lights

- The VSP *Elite* has a one N.O. S.P.S.T. (Single-pole single-throw) relay rated at 1A pilot load (⅛ HP).
- The VSP *Elite* has three LED lights. The right most LED represents the System relay operation. When the relay energizes, its LED will turn on.
- The other two LEDs blinks when the Injection pump increase or decrease its speed.
- Both pump outputs are dry contacts only. They do not source any power.
- The two Yellow wires control the System pump relay and the right LED.
- The two White wires control the injection pump.

Wiring the System Pump

- The Secondary Loop/System pump is the one circulating the water in the Secondary Loop.
- The VSP *Elite* will control the Secondary Loop / System Pump up to a maximum output of 1 Amp inductive or 1/8 HP.
- Wire the two Yellow wires to the System Pump circuit.
- The VSP *Elite* does not source any output power to the pump. The relay makes when energized to switch the power to the pump.



Wiring the Injection Pump

- The Injection pump is the one installed on the Injection Loop between the Secondary Loop and the Boiler Loop.
- The VSP *Elite* will control the Injection Pump up to a maximum output of 1.2 Amp (1/8 HP) (i.e. B&G NRF-33, Taco 0010, Grundfos 26-64, or equivalent). The pump must be of the permanent split capacitor type.
- Wire the two White wires to the Injection Pump circuit. They must be in series with the pump power. The signal cannot be wired through any pilot duty relay or pump starter.
- The VSP *Elite* does not source any output power to the pump. A separate power source is required for pump operation. What the VSP *Elite* does is change the electric signal powering the pump to achieve the desired speed need to achieve or maintain the target set point.
- After installing the Injection Pump, it is important to set the Minimum Speed Adjustment to guarantee injection pump flow at all levels. See Minimum Speed Adjustment on page 13.

Piping Design

When designing an injection systems, it is eminent that the Boiler Loop and the Secondary Loop are completely isolated. This can be achieved by following these simple rules (see Injection Piping Rules on page 5.):

- The Injection piping size must be at least one pipe size smaller than smaller of the Boiler Loop and the Secondary Loop piping.
- The distance between the Injection Loop tees on any of the other loops must not exceed 4 loop pipe diameters.
- After the injection pipe tee, there must be a minimum of 8 pipe diameters upstream the tees and a minimum of 4 pipe diameters downstream the tees on the Boiler Loop side to prevent any jet flow.
- A vertical drop of a minimum of one foot on each of the supply and return pipes of the Injection Loop will act as a thermal trap to prevent the Boiler Loop from supplying the Secondary Loop with heat when the injection pump is off.
- A circuit setter or globe or balancing valve can be used on the return leg of the Injection Loop to accurately balance the system.
- The Injection Pump must be of the permanent split capacitor type with a fraction horse power motor.

⚠ WARNING

The Injection Pump and pipe size selection MUST be done properly by a qualified engineer or trained technician to insure proper operation and prevent excessive or under heat zones as well as hazardous situations. The provided piping and pump sizing are general guidelines to help in general cost estimation.

Injection Pump and Pipe Size

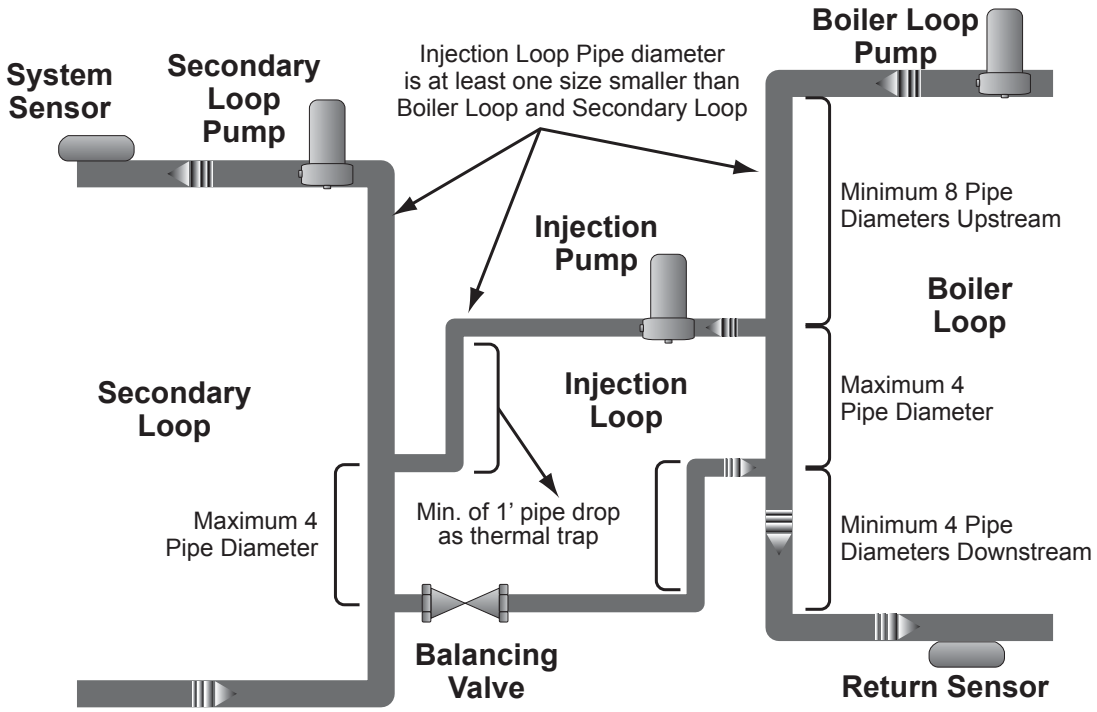
To size the system properly, start by calculating the Injection Heat Load. To select a pump, use the formula to calculate the Injection Flow Rate. Then, select a pump size, pipe size, and valve size based on the predetermined configuration provided.

