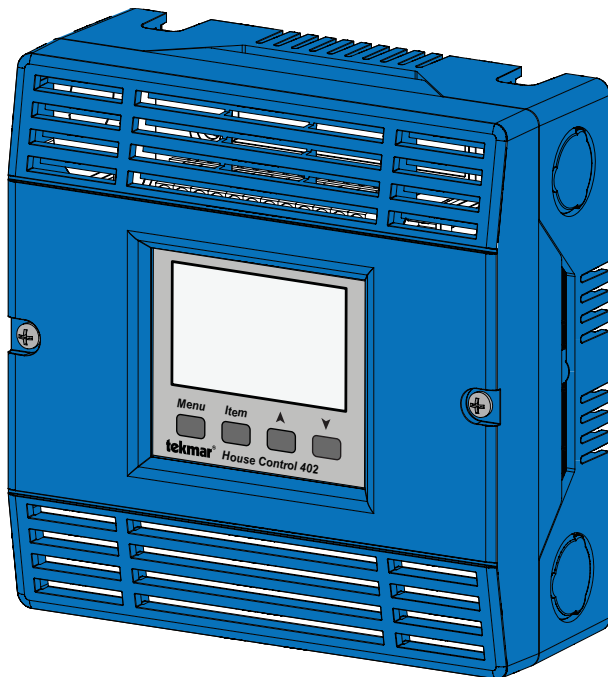


# Installation & Operation Manual

## Introduction

The House Control 402 is designed to operate as part of a complete hydronic heating system with tekmarNet<sup>®</sup>2 (tN2) thermostats. It can provide operation of two outdoor reset water temperatures in addition to Domestic Hot Water and Setpoint capabilities. It is easy to add more zones, add schedules or other convenient accessories through the use of the tekmarNet<sup>®</sup>4 (tN4) Expansion terminals.



## Features

- Operate up to two water temperatures (Boiler + Mixing)
- Control of a single on/off or modulating boiler control
- Mix with variable speed injection, floating action, or proportional (0-10 V(dc))
- For use with tN2 Thermostats (4 on board zones)
- Four 24 V (ac) powered zone valve outputs
- tN4 expansion ports
- CSA C US Certified for use in USA and Canada

## Benefits

- Energy efficiency through Outdoor Temperature Reset with Indoor Feedback
- Indoor Feedback minimizes the water temperature (increasing energy savings), and the efficiency of your mechanical equipment through integrated tekmarNet<sup>®</sup> Thermostats
- Zone Synchronization reduces equipment cycling
- Auto Differential - Manages the boiler cycles to reduce short cycling
- Compact enclosure for flexible installation
- Simple zone expansion using tN2 Wiring Centers

## Table of Contents

Introduction.....	1	Adjust Menu .....	13-14
Installation .....	2	Monitor Menu .....	15
Caution.....	2	Toolbox Menu.....	16
Control and Enclosure Location .....	2	Sequence of Operation .....	17
Wiring - Line Voltage .....	3	Section A: tekmarNet® Communication.....	17
Mounting the Control.....	4	Section B: Outdoor Reset + Indoor Feedback .....	17
Wiring - Low Voltage .....	4-5	Section C: Heat Calls .....	18
Sizing the Transformer .....	5	Section D: Pump Operation .....	18
Application Drawings.....	5	Section E: Exercising .....	18
Wiring Diagram .....	5-6	Section F: Boiler Operation .....	19-21
A402-1: DHW, Var Spd, 4 Mix Zones.....	7	Section G: Mixing Operation .....	22
A402-2: DHW, 2 Blr Zns, 3 Way Mix, 4 Mix Zns.....	8	Section H: Domestic Hot Water (DHW) Temperature Operation .....	23-24
User Interface.....	9	Section I: Setpoint Temperature Operation .....	24
Display.....	9	Section J: Energy-Saving Features.....	25
Symbols .....	9	Troubleshooting Guide.....	26
Using the Control .....	10	Error Messages.....	26
Installer Lock.....	10	tekmar Toolbox tips .....	27
Saving Indicator .....	10	Technical Data.....	28
Testing .....	11		
Testing the Control .....	11		
Programming .....	12		
View Menu .....	12		

## Installation

### **Caution**

Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury or death. It is your responsibility to ensure that this control is safely installed according to all applicable codes and standards. This electronic control is not intended for use as a primary limit control. Other controls that are

intended and certified as safety limits must be placed into the control circuit. Do not attempt to service the control. Refer to qualified personnel for servicing. There are no user serviceable parts. Attempting to do so voids warranty and could result in damage to the equipment and possibly even personal injury or death.

### Control and Enclosure Location

When choosing the location for the control, consider the following:

- Keep dry. Avoid potential leakage onto the control. RH ≤ 90% to 104 °F (40 °C). Non-condensing environment.
- Do not expose to operating temperatures beyond 32-104 °F (0-40 °C)

- Provide adequate ventilation.
- Keep away from equipment, appliances or other sources of electrical interference.
- Locate the control near the zone valves if possible.
- Provide easy access for wiring, viewing and adjusting the control.
- Mount approximately 5 ft. (1.5 m) off the finished floor.

## Wiring - Line Voltage

The House Control operates a number of system pumps through wiring on the back of the control. It must be mounted to a 4" x 4" electrical junction box so that these electrical connections are safely contained.

### Install the Pump Wires

- Ensure that a suitable control location has been chosen and an approved 4" x 4" electrical junction box mounted.
- **Turn all power off before performing any wiring.**
- Pull each of the pump wires into the electrical box as shown in Figure 1.
- The pumps require a 115 V(ac) source of power. Pull this wiring into the electrical box.

### Ground the Pumps

- Connect the pump grounds to the power supply ground as shown in Figure 1. The ground wire must also be grounded to the electrical box.

### Wire the Pump Neutrals

- Connect the Neutral (N) wires from each pump and wire to the 115 V(ac) Neutral (N) wire. If the transformer has been mounted to this electrical box, connect its neutral wire with this group. This is shown in Figure 2.

### Wire the Pump Power (L)

- Connect the 115 V(ac) line voltage (L) wire to the red Pump Power (L) wire on the back of the House Control and to the 115 V (ac) side of the transformer. Use a wire nut or approved connector. See Figure 3.

### Wire the Pumps

- Strip each of the remaining pump wires 1/2".
- Wire each remaining line voltage pump wire into the push-in wire connector of the corresponding pump lead on the back of the House Control. This is shown in Figure 4.

Figure 1 - Connect Ground Wires

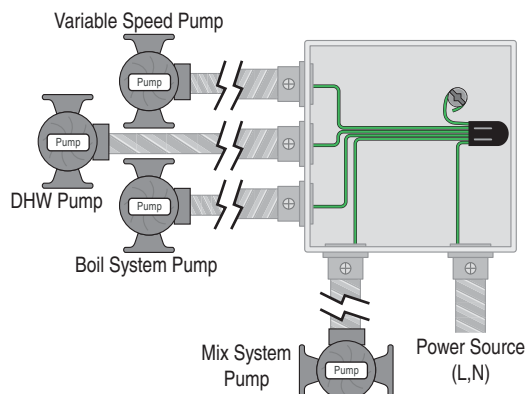


Figure 2 - Connect Neutral Wires

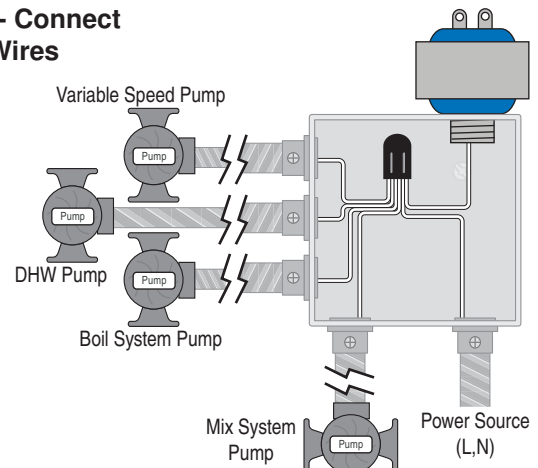


Figure 3 - Connect Line Voltage (Hot)

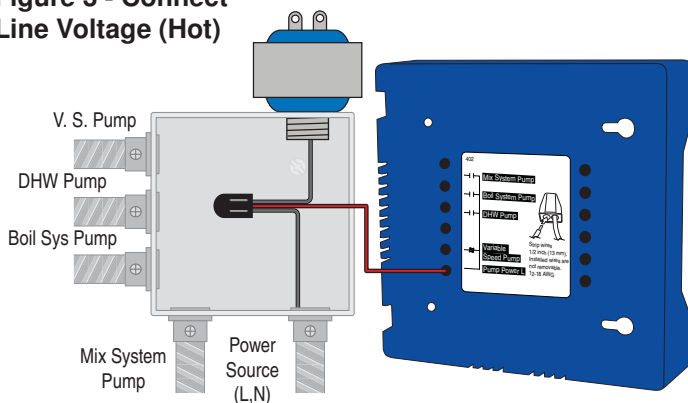
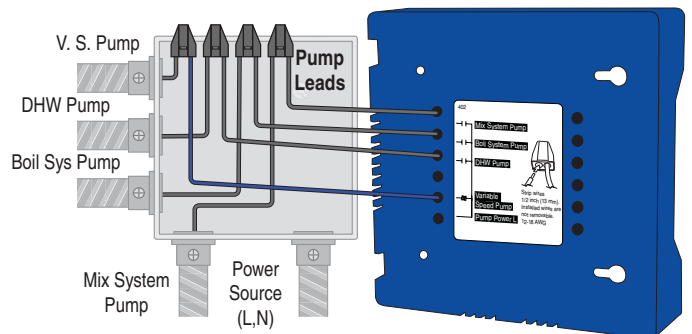


Figure 4 - Connect Pump Line (Hot)



## Mounting the Control

### Install the Enclosure

- Ensure that the pump wires are neatly tucked inside the electrical box.
- Using the 2 of the 4 holes in the back of the enclosure, securely fasten it to the electrical box with 2 size 10 screws as shown in Figure 5.

### Install the Low Voltage Wiring

- Refer to the next section titled “Wiring - Low Voltage” for information on the low voltage connections.

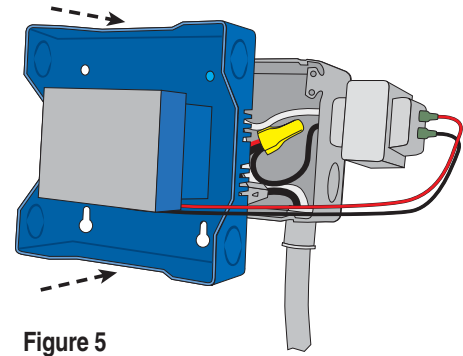


Figure 5

## Wiring - Low Voltage (Refer to Electrical Drawings for illustration)

### External Power Supply

It is strongly recommended that a transformer with an in-line fuse be used in order to protect the transformer from high currents. The tekmar Transformer 009 includes a fuse. Once the transformer has been correctly sized as described in the “Sizing the Transformer” section, connect the 24 V (ac) leads from the transformer to the C and R terminals marked “Input Power” on the House Control

### tN2 Thermostats

The House Control 402 is designed to operate with tN2 Thermostats. They provide the heating and cooling control for each zone, and communicate with any other tN2 or tN4 device on the system.

- Connect the tN2 terminals from each thermostat to the corresponding terminals for each zone on the House Control 402.

### Zone Valves

- Wire the zone valves to the C and Vlv terminals on the 402.
- End switches on zone valves are not required when using the 402.

### tN4 Expansion terminals

The House Control 402 uses communication to share information between itself and the thermostats in the system, in order to maximize system efficiency. The House Control uses tN4 and C terminals to “share” the information with more thermostats, setpoint controls, and other tN4 devices. There are two sets of tN4 and C terminals on the House Control 402.

### Boil Exp.

To add boiler water temperature zones (typically baseboard or fan coil zones) to the system, use a tekmarNet® Wiring Center, and connect the Boil Exp. tN4 and C terminals of the 402 directly to the tN4 Expansion terminals on a Wiring Center.

