January 2000

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This section deals with the electrical safety aspects of the Model 234 Power Supply / Cooler. Additional safety instructions can be found in the appropriate laser section of this manual. Please read all safety sections and instructions prior to system operation.

All warning and caution notices appearing in the manual are boxed. Warning notices indicate the potential for personal injury. Caution notices indicate the potential for equipment damage. Please read these notices carefully.

**Warning**

Lethal electrical voltages exist in the Model 234 Power Supply / Cooler. Follow manual instructions. Do not attempt any modifications to the electronic control system or electrical triggering system.
Warning Labels

MAIN INPUT
A/C POWER CABLE

PHASE A — RED
PHASE B — BLK
PHASE C — ORG
GND — GRN

CAUTION
LINE VOLTAGE ALWAYS
PRESENT INSIDE ENCLOSURE

CAUTION
FAN MUST BE UNPLUGGED
BEFORE COVER CAN BE
FULLY REMOVED

CAUTION
DISCONNECT LINE VOLTAGE
SOURCE PRIOR TO REMOVING
REAR COVER

CAUTION
NO USER SERVICABLE PARTS
INSIDE. TO REDUCE THE RISK OF
ELECTRIC SHOCK, DO NOT REMOVE
COVER. REFER SERVICING TO
QUALIFIED SERVICE PERSONNEL

TB1  T1  φA  T2  φB  T3  φC
1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23

TB1- (TOROID TAP VAC)

<table>
<thead>
<tr>
<th></th>
<th>190</th>
<th>200</th>
<th>208</th>
<th>220</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1(φA)</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>T2(φB)</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>T3(φC)</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

This page is from a technical manual, containing important safety and electrical connection instructions. It details the main input power cable connections, electrical voltage, and the necessary precautions for handling the device.
Remote Interlock

Federal law requires every laser system to have a remote interlock (see the Laser Safety section of your manual). For your laser system, this interlock is located on the rear panel of the Model 234 Power Supply / Cooler. The function of the remote interlock is to provide a means for electrically disabling the laser from a remote location (e.g., door interlock).

Information for the installation of this interlock is contained in the Installation Section of this manual.

General Rules for Electrical Safety

1. Disconnect main power lines before working on any electrical equipment if it is not necessary for the equipment to be operating.

2. The main system circuit breaker MUST be in the “OFF” position prior to changing the lamp. The laser power supply is not isolated from the power source. High voltage or current may be transmitted to the lamp leads if the circuit breaker is in the “ON” position.

For maximum protection, disconnect the main power line before changing the lamp.

3. After disconnecting the power, wait at least 5 minutes for the capacitors to discharge through the bleeder resistors before touching any electrical equipment.

4. Do not short or ground the power supply output. The power supply is NOT electrically isolated from the power line. Positive protection against possible hazards requires proper connection of the ground terminal on the power cable and an adequate ground. Check these connections at the time of installation and periodically thereafter.

5. Never work on electrical equipment unless there is another person present who is familiar with the operation and hazards of the equipment and who is competent to administer first aid.

6. When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body.
7. Always use approved, insulated tools when working on high voltage circuits

8. Special measurement techniques are required for this system. A technician who has a complete understanding of the system’s operation and associated electronics must select ground reference.
System Description

Model 234 Power Supply / Cooler is a modular system designed to operate all the Quantronix krypton arc lamp pumped Nd:YAG and Nd:YLF laser heads. The unit contains the following modules, which provide all the required functions for a fully integrated power supply and cooling system:

- Logic and Control Unit
- Krypton Arc Lamp Power Supply
- Water Cooling System
- Power Distribution Unit
- Options

Control and monitoring of the laser operating parameters is provided by the control panel on the front of the Model 234 Power Supply / Cooler.

Control and operating parameters of the laser can also be controlled remotely via the RS-232 interface provided on the rear of the Model 234 Power Supply / Cooler.

Control and operating parameters of the laser can also be controlled remotely using the optional Remote Control Unit. A special connector is provided on the front of the Control Unit of the Model 234 Power Supply / Cooler panel for this purpose.

Model 234 Power Supply / Cooler has a height of 53.5 cm (21 inches) and will fit under most optical benches or work tables.
Figure 2.1 Model 234 Power Supply / Cooler

CONTROL UNIT

POWER SUPPLY

RF DRIVER (OPTION)

POWER DISTRIBUTION

WATER COOLING SYSTEM

F R O N T  V I E W

R I G H T  S I D E
Figure 2.2 Control Unit

- **Remote Control Connector**
- **Key Switch**
- **Pump Status Indicator**
- **Coolant Level Indicators**
- **Coolant Temperature Indicators**
- **Lamp Status Indicator**
- **Coolant Flow Indicator**
- **Coolant Ionization Indicators**
- **Lamp Switch**
- **Lamp Current Control**
- **Lamp Current Display**
- **Internal/External Modulation Select Switch**
- **Pulse Repetition Frequency Display**
- **Modulation Range Select Switch**
- **Timer Display**
- **Shutter Status Indicator**
- **Shutter Control Switch**
- **Timer Toggle Switch**
- **Modulation Frequency Control**
- **Modulation Selection Switch**
Control Unit

The control panel on the Model 234 Power Supply / Cooler is the main user interface for the control and monitoring of the laser operating parameters. The control and monitoring functions provided are listed below:

**Keyed lockout switch**

**Cooling Status Indicators**
- Pump Status. *Indication, on or off*
- Primary Coolant Level. *Indication, Safe, Warning and Fault*
- Primary Coolant Temperature. *Indication, Safe, Warning and Fault*. In the Warning Mode, the warning lamp blinks when the temperature is too cold. In the Fault Mode, in addition to the indication lamp, a beeper sounds.
- Primary Coolant Flow. *Indication, Safe, Fault*. In the Fault Mode a beeper sounds and the system shuts down after a few seconds.
- Primary Coolant Ionization. *Indication Safe, Warning and Fault*.

**Krypton Arc Lamp Control**
- Lamp Switch, on or off
- Display of lamp current
- Lamp Current Adjust potentiometer. An internal trim pot limits the current to a preset maximum value

**RF Modulation Control**
- Three position switch to control RF ON, PULSE and RF OFF
- Range Switch, HI, MED and LOW to provide improved resolution over the adjustment range.
- PRF Display (Pulse Repetition Frequency)
- Internal/External switch to enable a external pulse source to be used.

**Dual Timer**
- Displays Total Time the laser has been in operation (Not Resetable) and a second timer that can be reset. The Total Time Display is used to log operating time and for preventive maintenance. The Resetable Timer is used to log lamp life.
- Timer toggle switch used to alternate between the Total Time Display and the Resetable Display. This switch is also used to reset the Resetable Display.

Windows Based Control Software and an optional handheld Remote Control Unit are also provided to control and monitor the functions listed.

- Laser status, select Ready, Standby or Idle
• Select Fire Mode, Single Shot, Continuous or Timed
• Adjust and display lamp current.
• Adjust and display the Q-switched Pulse Repetition Frequency
• Turn PRF on or off.

Power Supply

The power supply is a compact, lightweight, constant current regulated source of D.C. power for the krypton arc lamp/lamps in the laser head. The main power switch, located on the front panel, is a UL listed, 3 phase circuit breaker that combines primary circuit protection with on/off control. The current control, power supply enable, trigger ready, current read back, ignition and interlock functions are all remotely controlled via a 15 pin sub-D connector on the back of the unit.

The supply is built into a 19” rack-mountable chassis. All cabling and wiring connections are made at the rear of the power supply. The power supply chassis is mounted on slides in the Model 234 cabinet and can be easily pulled out for service or replacement.

Water Cooling System

The Water Cooling System is a closed-loop primary system that supplies filtered, deionized water to cool the laser and an open loop, secondary system for heat exchange. All materials in contact with the deionized primary cooling system are non-contaminating. The Water Cooling System is located in a separate section of the Model 234 cabinet. It is isolated from the electronics bay by a continuous bulkhead running the entire width of the cabinet. The water system itself is mounted to the cabinet with chassis slides that enable the cooler to be pulled out for routine maintenance and accessibility.

