

OPERATING MANUAL  
MODEL 922 SWITCH HEATER CONTROL  
240VAC/480VAC

MANUFACTURED  
BY

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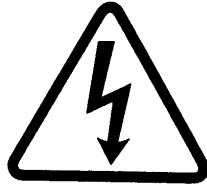
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**CAUTION**

**PLEASE READ – PLEASE READ – PLEASE READ**

**PLEASE READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING TO INSTALL, OPERATE, OR SERVICE THE MODEL 922 SWITCH HEATER CONTROL SYSTEM.**

**THE MODEL 922 SWITCH HEATER CONTROL SYSTEM OPERATES ON HIGH VOLTAGE LEVELS. CONTACT WITH ELECTRICITY CAN BE HAZARDOUS, CAUSING SHOCK, BURNS, AND DEATH. NUMEROUS COMPONENTS WITHIN THE CONTROL SYSTEM ARE ELECTRICALLY “HOT”. USE CAUTION WHEN WORKING IN AND AROUND THIS SYSTEM.**

**THIS CONTROL SYSTEM CAN BE OPERATED REMOTELY OR BY SNOW DETECTOR. THEREFORE, OPERATION MAY BEGIN UNEXPECTEDLY.**

**IF YOU HAVE ANY QUESTIONS CONCERNING THE MANUFACTURE, DESIGN, FUNCTION, INSTALLATION, OPERATION, OR MAINTENANCE OF THIS SYSTEM, PLEASE CONTACT RAILWAY EQUIPMENT COMPANY BEFORE PROCEEDING ANY FURTHER.**

# I. CUSTOMER CONNECTIONS

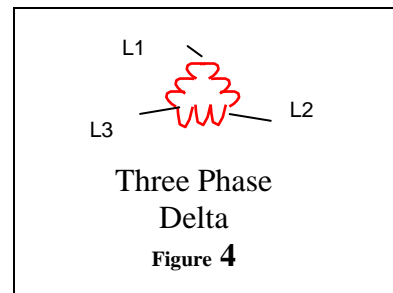
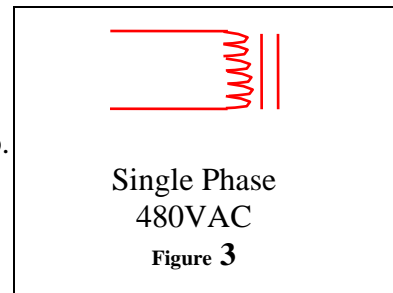
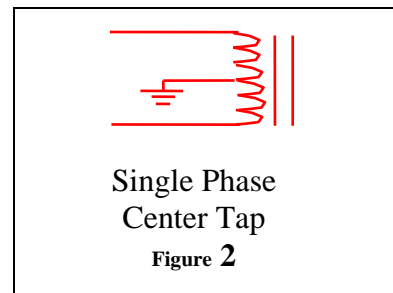
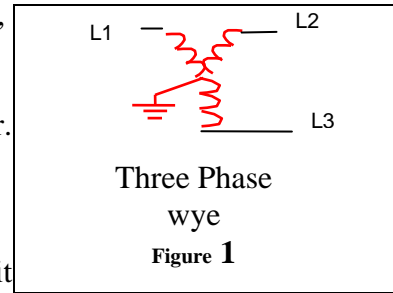
## A. INCOMING AC

The incoming power, 480VAC, 60Hz, 1 or 3 phase, should be connected directly to the main circuit breaker. The neutral should be connected to the neutral lug located to the right of the circuit breaker. An earth ground should also be connected to the neutral bus bar.

**NOTE:** On some models, an adjustable main circuit breaker is factory-adjusted for the load of each specific panel. The panel nameplate will show what setting the circuit breaker is set for. Refer to print 9224-5403, in the back of this manual, for the various adjustments, in the event that changes are made to the panel.

**NOTE:** The heater fault detection will only work properly if the incoming power to the main panel is single phase with a center tap or three phase Y. This is because, to detect a heater fault, a return path through earth ground is necessary. Refer to figure 1 and 2.

The system will not work properly if the input power is single phase 480VAC without a center tap. Single phase 480VAC can be used only if the control panel for the heaters is made by Railway Equipment and an additional jumper is used on the panel (refer to figure 3, and print 9224-5403 Note 1). The system will not work properly if the power is in a delta configuration unless a wye neutral panel is also used. Railway Equipment has a suitable wye neutral panel available. This configuration does not have a ground return path without the wye neutral panel (refer to figure 4).



## **B. CONTROL**

The system can be turned on by providing a circuit closure across terminals 1 and 2 on TB2

## **C. RAIL TEMPERATURE SENSOR**

There are three options for rail temperature sensors:

- 1.** One hard wire rail temperature sensor can be connected to the control module. This sensor monitors rail temperature at one location and can be used to switch all outputs between full power and half power.
- 2.** Each output may also have a hard wire rail temp sensor. When a rail temperature sensor is hooked to an output, it will override the control module sensor, and each output can switch between full or half power depending on the rail temperature. These hard wire sensors should be mounted on the web of the stock rail approximately six inches from the heater terminal, in the direction of the element. They attach to the rail by magnet.
- 3.** The third option is a wireless combination rail temperature and snow detector. This sensor receives power from a separate source, and can inform the output of the presence of snow and the temperature of the rail. These sensors are also connected to the web of the rail by magnet and are placed near the switch point. The sensors allow each output to be turned on or off independently due to the presence of snow at the switch point, and will allow the output to switch between high and low power dependant on rail temperature.

