Silicon Expansion Valve and Superheat Controller

Refrigeration Retrofit Installation Guide

Contents

INTRODUCTION

The Microstaq Silicon Expansion Valve (SEV) is a two-stage proportional control expansion valve ideally suited for electronic refrigerant control systems. It utilizes Microstaq's patented Ventilum™ silicon Micro-Electro-Mechanical Systems (MEMS) technology to provide precise fluid control in today's industry-standard HVAC and refrigeration applications

The Microstaq Superheat Controller (SHC) is a device that is used to drive and control a Silicon Expansion Valve (SEV). The hardware includes temperature and pressure sensors, while the software is adaptable to the system.

OBJECTIVE

The objective of this guide is to give clear instructions to the user about how to install the SEV and the SHC in a refrigeration system.

OPERATION

The pilot valve applies varying fractions of the liquid line pressure to the second stage spool according to the command signal, such that the spool follows the fractional opening of the pilot. The valve is controlled by the SHC, which is attached at the exit of the evaporator using a standard ¼" Schrader connection. The SHC is powered by a 12V or 24V supply and the SEV is actuated using a 12VDC or 24VAC PWM command signal.

The SHC measures suction pressure and temperature, calculates superheat, and transmits appropriate command to the valve. The SHC cable includes the necessary temperature sensor, power input, power output cable (to valve), and communications cable to operate the valve.

Figure 1: Silicon Expansion Valve

Figure 2: Superheat Controller

INSTALLING THE SEV

The SEV installation is similar to that of a conventional Thermostatic Expansion Valve (TXV), or other Electronic Expansion Valves (EEVs). The SEV should be installed at the inlet of the evaporator, in place of the TXV (or EEV). The SHC should be installed at the exit of the evaporator, in place of the TXV bulb (or EEV controller sensing device), with the provided SHC wiring harness, connecting the SEV and SHC. As with any cooling system safety and cleanliness must be a priority. Use of an upstream filter-drier is highly recommended to prevent contamination of the SEV.

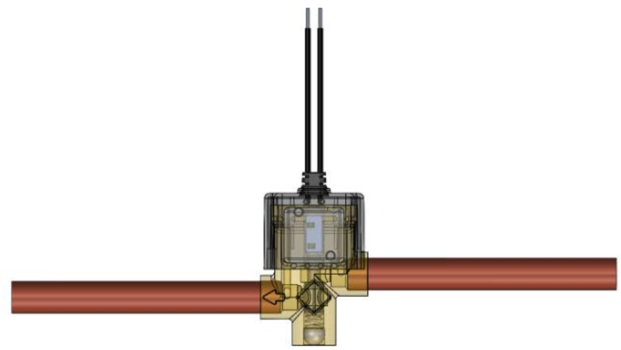

Figure 3: SEV Cross-section

To install the SEV first make sure that they existing system is operating normally. Next, complete the following steps:

1. Reduce the system pressure to atmospheric conditions.
2. Remove the TXV and bulb, or EEV and controller.

The TXV and bulb, (or EEV and Controller) can be removed by either cutting or brazing.

Care must be taken to minimize external contamination when removing previous valve.

3. Position the SEV to ensure proper orientation and flow direction.

Installation of the SEV can be either horizontally or vertically oriented. However, it should not be installed with the pilot (top) facing downward or at a downward angle. (See Figure 4)

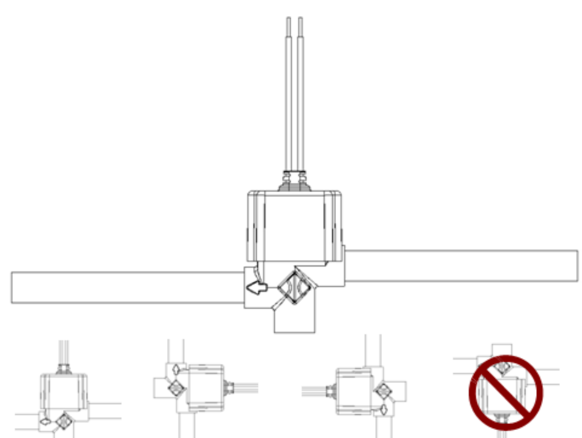

Figure 4: SEV Installation Orientation

4. Clean the copper connections before brazing.

The SEV comes standard with 3/8” copper tube extensions, each 3” in length. Additional fittings may be required to accommodate the desired application. If possible, avoid shortening the length of extensions.

