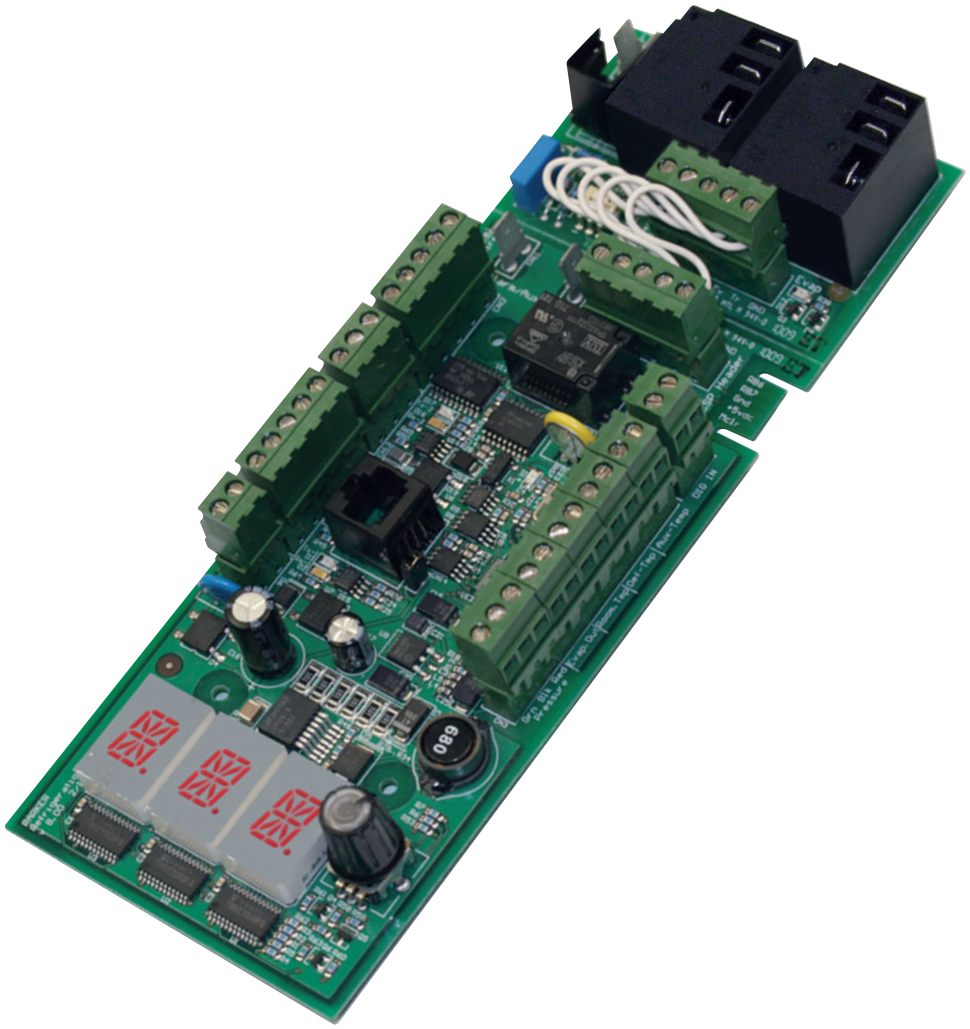
March 2013 / **Bulletin 100-50-4.1**

SPORLAN

Cold Room Control

Installation and Operating Instructions



Controller v. A

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Contents

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Bulletin 100-50-4.1, March 2013 supersedes SD-302M, November 2011 and all prior publications.

Introduction

The Sporlan **Cold Room Control (CRC)** is a microprocessor-based system designed to precisely control refrigeration evaporators in walk-in coolers and freezers. It accurately controls refrigerant flow and provides a single point of reference for all control components. By monitoring pressure and temperatures, the CRC controls evaporator temperature more accurately and consistently than mechanical thermostatic expansion valves. In addition to superheat and room temperature control, the CRC is configured to control evaporator fans, the liquid line solenoid, defrost heaters, and defrost schedules. Valves and sensors may be purchased from Sporlan.

Features

- Integrated digital temperature control
- Pressure/Temperature Superheat control
- Networked controllers for multiple evaporators
- "One push" setup for slave controllers
- Defrost scheduling
- Compressor protection algorithm
- 3-digit LED display
- Modbus® communication for remote monitoring
- Removeable connectors for quick and easy installation
- Four temperature inputs (Sporlan surface or air sensors)
- One pressure input (Sporlan transducer)
- One digital input (for external switch or relay)
- Real-time clock

1. Installation

TOOLS REQUIRED:

- Small flat screwdriver for terminal connections
- Cordless screwdriver
- Phillips and flat screwdrivers
- Needle-nose pliers
- Wire cutters
- Scotch-Brite™ pad
- Two #10 self-tapping screws to mount SnapTrack panel

COLD ROOM CONTROL

The Cold Room Control should be installed in an indoor or protected location, away from electromagnetic interference. Place it in an easily viewed area where it can be used as a digital thermometer. It can be installed near the evaporator or by the entrance to the refrigerated space. Waterproof connections and an enclosure must be used in wet areas.

1. Use self-tapping #10 screws to mount the SnapTrack panel flush on a flat surface. To leave enough working space, the suggested mounting area is 10 inches high and 6 inches wide. The minimum depth is 2.5 inches. See *Figure 1*.
2. Do not power up the CRC until all system components are installed (later in this section) and the system is ready for the setup procedure. See *Section 2*.

For multiple evaporator systems, install one CRC per evaporator.

The CRC board has removeable terminals for most connections. Use the screw terminals on the board (3.5 in-lbs maximum torque) or unplug them and make the connections off of the board. Follow local wiring regulations. The wiring schematic is for illustration only, Sporlan is not responsibile for incorrect wiring.

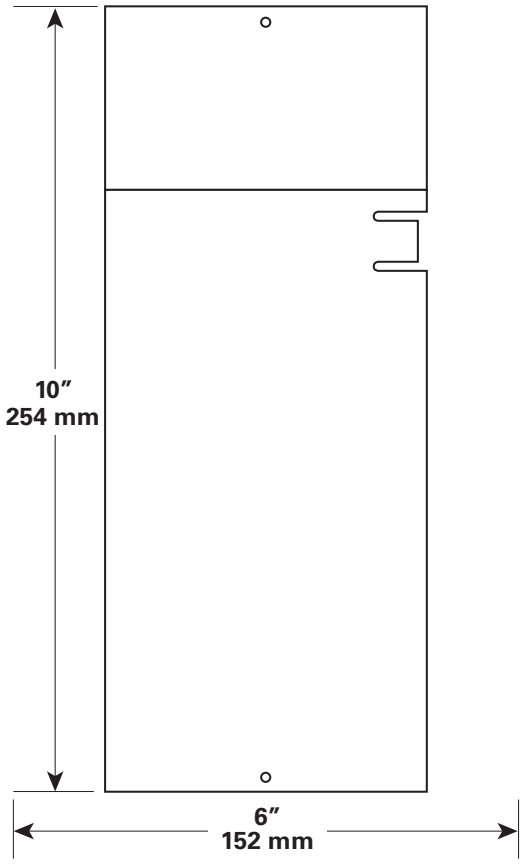


Figure 1 - Recommended Mounting Clearance

WARNING: Use caution when working around high voltage components. Safety covers should be used for personal safety on high voltage panels.

NOTE: The Sporlan CRC refrigeration controller should be installed only by a qualified professional. All other system components (valves and sensors) should be supplied by Sporlan to ensure compatibility and proper operation.

SENSORS

The Sporlan CRC uses the input from one pressure transducer and three 3K temperature sensors to control superheat, defrost, and room temperature. Sensor cables may be extended to 100 ft. (30.5 m) using 18 gauge shielded twisted pair cable and Scotchlok™ UR connectors for long-term integrity.

WARNING: Route and secure sensor cables away from hot surfaces, high voltage lines, and moving components.

See *Appendix G - System Schematic* for sensor locations, and refer to Sporlan's sensor installation instructions, SD-245, available at www.sporlanonline.com.

Pressure Transducer

The pressure transducer sends suction pressure data to the controller. Suction pressure and suction outlet temperature is used by the controller to calculate superheat. The CRC will automatically select a pressure transducer range based on the refrigerant selected. The transducer range can also be set manually in the Programming Menu.

Refer to *Appendix G - System Schematic*, page 24.

1. Locate or install a ¼" SAE access fitting on the suction line near the outlet of the evaporator. Mount it at 12 o'clock on a free-draining horizontal line to minimize oil trapping.

WARNING: Remove pressurized refrigerant from the line before installing the fitting.

2. Install the transducer, tighten it to 8 ft-lbs, and check for leaks. Do not use a gasket or a washer.

WARNING: For safety, ensure that the correct Schrader core is installed in the access fitting and use caution when removing Schrader cap / installing transducer to avoid any escaping refrigerant.

3. Connect the pressure transducer cable to the transducer.
4. Connect the transducer leads to the three terminals labeled "CN3" on the board. See *Table 1 - Pressure Transducer Wire Colors.*
5. After startup (*Section 3*), use a gauge set to verify proper pressure reading to the CRC. An incorrect or improperly installed Schrader core can cause erroneous pressure readings.
6. Check for leaks after the system is in operation.

Table 1 – Pressure Transducer Wire Colors

	CRC TERMINAL	TRANSDUCER CABLE
+	Red	Black
-	Black	Green
S	Green	White

Suction Outlet Temperature Sensor

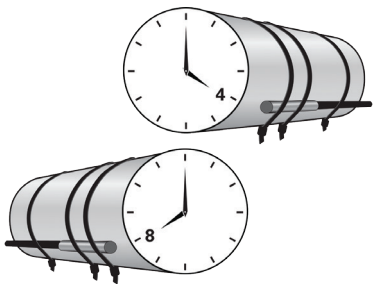
1. Per *Appendix G - System Schematic*, page 24, the temperature sensor should be installed 10-14 inches from the evaporator outlet on a free-draining horizontal line. Minimize the distance from the pressure transducer.
2. Use Scotch-Brite™ to clean the copper line at the area of installation. Remove oxides and dirt to increase sensor accuracy.
3. Fasten the temperature sensor to the copper line in the orientation shown in *Figure 2*.
4. Connect sensor leads to the terminals labeled "Evap. Out" on the CRC board as shown in *Appendix E - CRC Wiring Diagram.* The leads are not polarized.
5. Wrap temperature sensor and copper line with foam insulation to minimize ambient temperature effects. See *Figure 3*.

Defrost Termination Temperature Sensor

1. Per *Appendix G - System Schematic*, page 24, position the Defrost Termination sensor on the coldest point on the evaporator coil. This location is typically the final return bend in the coil before entering the suction manifold. **Consult the coil manufacturer for the best location for the Defrost Termination sensor.**
2. Connect sensor wires to the terminals labeled "Def-Tmp" on the CRC board as shown in *Appendix E - CRC Wiring Diagram.* The sensor leads are not polarized.

