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Secondary Fluid Control System with Remote Display

Installation and Operation Instructions

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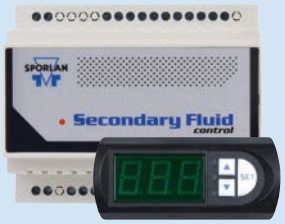
Introduction



The **Sporlan Secondary Fluid Control** is an innovative solution for managing heat exchangers and simple case functions on medium temperature secondary glycol applications. The controller is designed for use with Sporlan SFV Series electric valves and eliminates the need for case mounted balancing valves and pulse width (on/off) solenoid controls. The Secondary Fluid Control provides unique algorithms to optimize heat exchanger efficiency during start up, after defrost, and steady state conditions. It displays actual liquid temperature entering and leaving the coil, and discharge air temperature. It also allows manual control of the valve position and a commissioning feature to help reduce start up time. An internal relay and digital output are available to control case functions, such as lighting and fans, along with a built-in defrost schedule.

Features

- Self optimizing control algorithm
- Multi-level fault analysis for alarming
- Built-in commissioning tool
- Single Valve control (Sporlan Type SFV)
- Remote display
- Controller networking via RS-485
- One digital input
- Four temperature inputs (Sporlan Type 3k)
- One internal relay
- One digital output
- Simple defrost schedule

1. Installation

Refer to *Appendix F – Typical Wiring Diagram*.

TOOLS REQUIRED:

- Small flat screwdriver for terminal connections
- Phillips and flat screwdrivers
- Cordless screwdriver
- Needle-nose pliers
- Wire cutters
- Scotch-Brite™ pad
- Two #8 x ½″ self-tapping screws to mount DIN rail
- Cable ties

VALVE

The SFV Series valve can be mounted in conditioned spaces, such as walk in coolers or refrigerated display cases.

1. Using standard brazing or soldering practices, install the valve on the return line leaving the heat exchanger. Recommended distance from heat exchanger outlet to valve inlet is shown in *Appendix F – Typical Wiring Diagram*. The valve can be installed complete (without removing the motor kit), but internal temperatures must not exceed 250°F / 121°C. Ensure that the valve motor is kept at or above horizontal position as shown in *Appendix J – Valve Motor Position*.
2. Route the valve cable back to the controller and secure with cable ties.

Note: Take caution to keep valve motor enclosure and cable away from defrost heaters. If the motor kit is removed from the valve body, ensure that the valve motor is not powered while it is removed. Valve must be open before removing motor kit.

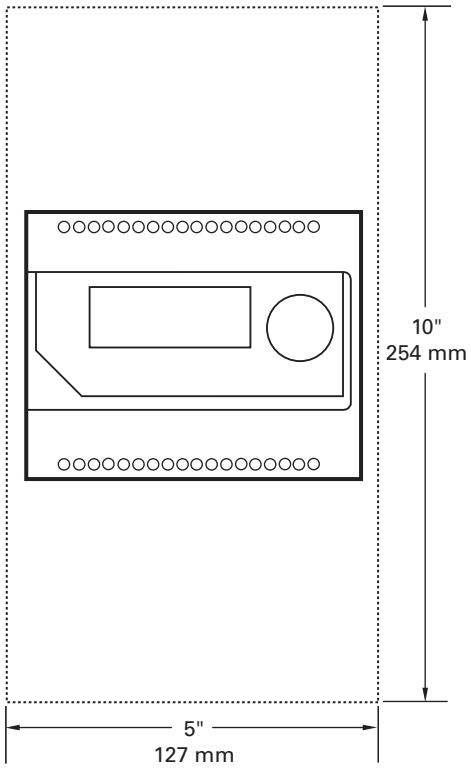


Figure 1 - Recommended Mounting Clearance

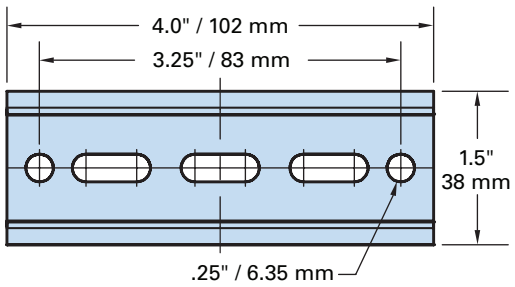


Figure 2 - DIN Rail Detail

CONTROLLER AND SENSORS

1. Mount the controller in a rain-tight, protected location using the supplied DIN rail. To leave enough working space, the suggested mounting area is 10” (254 mm) high and 5” (127 mm) wide. The minimum depth is 3” (76 mm). See Figures 1 and 2.
2. Mount the remote display through a panel cutout using the provided plastic retainer and seal. Rough opening dimensions required are 2.5” (63.5 mm) by 1.14” (29 mm) with a bulkhead thickness of 3/16” (5 mm) maximum.

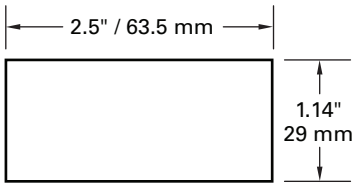


Figure 3 - Remote Display Panel Cutout

3. Mount the blue Liquid Inlet (supply) sensor to the copper tube feeding the coil. The recommended distance is shown in *Appendix F – Typical Wiring Diagram.* Secure the sensor with two cable ties, one on the sensor and one on the sensor cable 2-3” (50-75 mm) from the brass sensor housing. Do not over tighten the cable ties.
4. Mount the black Liquid Outlet (return) sensor to the copper tube leaving the coil. The recommended distance is shown in *Appendix F – Typical Wiring Diagram.*
5. Mount the yellow Defrost Termination Temperature sensor (optional) to the evaporator coil at the coil manufacturer’s recommended location.
6. Thermally insulate the inlet, outlet, and defrost termination (optional) sensors using appropriate material such as Armaflex. The insulation should completely cover the brass sensor.
7. Mount the green Discharge Air sensor to the inside or outside of the discharge air honeycomb at the center of the case. The sensor may also be installed to the plenum directly behind the honeycomb. For walk in coolers, the sensor is placed in the return air stream.
8. Connect the Liquid Inlet Temperature sensor wires to terminals 29 and 30 (blue jacket). The sensor is not polarized. **Maximum torque on screw terminals is 3.5 in-lbs.**
9. Connect the Liquid Outlet Temperature sensor wires to terminals 27 and 28 (black jacket). The sensor is not polarized.
10. Connect the Discharge Air Temperature sensor wires to terminals 31 and 32 (green jacket). The sensor is not polarized.
11. Connect the Defrost Termination Temperature sensor wires (optional) to terminals 25 and 26 (yellow jacket). The sensor is not polarized.
12. Connect the Sporlan SFV wires to terminals 5, 6, 7 and 8. Valve wires are color coded. See *Appendix F – Typical Wiring Diagram.*
13. Connect an externally controlled load (e.g. lights or defrost heater control relay) to the internal relay on terminals 19 and 20. Internal relay can support 120-240VAC, 3A maximum. This relay is always on unless overridden via RS-485 communication from a host controller.
14. Connect an external load control relay (e.g. fans) to the digital output on terminals 11 and 12. Digital output can provide 22-28 VDC, 250 mA maximum.
15. Connect terminals 9-10 to a normally open dry contact (optional). A short or closed contact from an external relay will initiate defrost.
16. Connect the controller to the remote display using a communication cable with RJ-45 connectors.
17. Connect power to terminals 1 and 2. Transformer requirements are 24 VAC at 40VA, Class II.