The primary and secondary water connections are located on the lower right side of the cabinet and are clearly marked. Connections to the primary water hook-ups are made with hose clamps, which firmly seal the braided hose to the barbed fitting. This will ensure a leak-free connection for DI water flow between the cooling section and the laser head. The secondary water fittings are standard 3/4” female garden hose connections.
Power Distribution Unit

The Power Distribution Unit of the Model 234 Power Supply/Cooler receives the 208 VAC 3-phase input power and distributes it as a variety of voltages (i.e., 208 VAC 3 Phase, 208 VAC 1 Phase, 120 VAC, 24 VAC, +/-15 VDC and +/-5 VDC) to all the other major assemblies. Two versions are offered, a 6 kW and a 10 kW unit. Both assemblies follow the same schematic and include the following components:

1. Main Circuit Breaker
2. Main Contactor
3. Low Voltage/Phase Monitor Relay
4. Transformers: 220 VAC to 120 VAC
   220 VAC to 24 VAC
5. Pump Overload Relay
6. +15, -15 and 5 VDC Power Supply
7. +/- 5 VDC Power Supply
8. Cooling Fan
9. Key switch Relay

Options

Model 391 AO Q-Switch Driver

The Model 391 RF Driver provides up to 100 watts of RF power for an AO Q-Switch used to Q-Switch your laser. The RF Driver allows many different options to be set up using an on-board multi-configuration switch.

An adjustable first pulse suppression ramp generator is built in to prevent excessive laser peak power in the first pulse.

A fault diagnostics feature will indicate the particular fault on the front panel by an indicator light. Any fault will result in automatic RF power shutdown.
## System Specifications

<table>
<thead>
<tr>
<th></th>
<th>234-1 6 kW</th>
<th>234-2 10 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical</strong></td>
<td>200-220 volts AC</td>
<td>200-220 volts AC</td>
</tr>
<tr>
<td></td>
<td>50/60 Hz, 3 Phase, WYE or Delta</td>
<td>50/60 Hz, 3 Phase, WYE or Delta</td>
</tr>
<tr>
<td>Current per Phase (amps)</td>
<td>35</td>
<td>50</td>
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<tr>
<td><strong>Mechanical</strong></td>
<td></td>
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<tr>
<td>Height (in)</td>
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<tr>
<td>(cm)</td>
<td>53.5</td>
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<tr>
<td>Width (in)</td>
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<td>33.5</td>
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<tr>
<td>(cm)</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Depth (in)</td>
<td>22.8</td>
<td>22.8</td>
</tr>
<tr>
<td>(cm)</td>
<td>58</td>
<td>58</td>
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<tr>
<td>Weight (lbs)</td>
<td>290</td>
<td>350</td>
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<tr>
<td>(kg)</td>
<td>130</td>
<td>160</td>
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<tr>
<td><strong>Water Cooling System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Flow (gpm)</td>
<td>3 to 6</td>
<td>3 to 7</td>
</tr>
<tr>
<td>(lpm)</td>
<td>11.3 to 22.7</td>
<td>11.3 to 26.5</td>
</tr>
<tr>
<td>Temperature (deg F)</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>(deg C)</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Flow (gpm)</td>
<td>2 to 5</td>
<td>4 to 6</td>
</tr>
<tr>
<td>(lpm)</td>
<td>8 to 20</td>
<td>16 to 24</td>
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<td>Temperature (deg F)</td>
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<td>(deg C)</td>
<td>7 to 18</td>
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<tr>
<td>Pressure (psig)</td>
<td>15 to 100</td>
<td>15 to 100</td>
</tr>
<tr>
<td>(kg/cm²)</td>
<td>1 to 7</td>
<td>1 to 7</td>
</tr>
</tbody>
</table>
Site Requirements

Electrical

The electrical service at your site must be compatible with the label affixed to the Model 234 Cooler unit rear panel with respect to voltage, frequency, and load current requirements.

Configuration

User site electrical configuration may be either 3 phase WYE with ground or 3 phase DELTA with ground.

Input Voltage: 200-220 VAC, 3 Phase
- Maximum: 220 VAC Phase to Phase
- Minimum: 200 VAC Phase to Phase

Voltage Imbalance, Phase to Phase: 1% Maximum

Circuit Breaker/Fused Current
- Model 224-1, 6 kW: 40 Amperes per phase
- Model 224-2, 10 kW: 50 Amperes per phase

Main Input AC Power Cable
Phase A ...........RED
Phase B...........BLACK
Phase C.........ORANGE
GROUND ......GREEN
All Connections on Rear Apron of Power Distribution Box

Main Input AC Power Cable, P/N (3502—00216)
(20 foot No. 8 AWG)

For safety considerations, a 3 Phase ground fault interrupter and a manually operated 3 Phase disconnect switch at user site is recommended. Because of the wide variation in outlet configurations, the plug or junction box is supplied by the user.

CAUTION
DO NOT TURN ON MAIN AC POWER TO THE MODEL 234 POWER SUPPLY/COOLER AT THIS TIME.
REFER TO INSTALLATION SECTION 4.
Secondary Water

Maximum Inlet Pressure: 100 psig. (7 kg/cm²)
Inlet Temperature
Minimum 45 deg F (7 deg C)
Maximum 65 deg F (18 deg C)
Flow
Model 234-1, 6 kW: 2-6 gpm (8-24 lpm)
Model 234-2, 10 kW: 3-6 gpm (12-24 lpm)
Minimum Inlet/Outlet Differential Pressure to obtain 6 gpm.
(24 lpm) secondary flow is 2 psig.

Plumbing
Two 20 foot long, standard garden hoses are supplied with the system.

User to supply a 3/4” MALE GARDEN HOSE FITTING at both supply and return line.

CAUTION
DO NOT USE 3/4” MALE THREAD PIPE FITTINGS

An ON/OFF gate valve should be located at supply side. If system is closed loop, a similar valve should be located on return side.

User supply and return lines must be capable of handling a 6 gpm (24 lpm) volume.

A user-supplied, in-line string filter placed before the secondary inlet water fitting is recommended.

CAUTION
DO NOT AT THIS TIME CONNECT SECONDARY INLET AND OUTLET COOLANT HOSES TO MODEL 224 POWER SUPPLY/COOLER. REFER TO INSTALLATION SECTION 4.

Environment

Ambient air temperature, Maximum 104 deg F (40 deg C) at 100% of Rated Input Power. Minimum 33 deg F (1 deg C)
Humidity: Below the dew point at ambient air temperature.
Installation

Unpacking

Visually examine the container for signs of shipping damage prior to unpacking. If damage is evident, or a container missing, notify the carrier and Quantronix Corporation.

If no damage is noted, carefully unpack the Model 234 Power Supply/Cooler and any accessories. Compare unpacked items with the packing list and report any discrepancies to Quantronix Corporation.

Due to the custom nature of the laser system packaging, you may want to retain some or all of the packing supplies for future use.

**CAUTION**

*IF THE LASER SYSTEM RECEIVED REQUIRES INSTALLATION BY QUANTRONIX FIELD SERVICE OR A QUANTRONIX REPRESENTATIVE DO NOT PROCEED BEYOND STEP 4, UNPACKING.*

*REFER TO THE LASER SYSTEM PORTION OF THIS MANUAL FOR CLARIFICATION. CONTACT QUANTRONIX OR THEIR AUTHORIZED REPRESENTATIVE TO SCHEDULE THE INSTALLATION AT USER SITE.*

Site Location, 234 Power Supply/Cooler

The Model 234 Power Supply/Cooler should be located on a flat level surface, below the level of the laser head.

A minimum of one foot clearance from the wall to the rear panel of the Model 234 Power Supply/Cooler is required to allow for adequate forced—air circulation.

A three-foot clearance forward of the front panel is required to service subsystems mounted on chassis slides.

Verify that all the following switches are in the OFF position:

- Power Distribution Box, 3 Phase Circuit Breaker
- Power Supply; 3 Phase Circuit Breaker
- Model 391 RF Driver
- Other Accessories
Connect or verify that all appropriate electrical cables are correctly interconnected between Model 234 Power/Supply Cooler and the laser head portion of system; paying particular attention to:

**KRYPTON ARC LAMP CABLE, BLACK AND RED BANANA PLUGS**

**TWO (2) BNC TERMINATED COAXIAL CABLES FROM MODEL 391 RF DRIVER TO Q-SWITCH. (OPTION)**

**RF OUTPUT (J5) TO Q-SWITCH**

**TEMPERATURE FAULT (J2) INTERLOCK**

**INTRACAVITY LASER SHUTTER, J102**

**OTHER ACCESSORIES OR ELECTRICAL OPTIONS**

Refer to the laser section of your manual and your test data reports to determine your exact system configuration.

Key switch on the front panel of the 234 logic unit should be in the OFF Position.
Connect the Model 234 Remote Control Unit (this is an optional item) to the connector on the front panel of the 234 logic unit

**Primary Hoses**
Connect and secure each of the two hoses to the appropriate DI IN/DI OUT barbed fittings. The hose connected to DI OUT at the cooler should be connected to the input on the laser head. The hose that connects to DI OUT is marked with a red band.