- Total Injection Heat Load (Btu/Hr) for the secondary loop
- Boiler Loop Temperature (T_B)
- Secondary Loop Temperature (T_S)
- The design differential between the Secondary Loop supply and return temperatures (ΔT_S)
- Injection Flow Rate (Gal/Min)

$$\text{Injection Flow Rate} = \frac{\text{Injection Heating Load}}{500 \times (T_B - T_S + \Delta T_S)}$$

The Injection pump, pipe size, and valve size combination can then be selected from the table;

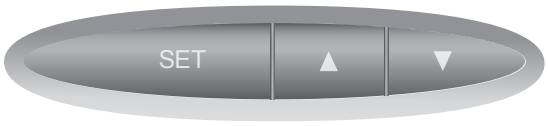
Injection Piping Rules



Injection Pump Selection Table

Injection Flow Rate (GPM)	Injection Loop Pipe Size (Inches)	Glove Valve/Balancing Valve/Circuit Setter Size (Inches)	Valve % Opening	Pump Size (or equivalent permanent split capacitor pump)
0 - 3.5	½"	½"	20%	Taco 007, Grundfos U15-42, B&G NRF-22
4 - 5.5	½"	½"	100%	Taco 007, Grundfos U15-42, B&G NRF-22
6 - 9	¾"	¾"	100%	Taco 007, Grundfos U15-42, B&G NRF-22
10 - 14	1"	1"	100%	Taco 007, Grundfos U15-42, B&G NRF-22
15 - 20	1 ¼"	1 ¼"	100%	Taco 007, Grundfos U15-42, B&G NRF-22
21 - 24	1 ¼"	1 ¼"	100%	Taco 001, Grundfos U26-64, B&G NRF-33
25 - 30	1 ½"	1 ½"	100%	Taco 001, Grundfos U26-64, B&G NRF-33

The table information is based on 5 feet of injection pipe loop, 4 90° elbows, and 4 tees

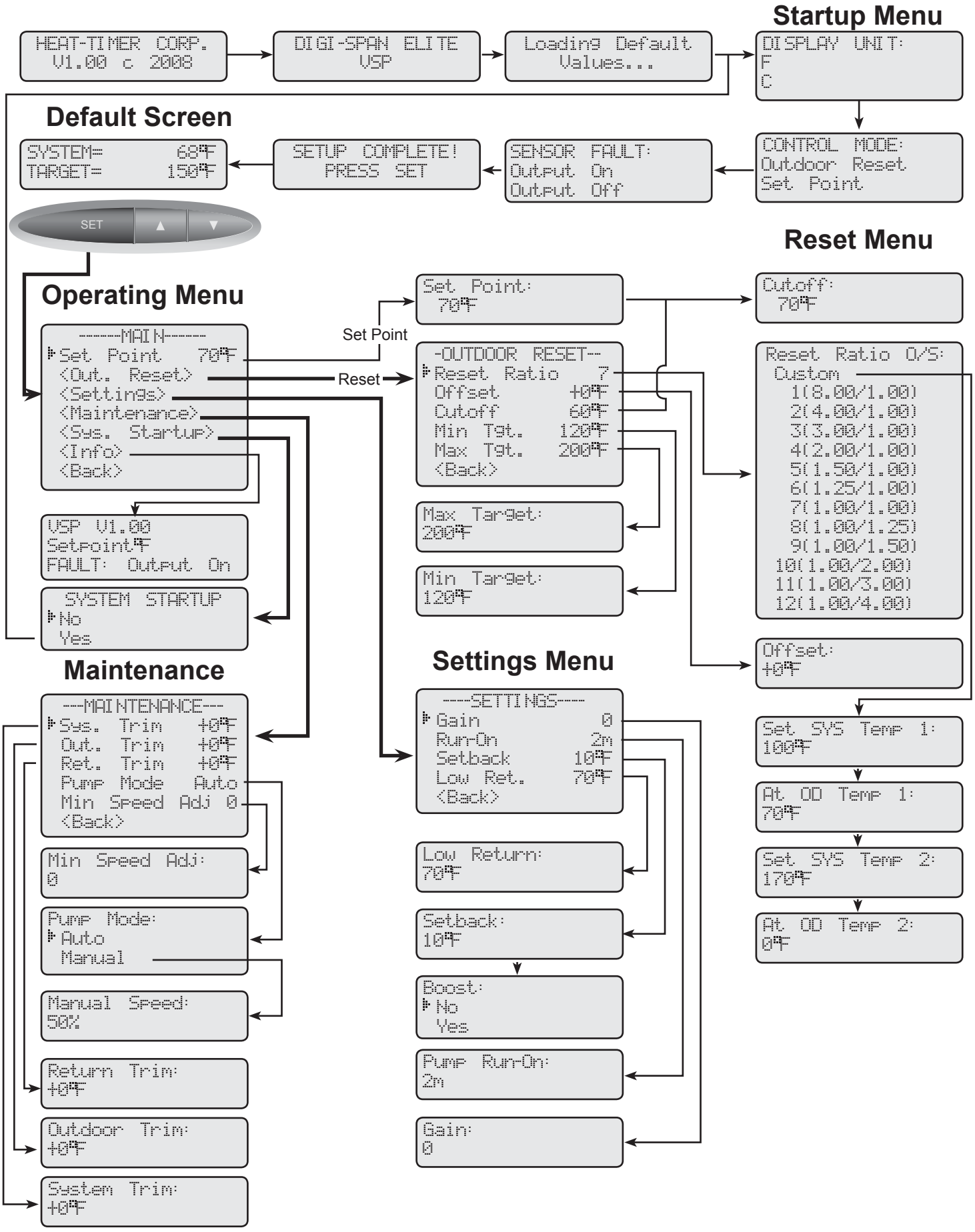


Button and Navigating Menus

The VSP *Elite* has three buttons.

