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QUANTUM NXT
DI WATER HEATER

Operation / Maintenance Manual

SERIAL NUMBER:

PATENTS: U.S. 5971402, U.S. 6433319, U.S. 6479094B2, U.S. 6544583B2, U.S. 6580061B2, U.S. 6663914, U.S 6674053B2;
ADDITIONAL PATENTS PENDING

10/16 – QUANTUMNXT

CONTENTS

1 INTRODUCTION

QUANTUMNXT DI WATER HEATER

TREBOR's QuantumNXT deionized water heater will meet the most stringent application requirements for process cleanliness and temperature control. Trebor's unique heater design virtually eliminates the potential for metal contamination due to potentially exposed metal heating elements in immersion style heaters, while process control and reliability are designed to outperform and outlast other available quartz heating systems.

Trebor's DI water heater uses a revolutionary heating technology to provide exceptional process purity and control. Heat is generated using resistive heating elements conducted to the fluid through quartz tubes using convective heat transfer. This conductive/convective heating method allows the heating element to operate at a much cooler temperature than IR heating systems and provides the basis for a highly responsive heating control system.

The QuantumNXT heater modules have smooth surfaces with minimal cracks and crevices, reducing particle traps. Furthermore, no pipe threads or elastomeric O-rings are used in the construction of the fluid path including the modules. With the exception of the exposed tip of the titanium temperature sensor (included in standard options), the DI water is exposed only to semiconductor grade quartz, PTFE, and PFA wetted surfaces.

Trebor's patented heating module technology is constructed to provide excellent process control by minimizing hold-up volume and thermal heat capacitance while maximizing the heat transfer. While heating, the system can ramp to a process temperature in a "no flow" condition. This also reduces the consumption of DI water by minimizing temperature transition time and bypass to drain requirements.

Many product safety features have been incorporated into the QuantumNXT heater. Each system has a liquid level sensor, leak sensor, grounded heater modules, ground fault protection, and redundant control system interlocks. An electro-mechanical contactor disengages power to the heaters when a fault condition occurs.

This equipment is built and complies with semiconductor manufacturing industry requirements of SEMI S2-0715. Please contact Trebor regarding any questions.

This equipment complies with the requirements of the EU guidelines:

Figure 1-1: 2014/35/EU “Low Voltage Directive”
2014/30/EU “European EMC Directive”

Conformity of the equipment with the above guidelines is attested by the CE mark.

This equipment also complies with the requirements of the “Management Methods for Controlling Pollution of Electronics Information Products”, known as “China RoHS”.

Figure 1-2: China RoHS - Electronic information product pollution control symbol

Trebor will use an EFUP (Environmental Friendly Use Period) of 25 years, which is consistent with the industry mean. The EFUP label is located next to the main system nameplate and a declaration table is included below.

Table [表]

Part Name [部件名称]	Table of Hazardous Substances and Elements [产品中有毒有害物质或元素的名称及含量]					
	Lead [铅] (Pb)	Mercury [汞] (Hg)	Cadmium [镉] (Cd)	Hexavalent Chromium [六价铬] (Cr (VI))	Polybrominated biphenyl [多溴联苯] (PBB)	Polybrominated diphenyl ether [多溴二苯醚] (PBDE)
QB2V208P10	X					
QB1V400P15	X					
QB1V480P15	X					
QB1V480P18	X					

O = This substance is present at a concentration below the limit in SJ/T 11363-2006 in **all** of the homogeneous materials for this part, and it has not been intentionally added to any metallic coating. (See SJ/T 11363-2006 for definition of homogeneous materials)
X = This substance is present at a concentration above the limit in SJ/T 11363-2006, in **at least one** of the homogenous materials for this part, or it has been intentionally added to a metallic coating. (See SJ/T 11363-2006 for definition of homogeneous materials)
Notes: concentration limits of 1000 ppm (0.1% by weight) for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyls ether (PBDE), or 100 ppm (0.01% by weight) for cadmium.
Please refer to AeA's website for an English translation of SJ/T 11363-2006 (or the latest revision of this document):
http://www.aeanet.org/governmentaffairs/gajl_MCV_SJT11363_2006ENG.asp

2 SAFETY

This section describes information that is important for safe equipment operation. Included is a listing of message conventions used in this manual, as well as equipment safety interlocks, push buttons, and labels.

The equipment described in this manual uses hazardous voltage electricity that can be dangerous. Only personnel trained in the procedures and safety messages outlined in this manual should install (if applicable), operate, or maintain this equipment. Read and understand this manual before installation or operation of the system. Follow all recommended practices and procedures that apply to your actions and conduct. All safeguard devices must be in place when equipment is in operation. Operators, technicians, helpers or installation personnel should not alter, remove or disable safety equipment. When using this equipment, be sure to follow the safety procedures outlined by your facility. These safety procedures should cover the two primary types of hazard training: (1) equipment hazards and (2) facility-related hazards.

2.1 SAFETY MESSAGE CONVENTIONS

Safety messages contained in this manual; **Dangers, Warnings, and Cautions,** are highlighted for quick identification.

2.1.a Danger

A Danger message indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Messages identified by the word **Danger** are used sparingly and only for those situations presenting the most serious hazards.

2.1.b Warning

A Warning message indicates a potentially hazardous situation that, if not avoided, could result in serious injury. Following is a typical example of **Warning** symbols as they could appear:

Explosion

Electrical Shock/Electrocution

2.1.c Caution

A Caution message indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices. Following is a typical example of a **Caution** message as it could appear:

2.1.d Mandatory Action

A Mandatory Action symbol indicates that action should be taken to avoid a hazard. Following is a typical example of a **Mandatory Action** symbol as it could appear:

2.2 EQUIPMENT SAFETY

The rest of this section describes equipment safety features:

Emergency Off Push button (EMO)

Process Interlocks

Main Power Disconnect Switch

Lockout/Tagout Information

Equipment Safety Labels

2.3 EMERGENCY OFF (EMO)

The EMERGENCY OFF button (EMO) is located on the front of the door. When the EMO circuit is activated by pushing the button in, the equipment will be placed into a safe shutdown condition. The EMO will de-energize the heaters and process interlock devices. Other devices on the panel remain energized and hazardous voltages will be present on the power supply and power supply fuses, sub panel circuit breakers and contactors. Use the Main Power Disconnect Switch to remove power from the panel.

