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Innovations that flow

**Silicon Expansion Valve and
Superheat Controller**
HVAC Retrofit Installation Guide

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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 HVAC 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 1/4" Schrader connection. The SHC is powered by a AC or DC power 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: Super Heat 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.

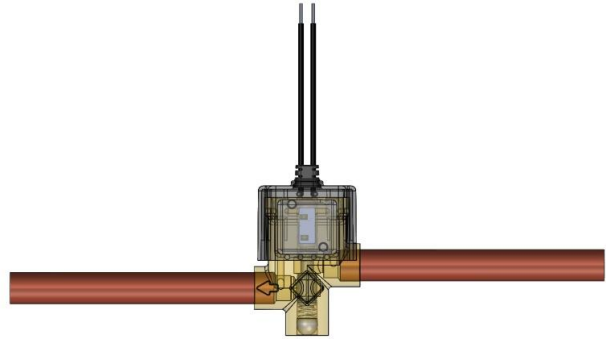


Figure 3: SEV Cross-section

To install the SEV first make sure that the 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)

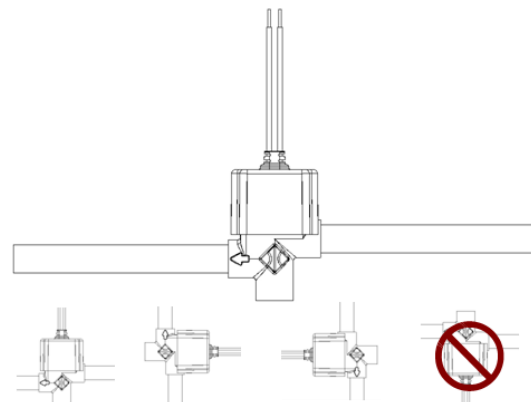


Figure 4: SEV Installation Orientation

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 1/4" 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 1/4" 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/insulation 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

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.

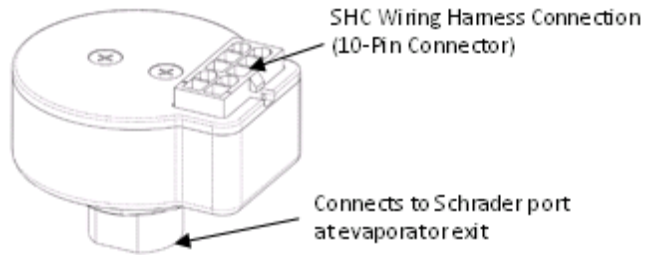


Figure 5: Superheat Controller Schrader Ports

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).

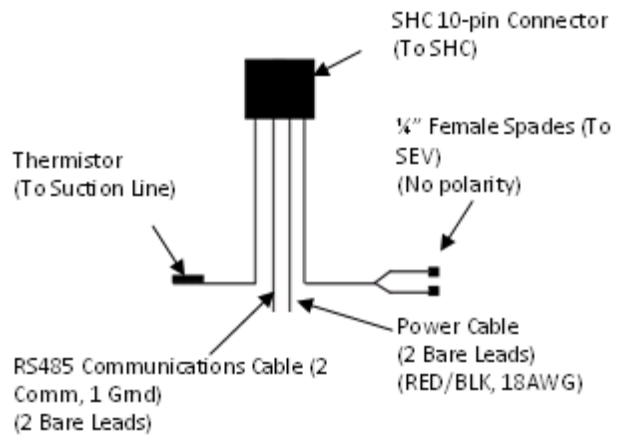


Figure 6: SHC Wiring Harness Diagram



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

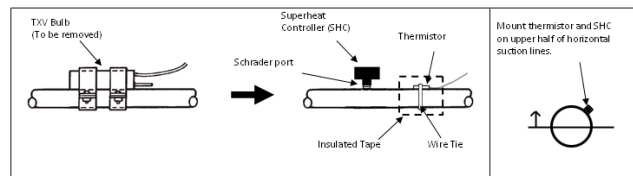


Figure 7: Evaporator Exit

5. 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.