- The SET button function varies. When the Default Screen is displayed, pressing the SET Button views the MENU. When in the Menus and settings, the SET Button accepts the selected entry or setting value.
- When in the menus, pressing the Up and Down buttons will scroll through the menu options. They can be used to change the setting of a specific function. i.e., change the Set Point, Differential, or System Trim. In addition, when in the default screen, the Up and Down buttons will display the outdoor temperature and Outdoor Cutoff when no return sensor is available, or the outdoor temperature and the return temperature when an active return sensor is connected.
- At the end of every operation menu there is a <Back> option that allows the user to go back one menu level. If the SET Button was held down for three seconds on the <Back> option, the display will go back to the default screen.

Menus


Startup Menu
HEAT-TIMER CORP.
V1.00 c 2008
DIGI-SPAN ELITE
VSP
Loading Default
Values...
DISPLAY UNIT:
F
C
CONTROL MODE:
Outdoor Reset
Set Point
SENSOR FAULT:
Output On
Output Off
SETUP COMPLETE!
PRESS SET
Default Screen
SYSTEM= 68°F
TARGET= 150°F
SET
Operating Menu
-----MAIN-----
Set Point 70°F
<Out. Reset>
<Settings>
<Maintenance>
<Sys. Startup>
<Info>
<Back>
Set Point
Reset
VSP V1.00
Setpoint°F
FAULT: Output On
SYSTEM STARTUP
No
Yes
Set Point:
70°F
-OUTDOOR RESET--
Reset Ratio 7
Offset +0°F
Cutoff 60°F
Min Tgt. 120°F
Max Tgt. 200°F
<Back>
Max Target:
200°F
Min Target:
120°F
Reset Menu
Cutoff:
70°F
Reset Ratio O/S:
Custom
1(8.00/1.00)
2(4.00/1.00)
3(3.00/1.00)
4(2.00/1.00)
5(1.50/1.00)
6(1.25/1.00)
7(1.00/1.00)
8(1.00/1.25)
9(1.00/1.50)
10(1.00/2.00)
11(1.00/3.00)
12(1.00/4.00)
Offset:
+0°F
Set SYS Temp 1:
100°F
At OD Temp 1:
70°F
Set SYS Temp 2:
170°F
At OD Temp 2:
0°F
Maintenance
--MAINTENANCE--
Sys. Trim +0°F
Out. Trim +0°F
Ret. Trim +0°F
Pump Mode Auto
Min Speed Adj 0
<Back>
Min Speed Adj:
0
Pump Mode:
Auto
Manual
Manual Speed:
50%
Return Trim:
+0°F
Outdoor Trim:
+0°F
System Trim:
+0°F
Settings Menu
---SETTINGS---
Gain 0
Run-On 2m
Setback 10°F
Low Ret. 70°F
<Back>
Low Return:
70°F
Setback:
10°F
Boost:
No
Yes
Pump Run-On:
2m
Gain:
0

Startup Options

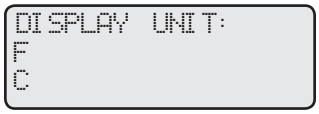
When the control is initiated for the first time or after a manual reset, it will start its operation with the Startup Menu. Later, the Startup menu can be accessed as an option from the operation menu. An option must be accepted in each screen in the Startup Menu to move to the next level.

Display Unit

***Options:* °F, °C** **Default: °F**

SET */<System Startup>/Display Unit*

- The VSP *Elite* will offer two different temperature displays. If °F is selected, all temperatures will display in Fahrenheit. If °C is selected, all temperatures will display in Celsius.

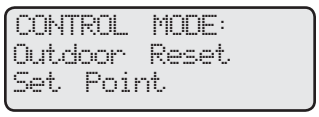


Control Mode

***Options:* Outdoor Reset, Set Point** **Default: Outdoor Reset**

SET */<System Startup>/Display Unit/Control Mode*

- The new VSP *Elite* have two heating logics. Outdoor Reset; varies the system set point/target based on outdoor temperature. This selection will add several menu options, Reset Ratio, Offset, Min Water temp, Max Water temp, and Outdoor Cutoff, to allow of adjustment and fine tuning of the Reset Curve. In addition, a customized curve will be available for specialized applications.
- Set Point; Gives the installer the flexibility of selecting a fixed set point. The Outdoor Cutoff will be available if an outdoor sensor was installed.



Sensor Fault

***Options:* Output On, Output Off** **Default: Output On**

SET */<System Startup>/..../Sensor Fault*

- The Sensor Fault will determine the operating status of the output relays when a sensor reads Short or Open. On sensor fault the Set Point will indicate FAULT TGT=ON or OFF to indicate the condition of the output and the faulty sensor will read OPEN or SHORT to indicate the condition of the sensor.

Outdoor Reset Mode

- When Output-On is selected, the VSP *Elite* will energize the system relay when System reads Short. or Open and Outdoor is below Outdoor Cutoff. However, if the Outdoor sensor fails and the Outdoor reads Short. or Open, the VSP *Elite* will change the Target Set Point to the Max Water Temperature.
- When Output-Off is selected, the VSP *Elite* will stop the Injection Pump when the System sensor reads Short. or Open. The System/Secondary Loop pump will remain energized for the Run-On delay then turn off. However, when the Outdoor sensor fails, reads Short. or Open, the VSP *Elite* will change the Target Set Point to be the Minimum Water Temperature.