## **D. INDICATION**

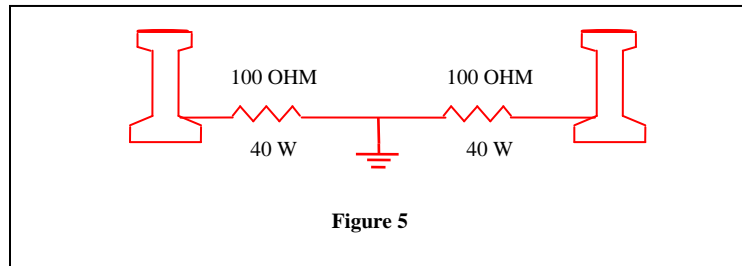
Refer to print 9224-5403 for all indication connections.

A 120VAC indication signal can be obtained from terminals 3 and 6 on TB2 by placing a circuit closure between terminals 4 and 5 on TB2. This will provide 120VAC from terminals 3 and 6 on TB2, with terminal 3 “hot” and terminal 6 “neutral”. The electrical rating of is contact is 2 amps @ 125VAC. A “dry” contact indication can be obtained between terminal 3 and 4 by removing the circuit closure across 4 and 5.

The 120VAC can be changed to 24VDC by removing the jumper from TB2-4 and TB2-5 and adding the jumper between TB2-2 and TB2-3. The 24VDC indication will be between TB2-4 and TB2-9.

### E. HEATER FAULT RESISTORS

A hard-wired connection should be made from each rail (at the switch) to a 100 ohm 40 watt resistor (customer provided), and then to a good earth ground. This will ensure that there is an electrical path from each rail to ground. This will allow the heater fault detection system to function, while maintaining isolation between the rails (refer to figure 5).



### F. HEATERS

The heaters are connected to the output terminals at the bottom of each output section.

### G. FAULT INDICATION LIGHT

A 120VAC, 40W fault indicating light (provided by customer) may be connected to 8 and 6 on TB2. Then jumper TB2-5 and TB2-7 together.

### H. TEMPERATURE SENSOR

A hole in the bottom of the enclosure has been drilled for the probe of the air temperature sensor. Run the sensor wire up through the hole from underneath. Attach the probe to the enclosure by tightening the nut. Plug the temperature sensor connector into terminal J5 on the control module.

### I. OPTIONAL SNOW DETECTOR

Either 1 or 2 sensing heads may be used. Each sensing head has three lead wires: black, white, and green. Connection is as follows:

**Green:** One, or both, connected to terminal post TB2-9

**Black #1:** Connected to terminal post TB2-11

**Black #2:** Connected to terminal post TB2-12

**White:** One, or both, connected to terminal TB2-10

Refer to the connection diagram 9224-5403 when connecting wires for the sensing heads. It is important to properly connect the sensing head wires. Improper connection of the sensing head wires may result in damage to the

control board and/or the sensing heads.



## II. CONTROL MODULE

### A. DESCRIPTION

The 922 control module contains all of the elements and functions necessary for advanced snow melter operation. The unique single-chip microcomputer has been programmed with logic and timing sequences to provide complete heater control as well as operational control and system interface. Some of the many features included in the control module are:

- Auto-Off-Local selector switch
- Adjustable air temperature setting
- Built-in snow detector (requires optional snow detector head)
- Adjustable run timer for timed or continuous operation
- Adjustable snow detect timer for use with optional snow detector
- Operator control and indication
- Remote fault test
- Status indication lights:
  - Inputs:
    - Air Temperature
    - Moisture Detector
    - Remote Control
    - Rail Temperature
    - Indication
    - Fail

### B. SET-UP AND ADJUSTMENTS

To change settings and adjust times do the following

#### **Mode Up Selector Switch**

Move the mode selector switch (SS2) to the up position. This will move you up one menu item. Each time you move the mode switch from center position to the up position you will move up one menu selection.

#### **Mode Down Selector Switch**

Move the mode selector switch (SS2) to the down position. This will move you down one menu item. Each time you move the mode switch from center position to the down position you will move down one menu selection.

#### **Selector Dial**

The selector dial allows you to change values. To change a value turn the selector dial clockwise to increase it. To decrease the value turn selector dial counterclockwise. The value will be saved. To initiate actions on some screens, (i.e. heater fault test) spin the dial in either direction. To move between menus rotate the dial in the direction desired to move in. For example, to move from Master Menu to Output 1 Menu turn the dial clockwise.

**The following is the layout of the controller menu:**

**C. MASTER MENU**

**1. DEFAULT SCREEN**

This screen has three different display modes:

- a. In the screen saver mode, when the user controls have been idle for 60 minutes, the screen will go blank. To wake from screen saver mode, simply rotate dial or move the mode selector switch (SS2).
- b. The idle screen will always display the current air temperature on the top line (if a sensor is installed). On the bottom line, it will display information relevant to the state the 922 is currently in.
- c. If there currently is a fault, the screen will display which fault is occurring. If more than one fault is happening, the screen will scroll through them.

**2. LINE VOLTAGE 1, 2, & 3**

This will display the voltage of all three phases of line power coming into the 922 control module. If single phase is selected, it will display the voltage on the single phase coming into the 922 control module.

**3. LINE CURRENT 1, 2, & 3**

For a three phase unit, this screen will display the current draw for all three phases of line power. If single phase is selected, it will display the single phase current.

**4. AC FREQUENCY**

This screen displays the frequency of the line power coming into the 922 control module.

**TOTAL WATTS**

Displays the total power in watts currently being consumed by this 922 and all outputs connected to it (all phases added together).

**5. KWH TOTAL**

Displays the total power currently being consumed by this 922 and all outputs connected to it (all phases added together).

**KWH RESET**

Resettable KWH counter.

**6. RAIL TEMP**

This screen will display the current rail temperature.