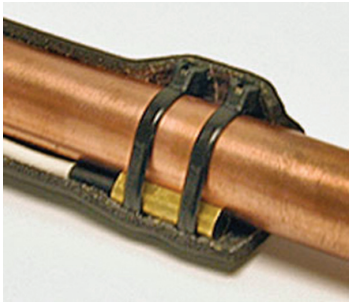
WARNING: Ensure that "Suction" and "Termination" temperature sensor locations are not reversed. Severe system damage may occur if these two sensor locations are interchanged.

Figure 2 - Suction Outlet Temperature Sensor Position



Temperature sensors should be mounted at either 4 or 8 o'clock, on a free-draining horizontal line.

Figure 3 - Cutaway of Pipe Insulation



3K Suction Temperature Sensor

Room Temperature Sensor

1. Mount the Room or Box Temperature sensor in the area to be controlled. If the room sensor is mounted in the return air, ensure sensor is greater than 4" away from the evaporator coil surface.
2. Connect sensor wires to the terminals labeled "Room. Tmp" on the CRC board as shown in *Appendix E - CRC Wiring Diagram.* The sensor leads are not polarized.

Auxiliary Temperature Sensor

1. Mount the optional Auxiliary Temperature sensor in any desired location to monitor additional temperatures such as food product temperature, additional case areas, etc. Unlike the other sensors, it is not necessary for system function.
2. Connect sensor leads to the terminals labeled "Aux-Temp" on the CRC board as shown in *Appendix E - CRC Wiring Diagram.* The leads are not polarized.

NOTE: 3K sensors have approximately 2.8kΩ at 80°F measured across the sensor wires.

RELAYS

The defrost heater relay and fan relay are both rated for 30A inductive inrush loads and 40A resistive loads; maximum 240VAC. The board also has solid state relays for the liquid line solenoid and an external alarm. The alarm relay is rated at 6A resistive load; maximum 277VAC. The liquid line solenoid relay is rated at 3A resistive load; maximum 400VAC.

If the heater relay or fan relay on the board are used to pilot an external contactor, snubbers or appropriate arc suppression devices should be used. This will eliminate noise that could interfere with the operation of the CRC.

Evaporator Fan Relay

1. Crimp two 1/4" female terminals to 18 gauge wires that will be used on the relay.
2. Connect the L1 (hot) lead from the power supply to the common (COM) terminal on the fan relay.
3. Connect the normally closed (N.C.) relay terminal to one terminal on the fan.
4. Connect the L2 (neutral) leg of the power supply to the other terminal on the fan.

Defrost Heater Relay

1. Crimp two 1/4" female terminals to 18 gauge wires that will be used on the relay.
2. Connect the L1 (hot) lead from the power supply to the common (COM) terminal on the heater relay.
3. Connect the normally open (N.O.) relay terminal to one terminal on the heater.
4. Connect the L2 (neutral) leg of the power supply to the other terminal on the heater.

For electric defrost, the heater will be OFF during normal refrigeration and ON during defrost as set by menu options.

Alarm Relay

1. Crimp two 1/4" female terminals to 18 gauge wires that will be used on the relay.
2. Connect the L1 (hot) lead from the power supply to the Alarm terminal labeled "CN5" on the board.
3. Connect one end of an extension lead to the Alarm terminal labeled "CN11" on the board. Connect the other end to one terminal or lead on the alarm.
4. Connect the L2 (neutral) leg of the power supply to the other lead or terminal on the alarm.

High and low thresholds, as well as alarm delays, can be set for each pressure and temperature input on the CRC. These parameters can be set through the Programming Menu. The alarm will sound when any threshold is reached. See *Table 11 – Alarms* for a list of alarms and display codes.

For help troubleshooting an alarm, see *Appendix B – Troubleshooting Chart*.

VALVES

Electric Expansion Valve

The Electronic Expansion Valve (EEV) must be installed at the inlet to the evaporator using standard brazing practices. Refer to Sporlan's valve installation instructions available at www.sporlanonline.com. Use only Sporlan EEVs. See Sporlan Bulletin 100-20 for EEV capacities and sizing.

Table 2 – Electronic Expansion Valves

SPORLAN MODEL NUMBERS	STEPS
SEI-.5, SEI-1, SER-1.5, SEI-2, SEI-3.5 SEI-6, SER-6, SEI-11, SER-11, SER-20	1596
SER-AA, A, B, C, D, G, J, K, L	2500
SEI-30	3193
SEI-50, SEH-100, SEH-175	6386

WARNING: Do not overheat the valve during installation.

Connect the EEV wires to the terminals labeled "CN2" on the board. See *Appendix E - CRC Wiring Diagram.*

Refrigerant Distributor

A refrigerant distributor can be connected to the outlet of the EEV to equally distribute refrigerant into each circuit of a multi-circuit evaporator. Optimum distributor performance is obtained when it is mounted directly to the EEV outlet. If the distributor cannot be mounted directly to the valve outlet, it can be connected by a piece of straight copper line. The line should not exceed two feet, and it should be sized to maintain high refrigerant velocity. Elbows between the EEV and distributor hinder proper distribution, and are not recommended.

The distributor can be positioned in any direction. If the system operates over widely varying conditions, best performance is obtained when the distributor feeds vertically upward or downward. For applications where the distributor is not mounted directly to the EEV, the vertical feed arrangement is also recommended.

Liquid Line Solenoid Valve (Normally Closed)

See *Appendix E - CRC Wiring Diagram* and Sporlan Bulletin 30-10 at www.sporlanonline.com.

The solenoid valve must be installed in the liquid line feeding the EEV. In multiple evaporator systems, it is recommended that individual solenoid valves be used for each evaporator. The liquid line solenoid valves will ensure safe shutoff of refrigerant flow during power loss. This will also ensure safe restart of the compressor.

1. Check the valve label to verify the required voltage.
2. Crimp two 1/4" female terminals onto 18 gauge wires that will be used on the valve.
3. Connect the L1 (hot) lead from the power supply to the "Line" terminal labeled "CN9" on the board.
4. Connect the other lead between the "load" terminal labeled "CN10" on the board and one terminal on the solenoid valve.
5. Connect the L2 (neutral) leg of the power supply to the other terminal on the solenoid valve.

The valve will be OPEN during normal refrigeration and CLOSED when the refrigerated space reaches the temperature setpoint or if the system loses power.

Power Supply

When all system components have been installed and the system is ready for the setup procedure (*Section 2*), connect power supply leads to the terminals labeled "24Volt" on the board. Power requirements are 24 volts AC at 40 VA, Class II transformer. See *Appendix E - CRC Wiring Diagram.*

2. System Setup

The Sporlan Cold Room Control may now be powered up. The controller has preset setpoints for most system parameters, which can be changed through the standard Setup Menu. If additional parameter setpoints (such as defrost) need to be changed, follow the steps in this section and in *Section 4 - System Operation*.

SINGLE EVAPORATOR SETUP

On initial power-up, the EEV will close and the controller will display the first parameter in the Setup Menu. Each of the following parameters must be set/verified before the controller will begin normal operation:

1. Set **M/S** - Master/Slave. For a single evaporator system, the CRC may be set up as either a Master **MST** or a Slave **SLV** controller. Press the SELECT knob once to view the setting. Press the knob again to save the value; the next variable is displayed.

NOTE: Multiple evaporator systems are described later in this section. If a Slave detects a Master on the network, the setup menu is bypassed and the controller will go to the address assignment mode.

2. Set **F-C** - Temperature Units. Select Fahrenheit or Celsius, following the steps above. Default is Fahrenheit (**Fah**).
3. Set **L/M** - Low (**LT**) or Medium (**MT**) Temperature Selection, following the steps above. Default is Medium (**MT**).
4. Set **RTS** - Room Temperature Setpoint. The range is -40° F to 60° F. Default for **LT** application is -10° F, for **MT** it is 35° F.
5. Set **Vty** - Valve Type. See Table 2 for EEV settings or *Section 4 – System Operation* for TEV setup. Default is 2500 step EEV (**2**).
6. Set **Rfg** - Refrigerant. Set this value to the **actual** refrigerant used in the system. See *Appendix A - Parameter Definitions* for available options. Default is R404A (**04A**).
7. Set **Clc** - System Clock. Set hour (**xxH**) and minutes (**xxM**). Time is based on a 24-hour clock.

Once setup is complete, the display will alternate between the room temperature and the current operating mode (*Table 5*). Any alarms (***A***) will also be displayed (*Table 11*).

NOTE: If the controller loses power before Setup is completed, the controller will start at the first item in the Setup Menu on next power up. There is no timeout in the Setup Menu. These parameters can be changed at any time, see *Section 4 - System Operation.*

Default Display

On subsequent power ups, the controller will close the

EEV and display the firmware version. It then displays:

- Its network identity, **MST** (Master), or **SLV** (Slave)
- The number of evaporators, **IE**
- The system clock in hours, **xxH**
- The system clock in minutes, **xxM**

In normal operation, the display will alternate between the room temperature and the current operating mode (*Table 5*). Any alarms (***A***) will be displayed (*Table 11*). The Master controller of a network will also display **MST**.

MULTIPLE EVAPORATOR SETUP

Multi-evaporator systems require individual Sporlan CRC to be configured into a private controller-to-controller network. One CRC must be configured as the 'Master' (*Section 2 - System Setup*), and the other controllers as 'Slaves'. The private network can support up to a total of 8 controllers. **Do not set up 3rd party devices on the CRC private RS-485 network.**

To simplify setup, the CRC offers a convenient "one push" activation of Slave controllers. This will assign each Slave controller on the network a unique address, automatically synchronize the mode of operation between Master and Slave controllers, and transfer all parameter settings from the Master to each newly assigned Slave.

1. Set up a private network by interconnecting port **RS-485-2** between all controllers. Use 18ga shielded twisted pair wire. For more details, see *Section 5 - Communications*.
2. Power up all controllers. Each display will flash **M/S**.
3. Choose which CRC will be the Master controller.
4. Set up the Master controller as described earlier in this section for single evaporators, except set **M/S** to **MST** (Master). **Be sure to complete all steps in System Setup Menu before continuing.**
5. Upon completion of Master setup, the display will show **MST** and then flash **Scn**, then the number of evaporators, followed by the hour, then minutes. The **Scn** feature searches for configured Slaves that are attached to the Master. If no Slaves are found (i.e new setup), it will show **1E** for one evaporator. Any connected and unconfigured Slave controllers will flash '**- - -**'.
6. To set up a Slave controller on the private network, press the SELECT knob on a controller that is flashing '**- - -**'. The Slave controller will display **SLV**, then the number of evaporators on the system, followed by the hour, then minutes. At this time, the Master controller will detect the Slave controller and automatically transfer its parameter settings to the Slave controller.
7. Once the Slave is set up, the Slave display will synchronize with the Master display. Verify that the Status displays match (e.g. both say **OFF** or **REF**). The displays, by default, will alternate between Room Temp, Operating Mode, and Alarms.