5. Wrap the valve body in a wet cloth, before brazing.

While brazing, direct heat away from the valve body. Ensure that the heat of the valve body does not exceed 221°F (105°C) during installation.

6. Allow the valve to air-cool after brazing.
7. The valve must be protected against contaminants.

Install a filter drier upstream of the valve.

8. The SEV installation is now complete.

INSTALLING THE SHC AND WIRING

The SHC mounts on a standard ¼” Schrader port at the exit of the evaporator in the same general location, where a TXV bulb is typically mounted.

Most applications include an adequate port to install the SHC. However, certain applications may not have an adequate port for the installation of the SHC. The installation port should be located on the suction line directly after the evaporator. However, almost any suction side port is acceptable, if it reaches from the SHC cable Thermistor (24 inches) to the evaporator exit.

Typically, the transformers have a ¼” male spade terminal for connection, which will likely be occupied. It may be necessary to install a double female spade (or other termination) to add the SHC cable to the secondary terminals.

Ensure that copper shavings do not enter the refrigerant line during Schrader port installation. Replace any Schrader cores removed earlier.

RECOMMENDATIONS

- Use 16 AWG when powering multiple SHC’s. 18 AWG may only be used for single SHC installation sup to 20’.
- Use appropriate connections and insulations to prevent water infiltration.
- Use dielectric grease-filled wire nuts or insulated mating connectors for all power interconnects.
- Install the SHC to the side or at an angle to allow condensation to fall away from the device. Use SHC housing for the first few turns on the Schrader.
- For proper adhesion, ensure electrical tape has the correct low-temperature rating.

Use the SHC housing body for the first few turns on the Schrader but do not tighten the SHC using the housing. See Figure 5 and Figure 8.

To install the SHC and wiring, complete the following steps:

1. Braze in Schrader ports, if required.
2. Install the SHC on the Schrader port.

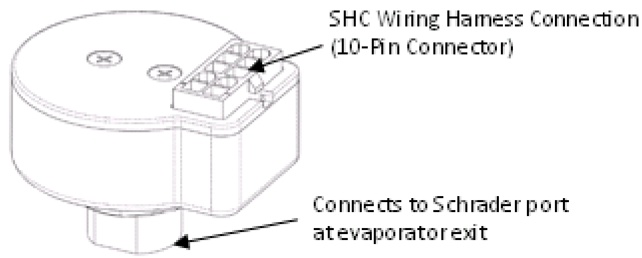

Figure 5: Superheat Controller Schrader Ports

3. Use a 9/16” wrench on the hex nut at the bottom of the SHC, as soon as there is resistance.
4. Attach the SHC wiring harness (10-pin connector) to the SHC and install the Thermistor (See Figure 5, and Figure 6).

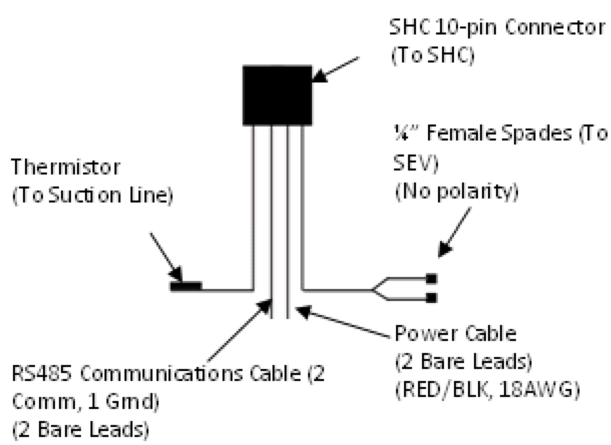

Figure 6: SHC Wiring Harness Diagram

The SHC Wiring Harness includes a large 10-pin white Molex connector that fits into the SHC and a Thermistor. (See Figure 6*)*

