

Service Manual

Immersion Circulators
Heat-Only Circulators
Refrigerated/Heated Circulators
With
Standard Controllers



Before performing any service to the unit, reset the controller to its default settings. It is our experience that many problems can be resolved by doing so. See Sec. 4.1 of this manual for instructions.



Refrigeration service should only be performed by a qualified refrigeration technician.
The refrigeration system contains no user-serviceable parts.



This manual is intended for use by qualified service personnel only. Disconnect power cord before removing cover, exposed voltage when cover is removed. Hazard from moving parts present when cover is removed.

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Section 1 – Identifying Your Unit

Within this manual, units are identified using the following format:

- ▶ “Immersion circulator” refers to the immersion circulator with standard controller, model 7306
- ▶ “xx Liter Heating Circulator” (i.e. 13 liter heating circulator) refers to heat only circulators with internal reservoir, models 8006, 8106, 8206, 8306
- ▶ “xx Liter Refrigerated Circulator” (i.e. 28 liter refrigerated circulator) refers to heating/refrigerating circulators with internal reservoir, models 9006, 9106, 9506, 9606, 9706
- ▶ Model 9706, 13 liter low temperature models will be identified as “13 liter low temp refrigerated circulator”.
- ▶ “Controller” refers to the upper portion of the unit that includes the PC boards, pump, and heater. In the case of Immersion Circulators, the entire unit is the controller.

Section 2 – Specifications

2.1 – General Description, Heating and Refrigerated Circulators (9006 ,9106, 9506, 9606, 9706, 8006,9106,8206, 8306)

Refrigerated and Heat Only Circulating Baths with the Standard controller are designed for use as stand-alone baths or to provide precise temperature control of fluids for closed loop circulation to external equipment. Refrigeration is normally required for operation at temperatures below 30°C.

All Circulating Bath models feature a reservoir, which may be used for immersing samples while the unit is connected to an external device. Circulating Bath models are equipped with a 6, 13, or 28 liter reservoir. All wetted parts are corrosion-resistant 300 series stainless steel.

2.2 – General Description, Immersion Circulators (7306)

Immersion Circulators with Standard Controllers are designed for use in user-supplied reservoirs. These units can be used with many sizes and shapes of reservoirs, making them extremely versatile and useful for a wide variety of applications. They may be used for closed loop applications. Operation of the Controller is the same as that for Circulating Bath models.

2.3 – General Specifications, all units

Model Type	Temperature Range	Amps @ 120v 60Hz	Amps @ 240v 50Hz
6L 9106, 9006	-20° to 150 °C	12	9.9
13L 9506	-30° to 150 °C	13	9.8
28L 9606	-25° to 150 °C	13	9.8
13L 9706	-40° to 150 °C	14	9.9
8006,8106,8206, 8306	Ambient +5° to 150 °C	11	9.8
7306 8306	Ambient +5° to 150 °C	11	7.5

The following specifications apply to all units:

Temperature Stability ¹	±0.05 °C
Readout Accuracy	LED, °C or °F, ±0.25 °C
Heater	1100W – 115V, 1600W – 240V
Maximum Pressure Flow Rate	15 LPM
Over-Temperature Protection	Yes, user-adjustable
Low-Liquid Protection	Yes
Pump Speed	2 speeds, 9 or 15 lpm
Pump Inlet and Outlet	¼ inch FPT rear discharge (except immersion circulator)

1. Temperature stability may vary depending on bath volume, surface area, insulation, and type of fluid.

NOTE: Performance specifications determined at ambient temperature of 20 °C (68 °F).

Environmental Conditions:

- Indoor Use Only
- Maximum Altitude: 2000 meters
- Relative Humidity: 80% for temperatures to 30°C
- Class 1: Residential, Commercial, Light Industrial
- Over Voltage: Category II
- Operating Ambient: 5° to 30°C
- Pollution Degree: 2
- Class 2: Heavy Industrial

Section 3 – Maintenance

3.1 – Heater

The heater should be kept clean. If deposits build up on the heater, they may be removed by scrubbing with a non-metallic abrasive pad. Do not use steel wool.

3.2 – Pump Motor

The pump bearings are permanently lubricated with high-temperature silicone grease and do not require additional lubrication. Should the bearings become noisy, replacement of the entire pump motor is recommended. This will reduce repair labor costs and retain fluid pumping reliability.

3.3 – Cleaning

Only mild detergents and water or an approved cleaner should be used on the painted and stainless steel surfaces of the Circulator. Do not allow cleaning liquids or sprays to enter the Controller vents.

3.4 – Maintaining Clear Bath Water

When water is used as the bath fluid, optimal conditions are present for algae growth. To prevent algae contamination and minimize the need for draining the reservoir, an algicide should be used.

Do NOT use chlorine bleach in the reservoir or on any pump parts.

3.5 – Condenser, Air Vents, and Reusable Filter (Refrigerated Circulators Only)

To keep the refrigeration system operating at optimum cooling capacity, the condenser, the front and back air vents, and reusable filter should be kept free of dust and dirt. They should be checked on a scheduled basis and cleaned as required.

The reusable filter is easily accessed from the bottom/front of the unit. Turn the filter-retaining clip away from the filter cutout and remove the filter as shown in figure B. Use a mild detergent and water solution to wash off any accumulated dust and dirt and then rinse and dry thoroughly before reinstalling.



Figure B – Removing Air Filter

3.6 – Calibration

Calibration allows the user to match the Controller's bath temperature display to an external reference thermometer. Calibration is performed as follows:

Set the desired operating fluid temperature set point and allow temperature to stabilize.

Press the P2 and P3 simultaneously and release and repeat until the display reads (oCx.x). Press P1 and hold until (Cal) is displayed. This will take about 2 seconds.

At one second intervals, the displayed value will alternate between the actual bath fluid temperature and the current offset value, which is the difference between the factory calibration setting and the user's reference temperature sensor. The maximum offset is $\pm 0.9^{\circ}\text{C}$ from factory calibration.

To change the calibration offset value, rotate the Select/Set Knob until the display matches the reading on the reference temperature sensor. The display will continue to alternate between the offset value and the calibrated display temperature.

Press the Select/Set Knob or the P1 Button to accept the entered value. When the new calibration is stored and the mode is exited, (dONE) will appear on the display.

NOTE: The displayed offset value will also be accepted if there no activity for 20 seconds.

Section 4 – Controller

4.1 – Resetting unit to Factory Defaults (all units)

Before performing any service to the unit, reset the controller to factory defaults. It is our experience that a number of common problems can be resolved by doing so.

To reset the unit to default settings and operate in °C:

Set Circuit Breaker/Power Switch on the rear of the Controller in the OFF position

Press and hold the P2 Button while turning the power back ON

To reset the unit to default settings and operate in °F:

Place the Circuit Breaker/Power Switch in the OFF position

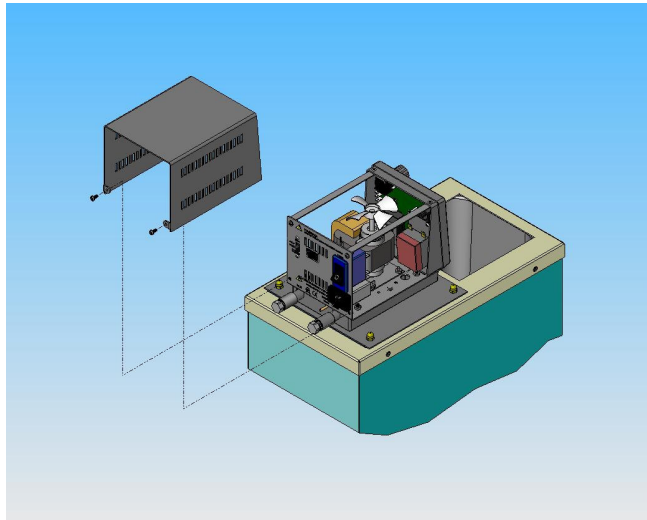
Press and hold the P3 Button while turning the power back ON

Note: When defaulting the unit, the high limit value and all temperature presets revert to the factory-default values. If a calibration value has been entered, the value will be retained.

