November 2012 / **Bulletin 100-50-5.3**

SPORLAN

Temperature Control

Installation and Operation Instructions

Controller v. A

Parker

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Contents

Introduction

The **Sporlan Temperature Control** is a standalone controller used to regulate liquid or air temperature at a specific location by controlling a Sporlan electric valve. The Temperature Control may also be connected with a Modbus® master for remote access to temperature and pressure readings in addition to viewing and editing the controller's setpoints.

Features

- Hot Gas Bypass, Evaporator Discharge, or Temperature Delta Control
- Auto tuning PID with manual override
- 4-digit LED display and input knob
- Flexible configuration of backup sensor and alarm actions
- Optional controller networking for remote access
- Four temperature inputs (Sporlan surface or air sensors)
- One pressure input (Sporlan transducer)
- One digital input (for external switch or relay)
- Alarm output

1. Installation

Refer to *Appendix F - Wiring Diagrams* for common system setup and connections. For additional information on mounting and testing sensors, please consult Sporlan's Pressure Transducer & Temperature Sensor Installation Instructions (Form SD-245).

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

Maximum torque on screw terminals is 3.5 in-lbs.

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 inches high and 5 inches wide. The minimum depth is 3 inches; see Figures 1 and 2.
2. Mount the temperature sensor, T1, per the evaporator manufacturer's recommendation. Connect the sensor wires to terminals 31 and 32. The sensor is not polarized.
3. Mount the second temperature sensor, T2 (optional). Connect the sensor wires to terminals 29 and 30. The sensor is not polarized.
4. Connect terminals 25 and 26 to a digital input. A short or closed contact from an external relay will enable pump-down.
5. Connect the Sporlan electric valve wires to terminals 5, 6, 7, and 8, matching the colors shown in the wiring diagram.
6. Connect power wires to terminals 1 and 2. Transformer requirements are 24 volts AC at 40VA, Class II.
7. Remove the protective clear film cover from the front of the Temperature Control.

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

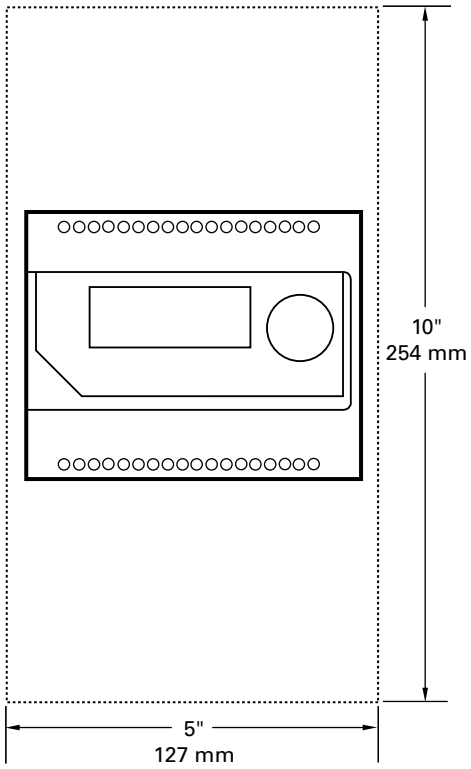


Figure 1 - Recommended Mounting Clearance

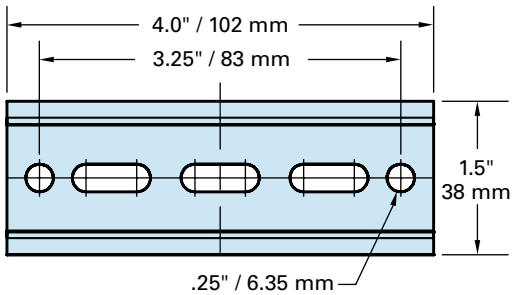


Figure 2 - DIN Rail Detail

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

NOTE: The Sporlan Temperature 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 the Temperature Control. Opening the case will void the warranty.

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

2. Setup

TEMPERATURE CONTROL

The Temperature Control has preset setpoints for most system parameters. Basic system parameters will be established through the setup menu. If additional presets need to be changed, follow the steps in this section and in *Section 3 - Setpoint Menu Operation*.

Enter values for three system variables following the steps below. Refer to *Appendix A - Setup Menu*. The electric valve is closed upon power-up and the system will not operate until completing setup. The controller will display the firmware versions for the display and the controller. It will then display the first variable to set.

1. Set tSP, Temperature Setpoint. Press and then turn the SELECT knob to set the operational setpoint. Press the SELECT knob again to save the value. The next variable is displayed.
2. Set StEP, Valve Steps. Select the correct number of steps for the electric valve being used (refer to Table 1). Press the SELECT knob to save the value.
3. Set trUd, Temperature Rise Valve Direction. Select Open on Temperature Rise (OPTR) or Close on Temperature Rise (CLTR). Default is OPTR. Press the SELECT knob to save the value.

NOTE: The controller defaults to a 3K temperature probe. If using a 2K or 98.6K sensor, see Section 3 - Setpoint Menu Operation for instructions on changing to the correct probe profile.