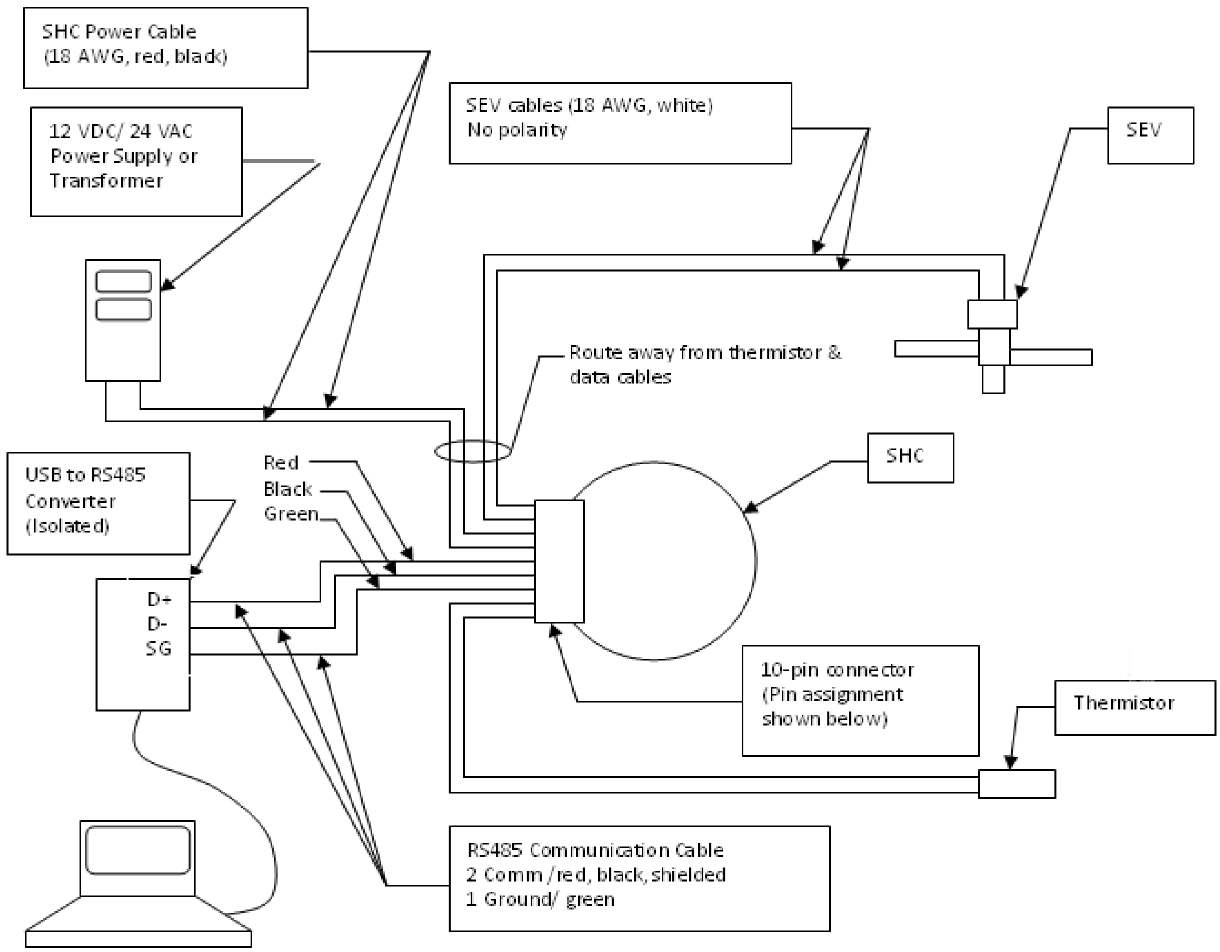

Figure 7: SHC Wiring Diagram, including AC/DC Power Supply & USB to RS422/485 Converter

<u>10 Pin Connector - Pin Assigment</u>

1-Red (18 AWG) – Power Input
2-Black (18 AWG) – Power Input
4-White (18 AWG) – SEV Control
6-White (18 AWG) – SEV Control
7-Red comm. wire Shielded – RS485 +
5-Black comm. wire Shielded – RS485 -
3-green (ground signal)
8-thermistor (power)
3-thermistor (ground signal)
9-Spare Pin
10-Spare Pin