4.2 – Removing Controller Cover (all units)

Remove the 2 screws that secure the cover to the controller chassis. Slide the cover backward and then lift up to remove.

Figure E – Removing Controller Cover



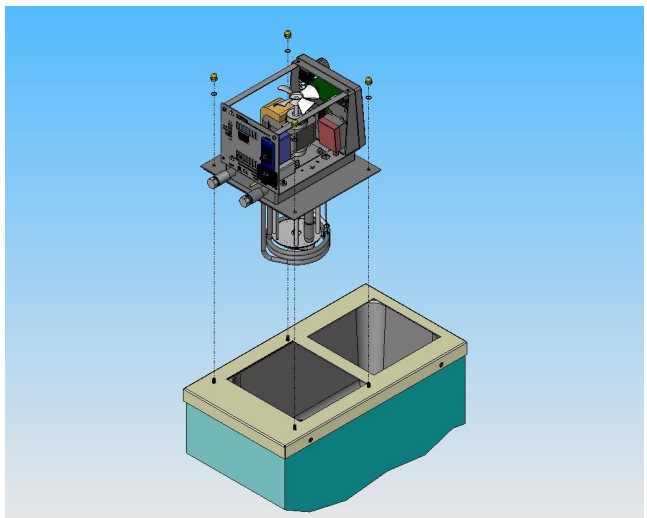
4.3 – Removing Controller from Unit (9006,9106, 9506, 9606, 9706 Only)

Remove the 4 knurled nuts that secure the controller to the lower assembly. For refrigerated models, disconnect the wiring that is routed to the lower refrigeration assembly.

Lift the controller up and away from the deck plate.

Note: To remove the controller and top deck plate at once, remove the 4 Phillips screws located on the outside edge of the deck plate instead of the 4 knurled nuts that hold the controller to the deck plate.

Figure F – Removing Controller From Unit

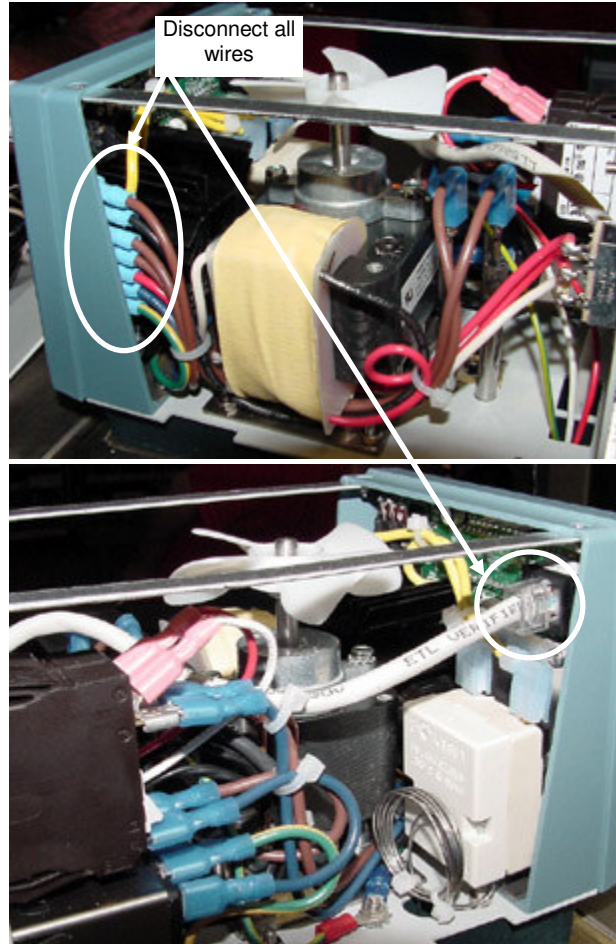


4.4 – Replacing Front Bezel Assembly (Main PC Board – all units)

1. Remove controller cover (see Sec. 4.2)

Note the color and location of the wires which are connected to the terminals on the back of the bezel, including the RJ45 cable. Disconnect all wires. (See Fig. G)

Figure G – Disconnecting wiring



Loosen the Phillips screw that secures temperature probe to retaining clip.

Figure H – Temperature probe retaining clip

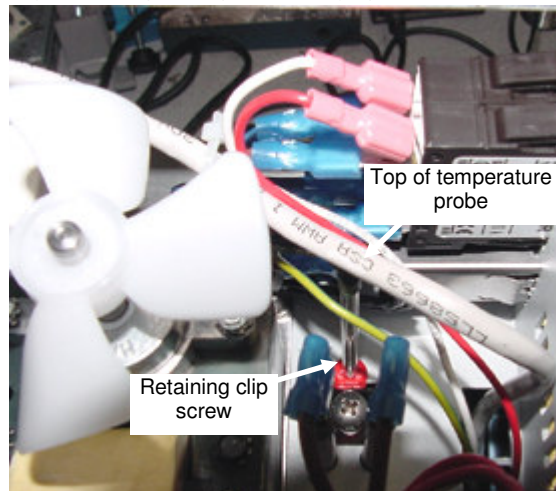


Figure I – OTP Retaining Clip

3. Remove controller from unit (*except immersion circulators*) (see Sec. 4.2).
4. Remove 4 screws that secure bezel to controller chassis.
5. Remove screw and clips that hold OTP thermostat to heater, then remove OTP sensor from heater (see Fig. I)
6. Remove bezel assembly, being careful to pull the temperature probe up and out of the controller (see Fig. J)

Installation of a new bezel is the reverse of the previous steps.

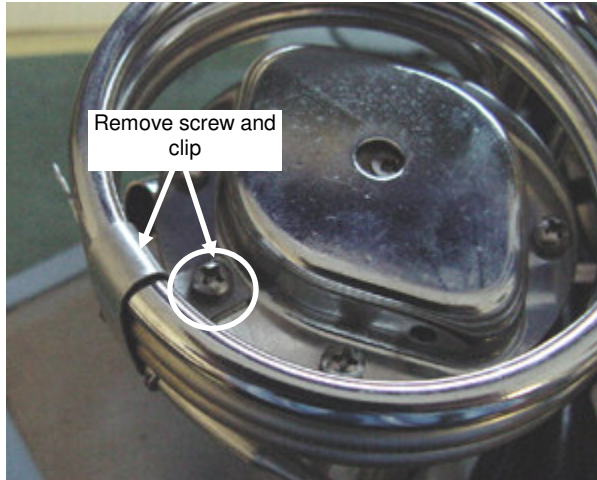
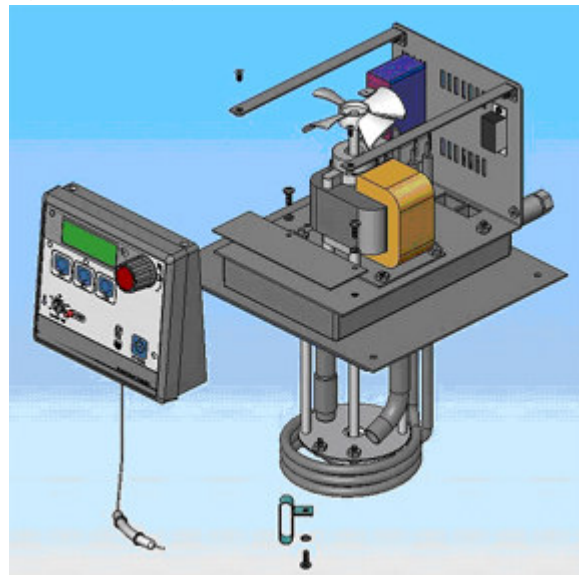


Figure J –Removing Bezel From Controller

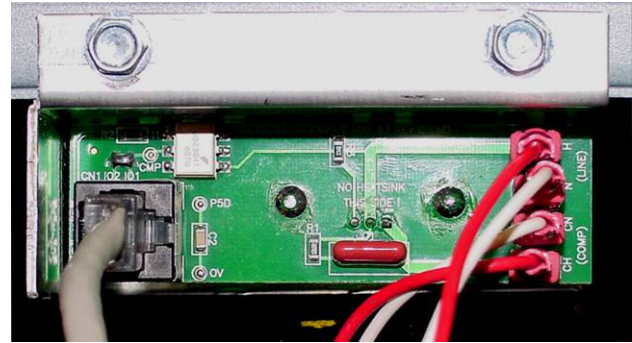


4.5 – Replacing the Compressor Control PC Board (9106, 9006 only)

1. Remove the controller and deck plate from the refrigeration assembly along (see Sec. 4.3).
2. Slide the case assembly from the refrigeration assembly.
3. Note the color and location of the wires that are connected to the Compressor Control PC Board. Disconnect the wires and remove the screws that secure the PCB to the refrigeration unit.