Set Point Mode

- Output On, the VSP *Elite* will energize the System relay and increase Injection Pump speed to 100% when the System sensor reads Short. or Open.
- Output-Off, the VSP *Elite* will de-energize the System relay and stop the Injection Pump speed when the System sensor reads Short or Open.
- The Outdoor Sensor Short or Open status will not affect the control operation in Set Point mode.

Setting the Control to Factory Default

To Reset the VSP *Elite* control to its original factory defaults, power down the control. Hold down the SET and DOWN buttons while powering the control back up until the Loading Default Values screen appears. The Display will direct you to the Startup menu after the defaults are loaded to program the control.

⚠ ALERT

When resetting the control to original factory defaults all control settings will be over written and will no longer exist.

Default Display

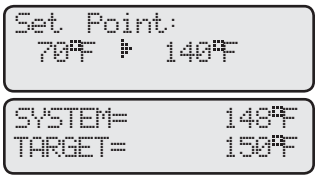
The default display will show the current Secondary Loop/System temperature and the Target temperature. In addition, by clicking the Up or Down button, the display will show the current Outdoor temperature and the current Return temperature, only if the return sensor is connected to *T3*± terminals. However, if no return sensor is connected, the control will display the current Outdoor temperature and the Outdoor Cutoff on a click on the up or down buttons.

Operating Menu Options

To enter the menus, press the Set button SET.

Set Point and Reset

Set Point



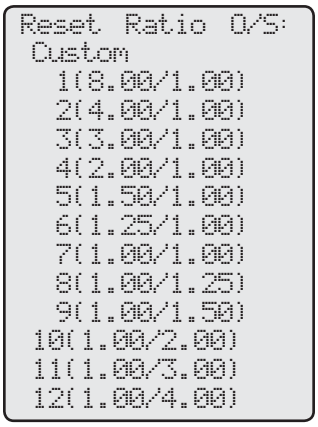
Options: **From -10°F/-23°C to 230°F/110°C** **Default: 70°F/21°C**

SET */Set Point*

(Available when Startup Control Mode = Set Point)

- The Set Point option provides the user with an adjustable fixed Target temperature to control the system. If an Outdoor Sensor was connected, the next menu option will show Outdoor Cutoff, otherwise there will be no Outdoor Cutoff option.

Outdoor Reset



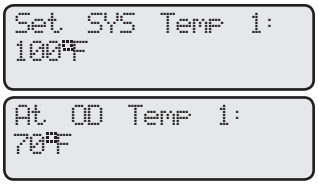
Options: **From 1(8.00°/1.00°) to 12(1.00°/4.00°), Custom** **Default: 7(1.00°/1.00°)**

SET */<Out. Reset>/Reset Ratio*

(Available when Startup Control Mode = Outdoor Reset)

- The Reset Ratio determines how the System water/Secondary Loop temperature will vary with Outside temperature (O). With any of the ratios, the colder it becomes outside, the hotter the temperature of the system water. The Ratio is measured as; Outdoor : System Water temperature.
- With a 1.00:4.00 ratio, the System water temperature will increase rapidly as the outside temperature falls, hitting the maximum water temperature of 240°F at 24°F outdoor temperature. With a 4.00 (O):1.00 (S) ratio, the System water temperature (S) will increase slowly as the outside temperature falls.
- The Reset Ratio controls the amount of heat that enters the heating system based on the outdoor temperature. A higher numbered Reset Ratio will result in a higher Calculated water temperature. See the Reset Ratio chart on page 2. If the application has radiant heat, a lower numbered Reset Ratio curve should be selected.
- If required: **Adjust the RESET RATIO in cold weather.** If the ambient building temperatures are too cold in cold weather, move the ratio to a higher selection. That is, if 1.00 (O):1.00 (S) was initially selected, change the selection to 1.00 (O):1.25 (S). If the building temperatures are too warm in cold weather, move the ratio to a lower selection. That is, if 1.00 (O):1.00 (S) was initially selected, change the selection to 1.25 (O):1.00 (S).
- The Custom option gives the user the capability of creating a specialized Reset Ratio curve. Setting two points on the Reset Ratio chart generates the customized curve. Each point requires a System Water Temperature and an Outdoor Temperature. The line connecting the two points will be the customized reset ratio.
- Reset Ratios are adjustable based on the building and application. See Types of Radiation in Buildings on page 2.

Custom Outdoor Reset Curve



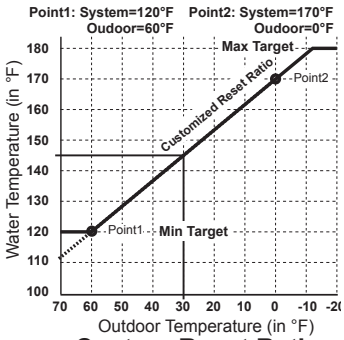
Options: **Sys Temp 1, 2 (-10°F/21°C) to (210°F/99°C)** **Default: 1(100°F/38°C), 2(171°F/77°C)**

Options: **Outdoor Temp 1, 2 (-10°F/-23°C) to (100°F/38°C)** **Default: 1(70°F/21°C), 2(0°F/-18°C)**

SET */<Out. Reset>/Reset Ratio/Custom*

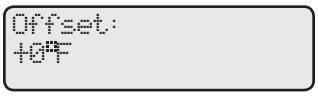
(Available when Startup Control Mode = Outdoor Reset)

- For situations where the provided reset ratios do not provide the perfect building heat-loss equilibrium, the customized option can be used.
- The Custom Reset Ratio is only available when Custom is selected from the Reset Ratio menu option. It provides the user with the capability of assigning two points on the reset ratio diagram and use the line that connects those two points as the customized reset ratio curve. Each of the two points will need a specific System and Outdoor Temperature to identify it on the diagram.
- To Set the first point, specify Sys Temp 1, and OD Temp 1. Then, specify Sys Temp 2, and OD Temp 2, to set the second point on the curve. The two points can be any where on the line, not necessarily at the ends. As well, the slope can be in any direction.
- The chart shows an example of a customized curve 6(O):5(S) that do not exist in the standard curve options. If the outdoor temperature reaches 30ºF, the system target will be 145ºF.
- Remember that the Min Target and Max Target apply to all reset ratios including the customized reset ratio ones.