- Connect the tN4 and C Boil Exp. terminals to the corresponding tN4 and C Expansion terminals on the external Wiring Center.

### Mix Exp.

The House Control 402 has the capacity to expand the number of mixing zones in the system beyond the four on board zones. To add mix water temperature zones (typically radiant floor zones) to the system, use a tekmarNet® Wiring Center and connect the Mix Exp. tN4 and C terminals of the 402 directly to the tN4 Expansion terminals on a Wiring Center.

- Connect the tN4 and C Mix Exp. terminals to the corresponding tN4 and C Expansion terminals on the external Wiring Center.

### Sensors

In order for the House Control to properly operate the different components that make up a hydronic heating system, the control must be able to know the water temperatures and the outdoor air temperature. Do not apply power to the sensor terminals!

- Connect the Boiler Supply sensor to the Boil and Com Sensor terminals. This sensor should be placed on the boiler outlet piping before any load (DHW or zone) to ensure that the control is reading the temperature the boiler is supplying.
- Connect the Mix Supply sensor to the Mix and Com Sensor terminals. This sensor should be placed on the mix system piping, after the mixing device, but before any mix load (zones).
- Connect the Outdoor sensor to the Out and Com Sensor terminals. This sensor should be placed so as to avoid any auxiliary heat source such as the sun, dryer vents, opening windows, or heat transfer from the building.

## Wiring - Low Voltage (continued)

### Calls (DHW and Setpoint)

These terminals are to create a DHW or Setpoint call to the House Control 402. When the control receives a DHW or Setpoint call it will override Outdoor Reset and Indoor Feedback and operate the boiler to supply 180°F.

- To create a DHW call wire a dry contact **OR** apply 24V (ac) to the DHW call terminals.
- To create a Setpoint call; wire a dry contact **OR** apply 24V (ac) to the Setpoint call terminals.

### Wiring the Boiler

The House Control 402 can operate a modulating boiler or On/Off boiler.

#### On/Off Boiler

- Connect the Boiler terminals on the House Control 402 to the T-T (or R-W) terminals on the boiler.

#### Modulating Boiler

- Wire the 0-10 V(dc) Mod terminals on the House Control 402 to the input signal terminals on the boiler.

- If needed, wire the Boiler terminals on the House Control 402 to the enable terminals on the modulating boiler, if applicable.

Note: The House Control 402 is compatible with most modulating boilers that can accept a 0-10 V(dc) signal. SB057 (included) references common residential modulating boilers and the associated settings for the House Control 402 to properly operate them.

### Floating Action terminals

The Floating Action terminals are used to modulate a floating action actuator. If doing floating action mixing then wire the floating action actuator to the floating action terminals on the 402. This is a powered output (24 V(ac)).

- Wire the open, close, and C terminals on the 402 to the open, close, and C terminals on the floating action actuator.

### Proportional Mixing (0-10V (dc))

Wire the proportional mixing device to the Mod V (dc) output on the control. Wire the common on the actuator to the - terminal on the 402 and the positive to the + terminal.

## Sizing the Transformer

The 402 requires an external transformer. A tekmar Transformer 009 (or 009K which includes a 4"x4" electrical box) can supply up to 40 VA, and includes an in-line fuse to protect the transformer and control.

In order to correctly size the external transformer, all loads connected to the control must be taken into account.

When adding up the loads, consider the following:

- tN2 Thermostats draw approximately 2 VA each.
- Each zone valve must be sized for peak load. This can be obtained by multiplying the peak current draw (in Amps) by 24 V (ac).

- If using a Floating Action mixing valve, add the VA draw for the actuating motor. A tekmar Actuating Motor 741 draws 1.8 VA during normal operation.

The total power capacity of the power supply should be larger than the total load of all the devices connected to the tekmarNet® House Control. This total load must not exceed 100 VA. Multiple tekmar Transformer 009's can be wired together to increase total VA capacity.

The following chart is provided to simplify transformer sizing:

Zone	1	2	3	4		
Thermostat Load	2	2	2	2		
Zone Valve Load					Floating Action (VA)	Control Load (VA)
Total Zone Load	+ _____	+ _____	+ _____	+ _____	+ _____	2

Transformer must exceed: \_\_\_\_\_ VA

## Application Drawings

### Wiring Diagram

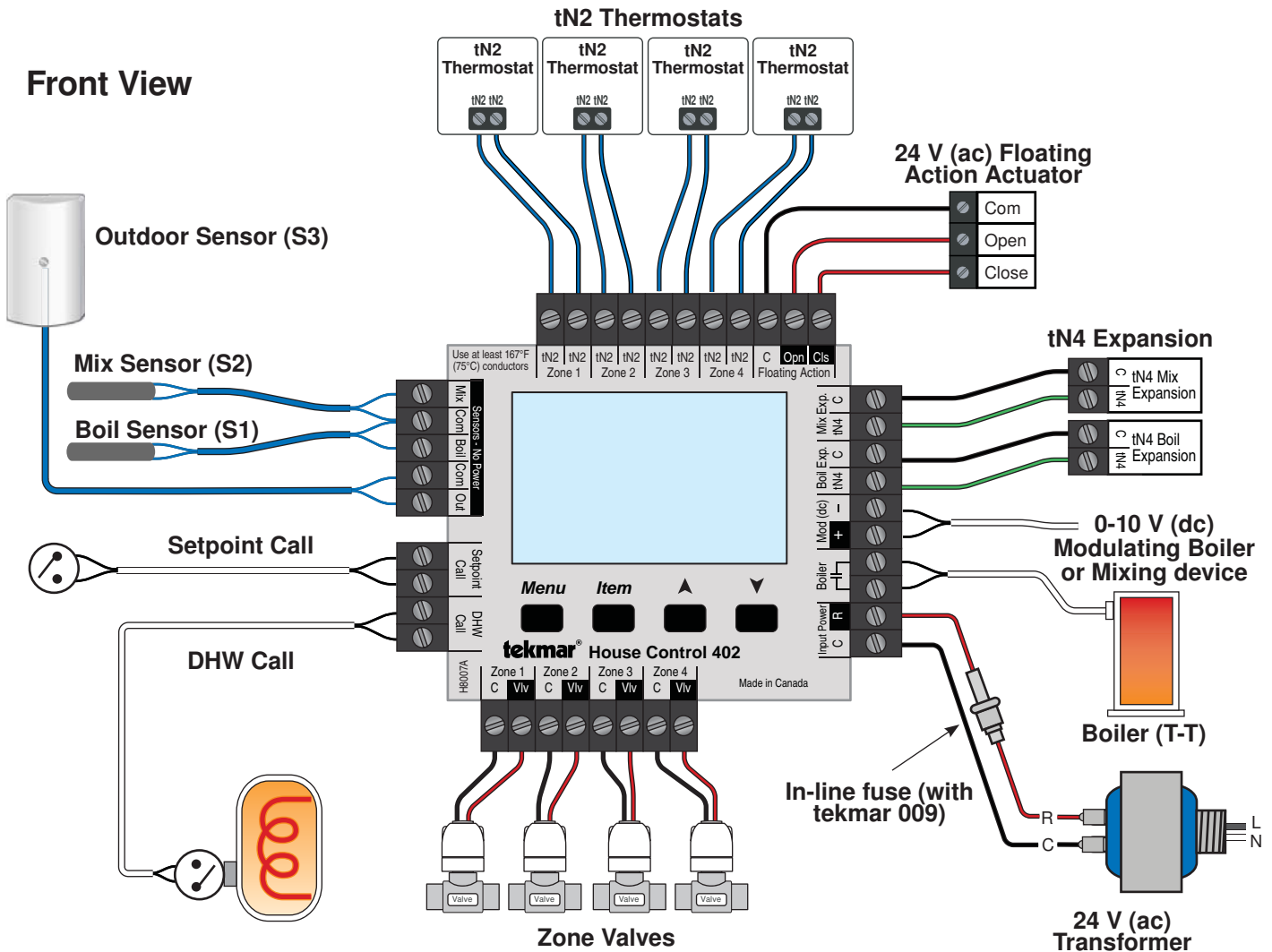
⚠ The electrical drawing examples on the following pages show the 402 in common applications. These drawings have a brief explanation of what is being operated in each system. Choose the components in your system and use the drawings as a guide to aid in wiring your system.

These are only concept drawings, not engineered drawings. They are not intended to describe a complete system nor any particular system. It is up to the system designer to

determine the necessary components for and configuration of the particular system being designed including additional equipment isolation relays (for loads greater than the controls specified output ratings) and any safety devices which in the judgement of the designer are appropriate in order to properly size, configure and design that system and to ensure compliance with building and safety code requirements.

## Wiring Diagram

The following electrical diagram shows all inputs and outputs to the House Control 402. Your application will not require the use of all terminals.

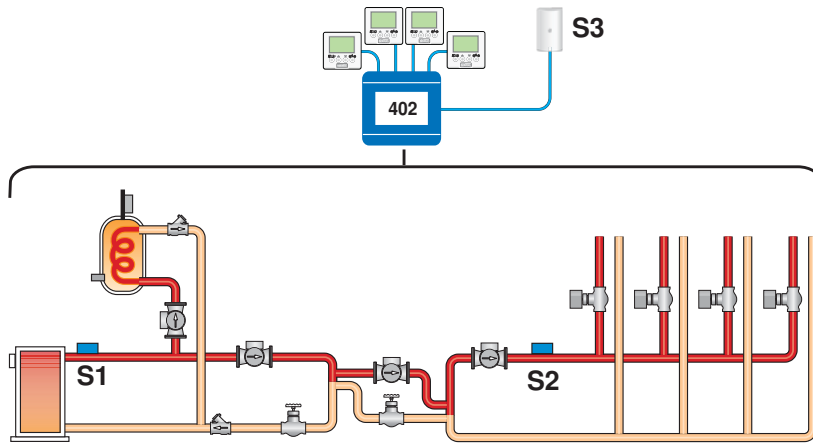




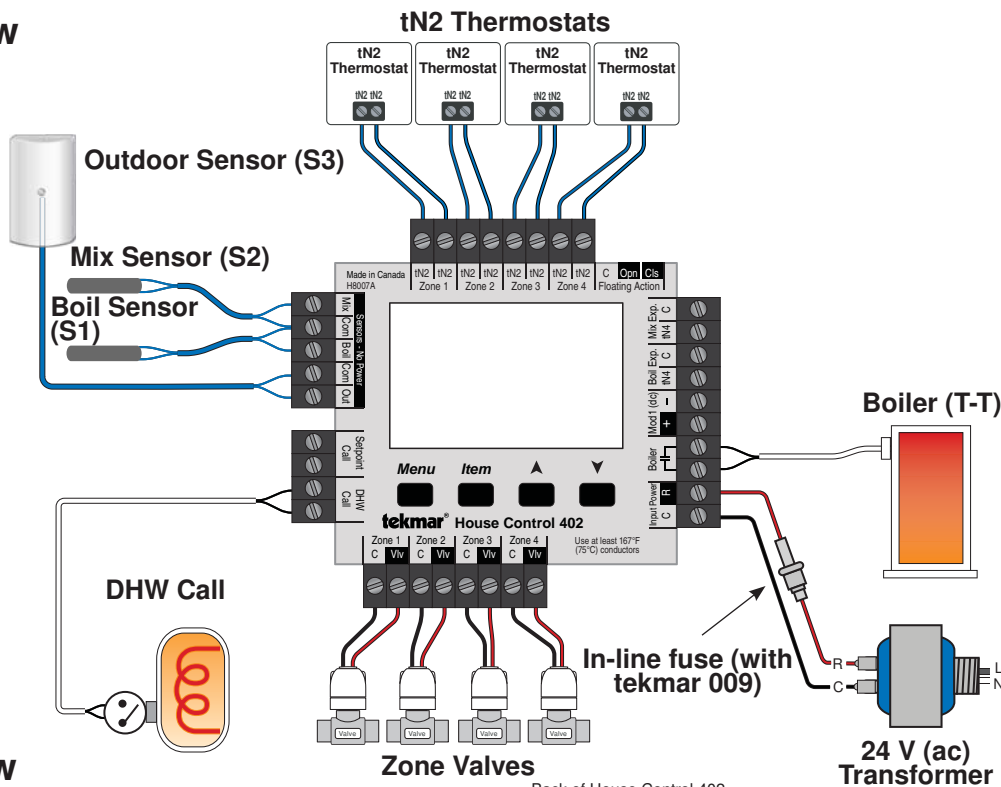
**Description:** The House Control 402 operates an On/Off boiler with indirect Domestic Hot Water. Mixing is performed with variable speed injection, which supplies an outdoor reset water temperature to the 4 onboard mix temperature hydronic zones. Additional zones (boiler or mix) can be added using the tN4 Expansion terminals.