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

NOTE: The Sporlan Secondary Fluid Control 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. There are no user-serviceable components inside controller. Opening the case will void the warranty.

NOTE: Sensor leads may be extended to 100 ft. (30.5 m) with 18 awg wires and Scotchlok™ UR connectors for long-term integrity.

2. Setup

Ensure all connections have been made before applying power. Upon start up, the SFV will initialize, and then position the valve 50% open. System will not operate until completing setup. Once powered up, the controller will display the firmware versions for the display and the controller. It will then display the first variable to set. To change setpoint parameters, press the SET button to enter the setpoint range, use the arrows to make the desired selection, and then press the SET button to enter the value and move to the next parameter.

1. Set dAS, Discharge Air Setpoint. Default is 28F.
2. Set dty, Defrost Type. Default is oFF for off time defrost. If warm fluid defrost is required, select FLU. If electric defrost, select ELE. The controller defaults to zero defrosts per day, which means if defrost is required, it must be initiated via network communication or by closure of the digital input on terminals 9 and 10. To initiate defrost via the built-in schedule, additional parameters must be set. Refer to *Section 5 – Advanced Setup*.
3. Set Add, network address, between 1 and 127 (master), or 128 and 247 (slave). Default is 128.
4. Once setup is complete, the controller will display dAt, Discharge Air Temperature. After the system is in operation, verify that the Discharge Air Setpoint, dAS, is met. Other parameters can be monitored during operation; refer to *Section 4 – System Operation* for more information.
5. If additional controllers are being installed, refer to *Section 6 – Controller Networking* to aid in network set up.

3. Commissioning Mode

In order to manually position the valve indefinitely during commissioning or service, Commissioning Mode may be used.

NOTE: Do not leave the system unattended while in Commissioning Mode. There is no timeout function to resume normal control. Care should be taken when choosing a valve position to monitor overall system performance. It is recommended to limit the valve position to 50% or below unless otherwise required for a specific reason.

1. Hold both arrows on the remote display for 5 seconds. The valve will drive to the 50% open position.
2. The display will read SPo (Stepper Valve Position) and the valve opening percentage. The center LED will also blink once for every 10% of valve opening.
3. Use the arrows (up or down) to set the desired valve position.
4. Hold both arrows for 10 seconds to exit Commissioning Mode and return to normal control.

4. System Operation

The Sporlan Secondary Fluid Control has been designed to manage heat exchangers (coils) and simple case functions on medium temperature secondary glycol applications. The control package includes the controller, a remote display, one Secondary Fluid Valve and three or four temperature sensors per coil. With standard MODBUS or BACnet communication, each controller may be wired back to the enterprise or host controller for access to key system parameters, but the controllers may also function as pure standalone controls. The use of the Secondary Fluid Control solution eliminates multiple balancing valves and solenoid valves traditionally seen in secondary applications. The SFV is mounted on the outlet of the heat exchanger and the sensors are installed to measure coil inlet and outlet liquid temperature, and coil discharge air temperature. The controller monitors the sensor inputs during operation and adjusts the electronic valve to optimize air to fluid heat transfer, and control refrigerated space temperature. This unique combination improves overall system performance, and reduces secondary fluid pump requirements. The controller also incorporates an automatic self-optimizing algorithm, along with a commissioning feature to help with start up.

REGULATING DISCHARGE AIR TEMPERATURE

Refrigeration Control

Refrigerated space temperature control is achieved by modulating the flow of secondary fluid in the heat exchanger. As temperature in the conditioned space transgresses the set point value, the valve position is adjusted accordingly.

- A transgression above set point is countered by an increase in secondary fluid flow (valve opening).
- A transgression below set point is countered by a decrease in secondary fluid flow (valve closure).

The control utilizes an adaptive algorithm for temperature control and requires that only the desired space temperature (commonly discharge air) set point be configured in the control parameters.

NOTE: During normal operation, the valve is never positioned fully closed except during defrost or when requested during manual valve operation. The minimum valve position is 0.5% and is non-adjustable.

Defrost

The control will initiate and terminate coil defrost action in response to a signal from a host controller via RS-485 communication, by closure of a dry contact, or according to a schedule selected in the Secondary Fluid Control. When configured for Off Time defrost, the control will stop secondary fluid flow by closing the electric valve, and the digital output (for fan control) will remain on. If configured for Electric defrost, the control will stop secondary fluid flow by closing the electric valve, but the digital output (for fan control) will turn off as well. If configured for warm fluid defrost, the electric valve will open to 100%, and the digital output (for fan control) will turn off. The valve and fans will remain in the assigned state until signaled that the defrost cycle has been terminated, or the Defrost Termination Time or Temperature are reached (if internally initiated). Temperature control and all alarms are disabled during the duration of the defrost period, and the remote display will show dEF. At defrost termination, a pull down cycle is initiated. See *Section 5 – Advanced Setup* under Defrost Management for more information.

Pull Down Control

After defrost, the Secondary Fluid Control uses a unique algorithm to maximize heat transfer of the secondary fluid coil. The control uses multiple temperature inputs and adjusts the control logic based on discharge air, coil inlet and outlet temperatures. This allows for rapid pull down, with a seamless and efficient transition into steady state control, while minimizing load fluctuations and power consumption at the pump station.

PROCESS VALUE MENU

During operation, the controller status can be viewed through the Process Value menu. When no other operation is active, the controller will display the Process Menu. By default, the display will read dAt, Discharge Air Temperature, followed by the current temperature measured on the Discharge Air Temperature sensor. It is possible to view the following values using the arrow keys:

Discharge Air Temperature, dAt – displays the current temperature measured by the Discharge Air Temperature sensor.

Coil Inlet Liquid Temperature, t in – displays the current temperature measured by the Coil Inlet Temperature sensor.

Coil Outlet Liquid Temperature, toU – displays the current temperature measured by the Coil Outlet Temperature sensor.

Coil Temperature Delta, dEL – displays the current coil liquid temperature delta, measured by the difference between the Coil Inlet and Coil Outlet Temperature sensors.

Defrost Termination Sensor, S-4 – displays the current temperature read by the Defrost Termination Temperature sensor. S-4 will display -60 if this sensor is not utilized.

Current Valve Position, PoS – displays the current position of the electric valve as percent open.