Custom Reset Ratio

Offset

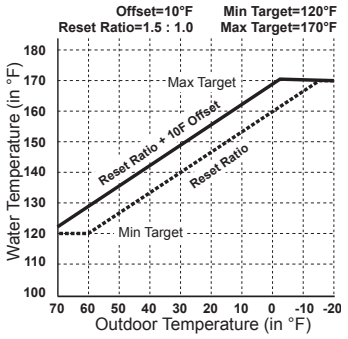


Options: **From -40°F/-22°C to +40°F/+22°C** **Default: 0°F/0°C**

SET */<Out. Reset>/Offset*

(Available when Startup Control Mode = Outdoor Reset)

- The Offset setting lets you adjust the starting points of the Reset Ratio curves. This means that, regardless of the Outdoor temperature (O), or the Reset Ratio that has been selected, when the Offset setting is changed, that change is directly added to or subtracted from the calculated temperature/Target. For example, if the Set Point temperature was 130°F and the Offset was changed from 0° to +10°, then the Set Point temperature would increase to 140°F
- If required: **Adjust the Water Offset in mild weather**. If the ambient building temperatures are too warm in the mild weather, decrease the Offset. If the ambient building temperatures are too cold in the mild weather, increase the Offset. The rule of thumb for baseboard radiation is to change the Offset 4°F for every 1°F you wish to change the building temperatures. In radiant heat applications, change the Offset 1°F or 2°F for every 1°F you wish to change the building temperature.



Target Offset

Outdoor Cutoff

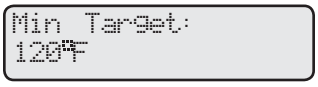
Options: **Off, 20°F/0°C to 100°F/25°C, On** **Default: 65°F**

SET */Set Point/Cutoff* **in Set Point**

SET */Set Point/<Out. Reset>/Cutoff* **in Reset**

- In Set Point, if the outdoor sensor is installed (see Outdoor Sensor Installation on page 3), the Outdoor Cutoff setting screen will automatically appear after the temperature Set Point has been selected and saved.
- The outdoor and its cutoff temperatures can be viewed from the default screen by clicking the Up or Down buttons.
- When the outdoor temperature falls to the adjustable Outdoor Cutoff temperature, the VSP *Elite* will control the System Pump relay and the injection pump output to provide heat.
- When the outdoor temperature rises to the Outdoor Cutoff plus a 2°F differential, the VSP *Elite* will stop the injection pump. However, will allow the System relay to remain energized for the Pump Run-On delay then de-energize it.
- The Outdoor Cutoff can be set from 20°F to 100°F. In addition, the Setting can be set to ON or OFF. If ON is selected, the System Relay will energize regardless of the Outdoor temperature and the VSP *Elite* will control the injection pump to hold the target temperature. If OFF is selected, the System relay and injection pump output will always be off.

Minimum Target



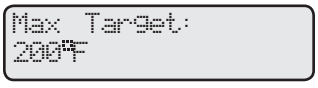
Options: **From 70°F/21°C to 180°F/77°C** **Default: 70°F/27°C**

SET */Set Point/<Out. Reset>/Min. Tgt*

(Available when Startup Control Mode = Outdoor Reset)

- The Minimum Target Temperature must be set to the system design specification. The VSP *Elite* will calculate the Target based on the Outdoor temperature (O), the Reset Ratio, and the Offset value. The VSP *Elite* will control the injection pump to hold either the calculated temperature or the Minimum Target Temperature whichever is higher.
- The Minimum Target Temperature must be at least 20°F lower than the Maximum Temperature (See next setting).

Maximum Target



Options: **From 90°F/38°C to 240°F/116°C** **Default: 240°F/116°C**

SET */Set Point/<Out. Reset>/Max. Tgt*

(Available when Startup Control Mode = Outdoor Reset)

- This is the highest temperature heating water the VSP *Elite* will circulate through the heating system.
- When using a radiation system, it should be set according to the tubing or floor manufacturer's specification.
- The Maximum Temperature must be at least 20°F higher than the Minimum Temperature.

Gain

Options: **From -10 to +10** **Default: 0**

SET */Settings>/Gain*

- The Gain adjusts the aggressiveness of the VSP *Elite* PID logic. It controls the amount of change in the speed of Injection Pump when the Secondary Loop temperature differs from the Set Point. It is based on he rate of change.
  A Gain of 0 is a good starting point for all systems.
- If during normal load conditions, the Secondary Loop temperature tends to oscillate significantly, decrease the Gain by two numbers (for example, from 0 to -2). Wait for at least 15 minutes before evaluating effect on the system.
- If during normal load conditions the Secondary Loop temperature tends to remain consistently below the Set Point (or consistently above the Set Point), increase the Gain by two numbers (for example, from 0 to 2). Wait for at least 15 minutes before evaluating the effect on the system.

Run-On

Options: **From 0 min to 60 min** **Default: 2 min**

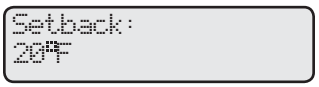
SET */Settings>/Run On*

- The Run-On applies only to the System relay (Secondary Loop Pump).
- The System relay will energize whenever the Outdoor temperature is below the Outdoor Cutoff. When the Outdoor temperature increases 2°F above the Outdoor Cutoff, the SYS relay will stay on for a period set by the System Run-On. This allows the Pump to dissipate the residual heat within the system back into the building.
- The Run-On time should be set based on the size and type of the piping and pumps.