   NOTE: Any alarms ***A*** will be shown at this time. Alarms may differ from Master to Slave. The Master will also show **MST** in the sequence.
8. For additional evaporators, repeat step 6. Do not press the SELECT knob on two Slave controllers simultaneously.
9. Once all the controllers are set up, the number of evaporators on the system can be verified from any controller.
   - Press SELECT knob to go to **Sta** in the Main menu.
   - Press SELECT knob and scroll to **NES**.
   - Press SELECT knob to see the number of evaporators.
10. In normal operation, the Master controller can be identified by **MST** flashing on it.

NOTE: Record important setpoint changes in this document and keep it near the controller for future reference.

3. System Startup

After installing the Cold Room Control and all components, and once the system is charged, complete the following checklist for trouble-free system startup. For multiple evaporator systems, repeat for each controller.

- ☐ All wiring is properly connected and routed away from heat sources, electromagnetic devices, and moving components.
- ☐ Proper temperature sensor and pressure transducer locations.
- ☐ Controller displays accurate (room) temperatures.
- ☐ Controller displays same pressure reading as gauge set.
- ☐ Proper relay operation. (Use the test functions available under the System Test Menu to help verify operaterion, see *Table 9*.)
- ☐ Operating set points agree with the system specifications and components.

The default parameter settings may not be ideal for all refrigeration systems. See *Appendix A - Parameter Definitions* for default settings and to confirm set points.

See *Section 6 - PID Tuning* to ensure proper superheat control and EEV operation. System stability and performance may be improved by adjusting PID settings.

This completes the commissioning of the CRC in preparation for refrigeration startup. Other components of the system may need to be commissioned separately.

4. System Operation

REFRIGERATION

The CRC is designed for walk-in freezers and coolers typically found in supermarkets and convenience stores. It can be used on systems with single or multiple evaporators. When used on multiple evaporator systems, one CRC per evaporator is used and a private communication network must be established between controllers. The CRC can be used on systems with a single condensing unit or tied into a supermarket suction group. On single condensing unit systems, a standard pressure switch may be used in the suction line after the evaporator to indirectly control the compressor.

The CRC can be set up for medium temperature (coolers) and low temperature (freezer) applications. The selection of medium or low temperature in the Setup Menu determines the default values for the room temperature and defrost parameters.

During refrigeration, the CRC adjusts the EEV to ensure efficient use of the evaporator coil to maintain room temperature.

Using the CRC with a TEV

The valve type, **VTy**, can be set to **TEV** if a thermal expansion valve is used instead of an electric expansion valve. This disables the EEV output on the controller. The CRC continues to operate the liquid line solenoid, evaporator fans, and defrost heaters in order to maintain room temperature and defrost schedule. The Suction Pressure and Evaporator Outlet Temperature inputs become auxiliary, and can be used for monitoring system status if desired.

Single Evaporator Systems

Single evaporator systems use one CRC. The private network connection, terminal RS-485-2, will not be used, and the CRC may be designated as a Master or a Slave. All setpoint adjustments may be made directly through the controller or via Modbus.

Multiple Evaporator Systems

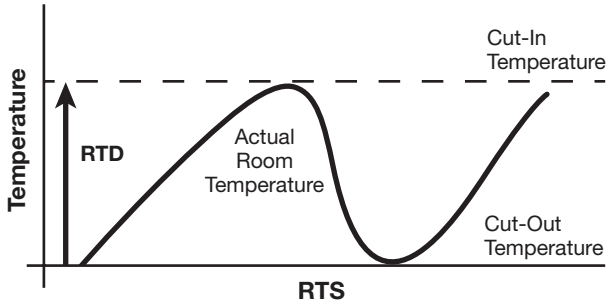
Multiple evaporator systems require one CRC per evaporator. A private RS-485 network must be set up via terminal RS-485-2 to each controller. The system will support up to eight evaporators. One CRC on the network must first be set up as the Master controller. All additional controllers are then set up as Slave controllers.

Once the controllers are networked, all of the evaporators are controlled in a synchronized fashion – all in cooling mode, all in defrost, etc. The same set of parameter settings are shared between all controllers on the network. Changes to system setpoints may be entered at any CRC. All changes are automatically shared between each networked controller. Setpoint adjustments may also be made remotely using Modbus.

Setting Room Temperature

Room temperature control is based upon the room temperature setpoint, **RTS**, and the room temperature differential, **RTD**. When the temperature measured by the Room Temperature sensor is above the setpoint plus differential, the CRC will cut-in refrigeration and enter Refrigeration mode. When the temperature measured by the Room Temperature sensor falls to the setpoint, the CRC will cut-out refrigeration and enter Off mode. See *Figure 4*.

Figure 4 - Controlling Room Temperature



DEFROST

The CRC can be set up to perform scheduled defrosts. Defrost control is based upon the parameter settings located in the Programming Menu. These parameters are:

Table 3 – Defrost Parameters

DISPLAY	DEFINITION	DATA RANGE
A-E	Defrost Type	Air = Air, Ele = Electric
DFS	Defrost Failsafe Time	30 to 100 minutes
DTT	Defrost Termination Temperature	40°F to 70°F (4.4°C to 21.1°C)
DST	Defrost Start Time ##H, ##M	0 to 23H, 0 to 59M
DPD	Defrosts Per Day	1 to 12
DSc	Defrost Schedule	See Table 4
CDT	Coil Drain Time	1 to 10 minutes

NOTE: If Low Temperature is selected during System Setup, the default defrost type is Electric; if Medium Temperature is selected during System Setup, the default defrost type is Air. A Medium Temperature application may be set to Electric defrost by modifying the A-E parameter.

A-E – Defrost Type – When **Air** defrost is selected the evaporator fans remain on during defrost until termination is reached. When **Ele** defrost is selected the evaporator fans are off and the defrost heaters are turned on until defrost termination is reached.

DFS – **Defrost Failsafe Time** – The maximum amount of time that defrost can run before the defrost cycle is terminated.

DTT – **Defrost Termination Temperature** – The minimum temperature the defrost termination sensor must reach before the defrost cycle is terminated.

DST – **Defrost Start Time** – The time at which the first defrost cycle of the day occurs. The default for the first start time is 00:00 (Midnight).

DPD – **Defrost Per Day** – The number for defrost cycles per day, with the first on beginning at the Defrost Start Time. The default is 4 per day for Medium and Low Temperature applications.

DSc – **Defrost Schedule** – Menu that allows the user to modify the start time of any daily scheduled defrost. After setting the Defrost Start Time and Defrost Per Day the defrost schedule is automatically populated with number of defrost evenly spaced in a 24 hour period. The start time of any defrost can be modified by selecting a specific defrost and choosing a different time.

Table 4

D01	Time of Defrost #1
D02	Time of Defrost #2
D03	Time of Defrost #3
D04	Time of Defrost #4
…	…
D12	Time of Defrost #12

CDT – **Coil Drain Time** – The time the evaporator coil is allowed to drain after terminating defrost.

Manual Defrost

To manually start a defrost event, go to the **Service Tools menu**, **Ser**, under the main menu, and press the SELECT knob. Scroll to the defrost setting **MDf** and select **On**.

To manually stop a defrost event, go the Service Tools menu, **Ser**, under the main menu, and press the SELECT knob. Scroll to **Clr** and press SELECT.

OPERATIONAL FEATURES

The CRC offers several features that provide increased system performance and ease of use:

MOP – **Maximum Operating Pressure** – A user-defined setpoint for the maximum suction pressure in the system. If the setpoint is reached during operation, the EEV will slowly close to reduce the suction pressure below the setpoint. During this time, the superheat may increase above the superheat setpoint. The default setpoint is set high from the factory to allow full superheat control.

MCt – **Minimum Cooling Time** – A user-defined setpoint for the minimum time the system stays in refrigeration mode. The minimum time will override room temperature. If this setpoint is increased, the room temperature may fall below the room temperature setpoint during refrigeration. This feature can be used to minimize compressor short cycling. Factory default is 2 minutes.

MFT – **Minimum Off Time** – A user-defined setpoint that will limit the time before the system can restart refrigeration. The minimum off time will override the room temperature differential setpoint. If this set point is increased, the room temperature may rise above the room temperature differential setpoint during off time. This feature can be used to minimize compressor short cycling. Factory default is 4 minutes.

CFP – **Compressor Flood Protection** – An additional safeguard during low superheat conditions to ensure that the compressor will not be exposed to liquid refrigerant during operation. When superheat falls below 2°F, then the controller will automatically adjust the EEV closed more rapidly to slow down refrigerant and reduce the potential for flood conditions. Low superheat conditions may exist in the system when the heat load on the evaporator suddenly drops off. This could occur if evaporator fans become unplugged or fail.

VMX – **EEV Valve Maximum % Open** – A user-defined setpoint for the maximum opening of the EEV. This feature can be used if improper valve selection results in an oversized EEV. Default value is 100%.

MVC – **Manual Valve Control** – Allows manual control of the EEV. This option can be used for troubleshooting expansion valve response to an open or closed position signal from the controller. In normal operation, the manual mode should never be used.

PBS – **Pressure Backup Setting** – Allows multiple CRC controllers to share a common pressure in the event of a pressure transducer failure. This requires a multiple evaporator setup and each CRC must be configured with its own transducer. Should a transducer failure occur, the controller will utilize a common pressure shared over the network. This allows it to continue operating. An alarm will remain active until the transducer fault is corrected.

OPERATING MODES

In normal operation, the CRC display will alternate between room temperature and the current operating mode. The following operating modes (see *Table 5*) describe both single and multiple evaporator unit sytems.

Table 5 – Operating Modes

DISPLAY	DEFINITION
DLY	Delay on Startup - System waiting to restart
OFF	Off - Room temperature setpoint reached
REF	Cooling - Room temperature being controlled
Dfr	Defrost mode
DRN	Draining
FAN	Fan Delay
Tst	Test
Ser	Service
SHd	Shutdown
PdN	Pumpdown
OVd	Electric Defrost Override

DLY – **Delay on Startup** – After initial setup or after a power cycle, the system will remain off a minimum amount of time before controlling the refrigeration system. The startup delay time is controlled by the Minimum Off Time setpoint in the programming menu.

OFF – The system has reached room temperature setpoint. The Liquid Line Solenoid and EEV will be closed. The evaporator fans will remain on. The system will remain in off mode until one of the evaporators in the system reaches the cut-in temperature.

REF – **Refrigeration** – The refrigeration system is operating and controlling room temperature. The Liquid Line Solenoid will be open and the EEV will control the refrigerant flow through the evaporator based on superheat setpoint. The system will remain in refrigeration mode until the room temperature setpoint has been met for all evaporators on the system.

Dfr – **Defrost** – The system is currently defrosting. The Liquid Line Solenoid and EEV will be closed. Defrost type can be set to either Air (fans on) or Electric (fans off). The system will remain in defrost mode until all evaporators have reached their defrost termination setpoints. If the controller loses power during a defrost cycle, it will automatically resume defrost when power is restored.

DRN – **Drain** – The system has terminated defrost. This time allows the evaporator coils to properly drain any condensate resulting from defrost.

FAN – **Fan Delay** – The system has completed a defrost and drain cycle and is resuming refrigeration. This delay allows the system to lower the temperature of the evaporator coil and refreeze any residual moisture prior to turning on the evaporator fans. The system will remain in fan delay mode until the fan delay temperature on all system evaporators or maximum fan delay time has been reached.