**Electrical**

Review Site Requirements.
Verify Model of 234 Power Supply/Cooler to be installed, 234-1, 6 kW or 234-2, 10 kW. This information is imprinted on the system serial number tag and written on your order confirmation and Test Data Report.

Electrical service must conform to values specified in section entitled Site Requirements, Configuration. If electrical service does not conform, do not proceed with installation.

**Model 234-1**
Connect main input AC power cable to user electrical service as per description in section entitled Site Requirements, Configuration.

Verify correct phase rotation. (See “Phase Rotation Verification on next page.”)
Model 234-2

CAUTION
THE MODEL 234-2 POWER SUPPLY/COOLER IS TESTED
AND SHIPPED CONFIGURED FOR 3 Phase, 208 VAC +/-2.4%,
INCOMING SUPPLY VOLTAGE.

This Model includes a 3 Phase, multi-tapped, toroidal step-up
autotransformer located between the rear panel of the 234 Power

The tapped toroidal autotransformer provides the required 3 Phase,
230 VAC input needed for the Krypton Arc Lamp supply over
input voltage ranges of 190, 200, 208 and 220 VAC.

To correctly configure the transformer, first measure and record
your site’s phase-to-phase voltage:

Phase A to Phase B = __________ volts AC
Phase A to Phase C = __________ volts AC
Phase B to Phase C = __________ volts AC

Next, check the values in Table 4.1. If necessary, move jumpers
to appropriate tap(s) on TB-1 of the toroidal autotransformer.
This will provide a measured phase-to-phase voltage match within
5 VAC of listed values in Table 4.1.

Connect main input AC power cable to your electrical service as
per description section entitled Site Requirements, Configuration.

Table 4.1 Autotransformer Connection Chart

<table>
<thead>
<tr>
<th>Measured Incoming Phase-to-Phase Voltage</th>
<th>190</th>
<th>200</th>
<th>208</th>
<th>220</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A, Connect Terminal 10 to</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Phase B, Connect Terminal 10 to</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Phase C, Connect Terminal 10 to</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>
Phase Rotation Verification

**WARNING**
INCORRECT PHASE ROTATION WILL RESULT IN THE SYSTEM APPEARING TO BE “ELECTRICALLY-DEAD” AS IF DISCONNECTED FROM ELECTRICAL SERVICE.

EXERCISE EXTREME CAUTION.
LETHAL POTENTIALS DO EXIST WITHIN THE POWER DISTRIBUTION BOX.

Again, verify that all switches are in the OFF position.
Connect main AC plug into main receptacle.
Turn on main incoming 3 Phase AC voltage.

Turn on 3 Phase circuit breaker located on front panel of Model 234 Power Supply/Cooler Power Distribution Box.

Turn the key switch on 234 Control Unit from the OFF position, clockwise to ON position. If the phase rotation is correct the LEVEL, TEMPERATURE, FLOW and IONIZATION Status Indicator LED’s will illuminate, indicating the appropriate status. If illuminated, continue installation.

If the Status Indicator LED’s did not illuminate, two phases (leads) at main incoming AC female receptacle, or junction box, must be interchanged to obtain correct phase rotation. Before proceeding, turn key switch on 234 Control Unit to OFF position. Turn 3 Phase circuit breaker on Power Distribution Box to OFF position. Disconnect main AC plug to Model 234 Power Supply/Cooler. Remove main incoming AC power and/or padlock in OFF position before interchanging any two phase leads.

After changing leads, retest. If problems persist, contact the Quantronix Field Service group nearest you or Quantronix authorized representative for assistance.

Secondary Water Connections

Prior to connecting hoses, flush secondary water supply into a suitable drain until free of particulate matter such as solder globules and water flow appears clear.

At the Model 234 Power Supply/Cooler secondary inlet/outlet female fittings, verify that a rubber washer is present in each fitting before making hose connections. Connect opposite end of hoses to APPROPRIATE secondary supply and return, 3/4” MALE GARDEN HOSE fittings. Again, verify presence of the rubber washer at each fitting before making connection.

Open secondary supply gate valve (and return gate valve if applicable) and visually check for water leaks. If no leaks are
visible, proceed to initialize water pump/cooler operation.

**Initializing Water Pump/Cooler Operation**
Again, verify that all switches are in the OFF position.
Connect main AC plug into main receptacle.
Turn on main incoming 3 Phase AC voltage.

Turn on 3 Phase circuit breaker located on front panel of Model 234 Power Supply/Cooler Power Distribution Box.

**Primary (Laser Head) Water**
Seven gallons (26.5 liters) of steam distilled water is required for initially filling system.

**CAUTION**
*DO NOT USE DEIONIZED WATER FOR INITIALLY FILLING SYSTEM. DO NOT USE DEIONIZED WATER TO MAINTAIN WATER LEVEL IN RESERVOIR. ADD ONLY STEAM-DISTILLED WATER.*

**Initial Fill**
Remove right hand side panel of cooler by lifting directly upward at the underside of the panel.

Slide out water cooler subassembly on chassis slide by disengaging each one-quarter-turn, twist lock retainer located on each side.

Remove top cover of reservoir.

Fill reservoir to the water level line indicated on reservoir.

**DO NOT OVERFILL**
The hydraulic system is designed so that the water pump will be self-primed as water is introduced into the reservoir. Turn the 234 Control Unit key switch, from OFF position, clockwise to the ON position and push up on the Pump Switch. The water pump should turn on and after a couple of seconds shut off due to low level water sensor being actuated.
Again fill reservoir until low level fault indicator extinguishes. To restart the water pump, push up on the Pump Switch. The water pump will again turn on. It will be necessary to repeat this sequence several times until the laser head, primary water hoses and D.I. cartridge have been filled. With primary water flow established, adjust the water level to the line indicated on the reservoir.
While filling system, verify proper water flow direction through laser head (anode to cathode) by observing flow of air bubbles. Confirm that system has no water leaks when under pressure.

**User-Site with Utilities Other Than 3 Phase. 208 +/- 10% VAC**
Electrical service at user site must be made to provide and conform, via a three phase transformer if necessary, to site
requirements stated in section entitled Site Requirements, Configuration.

Prior to installation of Model 234 Power Supply/Cooler, a three phase transformer having a minimum of 13 KVA rating for the Model 234-2 and a 10 KVA for Model 234-1 rating for continuous commercial service must be installed by the user.

CAUTION
ATTEMPTING TO INSTALL AND OPERATE A MODEL 234 POWER SUPPLY/COOLER WITH ELECTRICAL UTILITIES NOT CONFORMING TO REQUIREMENTS MAY RESULT IN DAMAGED COMPONENTS, AND VOID WARRANTY COVERAGE.

Installation of the Remote Interlock
As mentioned in the Safety section of this manual, your Model 234 Power Supply/Cooler is equipped with a remote interlock, per Federal Regulations. This feature allows the user to inhibit lasing via the intracavity shutter from a remote location.

Most commonly, this feature is used as a door interlock in the area where the laser is used.

At the rear of the Model 234 Power Supply/Cooler, there is a 15 pin male connector located below where the main power cable enters the cabinet (see Figure 4.2). The interlock is terminated to pins on this connector.