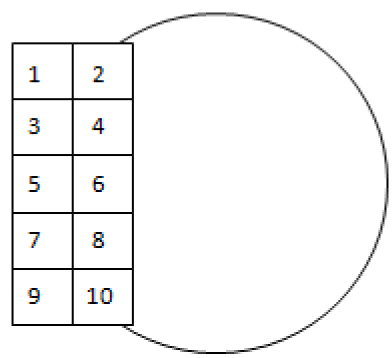

Figure 8: 10-Pin Connector – Pin Assignment

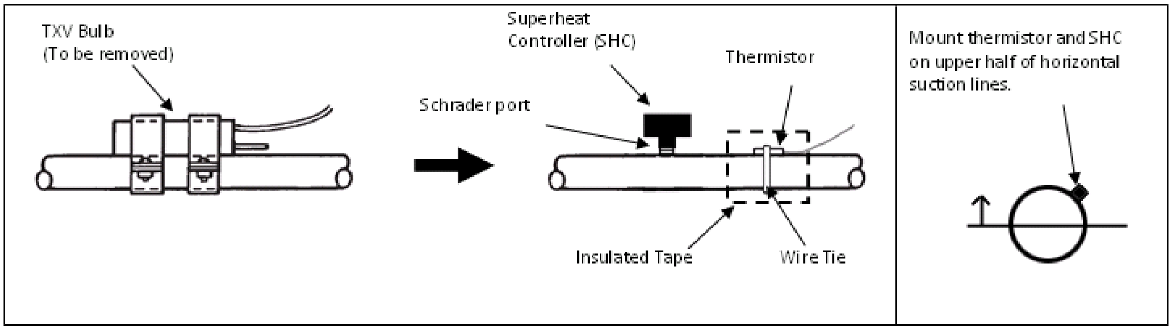

Figure 9: Thermistor at Evaporator Exit

1. Wire-tie the evaporator suction line and wrap with insulated tape (See Figure 7*)*. Ensure the thermistor body is aligned parallel with the pipe.

Ensure that you keep the Thermistor and RS485 cables away from AC wires and SEV wires.

Figure 7 assumes a single SHC.

The SEV type determines the required input power type.

For greatest superheat accuracy, use of thermal grease between the thermistor and pipe is recommended.

INSTALLING THE TRANSFORMER

The SHC power cables (18 AWG red/black cables) should be connected to a 24 VAC or 12 VDC source. Usually, the system fan power can be used as the primary power source, provided the fans are always powered. Otherwise, a transformer is installed for power supply.

For walk-in coolers and freezers, the transformer should be mounted outside the cooled environment, and connected to a constantly powered source, such as door alarms or electrical outlet.

To install the transformer, complete the following steps:

1. Obtain a transformer with a capacity of 100VA and an output of 24VAC 60Hz, or 12VDC to step down from 120 VAC power source.
2. Install the transformer at the Raceway, the preferred location (See Figure 10).
3. Check the voltage output using a multimeter.

The output voltage should be either 24VAC or 12VDC dependant on SEV type.

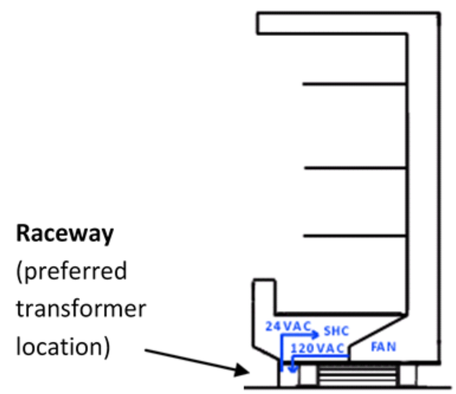

Figure 10: Transformer Power (Display Case Example)

4. Split the power from the secondary side of the transformer into two by using 16 AWG stranded copper wire (See Figure 12).

Up to six superheat controllers or valves can be powered with one 100VA transformer.

5. Connect the split cables to the SHC wiring harness power cables (18 AWG red/black cables, bare leads) that are closest to the transformer on either side (See Figure 11).