**Change Settings:**

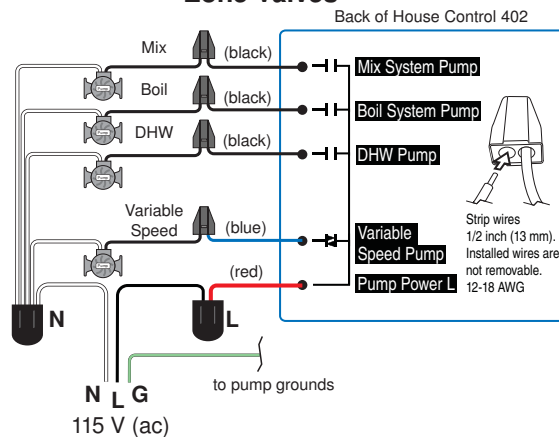
This application uses the default settings. It is recommended to change the Design temperatures (Outdoor, Mix) to match the geographical location and specific application.



**Front View**



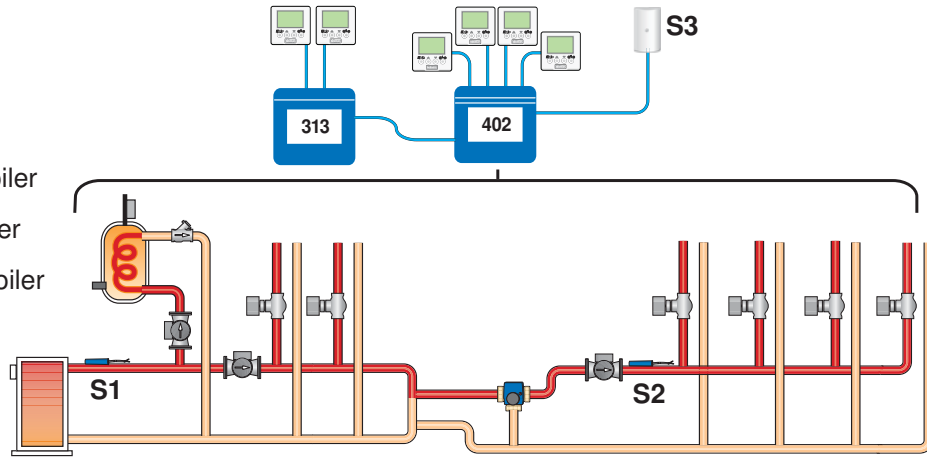
**Back View**



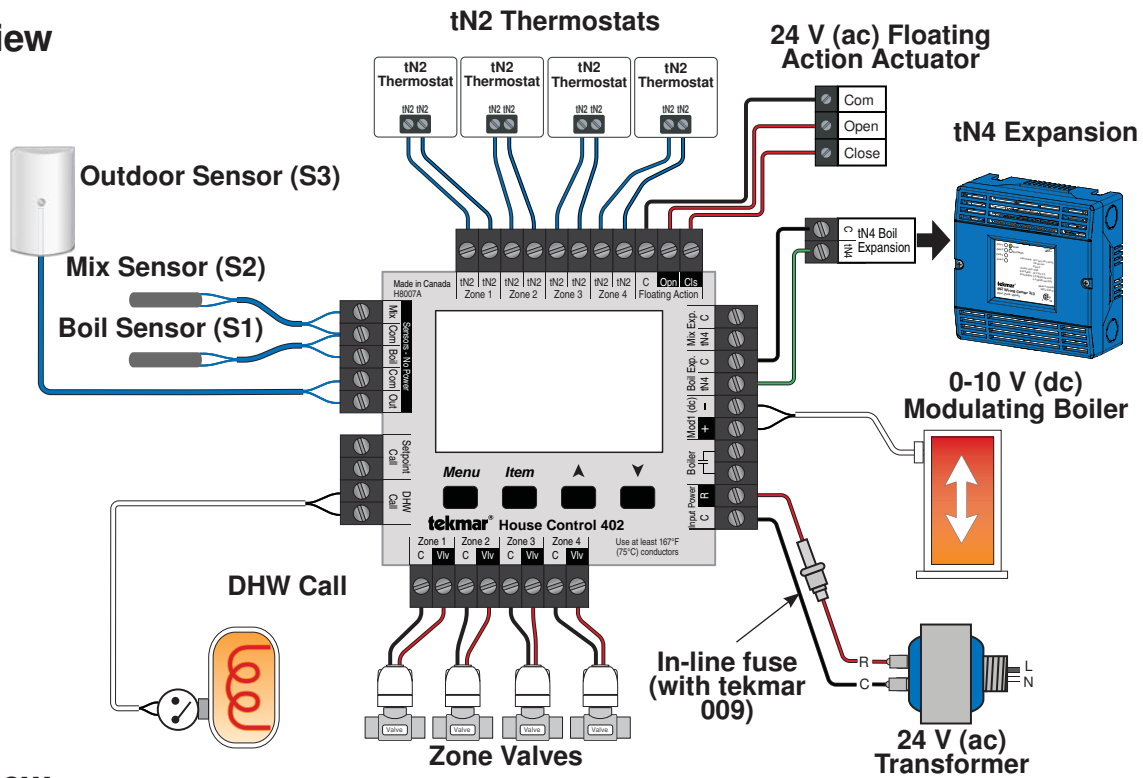
**Description:** The House Control 402 operates an On/Off boiler with indirect Domestic Hot Water. Mixing is performed with a three-way floating action mixing valve, which supplies a reset water temperature to four mix temperature hydronic zones. Two boiler water temperature zones shown are operated by a Wiring Center through the tN4 Boil Expansion.

Change Settings:

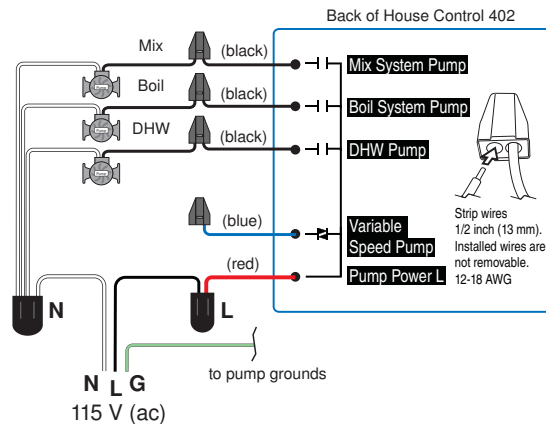
- 1) Mix Type: FLOT
- 2) Boil Type: Mod
- 3) Boil Motor: Per Boiler
- 4) Min Mod: Per Boiler
- 5) Mod Delay: Per Boiler



**Front View**



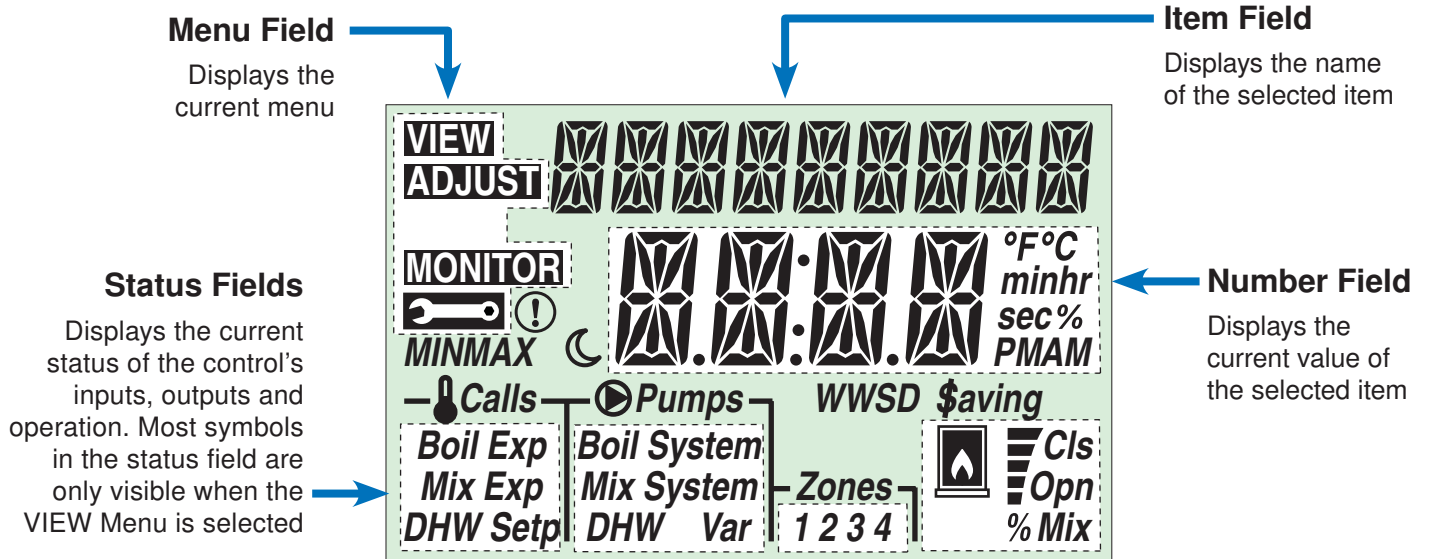
**Back View**











# User Interface

## Display



## Symbols

 <b>CALLS</b> Displays any call for heat the control is receiving.	$^{\circ}\text{F}^{\circ}\text{C}$ <i>minhr</i> <i>sec%</i> <i>PMAM</i> $^{\circ}\text{F}$ , $^{\circ}\text{C}$ , %, HOURS, MINUTES, SECOND Units of measurement for current number.
 <b>PUMPS</b> Displays any pump currently operating.	 <b>UNOCCUPIED</b> Indicates that a User Switch or Timer has put the system into UnOccupied.
<b>ZONES</b> <i>1 2 3 4</i> Displays if an on-board zone is operating.	 <b>BOILER</b> Indicates that the boiler should be running.
 <b>WARNING</b> Displays if an error exists on the system.	 <b>DEVICE OUTPUT SCALE</b> Displays output of the mixing valve or injection pump.
<b>ENERGY SAVING INDICATOR</b> <i>\$aving</i> Displays when the system is saving energy. See the Saving Indicator section.	<i>Cl's</i> <i>Opn</i> <b>CLOSE/OPEN</b> Displays whether the mixing valve motor is opening or closing.
<b>WWSD</b> Displays when the system is in Warm Weather Shut Down.	<i>MINMAX</i> <b>MIN / MAX</b> Displays when an operating temperature reaches a minimum or maximum value.

## Using the Control

The House Control 402 uses a simple user interface to accomplish a variety of functions. The four buttons beneath the display are used to change menu, sort through Items, and adjust each setting as required.

This section explains the purpose of each button and how to quickly and easily operate the control.

### Menu Button

The menus display in the Menu Field at the top left side of the LCD. Four menus are available: View, Adjust, Monitor and Toolbox (identified by the wrench symbol).

- The **View** menu allows the user to view the current status of various system parameters.
- The **Adjust** menu allows the installer to adjust settings to ensure control operation matches requirements of the mechanical system.
- The **Monitor** menu keeps track of run times and other important data that is collected during system operation.
- The **Toolbox** menu is a source of system information and includes useful tools for commissioning and testing the system.