Shutter Remote Interlock
The Shutter Remote Interlock (pins 1 and 2) is designed to drive the intracavity shutter to the closed position (preventing lasing) when open. A remote interlock switch (SPST) wired into these pins will disrupt lasing when opened, but it will not shut down the electrical system of the cooler, logic, or power distribution assemblies.
Table 4.2 Model 234-2 Autotransformer Terminal Strip

<table>
<thead>
<tr>
<th>TERMINAL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PHASE A ARC TO LAMP POWER SUPPLY</td>
</tr>
<tr>
<td>2</td>
<td>PHASE B ARC TO LAMP POWER SUPPLY</td>
</tr>
<tr>
<td>3</td>
<td>PHASE C ARC TO LAMP POWER SUPPLY</td>
</tr>
<tr>
<td>4</td>
<td>NOT USED</td>
</tr>
<tr>
<td>5</td>
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<tr>
<td>6</td>
<td>PHASE A VOLTAGE CORRECTION FOR 220 VOLTS</td>
</tr>
<tr>
<td>7</td>
<td>PHASE A VOLTAGE CORRECTION FOR 208 VOLTS</td>
</tr>
<tr>
<td>8</td>
<td>PHASE A VOLTAGE CORRECTION FOR 200 VOLTS</td>
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<tr>
<td>9</td>
<td>PHASE A VOLTAGE CORRECTION FOR 190 VOLTS</td>
</tr>
<tr>
<td>10</td>
<td>PHASE A INCOMMING VOLTAGE</td>
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<td>22</td>
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Table 4.3 J105 DB 15 Male Connector

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<thead>
<tr>
<th>Pin No.</th>
<th>Signal</th>
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<tbody>
<tr>
<td>1</td>
<td>Shutter Interlock</td>
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<tr>
<td>2</td>
<td>+5 Volts DC</td>
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<tr>
<td>3</td>
<td>Ext PRF Enable</td>
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<tr>
<td>4</td>
<td>Ext PRF Pulse</td>
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<tr>
<td>5</td>
<td>Ext PRF Gate</td>
</tr>
<tr>
<td>6</td>
<td>Ext PRF First Pulse Suppression</td>
</tr>
<tr>
<td>7</td>
<td>Ext PRF Return</td>
</tr>
<tr>
<td>8</td>
<td>Ext Current Enable</td>
</tr>
<tr>
<td>9</td>
<td>Ext Current Control</td>
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<tr>
<td>10</td>
<td>Ext Current Return</td>
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<tr>
<td>11</td>
<td>Current Readout</td>
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<td>Shutter Open Command</td>
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<td>Shutter Close Command</td>
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<td>14</td>
<td>Shutter Open</td>
</tr>
<tr>
<td>15</td>
<td>Ground</td>
</tr>
</tbody>
</table>
Controls

WARNING
Read all safety sections of this manual prior to operation of any controls.

Control of the Model 234 Power Supply/Cooler is exercised via the Control Panel (Fig. 2.2). This control unit consists of a key switch, pump switch, pump status indicator, coolant status indicators, modulation select switch, modulation frequency control, range select switch, pulse repetition frequency display, lamp switch, lamp status indicator lamp current display, lamp current control, dual timers, timer select switch, shutter control switch and shutter status indicator.

This section of the manual will introduce you to the various switches, indicators and displays. The actual use of these switches, indicators and displays to operate your laser system will be covered in the Operations Section of this manual.

Remote Control Connector
A connector provided to attach the optional remote control unit.

Key Switch
Turns the controller on and off. A key switch is provided to prevent the laser from being operated by unauthorized personnel.

Pump Switch
Turns the primary cooling water pump on or off and initiates the laser cooler interlocks.

Pump Status Indicator
Indicates that the pump is on or off.

Coolant Level Indicators
Provides a visual indication of primary water level. Green lamp on indicates the primary cooling water is at the correct level. Yellow lamp and audible beeper pulsing indicates that the primary cooling water is not at the correct level. Red lamp and audible beeper on indicates that the primary cooling water level is too low and shuts down the laser.

Coolant Temperature Indicators
Provides a visual indication of primary water temperature. Green lamp on indicates that the primary cooling water is in the correct temperature range. Yellow lamp pulsing indicates that the primary cooling water has not reached correct operating range. Red lamp and audible beeper pulsing indicates that the primary cooling water temperature is hot. Continuous red lamp and audible beeper
indicates that the primary cooling water temperature is too hot and shuts down the laser.

**Coolant Flow Indicators**
Provides a visual indication of primary water flow rate. Green lamp on indicates the primary cooling water is flowing at the correct flow rate. Red lamp and audible beeper on, indicates that the primary cooling water flow rate is too low. After 5 seconds, this condition will cause the laser to shut down.

**Coolant Ionization Indicators**
Provides a visual indication of the ionization level of the primary water. Green lamp on indicates that the deionized water in the primary cooling water loop is in the correct conductivity range. Yellow lamp on, indicates that the conductivity of the deionized water in the primary cooling water loop is too low and maintenance is required. Red lamp on indicates that the conductivity of the deionized water in the primary cooling water loop is too high and maintenance is required. The arc lamp will not operate when the high conductivity alarm is active.

**Lamp Switch**
Turns the arc lamp on or off.

**Lamp Status Indicator**
Green lamp on indicates that the arc lamp is on.

**Lamp Current Display**
Displays the current, in amperes, the arc lamp is using.

**Lamp Current Control**
This potentiometer is used to adjust the arc lamp current. An internal trim pot is preset to limit the maximum current to a safe operating range. This control will not operate when under computer control.

**Modulation Select Switch**
This is a three-position switch. When set to RF ON it turns on the Q-switch and stops the laser from lasing. When set to PULSE, the laser pulses at the repetition frequency indicated on the display. When set to RF OFF, there is no RF power to the Q-switch and the laser operates in the CW mode.

**Modulation Frequency Control**
This potentiometer is used to adjust the pulse repetition frequency. The PRF can be adjusted between 10 Hz and 50 kHz.

**Range Select Switch**
Used to provide improved resolution of the Modulation Frequency Control adjustment range. In the low range, it will allow adjustment in the range of 10 Hz to 500 Hz. In the medium range, it will allow adjustment in the range of 10 Hz to 5000 Hz. In the high range, it will allow adjustment in the range of 10 kHz to 50
kHz.

**Pulse Repetition Frequency Display**
Displays the pulse repetition frequency that will be applied to the Q-switch.

**Maintenance Timer Display**
This is a dual function timer. As a total time display, indicates the total time the laser has been in operation. This function is used to indicate when scheduled maintenance is to be performed. As an elapsed timer, it is used to log arc lamp life.

**Timer Toggle Switch**
Used to alternate between the total time display and the elapsed time display. To reset the elapsed time press and hold for 15 seconds.

**Shutter Control Switch**
Used to open and close the shutter. Push switch up to open the shutter.

**Shutter Status Indicator**
Provides a visual indication of the position of the shutter. Green indicates the shutter is open.

**Quantronix Model 234 Power Supply / Cooler RS-232 Serial Interface**
The 234 Power Supply/Cooler can also be controlled through the RS-232 Serial Interface located on the rear panel of the controller board. The functions provided are:

**RS-232 Enable, Disable and Status**
Provides commands to enable, disable or request the status of the RS-232 Interface.

**Cooler On, Off and Status**
Provides commands to turn cooler pump on, off or to request the status of the pump.

**Current Control**
Used to set the arc lamp current and request the current setting.

**RF Source External/Internal**
Used to select the RF source. Default is internal source.

**Laser On/Off and Status**
Provides commands to turn laser on, off or to request the status of the laser.

**PRF On/Off, Control Frequency and Request Status**
Used to set and turn on and off the PRF and to request frequency setting.
Q-Switch RF On/Off
Command used to turn Q-Switch on and off

Shutter Open/Close and Status
Used to open and close the shutter and to request the shutter setting.

Warning Information
Used to request warning information on the water level, water temperature and DI water.

Laser Commander Control Software
The opening window of the Laser Commander creates a direct interface to the laser system. Using the controls in the Laser Commander Software the laser status can be monitored and operating parameters adjusted. Windows Based Control Software is also provided to control and monitor the functions listed.

Interlocks
Interlock faults result in laser shutdown and are reported to the system operator via the status indicators in the Laser Commander’s window. Interlocks protect the user and laser system from possible damage or injury. Cooling water temperature, flow and level are continually monitored during laser operation.

Laser Status
The Laser Status selects the laser’s operating mode. The laser can be set to operate at Idle, Stand-by or Ready.

Laser Power and Pulse Repetition Rate
Remote control of the laser power and pulse repetition rate is accomplished by adjusting the lamp current and frequency. To adjust the lamp current and frequency click on the Laser Set-up Button. This will launch the Laser Set-up dialog box. After setting the desired values, send the command to the laser by clicking the Update Button.

Fire Mode
Select the fire mode from the pull down menu.

Shutter Control
To fire the laser in the selected Fire Mode, click the Fire icon.

Shut Down
To shutdown the laser System, click in the exit button. The laser Commander will affect an orderly system shutdown.
Operation

Introduction

The following section outlines some of the most commonly used procedures required for normal operation of your Model 234 Power Supply / Cooler. These procedures assume that your system has been properly installed following the instructions in the section entitled Installation and is working according to the Specifications in the section entitled Introduction.

Please read and fully understand the safety section of this manual prior to operation.

If, during the operations of your Model 234 Power Supply / Cooler, an error indication is displayed, please refer to the troubleshooting guide outlined in the Customer Service Section. If, after following the recommended procedures your system is still not performing to specifications, please call Quantronix Customer Service.

Turning On the Model 234 Power Supply / Cooler

Assure proper secondary flow and drainage as specified in the installation section of the manual.