Internal Relay Status (Relay 1), rL 1 – displays the status (oFF or on) of the internal mechanical relay on terminals 19 and 20, typically used to control lights or to pilot an external defrost heater relay. This relay is always on unless overridden via RS-485 communication from the host controller.

Digital Output Status (Relay 2), rL2 – displays the status (oFF or on) of the digital output on terminals 11 and 12, typically used to pilot an external relay for fan control.

Defrost Signal Input, d in – displays the status (dEF for Defrost, or Coo for Cooling) of the digital input signal. This signal is used to initiate a defrost sequence over RS-485 communication, and can also be modified by using a dry contact on terminals 9 and 10.

Operating Status, StA – displays current operating status of the controller. See *Appendix B – Process Values* for description of display parameters.

Alarm Status, ALS – displays a list of all active alarms on the controller. If no alarms are active, the controller will display non. For a list of all alarm types, see *Section 7 – Alarms.*

5. Advanced Setup

Additional parameter changes may be necessary to achieve the desired or optimum system functionality. Refer to *Appendix C – Setpoint Parameters* for a summary of the parameter menu, including setpoint ranges and default values. Refer to *Section 6 – Controller Networking* for more details on parameters involved in RS-485 communication.

NOTE: The Parameter Menu times out after 60 seconds of inactivity and all changes will be lost.

1. Enter the Parameter Menu: Press and hold the SET button for 5 seconds. When prompted with Ent, use the arrow keys to set the password (default 111), and press the SET button again.
2. To change a value, use the arrow buttons to select the desired parameter, and press the SET button. The current value will display.
3. Use the arrows to change the value, and then press the SET button to enter the value and return to the Parameter Menu.
4. After all parameters are set, use the UP arrow to return to ESC, and then press the SET button to save all changes. Observe the system for proper operation. **NOTE: Setting changes are not saved until ESC is selected. If the Parameter Menu times out, all changes will be lost.**

DEFROST MANAGEMENT

The Sporlan Secondary Fluid Control can be used to manage off time defrost using a selectable schedule. Based upon the number of defrosts selected per day, defrosts will initiate automatically at regular intervals. Note: If power is reset to the control, the defrost schedule will reset as well. For electric or warm fluid defrost, additional system interaction is required, and defrost should be initiated via RS-485 communication by the host controller (not using the internal schedule).

For more advanced defrost management, such as at specified times of day, or to stagger defrost in a system with numerous evaporators, defrost can be managed via RS-485 communication by setting number of defrosts per day to zero. Defrost can always be initiated manually utilizing the digital input on terminals 9 and 10.

Defrosts Per Day, dPd – Can be set from 0 (defrost is not required, or managed over RS-485 communication) to a maximum of 12 defrosts per day. Defrost will initiate automatically at regular intervals over a 24 hour period.

Defrost Shortest Time, dSt – For internally initiated defrost, defines the shortest possible defrost time. If the Defrost Termination Temperature sensor is not utilized, or if there is an alarm for a sensor fault, defrost will terminate when it reaches the dSt setting. The default is 10 minutes, but can be set from 0 to 120 minutes. dSt will take precedence over dFS if dFS is set lower than dSt.

Defrost Failsafe Time, dFS – For internally initiated defrost, defines the longest possible defrost time. If the Defrost Termination Temperature sensor is being used, but the temperature is not reached within a reasonable time defined by dFS, then normal refrigeration will resume. The default is 60 minutes, but can be set from 30 to 120 minutes. If set shorter than dSt, then dSt will take precedence.

Defrost Termination Temperature, dtt – Defines the temperature at which the scheduled defrost will terminate once the shortest defrost time dSt has passed, based upon input from the Defrost Termination Temperature sensor. Default is 55°F (12.8°C), but can be set from 40 to 70°F (4.4 to 21.1°C).

Drip / Drain Time, drP – Upon completion of defrost, the Secondary Fluid Valve will remain in the defrost position until the drip / drain time drP has elapsed, to allow the coil to dry. Defrost heaters (if used) and fans will remain off during this time. The default is 3 minutes, but can be set from 0 to 10 minutes.

Fan Delay Temperature, Fdt – If the Defrost Termination Temperature sensor is used, fans will remain off after the drip / drain time has elapsed and the valve has returned to a refrigeration position, until this sensor reading falls below the Fan Delay Temperature Fdt. The maximum setting is 32°F (0°C), which will prevent moisture from blowing off of the coil into the refrigerated space. The default is 28°F (-2.2°C), but can be set as low as 10°F (-12.2°C).

Fan Delay Time, Fdt – If the Defrost Termination Temperature sensor is not utilized, or if there is an alarm for a sensor fault, the Fan Delay Time Fdt will start after the drip / drain time drP has elapsed. Fans will turn on after this time has elapsed, which can be set from 0 to 10 minutes. The default is 5 minutes.

Defrost Start / Stop, dSS – Defrost can be manually initiated using the dSS setting. Selecting oFF will terminate an active defrost. Selecting on will immediately initiate a defrost cycle. dSS will reset to oFF upon termination of defrost (you must exit the dSS menu and reenter for the display to refresh).

MANUAL VALVE POSITION

Stepper Position, SPo – The Secondary Fluid Control can be used to manually control the electric valve position, by adjusting SPo in 1% increments of valve opening. The 0.5%

minimum valve position is ignored when operating in this mode, allowing the valve to go fully closed if desired. The system will time out after 60 minutes of inactivity while in manual control. To end manual control sooner, simply press the SET button again on the display. To use this feature remotely, a proper RS-485 network connection is needed. Refer to *Appendix G – MODBUS Memory Map* or *Appendix H – BACnet Memory Map* for the correct fields and values to write.

For commissioning valves in large systems, or purging air from the system, the controller can be placed in an indefinite user-defined position. This feature is similar to the manual valve position SPo, except with the time out disabled. To utilize this feature, refer to *Section 3 – Commissioning Mode*.

NOTE: Do not leave the system unattended while in Manual Valve Position Mode. Care should be taken when choosing a valve position to monitor overall system performance. It is recommended to limit the valve position to 50% or below unless otherwise required for a specific reason.

TEMPERATURE SENSOR CALIBRATION

Discharge Air Temperature Calibration, Ct 1 – allows a temperature offset to be applied to the Discharge Air Temperature sensor. For additional information, see *Section 7 – Troubleshooting*.

Coil Inlet Temperature Calibration, Ct2 – allows a temperature offset to be applied to the Coil Inlet Temperature sensor.

Coil Outlet Temperature Calibration, Ct3 – allows a temperature offset to be applied to the Coil Outlet Temperature sensor.