Setback

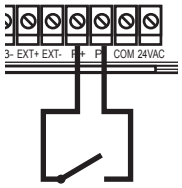
Options: **From 0F°/0C° to 80F°/44C°** **Default: 11F°/6C°**

SET */Settings>/Setback.*



- The Setback feature can be used to provide the VSP *Elite* with a lower temperature set point when less load is required.
- The lower set point will appear on the main display indicating SBC TGT= .
- For example; when the calculated temperature is 160°F and the Setback is set to 20F°, a setback call will change the set point to (160°F - 20F°) 140°F.
- A typical use for Setback is to provide less system temperature to a building during the night or on the weekends when the building is not occupied, but heat is still required.
- The Setback is activated by closing/shorting the *P*± terminals using an external timer.

Setback/Boost Wiring



Boost

Options: **Yes, No** **Default: No**

SET */Settings>/Setback/Boost.*

- The morning Boost is designed to return the building to comfortable ambient temperatures after the Setback period. The VSP *Elite* will accomplish this by running elevated water temperatures (will add Setback setting to calculated water temperature) for 30 minutes after the opening of the setback terminals *P*±. That is, if the normal set point at a specific outdoor was 145°F and the Setback setting was 20F°, the boost will raise the system calculated temperature to 165°F for 30 minutes after the setback.

Low Return

Options: **From 70°F/21°C to 180°F/77°C** **Default: 70°F/27°C**

SET */Settings>/Low Return*

(Requires Return Sensor Installation)

- Some boilers require that the return temperature not to drop below a specific temperature to eliminate condensation of flue gases. In the event of low boiler return water temperatures, the Low Return setting can be used to help in a speed recovery.
- If the VSP *Elite* registers that the temperature of the boiler return is below the Low Return setting, it will immediately reduce the Injection Pump speed by half and not allow the speed to increase again until the return temperature rises to the Low Return setting. This means that the VSP *Elite* will decrease the load on the Boiler Loop, but will still provide some heat to the Secondary Loop.

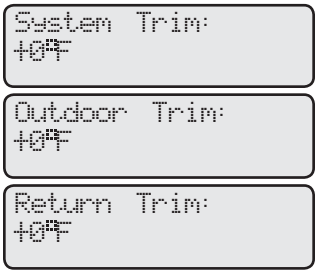
- If the minimum return water temperature is not specified by the boiler manufacturer or if the Secondary Loop size is such that it will have little impact on the Boiler Loop temperature, the Boiler Return sensor must not be installed or set the Low return to a very low value (i.e. 70°F). Otherwise, set the Low Return to the boiler manufacturer's specification.

System, Outdoor, and Boiler Return Trim

Options: **From -20Fº/-11Cº to +20Fº/+11Cº** **Default: 0Fº/0Cº**

SET */<Maintenance>/Sys. Trm, Out. Trim, or Ret. Trim*

- The Heat-Timer temperature sensors are very accurate. However, sometime it might be beneficial to adjust the values to match and existing system. The System, Outdoor, and Boiler Return Sensor Trim values adjust the respective sensor readings using positive or negative values.
- Do not adjust the Outdoor Trim to match the TV as temperature values vary drastically between weather stations and the sensor location.

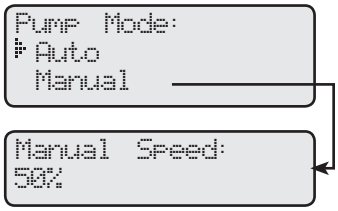


Pump Mode

Options: **Auto, Manual** **Default: Auto**

SET */<Maintenance>/Pump Mode*

- For the VSP *Elite* to control the Injection Pump using its PID logic, the Pump Mode must be set to Auto. This allows the VSP *Elite* to modulate the pump.
- However, if the system is properly balanced based on a fixed Boiler Loop temperature and a fixed Secondary Loop temperature and a constant fixed load, then using the Manual Mode might be better suited. Also, the Manual Mode can be used to adjust and test for the Minimum Speed Adjustment allowed to guarantee flow at all pump speeds. See next setting.
- In Manual Mode, no set point or reset value will be observed. The first line of the display will show the current Secondary Loop temperature (System) and the second line will always indicate the manual speed percentage Manual 50%.
- If Manual Mode was set to 0%, the Injection Pump will seize to operate and the display will show Manual Off as an error.

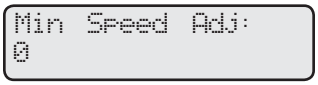


Minimum Speed Adjustment

Options: **From -5 to +5** **Default: 0**

SET */<Maintenance>/Min Speed*

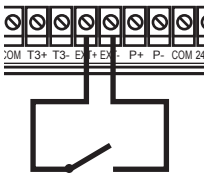
- This is the slowest speed at which the VSP *Elite* is allowed to run the Injection Pump. The VSP *Elite* will modulate the Injection Pump starting from the Minimum Speed Adjustment and all the way to the full speed of that pump..
- To set the Minimum Speed Adjustment, first put the Pump Mode to Manual at 5%. Then, set the Minimum Speed Adjustment to the lowest value so that flow can be achieved. Then set the Pump Mode to Auto again for normal operation.
- If the Secondary Loop never reaches its target set point, it could be an indication of a low Minimum Speed Adjustment. In this case, increase the value by two and wait for at least15 minutes before evaluating the system.



Enable/Disable Input

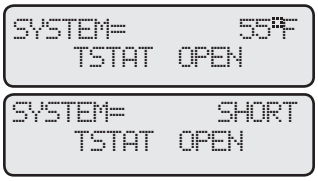
- The VSP *Elite* will provide heat only if the *EXT*± terminals are shorted. If no external equipment or switch is connected to these terminals, leave the factory installed jumper.
- When the terminals are OPEN, the Target will display TSTAT OPEN.
- The Enable /Disable terminals can be used as a Summer/Winter switch when connected to an external control.