Turn the key switch on the Control Unit to the on position. Turn on the Pump Switch. Observe that the Coolant Level, Coolant Temperature, Coolant Flow, and Coolant Ionization indicators are lit GREEN, indicating all parameters are in the correct operating range. If an error indication is displayed, please refer to the troubleshooting guide outlined in the Customer Service Section.

Use the Modulation Select Switch to select the desired mode of operation. This is a three-position switch. When set to RF ON it turns on the Q-Switch and stops the laser from lasing. When set to PULSE, the laser pulses at the repetition frequency indicated on the display. When set to RF OFF, there is no RF power to the Q-Switch and the laser operates in the CW mode.

If the Modulation Select Switch has been set to PULSE, the Modulation Frequency Control potentiometer can be used to adjust the pulse repetition frequency. The PRF can be adjusted between 10 Hz and 50 kHz. The range select switch is used to provide improved resolution of the Modulation Frequency.

Initializing Lasing

Turn on the Lamp Switch and adjust the Lamp Current to the desired value using the Lamp Current Control Potentiometer. A
Green Indicator Light above the lamp control switch indicated the arc lamp is on.

Use the Shutter Control Switch to open the shutter. At this point the laser should be on.

**Turning Off the Model 234 Power Supply / Cooler**

Use the Shutter Control Switch to close the shutter.

Turn off the Lamp Switch. The Green Indicator Light above the lamp control switch should be off. Wait 2 minutes to allow the lamp to cool down.

Turn off the Pump Switch.

Turn the Key Switch to the off position. The laser is now shut down.

Turn off the secondary cooling water supply line and then the secondary cooling water return line.

**WARNING**

*For servicing, it is necessary to shut off the wall circuit breaker and remove the wall plug from its receptacle.*
Maintenance

The Model 234 Power Supply / Cooler was designed for ease of periodic maintenance and modular repair or replacement of assemblies in the case of failure. This section of the manual will deal with the periodic maintenance of the filters and removal of major sub assemblies should return or replacement become necessary.

Should a fault occur in your system, please refer to Troubleshooting section of the manual to isolate the problem.

Periodic Maintenance

The only periodic maintenance required for the Model 234 is to replace the Deionizing (DI) Cartridge and to clean or replace the particle filter. Replace the DI cartridge every 6 months.

WARNING

Disconnect the Model 234 Power Supply/Cooler from the wall prior to performing any maintenance tasks.

Accessing the Cooling System

To access the cooling unit, first remove the right side panel by lifting the panel and tilting it away from the cooler.

Slide out the water cooler subassembly on the chassis slides by disengaging each one-quarter-turn twist lock retainer located on each slide. The cooling unit is now free to be pulled from the cabinet on slides. Pull the cooling unit far enough from the cabinet so that the circular cover of the reservoir is exposed.

Replacing the De-ionizing Cartridge

It is not necessary to drain the unit to replace the DI cartridge. Turn Off the system Remove the hose from the top fitting of the used cartridge by pulling upward. There is a quick disconnect fitting on the lower end of the DI cartridge. Disconnect at the quick disconnect fitting and remove the assembly. Remove the hose with the fitting from the old DI assembly and reinstall it on the new DI cartridge. Please check that the flow markings on the cartridge match the system flow (are pointed upward).

Cleaning the Particle Filter

The Model 234 Power Supply / Cooler is fitted with a re-usable particle filter which can be cleaned many times before requiring
replacement. The filter is located in the bottom center of the primary water reservoir.

Turn Off the system. To clean the filter, reach into the reservoir and remove the filter assembly by turning counter clockwise. Reaching into the system with your hand will cause a DI error when the system is restarted. To eliminate this problem wear very clean latex gloves. Once the filter assembly is free of the threads, remove to a sink. Invert the filter assembly and run tap water through the inverted assembly. Use a soft brush and gently scrub the filter face. Once rinsed, place the particle filter back in the reservoir and fasten in place by turning clockwise.

NOTE
Please see the Spare Parts section of this manual for Part Numbering and ordering information. Quantronix strongly recommends using only original OEM replacement parts to ensure the continued operation of the Model 234 Power Supply / Cooler.

Draining the Reservoir
Remove the circular reservoir cover. Siphon the water from the reservoir as much as possible. Mop up any remaining water with a towel or sponge.

User Maintenance
Every effort has been made in the design and manufacture of your Model 234 Power Supply / Cooler, to ensure uninterrupted operation. In the unlikely event of a failure, please refer to the troubleshooting section of this manual. Once the cause of the problem has been isolated, please use the following guidelines for repair or replacement. This guide is not meant to be all-inclusive, but will cover those parts with a finite life cycle, and those which are considered user-serviceable.

Removing Sub-Assemblies for Repair or Replacement
LOGIC UNIT, POWER SUPPLY, RF DRIVER
Several of the major sub-assemblies in the Model 234 have been designed for ease of removal for repair or replacement. These include the Logic Unit, RF Driver, and Power Supply.

To remove these units, slide them out to the full extension of the chassis slides. Disconnect all wires and cables, making sure they are marked for ease of replacement. Depressing the slide latch buttons, pull the assembly off the cabinet slides. Remove the slide adapters from the sides of the units and carefully pack the unit for
NOTE
In the case of any return, please follow the return procedure to expedite service. Obtaining a Return Materials Authorization (RMA) number and providing any pertinent failure information speeds response and helps us to continuously improve our product.

POWER DISTRIBUTION BOX
Although a modular unit, the Power Distribution box is hard wired to your electrical service via the umbilical cord. Therefore, removal for return is difficult and not recommended. However, the Power Distribution box has been designed so that access to any part is easily achieved through removal of the top cover.

Component Replacement

**THERMOSTAT SWITCH**
The Thermostat Switch is located in the bottom of the primary water reservoir. This small, metallic switch is removed after full draining of the reservoir. Unscrew the retaining bolt on the bottom of the reservoir and remove the switch head. Then disconnect the electrical wires for the switch from S3 on the cooler terminal block.

When replacing a sensor, please apply pipe tape or other sealing compound to the Thermostat Switch threads to assure leak-free cooler operation.

**LEVEL SWITCH**
The Level Switch is located at the top of the cooler, and is a float-type switch used to sense the proper water level in the reservoir. To remove, push the sensor body up through the cutout in the reservoir. Then remove the wires from S2 on the cooler terminal strip.

**DEIONIZATION (DI) SENSOR/TEMPERATURE SENSOR**
The DI sensor is located on the inner wall of the reservoir. To replace, pull the assembly out of the wall bracket. Loosen the hose clamp on the feeder hose and remove the unit from the hose. Then unscrew DI sensor from the “T” fitting. Disconnect the wires at S1, P1 on the cooler terminal block.

NOTE
Quantronix has a Field Engineering Department ready to assist you. Please call us should your cooler exhibit failure of any sort, or should you need operational assistance.
Shipping and Storage

Shipping

The Model 234 Power Supply / Cooler and associated laser will arrive in a specially designed shipping crate. If possible, retain this crate for future use in shipping or moving the system.

Should the original packing not be available, please take care in supporting the cooler in shipping. We recommend a wooden pallet to support the weight. Always completely drain the cooler prior to shipping.

Storage

Should you have to store the Model 234 Power Supply / Cooler for any length of time, please follow these simple guidelines:

1. Drain the cooler components completely. Any residual water can cause corrosion or damage via freezing should the temperature be below freezing.

2. Clearly label all connections for ease of assembly after storage.

3. Assure that the cooler is in a dirt/dust free environment, or package it to prevent dust and dirt from permeating the system.
Customer Service

The following information is supplied to the user as a helpful guide in evaluating possible problems during the operation of the Model 234 Power Supply / Cooler. If after following these guides, your system is still not performing to specification, please call Quantronix Customer Service.

Faults

When a fault is detected, a FAULT indicator will illuminate and the Model 234 system will shutdown. The indicator will stay illuminated until the user corrects the FAULT and resets the system.

To reset the system, return the Key Switch located on the Control Panel to the OFF position and follow the turn on procedure outlined in Operation Section of this manual.

Fault Indicators and their Causes

**Pump Status Indicator**
When this indicator is lit the primary cooling water pump is on. If this indicator does not turn on when the pump is turned on the pump is not operating.

**Coolant Level Indicators**
Provides a visual indication of primary water level. Green lamp on indicates that the primary cooling water is at the correct level. Yellow lamp and audible beeper pulsing, indicates that the primary cooling water is not at the correct level. Red lamp and audible beeper on indicates that the primary cooling water level is too low and shuts down the laser.