Installation of a new compressor control PCB is the reverse of the previous steps.

Figure K – Compressor Control PC Board

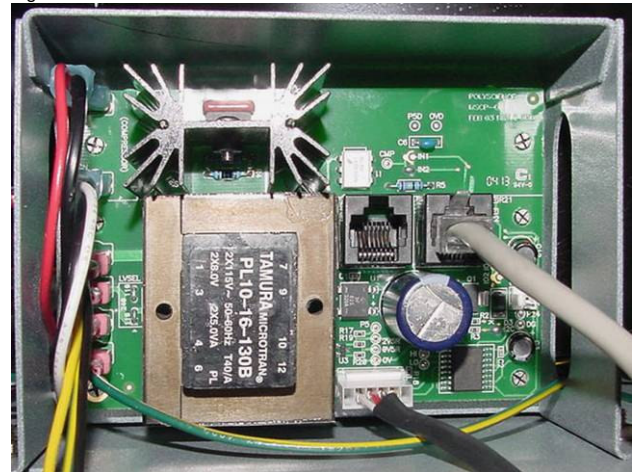


4.6 – Replacing the PWM Control PC Board (9506, 9706, 9606 only)

1. Remove the controller and deck plate from the refrigeration assembly (see Sec. 4.3).
2. Slide the case assembly from the refrigeration assembly.
3. Note the color and location of the wires that are connected to the PWM Control PC Board. Disconnect the wires and remove the screws that secure the PCB to the refrigeration unit.

Installation of a new PWM control PCB is the reverse of the previous steps.

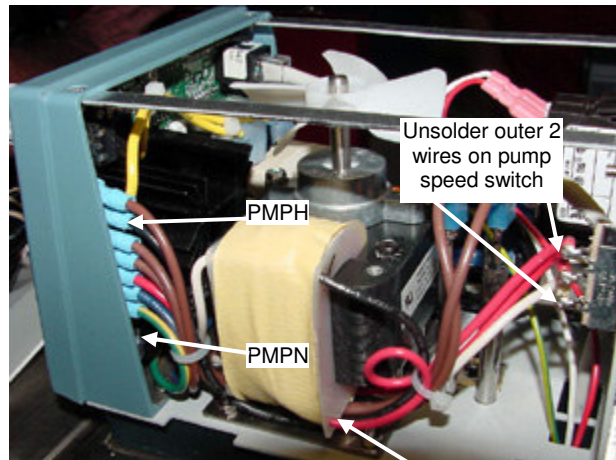
Figure L – PWM Control PC Board



4.7 – Replacing Pump Motor (all units)

1. Remove controller from unit (if applicable) and remove cover (see Sec. 4.2 & 4.3)
2. Note the color and location of the wires which are connected to the pump motor at PMPH and PMPN. Disconnect these 2 wires.
3. Unsolder the wires connected from the motor to the pump speed switch. Note, only the top and bottom wire on the switch should be removed; the center wire should NOT be removed.

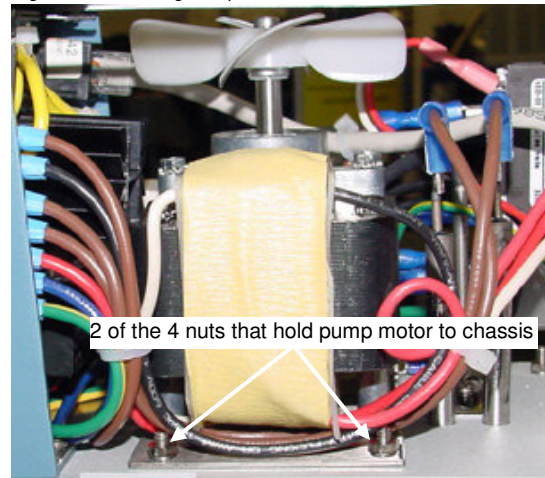
Figure M –Disconnecting Pump Motor Wiring



Pump Motor Ground Wire

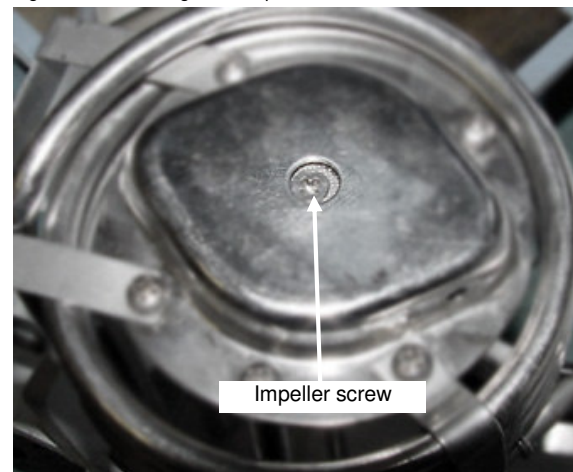
4. Remove the 4 nuts that secure the pump motor to the chassis.

Figure N –Removing Pump Motor from Controller



5. Position the controller upside down. Remove the screw that secures the Impeller to the pump shaft. It is not necessary to further disassemble the pump housing.
6. Note position of red rubber slinger located where motor shaft meets the bottom of the controller chassis. Remove the pump motor from the controller chassis.

Figure O – Detaching lower impeller



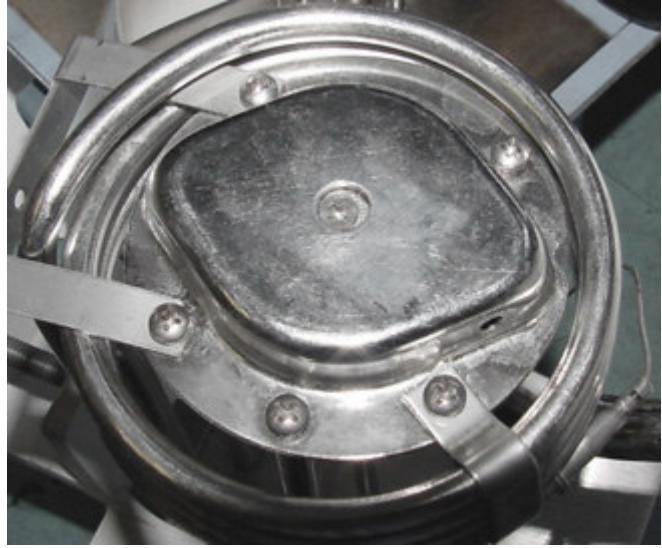
Install the new pump motor by following the previous steps in reverse.

4.8 – Replacing Pump Impeller (all units)

1. Remove controller from unit (*if applicable*) and remove cover (see Sec. 4.2 & 4.3)
2. Position the controller upside down. Remove the screw that secures the impeller to the pump shaft.
- 3.
4. Remove all screws that secure the impeller cover assembly to the heater/standoff and OTP sensor (see Fig. P)
5. Remove impeller bottom cover and plate.
6. Before removing the impeller, note the direction the impeller blades are facing. Remove the impeller.