16 AWG stranded copper wire is recommended for connection between the controllers. The controller wiring connection has no polarity.

Use appropriate connections or insulation to prevent water infiltration.

It is recommended that dielectric grease-filled wire nuts are used for all power and network interconnects.

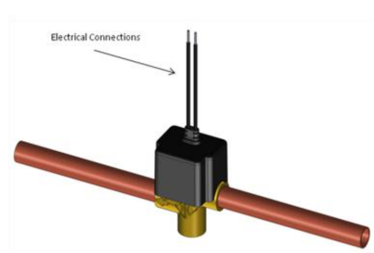

Figure 11: SEV Electrical Connection

6. Connect the power from SHC 3 to SHC 1 and SHC 2.
7. Connect the power from SHC 4 to SHC 5 and SHC 6 (See Figure 12).
8. Allow 6” of free cable length past the last wire tie.
9. Wire-tie and insulate all loose or dangling wires to existing structures neatly.

This wiring methodology is recommended so that the voltage loss to controllers on either end of the transformer will be the same.

For now, the communications cable can be left as is, but it should also be wire-tied to an existing structure.

Ensure all cables are clear of fans and potential water submersion.

Ensure the communication cable is at least 2’ away from high voltage wires, motors, and the SEV & SHC power cables.

Ensure any bare cable leads do not touch metal structures or each other.

Cover bare wire end and exposed cable shield foil with electrical tape.

10. Connect the two ¼” female spade connectors of each SHC wiring harness to the terminals of their respective SEV’s (See Figure 11 and Figure 12).

    You have now completed installing the transformer.