**Coolant Temperature Indicators**
Provides a visual indication of primary water temperature. Green lamp on indicates that the primary cooling water is in the correct temperature range. Yellow lamp pulsing, indicates that the primary cooling water has not reached correct operating range. Red lamp and audible beeper pulsing indicates that the primary cooling water temperature is hot. Continuous red lamp and audible beeper indicates that the primary cooling water temperature is too hot and shuts down the laser.
**Coolant Flow Indicators**
Provides a visual indication of primary water flow rate. Green lamp on indicates that the primary cooling water is flowing at the correct rate. Red lamp and audible beeper on, indicates that the primary cooling water flow rate is too low. After 5 seconds, this condition will cause the laser to shut down.

**Coolant Ionization Indicators**
Provides a visual indication of the ionization level of the primary water. Green lamp on indicates that the deionized water in the primary cooling water loop is in the correct conductivity range. Yellow lamp on, indicates that the conductivity of the deionized water in the primary cooling water loop is too low and maintenance is required. Red lamp on indicates that the conductivity of the deionized water in the primary cooling water loop is too high and maintenance is required. The arc lamp will not operate when the high conductivity alarm is active.

**Lamp Status Indicator**
Green lamp on indicates that the arc lamp is on.

**Trouble Shooting**

**Coolant Level Indicators**
- **Yellow lamp and audible beeper pulsing** indicates that the primary cooling water is not at the correct level.
- **Probable Cause**, *water level dropped due to evaporation or a leak in the system.*
- **Possible Remedy**, add distilled water to fill line in reservoir. Always keep reservoir covered. Check for leaks.

- **Red lamp and audible beeper on** indicates that the primary cooling water level is too low and shuts down the laser.
- **Probable Cause**, *water level dropped due to evaporation.*
- **Possible Remedy**, add distilled water to fill line in reservoir. Always keep reservoir covered.

**Coolant Temperature Indicators**
- **Yellow lamp pulsing**, indicates that the primary cooling water is has not reached correct operating range.
- **Probable Cause**, *arc lamp is not on. It has not been turned on, it is burned out or it has just been turned on, or the solenoid valve is stuck open due to dirt in the secondary water.*
- **Possible Remedy**, turn on lamp, or replace. If the lamp is on, allow it to run for several minutes to stabilize the primary water temperature. Contact Quantronix Service.
Red lamp and audible beeper pulsing indicates that the primary cooling water temperature is hot.  
**Probable Cause,** insufficient secondary cooling water.  
**Possible Remedy,** increase the flow or decrease the temperature of the secondary water.

Continuous red lamp and audible beeper indicates that the primary cooling water temperature is too hot low and shuts down the laser.  
**Probable Cause,** insufficient secondary cooling water.  
**Possible Remedy,** increase the flow or decrease the temperature of the secondary water.

**Coolant Flow Indicators**  
Red lamp and audible beeper on indicates that the primary cooling water flow rate is too low. After 5 seconds, this condition will cause the laser will shut down.  
**Possible Cause,** Blockage in primary water flow or a bad Flow Switch.  
**Possible Remedy,** Remove the blockage or replace the Flow Switch.

**Coolant Ionization Indicators**  
Yellow lamp on, indicates that the conductivity of the deionized water in the primary cooling water loop is too low and maintenance is required.  
**Possible Cause,** Use of high purity distilled water instead of steam-distilled water.  
**Possible Remedy,** Allow system to run 30 minutes to see if the problem is eliminated. Replace the DI cartridge.

Red lamp on indicates that the conductivity of the deionized water in the primary cooling water loop is too high and maintenance is required. The arc lamp will not operate when the high conductivity alarm is active.  
**Possible Cause,** System put into operation after a long period of disuse. Reaching into the water bucket with a bare hand.  
**Possible Remedy,** drain and refill.

**System will not Turn On**  
**Possible Remedy,** Check circuit breaker and fuses.

**Possible Remedy,** verify incoming phase to phase line voltage (208 VAC 10%).

**Possible Remedy,** verify upon turning key switch on that an audible click is produced by the phase rotation relay in the power distribution. Otherwise refer to Installation Section for details.
External Control

Quantronix Model 234 Power Supply / Cooler RS-232 Serial Interface

The 232 Serial Interface connector is a 9-pin D-Shell (DE9), labeled J6 located at the rear of the main logic board J6.

Connections

<table>
<thead>
<tr>
<th>pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>224 Cooler Transmitted Data</td>
</tr>
<tr>
<td>3</td>
<td>224 Cooler Received Data</td>
</tr>
<tr>
<td>5</td>
<td>Signal Ground</td>
</tr>
</tbody>
</table>

Data Format

- Baud rate: 4800
- Start bit: 1 bit
- Stop bit: 1 bit
- Data: 8 bits
- Parity: None

Communication Procedure

The 234 Cooler may be connected and controlled by a dumb terminal or computer via the RS-232 link. This interface is coexistent with the 234 control panel. After the 234 is turned on, the dumb terminal will display "Quantronix Corp. 234 Cooler, Version 1.04"

To enable RS-232 communications, the command “232 1” is given at which time the dumb terminal echoes “RS-232 control”. While RS-232 communications are enabled, then the keypad on the remote control panel remains functional. Only the key position Off is operational.

If manual control is desired, the command “232 0” must be entered and the dumb terminal echoes message “Panel control

While parameters can be changed via RS-232, all parameters can be accessed via the control panel.
**Command line syntax**

```
CCC \vr
CCC Command should be 3 characters, case not sensitive
CCC is followed by a space character, but may also be excluded
V Value 0 for off, 1 for on, or value setting for CUR (current)
or PRF
\n Carriage return
\r Line feed
```

**Commands**

232 RS-232 enable/disable
- 232 \r RS-232 control enable
- 232 0\r RS-232 control disable
- 232\r Request RS-232 status on or off

COO Cooler on/off
- COO \r Cooler on
- COO 0\r Cooler off (may be turned off when laser is on)
- COO\r Request Cooler status

CUR Current control
To set current parameter, laser must be on. To set Range is limited to within remote panel setting. Unit is 1/100 Amp.
- CUR 3000\r Current will be set at 30 Amp
- CUR $0BB8\r Current will be set at 30 Amp
- CUR\r Request current setting, in 4 digits hexadecimal

DRS RF source external/internal. NOTE default is external
- DRS 0\r Set RF source to external, min. is 100Hz with Model 392 RF driver
- DRS 1\r Set RF source to internal, min. is 20Hz with main control board
LAS Laser on/off
LAS 1\r Turn on Laser, (224 Cooler must already be on)
LAS 0\r Turn off Laser
LAS\r request laser status

NOI Noise figure
NOI\r request noise figure (1-99), in 4 digits, Hexadecimal

PRF PRF on/off and frequency control.
The range is limited to within remote panel setting. Unit is 1/100kHz
PRF 1\r PRF on
PRF 0\r PRF off, single shot
PRF 1000\r PRF frequency will be set at 10 kHz, ext. RF
PRF $03E8\r PRF frequency will be set at 10 kHz, ext. RF
PRF 9\r Single shot, int. RF source
PRF 8\r Single shot, int. RF source
PRF 7\r PRF frequency will be set to 70Hz, int. RF source
PRF 6\r PRF frequency will be set to 60Hz, int. RF source
PRF 5\r PRF frequency will be set to 50Hz, int. RF source
PRF 4\r PRF frequency will be set to 40Hz, int. RF source
PRF 3\r PRF frequency will be set to 30Hz, int. RF source
PRF 2\r PRF frequency will be set to 20Hz, int. RF source
PRF\r request PRF frequency setting, in 4 digits hex

QRF Q-switch RF on/off
QRF 1\r Q-switch RF on
QRF 0\r Q-switch RF off. NOTE: sets laser to CW
QRF\r Request Q-switch RF on/off

SHU Shutter open/close. Manual override switch must be in open position
SHU 1\r Shutter open
SHU 0\r Shutter closed
SHU\r Request Shutter status

STB Stabilizer on/off
STB 1\r Stabilizer on
STB 0\r Stabilizer off
STB\r Request Stabilizer status

KTP  KTP shutter open/close
    KTP 1\r KTP shutter open
    KTP 0\r KTP shutter closed
    KTP\r Request KTP shutter status

WAR  Warning information
WAR\r request warning information, in 4 digits hexadecimal
       bit 0 is water level
       bit 1 is water temp
       bit 2 is DI water

Example Laser Operation
Key switched to ON
232 1\r RS-232 control
COO 1\r Cooler on
LAS 1\r Laser is turned on
QRF 1\r Q-switch RF is turned on

SHU 1\r Shutter is open.
CUR 2000\r Current set to 20 Amps
PRF 1\r RF on. Laser is set to continuous fire
PRF 0100\r PRF set to 1kHz (external RF source)
DRS 1\r RF source set to internal
PRF 2\r PRF set to 20 Hz (internal RF source)
PRF 8\r Single shot (laser is pulsed on/off)
PRF 8\r Another single shot
DRS 0\r RF source is set to external
PRF 0100\r RF set to 1kHz
PRF 1\r Laser is set to continuous fire (1kHz)
QRF 0\r Laser is set to CW
QRF 1\r Laser is returned to continuous fire

SHU 0\r Shutter is closed.
LAS 0\r Laser is turned off.
QRF 0\r Q-switch RF is turned off
COO 0\r
Cooler is turned off.