**CABINET TEMP**

This screen will display the current temperature inside the panel.

## D. OUTPUT 1 – 12 MENU

There is one menu for each enabled output. There can be 1 – 12 outputs enabled. Each output menu has BASIC and ADVANCED screens. The ADVANCED screens will only display if ADVANCED is selected in the SET POINTS menu.

1. **\_\_ OPEN HEATER \_\_A SETPOINT \_\_A**  
This shows the current that is being drawn by the output section on line one. On line 2 it displays, and allows you to change, the open heater setpoint for this output. This value should be set upon installation. While the output is running, and all heaters are working, take note of the current being drawn. Figure out which heater draws the least current, and how much that current is. Make the setpoint slightly larger than the difference between that current, and the total current.
2. **\_\_ RAIL TEMP \_\_F or C SETPOINT \_\_ F or C**  
This screen will display the current rail temperature and rail temperature setpoint, in Fahrenheit or Celsius depending on which temperature scale is selected on the SET POINTS menu. The factory default setpoint is 60 F (16 C) and can be set from 0 F to 280 F (-18 C to 138 C). When the rail temperature is above the setpoint, the output will go into half power mode. Half power mode will cut wattage requirement in half. If the rail temperature falls below setpoint, the output will return to full power. If no rail temp sensor is installed, this screen will notify you that no rail temp sensor is installed.
3. **\_\_ VOLTAGE \_\_ V WATTS \_\_**  
This screen displays the voltage at the output and the power currently being consumed by the output in watts.
4. **KWH TOTAL \_\_ KWH RESET \_\_ (ADVANCED)**  
This screen will display the total accumulation of power used by this output. A resettable value is also displayed (spin dial to reset the value).
5. **\_\_ RESET \_\_ FULL POWER HR \_\_ (ADVANCED)**  
Total number of hours, and resettable record of the number of hours this output has run on full power, is shown on this screen.
6. **\_\_ RESET \_\_ HALF POWER HR \_\_ (ADVANCED)**  
This screen shows the total number of hours, and resettable register of the number of hours, this output has run on half power.
7. **\_\_ FAULT CURRENT \_\_ HEATER TEST \_\_\_\_\_**  
Fault current is the amount of ground fault current that is leaking to ground from the

heaters. The fault current is displayed in amps. If the fault current rises above 200 milliamps, the output contactor will deenergize and the. Output fault will be set. To clear fault rotate dial clockwise. Check wiring connections and heater for shorts to ground.

To initiate a heater fault test for this individual output, rotate dial clockwise. The fault test will start by connecting a fixed load to ground to simulate a fault. The fault current should be approximately 220ma with a voltage of 277 volts to ground from all line voltages. The test will run for 30 seconds. At the end of test it will display Test Passed (Fault current was above 200ma) or Test Failed (Fault current was under 200ma) in either case rotate dial to clear fault. Also, the display shows the fault current seen by the output during normal operation.

**8. OUTPUT ENABLED /DISABLED (ENABLE IS DEFAULT)**

Options are output enabled or output disabled. To enable or disable, rotate the dial. Use this to disable any active output you do not wish to run. Use this if, for example, you set the module to control 5 outputs, and wish to disable output number 4.

**9. \_\_ OUTPUT RADIO 5.0V S/N \_\_\_\_\_ (ADVANCED)**

This screen is used for a radio controlled snow sensor only. The first digit indicates snow sense as follows: 0 = no snow, 1 = light snow, 2 = medium snow, 3 = heavy snow. The radio voltage is displayed, and the serial number of the radio communicating from the radio snow detector. The radio serial number can be changed by rotating the dial.

**10. PROGRAM REVISION \_\_\_\_ POWER UP COUNTER \_\_\_\_ (ADVANCED)**

This is the current program revision level.

Power up counter is the total number of times the output has turned on. This value is resettable, (spin dial to reset the value).

**11. \_\_RAIL TEMP \_\_ F or C**

The first digit is the output number. This screen only displays if a radio rail temp sensor is installed.

## **E. FAULT HISTORY MENU**

- 12. DAY COUNTER AND POWER UP COUNTER MASTER**  
Day counter is the number of days the unit has been powered up. Power up counter is the total number of times the control module has been turned on.
- 13. AC FREQUENCY FAULT COUNTER**  
Total number of times AC frequency has been too high or too low. To reset, turn the dial clockwise.
- 14. OUTPUT 1-12 OPEN HEATER FAULT COUNTER**  
Output open heater fault counter increments every time the output senses an open heater fault. To reset, turn dial clockwise.
- 15. PHASE 3 LINE VOLTAGE FAULT COUNTER**  
Total number of times the line voltage on phase 3 has been too high or too low. To reset, turn dial clockwise.
- 16. PHASE 2 LINE VOLTAGE FAULT COUNTER**  
Total number of times the line voltage on phase 2 has been too high or too low. To reset, turn dial clockwise.
- 17. PHASE 1 LINE VOLTAGE FAULT COUNTER**  
Total number of times the line voltage on phase 1 has been too high or too low. To reset, turn dial clockwise.
- 18. HEATER FAULT TEST ALL OUTPUTS**  
Heater fault test. This screen will allow you to initiate the heater fault test to all active outputs. To begin the test, spin the dial in either direction, the test will end after thirty seconds.
- 19. CLEAR ALL OUTPUTS FAULT MODE**  
This will be displayed ONLY if there is at least 1 output in fault. The screen is used to clear all faults from all outputs. To reset turn dial clockwise.

## F. SETPOINTS MENU

### 1. Password

The default password is 0. Most setpoints can be change using 0, critical setpoints require 5 to be entered to change those setpoints. To change password rotate dial.