The Temperature Control is now operational and displaying the Process Values Menu (*Appendix B*). To view system parameters while in operation, turn the SELECT knob and scroll through the menu. Select the desired parameter. For example, to view the temperature sensor input, turn the SELECT knob to TSI. After a few seconds, the actual temperature will be displayed. See *Appendix B - Process Values* for a description of each variable.

Table 1 - Sporlan Electric Valves

SPORLAN MODEL NUMBERS	STEPS
CDS-2, CDS-4, CDS-7	2500
SDR-3, SDR-3x	3193
CDS-9, CDS-17, SDR-4	6386

3. Setpoint Menu Operation

See *Appendix C - Setpoint Parameters*. All setpoints should be verified to ensure proper system operation. It may be necessary to adjust these parameters for a specific system. Details on advanced features can be reviewed in *Section 4 - System Operation*.

1. Enter the Setpoint Menu: Press the SELECT knob for 5 seconds. Enter the password and press the SELECT knob again. (The controller's default password is "111".)
2. To view a parameter, rotate the SELECT knob to the desired parameter and press the knob. The default value will display.
3. Turn the SELECT knob to change the value and then press the SELECT knob to enter the value and return to the Setpoint Menu.
4. After all desired parameters are set, turn the SELECT knob to "ESC" and press the knob to save and implement all changes. Observe the system for proper operation.

NOTE: The Setpoint Menu times out after 60 seconds of inactivity and you will lose all changes entered.

NOTE: Not all refrigeration systems are designed alike. See Section 7 - PID Tuning to adjust the settings according to the specific needs of the system.

4. System Operation

The Sporlan Temperature Control can be set up to support several types of system configurations. The most common type of control uses a single temperature set point. In this application, evaporator discharge (or return) air is controlled by regulating an electric evaporator pressure regulator valve (EEPR) or electric hot gas bypass valve (EHGBV). Additional control options include a high temperature single point control and a temperature delta control. For additional applications, contact Sporlan Division to ensure proper system performance and reliability.

For single temperature control, the Sporlan Temperature Control uses sensor T1 to maintain the setpoint, tSP. If at any time sensor T1 becomes faulty or is not connected, the Temperature Control will use sensor T2 (if connected) to maintain the setpoint; the alarm will also be activated. Once sensor T1 is restored, the alarm will cease and the controller will resume using sensor T1 as the control point.

Valve control is determined by the temperature rise valve direction parameter, trUd. The controller can be configured to either open the valve as the temperature rises or close the valve as the temperature rises.

This setting, configured during initial installation, also determines the default setting for pumpdown direction, Pdd. If trUd is initially configured for "open on temperature rise," then Pdd will default to "open on pumpdown"; if trUd is initially configured for "close on temperature rise," then Pdd will default to "close on pumpdown." Both trUd and Pdd can be configured independently through the Setpoint Menu. See Table 2 for recommended configuration for the listed applications.

Table 2 - Recommended Configurations

APPLICATION	CONTROL trUd	PUMPDOWN Pdd	SENSOR FAILURE SEFP
EEPR	OPTR	OPPD	100%
Hot Gas Bypass	CLTR	CLPD	0%
Hot Gas Reheat	CLTR	OPPD	0%

All configuration parameters can be viewed and changed through the Setpoint Menu. See Section 3 – Setpoint Menu Operation for directions.

REGULATING EVAPORATOR DISCHARGE AIR TEMPERATURE (EEPR or EHGBV)

For systems that use an EEPR or EHGBV, the T1 air sensor should be installed according to the evaporator coil manufacturer's recommendations. If no recommendation is given, mount the sensor in the discharge air stream. The sensor should be located a minimum of 4" away from the evaporator and not contacting any metal surface. Mounting the sensor directly to the evaporator will cause a temperature offset due to the refrigeration effect.

For systems that use an EEPR, the controller should be configured to "Open on Temperature Rise." The pump down direction and sensor failsafe valve position must also be set to ensure correct system operation. In this arrangement, the controller will regulate the EEPR to decrease the evaporator pressure and corresponding saturated temperature when temperature T1 rises above set point. Refer to *Appendix F* for an example system schematic.

For systems that use an EHGBV, the controller should be configured to "Close on Temperature Rise." The pump down direction and sensor failsafe valve position must also be set to ensure correct system operation. In this arrangement, the controller will regulate the EHGBV to decrease the amount of hot gas that is bypassed into the evaporator when the temperature T1 increases above set point. Refer to *Appendix F* for an example system schematic.

REGULATING HIGH TEMPERATURE FLUID

For applications that require a temperature setpoint greater than 140°F, the Temperature Control is compatible with Sporlan's high temperature sensor (surface mount only). To use the high temperature feature, the temperature sensor type (tEYP) parameter must first be set for the 98.6K probe. The controller then allows a temperature setpoint (tSP) value up to 299°F (148°C). High temperature, single point control can be used to control compressor discharge temperature (by injecting liquid into the suction) or heat reclaim. Consult Sporlan for proper valve selection for high temperature applications.