Enable/Disable Wiring



⚠ ALERT

On a sensor fault while the Enable/Disable terminals are open, the control will follow the Enable /Disable state regardless of the sensor fault condition.



Troubleshooting

No Display or LED Lights

Check the power to the VSP *Elite*. The VSP *Elite* requires 120VAC power to the Black wires. Turn the power off and back on to restore the display. If unsuccessful, make sure the Display Cover of the control is securely mounted to the Base.

System or Outdoor Reads OPEN or SHORT

If Open, short the sensor input terminals. The display should read SHORT. If it doesn't, the VSP *Elite* may be damaged.
If Short, remove the wires from the input terminals. The display should read OPEN. If it doesn't, the VSP *Elite* may be damaged.

System or Outdoor Reads an Incorrect Temperature

Remove the wires from the input terminals. The display should change to read OPEN. If it doesn't, the VSP *Elite* may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the Temperature Sensor Chart. If the difference is within 5°F adjust the Trim for the sensor Otherwise, the sensor may be damaged.

No Heat - All LEDs are OFF

Check the outdoor temperature and Outdoor Cutoff readings. If the outdoor temperature is above the Outdoor Cutoff, the VSP *Elite* will not give heat. If the display shows TSTAT OPEN then, check the *EXT*± terminals. If the *EXT*± terminals are not jumped together, the VSP *Elite* will not give heat. See Enable/Disable Inputs on page 13. Finally, if the display shows MANUAL OFF then, the Pump Mode has been set to Manual with a speed of 0%. Change Pump Mode to AUTO. See Pump Mode on page 13.

No Heat - System Pump LED ON - Pump Not Running

Remove any connections to the Yellow wires for the Heating System Pump. Test for continuity across the pair of Yellow wires. If the wires are continuous, the VSP *Elite* is calling for the Secondary Loop/System Pump to run and the problem is not with the VSP *Elite*. Check the power source and the pump to determine why it is not circulating.

No Heat - System Pump LED ON - Pump Running

Check that the boiler (or other hot water source) is providing hot water to the Boiler Loop and no valve obstruction between the Boiler Loop and the Injection Loop. Check that the Injection Pump is running by measuring the pipe temperatures on the Injection Loop and the Secondary Loop. Check the Minimum Speed Adjustment. If the Minimum Speed Adjustment is set too low, the pump motor might not have the torque to maintain its operation. See Minimum Speed Adjustment on page 13.

Too Little Heat

First check that the Outdoor sensor reads a temperature not Short or Open. If it does and Sensor Fault has been set to Output Off, the VSP *Elite* will try to maintain the Minimum Target temperature. Follow the System or Outdoor Reads Open or Short section. Repair or replace the faulty sensor. Otherwise, if all sensor readings are accurate, check if the Target temperature is the same as the Maximum Target. If so, check the Maximum Target has not been set too low for the system (DO NOT increase the Maximum Target without consulting the installer or tubing/flooring manufacturer). Finally, adjust the Reset Ratio or Offset to increase the temperature of the circulating hot water. Note that, depending on the type of radiation, it may take several hours before the ambient temperature increases.

Too Much Heat

Check if the Outdoor or System temperature is not reading Short. or Open. Follow the System or Outdoor Reads Open or Short section. If Sensor Fault was set to Output ON, the VSP *Elite* will provide excess heat to the building injection zone. Repair or replace the faulty sensor. Otherwise, if all sensor readings are accurate, adjust the Reset Ratio or Offset to decrease the temperature of the circulating hot water.

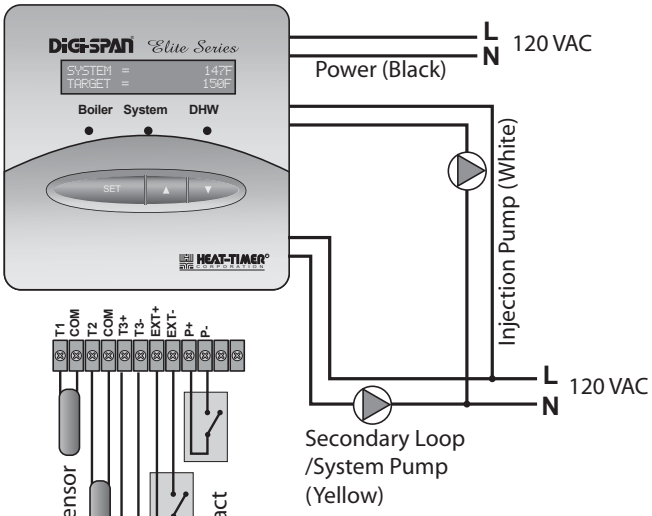
Temperature Sensor Chart

TEMPERATURE (in Degrees °F)	Value (in Ohms)
-30	117720
-20	82823
-10	59076
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

TEMPERATURE (in Degrees °F)	Value (in Ohms)
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412
210	349
220	297
230	253
240	217
250	187