Tst – **Test** – Test Mode is part of the Service Tools Menu. This allows the user to test the operation of individual input and outputs connected to the CRC.

Shd – **Shutdown** – Shutdown Mode is part of the Service Tools Menu. This allows the user to shut down the refrigeration system. The Liquid Line Solenoid and EEV will be closed and the evaporator fans will be off. In a multiple evaporator system all evaporators are shut down when one controller is placed in shutdown mode. If power is lost while the system is shut down, the system will remain shut down when power is restored. To exit shutdown mode select Clr in the service tools menu.

PdN – **Pumpdown** – The system has received an external pumpdown signal. Closing, or shorting, the Auxiliary Temperature input terminals will trigger the controller to close the EEV, close the solenoid, turn off the evaporator fans, and turn off the heaters. Once the short is removed, the controller will resume normal operation.

OVd – **Electric Defrost Override** – The system has received an external defrost override signal. Closing, or shorting, the Digital Input terminals will disable the electric heaters. This is used to prevent the electric heaters and compressors from being turned on at the same time. This feature is enabled by setting the **EDO** setpoint to On.

SYSTEM MENUS

There are three menu structures in the CRC; System Status, Program Set-Points and Service Tools. System status menu allows a quick look into the current system conditions. This menu is used to verify that the system is running properly and can be used to review the time from last defrost and the time until next defrost. Time will be in hours and minutes. Parameters and set points cannot be changed through the System status menus. Program set-point menu allows entry into the CRC to view and change system set-points.

Press and rotate the SELECT knob to access the menus:

- **Sta** System Status Settings (*Table 7*)
- **Prg** Program Set Points (*Appendix A*)
- **Ser** Service Tools (*Table 8*)

To enter one of these menus, press the SELECT knob and rotate it to see the three menus. To exit the system menus, rotate the SELECT knob to **ESC** and press the knob. The system menu will time out after 60 seconds.

Table 6 – System Menu

DISPLAY	DEFINITION
Sta	System Status (Table 7)
Prg	Program Set Points (Appendix A)
Ser	Service Tools (Table 8)
ESC	Return to default display

Status Menu
To view the status of various system parameters, including process variables, select **Sta** from the main menu and press the SELECT knob. The Status Menu will time out after 5 minutes. See *Table 7 – Status Menu.*

Programming Menu
To view or modify system set points (system clock, etc.), select **Prg** from the main menu and press the SELECT knob. To save changes and exit the menu, rotate the SELECT knob to **ESC** and press the knob. The Programming Menu will time out after 60 seconds. See *Appendix A – Parameter Definitions.*

Service Tools Menu
To run system tests and manually control the system, select **Ser** from the main menu and press the SELECT knob. To save changes and exit the menu, rotate the SELECT knob to **ESC** and press the knob. See *Table 8 – Service Tools Menu.*

System Test Menu
Each output connected to the CRC can be tested to ensure proper operation. See *Table 9 – System Test Menu.* See *Section 7 – Troubleshooting for Automatic Test Mode.*

Password Protection
By default, the controller is unlocked and all menus can be accessed. When locked, a password is required to enter the Program Set Points Menu. The password is **111**.

To lock the controller, go to the parameter **Loc** under the Program Set Points menu (**Prg**).

When the controller is locked and the **Prg** menu is accessed, the display will show **P/W**. Rotate the Select knob until the display reads **111**. Press the knob again to enter the password and edit the Program Set Points Menu.

5. Communications
The Sporlan Cold Room Control can communicate to external devices via Modbus protocol for remote monitoring or setpoint adjustment. The CRC also communicates with a controller-to-controller RS-485 network in multiple evaporator systems.

PRIVATE CONTROLLER NETWORK
Controller-to-Controller
The CRC has been designed with two RS-485 communication ports. These ports offer both controller to controller communications for multiple evaporator systems and a standard Modbus communication port for remote or local access.

The RS-485-2 port is used between controllers. This port establishes a communication network between controllers

Table 7 – System Status Menu

DISPLAY	DEFINITION
RmT	Room temperature
Vlv	Valve percent
S_h	Superheat
S_P	Suction pressure
COT	Coil outlet temperature
TrT	Termination temperature
AuT	Auxiliary temperature
SST	Saturation system temperature
DI	Digital Input Status (on or off)
DNT	Time to next defrost
DLT	Time elapsed since last defrost
NES	Number of evaporators on system
ESC	Return to system menu

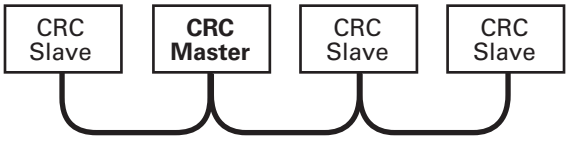
Table 8 – Service Tools Menu

DISPLAY	DEFINITION
TSt	System test (Table 9)
Shd	Shut down system for service
Clr	Clear alarms and skip delay on start up
MDf	Manual defrost
MVC	Manual valve control
Ver	Firmware version
ESC	Return to system menu

Table 9 – System Test Menu

DISPLAY	DEFINITION
ESC	Escape to previous menu
ATM	Automatically cycle relays for 15 sec.
EFR	Test evaporator fan relay
DfR	Test defrost relay
LLR	Test liquid line relay
AIR	Test alarm relay
StP	Test stepper valve
ESC	Return to previous menu

Figure 5 - Private Controller Network



Note that any one CRC can be the Master controller for a multi-evaporator system.

on multiple evaporator systems. The communication wiring must be daisy chained between all RS-485-2 ports on each controller, per walk-in freezer or cooler, for proper system operation. See *Figure 4*. One button setup establishes addresses of slaves.

Connections

Wire Type: 22-24 AWG Universal Twisted Pair
Maximum Number of Network Nodes: 8
Maximum Run Length: 40 ft (100 ft for public)

Recommended Network Configuration: Daisy Chain, a single continuous transmission line from one end to the other. Other configurations involving triple-lug connections, such as star, are not recommended. See *Figure 4*.

Wiring: Proper communication wiring and routing is necessary to avoid nuisance errors or poor system performance. The following guidelines must be followed:

- The correct wire type and shielding must be used for communication lines.
- The correct network wire configuration must be used.
- Communication lines must run at least 6" away from high power lines if they run parallel with each other.
- Communication lines must run perpendicular to high power lines if they cross each other.
- Communication lines should not be installed near high voltage or electromagnetic components.
- Proper grounding must be used for both controller and system.

Noise Reduction: Termination resistance is recommended to reduce reflections and noise on the data transmission lines. Place the resistance at the extreme ends of the cable with the resistance value matching the characteristic impedance of the transmission line (typically 120 ohms for twisted pair cables). Shielding prevents noise from EMI sources. If the cable is shielded, connect the shield to earth ground at one end only.

NOTE: Do not connect shield to RS-485 GND.

Keep RS-485 wiring away from high voltage AC lines to reduce noise and data errors on communication lines. RS-485 cable should be perpendicular to AC lines at any intersection.

System Grounding: The walk in freezer or cooler box must be grounded correctly per local electrical codes to ensure proper controller operation. This will minimize stray noise that could interrupt communication and affect system operation.

Controller Grounding: Connect an optional third conductor to RS-485-2 GND to prevent ground potentials from node to node. This conductor should be included in the shield of the twisted pair cable to prevent noise.
NOTE: Do not connect RS-485 GND to earth ground.

Third Party Controllers: To avoid nuisance "network errors", the use of third party controllers on the same RS-485 network with the Sporlan Cold Room Control is not recommended.

MODBUS NETWORK

CRC Network-to-External Device
RS-485-1 is used to connect a Modbus network that can be used to view system parameters, provide remote access and log system data from the CRC. Third party web servers or equivalent devices are available for these extended features. It may also be networked into a system level controller such as a rack controller. Contact Parker Hannifin-Sporlan Division to review available products. RS-485-1 port does not need to be used unless the above features are needed. It should be noted that communication wiring must be daisy chained between all controllers on the RS-485-1 network. See C*RC Modbus Map – Appendix D.*

6. PID Tuning

NOTE: Only experienced professionals should access this feature. System stability and performance may be improved by adjusting PID settings.

It will be necessary to verify proper superheat control and EEV operation after the system is running. The Cold Room Control is factory programmed with default Proportional-Integral-Derivative (PID) settings that will provide efficient control. The PID values may be adjusted if superheat or EEV movement is not stable. If superheat is oscillating around setpoint at steady state conditions, reduce PID settings to half of the existing values. When PID adjustments are made, allow adequate time for the system to respond to changes. In general, when the superheat is oscillating to extremes, the Proportional and/or the Integral may be too high. If superheat is slow to react to a transient system change, then the Proportional and/or the Integral value may be too low.

NOTE: Not all refrigeration systems are designed alike. Use caution when tuning PID setpoints.

7. Troubleshooting

As with any refrigeration component troubleshooting, actual system conditions should be verified with a gauge set and calibrated temperature sensor (i.e verify actual superheat, subcooling and refrigerant condition). This system information is valuable in determining whether it is component related or system related.

For systems or applications that experience light loads, it is important that the evaporator and refrigerant lines are sized correctly. This will ensure proper oil return and will minimize the effects of oil logging in the evaporator. Refer to the evaporator manufacturer's installation instructions.

COLD ROOM CONTROL

Tst – Test can be used as a diagnostic tool to check operation of the controller outputs such as relays and the EEV. System must be off (not running) during this mode to avoid damage to the compressor. For more information see *Appendix B – Troubleshooting Chart.* The Test feature is located under the SERVICE menu. The CRC offers two test modes; Automatic and Manual. See *Table 9* for test menu options.

ATM – **Automatic test mode** – enter SERVICE menu and scroll to **ATM**. Press SELECT button once to start the automatic procedure. The controller will cycle thru and test each output starting with **EFR** – Evaporator Fan Relay. The relay will be powered on for 15 seconds. At this time, operation can be verified. The relay will then cycle off for 2 seconds before moving to **DFR** – Defrost Relay. After this, the controller will test the **LLR** – Liquid Line Relay followed by the **AIR**- Alarm Relay. The final test is for **StP** – Stepper Motor (EEV) output. The valve must be connected to the controller to verify operation. The controller will overdrive the valve closed. At this time, a light buzzing should be heard around the EEV. When the automatic test is complete, it will then display **ATM**. To exit, scroll to **ESC**. If at any time the test needs to be cancelled, press the SELECT button to exit. Sixty seconds after the procedure completes, the system will time out and return to the default menu.

EFR – **Manual Test Mode** – enter SERVICE menu and scroll past **ATM** and enter **EFR** to manually test each relay. Do not press select button while **ATM** is displayed. This will enter automatic mode. For example, to test the Defrost Relay, scroll to **EFR** and press the SELECT button. At this time, the controller will use the standard 15 seconds on and 2 second off cycle. All relays and EEV can be checked in manual mode by scrolling to the menu display and pressing the SELECT button. To exit, scroll to **ESC** and press SELECT button.

