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Sporlan Kelvin II Refrigeration Controller

User's Manual, November 2009



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Description

The Kelvin II is a standalone superheat controller. The Kelvin II may be connected with a MODBUS master or a Network Master to give remote access to pressure and temperature readings in addition to viewing and editing the controller's setpoints. The user can also take advantage of the easy to use local display or a Remote Display to accomplish the same tasks.

1. Kelvin II Configuration

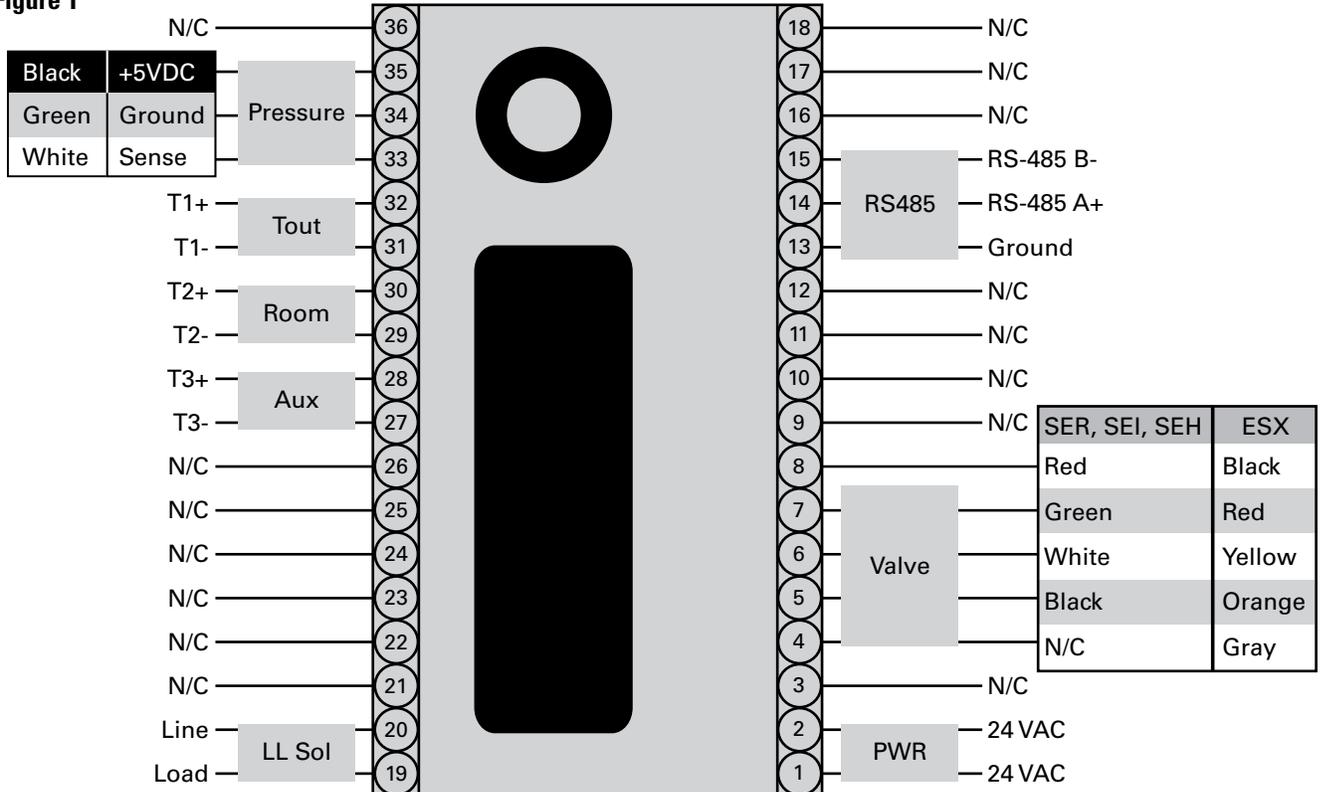
Specifications

- Input Voltage: 24 VAC ($\pm 10\%$), 40 VA minimum to board with external transformer
- Operating ambient temperature: -40°F to 120°F
- LED: One Power LED
- Communications: 1 RS485 Port, 1 USB port (Not operational)
- 4 Digit 7 segment display
- Inputs:
 - Optical Encoder (Knob)
 - One Pressure Input
 - Three Temperature inputs
- Valve Control of all Sporlan Electric Expansion Valves "EEV"
- 3 amp Solid State Relay for Liquid Line Solenoid Kelvin II w/o Local Display
- 1 amp Solid State Relay for Liquid Line Solenoid Kelvin II w/Local Display

2. Kelvin II Connections

The Kelvin II has screw terminals on the each side of the controller. The controller should be wired as follows and as shown in Figure 1.