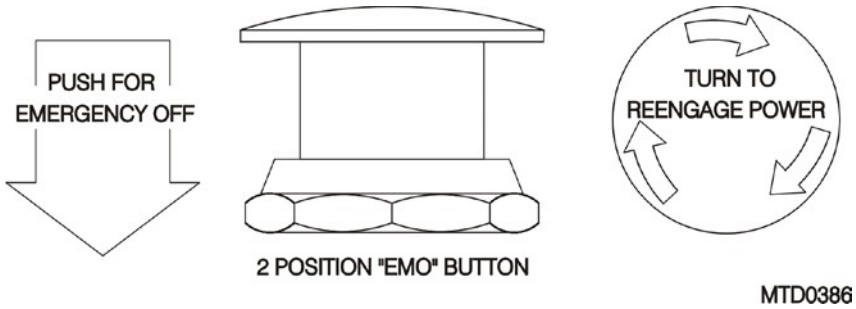

Figure 2-1

On power up or after the EMO has been pushed, the heater must be reset by pressing the blue RESET button to reactivate the controls. This must be done at the machine.

Some options include a remote EMO option. This option allows the user to wire an external EMO switch to the DI heaters internal EMO circuit. Consult the factory for more information.

2.4 PROCESS INTERLOCKS

The process fault interlocks are latched into the logic controller (PLC) memory. When a fault occurs, the user interface will display the alarm condition and the horn will sound. Pressing the RESET button will silence the audible horn. The system will retain the fault until it is cleared. Pressing the RESET button may restart the heater. If the indicator LED's remain illuminated then one or more faults are still active. Refer to Section 8, Troubleshooting.

CAUTION: The interlock circuit does not remove hazardous voltage from the circuit breakers, contactor, and the control transformer. Only authorized, qualified, trained personnel should service this equipment.

2.4.a Low Pressure Switch Interlock

The pressure switch will disengage power if system inlet water pressure drops below 15 psig (103 kPa). The heater will come back online if the pressure recovers within a 10 second time period. This prevents nuisance trips due to transient conditions in the DI water supply while still protecting the heater. However, erratic process temperature control may result if heater power is disengaged during the pressure transient.

2.4.b Liquid Level Sensor Interlock

The Liquid Level Sensors will disengage power to the system if the heater modules are not full of water or if boiling in the heating module occurs. The heater will reengage if fluid is present within a 10 second time period. This prevents nuisance trips due to transient conditions in the DI water supply while still protecting the heater during startup. It is critical that these sensors operate properly. Do not tamper with the sensors. Damage to the system can result if the sensors are altered or overridden.

2.4.c Element Over-Temperature Protection

The temperature limit controller monitors a thermocouple attached to each heater element. In the event that the element temperature exceeds the normal operating temperature, the system will immediately disengage power and alarm. If this occurs, check element continuity before continuing normal operation. See Section 7.1.

2.4.d Leak Sensor

The Leak Sensor will disable heater power immediately when water is detected in the leak tray. Fix any leaks and dry the leak sensor and leak tray prior to turning power on to the system.

2.4.e Over-pressure Relief

The over-pressure relief valve (“Relief Drain”) is self-resetting and connected in-line with the cold DI inlet port to provide a mechanical safeguard against possible over-pressure damage. Do not operate the heater above 414 kPa (60 psig).

If the over-pressure relief device opens, pressure will relieve out the over pressure drain and the low-pressure sensor may alarm.

2.4.f Low/Stop Flow

Low/Stop Flow is a function that can be turned on by checking the Low/Stop Flow box on the configuration page. This function, when turned on, will prevent power to the heater elements if the flow meter senses flow under the set value of the flow switch. See Section 3.5.e for more details.

2.4.g Continuous High

When the heater is operated continuously above the recommended 85% for longer than 30 minutes, the heater will show a warning on the home screen as well as show a continuous alarm on the alarm page. This alerts the user that either the system is overworked or element failures have caused the heater output to increase above the recommended limit. Pressing the reset button will silence the audible beep, but the alarm will repeat if the heater continues to output above 85%.

2.5 LOCKOUT / TAGOUT

Before installation or servicing the DI water heater, the facility's power source, air source and water source to the heater must be de-energized to prevent serious injury to personnel and equipment. An authorized employee representing the facility installing the DI water heater must follow approved company guidelines and lockout or use suitable means to prevent re-energizing the electrical system, air system, and water system during installation or servicing.

It is the responsibility of the End-User to provide and affix lockout/tagout devices for the electrical, clean dry air and water by following established facility lockout/tagout procedures.

2.5.a Definitions

Lockout: the placement of a lockout device on an energy isolating device, in accordance with established company procedures, ensures that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Tagout: a prominent warning device such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with established company procedure, ensures that the energy isolated device and the equipment being controlled may not be re-energized or operated until the tagout device is removed.

This table lists the Lockout/Tagout information for the system.

Energy Type	**Electrical**
Hazard:	Electrocution, electrical burns, and shock
Magnitude:	480 VAC or 400 VAC or 208 VAC See system label for exact voltage.
Control Method:	Main Power
Shutdown Procedure	
Switch off circuit breaker disconnect on front of system.	
Energy Type	**Compressed Air**
Hazard:	Personal injury
Magnitude:	400-550kPa (45-80PSIG)
Control Method:	Solenoid Valve
Shutdown Procedure	
Switch off circuit breaker disconnect on front of system or turn off incoming air supply from facility	

Energy Type	Pressurized Water
Hazard:	Flooding leading to possible other hazards
Magnitude:	103-414kPa (15-60PSIG)
Control Method:	Fluid Valve
Shutdown Procedure	
Switch off circuit breaker disconnect on front of system or turn off incoming air supply from facility	

2.5.b Machine Shutdown with door closed

Perform the following sequence of events in the order listed for electrical energy isolation of the tool:

1. Notify personnel in the area that you are going to shut down the equipment.
2. Shutdown the system in an orderly fashion.
3. Locate the main circuit breaker disconnect switch.
4. Move the actuating handle to the "OFF" position.
5. Apply the locking energy isolation device (lock) through the hole in the actuating handle and secure the lock.
6. Verify that the tool has been isolated and de-energized by attempting to turn the main power disconnect back to the “ON” position and/or by pressing the machine start button. The machine power must not be reapplied and/or the machine must not start.