### Item Button

Each menu contains a list of Items that can be viewed and, in some cases, adjusted. Press the item button to scroll through the list in each Menu.

- To view the next available item, press and release the Item button.
- To view the previous item, hold down the Item button, and press and release the Up button.

### Up and Down Buttons

The Up and Down buttons are primarily used for adjusting settings. To adjust a setting:

1. Select the appropriate menu using the Menu button.
2. Select the item using the Item button.
3. Use the Up or Down button to make the adjustment.

### Default Item

- To set the default item in the View menu, display the item for more than five seconds.

When navigating menus, the display reverts back to the default item (View Menu) after 60 seconds of button inactivity.

## Installer Lock

The House Control 402 is shipped pre programmed with common settings. These are fully adjustable by the installer, and can be locked out of sight if desired. The access level of the control can be changed in the Toolbox menu. By switching from 'Installer' to 'User' access, all Adjust menu settings are hidden with the exception of WWSD and Units.

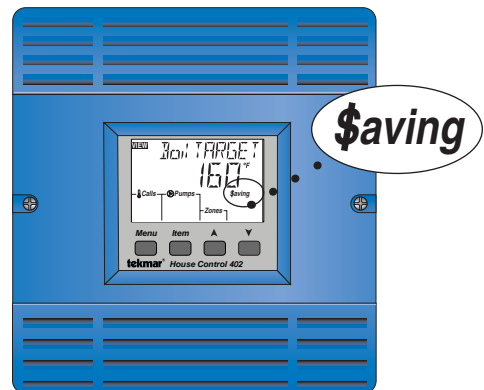
- In the Toolbox menu, locate Access
- Adjust the access level to 'User' by pressing the up or down button. This prevents unwanted setting changes to the control.

## Saving Indicator

The House Control 402 is packed with features intended to increase system efficiency while improving overall comfort. Whenever one of these features is active, the \$aving indicator will display in the View menu.

The Monitor menu will maintain a record of the accumulated time that the \$aving icon has been active.

Section J describes a number of Energy Saving features that can be used to save even more energy with the House Control 402.



# Testing

## Testing The Control

The control has a built-in test routine that tests the main control functions. The control continually monitors the sensors and displays an error message whenever a fault is found. The individual outputs and relays are tested using a test sequence.

### User Test

The User Test is found in the Toolbox menu of the control.

- Press the Menu button to access the Toolbox Menu. Press the Item button to locate the User Test.
- Start the test sequence by going to the User Test item and pressing the 'Up' arrow.
- Pause the test sequence by pressing the Item button. To advance to the next step, press the Item button again.
- If the test sequence is paused for more than five minutes, the control exits the entire test routine.
- To advance to a particular step, repeatedly press and release the Item button to display the appropriate device. The User Test follows the sequence shown on the right.

### Safety Feature: Abort Test

If at any time during the User Test the Boil Supply or Mix Supply temperatures rise above their maximum values, the control will shut the boiler off and display "Abort Test" on the screen. It will then resume normal operation.

If a device fails to operate during the test sequence, refer to the Troubleshooting Guide to check the operation of the control. If the control works properly, refer to any troubleshooting information supplied by the equipment manufacturer.

### Max Heat

The control has a function called Max Heat. In this mode, the control turns on and operates the system up to the maximum set temperatures as long as there is a call for heat. Use this mode to run the circulators during system start-up to purge air from the piping.

To enable Max Heat, enter the Toolbox Menu and find Max Heat. Use the up arrow to select 'On'.

- When a space heating call is present, the boiler will run to maintain a target of Boil Design + 10°F (One can purge the system using this test and leave the boiler unpowered. This will prevent heat from entering the system during the purge.)
- When a DHW Call or Setpoint Call is present, the boiler will run to maintain a target of 180°F.
- WWSD and DHW Priority is disabled during Max Heat mode.
- When Max Heat is on the display will show "Max Heat Test:
- Max Heat will automatically turn off after 24 hours.

### User Test Sequence

- Step 1** The Mix 1 device ramps up to 100% over 30 seconds or according to the motor speed setting.
- Step 2** The Mix 1 device ramps down to 0% over 30 seconds or according to the motor speed setting.
- Step 3** Zone Relays 1 through 4 turn on for 10 seconds each
- Step 4** The mix system pump turns on for 10 seconds.
- Step 5** The DHW pump turns on for 10 seconds.
- Step 6** The boil system pump turns on for 10 seconds.
- Step 7** During the boiler test step, zone relays 1 through 4 turn on, the mix system pump turns on, and the boil system pump turns on. The mixing device operates up to 20%. This ensures there is a location for heat to move when the boiler is turned on.

If Boil Type is On/Off, the boiler relay is closed for 10 seconds and then opened.

If using a modulating boiler through the Mod (dc) outputs on the 402, the boiler operates at 50 % output for 10 seconds. (See Start Modulation in Section F)

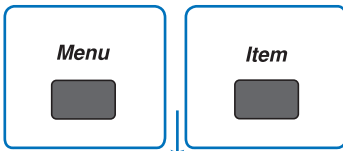
### Modulating Boilers: Change the Firing Rate

By pressing the Item button during Step 7, the modulation level will hold for up to 5 minutes. By pressing the up and down buttons, modulation can be adjusted and held at various levels for testing and setup of the boiler.

Press item again to exit the modulation test.

# Programming

## View Menu



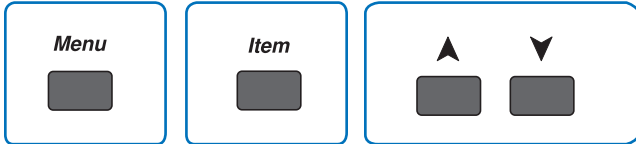
The View menu items display the current operating temperatures and status information of the system.

VIEW MENU

Item Field	Range	Description
<p>VIEW Outdoor 30 °F Calls Pumps Zones</p>	-76 to 149 °F (-60.0 to 65.0 °C)	<b>OUTDOOR</b> <span style="float: right;"><i>SECTION B</i></span> Current outdoor air temperature as measured by the outdoor sensor.
<p>VIEW Mix SUPPLY 105 °F Calls Pumps Zones</p>	-22 to 266 °F (-30.0 to 130.0 °C)	<b>MIX SUPPLY</b> <span style="float: right;"><i>SECTION G</i></span> Current mix supply water temperature as measured by the mix supply sensor.
<p>VIEW Mix TARGET 120 °F Calls Pumps Zones</p>	---, 35 to 180 °F (1.5 to 82.0 °C)	<b>MIX TARGET</b> <span style="float: right;"><i>SECTION G</i></span> The temperature the control is currently trying to maintain at the mix supply sensor. “---” is displayed when no heat is required for mix zones.
<p>VIEW Boil SUPPLY 145 °F Calls Pumps Zones</p>	-22 to 266 °F (-30.0 to 130.0 °C)	<b>BOILER SUPPLY</b> <span style="float: right;"><i>SECTION F</i></span> Current boiler supply water temperature as measured by the boiler sensor.
<p>VIEW Boil TARGET 160 °F Calls Pumps Zones</p>	---, 35 to 200 °F (1.5 to 93.0 °C)	<b>BOILER TARGET</b> <span style="float: right;"><i>SECTION F</i></span> The boiler target is the temperature the control is currently trying to maintain at the boiler supply sensor. “---” is displayed when no heat is required for boiler zones.
<p>VIEW Boil MOD 85 % Calls Pumps Mix System Zones % Mix</p>	0-100%	<b>BOILER MODULATION</b> <span style="float: right;"><i>SECTION F</i></span> Current percent modulation of the boiler’s burner. <b>Note:</b> This item is only available when the Boil Type setting is set to Mod.
<p>SYSTEM IN AWAY</p>	--	<b>SYSTEM IN AWAY</b> The heating system is in the Away scene. The DHW tank will not be heated. Setpoint calls are still responded to. Use the User Switch to change scene out of Away.

After the last item, the control returns to the first item in the menu.

## Adjust Menu (1 of 2)



The Adjust Menu items are the programmable settings used to operate the mechanical equipment.

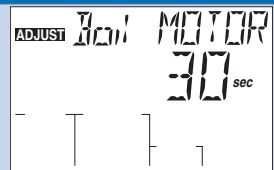
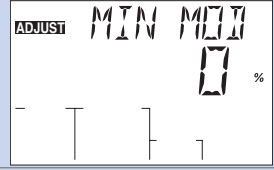
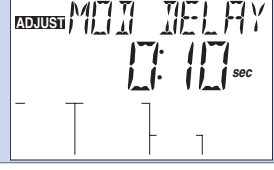
ADJUST MENU

Item Field	Range	Description
	-60 to 45°F (-51.0 to 7.0°C) Default = 10°F (-12.0°C)	<b>OUTDOOR DESIGN</b> <span style="float: right;"><i>SECTION F</i></span> Typically set to the temperature of the coldest day of the year. The design outdoor air temperature used in the heat loss calculations for the heating system.
	70 to 180°F (21.0 to 82°C) Default = 120°F (49.0°C)	<b>MIX DESIGN</b> <span style="float: right;"><i>SECTION G</i></span> The supply water temperature required for the mix zones on the typical coldest day of the year.
	VAR, FLOT, 0-10 Default = VAR	<b>MIX TYPE</b> <span style="float: right;"><i>SECTION G</i></span> Select the type of mixing device. Can be variable speed injection pump (VAR), floating action (FLOT) or 0-10 Vdc actuator. <b>Note:</b> 0 -10 is only available when Boiler Type = OnOf
	30 to 230 seconds Default = 105	<b>MIX MOTOR</b> <span style="float: right;"><i>SECTION G</i></span> The time that the mix actuating motor requires to operate from fully closed to fully open. <b>Note:</b> This item is only available when the Mix Type is set to FLOT (floating action motor) or 0-10.
	OnOf or MOD Default = OnOf	<b>BOILER TYPE</b> <span style="float: right;"><i>SECTION F</i></span> The type of boiler connected to the control. On-Off (OnOf) or Modulating (MOD). <b>Note:</b> This item is only available when the Mix Type is set to FLOT (floating action motor) or VAR (variable speed)
	70 to 200°F (21.0 to 93°C) Default = 180°F (82°C)	<b>BOILER DESIGN</b> <span style="float: right;"><i>SECTION F</i></span> The supply water temperature required for the boiler zones on the typical coldest day of the year.
	On or Off Default = On (On/Off) Default = Off (Mod)	<b>BOILER MINIMUM</b> <span style="float: right;"><i>SECTION F, G</i></span> Boiler return protection. When on, boiler target will not go below 140°F and the mixing device will provide boiler protection against cold return water. <b>Note:</b> If Boiler Type is MOD, this setting is default Off.

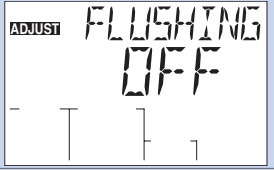
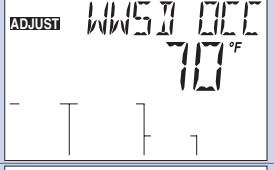
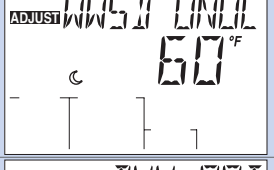
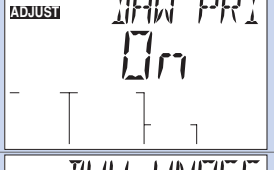
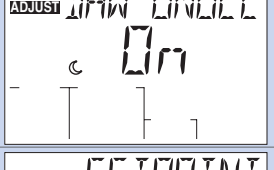
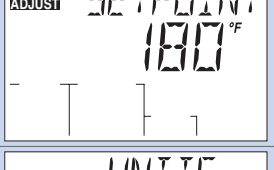
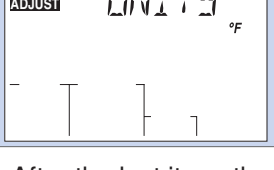
Continued on next page.