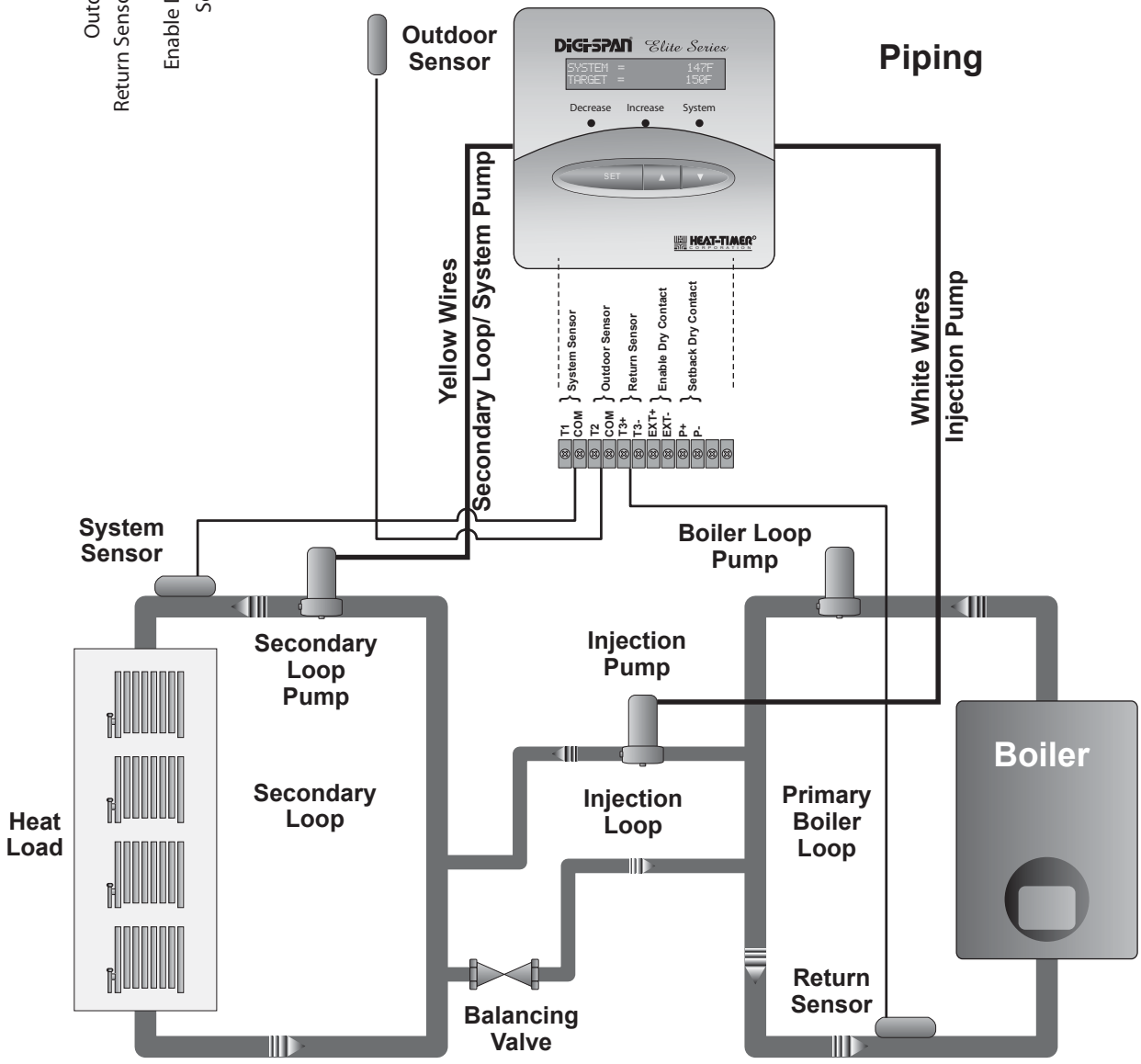
VSP-*Elite* Piping and Wiring Diagrams

Wiring



NOTE: The diagrams are conceptual only. Heat-Timer is aware that each installation is unique, however, the diagrams in this document are to represent control operation concept. It is the installer responsibility to comply with local codes and to install safety controls.

Piping



Specifications

Voltage Input: . . . . . 120 VAC 60 Hz(2 Black wires)
Power Consumption: . . . . . 5 VA Max
Operating Temperature: . . . . . from 20°F to 120°F
Operating Humidity: . . . . . from 20% to 80%
Dimensions: . . . . . 4"W x 4"H x 2½"
Weight: . . . . . .1 pound
Display: . . . . . Back Lite 2 Line Alphanumeric LCD Display
Standard: . . . . . English or Metric
System Output Relay Ratings: . . . . . 1 Amp inductive (Maximum of 1/8 HP), 6Amp resistive at 120 VAC 60 Hz
Injection Output Ratings: . . . . . .1.5A inductive (Maximum 1/8HP) at 120VAC 50-60Hz
Control Modes: . . . . . .Outdoor Reset, Set Point
Reset Ratios: . . . . . 12 Standard ranging from 8:1 to 1:4 (Outdoor: System), and one Custom
Setback: . . . . . from 0˚F (0˚C) to 80˚F (44˚C)
Boost: . . . . . Yes (30Min), No
Sensor Fault Operating Options: . . . . . Output On or Output Off
Sensor Operating Range: . . . . . from -35˚F (-37˚C) to 250˚F (121˚C)
Offset: . . . . . .from -40˚F (-22˚C) to 40˚F (+22˚C)
Minimum Target: . . . . . from 70˚F (21˚C) to 170˚F (77˚C)
Maximum Target: . . . . . from 90˚F (32˚C) to 240˚F (116˚C)
Set Point: . . . . . from -10˚F (-23˚C) to 230˚F (110˚C)
Setback Input: . . . . . *Terminals T3+, T3-*
Minimum Return: . . . . . from 70˚F (21˚C) to 170˚F (77˚C)
Injection Pump Speed: . . . . . .+0% to 100%
Buttons: . . . . . 3 (Set, Up, Down)
Enable/Disable: . . . . . *Terminals EXT+, EXT-*
Pump Run-On: . . . . . from 0 to 60 minutes
LED: . . . . . 3 LEDs (Left=Decrease/Close Middle=Increase/Open Right=System Relay)