2.5.c Machine Start-Up with door closed

Perform the following sequence of events in the order listed for electrical re-energization of the tool:

1. Ensure that all hand tools are removed from the equipment and that it is ready for start-up.
2. Notify personnel in the area that you are going to start-up the equipment.
3. Open the lock and remove the locking energy isolation device (lock) from the hole in the actuating handle of the main circuit breaker disconnect switch.
4. Move the actuating handle to the "ON" (up) position.
5. Press the machine “Reset” button. The machine should start.

2.6 SEISMIC PROTECTION

It is the user's responsibility to adequately secure and anchor the equipment to comply with local regulatory agency seismic requirements. Mechanical anchors are provided using anchors located on the top of the heater enclosure and on the bottom of the side panels. Optional seismic brackets can be attached to the bottom of the side panels of the cabinet enclosure. See Facility Layout in Appendix for anchor locations and additional information.

2.7 CAUTION USING N_2

If using N_2 in place of CDA, proper precautions must be taken according to company policy.

3 INSTALLATION

3.1 UNPACKING

Remove heater system from crate and inspect heater cabinet for any signs of damage (dented panels, paint scratches, etc.). Shock indicators on the heater cabinet should be checked for rough handling during shipment. Any damage to the system should be reported to the carrier immediately.

CAUTION: Heavy Object. When lifting or moving the system, follow safe heavy object handling methods to prevent injury.

Be careful to not damage the drain fitting located under the heater cabinet when using a dolly or forklift.

3.2 LOCATION

Locate the heater near the point-of-use to reduce plumbing heat loss. Access to the front and rear of the system will be necessary for maintenance and hook-up.

3.3 HOOK-UP

3.3.a Facilities

All utility hook-ups associated with the DI water heater are easily accessible and are referenced in the Appendix.

After positioning heater at operating location, adjust the four leveling feet until the heater is level and stable.

DI Supply:

Connect the DI supply line to the “Cold DI Inlet” connection.

DI Outlet:

Connect the hot DI process lines to the “Hot DI Outlet” connection. Use only hot DI compatible plumbing components which must be rated at a minimum of 110°C (230°F) and 414kPa (60 psig).

NOTE: The DI hot water line should have a bleed, or purge, at the point-of-use to reduce the possibility of the DI water becoming stagnated in the heaters when not in use. The amount of this bleed is best evaluated on a case-by-case basis, taking into account each user’s criteria and production standards.

Recommendation: Either insulate the hot DI water process line or place a Hot Surface hazard warning (example shown below) on the tubing every 20 feet. Conform to local codes while evaluating hot water line routing.

Drain

Connect the "Over-Pressure Relief Drain" to an open drain line with no more than 30' of ¾" tubing. Do not connect restrictive fittings or valves in line with the drain. If an over-pressure condition occurs in the heater, a valve will relieve pressure in the heater.

Attach drain line to bottom of the cabinet. If a cabinet drain line is not installed, any leak inside the cabinet will leak out of the drain fitting.

CAUTION: Depending on installation and routing of water supply lines, a trip hazard may be created. It is the responsibility of the facility installation personnel to eliminate or minimize any and all trip hazards or identify such hazards with visual warning signs.

Electrical

1. **Lockout** and **Tagout** facility heater power disconnect switch or equivalent before installing system.
2. Open the front door by rotating the electrical disconnect handle to the OFF position and open the three cam latches on the right side of the door. This will allow access to the electrical connections.
3. Route the wires from the electrical source (480 VAC, 400 VAC, or 208 VAC 3-phase) into and through the conduit opening on the top of the enclosure. To secure an electrical conduit fitting, remove lifting eyebolts located on top of the system. The conduit nut may then be secured. Reassemble the top panel to the enclosure.
4. Connect the supply grounding wire to the grounding lug

5. Remove the Line side (Top) cover and secure the other three lines into the top of the circuit breaker connections (L1, L2, and L3) as shown in Figure 3-1 (see Table 7-1 for torque values).
6. Replace Line side terminal cover

Figure 3-1: Main Circuit Breaker

7. Close the door and secure.
8. Check ground continuity on cabinet to any facility ground.
9. Remove Facility power Lockout/Tagout.
10. Restore Facility power supply to the heater.
11. Follow heater Pre-Start Inspection (see Section 5.1).

NOTE: Before starting the system, it is important to become familiar with Section 4, Operation. Only trained, qualified, authorized, personnel should operate this system.

3.3.b Ethernet Communication

For remote monitoring and control of the heater, plug an Ethernet cable into the RJ45 connector on the rear connection panel of the system. See appendix.

3.4 GENERAL

After completion of Section 3.3, refer to the touch screen for heater operation. Once DI water is flowing through the system and power is turned on, a process temperature can be selected and power switched on to the heater modules. The controls will do the rest.

If there is a problem with the DI water heater, the system controller will notify the operator that the heater requires attention. After the fault condition is corrected, the heater can be reset using the RESET button located on the heater door (the fault condition will also be cleared if the entire system power is cycled off and on). Redundant hardware relay interlocks back up heater element temperature, leak sensor, and component temperature faults.

3.5 TOUCH SCREEN

A touch screen provides an intuitive interface to the DI water heater. The heater can also be operated using both hardware and software remote interfaces (depending on the heater options). The display is divided into several pages.