6. Connect the SHC power cables (18 AWG red/black cables, bare leads) to a 24 VAC or a 12 VDC (if applicable) source.
7. Check the voltage of the transformer with a multimeter to identify the secondary voltage terminal.



The reading should be at or near 24VAC. The voltage can be slightly higher than 24V, but should not exceed 29V. For a 12 VDC valve, where applicable, connect the SHC to a 12 VDC Transformer unit. The voltage for the 12 VDC can be slightly higher than 12 VDC, but should not exceed 15 V.



In most cases, there will be a 24V transformer mounted in the control box of the indoor AC unit (evaporator). The transformer will likely be labeled to identify the secondary voltage terminals. See Figure 8: System Transformer.

8. Once the secondary voltage terminal has been identified and checked, shut off power to the system.
9. Check again with a multimeter to ensure power is off and connect the SHC power cables (18 AWG red/black cables).
10. Connect one cable to each of the two secondary transformer terminals. See Figure 8, System Transformer.

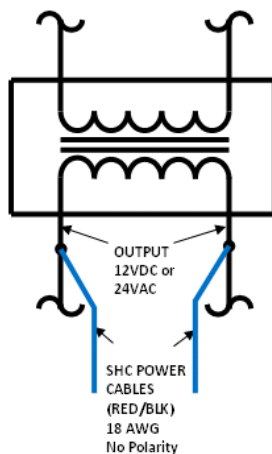


Figure 8: System Transformer: AC or DC Supply



Since there is no polarity with the SHC, the cable order does not matter and the colors have no significance.

If the SHC cables do not reach the system transformer, add 16 AWG extensions to the cables.

11. Connect the two ¼" female spades on the SHC to the two male spades on the SEV.



There is a two-wire white cable on the SHC wiring harness assembly that is already fitted with insulated ¼" female spade connectors. See Figure 9: SEV Electrical Connections.

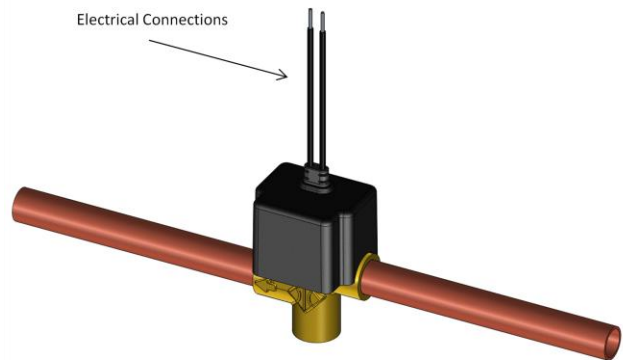


Figure 9: SEV Electrical Connections

12. Leave the remaining unconnected cables such as a 2-wire RS485 data line (small GA. red/black) and the data ground line (green) as is, but cover any exposed metal with electrical tape and wire-tie them to an existing structure.
13. Allow 6" of free cable length past the last wire tie.



For GUI / SHC interface set-up, see Figure 10: SHC Wiring Diagram for wiring connections. For a single SHC set-up, the RS485 will require an adaptor with built-in isolation

14. Wire-tie all loose or dangling wires to existing structures in a neat work-man like manner.



Ensure all cables are away from fans and potential water submersion. Ensure any bare cable leads are covered with electrical tape and do not touch metal structures or each other.

15. Check for leaks at SHC/Schrader and all braze joints.
 16. Restore refrigerant and restart the unit.
 17. Check again for leaks at SHC/Schrader and all braze joints.
- The SHC will automatically begin controlling the SEV upon startup.