SENSORS

Failed sensors will trigger an alarm. An alarm code will show which sensor is miswired, disconnected, or faulty. (See *Appendix B - Troubleshooting Chart)* The alarm will persist until the problem is corrected.

Failed temperature sensors will generally read extremely low or infinite resistance when tested with an ohmmeter. Readings should be taken with the sensor disconnected from the Subcool Control. A missing or disconnected temperature sensor will read **-60** on the controller.

Temperature sensor output can be checked by measuring the DC voltage across the sensor wire using the tables in Appendix C.

Since the liquid and room temperature sensors are identical, no alarm will be triggered if the sensors are switched.

Figure 5 - Pressure Sensor Cable

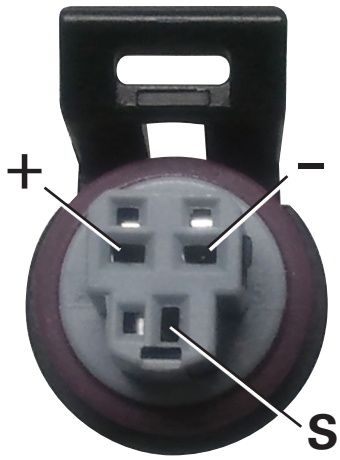


Table 10 - Pressure Transducer Specifications

PRG	Label Color	psi
150	Green	(v-.5) x 37.5
300	None / Silver	(v-.5) x 75
500	Yellow	(v-.5) x 125

WARNING: Severe system damage may occur if these two sensor locations are interchanged.

Pressure transducers must be installed tight enough to depress the valve stem in the fitting. Failure to do so will result in erroneous pressure readings and possibly leaks.

Pressure transducers should be tested while connected to the controller and powered. Test at the controller terminals. Voltage between terminals 34 and 35 should be 4.8 - 5.2 volts DC. Voltage between 33 and 34 should be between 0.5 and 4.5 volts DC. See *Table 1 - Pressure Transducer Wire Colors*, page 4.

To test the accuracy of the transducer, use a a gauge set to obtain the actual system pressure. For volts-to-pressure conversion, measure the voltage between terminals 33 and 34. Identify the pressure transducer used and find the correct range **PRG** in *Table 10.* Substitute the measured voltage (**v**) in the formula in the PSI column. The result should be within 3 psi of the actual system pressure shown on the gauge set. If not, check transducer for proper installation, correct schrader valve, and verify the pressure range identified on the transducer.

To test the transducer cable, disconnect the cable from the transducer and check for 4.8 - 5.2 volts between terminals + and – . See *Figure 5 - Pressure Sensor Cable.*

CONTROLLER REPLACEMENT

1. Safely shut down refrigeration system.
2. Record all system parameters and set points from the controller.
3. Remove power from the CRC.
4. Carefully label and unplug all connections to the CRC.
5. Remove controller from snap track.
6. Referring to Section 1 of this manual, install replacement CRC.
7. If the replacement controller was a networked MASTER, See Section 2 and information from Step 2 above to complete setup. Press SELECT knob on each Slave controller after the new Master board is set up and operating.
8. If the replacement controller was a networked SLAVE, press the SELECT knob on the new controller after it is installed and powered up.

COMMUNICATION ERROR

On multi-evaporator setups, a communication error will activate the CoE alarm on the MASTER controller and the affected SLAVE. If this occurs, there will be no effect on the MASTER controller operation, and the SLAVE controller will continue to operate with the last known settings (including defrost).

Clearing the alarm on the MASTER will reset the alarm status and detach the faulty SLAVE from the network. Clearing the alarm on the SLAVE will reset the alarm status and the SLAVE will operate in stand-alone mode. To reattach the SLAVE controller to the CRC network, reestablish the network connection the MASTER and then press the select button on the SLAVE.

ALARMS

Alarm codes are in Table 11 below. To reset alarms, go to Clear Alarms (**Clr**) under Service Tools (**Ser**). System test options are also located under the Service Tools menu (**TSt**). See *Table 9 - System Test Menu,* and *Appendix B - Troubleshooting Chart.*

Table 11 - Alarms

DISPLAY	DEFINITION
ShL	Superheat Low[1]
ShH	Superheat High
RmL	Room Temperature Low[2]
RmH	Room Temperature High[2]
SuL	Suction Pressure Low[3]
SuH	Suction Pressure High[3]
COL	Coil Outlet Temperature Low[4]
COH	Coil Outlet Temperature High[4]
TTL	Termination Temperature Low[5]
TTH	Termination Temperature High[5]
AxL	Auxiliary Temperature Low
AxH	Auxiliary Temperature High
CoE	Communication Error Alarm

1. Low superheat action is determined by the CDP parameter.
2. If RmT in the System Status Menu shows Err, the CRC will use Coil Outlet Temp to maintain refrigeration.
3. If S_P in the System Status Menu shows Err, the CRC will position the EEV at the failsafe position. If the system is a multi-evaporator system and PbS is enabled, the Master will use an available pressure transducer on the CRC network to continue to operate.
4. If COT in the System Status Menu shows Err, the CRC will position the EEV at the failsafe position. Following defrost, the CRC will use the FMD parameter to determine fan delay.
5. If TrT in System Status Menu shows Err, the CRC will use the DFS parameter to end defrost.

8. System Specifications

ELECTRICAL

Supply Voltage
20-26VAC 50/60Hz or 22-26.6VDC; Class II Input

Digital Inputs
0-5VDC Maximum Range
Interface to dry contact or open collector

Analog Inputs
(4) Temperature Sensors – 3K ohm
(1) Pressure Transducer – 0.5 to 4.5VR
(150 psig, 300 psig, or 500 psig)

Relay Outputs
Heater/Fan – 240VAC/40A res (30A ind)
Solenoid – 400VAC/3A res
Alarm – 277VAC/6A res

Battery Life
More than 10 years (during active operation)

Digital Display
LED - Red, 16 segment, 3 digit

Indicators
LED – Power (Green), Relay Active (Red), Communication (Green/Yellow)

User Interface
Optical Encoder (SELECT knob)

Data Interface
(2) RS485, Modbus

MECHANICAL

Operating Temperature
-40°F to 158°F (-40°C to 70°C)

Humidity
0-95%RH (Non-Condensing)

Wiring
Screw Terminals

APPENDIX A - Parameter Definitions

Found in Programming Menu

PROGRAMMING MENU OPTIONS	DESCRIPTION	DATA RANGE	DEFAULT
ESC	Escape to Previous Menu	–	–
Clc	System Clock	Set during Setup	–
RTS	Room Temperature Setpoint	-40 to 60°F (-40 to 15.6°C)	35°F (Medium Temp.) 10°F (Low Temp.)
RTD	Room Temperature Differential	1 to 10°F (0.6 to 5.6°C)	5°F
S/H	Superheat Setpoint	4 to 30°F (2.2 to 16.7°C)	8°F
VTy	Valve Type	TEV = Mechanical Valve 1 = 1596 steps 2 = 2500 steps 3 = 3193 steps 6 = 6386 steps	2500 steps
Rfg	Refrigerant	r22 = R-22 34A = R-134A 02A = R-402A 04A = R-404A 07A = R-407A 07C = R-407C 10A = R-410A 17A = R-417A 22A = R-422A 22d = R-422D 507 = R-507A 744 = R-744 245 = R-245FA rE5 = RE5 438 = R-438A 01B = R-401B	R404A
-P-	Superheat Proportional Gain Coefficient	0 to 100	5
-I-	Superheat Integral Gain Coefficient	0 to 100	12
-D-	Superheat Derivative Gain Coefficient	0 to 100	2
Vmx	Stepper Valve Maximum % Open	30% to 100%	100%
MOP	Maximum Operating Pressure	20 PSI to 500 PSI	150 PSI
PRG	Pressure Transducer Range	Aut = Auto (based on refrigerant) 150 = 0-150 psig 300 = 0-300 psig 500 = 0-500 psig	Aut
CFP	Compressor Flood Protection	On or Off	On
A-E	Set Defrost Type	Air = Air Ele = Electric	Air (Medium Temp.) Ele (Low Temp.)
DFS	Defrost Failsafe Time	30 to 100 minutes	60
DTT	Defrost Termination Temperature	40 to 70°F (4.4 to 21.1°C)	40°F (Medium Temp.) 55°F (Low Temp.)
DST	Defrost Start Time ##H, ##M	0 to 23H, 0 to 59M	00:00
DPD	Defrosts Per Day	1 to 12	4
DSc	Defrost Schedule	24 hour clock	00:00, 06:00, 12:00, 18:00
EDO	Electric Defrost Override	On or Off	Off
PbS	Pressure Backup Setting	On or Off	On
SuH	Alarm Suction Pressure High	20 to 500 PSI	150 PSI
SuL	Alarm Suction Pressure Low	0 to 20 PSI	0 PSI
SuD	Alarm Suction Pressure Time Delay	0 to 120 minutes	60 minutes
CoH	Alarm Coil Outlet Temperature High	-40 to 80°F (-40 to 26.7°C)	80°F

APPENDIX A - Parameter Definitions (continued)

PROGRAMMING MENU OPTIONS	DESCRIPTION	DATA RANGE	DEFAULT
CoL	Alarm Coil Outlet Temperature Low	-40 to 80°F (-40 to 26.7°C)	-40°F
CoD	Alarm Coil Outlet Temperature Time Delay	0 to 120 minutes	60 minutes
RmH	Alarm Room Temperature High	-40 to 80°F (-40 to 26.7°C)	50°F (Medium Temp.) 30°F (Low Temp.)
RmL	Alarm Room Temperature Low	-40 to 80°F (-40 to 26.7°C)	30°F (Medium Temp.) -25°F (Low Temp.)
RmD	Alarm Room Temperature Time Delay	0 to 120 minutes	60 minutes
TTH	Alarm Defrost Termination Temperature High	-40 to 80°F (-40 to 26.7°C)	80°F
TTL	Alarm Defrost Termination Temperature Low	-40 to 80°F (-40 to 26.7°C)	-40°F
TTD	Alarm Defrost Termination Temperature Time Delay	0 to 120 minutes	60 minutes
AxH	Alarm Auxiliary Temperature High	-40 to 120°F (-40 to 48.9°C)	120°F
AxL	Alarm Auxiliary Temperature Low	-40 to 120°F (-40 to 48.9°C)	-40°F
Axd	Alarm Auxiliary Temperature Time Delay	0 to 120 minutes	60 minutes
ShH	Alarm Superheat High	20 to 50°F (11.1 to 27.8°C)	20°F
ShL	Alarm Superheat Low	0 to 15°F (0 to 8.3°C)	0°F
ShD	Alarm Superheat Time Delay	0 to 120 minutes	60 minutes
MCT	Minimum Cooling Time	1 to 40 minutes	2 minutes
MFT	Minimum Off Time	1 to 20 minutes	4 minutes
CDT	Coil Drain Time	1 to 10 minutes	3 minutes
FDT	Evaporator Fan Delay Temperature	10 to 32°F (-12.2 to 0°C)	28°F
FMD	Maximum Fan Delay Time	0 to 10 minutes	5 minutes
F-C	Set Units to Fahrenheit or Celsius	FAH = Fahrenheit CEL = Celsius	FAH
Loc	Lock/Unlock	Lck = Lock Unl = Unlock	Unl
M/S	Master / Slave Select	MSt = Master Slv = Slave	Slv
Adr	Modbus Address	1 to 32	1
Bau	Modbus Baud Rate	96 = 9,600 bps 192 = 19,200 bps 384 = 38,400 bps	9600 bps
Par	Modbus Parity Mode	Non = No Parity Evn = Even Parity Odd = Odd Parity	Even Parity
SAR	Slave Address Reset	No = Don't Reset Yes = Reset	No
L/M	Low or Medium Temperature Selection	Lt = Low Temp. Mt = Medium Temp.	Set during Setup
LOG	Data Logging Span	1 to 7 days	1 day
ESC	Escape to Previous Menu	–	–