REGULATING TEMPERATURE DELTA

The Temperature Control can be configured to maintain a temperature differential between the sensor inputs T1 and T2. By default, this feature is turned off by parameter Temperature Differential (td). The differential can be set at increments of 5°F, from 0-40°F. Changing parameter td to any non-OFF value enables delta control and sets the temperature delta setpoint to the value selected. Delta is calculated as T1 – T2, and both inputs must be present in order to activate this feature.

ADVANCED FEATURES

Pumpdown / Full Open

Closing or shorting terminals 25 and 26 (T4) places the controller in pumpdown mode and positions the valve based upon parameter Pdd. A standard dry contact relay should be used. During pumpdown, the controller will shut down the control scheme. Once the short is removed, the controller will resume normal operation.

Manual Valve Position

The Temperature Control can be used to manually control the electric valve, either locally or remotely. Access the Setpoint menu and change SPoS to the desired valve position (between 0 and 100% of full stroke). The system will time out after 60 minutes of inactivity while in manual control. To end manual control sooner, simply press the SELECT knob (the controller will return to the menu and now display SPoS).

The electric valve can also be manually controlled via Modbus. Writing a 1 to the "Manual Valve Enabled" coil activates manual control, and the desired position can then be written to the "Manual Valve Position" register (see *Appendix G - Modbus Memory Map*).

ADDITIONAL HELPFUL SYSTEM PARAMETERS

Temperature Sensor Type, tEYP – specifies the type of temperature sensor being used. The Temperature Control can accept 2K, 3K, or 98.6K temperature sensors. However, all temperature sensors connected to the Temperature Control must be the same type.

Sensor Error Failsafe Position, SEFP – the position that the controller will place the valve if sensor failure occurs. For single temperature control, both T1 and T2 must be faulty or disconnected; for temperature delta control, either T1 or T2 must be faulty or disconnected.

Maximum Valve Position, u HI – the maximum position (% open) that the controller will position the valve during normal operation. This parameter is ignored when the controller is in manual mode, pumpdown mode, or when setting SEFP due to sensor failure.

Minimum Valve Position, u LO – the minimum position (% open) that the controller will position the valve during normal operation. This parameter is ignored when the controller is in manual mode, pumpdown mode, or when setting SEFP due to sensor failure.

TSI High Alarm Value, tSI H – the temperature threshold for high temperature alarm. For single temperature control, the temperature of T1 must exceed tSI H; for temperature delta control, the delta temperature (T1-T2) must exceed tSI H.

TSI Low Alarm Value, tSI L – the temperature threshold for low temperature alarm. For single temperature control, the temperature of T1 must be below tSI L; for temperature delta control, the delta temperature (T1-T2) must be below tSI L.

TSI High Alarm Delay, tSdh – the delay (in minutes) after the measured temperature exceeds tSI H before the high temperature alarm is activated.

TSI Low Alarm Delay, tSdL – the delay (in minutes) after the measured temperature falls below tSI L before the low temperature alarm is activated.

Temperature Calibration, tCAL – allows a temperature offset to be applied to the temperature sensor T1. For additional information, see Section 7 – Troubleshooting.

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 tS 1 followed by the current temperature measured on sensor T1. Rotating the SELECT knob will allow the user to view the following:

Temperature Sensor Input, tS 1 – displays the current temperature measured by temperature sensor T1.

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

Pumpdown Status, StAt – displays whether the controller is currently in pumpdown mode (enabled) or normal operation (disabled).

Alarm Status, ALS – Displays a list of all active alarms on the controller. If no alarms are active, the controller will display nonE.

Auxiliary Temperature Input 2, Aut2 – displays the current temperature measured by temperature sensor T2. The controller will display -60 if no sensor is connected.

Auxiliary Temperature Input 3, Aut3 – displays the current temperature measured by auxiliary temperature sensor T3. The controller will display -60 if no sensor is connected.

Auxiliary Temperature Input 4, Aut4 – displays the current temperature measured by auxiliary temperature sensor T4. Note: this input is also used to activate pumpdown mode on the controller.

Auxiliary Pressure, PrES – displays the current pressure measured by the auxiliary pressure transducer.

5. Controller Networking

The Sporlan Temperature Control can communicate with a Modbus communication master via RS485 to transfer process values and setpoints. See *Appendix G - Modbus Memory Map.*

The Temperature Control supports only the RTU transmission mode. The serial settings are:

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

Scaling for Celsius / Bar

For better precision, scaling is used for Bar or Celsius units. PSI and Fahrenheit are whole numbers and have no scaling.

Celsius values transferred via Modbus are 10X. For example, a value of 45 will be transferred for the superheat when the actual superheat temperature is 4.5°C. Remember this when changing a setpoint.

Bar values transferred via Modbus are 100X. For example a value of 1034 will be transferred for the Maximum Operating Pressure when the actual pressure is 10.34 Bar. Remember this when changing a setpoint.

Setup

The Sporlan Temperature Control can be networked to communicate process variables back to a master controller. This information can be used for verifying system performance or updating individual setpoints via RS-485 and PC interface. Data can be accessed remotely through the master controller. For further information on remote monitoring, see the documentation for the master controller.