3.5.a Home Page

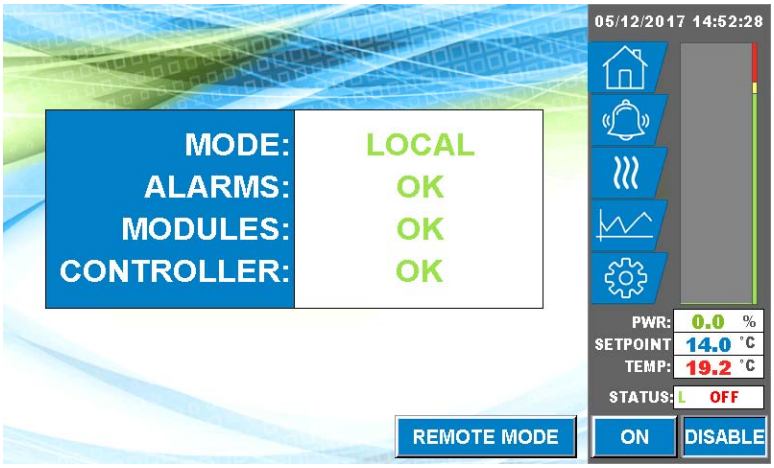

Figure 3-2: Home Page

The Home Page with the Status and Navigation Bar is displayed after the heater is powered on. The Status and Navigation Bar is visible on all pages on the right. The Home Page shows the current status of the heater at a glance showing the operation mode, alarm status, module status, and the controller status. The heater power, set point, process value temperature, and overall status of the heater are displayed in the bottom right in the Navigation Bar. A bar meter in the Navigation Bar provides a visual indication of total power being used.

Also located on the Navigation Bar are buttons to turn the heater on and off and to enable and disable the heater. When enabled, the inlet valve opens and allows the on button to function. After enabling the heater and when in local control mode, the on/off button can be used to turn the heater on or off.

The set point can be changed by touching the set point value, shown in blue on Figure 3-1, and entering the new value. Once “enter” is pressed the new set point takes immediate effect.

The mode of the heater can be toggled from local mode to remote mode by pressing the “Local Mode” or “Remote Mode” button on the Home Page (See Figure 3-1). The button text changes depending on the current mode of the heater and the current mode is reflected in the Mode section of the Home Page as well as an “L” or “R” in the status box of the Navigation Bar.

Local mode allows the heater to be turned on and off from the touch screen and disables turning the heater on and off remotely. Remote mode allows the heater to be turned on and off remotely using a software or hardware remote interface to the heater (depending on the heater options) and disables turning the heater on and off from the touch screen.

3.5.b Alarm Status Page

Figure 3-3: Alarm Status Page

The alarm page shows the alarm history, event history, and current state of the alarm sensors.

When the heater system enters an alarm state the heater is turned off and a horn sounds. This horn can be turned off by pressing the reset button on the front door. If the original cause of the alarm has not been cleared by the time the heater is turned back on, the system will return to the alarm state. Refer to the “Non-Fatal Alarms” section 4.5 for details about non-fatal alarms.

Alarm Name	Function
Pressure Alarm	Insufficient inlet water supply pressure
Liquid Level Alarm	Insufficient fluid level
Liquid Leak Alarm	Fluid Leak Detected – water in base area or fluid on back side of burst device (for optionally installed burst device rupture sensor)
Over Temperature Alarm	One or more elements in a heater module have exceeded the protective temperature limit or the process value has exceed 110°C

3.5.c Module Status Page

Figure 3-4: Module Status Page

The module status page shows the temperatures of each bank of heater modules. Each individual heater element’s status is indicated by the green boxes. If a box turns red, that element is likely failed. See Section 7.1.a for more details.

3.5.d Historical Plot Page

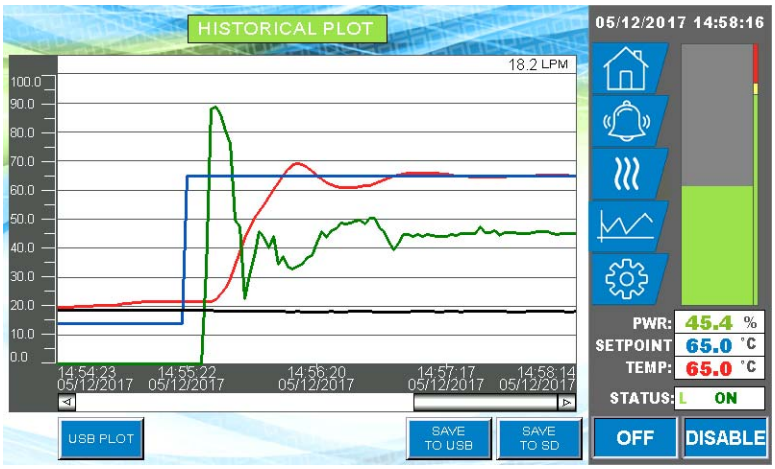

Figure 3-5a: Historical Plot Page

The Historical Plot Page shows a plot of the flow rate (LPM), set point (°C), process fluid temperature (°C), and Duty Cycle (%). The plot color corresponds with the value color of in the Navigation Bar.

Flow Rate (LPM):	Black
Set Point (°C):	Blue
Fluid Temperature (°C):	Red
Duty Cycle (%):	Green

The plot sample rate can be changed on the Configuration Page.

The plot log is saved to internal memory and can be exported to an SD card or USB drive by pressing the “Save to USB” or “Save to SD” buttons.

Immediate data can be saved to a USB drive inserted into the front door below the screen by pressing the “Record to USB” button. Once data is plotted, the save button saves the plot data to the USB and starts a new plot. Once plotting and saving is completed, touch the Remove USB button to safely remove the USB storage. See Figure 3-5b

When USB logging is complete, touch the “Live Data” button at the top to return to normal navigation. Logging will continue when navigating to other pages when the USB is inserted.