### 2. Number Of Outputs

This screen is used to tell the 922 control module how many outputs are connected to it. This is a critical 1 set point and requires a 5 to be entered in the password. The range is from 1 to 12. To change number of outputs rotate dial.

### 3. Select Temperature Setpoint

The ambient temperature below which the 922 unit will energize is set on this screen. When the outside temperature is below this setpoint, the 922 will be allowed to operate if requested. The factory default is 38 F. The range is from 10 F to 99 F. To change temperature setpoint, rotate dial.

### 4. Select Rail Temperature Setpoint

The rail temperature setpoint is selected on this screen. When the rail temperature is above this setpoint, the 922 will be allowed to operate in half power mode. The factory default is 120 F. The range is from 0 F to 280 F. To change rail temperature setpoint, rotate dial.

### 5. Cabinet Temp and Setpoint

This screen will display the current temperature of the panel and the setpoint. When the temperature is below the setpoint, the module will turn on the panel heater to reduce condensation. The factory default setpoint is 40° F. The range is from 0 F to 200 F. To change the cabinet temperature setpoint, rotate dial.

### 6. Run Timer Value

The run timer can be set from 0 to 1000 minutes. If zero is selected, the 922 outputs will operate continuously, until control on is disabled. If another value is selected, the unit will run until the run timer counts down to zero, after which the unit will shut down and drop indication. The unit can be restarted by removing the contact closure between TB2-1 and 2, then reinstalling it. If Run Timer Pulse Mode is activated, the minimum run time value is 10 minutes. The factory default setpoint is 60 minutes. To change the run timer setpoint, rotate dial.

### 7. Snow Timer Value

The snow timer can be set from 10 to 1000 minutes. The snow time starts counting down when the moisture detector no longer sees snow. The factory default setpoint is 60 minutes. To change the snow timer setpoint, rotate dial.

### 8. Snow Response Timer

The snow response timer can be set from 1 to 60 seconds. Snow must be sensed for the entire time the response timer is set for, after which the unit will start. This can

be used to eliminate nuisance tripping. To change snow response setpoint, rotate dial.

**9. Select Start Delay Time**

The start delay time can be set between 1 and 30 seconds. This will determine the delay time between starting individual outputs. The factory default setpoint is 5 seconds. To change start delay timer setpoint, rotate dial.

**10. Operation Mode**

The choices are Half power, Full power, or Auto:

**Half Power** – The power is distributed between the outputs to balance the load and provide half power to the heaters. This will save energy when the heaters do not need to operate at full power.

**Full Power** – The entire sine wave will be sent to power the heaters. This will allow the heaters to operate at full power.

**Auto** – The module will determine what mode the outputs should be in. This is the default (and recommended) setting. To change operation mode, rotate dial.

**11. Program Revision**

This is the current program revision level and date it was created.

**12. Fault Current Setpoint**

Used to change the heater fault current setpoint for all outputs. The factory default is 200 mA, the range is from 0 to 500 mA. This is a critical setpoint and requires a 5 to be entered in the password. To change the fault current, rotate dial.

**13. Line Voltage High Setpoint**

This is used to set the maximum voltage, of any phase, before a fault is set. The factory default value is 500 V, and the range is from 0 to 600 V. To change the line voltage high setpoint, rotate dial.

**14. Line Voltage Low Setpoint**

This is used to set the minimum voltage, of any phase, before a fault is set. The factory default value is 400 V, and the range is from 0 to 600 V. To change the line voltage low setpoint, rotate dial.

**15. AC Frequency High Setpoint**

This can be set to 0 Hz to 200 Hz.

**16. AC Frequency Low Setpoint**

This can be set to 0 Hz to 200 Hz.

**17. Unit Type**

Used to set how many phases and line voltage. The choices are:

460 volt 3 phase

460 volt 3 phase High Power (NOTE: Contact Railway for more information).

230 volt 3 phase  
460 volt 1 phase  
460 volt 1 phase High Power (NOTE: Contact Railway for more information).  
230 volt 1 phase  
This is a critical setpoint and requires a 5 to be entered in the password. To change the unit type, rotate dial.

**18. Local With Air Temperature**

If this is set to “without air temperature”, then the local run cycle will start by simply placing the selector switch (SS1) into local. However, if it is set to “with air temperature”, the switch must be in local, as well as the air temperature below setpoint for the local run cycle to begin. The default value is with air temperature. To change the local with air temperature, rotate dial.

**19. Snow Indication Value**

The choices are off or on. With snow indication off, indication will remain off during snow time if no faults are present. With snow indication on, indication will remain on during snow time if no faults are present. The default value is off. To change the snow indication, rotate dial.

**20. Run Timer Pulse Mode**

Choices are on or off; factory default is off. When on is selected, a pulse will start run sequence. The unit will continue to run until the run timer has timed out. When off is selected, the unit will operate until the run timer has expired (If a run timer value is entered) or until control on is removed, which ever occurs first.

**21. Select F or C**

Will change the temperature scale to Fahrenheit or Celsius, Default is Fahrenheit.

**G. FACTORY DEFAULT**

Factory default is used to place all parameters back to factory default settings. To enable factory default settings, rotate the selector dial clockwise. All settings are now at factory default settings.



## **H. AUTO/OFF/LOCAL SWITCH (SS1)**

The three position selector switch controls the operation mode the 922 will be in. The positions are described below.

### **1. AUTO**

This will allow operation by placing a circuit closure across terminal posts 1 and 2. It will also allow operation by an optional snow detector. Both of these modes require the use of an air temperature sensor (and the air temperature to be below the setpoint). Another way the 922 can run is through the use of the internet. A message can be sent to the 922 instructing it to run for a given amount of time.

### **2.OFF**

If set to off, the 922 cannot be run from remote control, snow detect, or the internet.