## Adjust Menu (2 of 2)

For Modulating Boilers Only

Item Field	Range	Description
	10 to 230 sec. Default = 30 sec	<b>BOILER MOTOR</b> <a href="#">SECTION F</a> The time required for the modulating actuating motor to fully open the gas valve or ramp the fan to full speed on a modulating boiler.
	0 to 50% Default = 0%	<b>MINIMUM MODULATION</b> <a href="#">SECTION F</a> The minimum percent modulation of the boiler.
	0 to 3:00 min. Default = 10 sec	<b>MODULATION DELAY</b> <a href="#">SECTION F</a> Delay time between the burner firing and the boiler releasing to modulation.

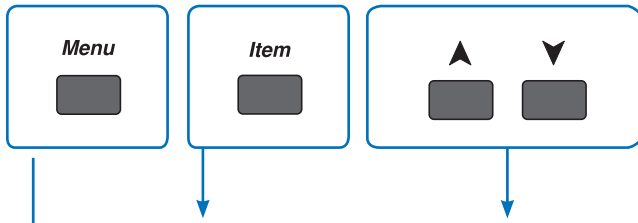
ADJUST MENU

	On or Off Default = Off	<b>FLUSHING</b> <a href="#">SECTION F</a> This feature is generally used when the hot water source is a domestic hot water tank. When On, it will ensure that each zone is operated at least once daily to prevent stagnation.
	40 to 100 °F (4.5 to 38 °C) Default = 70 °F (21.0 °C)	<b>WWSI OCCUPIED</b> <a href="#">SECTION J</a> The system's Warm Weather Shut Down temperature during Occupied periods.
	40 to 100 °F (4.5 to 38 °C) Default = 60 °F (15.5 °C)	<b>WWSI UNOCCUPIED</b> <a href="#">SECTION J</a> The system's Warm Weather Shut Down temperature during Unoccupied periods. <b>Note:</b> Item is only available when a schedule or User Switch is present on the system.
	On or Off Default = On	<b>DHW PRIORITY</b> <a href="#">SECTION H</a> Determines if DHW should have priority over space heating if both are required at the same time.
	On or Off Default = On	<b>DHW UNOCCUPIED</b> <a href="#">SECTION H</a> Selects whether a DHW Call should be responded to during Schedule #1 Unoccupied periods. <b>Note:</b> Item is only available when a schedule or a User Switch is present on the system.
	60 to 200 °F (15.5 to 93 °C) Default = 180 °F (82.0 °C)	<b>SETPOINT</b> <a href="#">SECTION I</a> The minimum boiler target temperature when a Setpoint Call is present.
	°F or °C Default = °F	<b>UNITS</b> Selects units for temperature display.

After the last item, the control returns to the first item in the menu.



## Monitor Menu



The Monitor Menu items provide information about the system's operation and performance.

To clear any item back to default, press and hold the Up and Down buttons while viewing that item.

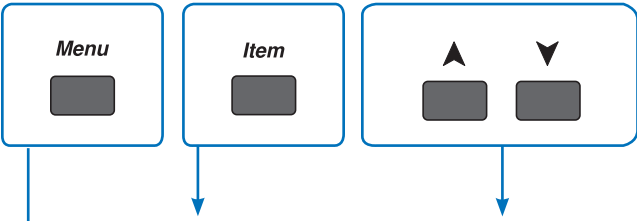
MONITOR MENU

Item Field	Range	Description
	-76 to 149°F (-60.0 to 65°C)	<b>OUTDOOR HIGH</b> Records the highest outdoor temperature since the item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	-76 to 149°F (-60.0 to 65°C)	<b>OUTDOOR LOW</b> Records the lowest outdoor temperature since the item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>RUN TIME (BOILER)</b> The total 'on' time of the boiler relay since the item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>RUN TIME (DHW PUMP)</b> The total running time of the DHW Pump since this item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>RUN TIME (BOIL SYSTEM PUMP)</b> The total running time of the Boil System Pump since this item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>RUN TIME (MIX SYSTEM PUMP)</b> The total running time of the Mix System Pump since this item was last cleared. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>RUN TIME (\$AVING)</b> Maintains a record of the total length of time the \$aving icon has been active. Press and hold the Up and Down buttons while viewing to reset.
	0 to 9999 Hours Default = 0 hr	<b>BOILER ENERGY USE</b> Multiply this value by the BTU rating (input BTU/hr) of the boiler to get an approximate energy consumption (in BTU's) for the boiler. Press and hold the Up and Down buttons while viewing to reset.

• After the last item, the control returns to the first item in the menu.

# Toolbox Menu

The Toolbox Menu is a location for system information and Test functions. If any errors are present on the system, they will be located at the beginning of this menu.



TOOLBOX MENU

Item Field	Range	Description
	On or Off Default = Off	<b>USER TEST</b> <span style="float: right;"><i>TESTING</i></span> Begins the test routine which tests the main control's functions. See the Testing the Control section for more details. Use the up button to turn the User Test On.
	On or Off Default = Off	<b>MAX HEAT</b> <span style="float: right;"><i>TESTING</i></span> When selected, control operates the system up to maximum set temperatures. Will operate up to 24 hours, or can be manually turned Off. See Max Heat in the Testing the Control section for more details.
	402 J11 xxA	<b>TYPE AND SOFTWARE VERSION</b> Displays the type number of the product, followed by the current software version beneath.
	USER or INST (Installer) Default = INST	<b>ACCESS LEVEL</b> Selects the Access Level of the control, which determines the Menu items available. USER provides the most limited level of access and shows the fewest possible items.
	OFF, SEL Default = Off	<b>FACTORY DEFAULTS</b> Loads the factory default settings. Hold the Up and Down buttons for 1 second until SEL is shown.
	0 to 24	<b>MIX DEVICES</b> Displays the number of devices on the Mix Network (Water Temperature). This network is made up of thermostats connected to the House Control, and to the Mix Exp. terminals.
	0 to 24	<b>BOIL DEVICES</b> Displays the number of devices on the Boil Exp. Network (Water Temperature). This network is made up of thermostats connected to the Boil Exp. terminals on the House Control.
	---	<b>HISTORY - 1 ..... HISTORY - 5</b> Displays a history of any past errors that have occurred on the system. Will clear after 30 days, or press Up and Down buttons for 1 second to manually clear. The last 5 history items will display if present.

After the last item, the control returns to the first item in the menu.

# Sequence of Operation

## A tekmarNet® System

The House Control 402 operates as a System Control on a tekmarNet® System. It talks to on-board tN2 Thermostats and to other tekmarNet® devices through the tN4 Expansion terminals.

## House Control 402

The House Control 402 is a tekmarNet® System Control that can operate up to 2 water temperatures (Boil and Mix) in a hydronic system. It communicates information between the on-board tN2 Thermostats and the tN4 Expansion Port, then operates mechanical equipment to maintain a comfortable and efficient building. The House Control uses both Outdoor Reset and Indoor Feedback to 'fine tune' the supplied water to the lowest possible temperature while still satisfying heating requirements.

## tN2 Thermostats

The House Control 402 allows for up to four tN2 Thermostats to be directly connected to the unit. These thermostats provide information back to the control regarding room temperature and heat requirements for that particular zone. This information is fundamental to Indoor Feedback, as described below. If the system is larger than 4 zones, more thermostats can be added through the tN4 Expansion port.

## tN4 Expansion

The tN4 Expansion terminals link the House Control with the rest of the tekmarNet® System. Any device with tN4 Communication terminals can be connected, including:

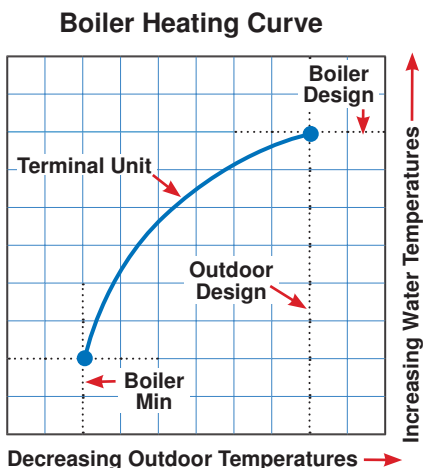
- tN2 Wiring Centers
- tN4 Timer 033
- tN4 User Switch 479
- tN4 Setpoint Control 161

These devices and their use in a tekmarNet® System will be discussed throughout this manual.

## Outdoor Reset

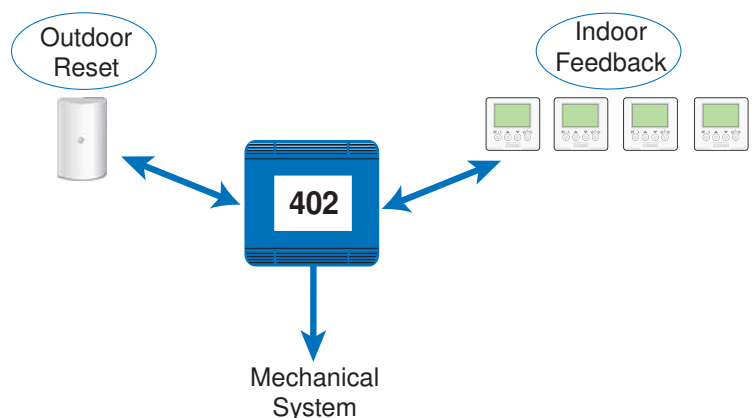
In a heating system, the rate of heat supplied to the building must equal the rate of which heat is lost. If the two rates are not equal, the building will either cool off or over heat.

The rate of building heat loss depends mostly on the outdoor temperature. Outdoor Reset allows a hot water heating system to increase the water temperature, adding heat to the building, as the outdoor temperature drops. The relationship by which the water temperature is changed is defined by the heating curve.



## Indoor Feedback

Most buildings have internal heat gains due to people, passive solar heating and mechanical or electrical equipment. Likewise, wind loads cause a building to lose heat faster than during design conditions. If only the outdoor temperature is measured, the control cannot compensate for these internal heat gains or losses and the building may over or under heat. In order to maintain the most comfortable temperature, the control uses indoor feedback from tekmarNet® Thermostats in order to continually adjust the water temperatures in the system. This ensures the building is comfortable, and operated efficiently, at all times.





The House Control operates the boiler whenever there is a “Call” for heat. These heat calls can come from a number of sources which are detailed below. Any Calls that are present on the system will be displayed in the “Calls” status area.

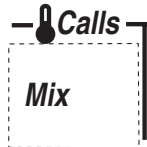
### Boil Exp Call

When a device connected to the tN4 Boil Expansion terminals calls for heat, the 402 registers a Boil Exp call.



### Mix Call

When an onboard tN2 Thermostat calls for heat, the 402 registers a Mix call.



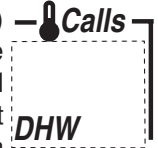
### Mix Exp Call

When a device connected to the tN4 Mix Expansion terminals calls for heat, the 402 registers a Mix Exp Call.



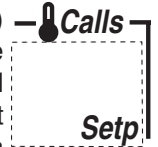
### DHW Call

When either a dry connection or 24 V(ac) is applied to the DHW Call terminals, the 402 registers a DHW Call. A DHW Call can also be made through a tN4 Setpoint Control. See Section H for more details on DHW operation.



### Setpoint Call

When either a dry connection or 24 V(ac) is applied to the Setpoint Call terminals, the 402 registers a Setpoint Call. A Setpoint Call can also be made through a tN4 Setpoint Control. See Section I for more details on Setpoint operation.



## Pump Operation

## Section D

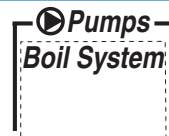


Once a heat call has been registered, the 402 will bring on certain pumps depending on the type of heating required. It may also bring on pumps during pump exercising as described below.

### Boil System Pump

The Boil System pump is switched on in the following situations:

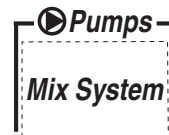
- There is a Boil Exp Call.
- There is a Mix Call or a Mix Exp Call.
- A call from tekmarNet® Setpoint control 161, or others, could cause this pump to run.