APPENDIX B - Troubleshooting Chart

PROBLEM	CHECK	SOLUTION
Controller board not powering up – no LEDS illuminated	Supply voltage	Correct supply voltage
	Wiring	Correct per instructions
Board powers up but display characters not recognizable	Possible defective board	Replace board
Board indicates active alarm status	Cancel alarm by SELECT keystroke	Correct cause of alarm, check sensors
	Sensor failure	Fix or replace sensor
	Wiring	Correct per instructions
Erratic superheat	Sensor location	Relocate to horizontal, clean suction line at 4 or 8 o'clock
	Pressure transducer location	Top of line near temperature sensor
	Temperature sensor and transducer wiring	Ensure wire contact in connectors
		Ensure wire contact in splices
		Ensure no corrosion in connectors
		Correct per instructions
	Valve wiring and function	Refer to valve service instruction SD-243
High superheat	Superheat setpoint	Set correct setpoint
	Sensor location	See above
	Temperature sensor and transducer wiring	See above
	System refrigerant charge	Correct charge
	Valve wiring and function	Refer to valve service instruction SD-243
	CRC refrigerant selection	Change to system refrigerant
Low superheat	Superheat setpoint	Set correct setpoint
	Sensor location	See above
	Temperature sensor and transducer wiring	See above
	System refrigerant charge	Correct charge
	CRC refrigerant selection	Change to system refrigerant
	Valve wiring and function	Refer to valve service instruction SD-243
Fan relay inoperative	Relay jumpers to board	Correct wiring to jumper connectors
Fans always on	Relay wiring	Correct wiring to N.C. terminals
		Correct per instructions
	Relay contacts	Common to N.O. should have infinite resistance
	Fan and defrost parameters	Correct
	Relay jumpers to board	Correct wiring to jumper connectors
Fans always off	Wiring	Correct wiring to N.C. terminals
		Correct per instructions
	Relay contacts	Common to N.C. should have zero resistance
	Fan and defrost parameters	Correct
	Relay jumpers to board	Correct wiring to jumper connectors
Heater relay inoperative	Wiring	Correct per instructions
		Correct wiring to N.O. terminals
Heater always on	Relay contacts	Common to N.O. should have infinite resistance
Heater always off	Fan and defrost parameters	Correct
	Relay jumpers to board	Correct wiring to jumper connectors
	Relay wiring	Correct wiring to N.C. terminals
		Correct per instructions
	Relay contacts	Common to N.O. should have infinite resistance
	Fan and defrost parameters	Correct
Liquid line solenoid inoperable	Solenoid coil	Replace
	Solenoid voltage	Correct or replace coil
	Solenoid wiring	Correct per instructions

APPENDIX C - 3K Temperature Sensor Specifications

°C	°F	RANGE VDC
-51.1	-60	4.747 - 4.941
-50.6	-59	4.741 - 4.935
-50.0	-58	4.735 - 4.928
-49.4	-57	4.728 - 4.921
-48.9	-56	4.722 - 4.915
-48.3	-55	4.715 - 4.907
-47.8	-54	4.708 - 4.900
-47.2	-53	4.700 - 4.893
-46.7	-52	4.693 - 4.885
-46.1	-51	4.685 - 4.877
-45.6	-50	4.677 - 4.868
-45.0	-49	4.669 - 4.860
-44.4	-48	4.660 - 4.851
-43.9	-47	4.651 - 4.842
-43.3	-46	4.642 - 4.832
-42.8	-45	4.633 - 4.823
-42.2	-44	4.623 - 4.813
-41.7	-43	4.613 - 4.802
-41.1	-42	4.603 - 4.792
-40.6	-41	4.593 - 4.781
-40.0	-40	4.582 - 4.769
-39.4	-39	4.571 - 4.758
-38.9	-38	4.559 - 4.746
-38.3	-37	4.547 - 4.734
-37.8	-36	4.535 - 4.721
-37.2	-35	4.523 - 4.708
-36.7	-34	4.510 - 4.695
-36.1	-33	4.497 - 4.681
-35.6	-32	4.484 - 4.667
-35.0	-31	4.470 - 4.653
-34.4	-30	4.456 - 4.638
-33.9	-29	4.441 - 4.623
-33.3	-28	4.426 - 4.608
-32.8	-27	4.411 - 4.592
-32.2	-26	4.395 - 4.576
-31.7	-25	4.379 - 4.559
-31.1	-24	4.363 - 4.542
-30.6	-23	4.346 - 4.525
-30.0	-22	4.329 - 4.507
-29.4	-21	4.312 - 4.489
-28.9	-20	4.294 - 4.470
-28.3	-19	4.275 - 4.451
-27.8	-18	4.256 - 4.431
-27.2	-17	4.237 - 4.411
-26.7	-16	4.218 - 4.391
-26.1	-15	4.198 - 4.370
-25.6	-14	4.177 - 4.349
-25.0	-13	4.157 - 4.327
-24.4	-12	4.135 - 4.305
-23.9	-11	4.114 - 4.283
-23.3	-10	4.092 - 4.260
-22.8	-9	4.069 - 4.237
-22.2	-8	4.046 - 4.213

°C	°F	RANGE VDC
-21.7	-7	4.023 - 4.189
-21.1	-6	3.999 - 4.164
-20.6	-5	3.975 - 4.139
-20.0	-4	3.951 - 4.114
-19.4	-3	3.926 - 4.088
-18.9	-2	3.901 - 4.062
-18.3	-1	3.875 - 4.035
-17.8	0	3.849 - 4.008
-17.2	1	3.823 - 3.981
-16.7	2	3.796 - 3.953
-16.1	3	3.769 - 3.924
-15.6	4	3.741 - 3.896
-15.0	5	3.713 - 3.867
-14.4	6	3.685 - 3.837
-13.9	7	3.657 - 3.808
-13.3	8	3.628 - 3.778
-12.8	9	3.598 - 3.747
-12.2	10	3.569 - 3.717
-11.7	11	3.539 - 3.686
-11.1	12	3.509 - 3.654
-10.6	13	3.478 - 3.623
-10.0	14	3.448 - 3.591
-9.4	15	3.417 - 3.558
-8.9	16	3.385 - 3.526
-8.3	17	3.354 - 3.493
-7.8	18	3.322 - 3.460
-7.2	19	3.290 - 3.427
-6.7	20	3.258 - 3.393
-6.1	21	3.226 - 3.360
-5.6	22	3.193 - 3.326
-5.0	23	3.160 - 3.292
-4.4	24	3.127 - 3.257
-3.9	25	3.094 - 3.223
-3.3	26	3.061 - 3.189
-2.8	27	3.028 - 3.154
-2.2	28	2.994 - 3.119
-1.7	29	2.961 - 3.084
-1.1	30	2.927 - 3.049
-0.6	31	2.894 - 3.014
0.0	32	2.860 - 2.979
0.6	33	2.826 - 2.944
1.1	34	2.792 - 2.909
1.7	35	2.758 - 2.874
2.2	36	2.725 - 2.838
2.8	37	2.691 - 2.803
3.3	38	2.657 - 2.768
3.9	39	2.623 - 2.733
4.4	40	2.590 - 2.698
5.0	41	2.556 - 2.663
5.6	42	2.522 - 2.628
6.1	43	2.489 - 2.593
6.7	44	2.455 - 2.558
7.2	45	2.422 - 2.524

°C	°F	RANGE VDC
7.8	46	2.389 - 2.489
8.3	47	2.356 - 2.455
8.9	48	2.323 - 2.421
9.4	49	2.290 - 2.386
10.0	50	2.258 - 2.353
10.6	51	2.226 - 2.319
11.1	52	2.193 - 2.285
11.7	53	2.161 - 2.252
12.2	54	2.130 - 2.219
12.8	55	2.098 - 2.186
13.3	56	2.067 - 2.154
13.9	57	2.036 - 2.121
14.4	58	2.005 - 2.089
15.0	59	1.974 - 2.057
15.6	60	1.944 - 2.026
16.1	61	1.914 - 1.994
16.7	62	1.884 - 1.963
17.2	63	1.854 - 1.932
17.8	64	1.825 - 1.902
18.3	65	1.796 - 1.872
18.9	66	1.767 - 1.842
19.4	67	1.739 - 1.812
20.0	68	1.711 - 1.783
20.6	69	1.683 - 1.754
21.1	70	1.656 - 1.725
21.7	71	1.628 - 1.697
22.2	72	1.602 - 1.669
22.8	73	1.575 - 1.641
23.3	74	1.549 - 1.614
23.9	75	1.523 - 1.587
24.4	76	1.497 - 1.561
25.0	77	1.472 - 1.534
25.6	78	1.447 - 1.508
26.1	79	1.422 - 1.483
26.7	80	1.398 - 1.457
27.2	81	1.374 - 1.432
27.8	82	1.351 - 1.408
28.3	83	1.327 - 1.383
28.9	84	1.304 - 1.360
29.4	85	1.282 - 1.336
30.0	86	1.259 - 1.313
30.6	87	1.237 - 1.290
31.1	88	1.216 - 1.267
31.7	89	1.194 - 1.245
32.2	90	1.173 - 1.223
32.8	91	1.153 - 1.202
33.3	92	1.132 - 1.180
33.9	93	1.112 - 1.159
34.4	94	1.093 - 1.139
35.0	95	1.073 - 1.119
35.6	96	1.054 - 1.099
36.1	97	1.035 - 1.079
36.7	98	1.017 - 1.060