### **3.LOCAL**

Placing SS1 in the LOCAL position will activate the outputs regardless of control, or moisture. Local with air temperature is used to decide if the local switch is controlled by the ambient air temperature or not. The outputs will remain on until LOCAL is turned off.

## **J. RESET**

Pressing the reset button (PB1) resets the processor. This is useful if the module is stuck in an undesirable state, or to clear all faults monitored by the master.

## **K. LED STATUS INDICATING LIGHTS**

The LEDs on the front of the control module indicate what state the inputs, and outputs are in.

### **1. AIR TEMPERATURE**

Turns on when the ambient air temperature is below set point.

### **2. MOISTURE**

Turns on when the optional snow detector sensing head(s) senses moisture.

### **3. CONTROL**

Turns on when there is a circuit closure across terminal posts TB2-1 and TB2-2.

### **4. RAIL TEMPERATURE**

Turns on when the rail temperature is above set point.

### **5. INDICATION**

This LED may be on if the SS1 is set to the AUTO or LOCAL position. It will be on if the 922 is running due to remote control (or snow detect, if snow indication is turned on). If the unit is running in LOCAL, and a contact is closed between TB2-1 and TB2-2, it will be on. It will also be on if the 922 is in fault and remote control is off. When on, a dry contact will close between TB2-3 and TB2-4.

## **6. FAIL**

Is on when ever a fault is present on the control module or any output module. When on, a dry contact will close between TB2-7 and TB2-8.

## **L. WIRELESS RAIL TEMPERATURE / SNOW DETECTOR**

This is an optional feature, that allows for a wireless form of rail temperature measurement and snow detect.

### **1. HARDWARE**

The wireless module consists of a plastic enclosure that contains circuitry, and a radio with 110vac power cord. A radio is also required to be installed on the master board.

### **2. SET-UP**

The only set-up required is to select (on the output) the serial number of the radio rail temperature sensor module (see **B. SET-UP AND ADJUSTMENTS** screen **36. Slave Radio Serial Number**).

## **M. MASTER CONNECTIONS**

The control module has a variety of connections to other things; some are necessary for operation, some are optional for additional features.

### **1. COMM. BOARD 115VAC (J13)**

Used for powering an optional communications board

### **2. EARTH GROUND (J14)**

Required for use of earth ground by the 922

### **3. WIFI 12VDC(J15)**

Power supply for optional cell modem

### **4. WIFI TRANSFORMER (J16)**

Connection to transformer for optional cell modem

### **5. MOV (J18)**

### **6. CONTROL MODULE TRANSFORMER (J21)**

Required for incoming power to the control module and output modules

### **7. COMM./POWER TO OUTPUTS 7-12 (J24)**

Required for any control module that is set up for more than 6 outputs. This cable is connected directly to output 7.

- 8. COMM./POWER TO OUTPUTS 1-6 (J25)**  
Required for a control module set up for any number of outputs. This cable is connected directly to output 1.
- 9. FAN (J26)**  
Power output (240VAC) for panel heater fan.
- 10. HEATER (J17)**  
Power output (240VAC) for panel heater.
- 11. LINE VOLTAGE MONITOR (J7)**  
Required cables used for measuring incoming line voltage.
- 12. A.R.R. POSTS (J6)**  
Required for the use of the A.R.R posts.
- 13. AMBIENT AIR TEMPERATURE (J5)**  
Required for the control module to run by remote control, or snow detect.
- 14. RAIL TEMPERATURE (J2)**  
Optional (highly recommended) for the output modules to be able to automatically set half-wave or full-wave operation
- 15. RADIO CARD (U18)**  
Optional, used for communication with the radio rail temp module
- 16. ETHERNET PORT**  
Optional connection for communication over the internet

## N. HEATER TEST

This is used to test the heater fault circuit. Note that if the module, or the output you wish to test, is in fault, you may not start the test, and the screens associated with the tests are not visible.

The test can be started in two different ways, depending if you want to test all outputs at the same time, or one output at a time.

- To test all outputs at the same time
  - Navigate to **Fault Current with Test** on master menu.  
Spin the dial in either direction to begin the test
- To test a single output
  - Choose the menu for the output you would like to work with
  - Navigate to screen **Fault Current with Test**
  - Spin the dial in either direction to begin the test
  - The benefit to using this method **.Test This Output** will display the leakage current of the output in question.

If you chose to run a test on all outputs (from the master screen), each output will run its test in turn, delayed by the delay time setting. Each output will run the following test routine:

- The output will connect the “leak test resistor” in circuit to create a leakage current to ground.
- The output will then energize the coil for the power contactor and output full power to the heater.
- The test will then run for another 30 seconds after which it will pass or fail
  - Pass
    - For the test to pass, the outputs must see at least 200mA of leakage current.
    - The output will turn off the contactor, open the circuit to the leak test resistor, and turn on the heater fault LED.
  - Fail
    - The test will fail if it does not see at least 200mA of leakage current. The output will remain in the heater test mode, but will indicate it is failing the test by blinking the heater fault LED.

Whether the test passes or fails, it will be in a state that will not allow it to run normally. To fix this you must clear the fault rotate dial to clear.