Prior to connecting the network, each controller must be assigned a separate address on the Modbus network, Addr. Refer to *Section 3 - Setpoint Menu Operation* to enter the Setpoint menu. Once in the Setpoint menu, scroll to Addr and assign each controller on the network an individual address. Note that no two controllers can have the same address. Default address for each controller is '1'.

NOTE: Addr is the Modbus address, CAdr is the controller display address.

Modbus Connection Requirements

See Figure 4 - Modbus Wiring.

Wire Type: 18 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 3. Other configurations involving triple-lug connections, such as star, are not recommended.

Noise Reduction: Termination resistance (R_T in Figure 4) 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 RS485 GND.**

Keep RS485 wiring away from high voltage AC lines to reduce noise and data errors on the communication lines. If

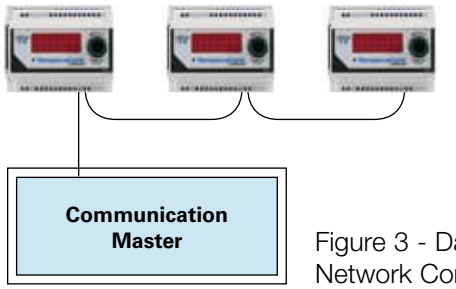
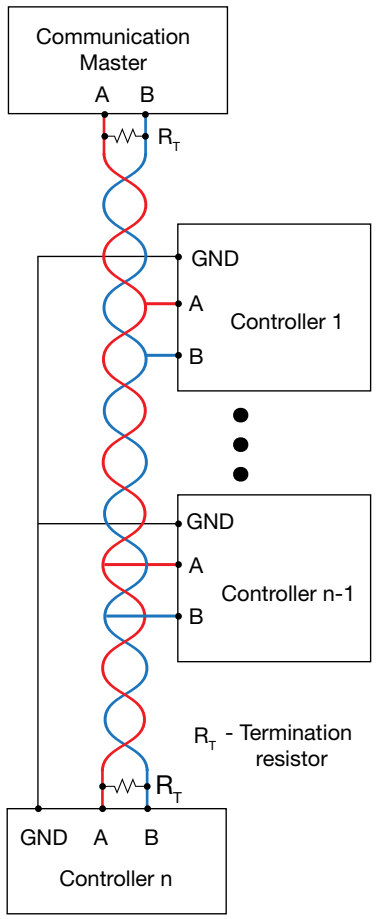


Figure 3 - Daisy Chain Network Configuration

Figure 4 - Modbus Wiring



necessary, RS485 communication cable should be placed perpendicular to AC lines at any intersection.

Grounding: Connect an optional third conductor to RS485 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 RS485 GND to earth ground.**

Third Party Controllers: To avoid nuisance "network errors," the use of third-party controllers on the same RS485 network with Sporlan controllers is not recommended.

See *Appendix G - Modbus Memory Map.* Also, refer to the documentation supplied with the communication master for additional RS485 network requirements.

6. PID Tuning

PID (Proportional-Integral-Derivative) setpoints can greatly affect system performance. These setpoints alter how the electric valve operates to maintain temperature setpoint. In general, the Proportional setpoint adjusts valve response based on "error" (actual temperature vs. desired); Integral setpoint adjusts valve response based on "error over time"; and Derivative setpoint adjusts valve response based on "rate of change."

To simplify tuning, the Temperature Control offers a default AUTO PID control to minimize the need to manually tune PID settings. For experienced users, a MANUAL PID control is available to fine tune the system as needed. It is recommended that AUTO PID be used.

NOTE: Before manual PID is selected, ensure that system performance is not affected by other valves, controls or system components upstream or downstream from the Temperature Control valve. A hunting TEV, faulty evaporator fan or blocked coil may cause unstable Temperature Control performance. Adjust or tune other system components prior to selecting MANUAL PID mode.

AUTO PID Control

The Temperature Control offers a default AUTO PID to optimize system performance and simplify system start up. This feature uses system information and valve response to tune PID setpoints while the system is operating. The controller is designed to minimize system oscillations and improve temperature control. In most cases, the controller should remain in AUTO PID mode.

MANUAL PID Control

NOTE: Only experienced professionals should access this feature. System stability and performance may be improved by adjusting PID. If PID adjustments are made, allow adequate time for the system to respond to the changes.

If PID settings need to be adjusted due to poor system performance, the PID Control Setting, CtrL, must first be set to "PID". The -P-, -I -, and -d - settings can then be set manually. See *Section 3 – Setpoint Menu Operation* for accessing the menu.

PID setpoints may be adjusted if the temperature is oscillating around setpoint at steady state conditions or if the system is experiencing poor temperature pull down. In most instances, adjustments to the PI setpoints are adequate. The following guidelines should be followed:

1. -P - (Proportional Coefficient) – Increase value to increase valve response to temperature; reduce value to minimize oscillations around setpoint.
2. - I - (Integral Coefficient) – Increase value to increase valve response to temperature over a given time period; reduce value to minimize setpoint offset.
3. - d - (Derivative Coefficient) – Increase value to increase valve response to rate of change in temperature; reduce value if valve movement is sporadic.