### Mix System Pump

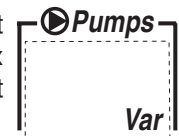
The Mix System pump is switched on in the following situations:

- One of the on-board tN2 Thermostats is calling for heat.
- A Mix Exp Call is present from a device on the tN4 Mix Expansion port.



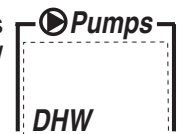
### Variable Speed Pump

The variable speed injection pump output operates only when there is a Mix or Mix Exp Call and the Mix Type in the Adjust menu is set to VAR.



### DHW Pump

The DHW pump operates whenever there is a DHW Call and the control is not in DHW Priority Override. See Section H.



## Exercising

## Section E

The system control will exercise all pumps, mixing valves and hydronic zones (zone valves and zone pumps) for 10 seconds every three days to prevent seizure. If a mixing valve is connected it will stroke it fully open and fully closed during this exercise period.

The 402 is able to operate a single on-off or modulating boiler as a heat source. For proper operation of the boiler, the 402 must be the only control that determines when the boiler is to fire.

**\*Important note:** The operating control in the boiler, also known as an aquastat, remains in the burner circuit and acts as a secondary upper limit on the boiler temperature. The boiler operator temperature setting must be adjusted above 210°F, which is the fixed Boiler Maximum on the 402.

### Boiler Target Temperature

The boiler target temperature is the temperature which the control is trying to operate the boiler at. There are four items that determine this temperature: a DHW Call, a Setpoint call, Boil Exp call, or a Mix Call if the mix loop requires heat. If the control receives all four calls for heat at one time, it will operate the boiler at the highest of the four. If there is a call for heat on the boiler loop, it will determine the target using outdoor reset and indoor feedback. It will also use outdoor reset and indoor feedback to determine the boiler target if the mixing loop requires heat. DHW and Setpoint calls will override the outdoor reset and cause the boiler to target a temperature of 180°F, unless a tekmarNet® Setpoint control is used, which allows the boiler target temperature to be custom set.

The control displays the temperature that it is currently trying to maintain as the boiler supply temperature in the View menu. If the control does not presently have a requirement for heat, it does not show a boiler target temperature. Instead, “— — —” is displayed in the LCD.

### Boiler and Mix Zone Expansion

The 402 is able to expand the amount of zones it can operate by using either the Boil Exp. terminals or the Mix Exp. terminals. This allows the control to operate two different water temperatures, one for low temperature applications, such as radiant floors, and another for high temperature applications such as DHW or second stage heat.

Thermostats that are connected through the Boil Exp. terminals help determine the boiler water target temperature based upon boiler outdoor reset and indoor feedback.

Thermostats connected through the Mix Exp. terminals help determine the mix target temperature based upon mix outdoor reset and indoor feedback. Thermostats onboard the control are always Mix System thermostats. When the control is to operate mix temperature zones, the boiler target temperature is determined using Boiler Load Reset. The boiler water temperature is maintained at the lowest possible temperature that satisfies the heat load of the system. See Mixing Operation for more information.

### Boiler Minimum

When operating non-condensing boilers, it is very important to prevent cool water from returning to the boiler. This could create flue gas condensation which, if left too long, can severely damage the boiler.

The House Control 402 protects the boiler through the Boiler Minimum setting. The boiler minimum is the lowest temperature that the control is allowed to use as a boiler target temperature. If Boil Minimum is turned On, the control will not allow a Boil Target below 140°F (60°C). If the boiler is operating at this lowest, safe condition, the “MIN” segment is turned on in the display when viewing either the boiler supply temperature or the boiler target temperature.

- Locate the Boil Minimum setting in the Adjust menu.
- Set to either On (uses boil min of 140°F) or Off

### Boiler Maximum

The boiler maximum is the highest temperature that the control is allowed to operate the boiler. The boiler supply temperature should never exceed 210°F (99.0°C). However, the boiler supply temperature could exceed this if the boiler is operating to satisfy minimum “On-time” requirements. These are designed to prevent short-cycling of the equipment.

### Outdoor Design

This is the typical coldest day of the year for the geographical area in which the control is being installed.

When the outdoor temperature is the same as the outdoor design setting:

- Mix Target = Mix Design
- Boil Target = Boil Design

Under extreme conditions, if the outdoor temperature drops below the Outdoor Design setting, the control will allow mix and boil targets to exceed their designs by up to 10°F (5.5°C).

### Boil Design

The boil design temperature is the water temperature required to heat zones connected to the tN4 Boil Exp. terminals on the typical coldest day of the year.

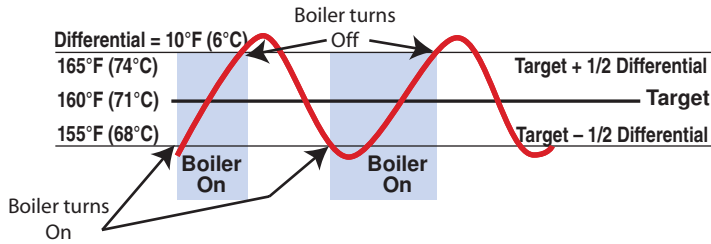


## On-Off Boiler Operation

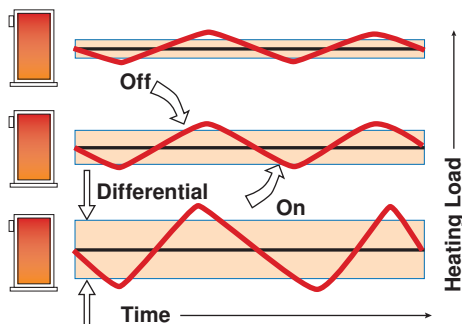
If the heat source is an On-Off Boiler or another source that uses the boiler contact on the 402 to operate, the Boil Type setting in the Adjust menu must be set to "OnOff".

### Auto Differential

An on / off heat source must be operated with a differential in order to prevent short cycling. The boiler contact closes when the boiler supply water temperature is 1/2 of the differential below the boiler target temperature. As the supply temperature reaches 1/2 of the differential above the boiler target temperature, the boiler is shut off.



In order to decrease temperature swings and increase boiler efficiency, the Auto Differential feature automatically adjusts the operating differential of the boiler based on the heating load. As the load increases, the differential will decrease to minimize temperature swings. As the load decreases, the differential will increase to prevent short cycling. This can significantly improve operating efficiency and prevent equipment failures through excessive cycling.



## Modulating Boiler Operation

The 402 can operate a single hot-water modulating boiler using the 0 - 10 V (dc) Mod output.

To operate a modulating boiler, the Boil Type must be set to MOD in the Adjust menu. The control operates the boiler by first switching the boiler contact to allow the modulating boiler to go through the ignition sequence (the boiler contact may not be required on all modulating boilers). A 0-10 V (dc) analog signal is then used to modulate the boiler firing rate from the Minimum Modulation setting using PID logic in order to satisfy the boiler target temperature.

### Modulating Boiler Differential

A modulating boiler must be operated with a differential while operating in low fire because this indicates the load is smaller than the minimum modulation of the boiler. The control will then treat it as an on/off boiler with a BTU capacity equal to the minimum output the boiler is rated for. The boiler burner ignites at low fire when the supply water temperature is 1/2 of the Boiler Differential setting below the boiler target temperature. The boiler is shut off in low fire as the supply temperature reaches at least 1/2 of the differential above the boiler target temperature. This differential is determined using the Auto Differential function.

When the boiler is modulating above low fire, the differential does not apply. Instead, the modulation output signal is determined using Proportional, Integral and Derivative (PID) logic in order to satisfy the boiler target temperature.

A modulating boiler requires all the same settings as an on-off boiler in addition to the settings described in this section. Refer to service bulletins SB032 and SB057 for manufacturer recommended settings for many popular boiler models. These bulletins are available at:

<http://www.tekmarcontrols.com/sb/sb.html>

### Boiler Motor

The Boiler Motor Speed is the amount of time the boiler requires to go from 0% modulation to 100% modulation.

The Boiler Motor Speed setting for a Variable Frequency Drive (VFD) is the amount of time required to go from a stopped position to 100% fan speed. Since a VFD has a very quick response rate, it may be necessary to increase the Motor Speed setting which will allow for a slower ramp up to high fire, providing a more stable flame.

Gas valve actuating motors have a design time from fully closed to fully open which can be found in the manufacturer's manual. The Boiler Motor setting should be set to this time.

- Locate the Boiler Motor setting in the Adjust menu.



## Minimum Modulation

The Minimum Modulation is the lowest the control can modulate the boiler while maintaining stable operation. It is based on the signal sent from the control to the boiler. This setting is determined by the boiler and corresponds to the minimum BTU output that the boiler is rated for.

The Minimum Modulation default setting is 0%.

For boilers with electronic operators, the boiler's input signal range may not match the output signal range of the 402. The Minimum Modulation setting limits the control output range in order to match the boiler's input range.

- Refer to the boiler manufacturer's literature to determine the minimum output that the boiler will successfully operate at.
- Locate the Min Mod setting in the Adjust menu.
- Calculate the Minimum Modulation using the following formula:

### For 0-10 V (dc):

$$\text{Minimum Modulation} = \frac{\text{Boiler's Minimum Input Signal}}{10 \text{ V (dc)}} \times 100\%$$

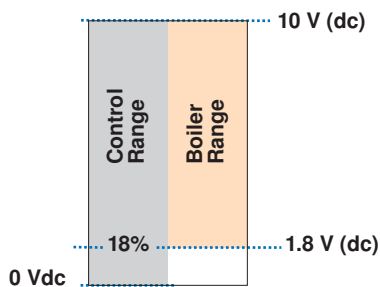
### Example:

A boiler requires a 1.8 V (dc) signal to fire the boiler at low fire. The boiler can be modulated to 10 V (dc) where it reaches high fire.

This means the boiler's input signal range is 1.8 to 10 V (dc). The 402 control has an output signal range of 0-10 V (dc).

To make the two signal ranges the same, the Minimum Modulation required is:

$$\text{Minimum Modulation} = \frac{1.8 \text{ V}}{10 \text{ V}} \times 100\% = 18\%$$



## Start Modulation

When the control wants to turn the boiler on, it will run the boiler at a Start Modulation value of 50% (5 volt signal) for 30 seconds. After this 30 second delay has elapsed, the control will then allow the boiler to modulate down to the minimum modulation setting, and it will hold the boiler at the minimum modulation setting for the Modulation Delay time as described below. These settings are in the Adjust Menu.

## Modulation Delay

The 402 includes a Modulation Delay setting in the Adjust Menu. This setting is the amount of time that the boiler must be held at minimum modulation in order to establish proper operation. Once this modulation delay has elapsed, the control will ramp up the boiler as required to satisfy the boiler target temperature.

## Flushing

Flushing is a feature that is available with the House Control 402. It is designed to turn on all zone valves or zone pumps, as well as system circulators in order to flush an open system which uses potable water. This is to help prevent the water from stagnating when using an open system for heating purposes.

Flushing operation will occur once every day. The control will operate as follows to perform flushing:

- Turn on all zones.
- Turn on all required system pumps.
- Operate the mixing device to allow proper flushing of both the high temperature loop, and the mixed temperature loop.

This will continue for 4 minutes, during which time the boiler will not operate.

To activate this feature, find Flushing in the Adjust menu and select "On".

**Mix Type**

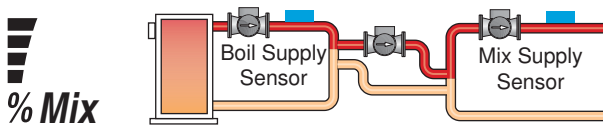
A mixing device allows the control to reduce the boiler water temperature down to a lower water temperature. This can be necessary when doing radiant floor heating and baseboard heating in the same application. A mixing device also allows the control to protect the boiler from sustained flue gas condensation and thermal shock.

The Mix outputs are built into the 402. The type of mixing device is selected using the Mix Type setting. The mixing devices that can be selected are variable speed injection (VAR), floating action (FLOT) or 0-10 V(dc).

- Locate the Mix Type setting in the Adjust menu.