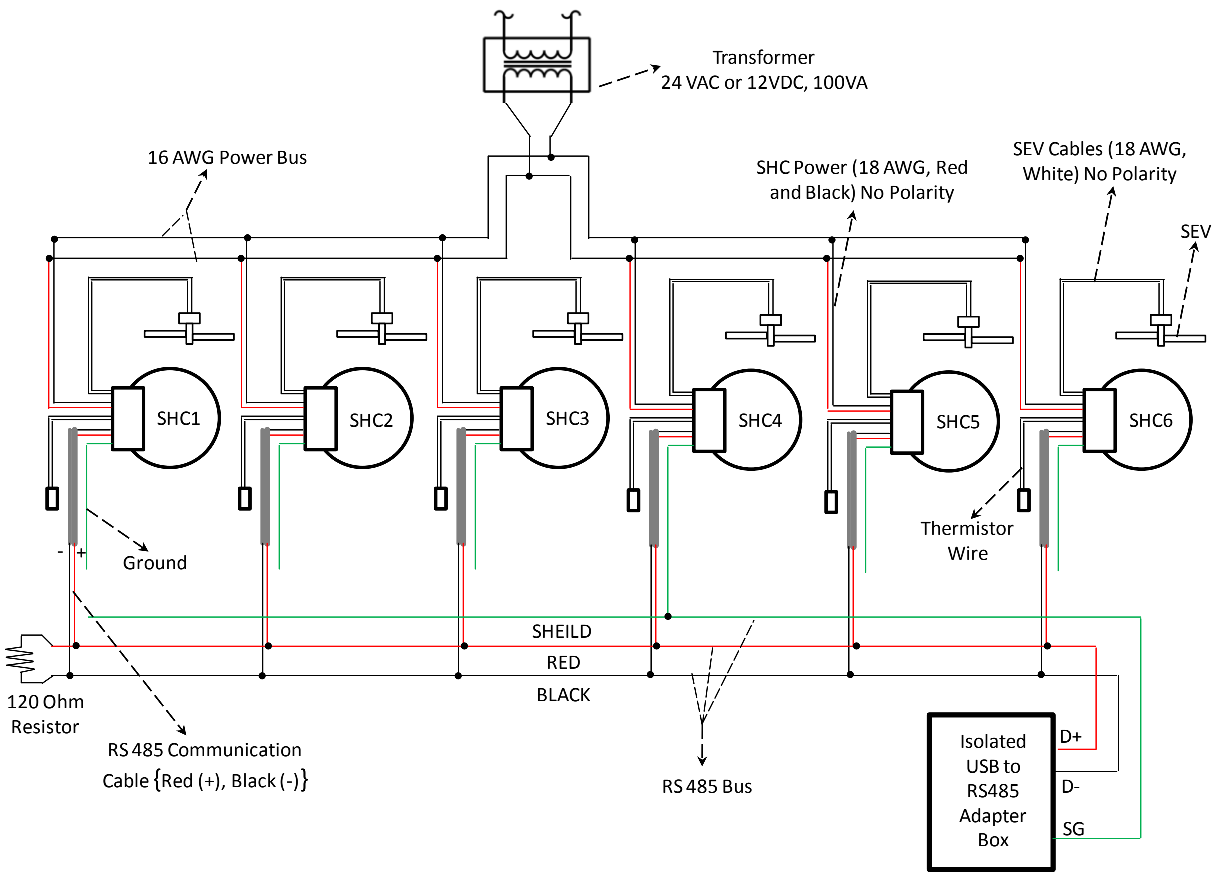

Figure 12: Connection Diagram – 1 Transformer and 6 Controllers

INSTALLING THE SHC NETWORK

The communications for the SHC utilizes the RS485 protocol. Each SHC wiring harness includes a 2-wire RS485 cable and signal ground wire connection (green wire). The RS485 wires on the SHC wiring harness should be cut to 12" (or shorter) while installing the interconnecting RS485 line.

Refer to Figure 13: SHC Networking for a typical SHC network installation. The installer has the option of choosing the routing of the cable, provided the following requirements are satisfied:

- RS485 allows up to 32 nodes (or SHCs) to be connected on one run (or daisy chain).
- The end of each daisy chain needs to have proper 120 OHM termination (See Figure 12 and Figure 13).
- One, and only one, SHC on each transformer must have its ground wire connected to the main RS485 signal ground line. (See Figure 13).
- The exposed metal on the ground wires of the remaining controllers should be covered with electrical tape and neatly wire-tied to an existing structure.
- An RS485 isolator must be installed on each daisy chain prior to entering the hub, or the hub must have isolation on each channel (See Figure 12).
- The communication cable must be kept away from high strength electric and magnetic fields, the SHC and SEV power cables, 110/220 VAC wire, fan motors, relay coils, etc.