When the temperature is oscillating to extremes, the Proportional and/or the Integral value may be too high. If temperature is slow to react to a transient system change, then the Proportional and/or Integral value may be too low.

7. Troubleshooting

Troubleshooting Recommendations

As with any refrigeration component troubleshooting, actual system conditions should be verified with a gauge set and

a calibrated temperature sensor. This system information is valuable in determining whether it is component related 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 Temperature Control. A missing or disconnected temperature sensor will read -60 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 H. The controller can be configured with a Temperature Calibration Offset,

Table 3 - Troubleshooting

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 Type (correct sensor set up in controller; 2K, 3K or 98.6K)
	Temperature Sensor wiring (ensure sensor locations are not mismatched)
	Electric Valve (correct valve set up in controller; 1596, 2500 steps, etc)
	EHGBP sizing (if Electric Valve position in controller is at 100% when symptom exists, Electric Valve may be undersized)
	Temperature Rise Valve Direction (trUd) set correctly
	Sensor location
	Electric valve seat leak
	Electric valve wiring connections at controller
Temperature Above Setpoint	Temperature Sensor Type (correct sensor set up in controller; 2K, 3K or 98.6K)
	Electric Valve (correct valve set up in controller; 1596, 2500 steps, etc)
	EEPR (if Electric Valve position in controller is at 100% when symptom exists, Electric Valve may be undersized)
	Heat exchanger sizing
	Proper system refrigerant charge
	Oil return (oil logging in heat exchanger)
	Liquid line filter (clogging or excessive pressure drop)
	Temperature Rise Valve Direction (trUd) set correctly
	Sensor location
	Electric valve seat leak
	Electric valve wiring connections at controller
	Evaporator fans
	Evaporator coil (icing, fouling)
Display Reads -60	Temperature sensor not connected or incorrectly wired
	Faulty temperature sensor
Temperature Unstable	Wiring terminals (power) at transformer and controller
	Wiring terminals (sensors) at controller
	Sensor locations
	Sensor operation (See additional information under Section 7 - Troubleshooting)
	Proper heat exchanger flow direction
	Stability of expansion valve
	Stability of rack controller (verify compressors are not short cycling)
	Controller PID setting (See Section 6 - PID Tuning)
	Oil logging in heat exchanger
No Communication	Wiring at controller and master communication board
	Addresses of controllers (see Section 5 - Controller Networking)
Communication Errors	Wiring terminals at controller and master communication board
	Network wiring from controller to master communication board (see Section 5 - Controller Networking)
	Proper network wire grounding (see Section 5 - Controller Networking)
	Termination resistors (see Section 5 - Controller Networking)
	Network parameters in controller and master communication board (baud rate, parity, etc; see Section 5)
	Third-party controllers on Control network
	Communication wires are not run near high voltage wires
Setpoints Not Saved	ESC must be set within 60 seconds of changes being made
Cannot Find Setpoints	See Section 3 - Setpoint Menu Operation

tCAL, of ±5°F. Greater discrepancies may indicate a faulty sensor.

For more information on sensor troubleshooting and proper installation, please consult Sporlan's Pressure Transducer and Temperature Sensor Installation Instructions (Form SD-245).

Alarms

When certain temperature or equipment problems arise, the Temperature Control will activate an alarm. See Table 4 for a complete list of alarms and how the controller responds when each alarm is active. To view alarms from the Process Menu, rotate the SELECT knob until the display reads AL5. The controller will now display all active alarms, one at a time. If no alarms are active, the controller will display nonE. *See Section 4 – System Operation* for alarm temperature thresholds and delays. Alarms will persist until the problem is corrected.

See table 3 for a troubleshooting checklist.

Table 4 - Alarm Actions

ALARM	DESCRIPTION	ACTION
SEAL	Temperature Sensor Failure	Electric Valve is positioned at SEFP (Sensor Error Failsafe Position)
TLA1	T1 Low Temperature	No System Response
THA1	T1 High Temperature	No System Response
TLA2	T2 Low Temperature	No System Response
THA2	T2 High Temperature	No System Response
TLAd	△T Low Temperature	No System Response
THAd	△T High Temperature	No System Response

APPENDIX A - Setup Menu

DISPLAY	DESCRIPTION		OPTIONS		
tSP	Temperature Setpoint	Counterclockwise	-50 to 150 Default is 35		Clockwise
StEP	Valve Steps		1596	1596 Step Bipolar Valve	
			3193	3193 Step Bipolar Valve	
			2500	2500 Step Bipolar Valve	
			6386	6386 Step Bipolar Valve	
trUd	Temperature Rise Valve Direction		OPtr	Open on Temperature Rise	
			CLtr	Close on Temperature Rise	

Default values are highlighted.