**Variable Speed Injection**

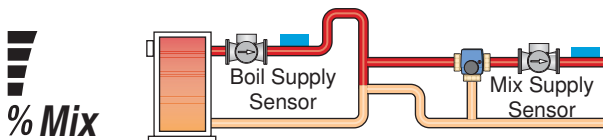
A standard wet rotor circulator can be connected to the Variable Speed Pump output on the back of control. The control varies the circulator speed to maintain the correct mixed supply water temperature at the mix supply sensor. For correct sizing and piping of the variable speed injection circulator, refer to essay E 021. A visual indication of the current variable speed output is displayed in the LCD in the form of a bar graph (shown below) along with the 'Var' segment under 'pumps' status section.



**Floating Action 24 V(ac)**

A 24 V (ac) floating action actuator motor can be connected to the Floating Action outputs on the front of the House Control 402. The control pulses the actuator motor open or close to maintain the correct supply water temperature at the mix supply sensor when there is a requirement for mixing.

The mixing valve that the actuator is connected to can be either a 2-way, 3-way or 4-way valve. A visual indication as to whether the control is currently opening or closing the mixing valve is displayed in the LCD with the words OPN and CLS while in the View menu. Also, a visual indication of the current position of the valve is displayed in the form of a bar graph (shown below).



**Modulating 0-10 V(dc)**

\*Only available if Boil Type = On/Off

A modulating 0-10 V(dc) actuating motor can be used to operate the mixing valve. The control uses the Mod output to provide an analog 0-10 V(dc) signal to the actuator in order to maintain the correct mix supply temperature.

**Mix Design**

The Mix Design setting is the mix supply water temperature required to heat the zones when the outdoor temperature reaches the outdoor design temperature. Increasing this setting generally increases the Mix Target. For example, if concrete radiant floors typically operate using 105°F (40°C) water on the coldest day of the year to keep the room comfortable, 105°F would be the Mix Design setting.

**Mix Maximum**

The control has a fixed mix maximum temperature of Mix Design + 10°F from the mix design setting. This is to allow the building to be heated during an unpredictable temperature drop that is colder than the outdoor design setting (typically the coldest day of the year). During this rare occurrence, the "MAX" segment will display when viewing the mix target or mix supply temperature in the view menu.

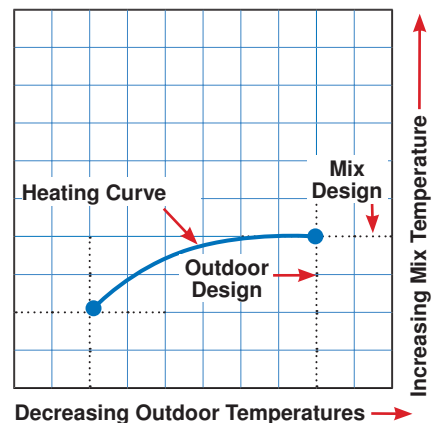
- Mix Maximum is fixed at Mix Design + 10°F.

**Boiler Minimum Protection**

The control is capable of providing boiler protection from cold return water temperatures. If the boiler supply water temperature is cooler than 140°F (60°C), the control reduces the output of the mixing device. This limits the amount of cool return water to the boiler and allows the boiler return water temperature to recover.

- Locate the Boil Minimum setting in the Adjust menu
  - Select either On (Boil Min = 140°F (60°C)), or Off
- See 'Boiler Minimum' in Section F for further details.

Mixing Reset Heating Curve



**DHW Call**

A DHW Call is required in order for the control to provide heat to a DHW tank. This can be done in two ways:

- A dry contact or 24 V(ac) signal is applied across the DHW Call terminals on the 402.
- A DHW Call is provided through the tN4 network. This can be done through the Boil Exp. tN4 terminals with a tekmarNet® setpoint device such as a Setpoint Control 161.

Once the control registers a DHW Call, it will display the “DHW” icon under Calls in the display.

**DHW Priority Operation**

The control can provide DHW Priority if desired. DHW Priority stops or limits the delivery of heat to the building heating system while the DHW tank calls for heat. This allows for quick recovery of the DHW tank.

- Locate the DHW Priority setting in the Adjust menu.
- Select either On or Off

**DHW with Priority OFF**

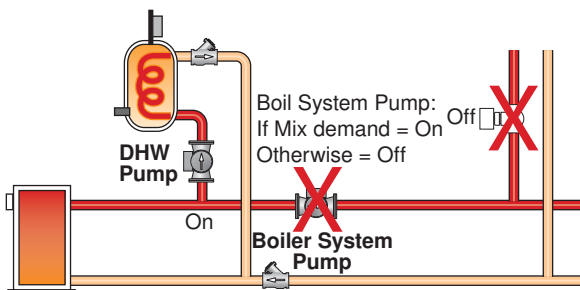
When a DHW Call is present, the DHW Pump contact closes. The boiler system pump does not turn on, but may operate based on either Boiler or Mixing requirements or another Setpoint Call.

It is assumed that the DHW pump will provide adequate flow through the heat exchanger and the boiler and does not require the boiler system pump to run.

**DHW with Priority ON**

When the control receives a DHW Call:

- The DHW Pump contact closes.
- The control will turn off all boiler zones using tekmarNet® communication.
- The mixing device output is also reduced to a minimum but may not shut off completely. Mixing zones may stay open during this time.
- The boiler system pump will remain on if there is a mix or mix exp. demand present. This is to provide minimal heat to the mixing device.



**DHW Unoccupied (Requires Timer 033 or User Switch 479)**

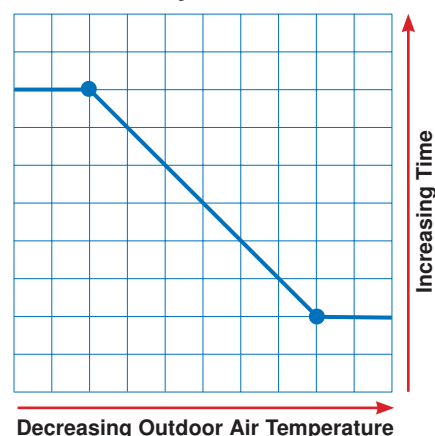
To take advantage of even more energy savings, use the DHW Unoccupied feature. In order to use this feature the tekmarNet® system requires the use of a tN4 Timer 033 set with Schedule #1, or a 479 User Switch. These devices are required in order to put the system into an unoccupied event. See ‘Energy Saving Features’ in Section J for more information.

The control has a DHW Unoccupied setting. When set to ON, the control will continue to respond to DHW calls during UnOccupied and Sleep periods of a setback schedule. If set to OFF, the control will ignore any DHW Calls during UnOccupied and Sleep periods which will help to prevent unnecessary cycling of the heating equipment. However, in order to ensure that hot water is available before the occupied event (i.e. people waking up in the morning), DHW is turned back on 1 hour prior to the occupied or wake time period.

**DHW Priority Override**

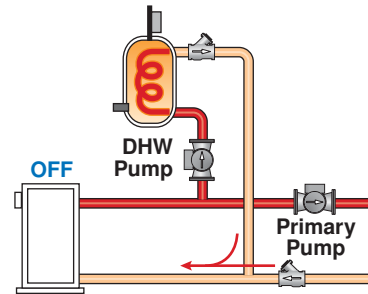
To prevent the building from cooling off too much or the possibility of a potential freeze up during DHW priority, the control limits the amount of time for DHW priority. As the outdoor air temperature becomes colder, the length of time that the control provides DHW priority is reduced. Once the allowed time for priority has elapsed, the control overrides the DHW priority and resumes space heating for 15 minutes. It will then revert back to DHW Priority and repeat.

**DHW Priority Override Time**



### DHW Post Purge

After the DHW Call is removed, the control performs a purge on the boiler. The control shuts off the boiler and continues to operate the DHW pump and the Boiler System pump if applicable. This purges the residual heat from the boiler into the DHW tank. The control continues this purge for a maximum of two minutes. The control also stops the purge if the boiler supply temperature drops below the current boiler target temperature.



### Setpoint Temperature Operation

### Section I

#### Setpoint Call

A Setpoint Call is required in order for the control to provide heat to a setpoint load, such as a spa, pool, or snowmelt load. This can be done in two ways:

- A dry contact or 24 V(ac) signal is applied across the Setpoint Call terminals on the 402.
- A Setpoint Call is provided through the tN4 network. This can be done through the tN4 Expansion terminals with a setpoint device such as a Setpoint Control 161.

Once the control registers a Setpoint Call, it will display the "Setp" icon under Calls in the display. Setpoint operation has a fixed priority of on.

#### Setpoint Operation

The control can operate to satisfy the requirements of a setpoint load in addition to a space heating load and a DHW load. A setpoint load overrides the current outdoor reset temperature and WWSD setting in order to provide heat to the setpoint load.

When the control receives a Setpoint Call:

- All Boil zones are turned off.
- The Mix device is ramped down to a minimum level.
- The boiler will operate to maintain the Setpoint temperature as set in the Adjust menu, or as set on the tekmarNet® Setpoint control if one is being used.

It is assumed that the Setpoint pump will provide adequate flow through the heat exchanger and the boiler.

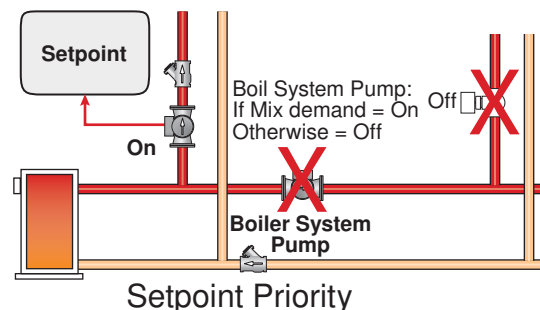
Setpoint calls will also be responded to when the system is in *Away*, as can be set using a 479 User Switch.

#### Setpoint Priority Override

To prevent the building from cooling off too much or the possibility of a potential freeze up during setpoint priority, the control attempts to limit the amount of time for setpoint priority.

As the outdoor air temperature becomes colder, the length of time the control provides setpoint priority is reduced. Once the allowed time for priority has elapsed, the control will check the space heating target.

- If there is a space heating target, the boiler operates at that target for 15 minutes.
- If after 15 minutes there is still a Setpoint Call, the control will reduce mixing outputs, shut off all boiler heating zones and target the Setpoint temperature.



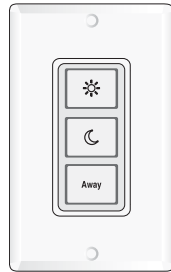
Note: It is possible to disable Setpoint Priority by using a tekmarNet® Setpoint control and turning the priority to Off in the Setpoint control.

## Network Schedules

Adding a schedule to a tekmarNet® system is both easy and valuable. A Timer 033 provides scheduling with up to 4 events per day for every tekmarNet® Thermostat. Turning down the room temperatures when they are unoccupied reduces boiler on-time and energy consumption which helps save money and the environment.



Timer 033



User Switch  
479

## One-Touch Setback

A User Switch 479 allows for one-touch overrides of the system. For example, if leaving the building for vacation, simply press the “Away” button and all the thermostats will immediately operate at a lower temperature, instead of having to walk around the building lowering the setpoint on each thermostat.

## DHW during Away

In addition to the One-Touch setback, a User Switch 479 also allows the user to press the ‘Away’ button and tell the House Control 402 to ignore DHW Calls, preventing the DHW tank from unnecessarily heating up when no one is living in the building.

## Outdoor Reset + Indoor Feedback

Traditional outdoor reset saves energy by adjusting the supply water temperatures to match changing outdoor conditions. This allows the system to operate at a reduced temperature for much of the year, anticipating interior load changes before they occur.

tekmarNet House Controls take outdoor reset one step further with ‘Indoor Feedback’. Each thermostat is now in communication with the outdoor reset control, allowing it to fine-tune supply water temperatures based on actual interior heat gains or losses. The end result? An integrated HVAC system providing unmatched occupant comfort. Remarkably, Indoor Feedback is just one of the House Control’s many features.