6. Controller Networking

The Sporlan Secondary Fluid Control can communicate via RS-485 to a master controller, utilizing MODBUS or BACnet protocol, to transfer process values and setpoints. See *Appendix G – MODBUS Memory Map* or *Appendix H – BACnet Memory Map*. The serial settings are:

- 9600 baud (default), 19200 baud, 38400 baud
- 8 data bits
- 1 stop bit
- No parity (default), even parity, odd parity

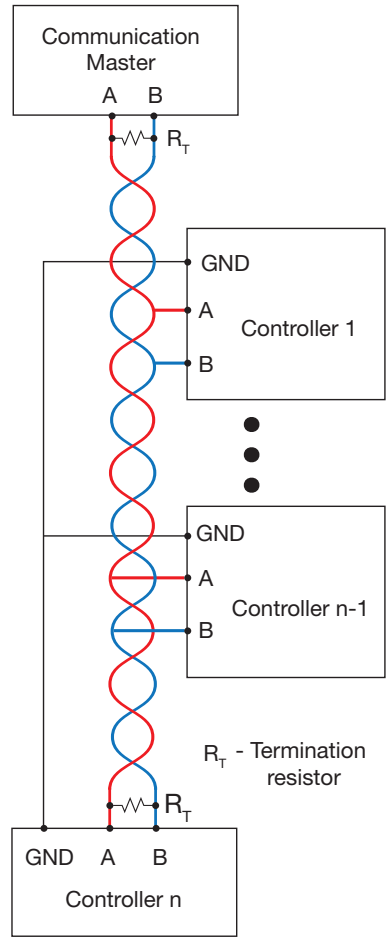
Scaling for Temperature

Temperature values contain 1 decimal place (10ths of a degree). For better precision in MODBUS, scaling is used for both Fahrenheit and Celsius Temperature units, and values transferred are 10X. A value of 45 will be transferred for the Temperature when the actual temperature is 4.5°F / -15.3°C. This is important to remember when reading or writing a setpoint via MODBUS. BACnet can store decimal places directly, and temperature scaling is not used.

Setup

Prior to establishing the network, each controller must be assigned a unique address Add. Refer to *Section 2 - Setup*. Once assigned, addresses can be changed in the Parameters Menu using the procedure shown in *Section 5 – Advanced Setup*. Note: No two controllers can have the same address.

Figure 3 - RS-485 Wiring



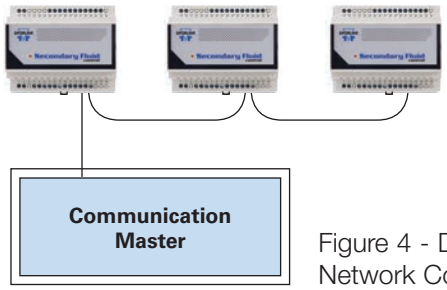


Figure 4 - Daisy Chain Network Configuration

MODBUS Communication Requirements

See *Figure 3 - RS-485 Wiring*.

Wire Type: 22-24 AWG Universal Twisted Pair

Maximum Number of Network Nodes: 100

Maximum Run Length: 4000 ft.

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

Noise Reduction: Termination resistance (RT in Figure 3) 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 the communication lines. If necessary, RS-485 communication cable should be placed perpendicular to AC lines at any intersection.

Grounding: Connect an optional third conductor to RS-485 GND (terminal 13) to prevent ground potentials between nodes. 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 Sporlan controllers is not recommended.

See *Appendix G – Modbus Memory Map* or *Appendix H – BACnet Memory Map*. Also, refer to the documentation supplied with the communication master for additional RS-485 network requirements.

7. Alarms

To take advantage of the alarming capability of the Sporlan Secondary Fluid Control, the following parameters must be set. Refer to *Appendix C – Setpoint Parameters* for value ranges and default settings.

Discharge Air Alarm Setpoint, dAH – the threshold for a high discharge temperature alarm. **Note: The lowest alarm value is 2 degrees above the Discharge Air Setpoint,** dA5.

Discharge Air Alarm Delay, dAd – the delay (in minutes) after the measured temperature exceeds dAH before the high temperature alarm is activated.

Table 1 - Alarm and Alarm Actions

ALARM	DESCRIPTION	ACTION
dAH	High Discharge Air Temperature	Valve moves to recovery position
t 1F	T1 (Discharge Air) Sensor Fault	Valve moves to recovery position
t2F	T2 (Coil Inlet) Sensor Fault	Notification
t3F	T3 (Coil Outlet) Sensor Fault	Notification
CtL	Unable to Control Case Temperature	Valve moves to recovery position
non	No Active Alarms	

When certain temperature or equipment problems arise, the Secondary Fluid Control will activate an alarm. See Table 1 for a complete list of alarms and how the controller responds when each alarm is active. To view alarms from the Process Menu, use the arrows to locate the AL5 selection. The controller will display any active alarms one at a time. If no alarms are active, the controller will display non. Alarms will persist until the problem is corrected. All alarms are self clearing and control will resume once the alarm condition no longer exists.

8. Troubleshooting

As with any complex refrigeration system component troubleshooting, actual system conditions should be verified by qualified technicians using proper tools. This system information is valuable in determining whether the problem is component or system related.

Sensors

Failed sensors will trigger an alarm, which will persist until the problem is corrected. Failed temperature sensors may read extremely low or infinite resistance when tested with an ohmmeter. Readings should be taken with the sensor disconnected from the Secondary Fluid Control. A missing or disconnected temperature sensor will read -60_0 on the controller. A shorted temperature sensor will read 150 on the controller.

Temperature sensor accuracy can be checked by measuring the voltage across the sensor. With the controller powered on and the sensor connected, measure the DC voltage between the sensor's two terminals on the controller. Compare this voltage to the expected values in *Appendix I – Temperature Sensor Specifications*. The controller can be configured with Temperature Calibration Offsets, Ct 1, Ct2, and Ct3, of ± 5°F / °C. Greater discrepancies may indicate a faulty or misplaced sensor. For more information on sensor troubleshooting, please consult *Sporlan's Pressure Transducer and Temperature Sensor Installation Instructions (Form SD-245)*.

For troubleshooting, it may be helpful to compare actual versus expected flow rate through the valve. The table in *Appendix K – Estimated Flow Rate* can be used to estimate actual flow using valve position and pressure drop. The valve position can be found using parameter Current Valve Position, Pos, as described in *Section 4 – System Operation*. The pressure drop can be measured using the 1/4" SAE fittings on the valve. By locating the intersection of these points on the table in Appendix K, an estimated flow rate in Gallons Per Minute (GPM) can be determined.