232 1\r
Panel control\n\r
Key switched to OFF
# Power Distribution Box

## J601 Cooler Connector

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump Phase A</td>
</tr>
<tr>
<td>2</td>
<td>Pump Phase B</td>
</tr>
<tr>
<td>3</td>
<td>Pump phase C</td>
</tr>
<tr>
<td>4</td>
<td>Solenoid 24 Volts AC</td>
</tr>
<tr>
<td>5</td>
<td>Solenoid</td>
</tr>
<tr>
<td>6</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Fan 24 Volts DC</td>
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<tr>
<td>14</td>
<td>Fan 24 Volts DC</td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

## J602 To Controller

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water Solenoid</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-15 Volts DC P/S 1</td>
</tr>
<tr>
<td>4</td>
<td>+15 Volts DC P/S 1</td>
</tr>
<tr>
<td>5</td>
<td>+5 Volts DC P/S 1</td>
</tr>
<tr>
<td>6</td>
<td>24 Volts AC</td>
</tr>
<tr>
<td>7</td>
<td>-5 Volts DC P/S 2</td>
</tr>
<tr>
<td>8</td>
<td>5 Volts DC Com P/S 2</td>
</tr>
<tr>
<td>9</td>
<td>24 Volts AC</td>
</tr>
<tr>
<td>10</td>
<td>Contactor On</td>
</tr>
<tr>
<td>11</td>
<td>15 Volts DC Com P/S 1</td>
</tr>
<tr>
<td>12</td>
<td>+5 Volts DC Com P/S 1</td>
</tr>
<tr>
<td>13</td>
<td>Logic On</td>
</tr>
<tr>
<td>14</td>
<td>5 Volts DC Com P/S 2</td>
</tr>
<tr>
<td>15</td>
<td>+5 Volts DC P/S 2</td>
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</table>
### J603 To RF Driver

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase A</td>
</tr>
<tr>
<td>2</td>
<td>Phase B</td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
</tr>
</tbody>
</table>

### J604 To Laser Head

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120 Volts AC</td>
</tr>
<tr>
<td>2</td>
<td>120 Volts AC Return</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Cooler**

### J301 To J103 on Controller

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Digital Level Fault</td>
</tr>
<tr>
<td>4</td>
<td>Digital Level Warning</td>
</tr>
<tr>
<td>5</td>
<td>Digital Flow Fault</td>
</tr>
<tr>
<td>6</td>
<td>Digital Temperature Fault</td>
</tr>
<tr>
<td>7</td>
<td>Digital DI Sense</td>
</tr>
<tr>
<td>8</td>
<td>Analog Temperature Sense</td>
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<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Digital Level 2 Return</td>
</tr>
<tr>
<td>11</td>
<td>Digital Level 1 Return</td>
</tr>
<tr>
<td>12</td>
<td>Digital Flow Return</td>
</tr>
<tr>
<td>13</td>
<td>Digital Temperature Return</td>
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<tr>
<td>14</td>
<td>Digital Sense Return</td>
</tr>
<tr>
<td>15</td>
<td>Analog Temperature Return</td>
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### J302 To J601 on Power Distribution Box

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump Phase A</td>
</tr>
<tr>
<td>2</td>
<td>Pump Phase B</td>
</tr>
<tr>
<td>3</td>
<td>Pump Phase C</td>
</tr>
<tr>
<td>4</td>
<td>Solenoid 24 Volts AC</td>
</tr>
<tr>
<td>5</td>
<td>Solenoid</td>
</tr>
<tr>
<td>6</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
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</tr>
</tbody>
</table>
### Power Supply

#### J201 To J107 on Controller

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remote On/Off Positive</td>
</tr>
<tr>
<td>2</td>
<td>Read Back Negative</td>
</tr>
<tr>
<td>3</td>
<td>Clear Internal Lock Positive</td>
</tr>
<tr>
<td>4</td>
<td>Read Back Positive</td>
</tr>
<tr>
<td>5</td>
<td>Program Voltage Positive</td>
</tr>
<tr>
<td>6</td>
<td>Remote On/Off Negative</td>
</tr>
<tr>
<td>7</td>
<td>Clear Internal Lock Negative</td>
</tr>
<tr>
<td>8</td>
<td>Program Voltage Negative</td>
</tr>
<tr>
<td>9</td>
<td>Trigger Ready Positive</td>
</tr>
<tr>
<td>10</td>
<td>Trigger Ready Negative</td>
</tr>
<tr>
<td>11</td>
<td>Remote Trigger Negative</td>
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<tr>
<td>12</td>
<td>Remote Trigger Positive</td>
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### J13 To J108 on Controller

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logic Ground</td>
</tr>
<tr>
<td>2</td>
<td>Logic Ground</td>
</tr>
<tr>
<td>3</td>
<td>CW/Q-Switch Ramp Select</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
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<tr>
<td>7</td>
<td>External PRF</td>
</tr>
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<td>8</td>
<td>PRF Gate</td>
</tr>
<tr>
<td>9</td>
<td>Internal/External PRF Select</td>
</tr>
<tr>
<td>10</td>
<td>Q-Switch On/Off</td>
</tr>
<tr>
<td>11</td>
<td>Logic Ground</td>
</tr>
<tr>
<td>12</td>
<td>Logic Ground</td>
</tr>
<tr>
<td>13</td>
<td>Q-Switch Fault</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
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<td>18</td>
<td>RF Ground</td>
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<td>RF On/Off</td>
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<td>24</td>
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<td>25</td>
<td>Logic</td>
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### J101 To Laser Head

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>+12 Volts DC Unregulated</td>
</tr>
<tr>
<td>2</td>
<td>-15 Volts DC</td>
</tr>
<tr>
<td>3</td>
<td>+15 Volts DC</td>
</tr>
<tr>
<td>4</td>
<td>Power Detect</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Isolated Ground</td>
</tr>
<tr>
<td>9</td>
<td>Logic Ground</td>
</tr>
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</table>
### J102 To Laser Head

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal SHT Return</td>
</tr>
<tr>
<td>2</td>
<td>KTP SHT Return</td>
</tr>
<tr>
<td>3</td>
<td>Emis Lt</td>
</tr>
<tr>
<td>4</td>
<td>Internal SHT Return</td>
</tr>
<tr>
<td>5</td>
<td>KTP SHT</td>
</tr>
<tr>
<td>6</td>
<td>24 Volts AC</td>
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### J105 To Hardware Interface (Optional)

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
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<tbody>
<tr>
<td>1</td>
<td>Shutter Interlock</td>
</tr>
<tr>
<td>2</td>
<td>+5 Volts DC</td>
</tr>
<tr>
<td>3</td>
<td>External PRF Enable</td>
</tr>
<tr>
<td>4</td>
<td>External PRF Pulse</td>
</tr>
<tr>
<td>5</td>
<td>External PRF Gate</td>
</tr>
<tr>
<td>6</td>
<td>External PRF First Pulse Suppression</td>
</tr>
<tr>
<td>7</td>
<td>External PRF Return</td>
</tr>
<tr>
<td>8</td>
<td>External Current Enable</td>
</tr>
<tr>
<td>9</td>
<td>External Current Control</td>
</tr>
<tr>
<td>10</td>
<td>External Current Return</td>
</tr>
<tr>
<td>11</td>
<td>Current Readout</td>
</tr>
<tr>
<td>12</td>
<td>Shutter Open Command</td>
</tr>
<tr>
<td>13</td>
<td>Shutter Close Command</td>
</tr>
<tr>
<td>14</td>
<td>Shutter Open</td>
</tr>
<tr>
<td>15</td>
<td>Ground</td>
</tr>
</tbody>
</table>