Figure 1



Item	Wire (line)	Kelvin II connect point
Power	24VAC	1
	24 VAC	2
Valve	SEI, SER, SEH ESX	—
	N/C	Gray
	Black	Orange
	White	Yellow
	Green	Red
	Red	Black
RS-485	Ground	13
	A+	14
	B-	15
Liquid Line Solenoid	Line	19
	Load	20
Auxiliary Temperature Sensor (Displayed menu item: S-3)	T3	27
		28
Room Temperature Sensor (Displayed menu item: CtP)	T2	29
		30
Coil Out Temperature Sensor (Display option: tout)	T1	31
		32
Pressure Transducer (Displayed menu item: SucP)	Sense (WHITE)	33
	Ground (GREEN)	34
	+5 VDC (BLACK)	35

3. Kelvin II Display

Upon the first power-up from Sporlan, the Kelvin II will enter the setup menu. This menu allows the user to set some critical setpoint values, seen in Table 1, before the controller will operate. These critical values can be set via the local or remote displays, MODBUS, or Network Master. (Note: Only the Valve Type and Refrigerant have to be set via MODBUS or Network Master for the controller to operate) Once these values are entered the Kelvin II will then begin its control. If the setup menu is displayed on the local or remote displays

and the user sets these values via MODBUS then the Kelvin II will automatically leave the setup menu.

Table 1 Setup Menu

Displayed Menu Item	Description	Selections
StEP	Valve Type	1596, 3192, 2500, 6384, 400
rEFr	Refrigerant	r22, 134A, 402A, 404A, 407A, 407C, 410A, 417A, r507, 422d, r744, 245F
PtYP	Pressure Sensor Type	gAUg, AbSL
un_T	Temperature Units	FAHR, CELS
un_P	Pressure Units	PSI, BAR

After setup, the Kelvin II defaults to showing the Superheat value. The user can then turn the knob to view the other process values of their system. The screen will alternate between the process values identity and value alternating every 3 seconds. For ease of use, the value that is displayed for a process value may come in the form of text to eliminate the need of ‘looking up the meaning’. The menu text and meanings for process values are described in Table 2.

The user may also view/edit the setpoints by pressing the knob and holding it down for 5 seconds. The user is then prompted for a password to verify his credentials. The knob should be rotated up to ‘111’ for the password. If the password is correct the user may change the setpoints to the value he desires in order to obtain optimum system performance. The menu text and meanings for setpoint values are described in Table 3. Setpoints are saved to the controller when the user leaves the Setpoint menu by pressing the knob when “ESC” is shown. The setpoint menu has a timeout of 60 seconds for inactivity. When this timeout is reached the controller goes back to showing the process values and does not save any setpoints that might have been changed. If the user is in the Manual Valve Position setpoint then this timeout length is 60 minutes. As long as the controller does not time out the 60 minutes, Setpoints are saved to the controller when the user leaves the Setpoint menu by pressing the knob when “ESC” is shown.

All process values and setpoints are accessible^① through the local and remote displays.