Install the new upper impeller by following the previous steps in reverse.

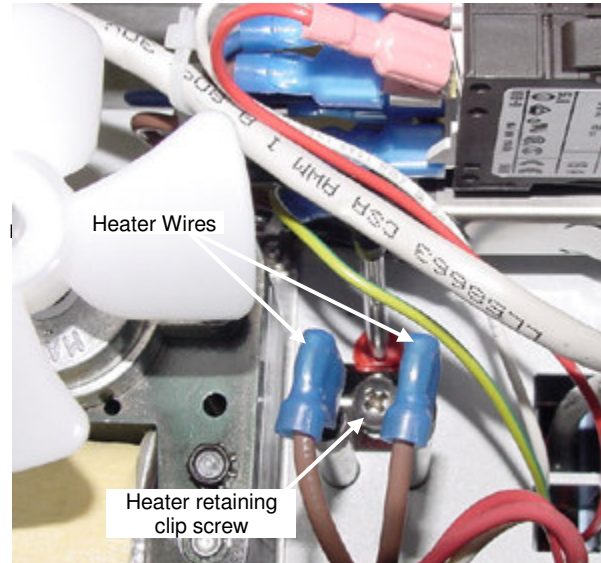
Figure P – Pump Assembly



4.9 – Replacing Heater (all units)

1. Remove controller from unit (*if applicable*) and remove cover (see Sec. 4.2 & 4.3)
2. Disconnect the two brown wires from the heater terminals (see Fig. Q)
3. Loosen the Phillips screw that secures the heater to retaining clip.

Figure Q – Disconnecting Heater Wires



- Position the controller upside down.

Remove the screw that holds the OTP sensor to the pump/heater assembly, then move the OTM sensor away from the heater.

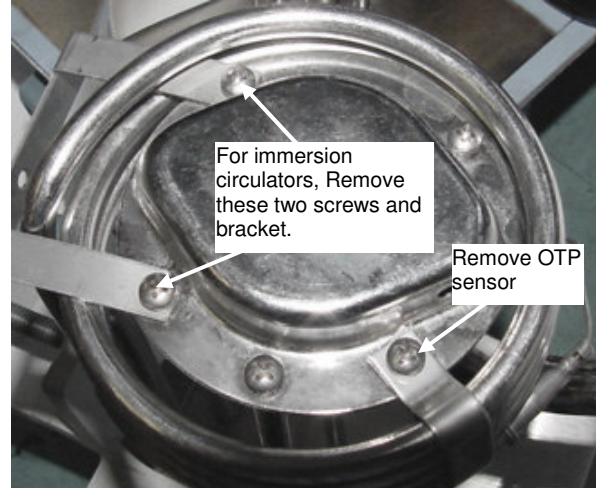
For immersion circulators only:

Remove the screws holding the bracket to the pump assembly.

- Remove heater from unit by sliding it down out of the controller.

Install the new heater by following the previous steps in reverse.

Figure S – Loosening Heater Retaining Clip



Section 5 – Refrigerant Charge (9106, 9006,9506,9706,9606 only)

Please note: Units are factory charged by refrigerant weight, not pressure. There are no published refrigerant pressure specifications available as they will vary with fluid temperature.

Models	Refrigerant Type	Charge (Grams)	Charge (Ounces)
9106,	R-134a	229 g	8.02 oz
9006	R-134a	229 g	8.02 oz
9506	R-134a	343 g	12.01oz
9706	R-404a	350 g	12.25 oz
9606	R-134a	343 g	12.01 oz

Section 6 – Basic Troubleshooting

6.1 – Stability problems (unit will not hold temperature within specified tolerances)

Confirm problem is with stability, not accuracy	Stability is the ability of the unit to hold a constant temperature within a specified tolerance. Stability is often confused with accuracy, which is the ability of the unit to display temperature within a given tolerance based on a known method of measurement. If temperature is being held at a constant temperature with little fluctuation, but the displayed temperature differs from that of a thermometer or separate device also reading temperature, the temperature display of the unit can be offset by using the calibration offset function.
Make sure the lid is used and that the fluid path is insulated	The included lid should always be used. Insulation should be used on the entire fluid path wherever possible. If an external tank is being used, it must be insulated and covered to achieve maximum stability. Stability specifications are based on the circulator's internal reservoir. External stability may be higher due to heat loss or gain as the fluid travels away from the circulator.
Check fluid properties	PolyScience specifications are based on tests performed with water or water/glycol at 20°C ambient room temperatures. Fluid properties, such as viscosity, density, specific gravity, etc. can greatly effect the performance of the unit.

Use bypass tube when circulating within the circulator	If the circulator is not being used to circulate fluid to another device or tank, the included bypass tubing should always be attached to the inlet and outlet of the unit. Blocking the inlet and outlet with plugs does not allow for optimum circulation within the reservoir and can affect stability.
Check tubing size, length, and look for restrictions and pressure drops	Achieving good stability with external applications requires that adequate fluid flow be maintained. Tubing smaller than 1/4 MPT ID will cause flow restrictions and will affect the performance of the unit. Also, consider the distance from the circulator and number of external devices being controlled when troubleshooting performance problems with the circulator.
Increase Auto-Refrigeration setting	Refrigerated units will achieve maximum stability when the refrigeration system is allowed to run, even at high temperatures. If possible, the auto-refrigeration setting should be set to the highest possible value.
Set pump speed to maximum	Set pump speed to maximum. Greater circulation can improve stability, especially when circulating to external devices or tanks.

6.2 – Accuracy problems (displayed temperature varies from that of an external thermometer or device)

Use calibration offset function	Accuracy is the ability of the unit to display temperature within given tolerances to a NIST traceable thermometer. The unit includes a calibration offset function which can be used to adjust the displayed temperature to match the users own temperature measurement equipment.
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6.3 – Heating too slowly

Check fluid properties	PolyScience specifications are based on tests performed with water or water/glycol at 20°C ambient room temperatures. Fluid properties, such as viscosity, density, specific gravity, etc. can greatly effect the performance of the unit.
Make sure the lid is used and that the fluid path is insulated	The included lid should always be used. Insulation should be used on the entire fluid path wherever possible. If an external tank is being used, it must be insulated and covered to reduce the possible cooling effect from the ambient air.
Check tubing size, length, and look for restrictions and pressure drops	Achieving responsive heating with external applications requires that adequate fluid flow be maintained. Tubing smaller than 1/4 MPT ID will cause flow restrictions and will affect the performance of the unit. Also, consider the distance from the circulator and number of external devices being controlled when troubleshooting performance problems with the circulator.

6.4 – No Heating

Increase safety set point (OTP)	PolyScience circulators include a redundant over-temperature feature. If the safety set point is set too low, the heater will be turned off when the bath temperature reaches the safety set point, regardless of the other settings on the control. Unless there are specific safety concerns, the safety set point should be set at maximum.
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6.5 – Cooling too slowly or not enough

Check fluid properties	PolyScience specifications are based on tests performed with water or water/glycol at 20°C ambient room temperatures. Fluid properties, such as viscosity, density, specific gravity, etc. can greatly effect the performance of the unit.
Make sure the lid is used and that the fluid path is insulated	The included lid should always be used. Insulation should be used on the entire fluid path wherever possible. If an external tank is being used, it must be insulated and covered to reduce the possible heating effect from the ambient air and condensation.
Check tubing size, length, and look for restrictions and pressure drops	Achieving responsive cooling with external applications requires that adequate fluid flow be maintained. Tubing smaller than 1/4 MPT ID will cause flow restrictions and will affect the performance of the unit. Also, consider the distance from the circulator and number of external devices being controlled when troubleshooting performance problems with the circulator.
Increase the auto-refrigeration setting	PolyScience circulators include an auto-refrigeration setting that allows the user to specify at what temperatures cooling should be active. Unless otherwise specifically required, the auto-refrigeration setting should be set to the highest temperature.
Check for refrigerant leaks	Sudden changes in the cooling capacity of the unit, without changes in the application, often indicate a loss of refrigerant. To distinguish between a refrigerant loss and compressor failure, listen for unusual noise from the compressor. Run the unit with no load to determine if any cooling is taking place. If there is cooling and no unusual noise from the compressor, a refrigerant leak is likely.