APPENDIX B - Process Values

DISPLAY	DESCRIPTION	RANGE
tSI	Temperature Sensor Input	-50 to 150°F (-45 to 65°C) for 2K/3K 60 to 299°F (16 to 148°C) for 98.6K
POSn	Current Valve Position	0 to 100%
StAt	Pumpdown Status	DISA (Disabled) or ENAB (Enabled)
AL5	Alarm Status (Lists all active alarms)	See Table 3
Aut2	Auxiliary Temperature Input 2	-50 to 150°F (-45 to 65°C) for 2K/3K 60 to 299°F (16 to 148°C) for 98.6K
Aut3	Auxiliary Temperature Input 3	-50 to 150°F (-45 to 65°C) for 2K/3K 60 to 299°F (16 to 148°C) for 98.6K
Aut4	Auxiliary Temperature Input 4	-50 to 150°F (-45 to 65°C) for 2K/3K 60 to 299°F (16 to 148°C) for 98.6K
PrES	Auxiliary Pressure Input	*Depends on pressure sensor range* Max: 0 to 500psig (0 to 34.47 bar)

APPENDIX C - Setpoint Parameters

PARAMETERS			
Counterclockwise	ESC	Escape and Save Changes	–
	tSP	Temperature Setpoint	-50 to 150°F (-45 to 65°C) for 2K/3K 60 to 299°F (16 to 148°C) for 98.6K
	tCAL	Temperature Calibration Offset	±5°F Default is 0
	ttyP	Temperature Sensor Type	TS2 – 2K Temp Sensor TS3 – 3K Temp Sensor TS98 – 98.6K Temp Sensor
	StEP	Valve Steps	1596 – 1596 Step Bipolar Valve 3193 – 3193 Step Bipolar Valve 2500 – 2500 Step Bipolar Valve 6386 – 6386 Step Bipolar Valve
	u HI	Maximum Valve Position	1 to 100% Default is 100%
	u LO	Minimum Valve Position	0 to 20% Default is 0%
	tSI H	TSI High Alarm Value	-60 to 310°F (-51 to 154°C) Default is 100°F (38°C)
	tSI L	TSI Low Alarm Value	-60 to 310°F (-51 to 154°C) Default is -40°F (-40°C)
	tSdH	TSI High Alarm Delay	0 to 60 minutes Default is 0
	tSdL	TSI Low Alarm Delay	0 to 60 minutes Default is 0
	Un_t	Units of Measure	°F / °C Default is °F
	trud	Temperature Rise Valve Direction	OPTR – Open on Temperature Rise CLTR – Close on Temperature Rise
	Pdd	Pumpdown Direction	OPPD – Open on Pumpdown CLPD – Close on Pumpdown
	td	Temperature Delta	OFF, 5, 10, 15, 20, 25, 30, 35, 40 Default is OFF
	SEFP	Sensor Error Failsafe Position	0%, 25%, 50%, 75%, 100% Default is 100%
	CErL	Auto/Manual PID Control	AUTO, PID Default is AUTO
	P	Proportional Coefficient	0 to 100 Default is 4
	I	Integral Coefficient	0 to 100 Default is 10
	d	Derivative Cofficient	0 to 100 Default is 1
	Addr	Device MODBUS Address	1 to 247 Default is 1
	nPAr	Parity Select	N – None E – Even Parity O – Odd Parity
	bAUd	Baud Rate	96, 192, 384 Default is 96
	Prn9	Pressure Sensor Range	150 – 0 to 100 psig 300 – 0 to 300 psig 500 – 0 to 500 psig
	SPOS	Manual Valve Position	0 to 100% Default is Current Position
	uEr	Firmware Version	(Current Firmware Version)
	cAdr	Controller Display Address	0 to 99% Default is 0
			Clockwise

APPENDIX D - Accessories

DESCRIPTION	ITEM	NOTES
Temperature Control	953462	Standalone Controller with display
Parker Sporlan Temperature Probes 3K Sensor - Brass 98.6K Sensor	 952551 952565	 Surface or air type High temperature; surface type
Parker Sporlan Pressure Transducers PSPT0500SVSP-S PSPT0300SVSP-S PSPT0150SVSP-S	 952576 952574 952572	 0-500 psis transducer (R-744 subcritical) 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
Troubleshooting Accessories SMA-12	 953276	 Handheld digital instrument for testing electric valve performance

APPENDIX E - Technical 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
(2 Kohm, 3 Kohm, or 98.6 Kohm)

1 Pressure Transducer .5 - 4.5VR
(150 psig, 300 psig, or 500 psig)

Relay Outputs
100-240VAC, 3A ind/250V
22-28VDC, 250mA digital output w/ground (Not currently used)

Digital Display
LED - Red, 7 segment, 4 digit

Indicators
LED - Red, Power

User Interface
Optical Encoder (SELECT knob)