Table 2 - Troubleshooting Checklist

SYMPTOM	CHECK
Will not power up	Wiring terminals for power at transformer and controller
	Supply Voltage (See Appendix E - Technical Specifications)
Temperature Below Setpoint	Temperature sensor wiring / location (ensure sensor locations are correct, wiring intact)
	Sensor location
	Electric valve seat leak
	Electric valve wiring connections to controller
Temperature Above Setpoint	Heat exchanger sizing
	Liquid supply temperature correct
	Evaporator fans operating
	Evaporator coil (icing, fouling)
	Return air not blocked
	Supply pumps operating
	Sensor location
	Electric valve wiring connections to controller
	Temperature sensor wiring / location (ensure sensor locations are correct, wiring intact)
Display Reads -60.0 when displaying temperature(s)	Temperature sensor not connected
	Faulty temperature sensor
Display Reads 150.0 when displaying temperature(s)	Shorted temperature sensor or wiring
Temperature Reading(s) Unstable	Wiring terminals (power) at transformer and controller
	Wiring terminals (sensors) at controller
	Sensor location(s)
	Primary heat exchanger (Chiller) operation
No Communication	Wiring terminals at controller and master device
	Controller addresses correct
Communication Errors	Wiring terminals at controller and Master device
	Proper network shielding
	Network termination installation / location
	Network parameters same in all networked devices (controllers, master device) parity, baud rate, data bits
	Third-Party controllers on control network
	Communication wires in same conduit as or ran with high voltage wiring
Setpoints Not Saved	ESC must be set within 60 seconds of last setpoint change
Cannot Find Setpoints	See Section 5 - Advanced Setup

APPENDIX A - Startup Menu

DISPLAY	DESCRIPTION	OPTIONS
dAS	Discharge Air Setpoint	10.0°F to 65.0°F (-12°C to 18°C) Default is 28°F
dty	Defrost Type	oFF Off Time Defrost FLU Warm Fluid Defrost ELE Electric Defrost
Add	Controller Network Address	1 to 127 (master), or 128 to 247 (slave). Default is 128

APPENDIX B - Process Values

DISPLAY	DESCRIPTION	RANGE
dA 1	Discharge Air Temperature	-60°F to 150°F (-51.1°C to 65.6°C)
t in	Liquid Inlet Temperature	-60°F to 150°F (-51.1°C to 65.6°C)
toU	Liquid Outlet Temperature	-60°F to 150°F (-51.1°C to 65.6°C)
dEL	Coil Delta Temperature	0.0°F to 210 Δ°F (0.0°C to 117 Δ°C)
S-4	Auxiliary / Defrost Temperature	-60°F to 150°F (-51.1°C to 65.6°C)
PoS	Current Valve Position	0.0 to 125%
rL 1	Mechanical Relay Status (Relay 1)	oFF Relay De-energized on Relay Energized
rL2	Digital Output Status (Relay 2)	oFF Relay De-energized on Relay Energized
d in	Defrost Signal Input	dEF If dry contact (terminals 9 and 10) is shortend Coo If dry contact (terminals 9 and 10) is open
StA	Controller Status	dEF Defrost Mode dAC Discharge Air Control CtC Temperature Delta Control Sto Manual Valve Control uHo Valve Homing Mode dAF Discharge Air Sensor Fail Mode tCL Temperature Control Fail Mode drn Drain Mode FAn Fan Delay Mode
AL5	Alarms	dAH High Discharge Air Alarm t1 F Discharge Air Sensor Fail Alarm t2F Outlet Sensor Fail Alarm t3F Inlet Sensor Fail Alarm CtL Temperature Control Fail Alarm

APPENDIX C - Setpoint Parameters

DISPLAY	DESCRIPTION	RANGE
ESC	Escape from Menu and Save Changes	-
dAS	Discharge Air Setpoint	10.0°F to 65.0°F (-12.2°C to 18.3°C) Default is 28°F
dty	Defrost Type	oFF Off Time Defrost FLU Warm Fluid Defrost ELE Electric Defrost
dPd	Defrosts Per Day	0 to 12 Default is 0
dSt	Shortest Defrost Time	0 to 120 Minutes Default is 10
dFS	Defrost Failsafe Time	30 to 120 Minutes Default is 60
dtt	Defrost Termination Temperature	40 to 70°F (4.4 to 21.1°C) Default is 55
drP	Drip / Drain Time	0 to 10 Minutes Default is 3
Fdt	Fan Delay Temperature	10 to 32°F (-12.2 to 0°C) Default is 28
FdL	Fan Delay Time	0 to 10 Minutes Default is 5
dSS	Defrost Start / Stop	oFF Request to Stop and Active Defrost on Request to Start a Defrost

Default values are highlighted.

APPENDIX C - Setpoint Parameters (continued)

DISPLAY	DESCRIPTION	RANGE
SPo	Stepper Position Override (Manual Valve Position)	0 to 100% (Timeout feature is extended to 60 minutes.)
nEt	Controller Network Type	nbU MODBUS bnE BACnet
Add	Controller Network Address	1 to 247 Default is 128
bAU	Controller Network BAUD Rate	96 9,600 bits / second 192 19,200 bits / second 384 38,400 bits / second
nPA	Controller Network Parity	non No Parity Evn Even Parity odd Odd Parity
Unt	Temperature Units	FAH °F CEL °C
Ct 1	Calibration Offset T1	-5.0°F to +5.0 Δ°F (-2.7°C to +2.7 Δ°C) Default is 0
Ct2	Calibration Offset T2	-5.0°F to +5.0 Δ°F (-2.7°C to +2.7 Δ°C) Default is 0
Ct3	Calibration Offset T3	-5.0°F to +5.0 Δ°F (-2.7°C to +2.7 Δ°C) Default is 0
dAH	Discharge Air High Alarm Setpoint	12.0°F to 80.0°F (-9.4°C to 26.6°C) Default is 40
dAd	Discharge Air High Alarm Delay	5 to 120 minutes Default is 120

Default values are highlighted.

APPENDIX D - Components and Accessories

DESCRIPTION	ITEM
Secondary Fluid Control	
Secondary Fluid Control - Less Display	953553
Remote Display	953554
Remote Display Cable - 14′	953494
Secondary Fluid Modulating Valve with Taps	
SFVT-9 5 ODF Less Cable	953303
SFVT-9 7 ODF Less Cable	953304
SFVT-9 9 ODF Less Cable	953305
SFVT-9 11 ODF Less Cable	953306
Valve Cable	
10 ft. (3m) with stripped ends	805194
20 ft. (6m) with stripped ends	805195
Parker Sporlan 3K Temperature Sensors - Surface or Air	
Green - 20′ Cable	953490
Blue - 20′ Cable	953493
Black - 20′ Cable	952571
Yellow - 20′ Cable	953492
Manual Valve Actuator	
SMA-12	953276

APPENDIX E - Technical Specifications

ELECTRICAL

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

Digital Inputs
Dry Contact

Analog Inputs
4 Temperature Sensors
(3 Kohm)

Relay Outputs
100-240VAC, 3A ind/250V
22-28VDC, 250mA digital output w/ground

Digital Display
LED - Green, 7 segment, 3 digit

Indicators
LED - Red, Power

User Interface
Remote Display

Data Interface
RS485, MODBUS, BACnet

MECHANICAL - CONTROLLER

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

Humidity
0-95%RH (Non-Condensing)

Enclosure
PC - Light Gray

Wiring
Screw terminal

Mounting
DIN Rail - EN 50 022

MECHANICAL - VALVE

Operating Temperature
0°F to 140°F (18°C to 60°C)

Phase Resistance
65 ohms ± 10%

MRP
400 psig (27.6 bar)