6.6 – Circulation / pump problems

Set pump speed to maximum	Lower pump speeds provide lower flow rates. This is especially useful if small diameter tubing is being used, or if the fluid path is fairly long. Note that circulators in general provide relatively low pressures. If the user requires the fluid to be moved over a great distance or up steep inclines, consider a chiller or secondary pump.
Check tubing size, length, and look for restrictions and pressure drops	Tubing smaller than 1/4 MPT ID will cause flow restrictions and will affect the performance of the unit. Also, consider the distance from the circulator and number of external devices being controlled when troubleshooting performance problems with the circulator.
Use bypass tube when circulating within the circulator	If the circulator is not being used to circulate fluid to another device or tank, the included bypass tubing should always be attached to the inlet and outlet of the unit. Blocking the inlet and outlet with plugs does not allow for optimum circulation within the reservoir.

6.7 – Can't Adjust Temperature / LLO is displayed on the screen

Disable local lockout	PolyScience circulators feature a control panel lockout option that can be used to prevent accidental or unwanted changes to the controller settings. When active the screen will display LLO or Local Lockout. It is enabled and disabled in the same manner: Press in and hold the set knob for 10 seconds.
Check high limit	The high limit setting allows the user to limit the functional temperature range of the circulator. If the desired set point is beyond the limit setting, the user will not be able to set that temperature. Unless otherwise required, the high limit should be set to maximum.

6.8 – No power / unit shuts down / unit trips breaker

Check line cord and outlet	Ensure that the included line cord is firmly plugged in at both ends. Make sure that the power outlet being used provides power that matches the unit requirements. The circulator's electrical requirements are located on the serial number tag at the back of the controller.
Increase safety set point (OTP)	PolyScience circulators include a redundant over-temperature feature. If the safety set point is set too low, the heater will be turned off when the bath temperature reaches the safety set point, regardless of the other settings on the control. Unless there are specific safety concerns, the safety set point should be set at maximum.

Section 7 – Technical Drawings

7.1 – Refrigeration Assemblies

1	Compressor	5	Capillary Tube (if applicable)
2	Condenser	6	High Side Line
3	Filter Dryer	7	Low Side Line
4	Solenoid Valve (if applicable)	8	Fan assembly

Fig. T – 6 Liter Refrigerated Refrigeration Assembly (9106)

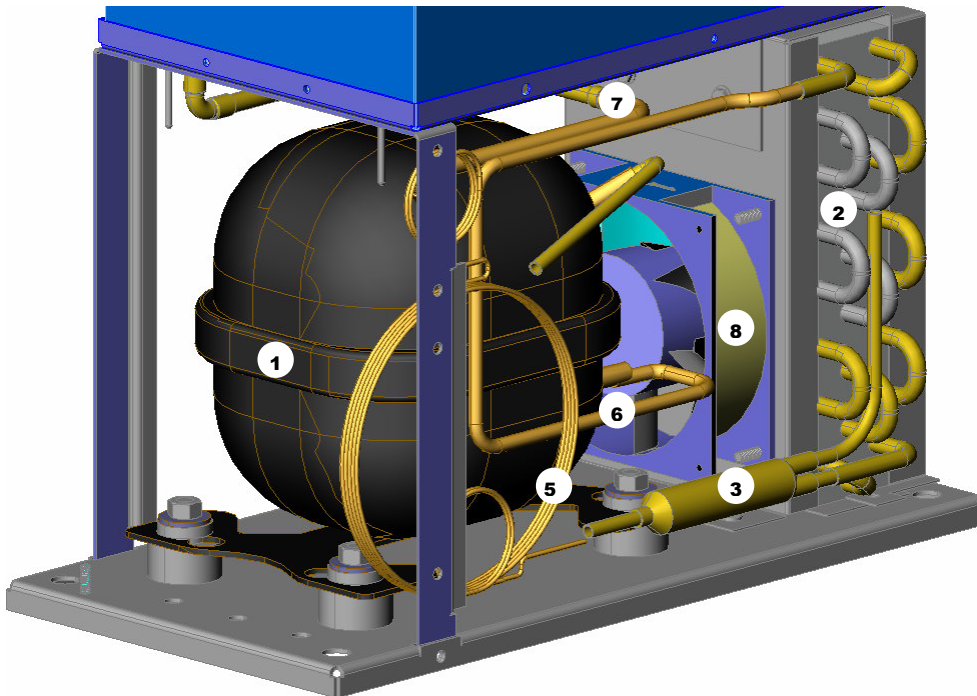
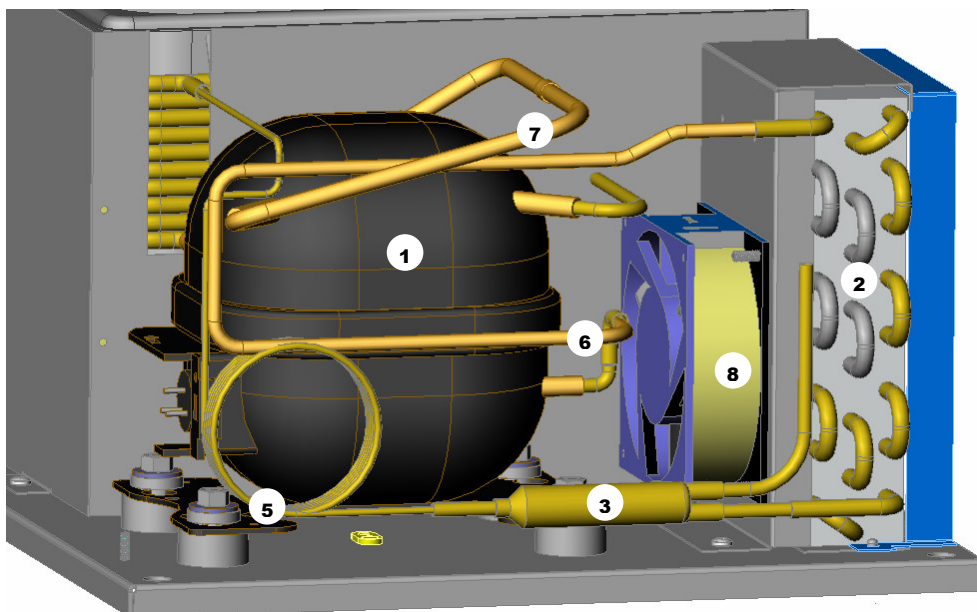
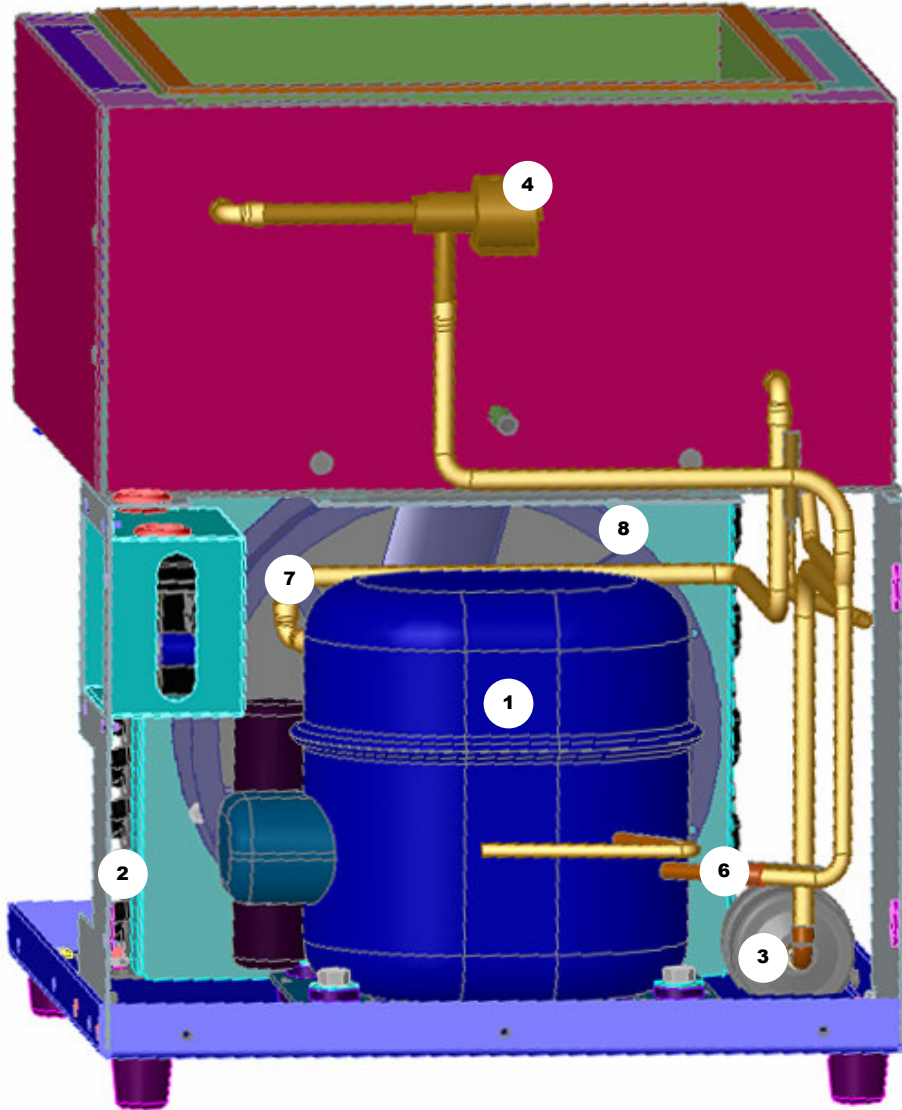