## DHW Unoccupied (Requires Timer 033 or User Switch 479)

To take advantage of even more energy savings, use the DHW Unoccupied feature. In order to use this feature the tekmarNet® system requires the use of a tN4 Timer 033 set with Schedule #1, or a 479 User Switch. These devices are required in order to put the system into an unoccupied event.

The control has a DHW Unoccupied setting. When set to ON, the control will continue to respond to DHW calls during UnOccupied and Sleep periods of a setback schedule. If set to OFF, the control will ignore any DHW Calls during UnOccupied and Sleep periods which will help to prevent unnecessary cycling of the heating equipment. However, in order to ensure that hot water is available before the occupied event (i.e. people waking up in the morning), DHW is turned back on 1 hour prior to the occupied or wake time period.

## Warm Weather Shut Down (WWSD)

During warmer weather, heating of the rooms is typically no longer required. To prevent energy waste from unnecessary boiler operation, the control goes into Warm Weather Shut Down (WWSD) when the outdoor temperature rises above the WWSD temperature set in the Adjust menu.

### Further Savings!

Use a Timer 033 with programmable schedule #1 to gain the WWSD UnOcc setting. This provides an additional WWSD temperature that can be set even lower for UnOcc and Sleep events.

- This setting will appear after WWSD in the Adjust menu if a Timer 033 or User Switch is present on the system.

## Zone Synchronization

Another feature of the House Control is Zone Synchronization. In typical zoned systems, the thermostats operate on a stand-alone basis. This means that a zone turns on and off as required without any regard for other zones. The net effect is random operation of the zones causing short cycling of the heat source. tekmarNet thermostats communicate to ensure that their cycles are synchronized. Energy is saved by ensuring zones requiring heat operate on the same cycle, therefore reducing short cycling of the boiler.


## Boiler Auto Differential

When the building load is small, the control increases the boiler differential, allowing for longer boiler on and off times. When the load is large, the boiler differential is reduced, minimizing temperature swings. Auto differential increases energy savings by reducing inefficient cycling of the boiler.

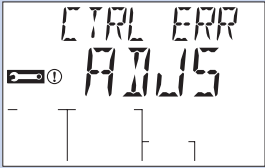
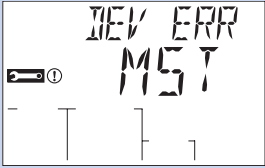
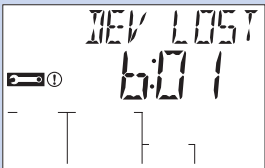
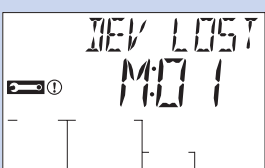
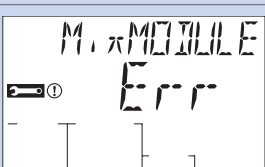
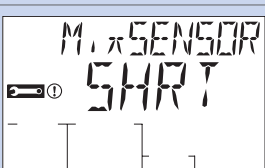
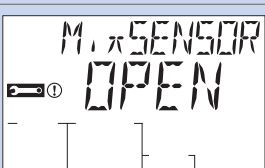


# Troubleshooting Guide

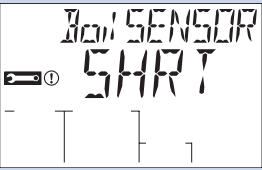
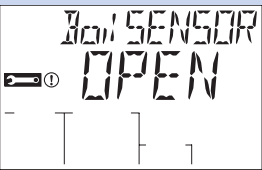
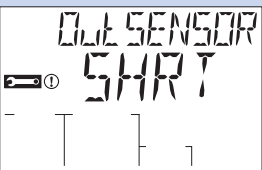
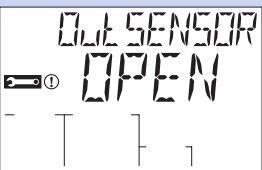
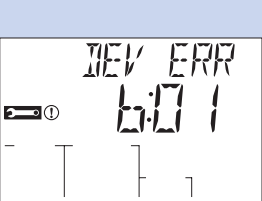
We expect your tekmarNet® System to operate trouble-free. If an error should occur, simply follow these steps:

- Find:** If the House Control or tekmarNet® Thermostat flashes  on the screen, it is indicating a problem on the system.
- Identify:** Use the Menu button to locate the Toolbox Menu. The Error code should appear as the first item.
- Solve:** Using the lookup chart below, match the Error code to the one on the control. Use the Description in the chart to solve the problem.

## Error Messages

Error Message	Description
	<p><b>ADJUST ERROR</b></p> <p>The control failed to read the Adjust menu settings, and reloaded the factory default settings. Operation stops until you check the Adjust menu settings.</p> <p><b>Note:</b> To clear the error, the access level must be set to Installer and each setting in the Adjust menu must be checked.</p>
	<p><b>MASTER DEVICE ERROR</b></p> <p>More than one master has been detected on the system. The House Control 402 is a “Master Device” and no other tekmarNet® reset controls can be added to the system. If one has been added, remove it from the system.</p>
	<p><b>BOILER DEVICE LOST (b:01 TO b:24)</b></p> <p>Communication is lost to a Boiler device (usually a thermostat) at address b:##. The LCD on the lost device displays Err. Ensure that there is power to the lost device. Trace the wires from the control to the lost device looking for loose or damaged wires.</p> <p><b>Note:</b> If you deliberately remove a tekmarNet® device, hold the Up and Down buttons to clear this error.</p>
	<p><b>MIX DEVICE LOST (M:01 TO M:24)</b></p> <p>Communication is lost to a Mix temperature tekmarNet® device (usually a thermostat) at address M:##. The LCD on the lost device displays Err. Ensure that there is power to the lost device. Trace the wires from the control to the lost device looking for loose or damaged wires.</p> <p><b>Note:</b> If you deliberately remove a tekmarNet® device, hold the Up and Down buttons to clear this error.</p>
	<p><b>MIX MODULE ERROR</b></p> <p>A Mixing Module has been connected to the Mix Exp. tN4 terminals. The 402 controls mixing devices through outputs on the control and cannot operate tekmarNet® mixing expansion modules. Remove the device and connect the mixing actuator or pump directly to the appropriate output terminals on the 402.</p>
	<p><b>MIX SENSOR SHORT CIRCUIT</b></p> <p>Due to a short circuit, the control failed to read the Mix supply sensor. As a result, the control operates the mixing device at a fixed output as long as there is a call for heat. Locate and repair the problem as described in the Data Brochure D 070.</p>
	<p><b>MIX SENSOR OPEN CIRCUIT</b></p> <p>Due to an open circuit (disconnected or broken wire), the control failed to read the Mix supply sensor. The control operates the mixing device 1 at a fixed output as long as there is a call for heat. Locate and repair the problem as described in the Data Brochure D 070.</p>



Error Message	Description
	<p><b>BOILER SENSOR SHORT CIRCUIT</b></p> <p>Due to a short circuit, the control failed to read the boiler sensor. When there is a call for heat, the control no longer controls the boiler(s). Instead, the control provides a boiler enable and the boiler operates on its aquastat/limit until the sensor is repaired. The control will not operate the boiler contact if the Boil Minimum setting is set to Off. Locate and repair the problem as described in the Data Brochure D 070.</p>
	<p><b>BOILER SENSOR OPEN CIRCUIT</b></p> <p>Due to an open circuit, the control failed to read the boiler sensor. The control no longer controls the boiler. Instead, the control provides a boiler enable and the boiler operates on its aquastat/limit until the sensor is repaired. The control will not operate the boiler contact if the Boil Minimum setting is set to Off. Locate and repair the problem as described in the Data Brochure D 070.</p>
	<p><b>OUTDOOR SENSOR SHORT CIRCUIT</b></p> <p>Due to a short circuit, the control failed to read the outdoor sensor. As a result, the control assumes an outdoor temperature of 32°F (0°C) and continues operation. Locate and repair the problem as described in the Data Brochure D 070.</p>
	<p><b>OUTDOOR SENSOR OPEN CIRCUIT</b></p> <p>Due to an open circuit (disconnected or broken wire), the control failed to read the outdoor sensor. As a result, the control assumes an outdoor temperature of 32°F (0.0°C) and continues operation. Locate and repair the problem as described in the Data Brochure D 070.</p>
	<p><b>DEVICE ERROR AT ADDRESS #:#</b></p> <p>#:# is the address of the device with the error. The letter before the colon indicates whether the device is on the Boil Exp. network (b) or the Mix Exp. Network (M), and the device number displays after. Go to the device with the address displayed.</p> <p><u>Possible Addresses:</u></p> <p><b>b:01 to b:24</b> - Device Error on Boil Exp. Network</p> <p><b>M:01 to M:24</b> - Device Error on Mix Exp. Network</p>

## tekmar Toolbox tips

### “Device Error at Address #:#”

Another advantage to a tekmarNet® System is the ability to quickly locate and isolate any errors that may occur. If a problem occurs with any tekmarNet® device on the system, the House Control 402 will identify the device with a special address. For tN2 Thermostats, this address can be found by pushing and holding the “up” and “down” buttons on the thermostat, then letting go when “Address” is displayed on the LCD screen. See the appropriate D527 for further details.

### Removing Devices

If a tekmarNet® Thermostat is ‘lost’ or disconnected from the system, the House Control will be alerted. Press and hold “up” and “down” keys while viewing the error message to clear the error if the device was deliberately removed.

### Control is ‘slow’ to Respond

The House Control 402 has advanced logic that manages cycle lengths to reduce equipment wear and increase system performance. When changing temperatures at the tekmarNet® Thermostats, you may notice the control does not immediately react. This indicates the control is in a cycle and must wait until the cycle is over to recalculate the most efficient response.

To force a cycle to restart, navigate to the Outdoor Temperature in the View menu. Press and hold the up and down key for 2 seconds to force a cycle restart. The Max Heat feature may also be useful in cases where heat is required immediately. This includes during system commissioning to remove air from the system.

### Testing the Modulating Output

It is sometimes desirable to test the Mod (dc) output voltage of the House Control to calibrate the modulating boiler.

Before testing the Mod (dc) output with an electrical meter, always ensure that no other wires are connected to the terminals. Failure to do so could result in inaccurate readings.

# Technical Data

<b>House Control 402</b>	
Packaged weight	1.37 lbs (0.62 kgs)
Enclosure	O-Enclosure, blue PC+ABS UL94-5VA plastic
Dimensions	5.5" H x 5.5" W x 2.25" D (140 x 140 x 57 mm)
Approvals	CSA C US, meets ICES & FCC regulations for EMI / RFI
Ambient conditions	Indoor use only, 32 to 104 °F (0 to 40 °C).
	RH ≤ 90% Non-condensing
Power Supply	24 V (ac) ±10% 60 Hz, 100 VA max, Class 2
Control Load	2 VA
Zone Valve/Floating Action Load	24 V (ac) 2 A, maximum combined current (zones 1 to 4): 89 VA (3.7 A)
Boiler Relay	24 V (ac) 5 A
Boiler System Pump Relay	115 V (ac) 5 A, 1/6 HP
Mix System Pump Relay	115 V (ac) 5 A, 1/6 HP
DHW Pump Relay	115 V (ac) 5 A, 1/6 HP
Variable Speed Pump Relay	115 V (ac) 5 A, 2.0 A
Pump Power	115 V (ac) 12 A max
Setpoint and DHW Calls	short, 0 - 32 V (ac)
Boil/Mix Modulating Output	0 - 10 V (dc), 3 kΩ minimum load impedance
Sensors	NTC thermistor, 10k Ω @ 77°F (25°C ± 0.2°C) β=3892
-Included	Outdoor Sensor 070 and 2 of Universal Sensors 082

The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. Conversely, this Class B digital apparatus complies with Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Regulations. However, if this control does cause harmful interference to radio or television reception, which is determined by turning the control off and on, the user is encouraged to try to correct the interference by re-orientating or relocating the receiving antenna, relocating the receiver with respect to this control, and/or connecting the control to a different circuit from that to which the receiver is connected.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.