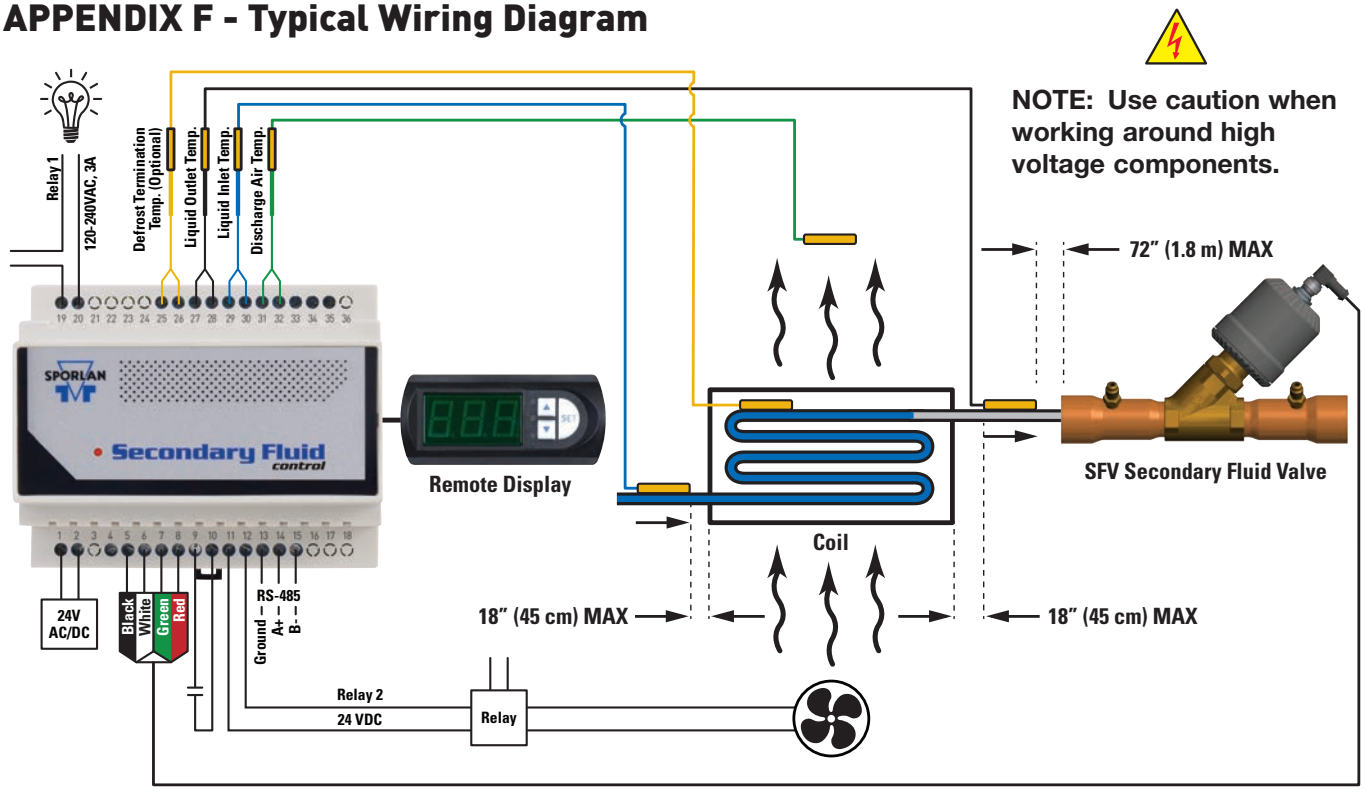
Flow Coefficients
Cv = 12
Kv = 10.3

COMPLIANCE

Environmental
RoHS
WEEE

Electrical
CE
UL/CUL (Recognized per 873)
FCC (Class A, part 15)
C-tick

APPENDIX F - Typical Wiring Diagram



APPENDIX G - MODBUS Memory Map

The Secondary Fluid Control supports the 'Read Input Registers,' 'Read Holding Register,' 'Write Single Register,' 'Read Multiple Coils' and 'Write Single Coil' function codes. Other requests will cause an exception response. The Secondary Fluid Control will allow a full and partial block read of the Input and Holding registers and coils. The Secondary Fluid Control supports only the RTU transmission mode.

MODBUS FUNCTION CODE	PARAMETER	ADDRESS	R/W	RANGE
Read Coils (0x01)	Manual Valve Control	0	R	0 = Disabled, 1 = Enabled
	Manual Timeout Active*	1	R	0 = Inactive, 1 = Active
	Defrost Status	2	R	0 = Inactive, 1 = Active
	Display Settings	3	R	0 = Disabled 1 = Enabled
	Defrost Self Terminate	4	R	0 = Disabled 1 = Enabled
Read Holding Registers (0x03) Setpoints	Discharge Air Setpoint	0	R/W	+10.0°F to +65.0°F
	Discharge Air High Alarm Setpoint	1	R/W	+12.0°F to +80.0°F
	Manual Valve Position	2	R/W	0.0 to 100.0%
	Alarm Delay	3	R/W	5 to 120 Minutes
	Network Address	4	R	1 - 254
	Display Units	5	R/W	0 = °F, 1 = °C
	T1 Offset	6	R/W	-5.0°F to +5.0°F
	T2 Offset	7	R/W	-5.0°F to +5.0°F
	T3 Offset	8	R/W	-5.0°F to +5.0°F
	Display Address	9	R	N/A
	Defrost Type	10	R/W	0 = Off Time, 1 = Fluid, 2 = Electric
	Defrosts Per Day	11	R/W	0 - 12
	Defrost Minimum Time	12	R/W	0 - 120
	Defrost Failsafe Time	13	R/W	30 - 120
	Defrost Termination Temperature	14	R/W	40°F - 70°F
	Drain Time	15	R/W	0 - 10
	Fan Delay Temperature	16	R/W	10 - 32
	Maximum Fan Delay Time	17	R/W	0 - 10
	Password Write	18	R/W	1-999
Read Input Registers (0x04) Process Variables	Discharge Air Temperature	0	R	-49.9°F to +149.9°F
	Inlet Temperature	1	R	-49.9°F to +149.9°F
	Outlet Temperature	2	R	-49.9°F to +149.9°F
	Coil Delta Temperature	3	R	-49.9°F to +149.9°F
	Defrost Temperature	4	R	-49.9°F to +149.9°F
	Valve Position	5	R	0.0 to 100%
	Relay 1 State	6	R	0 = OFF, 1 = ON
	Relay 2 State	7	R	0 = OFF, 1 = ON
	Defrost Input State	8	R	0 = INACTIVE, 1 = ACTIVE
	Alarm Flags	9	R	0 - 31 (See Alarms)
	System Mode	10	R	(See System Modes)
	Firmware Version	11	R	
Write Single Coil (0x05)	Manual Valve Control	0	R/W	0 = Disabled, 1 = Enabled
	Manual Timeout Active*	1	R/W	0 = Inactive, 1 = Active
	Defrost Status	2	R/W	0 = Inactive, 1 = Active
	Display Settings	3	R/W	0 = Disabled 1 = Enabled
	Defrost Self Terminate	4	R/W	0 = Disabled 1 = Enabled
Write Single Register (0x06) Setpoints	Same as 'Read Holding Register' Definitions		Selected Register to Write	

* Disables 60 minute manual mode timeout for Startup and Service.