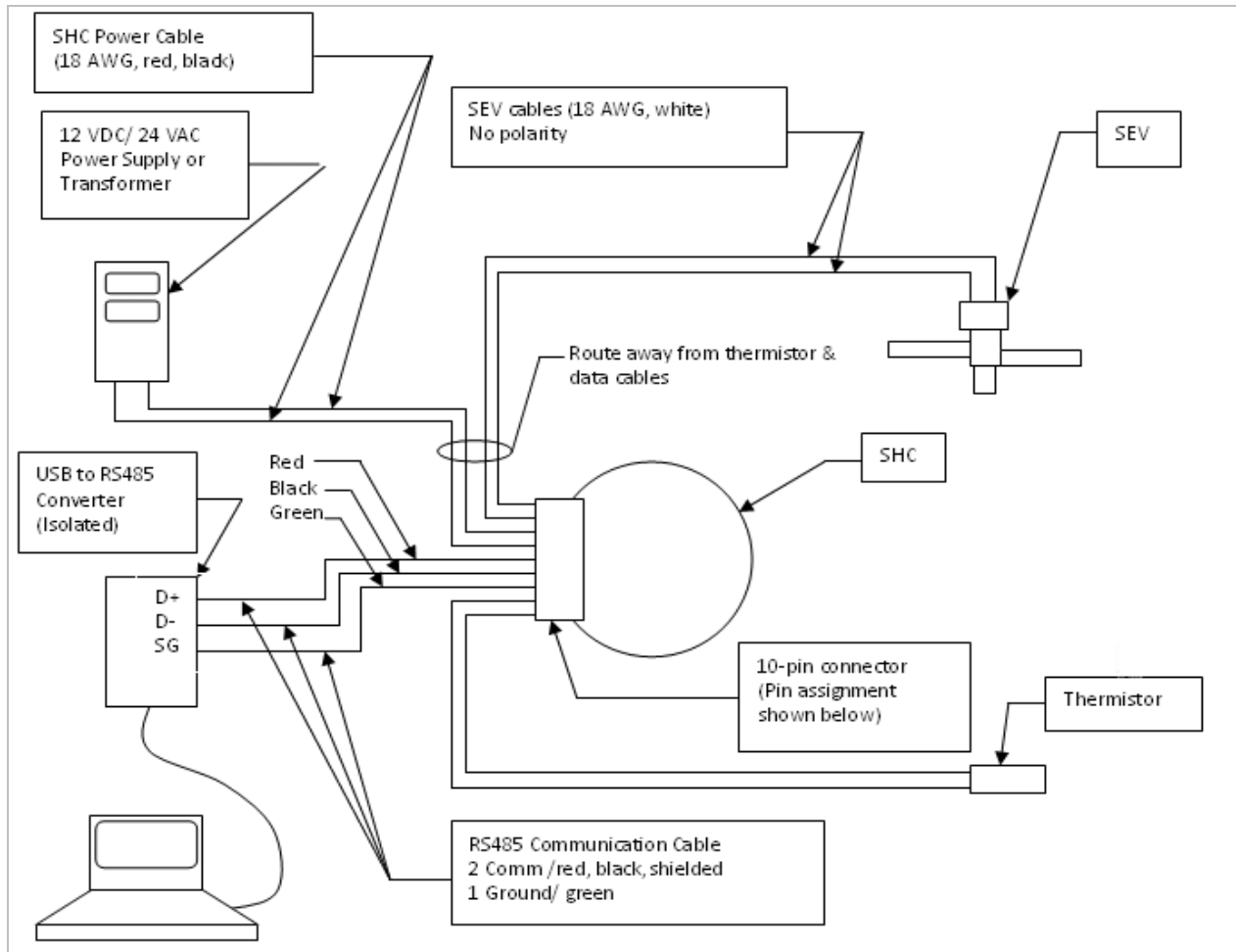


Figure 10: SHC Wiring Diagram, including AC/DC Power Supply & USB to RS422/485 Converter

10 Pin Connector - Pin Assignment

- 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

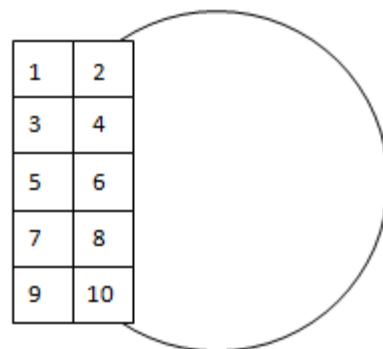


Figure 11: 10-Pin Connector – Pin Assignment

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 HVAC 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; <i>This may indicate that the SEV is not opening fully. Common symptoms include compressor short cycling and frost on the valve.</i>	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; <i>This may indicate that the SEV is staying open.</i>	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.