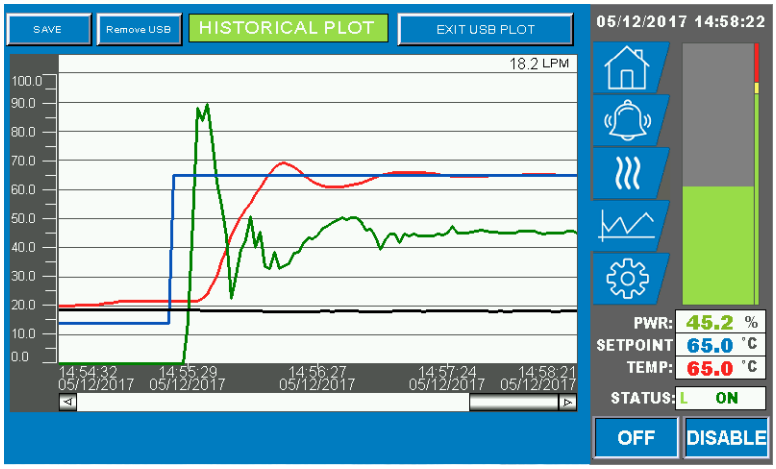

Figure 3-5b: USB Historical Plot Page

3.5.e Configuration Page

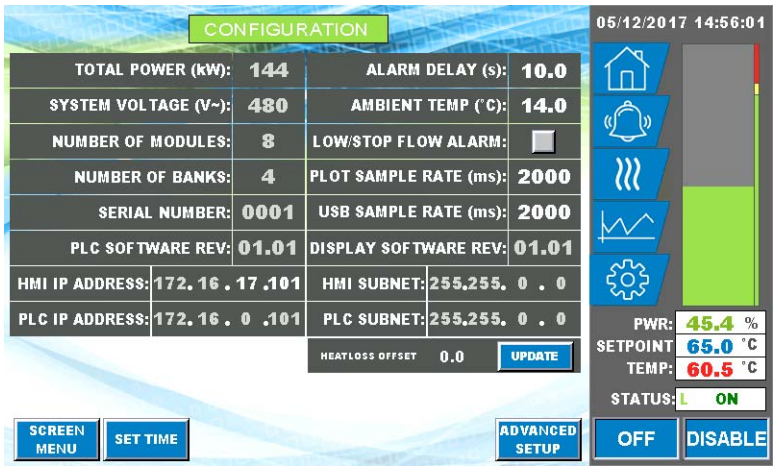

Figure 3-6: Configuration Page

The configuration page shows a summary of system information, and allows changes to some of the heater settings as described throughout this section. The values that are white can be edited. Values that are grey cannot. If grey values must be changed contact Trebor.

Alarm Delay Setting

Press the delay value to set the pressure and liquid level alarm delay. Enter the desired alarm delay in seconds and press enter. The default value is 10 seconds.

Ambient Temperature Setting

Setting the ambient temperature allows the heater to more accurately apply the correct amount of power, maximizing precision. Touch the value to change the ambient temperature. The default value is 14°C.

Low/Stop Flow Alarm

If it is desired to have the heater power disengaged when low flow or stopped flow is detected, check the box. The value for low flow is preset at 3.5LPM and can be changed on the flow meter located in the lower portion of the cabinet. To change this value, simply press the up or down arrows. More information on the flow meter functions can be obtained by contacting Trebor.

IP Address Settings

See Section 3.6 Remote Operation over a network.

Time/Date

- Press the “Set Time” to set the system time and date.

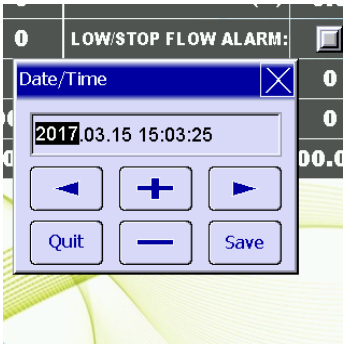

Figure 3-6b: Changing System Date and Time

3.5.f Advanced Setup

The QuantumNXT heater has advanced setup settings that are password protected. Changing these settings can significantly affect the performance of the heater. Changing these settings without training is not recommended. Contact Trebor Technical Support for assistance on advanced setup.

3.6 TOUCH SCREEN

3.6.a Ethernet Interface

The heater can be operated over an Ethernet network using either Modbus TCP or a proprietary software interface. A remote connection over Ethernet can turn the heater on and off, change the set point, and check the operation and the alarm status. Contact the factory for further information regarding an example of an Ethernet software interface. The IP address of the heater can be configured from the “Configuration” page on the heater touch screen (see Section 3.5.e).

ATTENTION: If unfamiliar with IP addressing, do not attempt to change IP settings of the heater.

The heater ships with an IP address already assigned to the HMI and PLC. For Modbus TCP communication, the HMI address will be used. The default address will be 172.16.17.1xx. The xx are the last two digits of the heater serial number found on the nameplate of the heater. The PLC address is 172.16.0.1xx, where xx are the same last two digits of the heater serial number.

The HMI IP address must have the same first two numbers (172.16.x.x) as the PLC.

To view the current IP address and subnet mask of the PLC and HMI, go to the configuration page of the touch screen.

The last two numbers of the HMI IP address can be changed freely as long as it is not the same as the PLC IP address. Contact Trebor for instruction on changing the first two numbers.

To change the last two numbers of the HMI IP address touch the value on the configuration screen and enter a number between1-255.

Please note that communication may be lost and the new IP address will not be active until the screen power has been cycled by pressing and holding the reset button for 7-10 seconds.

3.6.b Modbus Communication

QuantumNXT heaters can communicate on both Modbus/TCP and Modbus/RTU networks. Modbus/TCP communication is included in all QuantumNXT heaters; Modbus/RTU communication is an option on all QuantumNXT heaters. Using Modbus communication, QuantumNXT heaters can be turned on and off remotely, the set point can be changed, and the operation status and alarms status can be monitored.

Table 1 below contains the name, address, type, data type, size, and read/write permission for each register.

Note that the interface to the QuantumNXT heater is composed of Modbus registers only. The function 03 (read holding registers) and function 06 (write single register) are the only Modbus functions that will be needed.

To turn the heater on remotely, the value 1 must be written to the “Remote On/Off” register. The heater must be in remote mode (see Section 3.5.a) to enable remote on/off of the heater. To turn the heater off remotely, the value 0 must be written to the “Remote On/Off” register.

All of the Boolean data type registers are false when they contain the value 0 and true when they contain a 1. When writing to Boolean registers, false is represented by the value 0 and true is represented by the value 1.

The 'short' data type registers are in 10ths of units. For example, when the set point is intended to be 25.0°C, the value would read 250.

For more information regarding Modbus communication please visit www.modbus.org.