Table 2 Process Value Menus

Displayed Menu Item	Description	Range
SuPH	Superheat	0 to 165°F, 0 to 91.6°C
SucP	Suction Pressure ^②	0 to 150 PSI, 0 to 10.34 Bar
tSAat	Saturation Temperature	-60 to 150°F, -51.1 to 65.6°C
tout	Suction Temperature	-60 to 150°F, -51.1 to 65.6°C
CtP	System Temperature	-60 to 150°F, -51.1 to 65.6°C
PoSn	Valve Position	0 to 100% Open
S-3	Auxiliary Temperature ^③	-60 to 150°F, -51.1 to 65.6°C
rELA	Solenoid Status	dEng, Eng
StAt	System Cycle Status	Current cycle and manual valve position state
ALS	Alarm Status ^④	noAL or all active alarms

Table 3 Setpoint Menu

Displayed Menu Item	Description	Range	Default Setting	User Setpoints
ESC	Escape and save settings	—	—	
SHSP	Superheat Setpoint	0 to 45°F, 0 to 25°C	8	
rEFr	Refrigerant	r22, 134A, 402A, 404A, 407A, 407C, 410A, 417A, r507, 422d, r744, 245F	404A	
d_On	Delay On	0 to 60 seconds	0	
dOFF	Delay Off	0 to 60 seconds	0	
d_St	Delay Percent Open of Valve	0 to 100 percent	0	
CtSP	Cut-out Suction Pressure	0 to 150 [⊙] PSI, 0 to 10.3 [⊙] Bar	0	
H_oP	Maximum Operating Pressure	0 to 150 [⊙] PSI, 0 to 10.3 [⊙] Bar	150	
C_in	Cut-in Temperature	-60 to 125°F, -51.1 to 51.6°C	-59	
Cout	Cut-out Temperature	-60 to 124°F, -51.1 to 51.1°C	-60	
HiCP	Max Valve Capacity	20 to 100%	100	
SUPS	Supermarket Setting	OFF, ON	OFF	
-p-	Proportional Coefficient	0 to 100	40	
-I-	Integral Coefficient	0 to 100	25	
-d-	Derivative Coefficient	0 to 100	5	
StEP	Valve Type	1596, 3192, 2500, 6384, 400	1596	
SPoS	Manual Valve Position	0 to 100% Open	Present Position	
nEt	Network Type (MODBUS or Network Master)	nbUS (MODBUS) or ProP (Network Master)	nbUS	
Addr	MODBUS/Network Master Address	1 to 255	1	
un_P	Pressure Units	PSI, BAR	PSI	
un_T	Temperature Units	FAHR, CELS	FAHR	
PtYP	Pressure Sensor Type	AbSL, gAUg	gAUg	
CaLP	Pressure Sensor calibration value	-5 to 5 PSI, -0.34 to 0.34 Bar	0	
CLt1	Tout calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CLt2	Ctp calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CLt3	S-3 calibration value	-5 to 5°F, -2.7 to 2.7°C	0	
CAdr	Controller Display Address	0 to 99	0 or 1 for local display	

4. Kelvin II MODBUS

The Kelvin II can communicate with a MODBUS master. The Kelvin II will transfer process values and setpoints via MODBUS.

① Setpoints can only be viewed and edited when the proper password is entered.

② The Auxiliary Temperature sensor input has a special Pumpdown feature. If a “short” or switch closure is placed across these terminals, the valve will shut for pumpdown. The full details of this feature are described in Section 5.

③ The Alarm Status process value is described in Section 6.

④ The maximum value varies based on which refrigerant is selected. (R-410A is 300 PSI, R-744 is 500 PSI and all others are 150 PSI).

The Kelvin II only supports the RTU transmission mode. The serial settings are as follows:

- 9600 baud
- 8 data bits
- 1 stop bit
- Even parity

The Kelvin II supports the ‘Read Input Registers’, ‘Read Holding Register’, ‘Write Single Register’, ‘Read Multiple Coils’ and ‘Write Single Coil’ function codes. Any other request will result in an exception response. The Kelvin II will allow a full and partial block read of the Input and Holding registers and Coils.

4.1. Scaling

In order to preserve precision, scaling was implemented when using Bar or Celsius for units. PSI and Fahrenheit units are both in whole numbers and have no scaling. The tables of the MODBUS memory map below reflect this implementation.

The Celsius values that are transferred via MODBUS are 10X. For example, if Celsius is chosen for the temperature units then 45°C is transferred for the Superheat. The actual Superheat is 4.5°C. If the user desired to change a setpoint they should keep this in mind when they enter a value.