Fig. U – 6 Liter Low Profile Refrigerated Refrigeration Assembly (9006)



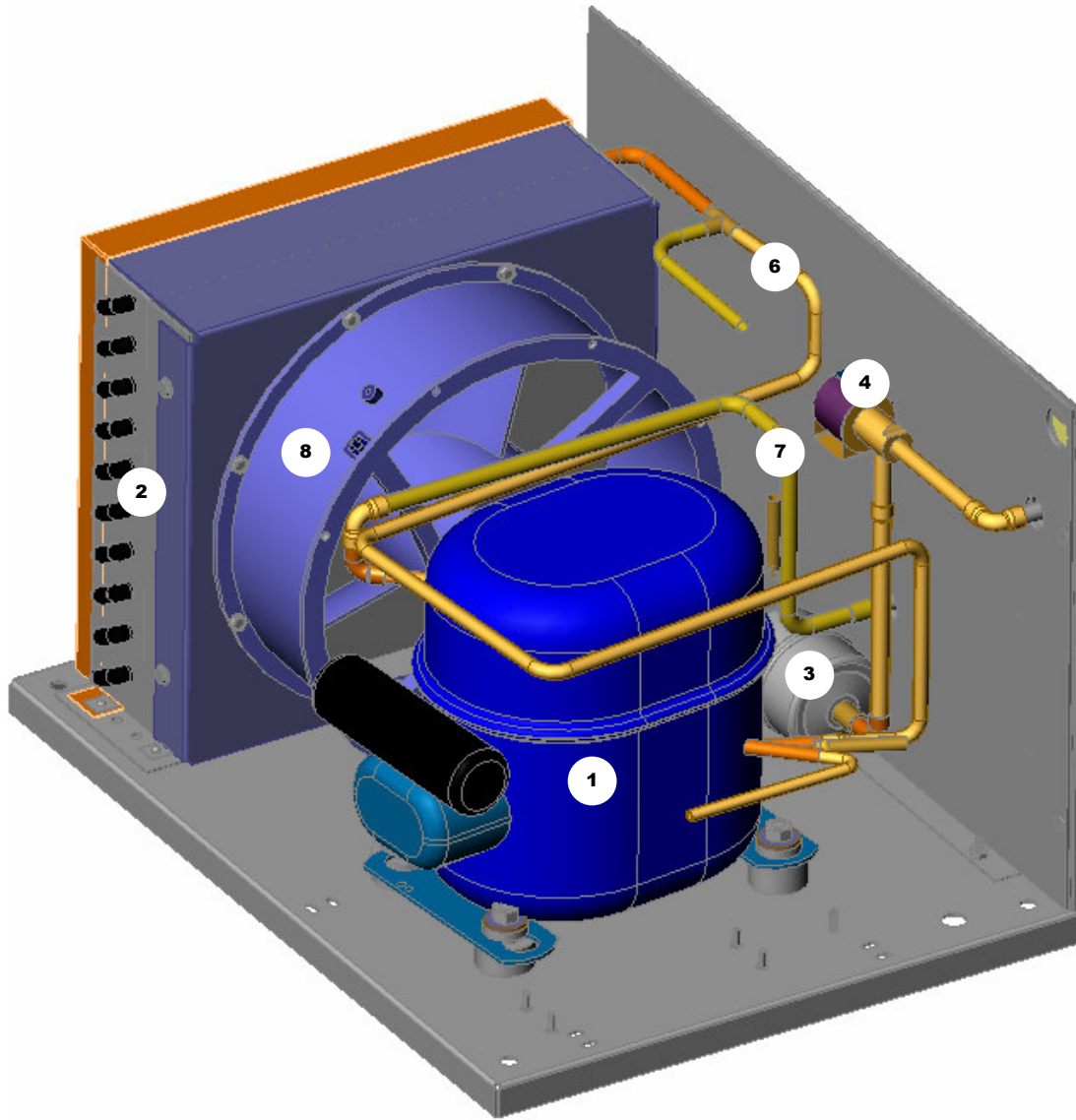
1	Compressor	5	Capillary Tube (if applicable)
2	Condenser	6	High Side Line
3	Filter Dryer	7	Low Side Line
4	Solenoid Valve (if applicable)	8	Fan assembly

Fig. V – 13 Liter & 13 Liter Low Temp Refrigerated Refrigeration Assembly (9506 & 9706)



1	Compressor	5	Capillary Tube (if applicable)
2	Condenser	6	High Side Line
3	Filter Dryer	7	Low Side Line
4	Solenoid Valve (if applicable)	8	Fan assembly

Fig. W – 28 Liter Refrigerated Refrigeration Assembly (9606)



7.2 – Wiring Diagrams & Schematics

Diagram 1 – Wiring Diagram – Controller - Models 7306, 8006, 8106, 8206, 8306 (All heat only circulators)