Name	HMI/PLC ADDRESS	MODBUS ADDRESS	Type	Data	Bytes	Perm
Set Point	$M100/D590	W42101	Reg	Short	2	R/W
Remote On/Off	$M101/D611	W42102	Reg	Bool	2	R/W
Process Temperature	$M102/D602	W42103	Reg	Short	2	R
Duty Cycle	$M103/D8001	W42104	Reg	Short	2	R
Mode	$M104/D610	W42105	Reg	Bool	2	R
Alarm Status	$M105/D11	W42106	Reg	Bool	2	R
Alarm Pressure	$M106/D12	W42107	Reg	Bool	2	R
Alarm Liquid Leak	$M107/D13	W42108	Reg	Bool	2	R
Alarm Liquid Level	$M108/D14	W42109	Reg	Bool	2	R
Alarm Flow	$M109/D15	W42110	Reg	Bool	2	R
Alarm Over Temp.	$M110/D16	W42111	Reg	Bool	2	R

Table 3-1: Modbus Mapping

4 START-UP

4.1 PRE-START INSPECTION

This Trebor DI Water Heater has been thoroughly tested and inspected for proper performance and operation prior to leaving the factory. Additional pre-start inspection can identify any damage or condition change that may have occurred during shipment of the heater and reduce nuisance problems during start-up.

4.1.a Verify Shipping Condition

Refer to Section 3.1, Unpacking.

4.1.b Hazardous Power Terminals

Refer to PM Schedule, Section 7.2. Tighten hazardous power connections at the main circuit breaker, distribution circuit breakers, distribution contactors and SSRs. Slightly loose connections at these hazardous power terminals can cause arcing. This arcing can introduce higher than normal operating temperatures, resulting in damage of electrical components. Tighten terminal in a clockwise direction only. Do not loosen terminals before tightening as this may affect the contact area.

4.1.c Electrical Inspection

Refer to system schematic. Visually inspect all electrical components for anything that seems unusual, such as damaged wire insulation, disconnected wires, etc.

4.1.d Plumbing Leak Check

Refer to PM Schedule, Section 7.2. Inspect heater for leaks during start-up. Remove the rear panel and visually watch the leak tray as the system is initially filled with water. Visually inspect heater module fittings and heater system plumbing for leaks.

If leaks are found at the flare fittings, hand-tighten fittings while they are at ambient temperature. Do not use a wrench to tighten flare fittings, as excessive tightening can cause damage to the fittings.

If any problems are encountered during start-up of this heater, contact Trebor for technical support.

4.1.e System Free of Air

On initial startup or after the heater has been drained air can get trapped in high spots in the plumbing system. Air will usually be found in the outlet manifold on the top of the heater modules. This can sometimes cause nuisance liquid level alarms.

In some cases, most or all air bubbles can be purged from the system simply by increasing and decreasing the water flow a few times. The increase in flow will push out most air bubbles. If flow alone will not remove all the trapped air, simply tap on the area where the air bubbles accumulate while flow is on. This will break up the air bubbles and allow them to flow out of the heater.

4.2 SYSTEM ON

Activate the power to the system by rotating the “Main Breaker” handle to ON. If the display on the control panel does not illuminate, ensure that the EMERGENCY OFF button is in the operate position. Press the reset button to engage control power.

4.3 HEATER MODULE POWER

In order to energize, the heater must be enabled and free of alarms.

4.4 PROCESS ALARMS

If a fault occurs, the main contactor will disengage, the associated alarm will show on the Alarm Status Page, and an audible alarm will sound. Pressing the RESET button will silence the audible alarm. If the RESET button is pushed and there are no active faults, the heater will be in standby and ready to turn on.

4.5 NON-FATAL ALARMS

The QuantumNXT has several non-fatal alarms that do not cause an audio alarm or turn off the heater but does effect the operation of the heater.

Pressure and Liquid level alarms delay for 10 seconds (editable on configuration page) before the alarm is activated. While delaying, the contactors will be disengaged removing power from the heating elements.

There is a “Soft Temperature Limit” that is associated with the maximum Process Value (PV) temperature (110°C). If the PV temperature becomes greater than 105ºC, the power is reduced without alarming. This will continue until the PV temperature goes below 105ºC at which time power is restored to normal operation. No audio alarms will sound when this happens. If the temperature continues to rise above 110°C an alarm will sound (See section 3.5.b).

A warning will be displayed accompanied by a 1 second beep every 10 seconds when either the liquid level or pressure alarm is activated but not yet reached the alarm delay or when the continuous high alarm is active. Pressing the reset button will silence the alarm, however, if the fault is not corrected, the alarm will return after the set time delay.

5 SHUT DOWN

The DI water heater may be shut down by the following methods:

Select the OFF button on the control screen to put the heater in standby (heater element power will be disengaged).

Rotate “Main Breaker” to off position.

Turn off the facility supply.

Lockout and tag out heater for maintenance, repair or decommissioning.

Refer to Section 2.5.

6 DECOMISSIONING

Drain the system (see section 7.1.c).

Shut down the heater (see section 5).

Reverse section 3.3 “hook-up” to disconnect all lines running to the heater.

Dispose of the heater by following approved company/facility guidelines or regulations.

7 MAINTENANCE

7.1 REPAIR INSTRUCTIONS

Maintenance should only be performed by qualified and trained personnel.

Heater modules have a finite life. Spare heating modules should be on hand in case of a failure to minimize process downtime.

If the control screen indicates a heater element has failed, check the heater Module Status Page for the indication of which module contains the failed element(s). Visually inspect the main and auxiliary circuit breakers. Then check the corresponding element isolation circuit breaker to see if it has tripped.

Check the resistance of the heating elements as follows:

1. Shut off power to the system.
2. Lockout and Tagout power to heater.
3. Switch off the element circuit breakers in the control enclosure.
4. Using an Ohm Meter, check the resistance between two screw terminals on the load side of the module breaker for each of the three phases of the suspect heater.
5. If the measured resistance is greater than 35ohms on one or more phases, replace the suspect heater modules; see Section 7.1.a Heater Replacement.
6. If the measured resistance is less than 35ohms on all three phases, then the heater elements in that module are OK. Refer to the Troubleshooting Section of this manual for other possible causes.

7.1.a Heater Replacement

The heater modules have been designed for quick replacement to minimize downtime and field service requirements. To replace a heater module, follow these procedures:

Turn power off to system (see Section 2.5 for Lockout/Tagout procedures).

Drain system (see Section 7.1.c, Draining the System).

Remove the rear panel of the enclosure to access heater modules.