## O. OPERATION

When switch SS1 is in the “auto” position, the unit can be activated three different ways. Note that any of these cycles can be stopped immediately by placing the SS1 in the “off” position

- RUN cycle
  - To start it
    - Introduce a circuit closure between TB2-1 and TB2-2
    - AND the ambient air temperature is below the setpoint
  - To end it
    - Remove the circuit closure between TB2-1 and TB2-2
    - OR the ambient air temperature rises above the setpoint
    - OR the run timer elapses (only if it set to a non-zero value)
      - If the run timer elapses, you MUST remove the circuit closure across TB2-1 and TB2-2 to begin the run sequence again.
- SNOW cycle (optional snow detect head must be installed)
  - To start it
    - The snow detector head senses moisture
    - AND the ambient air temperature is below the setpoint
  - To end it
    - The snow timer elapses
      - Only begins counting when it does not detect moisture, or air temperature is above setpoint
- NET cycle (optional internet connection must be established)
  - To start it
    - The website sends a message to the 922, instructing it to turn on for a period of time
  - To end it
    - The net timer elapses

If the switch SS1 is placed into the “local” position, the 922 will run until the switch is removed from that position.

Regardless of what cycle is being run, they all perform the same actions.

- The first output turns on immediately after the cycle has begun
- The rest of the outputs will delay turning on, dependant on the delay time setting
- Output modules always begin their cycles in full power mode, then switch to half power mode.
- After 30 seconds, if no faults have occurred, the output module will enter its normal running mode, dependant on the setting chosen on the **Half Full Auto Operation** screen
  - If **HALF POWER** is chosen, all the output modules will continue their entire run mode in half power.

- If **FULL POWER** is chosen, all the output modules will continue their entire run mode in full power.
- If **AUTO** is chosen, the rail temperature will determine if the output modules should run in half or full power. If no rail temperature sensor is installed, the air temperature sensor (and the rail temperature setpoint) is used to determine if the output module should run in half or full power.

Some faults can cause the 922 output modules to halt their operation cycles. For a list of these faults and their effects on operation, see the next section (**J. Fault Conditions**).

When the cycle ends (regardless of what cycle it is, or how it ends), the all outputs will turn off immediately.

## **P. FAULT CONDITIONS**

If there are any faults active, the LED labeled “Fail”, on the control module, will be light up. The dry contact between TB2-7 and TB2-8 will also close. Faults will be displayed on the default screen, if there is more than one fault they will all scroll through on the default screen. All faults can be cleared by resetting the output module that is in fault.

### **1. Master Faults**

These relate to faults occurring on the 922 control module.

#### **a. Fuse #1 24VDC**

24VDC fuse open indicates that fuse F1 is open.

- This could be caused by the remote control circuit. Check all connections to TB2-2
- This might be caused by one, or more, of the outputs. To find which one, turn off the main circuit breaker, unplug the control cable from one of the outputs, and turn the main circuit breaker back on. If the fault returns, try removing another output control cable.

#### **b. Fuse #2 5VDC**

5VDC fuse open indicates that fuse F2A is open.

- This could be caused by an output board. Perform the method of checking outputs, as described above for the Fuse #1 24VDC.
- It could also be caused by the rail, or air, temperature sensors. Power down, disconnect each and power back up to see if the fault has cleared.

- c. Fuse #3 Snow Head #1**  
Fuse #3 is tripped. This fuse controls the Snow Head #1. Check the wiring to that Snow Head. If the wiring is correct, the fuse should reset itself after a 1 minute power down.
- d. Fuse #4 Snow Head #2**  
Fuse #4 is tripped. This fuse controls the Snow Head #2. Check the wiring to that Snow Head. If the wiring is correct, the fuse should reset itself after a 1 minute power down.
- e. Fuse #5 240VAC**  
Fuse #5 is open. This fuse controls the 240VAC that goes to the outputs. Check the interconnect wire between the control module and output 1. Check the interconnect wires between each output. Check the wiring to the panel heater, as well as the wiring to the fan. If all wiring is correct, check to make sure all of the components work. This is not a resettable fuse. It must be replaced if open.
- f. Fuse #6 240VAC**  
Fuse #6 is open. Follow the same method, to fix the problem, as for Fuse #5.
- g. Line Voltage High (or Low) Phase 1 (2 or 3)**  
This indicates that the voltage, on the indicated phase(s), is too high (or too low). A low voltage fault will cause the outputs to turn off. Contact your energy supplier to alleviate the problem.

## 2. Output Faults

Output faults are faults happening on output sections.

- a. Open Heater Fault**  
This fault will only be checked for while the output is running in full wave mode. This indicates that too little current is being drawn by the heater(s). Check to see that the open heater setpoint is properly set for this output section. Also check to see that none of the heaters are damaged.
- b. Heater Fault**  
This indicates there is a leakage current to ground (ground fault). Check all connections to the heaters. This fault will immediately turn off the output, and lock it into a fault state. Use the clear fault screens (#15 or #51) to exit the fault mode.
- c. Heater Test Failed**  
This fault occurs when the heater test fails due to a lack of

simulated leakage current. Check to see if the test resistor is properly connected to the output board. This fault will cause the output to stay in the heater test mode. Use the clear fault screens (#15 or #51) to exit the test mode.

**d. SCR Fault**

This indicates the SCR likely is damaged. Replace the SCR. If this does not fix the problem, replace the output board.

**e. Comm. Loss Fault**

This indicates that the output shown is failing to communicate.

- The interconnect between the master and output 1 (or 7) may not be connected properly
- Interconnects between the individual outputs may not be connected properly
- The proper keying plugs may not be installed properly
  - Keying plugs should have a number on them corresponding to each output.
  - Ensure that each number is used only once.
  - Ensure no number is skipped (i.e. if you have 5 outputs, numbers 1, 2, 3, 4, and 5 must be used).
  - Replace any keying plugs that may be damaged.
- The output board may be damaged and need to be replaced.