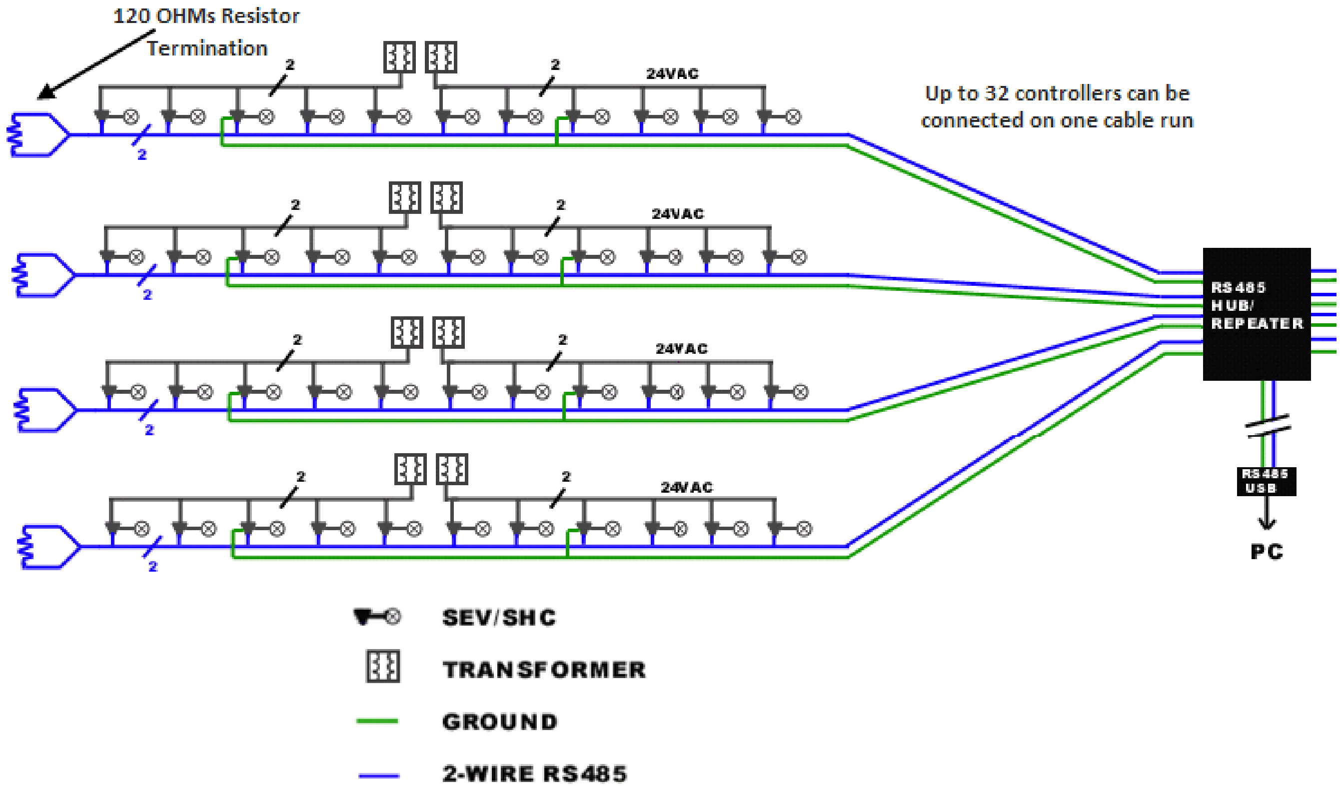

Figure 13: SHC Networking

OPERATING INSTRUCTIONS

- Turn 'ON' the power to the SHC.
- Turn the refrigeration system 'ON' and the SEV and SHC will begin operation
- In the event the SEV and SHC are powered by an independent power supply, turn 'ON' the power supply followed by the refrigeration system

TROUBLESHOOTING

- The following system problems could also result from SEV or SHC malfunction. Use the following table to diagnose the problem.

Problem	*Possible Causes*	*Action*
High Superheat:*This may indicate that the SEV is not opening fully. Common symptoms include compressor short cycling and frost on the valve.*	**Inadequate Power to the Valve**	Check voltages. The voltage leaving the transformer and entering the board should be near the intended supply voltage (24 or 12). If the transformer voltage is too low, there is a problem with the transformer or transformer wiring. If the voltage entering the SHC is low and transformer voltage is normal, there is a problem with the terminal connections or interconnecting wiring to the SHC. If the voltages are both normal, check the voltage exiting the controller (to the SEV). If these readings are zero, the controller is not transmitting a power signal to the valve.
	Temperature Sensor Incorrectly Mounted	Check the mounting of the SHC temperature sensor. The sensor connected should be firmly mounted to the exit of the evaporator on the upper half of the tube. Check that the temperature sensor is wrapped with insulated tape.
	Valve Damaged	Check resistance across the valve terminals. Remove both power connections from the SEV. Attach one pin of a multimeter to each of the two SEV terminals. The resistance reading should be 23-31 OHMS for a 24V valve, and 5-11 OHMS for a 12V valve. If the resistance is significantly out of this range, or zero, the SEV is damaged and should be replaced.
	Valve Stuck Closed	Manually connect and disconnect the power to the valve several times to manually actuate the valve. Check the filter drier. If the system still has high superheat, the SEV may be damaged due to high contamination in the system and may need replacement.
Low Superheat; *This may indicate that the SEV is staying open.*	**Valve Stuck Open**	Manually connect and disconnect the power to the valve several times to manually actuate the valve. Check filter drier
	Temperature Sensor Incorrectly Mounted	Check the mounting of the SHC temperature sensor. The sensor connected should be firmly mounted to the exit of the on upper half of the tube. Check that the temperature sensor is wrapped with insulated tape.
	Valve Damaged	Check resistance across the valve terminals. Remove both power connections from the SEV. Attach one pin of a multimeter to each of the two SEV terminals. The resistance reading should be 24-36 OHMS for a 24V valve, and X to X OHMS for a 12V valve. If the resistance is significantly out of this range, or zero, the SEV is damaged and should be replaced.