Disconnect the electrical connector to the failed module.

Remove process thermocouple (or thermocouple plug if bottom module) by unthreading the fitting from module. A wrench may be required to loosen.

Remove the 4 retaining nuts.

Loosen manifold side connection fittings on module to be removed as well as on the closest module adjacent. Also, loosen the “U” connection fittings from the failed module as well as the module adjacent.

Disengage the manifold by gently pulling the fitting from the module.

Disengage the “U” fluid connector by gently removing the ‘U’ shaped connector.

Use an absorbent cloth to remove any liquid from the leak sensor probe and leak containment well.

Install replacement heater module into cabinet in reverse order from above. Note: Carefully align the fittings because they can easily be cross-threaded.

Follow section 4.1.d to check for leaks before startup.

Return failed heater module to Trebor International.

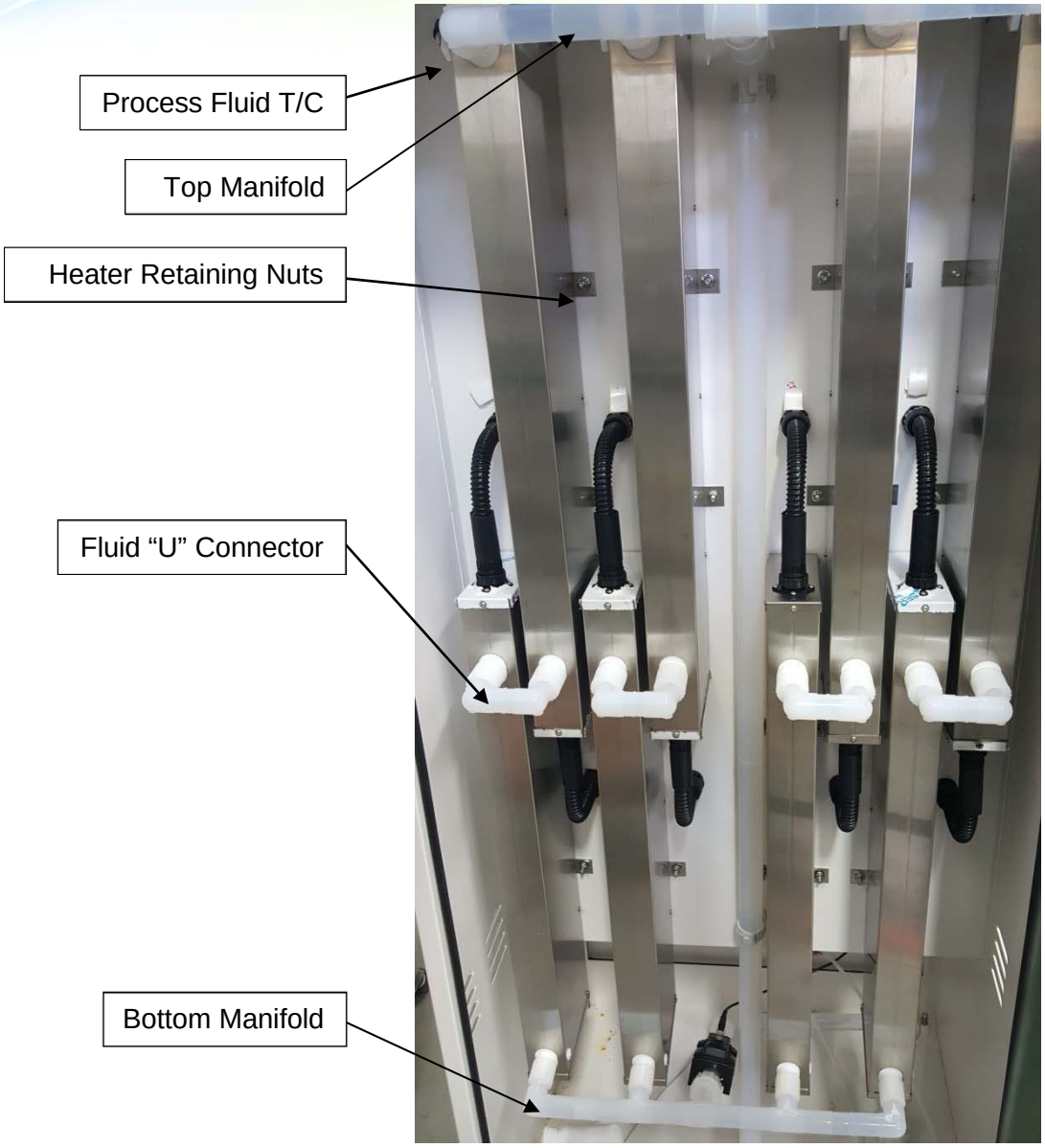

Figure 7-1: Heater Modules

NOTE: Do not disassemble the heater module. There are no user serviceable parts inside the module. If disassembled, any product warranties will be invalid.

7.1.b Liquid Level and Leak Sensor Calibration

Contact factory for calibration instructions.

7.1.c Draining the System

Close heater DI water inlet facility isolation valve.

Connect fluid inlet to an open drain line. (Alternate: If a drain line is connected to the cabinet drain on the bottom of the heater enclosure, the heater may be drained into the leak tray.)

Power system and open DI water inlet isolation valve by enabling the heater.

Loosen a fitting in the upper manifold to release internal vacuum in the line.

The system will drain through the cold DI inlet; a small amount of water will drain through fluid exit port.

Perform required maintenance.

Reconnect fluid inlet and outlet to process lines and refill the system.

Draining the system without power requires manual activation of the inlet isolation valve by pressing the blue button on the control solenoid located under the fans on the left side of the cabinet (see Figure 7-2: Isolation Valve control Solenoid).

Figure 7-2: Isolation Valve Control Solenoid

7.1.d Leaks

When a leak has been detected it is recommended that the supply water be shut off along with the main circuit breaker. Allow sufficient time for the heater and plumbing to cool down before inspection.

NOTE: If water is leaking out of the heater module shroud a replacement module will be required.