### J106 To RS-232 Interface

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Signal</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>DTR</td>
</tr>
<tr>
<td>2</td>
<td>TXD</td>
</tr>
<tr>
<td>3</td>
<td>RXD</td>
</tr>
<tr>
<td>4</td>
<td>DCD</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>NU</td>
</tr>
<tr>
<td>7</td>
<td>CTS</td>
</tr>
<tr>
<td>8</td>
<td>RTS</td>
</tr>
<tr>
<td>9</td>
<td>UN</td>
</tr>
</tbody>
</table>
Model 234-1 Power Supply/Cooler

Controller

- TO LASER HEAD
- TO LASER HEAD
- HARDWARE INTERFACE (OPTIONAL)
- RS-232 INTERFACE (OPTIONAL)

Cooler System

- FAN
- POWER DISTRIBUTION

RF Driver

- OUTPUT
- TO LASER HEAD

Power Supply

- INPUT
- NOMINAL INPUT
200-220VAC
3 PHASE 50/60 Hz
35 A

TB1

- TO LASER HEAD

To Laser Head


P101 P102 P103 P104 P105 P106 P107 P108 J111

P301 P302 J301 J302 J303

P5 P6 J5 J6 J2 J13 J14

P201 J201

P601 P602 P603 J601 J602 J603 J13 J14

+ - + -

NOMINAL INPUT
200-220VAC
3 PHASE 50/60 Hz
35 A

TO LASER HEAD
Model 234-2 Power Supply/Cooler

NOMINAL INPUT
200-220VAC
3 PHASE 50/60 HZ
50 A

TO LASER HEAD
P101
J101

TO LASER HEAD
P102
J102

HARDWARE INTERFACE (OPTIONAL)
P105
J105

RS-232 INTERFACE (OPTIONAL)
P106
J106

CONTROLLER

POWER DISTRIBUTION

COOLER SYSTEM

RF DRIVER

POWER SUPPLY

TOROID ASSEMBLY

FAN

INPUT

OUTPUT

TO LASER HEAD

TO LASER HEAD

TO LASER HEAD

TO LASER HEAD

+  -

+  -

TB1

P5
J4
P2
J2

P13
J13

P14
J14

P601
J601

P602
J602

P603
J603

P604
J604

INPUT

P301
J301

P302
J302

P201
J201

P103
J103

P104
J104

P108
J108

P107
J107

P106
J106

P105
J105

P102
J102

P101
J101

TO LASER HEAD

TO LASER HEAD

TO LASER HEAD
Water Flow Through Model 234 Cooler
Model 234 Cooler Schematic
# Spare Parts List

## 1 HP Cooler

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 HP Cooler water system</td>
<td>0202-05888</td>
</tr>
</tbody>
</table>

1. Hose, preformed ‘J’ reservoir to pump                        | 3002-01895 |
2. Pump water 1HP                                               | 2801-00749 |
   a. Volute Assembly
      * Volute case                                             | 2802-00408 |
      * Fitting 3/4 NPT(2)                                      | 3001-51015 |
      * Fitting Elbow(2)                                        | 3001-50973 |
      * Plug Orifice(2)                                         | 1402-02448 |
      * Adhesive(4oz)                                           | 1008-00189 |
   b. Volute Case                                                | 2802-00408 |
   c. Impeller                                                  | 2802-00424 |
   d. Seal, with seat                                           | 093740     |
   e. Gasket, end bell                                          | 093724     |
3. DI Water Sensor Assembly                                      | 0202-05667 |
4. Reservoir Tank Seal (small)                                   | 3002-01968 |
5. Hose Elbow, DI cartridge to reservoir                         | 3002-01887 |
6. Cartridge, DI Water                                          | 072835     |
7. Hose, preformed ‘5’ pump to DI out                            | 3002-01909 |
8. Heat Exchanger                                               | 2802-00459 |
9. Hose, preformed ‘U’ DI in to heat exchanger.                  | 3002-01925 |
10. Manifold, coolant fitting                                    | 1402-02626 |
11. Pump isolation mount(4)                                      | 2703-05368 |
12. Cable assembly, cooler to logic                              | 0202-05608 |
13. Cable assembly, Pump/solenoid to clr                         | 0202-05624 |
14. Reservoir                                                   | 3002-01933 |
15. Reservoir tank seal (large)                                  | 3002-01976 |
16. Reservoir Cover                                             | 3002-01941 |
17. Water flow switch                                            | 2802-00483 |
18. Thermostat Switch                                            | 2205-00944 |
19. Hose Elbow, heat exchanger/flow switch                       | 3002-01984 |
20. Water level switch                                           | 2802-00475 |
21. Garden hose connector (Secondary water)                     | 2703-02571 |
22. Solenoid valve                                              | 3002-01917 |
23. Hose clamp, (DI cartridge)                                   | 2305-1395  |
24. Filter, particle                                             | 2802-00467 |
Figure 12.1 Cooler
# 1.5 HP Cooler

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 HP Cooler water system</td>
<td>0202—05896</td>
</tr>
<tr>
<td>1. Hose, preformed ‘J’ reservoir to pump</td>
<td>3002-01895</td>
</tr>
<tr>
<td>2. Pump water 1.5HP2801-00757</td>
<td></td>
</tr>
<tr>
<td>a. Volute Assembly</td>
<td></td>
</tr>
<tr>
<td>* Volute case</td>
<td>2802-00408</td>
</tr>
<tr>
<td>* Fitting 3/4 NPT(2)</td>
<td>3001-51015</td>
</tr>
<tr>
<td>* Fitting Elbow(2)</td>
<td>3001-50973</td>
</tr>
<tr>
<td>* Plug orifice(2)</td>
<td>1402-02448</td>
</tr>
<tr>
<td>* Adhesive(4 oz)</td>
<td>1008-00189</td>
</tr>
<tr>
<td>b. Volute case</td>
<td>2802—00408</td>
</tr>
<tr>
<td>c. Impeller</td>
<td>2802—00416</td>
</tr>
<tr>
<td>d. Seal with seat</td>
<td>093740</td>
</tr>
<tr>
<td>e. Gasket, end bell</td>
<td>093724</td>
</tr>
<tr>
<td>3. DI Water Sensor Assembly</td>
<td>0202—05667</td>
</tr>
<tr>
<td>4. Reservoir Tank Seal (small)</td>
<td>3002—01968</td>
</tr>
<tr>
<td>5. Hose Elbow, DI Cartridge to reservoir</td>
<td>3002—01887</td>
</tr>
<tr>
<td>6. Cartridge, DI water</td>
<td>072835</td>
</tr>
<tr>
<td>7. Hose, Preformed ‘S’ pump to DI out</td>
<td>3002—01909</td>
</tr>
<tr>
<td>8. Heat Exchanger</td>
<td>2802—00505</td>
</tr>
<tr>
<td>9. Hose, Preformed ‘U’ DI in to heat exchanger</td>
<td>3002—01925</td>
</tr>
<tr>
<td>10. Manifold, coolant fitting</td>
<td>1402—02626</td>
</tr>
<tr>
<td>11. Pump Isolation mount (4)</td>
<td>2703—05368</td>
</tr>
<tr>
<td>12. Cable Assembly, cooler to logic</td>
<td>0202—05608</td>
</tr>
<tr>
<td>13. Cable Assembly, Pump/solenoid to clr</td>
<td>0202—05624</td>
</tr>
<tr>
<td>14. Reservoir</td>
<td>3002—01933</td>
</tr>
<tr>
<td>15. Reservoir Tank Seal (large)</td>
<td>3002—01976</td>
</tr>
<tr>
<td>16. Reservoir Cover</td>
<td>3002—01941</td>
</tr>
<tr>
<td>17. Water Flow Switch</td>
<td>2802—00483</td>
</tr>
<tr>
<td>18. Thermostat Switch</td>
<td>2205—00944</td>
</tr>
<tr>
<td>19. Hose Elbow, heat exchanger/flow switch</td>
<td>3002—01984</td>
</tr>
<tr>
<td>20. Water Level Switch</td>
<td>2802—00475</td>
</tr>
<tr>
<td>21. Garden Hose Connector (Secondary water)</td>
<td>2703—02571</td>
</tr>
<tr>
<td>22. Solenoid Valve</td>
<td>3002—01917</td>
</tr>
<tr>
<td>23. Hose Clamp, (DI cartridge)</td>
<td>2305—01395</td>
</tr>
<tr>
<td>24. Filter, Particle</td>
<td>2802—00467</td>
</tr>
</tbody>
</table>
Figure 12.2 Water Pump