°C	°F	RANGE VDC
37.2	99	0.998 - 1.041
37.8	100	0.981 - 1.022
38.3	101	0.963 - 1.004
38.9	102	0.946 - 0.986
39.4	103	0.929 - 0.968
40.0	104	0.912 - 0.951
40.6	105	0.895 - 0.934
41.1	106	0.879 - 0.917
41.7	107	0.863 - 0.900
42.2	108	0.848 - 0.884
42.8	109	0.832 - 0.868
43.3	110	0.817 - 0.852
43.9	111	0.803 - 0.837
44.4	112	0.788 - 0.822
45.0	113	0.774 - 0.807
45.6	114	0.760 - 0.792
46.1	115	0.746 - 0.778
46.7	116	0.732 - 0.764
47.2	117	0.719 - 0.750
47.8	118	0.706 - 0.736
48.3	119	0.693 - 0.723
48.9	120	0.681 - 0.710
49.4	121	0.668 - 0.697
50.0	122	0.656 - 0.684
50.6	123	0.644 - 0.672
51.1	124	0.633 - 0.660
51.7	125	0.621 - 0.648
52.2	126	0.610 - 0.636
52.8	127	0.599 - 0.624
53.3	128	0.588 - 0.613
53.9	129	0.577 - 0.602
54.4	130	0.567 - 0.591
55.0	131	0.557 - 0.580
55.6	132	0.547 - 0.570
56.1	133	0.537 - 0.560
56.7	134	0.527 - 0.550
57.2	135	0.518 - 0.540
57.8	136	0.508 - 0.530
58.3	137	0.499 - 0.520
58.9	138	0.490 - 0.511
59.4	139	0.481 - 0.502
60.0	140	0.473 - 0.493
60.6	141	0.464 - 0.484
61.1	142	0.456 - 0.475
61.7	143	0.448 - 0.467
62.2	144	0.440 - 0.459
62.8	145	0.432 - 0.450
63.3	146	0.424 - 0.442
63.9	147	0.417 - 0.435
64.4	148	0.409 - 0.427
65.0	149	0.402 - 0.419
65.6	150	0.395 - 0.412

APPENDIX D - CRC Modbus Map

MODBUS FUNCTION CODE	DATA MAP	DATA DESCRIPTIONS	DATA RANGE
Read Coils (0x01)	0	Evaporator Fan Relay Status	0 = De-energized 1 = Energized
	1	Defrost Relay Status	0 = De-energized 1 = Energized
	2	Liquid Line Solenoid Relay Status	0 = De-energized 1 = Energized
	3	Alarm Relay Status	0 = De-energized 1 = Energized
Read Holding Register (0x03)	0	Clock Time Hour	0 to 23
	1	Clock Time Minute	0 to 59
	2	Room Temperature Set Point	-40 to 60°F (-40.0 to 15.5°C)
	3	Room Temperature Differential	1 to 10°F (0.6 to 5.5°C)
	4	Superheat Setpoint	4 to 30°F (2.2 to 16.6°C)
	5	Valve Type	0 = TEV 1 = 1596 steps 2 = 2500 steps 3 = 3193 steps 6 = 6386 steps
	6	Refrigerant Type	0 = R-22 1 = R-134A 2 = R-402A 3 = R-404A 4 = R-407A 5 = R-407C 6 = R-410A 7 = R-417A 8 = R-422A 9 = R-422D 10 = R-507A 11 = R-744 12 = R-245FA 13 = R-E5 14 = R-438A 15 = R-401B
	7	Superheat Proportional Gain Coefficient	0 to 100
	8	Superheat Integral Gain Coefficient	0 to 100
	9	Superheat Derivative Gain Coefficient	0 to 100
	10	Stepper Valve Maximum % Open	30% to 100%
	11	Maximum Operating Pressure	20 PSI to 500 PSI
	12	Pressure Range	0 = Auto (Based on refrigerant) 1 = 0 to 150 PSI 2 = 0 to 300 PSI 3 = 0 to 500 PSI
	13	Compressor Flood Protection	0 = Off 1 = On
	14	Defrost Type	0 = Air 1 = Electric
	15	Reserved	
	16	Reserved	
	17	Defrost Failsafe Time	30 to 100 minutes
	18	Defrost Termination Temperature	40 to 70°F (4.4 to 21.1°C)

APPENDIX D - CRC Modbus Map (continued)

MODBUS FUNCTION CODE	DATA MAP	DATA DESCRIPTIONS	DATA RANGE
Read Holding Register (0x03)	19	Defrost Start Time Hour	0 to 23
	20	Defrost Start Time Minute	0 to 59
	21	Defrosts Per Day	2 to 12
	22	Defrost Time 1 Hour	0 to 23
	23	Defrost Time 1 Minute	0 to 59
	24	Defrost Time 2 Hour	0 to 23
	25	Defrost Time 2 Minute	0 to 59
	26	Defrost Time 3 Hour	0 to 23
	27	Defrost Time 3 Minute	0 to 59
	28	Defrost Time 4 Hour	0 to 23
	29	Defrost Time 4 Minute	0 to 59
	30	Defrost Time 5 Hour	0 to 23
	31	Defrost Time 5 Minute	0 to 59
	32	Defrost Time 6 Hour	0 to 23
	33	Defrost Time 6 Minute	0 to 59
	34	Defrost Time 7 Hour	0 to 23
	35	Defrost Time 7 Minute	0 to 59
	36	Defrost Time 8 Hour	0 to 23
	37	Defrost Time 8 Minute	0 to 59
	38	Defrost Time 9 Hour	0 to 23
	39	Defrost Time 9 Minute	0 to 59
	40	Defrost Time 10 Hour	0 to 23
	41	Defrost Time 10 Minute	0 to 59
	42	Defrost Time 11 Hour	0 to 23
	43	Defrost Time 11 Minute	0 to 59
	44	Defrost Time 12 Hour	0 to 23
	45	Defrost Time 12 Minute	0 to 59
	46	Pressure Backup Setting	0 = Off 1 = On
	47	Alarm Suction Pressure High	20 to 500 PSI
	48	Alarm Suction Pressure Low	0 to 20 PSI
	49	Alarm Suction Pressure Time Delay	0 to 120 minutes
	50	Alarm Coil Outlet Temperature High	-40 to 80°F (-40.0 to 26.6°C)
	51	Alarm Coil Outlet Temperature Low	-40 to 80°F (-40.0 to 26.6°C)
	52	Alarm Coil Outlet Temperature Time Delay	0 to 120 minutes
	53	Alarm Room Temperature High	-40 to 80°F (-40.0 to 26.6°C)
	54	Alarm Room Temperature Low	-40 to 80°F (-40.0 to 26.6°C)
	55	Alarm Room Temperature Time Delay	0 to 120 minutes
	56	Alarm Defrost Termination Temperature High	-40 to 80°F (-40.0 to 26.6°C)
	57	Alarm Defrost Termination Temperature Low	-40 to 80°F (-40.0 to 26.6°C)
	58	Alarm Defrost Termination Temperature Time Delay	0 to 120 minutes
	59	Alarm Auxiliary Temperature High	-40 to 120°F (-40.0 to 48.9°C)

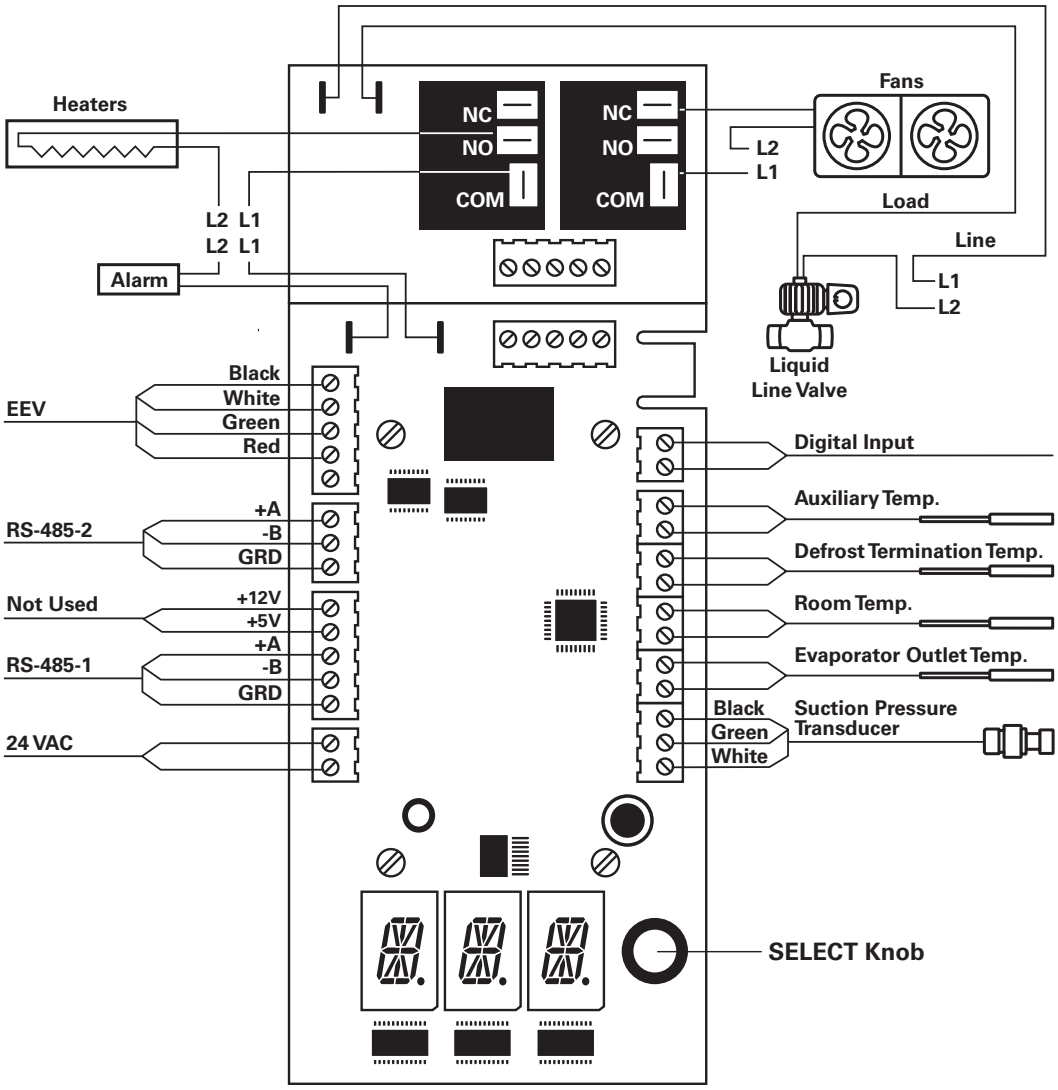
APPENDIX D - CRC Modbus Map (continued)