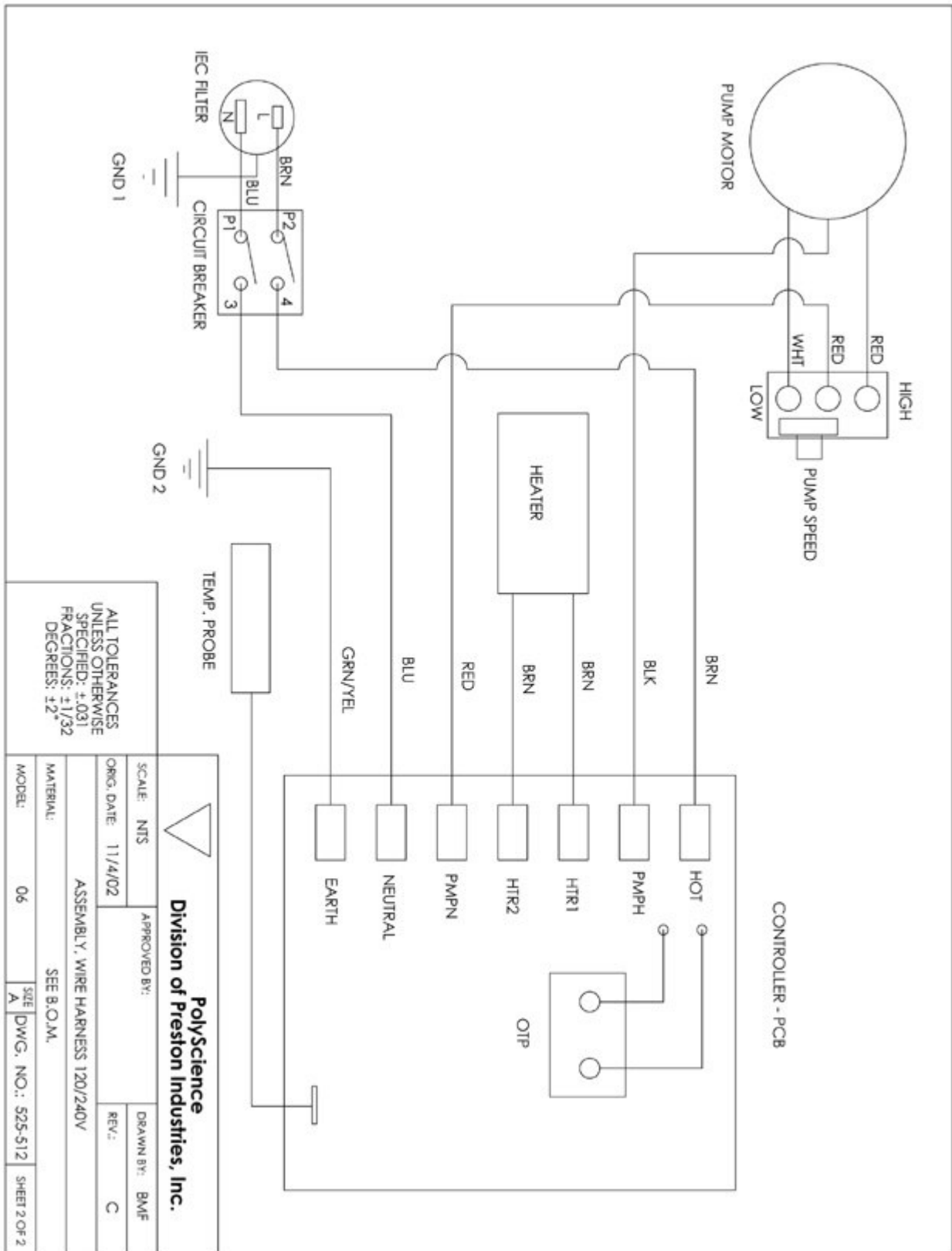


Diagram 2 – Wiring Diagram, Controller – All Refrigerated Units (Model 9006, 9106, 9506, 9606, 9706)