### **III. OUTPUT MODULE**

#### **A. DESCRIPTION**

The 922 output module contains all of the functions necessary to control rail heaters. Some of the features of the output module are:

SCR control

Power contactor control

Communications with control module

Output voltage, and current, measuring

Heater fault detection

Rail temperature sensor (optional)

LED status indicators

Heater fault

Open heater

Contactor

Half Power

Fault test

By-pass switch

**CAUTION: Switching the by-pass switch ON will interrupt all control and fault protection on the output and will POWER THE HEATERS.**



## **B. SET-UP AND ADJUSTMENTS**

All set-up and adjustments are done through the control module display menu system. For more information, see **B. SET-UP AND ADJUSTMENTS** in the **II. CONTROL MODULE** section.

## **C. LED STATUS INDICATING LIGHTS**

The following status lights exist on the output module to depict what state the output module is in:

### **1. HEATER FAULT**

This LED can indicate the output module is in one of three different states:

**OFF** – Indicates that the output module is currently not experiencing any fault associated with leakage current.

**ON** – Indicates that the output module is in fault due to a large leakage current.

- Because a heater fault test has been “passed”
- Because a heater fault is occurring

**BLINKING** – Indicates that a heater fault test has been initiated, and the output module has failed to see a large enough leakage current.(see **F. FAULT CONDITIONS** for more information)

### **2. OPEN HEATER**

This indicates the heater(s), on this output, are not drawing enough current (see **F. FAULT CONDITIONS** for more information).

### **3. CONTACTOR**

When the power contactor is closed, allowing current to flow to the heater(s), this LED is turned on.

### **4. HALF POWER**

This LED indicates that the output is in half power mode when it is blinking.

### **5. FAULT TEST**

This LED indicates that a heater fault test has been initiated.

## **D. OUTPUT CONNECTIONS**

The output module has multiple connections. All of which are required, except for the rail temperature sensor.

### **1. OUTPUT LOCATION (J6)**

This is required for the control module to be able to communicate with this output module. These are numbered plugs that give the output module a unique identification. The output modules must be incrementally numbered, starting at 1 for the leftmost module (the one connected directly to the control module). No number may be used more than once, no number may be skipped.

**2. INCOMING POWER AND COMMUNICATIONS (J4)**

This cable is required for powering, and communicating with, this output as well as any outputs further down the line.

**3. OUTGOING POWER AND COMMUNICATIONS (J1)**

This cable is required for allowing any further output modules to be powered, and communicated with.

**4. OUTPUT CONTROL AND SENSE (J3)**

This connector interfaces the output board to the contactor, leak test resistor, and voltage sense lines. It is required for output operation and feedback.

**5. CURRENT COILS (J5)**

This is required for monitoring for leakage current and open heater faults.

**6. SCR CONTROLLER (J10)**

Required to control the SCR between half and full power mode.

**7. RAIL TEMPERATURE THERMOCOUPLE (J9) (OPTIONAL)**

The rail temperature thermocouple can be placed on the control module (controlling all output modules off a single sensor), or on output modules (allowing each output module to use its own rail temperature sensor).

**E. OPERATION**

The output module operates dependant on instructions passed onto it by the control module. For detailed instructions on how to run the outputs, see **I. OPERATION** in section **II. CONTROL MODULE**. There are no user serviceable parts, and only one control, the bypass switch, on the output module.

When an output module is instructed (by the control module) to turn on, it will always follow these steps:

- The output controller will turn on in full power mode to test for shorted heaters.
- The output will switch to half power mode to test for correct SCR operation.
- After 30 seconds, the output will follow instructions (from the control module) as to whether it should stay in half power, go to full power mode, or be allowed to be controlled by the rail temp sensor.
- This run cycle will end depending on the control module settings.
- Any of these steps can be halted if the output module finds itself in specific fault situations (see next section for more information).

When an output module is instructed (by the control module) to run a heater test, it will always follow these steps:

- Turn SCR into full power mode.

- Turn on leak test resistor. This resistor is used to simulate a leakage current to ground.
- Turn on power contactor.
- After 30 seconds, it will determine if the test has passed or failed.  
**PASS** – Shows that the output module has detected a large enough leakage current. This state is indicated by the heater fault turning on (not blinking). The output module will end the test by turning off both the leak test resistor and the power contactor, and latch itself into a heater fault state (see **F. FAULT CONDITIONS**).  
**FAIL** – Shows that the output module has NOT detected a large enough leakage current. This state is indicated by a blinking heater fault LED. The output module will remain in the heater test until it is relieved (see **F. FAULT CONDITIONS**).

If an output module is not running properly, the by-pass switch can be used to allow heater operation. Doing this will by-pass the output module and automatically provide the power contactor's coil with 240VAC.

**Caution: Switching the by-pass switch on will interrupt all control and fault protection from both modules and the heaters will be powered.**

## **F. FAULT CONDITIONS**

The output module can detect a variety of faults. This section covers the faults that can be seen through the LEDs on the output module. For a complete list of output faults, refer to **FAULT CONDITIONS** in section **II. CONTROL MODULE**.

### **1. Open Heater Fault**

If too little current is being drawn by the heater(s) connected to the output section, the output module will enter an open heater fault state indicated by the open heater LED turning on. This fault will not cause the output module to alter its run cycle in any way.

### **2. Heater Fault**

If the output module detects a large enough leakage current to ground, it will enter a heater fault. This will cause the output module to enter a fault state that will end any current run cycle, and keep the output module from beginning a new run cycle. This state is indicated by the heater fault turning on. To release the output module from this state see **B. SET-UP AND ADJUSTMENTS** in section **II. CONTROL MODULE** for clearing faults.

### **3. Heater Test Failed**

The heater test can end in one of two ways. If the output module passes the heater test, it will enter a heater fault (see above). If the output module fails the test it will enter this state, indicated by a blinking heater fault LED. The output module will stay in the heater test (keeping it from entering a run cycle) until the output module

detects a large enough ground leakage current. To exit the test, ensure that the leakage current is large enough, or refer to **B. SET-UP AND ADJUSTMENTS** in section **II. CONTROL MODULE** for clearing faults.