7.2 PREVENTIVE MAINTENANCE SCHEDULE

Initial Start	Weekly	6 Months	2 Years	Items	Visually Inspect	Tighten	Remove & Inspect
X	X			Process Control / Heater Element Status	X		
X		X		Plumbing Leaks	X		
X		X		General Electronics (i.e. power supply, TLM, etc…)		X	
X		X		Solid State Relays (SSR's)		X	
X		X		Main Circuit Breaker		X	
X		X		Distribution Breakers & Contactors		X	
X		X		Branch Circuit Breakers		X	
			X	Process Fluid Thermocouples			X

See following tables for details on each item.

Verify torque at least every 6 months with a calibrated torque wrench. Do not over tighten. Consult factory with questions.

Table 7-1: Torque Values

Label	Part Number	Description		Torque Value
MCB1	See Factory	Circuit Breaker, 3P, 480VAC, 60A - 225A (XT1,XT3)		7,9 Nm / 62,80 in-lb
		Connection Terminal Block,6Wire,14-6AWG (XT1,XT3)		7,8 Nm / 53,71 in-lb
CB1-4	98004363	Circuit Breaker, 3P, 480VAC, 60A		7 Nm / 62 in-lb
CONT1-4	98004377	Contactor, 60A, 480V, 3P, 24VDC		4 Nm / 35 in-lb
SSR -8	98004381	SSR, 70A, 4-32VDC, 48-660V	Control Terminal	0.5 Nm / 4.4 in-lb
			Power Terminal	2.4 Nm / 21.2 in-lb
CBM1-4	98004378	Circuit Breaker, 3P, 480VAC, 32A		2.8 Nm / 25.0 in-lb
CB5	98003866	Circuit Breaker, 3P, 480VAC, 3A		2.4 Nm / 21 in-lb
CB6	98003867	Circuit Breaker, 1P, 480VAC, 5A		2.4 Nm / 21 in-lb
24VDC-PS	98004382	Power Supply, 10A, 320-575VAC, 3 Phase	Input Terminal	0.9 Nm / 8.1 in-lb
			Output Terminal	0.6 Nm / 5.4 in-lb
TLM1-2	98004131	16 Channel Temperature Monitor		0.4 Nm / 3.1 in-lb
	98003505	Connection Block, NO, 24VDC		0.8 Nm / 7.1 in-lb
	98003520	Connection Block, NC, 24VDC		0.8 Nm / 7.1 in-lb

Table 7-2: Visual Inspection Details

ITEM	DETAILS
Plumbing Leaks	Visually check DI water lines outside of heater cabinet for signs of leaks at the connections. (A leak sensor will detect leaks, but this periodic visual check is recommended.) Also, visually check bottom of cabinet inside heater module enclosure for DI water leaks. Tighten fitting(s) if necessary. If heater module is leaking, contact Trebor for instructions.
Over-pressure Relief Valve	Visually check the drain line for water running from the heater. The over-pressure relief valve is factory set to open at 60PSIG. If pressure is less than 60 PSIG and water is still running through the relief drain, the valve may need adjustment or replacement.
General Electronics	Visually check electronics inside control enclosure for any signs of overheating, deformation, or corrosion.
Solid State Relays	The SSR's should be free of corrosion at the terminals and should not have signs of overheating or deformation. The wires attached to the SSR's should be clean and in good condition. Check and tighten mounting screws for optimum heat transfer to heatsink.
Main Circuit Breaker	The main circuit breaker should be checked for signs of loose connections at the termination lugs. Damaged lugs should be replaced. The terminals should be checked for tightness.
Distribution Breakers & Contactors	The distribution breakers and contactors should be checked for signs of loose connections at termination lugs. Damaged lugs should be replaced. The terminals should be checked for tightness.
Branch Circuit Breakers	These should be checked for signs of loose connections at the termination lugs. The terminals should be checked for tightness.
Process Fluid Thermocouples	Recommend removing and inspecting thermocouples for any signs of wear, cracking or rupture at tip. Replace any thermocouple that exhibits any of these signs.

8 TROUBLESHOOTING

Danger!

If the heater is energized while the cabinet door is open, an arc flash hazard may exist. Only trained personnel should attempt to energize the heater with the cabinet door open.

Display is Not Illuminated

Cause:	Solution:
EMO button engaged	Twist EMO in direction of arrows (see Section 2.3).
No power at main circuit breaker	Review wiring procedure (see Section 3, Installation).
Control breaker is tripped	Reset breaker
Main breaker is OFF	Main breaker to ON.

Alarm Sounds

Cause:	Solution:
DI supply pressure	Check water supply pressure at source. Verify supply is at least 15 psig.
Liquid level	Check water supply at source. Check over-pressure relief diaphragm. Verify flow is on. Check plumbing for trapped air bubbles, see Section 4.1.e
Leak sensor	Check manifold and heater modules for leak. Visually inspect leak tray.
Thermocouple damaged	If fault repeats, check thermocouple leads to OTC for continuity. Check T/C plugs in top heater modules.
Plugged orifice in heater	Check fluid lines in and out of manifold for flow.
Over-temperature alarm	Check if heater element has failed and replace module (see section 7.1). If fault reports, check T/C leads to OTC for continuity. Verify fan operation.
Low/Stop Flow	Check box on configuration page is checked, see section 2.4.f. Flow switch is set too low see section 2.4.f

Element Not Heating

Cause:	Solution:
Failed heater	Check if heater element has failed and replace module (see Section 7.1).
Circuit breaker tripped	Check and reset the main, auxiliary and element isolation circuit breakers. Consult Trebor if circuit breaker repeatedly trips.
Heater disabled	Check touch screen to verify the heater is enabled. If the heater won't enable check that heater is in local mode on the home page.
Solid State Relay (SSR) may have "frozen" open or closed.	An SSR has failed in the open mode: Shut system off immediately and replace the failed SSR. SSR's should be replaced in pairs.

Fluid temperature won't reach set point

Cause:	Solution:
Element not heating	Check if heater element has failed and replace module (see Section 7.1). Check and reset the main, auxiliary and element isolation circuit breakers.
Ambient temperature setting variance	Set ambient temperature to correct value on Configuration Page
Too much flow	Lower flow rate to achieve desired set point

9 CONTACT INFORMATION

9.1 GENERAL CONTACT INFORMATION

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9.3 REGIONAL REPRESENTATIVES

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