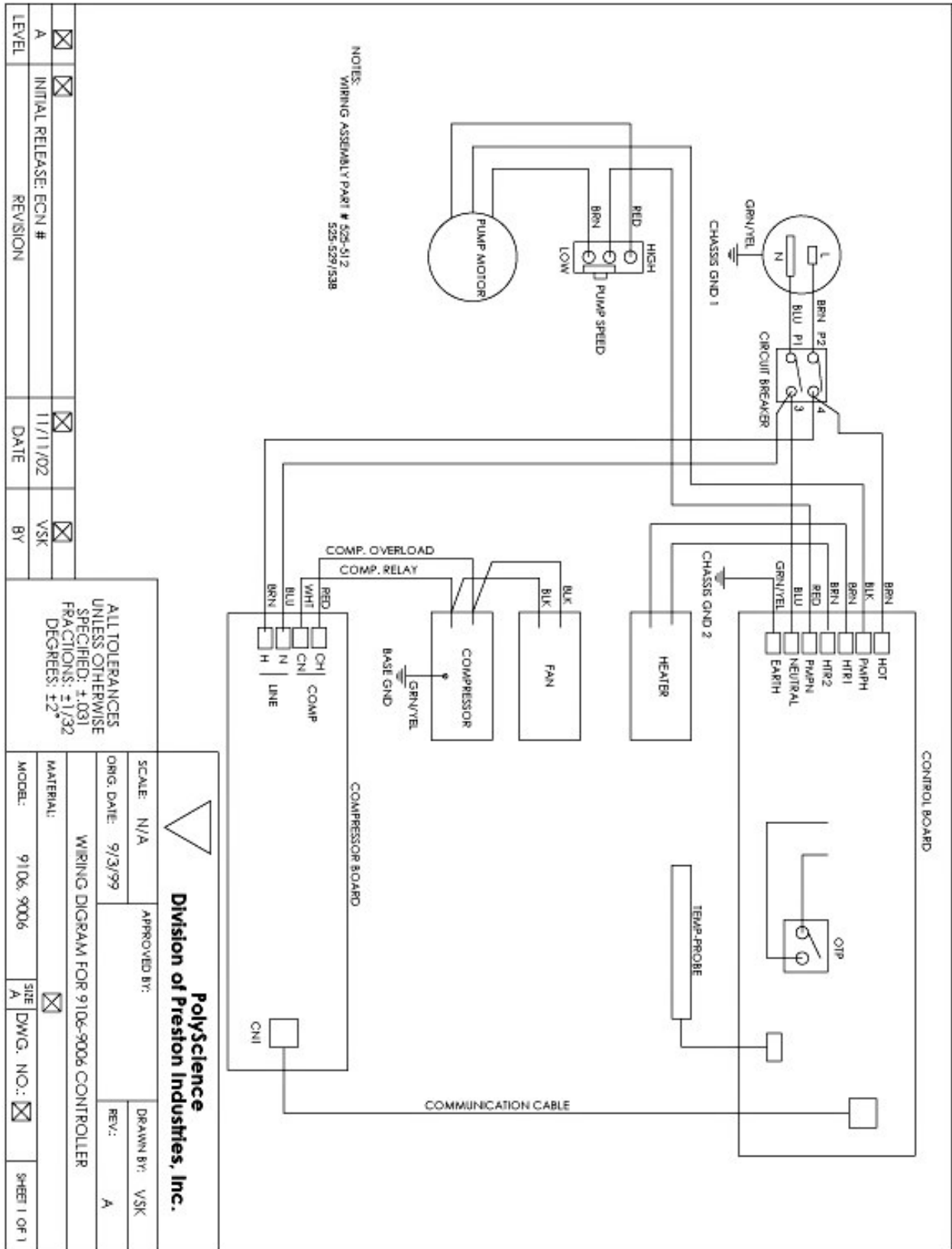


Diagram 3 – Pump power schematics

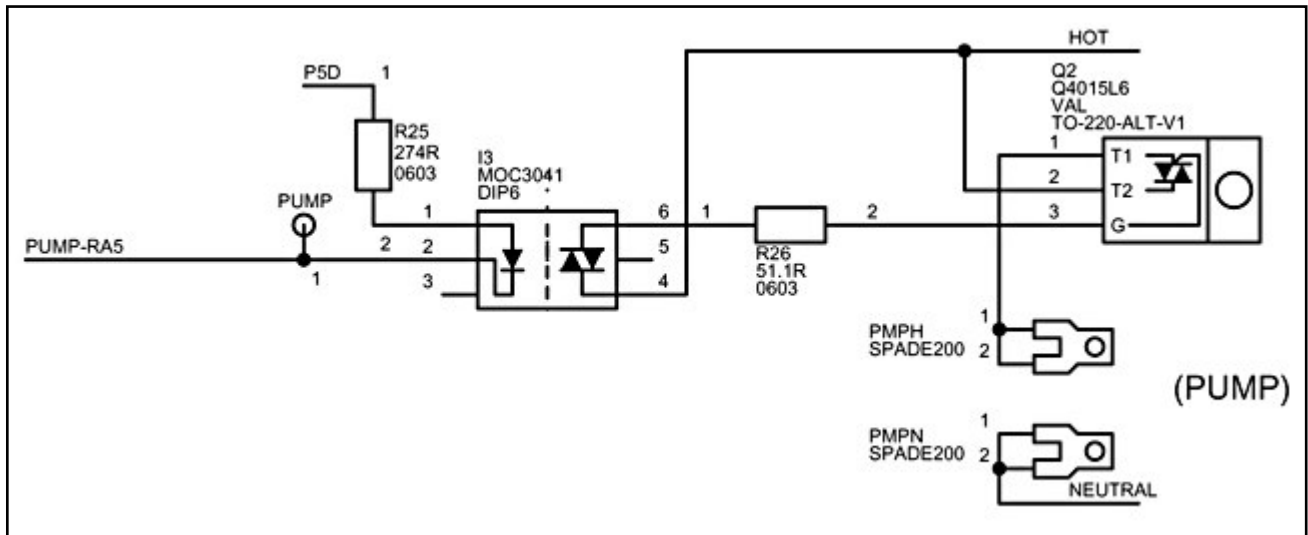


Diagram 4 – Heater power schematics

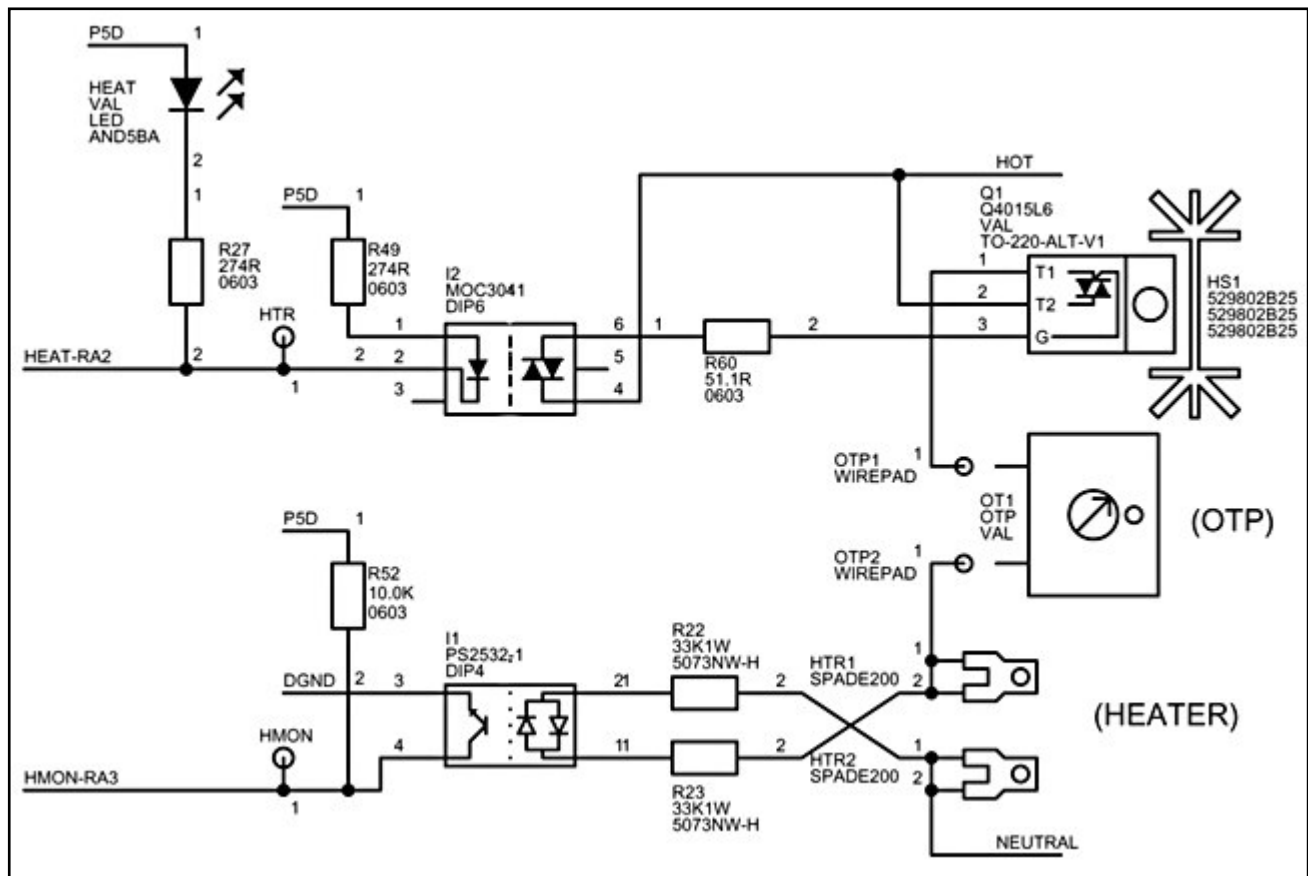


Diagram 5 –Compressor control pc board schematic (models 9006 & 9106)

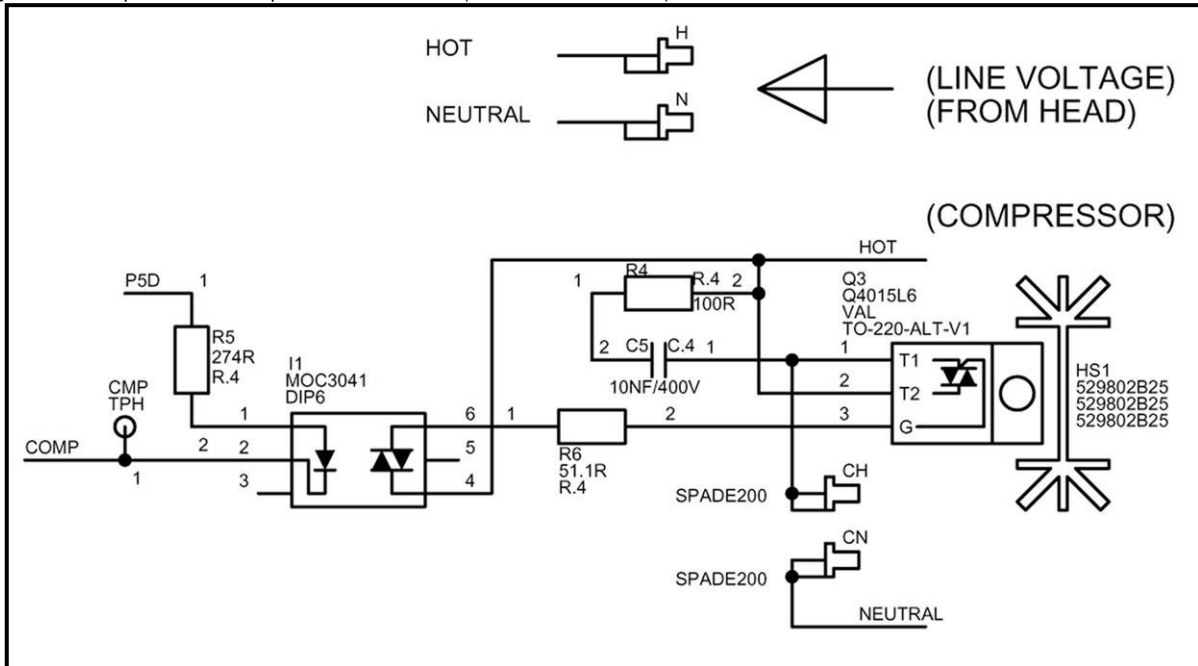


Diagram 6 –PWM control pc board schematic (models 9506, 9606, & 9706)