APPENDIX H - BACnet Memory Map

DEVICE OBJECT

OBJECT INSTANCE	OBJECT NAME	WRITEABLE PROPERTY RANGES	OPTIONAL PROPERTIES SUPPORTED
<Controller Address>	"SFMV_CONTROLLER-###" where "###" is the controller address. Ex. "SFMV_CONTROLLER-001" for controller address 1	None	None

DEVICE PROPERTY DESCRIPTION	RANGE
System Status	Operational
Vendor Name	"Parker Hannifin"
Vendor Identifier	287
Model Name	"KELVIN II - 4TEMP"
Firmware Revision	Latest Revision formatted as <Major Version> '.' <Minor Version>
Application Software Version	Firmware Date formatted as <Month> '/' <Day> '/' <Year>
Protocol Version	1
Protocol Revision	14
Protocol Services Supported	Read Property Write Property Who-Is I-Am
Object Types Supported	Analog Input Object Analog Value Object Binary Input Object Binary Output Object Binary Value Object Device Object Multistate Value Object
Object List	List of all objects in Device
Maximum APDU Size	480
Segmentation Support	Segmentation Not Supported
APDU Timeout	3000 milliseconds
Number of APDU Retries	1
Device Address Binding	None
Database Revision	1

ANALOG INPUT OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"TEMPERATURE-1"	Present Value	-60.0 to 150.0°F	Yes, when Out of Service is True
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	True or False	Yes
		Units	°F	No
2	"TEMPERATURE-2"	Present Value	-60.0 to 150.0°F	Yes, when Out of Service is True
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	True or False	Yes
		Units	°F	No
3	"TEMPERATURE-3"	Present Value	-60.0 to 150.0°F	Yes, when Out of Service is True
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	True or False	Yes
		Units	°F	No
4	"TEMPERATURE-4"	Present Value	-60.0 to 150.0°F	Yes, when Out of Service is True
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	True or False	Yes
		Units	°F	No

APPENDIX H - BACnet Memory Map (continued)

ANALOG VALUE OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"DISCHARGE_AIR_SP"	Present Value	10 to 65°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	°F	No
2	"DISCHARGE_AIR_HIGH_ALARM_SP"	Present Value	12 to 80°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	°F	No
3	"MANUAL_VALVE_POSITION"	Present Value	0.00 to 100.00	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	%	No
4	"ALARM_DELAY"	Present Value	5 to 120 minutes	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Minutes	No
5	"T1_OFFSET"	Present Value	-5 to 5°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Δ°F	No
6	"T2_OFFSET"	Present Value	-5 to 5°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Δ°F	No
7	"T3_OFFSET"	Present Value	-5 to 5°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Δ°F	No
8	"DISPLAY_ADDRESS"	Present Value	0 to 99	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	No Units	No
9	"DEFROSTS_PER_DAY"	Present Value	0 to 12	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	No Units	No
10	"DEFROST_MINIMUM_TIME"	Present Value	0 to 120 minutes	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Minutes	No
11	"DEFROST_FAILSAFE_TIME"	Present Value	30 to120 minutes	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Minutes	No
12	"DEFROST_TERM_TEMPERATURE"	Present Value	40 to 70°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	°F	No

APPENDIX H - BACnet Memory Map (continued)

ANALOG VALUE OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
13	"DRAIN_TIME"	Present Value	0 to 10 minutes	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Minutes	No
14	"FAN_DELAY_TEMPERATURE"	Present Value	10 to 32°F	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	°F	No
15	"MAXIMUM_FAN_DELAY_TIME"	Present Value	0 to 10 minutes	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Minutes	No
16	"COIL_DELTA_TEMPERATURE"	Present Value	0 to 210 Δ°F	No
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	Δ°F	No
17	"CURRENT_VALVE_POSITION"	Present Value	0.00 to 100.00	No
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Units	%	No

BINARY INPUT OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"DINPUT-1"	Present Value	0 or 1	Yes, when Out of Service is true
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	True or False	Yes
		Polarity	Normal	No
		Inactive Text	INACTIVE	No
		Active Text	ACTIVE	No

BINARY OUTPUT OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"RELAY-1"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Polarity	Normal	No
		Inactive Text	OFF	No
		Active Text	ON	No
		Priority Array	N/A	Not directly
		Relinquish Default	0 or 1	No
2	"RELAY-2"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Polarity	Normal	No
		Inactive Text	OFF	No
		Active Text	ON	No
		Priority Array	N/A	Not directly
		Relinquish Default	0 or 1	No

APPENDIX H - BACnet Memory Map (continued)

BINARY VALUE OBJECTS

OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"MANUAL_VALVE_CONTROL"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	DISABLED	No
		Active Text	ENABLED	No
2	"MANUAL_VALVE_TIMEOUT"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	DISABLED	No
		Active Text	ENABLED	No
3	"DEFROST_STATUS"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	INACTIVE	No
		Active Text	ACTIVE	No
4	"DISCHARGE_AIR_HIGH_LIMIT_ALARM"	Present Value	0 or 1	No
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	INACTIVE	No
		Active Text	ACTIVE	No
5	"TEMPERATURE_CONTROL_FAIL_ALARM"	Present Value	0 or 1	No
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	INACTIVE	No
		Active Text	ACTIVE	No
6	"DISPLAY_SETTINGS"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	DISABLED	No
		Active Text	ENABLED	No
7	"DEFROST_SELF_TERMINATE"	Present Value	0 or 1	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Inactive Text	DISABLED	No
		Active Text	ENABLED	No

APPENDIX H - BACnet Memory Map (continued)