Data Interface
RS485, Modbus

MECHANICAL

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

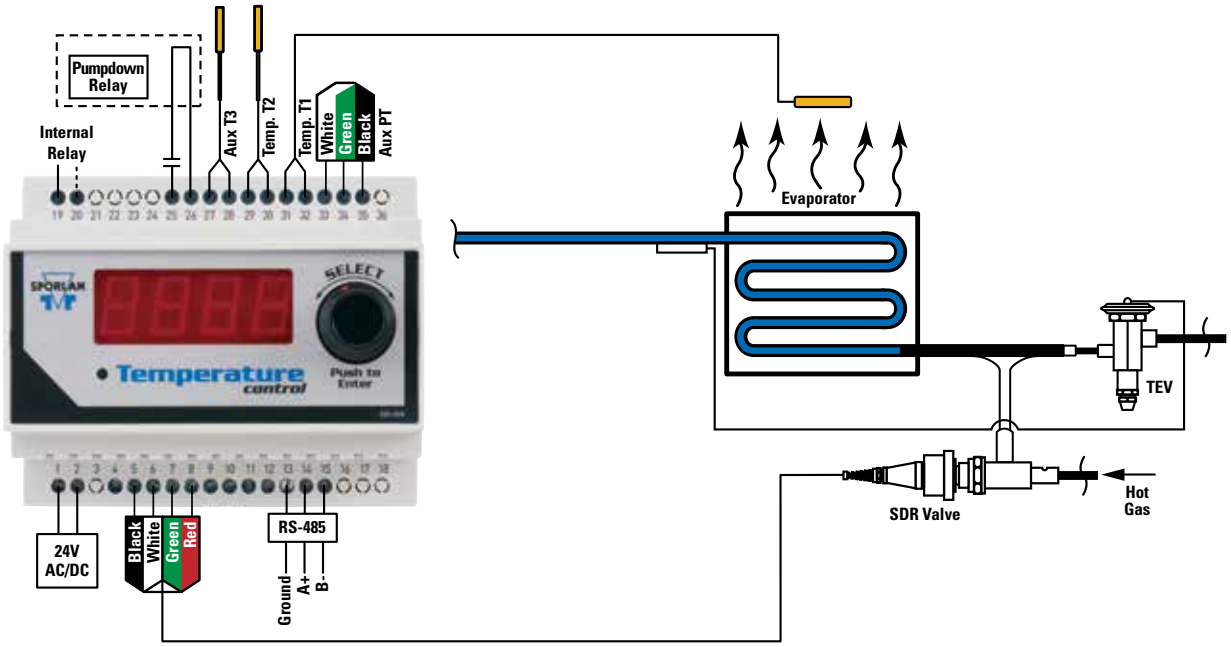
COMPLIANCE

Environmental
RoHS
WEEE

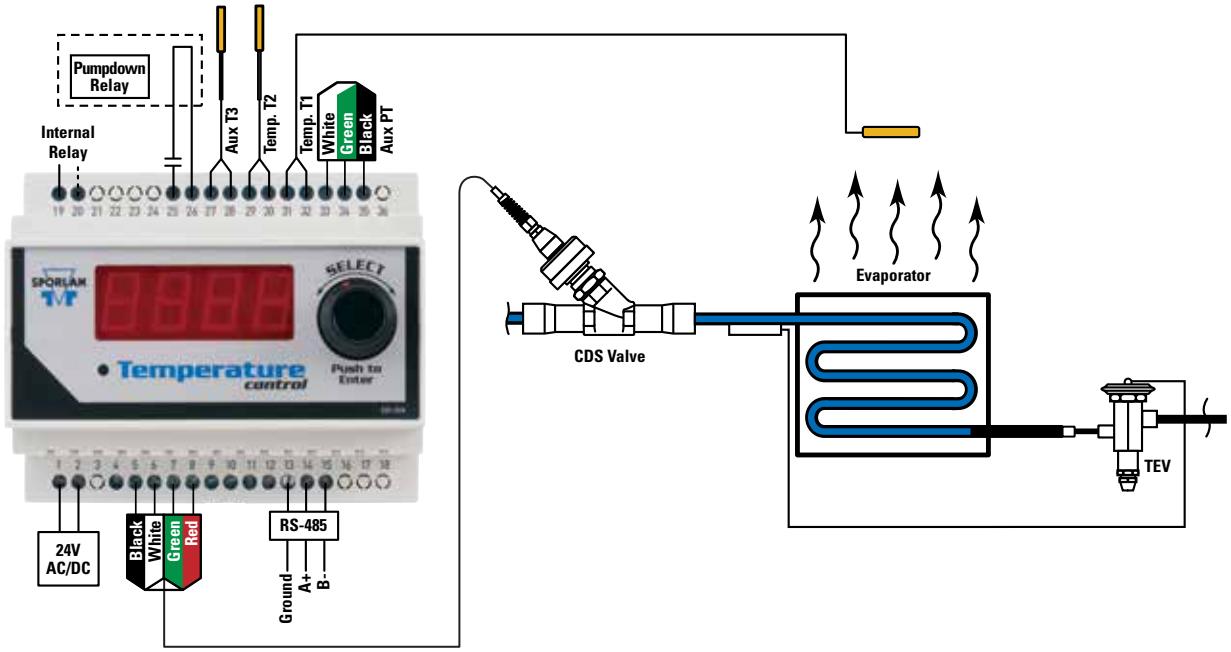
Electrical
CE
UL/CUL (Recognized per 873)
FCC (Class A, part 15)
C-tick

APPENDIX F - Wiring Diagrams

Hot Gas Bypass



Electric Evaporator Pressure Regulator



NOTE: Use caution when working around high voltage components.