MODBUS FUNCTION CODE	DATA MAP	DATA DESCRIPTIONS	DATA RANGE
Read Holding Register (0x03)	60	Alarm Auxiliary Temperature Low	-40 to 120°F (-40.0 to 48.9°C)
	61	Alarm Auxiliary Temperature Time Delay	0 to 120 minutes
	62	Alarm Superheat High	20 to 50°F (11.1 to 27.7°C)
	63	Alarm Superheat Low	0 to 15°F (0.0 to 8.3°C)
	64	Alarm Superheat Time Delay	0 to 120 minutes
	65	Minimum Cooling Time	1 to 40 minutes
	66	Minimum Off Time	1 to 20 minutes
	67	Coil Drain Time	1 to 10 minutes
	68	Evaporator Fan Delay Temperature	10 to 32°F (-12.2 to 0.0°C)
	69	Maximum Fan Delay Time	0 to 10 minutes
	70	Temperature Units	0 = Fahrenheit 1 = Celsius
	71	Lock/Unlock	0 = Unlock 1 = Lock
	72	Master/Slave Select	0 = Slave 1 = Master
	73	Modbus Address	1 to 32
	74	Modbus Baud Rate	0 = 9,600 bps 1 = 19,200 bps 2 = 38,400 bps
	75	Modbus Parity Mode	0 = No Parity 1 = Even Parity 2 = Odd Parity
	76	Slave Address Reset	0 = Don't Reset 1 = Reset
	77	Low or Medium Temperature Selection	0 = Medium 1 = Low
	78	Data Logging Span	1 to 7
	79	Electric Defrost Override	0 = Off 1 = On
Read Input Registers (0x04)	0	Firmware Version	0 to 65,535
	1	Room Temperature	-40 to 125°F (-40.0 to 51.6°C)
	2	Valve % Open	0 to 100.0% Open
	3	Superheat	0 to 165°F (0.0 to 91.6°C)
	4	Suction Pressure	0 to 500 PSI Maximum Range
	5	Coil Outlet Temperature	-40 to 125°F (-40.0 to 51.6°C)
	6	Defrost Termination Temperature	-40 to 125°F (-40.0 to 51.6°C)
	7	Auxiliary Temperature	-40 to 125°F (-40.0 to 51.6°C)
	8	Saturation Temperature	-40 to 125°F (-40.0 to 51.6°C)
	9	Digital Input Status	0 = Off 1 = On
	10	Time to Next Defrost Hour	0 to 12

APPENDIX D - CRC Modbus Map (continued)

MODBUS FUNCTION CODE	DATA MAP	DATA DESCRIPTIONS	DATA RANGE	
Read Input Registers (0x04)	11	Time to Next Defrost Minute	0 to 59	
	12	Time Since Last Defrost Hour	0 to 12	
	13	Time Since Last Defrost Minute	0 to 59	
	14	Number of Evaporators	1 to 8	
	15	Operating Mode	**Mode**	**Value**
			Delay on Startup	0x00
			Off	0x01
			Cooling	0x02
			Defrost	0x03
			Drain	0x04
			Fan Delay	0x05
			Test	0x06
			Shutdown	0x07
			Pumpdown	0x08
			Electric Defrost Override	0x09
	16	Alarm Indicator Flags	**Alarm**	**Bit Position**
			Suction Pressure High	0
			Suction Pressure Low	1
			Coil Outlet Temperature High	2
			Coil Outlet Temperature Low	3
			Room Temperature High	4
			Room Temperature Low	5
			Defrost Termination Temperature High	6
			Defrost Termination Temperature Low	7
			Auxiliary Temperature High	8
			Auxiliary Temperature Low	9
			Superheat High	10
			Superheat Low	11
			Controller Network Communications	12
			Defrost	13
			Reserved	14-15
Write Single Register (0x06)	The max number of registers written at a time is 1. The limits are listed under 'Read Holding Register.'			

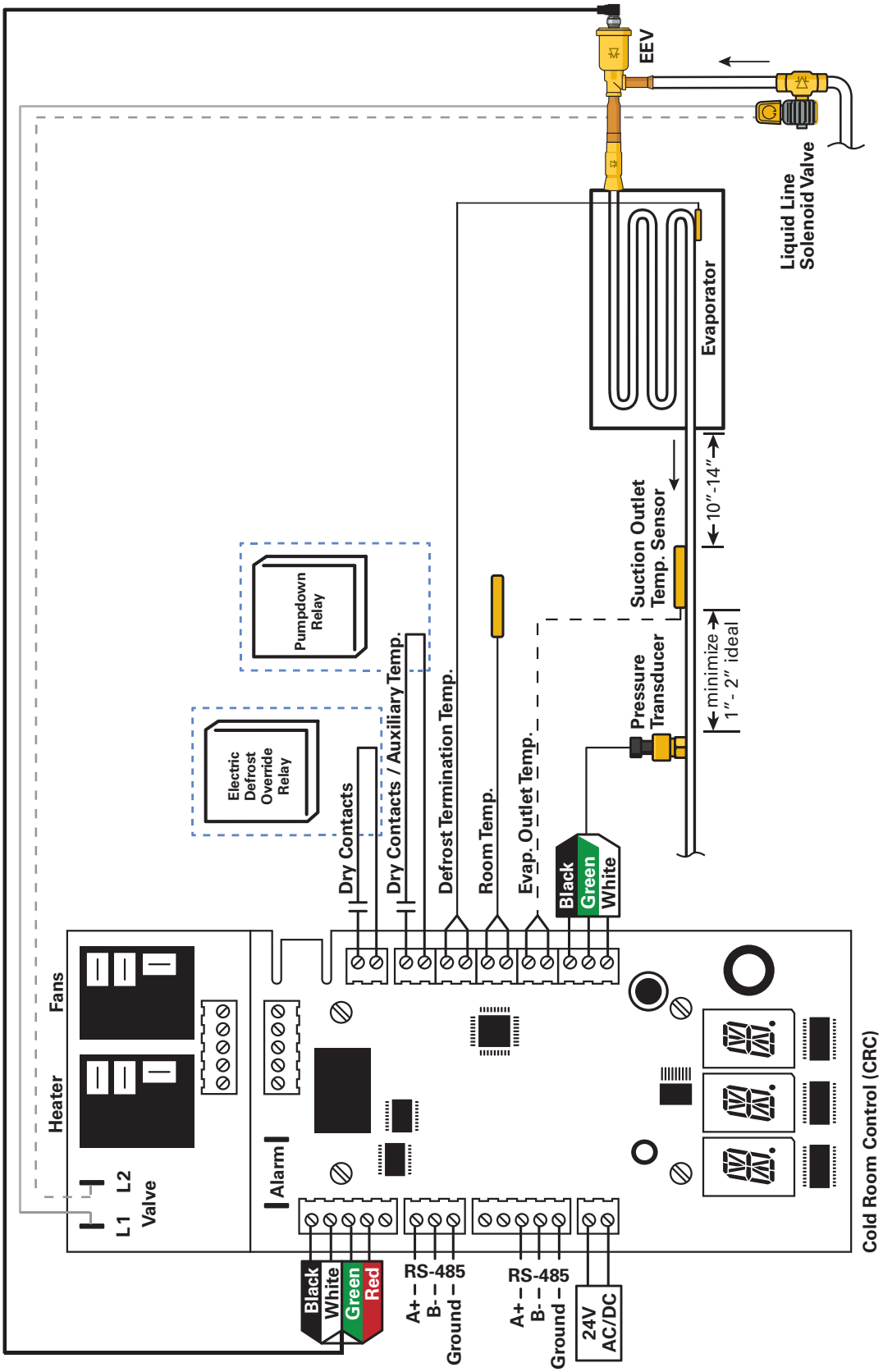
APPENDIX E - CRC Wiring Diagram



APPENDIX F - Accessories

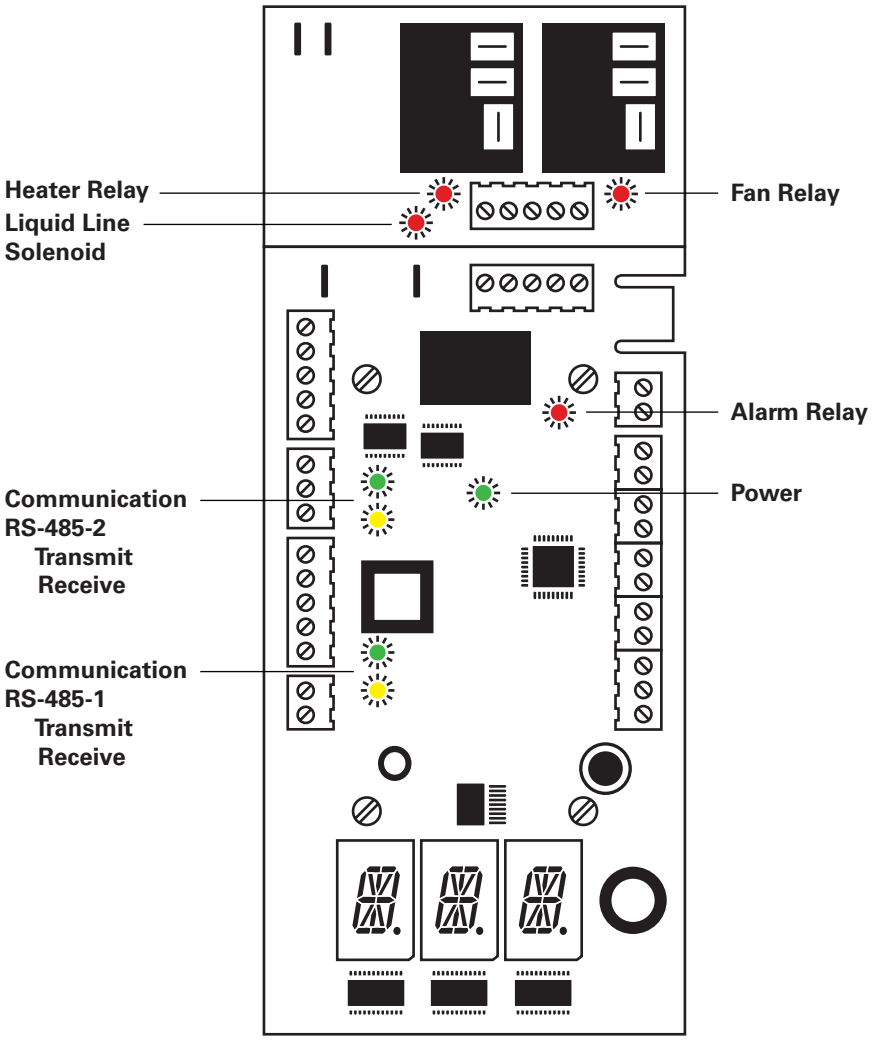
DESCRIPTION	ITEM NUMBER	NOTES
CRC Controller Board	953260	
Parker Sporlan Temperature Probe 3K SURFACE/AIR SENSOR - Brass	952551	Includes 2 meter cable
Parker Sporlan Pressure Transducer PSPT0500SVSP-S PSPT0300SVSP-S PSPT0150SVSP-S	 952576 952574 952572	 0-500 psis transducer (R-744) 0-300 psis transducer (R-410A) 0-150 psis transducer (all other refrigerants)
Transducer Cables PSPT000000CP50 PSPT000000CP20	 953100 953192	 5 meter cable 2 meter cable
Electronic Expansion Valve Various	 Various	 See Bulletin 100-20 or contact Sporlan for sizing.
Liquid Line Valve Various	 Various	 Contact Sporlan for sizing.
Troubleshooting Accessories SMA-12	 953276	 Handheld digital instrument for testing EEV performance

APPENDIX G - System Schematic



This schematic is for component location only, not a typical piping recommendation.
Schematic not to scale.
Insulation not shown.

APPENDIX H - CRC Board Indicator Lights



APPENDIX I - Maintenance Log Sheet

PARAMETER	DATE	SET PT	OPERATOR NAME

Bulletin 100-50-4.1 / 32013

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