MULTISTATE VALUE OBJECTS

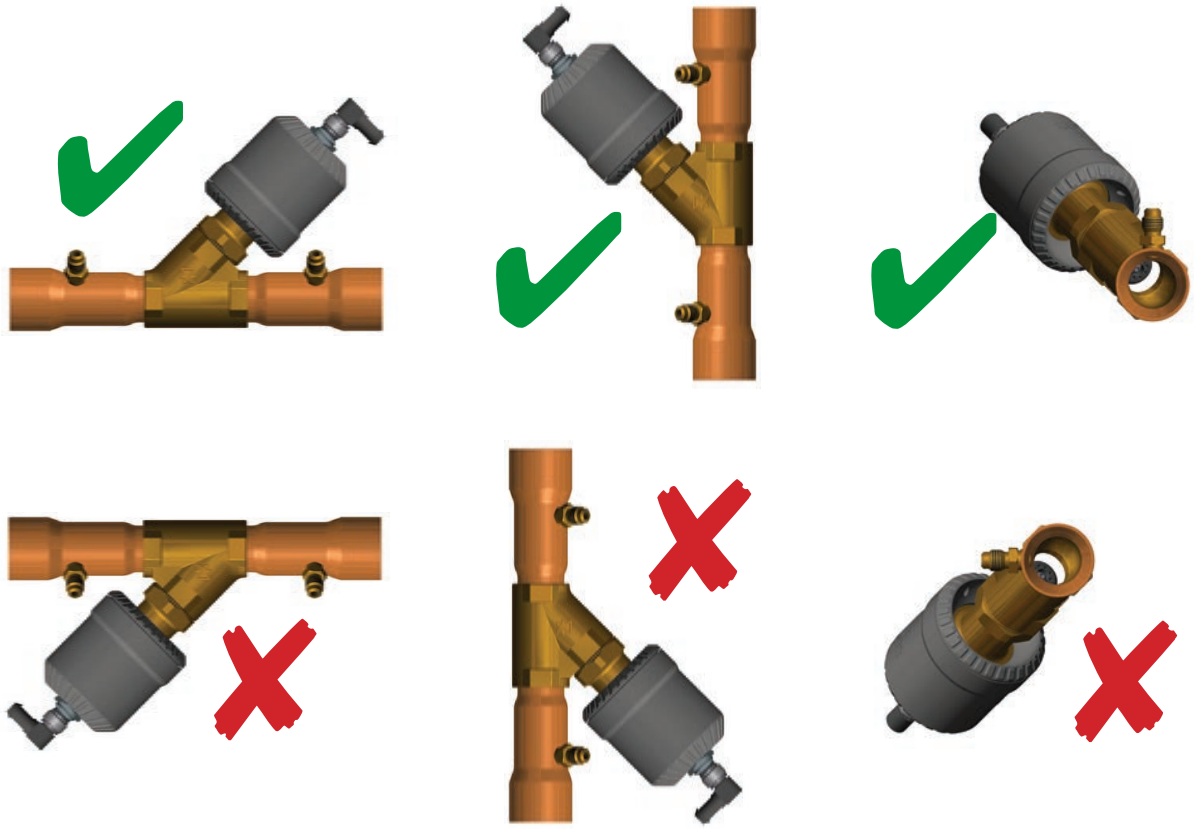
OBJECT INSTANCE	OBJECT NAME	PROPERTY	RANGE	WRITEABLE
1	"TEMPERATURE_UNITS"	Present Value	1 to 2	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Number of States	2	No
		State Text	1 = Degrees F 2 = Degrees C	No
2	"SYSTEM_MODE"	Present Value	1 to 12	No
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Number of States	12	No
		State Text	1 = Startup 2 = Fluid Defrost 3 = Off Time Defrost 4 = DA Control 5 = Delta T Control 6 = Manual Control 7 = Homing Mode 8 = DA Sensor Fail 9 = Temperature Control Fail 10 = Electric Defrost 11 = Drain Mode 12 = Fan Delay Mode	No
3	"DEFROST_TYPE"	Present Value	1 to 3	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Number of States	3	No
		State Text	1 = Off Time Defrost 2 = Fluid Defrost 3 = Electric Defrost	No
4	"PASSWORD_WRITE"	Present Value	1 to 999	Yes
		Status Flags	None	No
		Event State	Normal	No
		Out of Service	False	No
		Number of States	999	No

APPENDIX I - Temperature Sensor Specifications

TEMPERATURE		VDC
°F	°C	3K
0	-17.8	3.929
10	-12.2	3.643
20	-6.7	3.326
30	-1.1	2.988
40	4.4	2.644
50	10.0	2.306
60	15.6	1.985
70	21.1	1.691
80	26.7	1.428
90	32.2	1.198
100	37.8	1.002
110	43.3	0.835
120	48.9	0.696
130	54.4	0.579
140	60.0	0.483
150	65.6	0.404

APPENDIX J - Valve Motor Position

The SFV should be installed with the valve motor at or above horizontal position.



APPENDIX K - SFVT-9 Estimated Flow Rate (GPM)

		PRESSURE DROP ACROSS THE VALVE (psi)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
VALVE POSITION	5%	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1
	10%	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4
	15%	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7
	20%	0.6	0.8	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.1	2.2	2.3
	25%	0.8	1.1	1.4	1.6	1.7	1.9	2.1	2.2	2.3	2.5	2.6	2.7	2.8	2.9	3.0
	30%	1.0	1.4	1.7	2.0	2.2	2.5	2.6	2.8	3.0	3.2	3.3	3.5	3.6	3.7	3.9
	35%	1.3	1.8	2.2	2.5	2.8	3.1	3.3	3.6	3.8	4.0	4.2	4.4	4.5	4.7	4.9
	40%	1.5	2.2	2.7	3.1	3.4	3.8	4.1	4.3	4.6	4.8	5.1	5.3	5.5	5.7	5.9
	45%	1.9	2.7	3.3	3.8	4.2	4.6	5.0	5.3	5.6	5.9	6.2	6.5	6.8	7.0	7.3
	50%	2.3	3.3	4.0	4.6	5.1	5.6	6.1	6.5	6.9	7.3	7.6	8.0	8.3	8.6	8.9
	55%	2.9	4.1	5.1	5.9	6.5	7.2	7.7	8.3	8.8	9.2	9.7	10.1	10.5	10.9	11.3
	60%	3.8	5.4	6.5	7.6	8.4	9.2	10.0	10.7	11.3	11.9	12.5	13.1	13.6	14.1	14.6
	65%	4.7	6.6	8.1	9.4	10.5	11.5	12.4	13.3	14.1	14.8	15.5	16.2	16.9	17.5	18.1
	70%	5.6	8.0	9.8	11.3	12.6	13.8	14.9	15.9	16.9	17.8	18.6	19.5	20.3	21.0	21.7
	75%	6.6	9.3	11.3	13.1	14.6	16.0	17.3	18.5	19.6	20.6	21.6	22.6	23.5	24.4	25.2
	80%	7.5	10.5	12.9	14.9	16.6	18.2	19.6	21.0	22.3	23.5	24.6	25.7	26.7	27.7	28.7
	85%	8.2	11.6	14.2	16.4	18.3	20.0	21.6	23.1	24.5	25.8	27.1	28.3	29.4	30.5	31.6
	90%	8.9	12.5	15.3	17.7	19.8	21.6	23.4	25.0	26.5	27.9	29.3	30.6	31.8	33.0	34.1
	95%	9.4	13.3	16.3	18.8	21.0	23.0	24.8	26.6	28.2	29.7	31.1	32.5	33.8	35.1	36.3
	100%	9.9	14.0	17.1	19.8	22.1	24.2	26.1	27.9	29.6	31.2	32.7	34.2	35.6	36.9	38.2

Bulletin 100-50-5.4rd / 12016

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