APPENDIX G - Modbus Memory Map

MODBUS FUNCTION CODE	REGISTER ADDRESS/DESCRIPTION	RANGE
Read Coils (0x01)	0. Manual Valve Enabled Flag	0 = Disabled 1 = Enabled
	1. Pumpdown Status	0 = Disabled 1 = Enabled
Read Holding Register (0x03)	0. Temperature Setpoint	-50°F to 299°F (-45°C to 148°C)
	1. Temperature Calibration Offset	-5°F to 5°F (-21°C to -15°C)
	2. Temperature Sensor Type	0 = 2K 1 = 3K 2 = 98.6K
	3. Valve Steps	0 = 1596 1 = 3193 2 = 2500 3 = 6386
	4. Maximum Valve Position	1 to 100%
	5. Minimum Valve Position	0 to 20%
	6. TSI High Alarm Value	-60°F to 310°F (-51°C to 154°C)
	7. TSI Low Alarm Value	-60°F to 310°F (-51°C to 154°C)
	8. TSI High Temp Alarm Delay	0 to 60 minutes
	9. TSI Low Temp Alarm Delay	0 to 60 minutes
	10. Unit Select	0 = °F 1 = °C
	11. Temperature Rise Valved Direction	0 = Open on Temp Rise 1 = Close on Temp Rise
	12. Pumpdown Direction	0 = Open on Pumpdown 1 = Close on Pumpdown
	13. Temperature Delta	0 = OFF 1 = 5° 2 = 10° 3 = 15° 4 = 20° 5 = 25° 6 = 30° 7 = 35° 8 = 40°
	14. Sensor Error Failsafe Position	0 = 0% open on sensor error 1 = 25% open on sensor error 2 = 50% open on sensor error 3 = 75% open on sensor error 4 = 100% open on sensor error
	15. Auto/Manual PID Control	0 = Automatic 1 = Manual
	16. Proportional Coefficient	0 to 100
	17. Integral Coefficient	0 to 100
	18. Derivative Coefficient	0 to 100
	19. Device MODBUS Address	1 to 247
	20. Pressure Transducer Range	0 = 0 to 150 psi 0 = 0 to 300 psi 0 = 0 to 500 psi
	21. Manual Valve Position	0.0 to 100.0%

APPENDIX G - Modbus Memory Map (continued)

MODBUS FUNCTION CODE	REGISTER ADDRESS/DESCRIPTION	RANGE
Read Input Register (0x04)	0. Temp Sensor Input	-60°F to 299°F (-51°C to 148°C)
	1. Valve Position	0.0 to 100.0% Open
	2. T2	-60°F to 299°F (-51°C to 148°C)
	3. T3	-60°F to 299°F (-51°C to 148°C)
	4. T4	-60°F to 299°F (-51°C to 148°C)
	5. Pressure Sensor Input	0 to 500 psig
	6. Relay Status	0 = De-energized 1 = Energized
	7. Alarm Status	Bit 0 = T1 Temp Alarm High Bit 1 = T1 Temp Alarm Low Bit 2 = T2 Temp Alarm High Bit 3 = T2 Temp Alarm Low Bit 4 = DeltaT Alarm High Bit 5 = DeltaT Alarm Low Bit 6 = Sensor Fail
	8. Firmware Version	2 Byte Value
Write Single Coil (0x05)	0. Manual Valve Control	0 = Disabled 1 = Enabled
	1. Pumpdown Status	0 = Disabled 1 = Enabled
Write Single Coil (0x06)	Same as 'Read Holding Register' Definitions	Selected Register to Write
	User Password	Enables Parameter Modification

APPENDIX H - Temperature Sensor Specifications

TEMPERATURE		VDC		
°F	°C	2K	3K	98.6K
-50	-45.6	4.301	4.773	---
-40	-40.0	4.105	4.676	---
-30	-34.4	3.877	4.547	---
-20	-28.9	3.621	4.382	---
-10	-23.3	3.343	4.176	---
0	-17.8	3.050	3.929	---
10	-12.2	2.751	3.643	---
20	-6.7	2.455	3.326	---
30	-1.1	2.170	2.988	---
40	4.4	1.902	2.644	---
50	10.0	1.656	2.306	4.83
60	15.6	1.434	1.985	4.78
70	21.1	1.237	1.691	4.72
80	26.7	1.064	1.428	4.65
90	32.2	0.914	1.198	4.56
100	37.8	0.785	1.002	4.45
110	43.3	0.674	0.835	4.33
120	48.9	0.580	0.696	4.19

TEMPERATURE		VDC		
°F	°C	2K	3K	98.6K
130	54.4	0.500	0.579	4.04
140	60.0	0.431	0.483	3.87
150	65.6	0.373	0.404	3.68
160	71.1	---	---	3.48
170	76.7	---	---	3.27
180	82.2	---	---	3.06
190	87.8	---	---	2.84
200	93.3	---	---	2.62
210	98.9	---	---	2.41
220	104.4	---	---	2.20
230	110.0	---	---	2.01
240	115.6	---	---	1.82
250	121.1	---	---	1.65
260	126.7	---	---	1.48
270	132.2	---	---	1.34
280	137.8	---	---	1.20
290	143.3	---	---	1.08
300	148.9	---	---	0.97

Bulletin 100-50-5.3 / 112012

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