#### **4. SCR Fault**

The output section can determine if the SCR is not performing as it should be. This fault will not affect the run cycle. Check the wiring to the SCR; if it is correct replace the SCR. If that does not fix the problem, replace the output module.

### **IV. TROUBLESHOOTING**

Before looking through this section. Please make sure no faults exist, if any do refer to **J. FAULT CONDITIONS** in section **II. CONTROL MODULE** first. If, after reading this section, you cannot fix the problem, call Railway Equipment Co. to resolve the problem.

#### **A. Heaters are not on when they should be**

Many different causes could account for this problem, choose the symptoms that best describes the problem.

- 1. The LEDs on my output module DO turn on, but the heaters are not running**  
Make sure the wiring is correct from the output to its peripherals (leak test resistor, voltage sensor, contactor coil, and SCR). Check to see that the output circuit breaker is not tripped.

- 2. The LEDs on my output module DO NOT turn on**

- a. Check to make sure proper run conditions are satisfied (see I. OPERATION in section II. CONTROL MODULE)**
- b. Check all wiring to the output**
  - i. Interconnect wiring from control module to output module 1 (or 7).**
  - ii. Check all output module to output module interconnect wiring in front of this output module**
  - iii. Check that the output location plug is correct**
- c. Check to make sure the control module can communicate with the output module in question**
  - i. Put the selector switch (SS1) in OFF position**
  - ii. Reset the control module**
  - iii. Make sure you have set up the control module to communicate with the correct number of outputs on screen 17. Number Of Outputs.**
  - iv. Make sure the output module has not been disabled on screen 52. Disable This Output**
  - v. Navigate to screen 42. Communication Debugging**

- vi. Watch for the rightmost value to change from 0 and quickly cycle through all the output modules
  - i. If the number seems to get stuck on the output module in question, check the wiring, and if it is correct, replace the output module
  - ii. Otherwise, place the selector switch (SS1) into LOCAL and the output module should turn on

#### **B. Control Module Does Not Turn On**

1. Check the circuit breaker, and line power going into it
2. Check the fuses feeding power to the control module.
3. Check the wiring into the control transformer
4. Check the voltages coming out of the control transformer (T1)
5. Make sure the connector is properly plugged into J21
6. If all wiring is correct, replace the control module

## V. SPECIFICATIONS

**Input:** 240VAC or 480VAC, 1 or 3 phase, 60Hz

**Heater Fault to Ground Range:** Minimum 200mA (user settable)

**Open Heater Range:** Minimum 5A loss on any output (user settable)

**Indication:** 120VAC (2A max) signal on TB2-3 and TB2-6, or  
24 VDC (2A max) signal on TB2-4 and TB2-9, or  
Dry Contact (2A @ 28VDC or 2A @ 240VAC) on TB2-3 and TB2-4

**Air Temperature Setpoint Range:** 0°F to 100°F. Normally set at 38°F.

**Rail Temperature Setpoint Range:** 0°F to 280°F. Normally set at 120°F.

**Output Capacity:** 28KW per switch.

### **LIMITED WARRANTY**

Railway Equipment Co., Inc. ("Railway") warrants all of its products to be free from defects in material and workmanship when used under specified operating conditions and within specified limits. Railway's warranty shall extend for a period of two (2) years from the date of shipment to the original purchaser.

This warranty is expressly in lieu of and excludes all other expressed or implied warranties, including but not limited to warranties of merchantability and fitness for a particular purpose.

Railway, its agents, or representatives shall in no circumstance be liable for any direct, indirect, special, penal, or consequential loss or damage of any nature resulting from the malfunction of the product.

Remedies under this warranty are expressly limited to repair or replacement of the product at the sole discretion of Railway.

Before returning any defective product to Railway, contact the factory at the address or telephone number at the bottom of this article for a Return Merchandise Authorization number and instructions as to how and where the return is to be shipped. Materials received without this authorization will be returned at the customer's expense.

Products returned to Railway under warranty must be shipped freight prepaid, and return freight charges for repaired or replaced products, in or out of warranty, will be at customer's expense.

Railway reserves the right to reject any warranty claim on a product that has been altered by the user or damaged in shipping due to inadequate packaging or mishandling by freight carrier.

By returning a product to Railway the owner grants permission to Railway to open and disassemble the product as required for evaluation. Railway has the sole responsibility for determining the cause and nature of failure, and Railway's determination with regard thereto shall be final. Railway reserves the right to repair or replace any unit at its sole discretion.

A returned product that is found, upon inspection by Railway, to be operational within specification is subject to an inspection and testing fee, regardless of its warranty period.

Railway's liability on any claim of any kind (including negligence) for any loss or damage arising out of or resulting from this agreement, or from the performance of breach thereof, of from the products or services furnished hereunder, shall in no case exceed the price of the specific product or service which gives rise to the claim. All such liability shall terminate upon the expiration of the warranty period of two (2) years, as hereinabove stated.

The furnishing of advice or other assistance without separate compensation therefor will not subject Railway to any liability, either in contract, warranty, tort (including negligence) or otherwise.

Any alteration or modification of the product, or addition on non-Railway components to the product, unless expressly permitted by Railway in its documentation, will void warranty coverage.

This warranty is non-transferable, and warranty coverage is limited to initial user only.

Installation and/or use of the product shall demonstrate acceptance of the terms of this warranty.

Each of the foregoing paragraphs in this article will apply to the full extent permitted by law. The invalidity, in whole or part, of any paragraph will not affect the remainder of such paragraph or any other paragraph.

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