The Bar values that are transferred via MODBUS are 100X. For example, if Bar is chosen for the pressure units then 1034 Bar is transferred for the Maximum Operating Pressure. The actual Maximum Operating Pressure is 10.34 Bar. If the user desired to change a setpoint they should keep this in mind when they enter a value.

4.2. MODBUS Memory Map

Table 4 Memory Map

MODBUS Function Code	Mapped Data	Data Map	Range
Read Coils (0x01)	Manual Valve Control	Bit 0 = Manual Valve Enabled Flag Bit 1 = Manual Valve Duration Enabled Flag	0 = Disabled, 1 = Enabled.
Read Holding Register (0x03)	Setpoints	0. Superheat Setpoint	0 to 45°F, 0 to 250°C (0.0 to 25.0°C)
		1. Refrigerant Type	0 = r22 1 = 134A 2 = 402A 3 = 404A 4 = 407A 5 = 407C 6 = 410A 7 = 417A 8 = 422A 9 = 422d 10 = r507 11 = r744 12 = 245F
		2. Delay On Relay	0 to 60 seconds
		3. Delay Off Relay	0 to 60 seconds
		4. Delay Steps	0 to 100 % Open
		5. Cut-out Suction Pressure	0 to 150 ^⑤ PSI, 0 to 1034 Bar (0 to 10.34 Bar)

MODBUS Function Code	Mapped Data	Data Map	Range
Read Holding Register (0x03)	Setpoints	6. Max Operation Pressure	0 to 150 ^⑥ PSI, 0 to 1034 Bar (0 to 10.34 Bar)
		7. Temperature Cut-in	-60 to 125°F, -511 to 516 °C (-51.1 to 51.6 °C)
		8. Temperature Cut-out	-60 to 124°F, -511 to 511 °C (-51.1 to 51.1 °C)
		9. Valve Maximum	20 to 100 %
		10. Supermarket Mode	0 = OFF 1 = ON
		11. P	0 to 100
		12. I	0 to 100
		13. D	0 to 100
		14. Valve Type	0 = 1596 1 = 3192 2 = 2500 3 = 6384 4 = 400
		15. Manual Valve Position	0 to 100 % Open
		16. Network Type	0 = MODBUS 1 = Network Master
		17. Unit Address	1 to 255
		18. Pressure Units	0 = PSI, 1 = BAR
		19. Temperature Units	0 = FAHR, 1 = CELS
		20. Pressure Sensor Type	0 = GauG, 1 = ABSL
		21. Pressure Calibration Offset	-5 to 5°F, -34 to 34 Bar (-0.34 to 0.34 Bar)
		22. Suction Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
		23. Room Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
		24. Auxiliary Temperature Calibration Offset	-5 to 5°F, -27 to 27°C (-2.7 to 2.7°C)
		Read Input Registers (0x04)	Process Variables
1. Suction Pressure ^⑥	0 to 150 PSI, 0 to 1034 Bar (0 to 10.34 Bar)		
2. Saturation Temperature	-60 to 150°F, -511 to 656°C (-51.1 to 65.6°C)		
3. Suction Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)		
4. Room Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)		
5. Valve Capacity	0.0 to 100.0% Open (0.0 to 100.0)		
6. Auxiliary Temperature	-60 to 125°F, -511 to 656°C (-51.1 to 65.6°C)		
7. Relay Status	0 = Deenergized, 1 = Energized		

⑤ The maximum value varies based on which refrigerant is selected. (410A is 300 PSI, r744 is 500 PSI and all others are 150 PSI).

⑥ The maximum value varies based on which refrigerant is selected. (410A is 300 PSI, r744 is 500 PSI and all others are 150 PSI).

MODBUS Function Code	Mapped Data	Data Map	Range
Read Input Registers (0x04)	Process Variables	8. Alarm Status	If Bit set then alarm is active: Bit 0 = Suction Transducer Failure Bit 1 = Tout Sensor Failure Bit 2 = High Superheat Bit 3 = Low Superheat
		9. System Cycle Status	If Bit set then mode is active: Bit 1 = Setup Mode Bit 2 = Off Cycle Bit 3 = Cooling Cycle Bit 4 = Pump-down Cycle Bit 5 = Manual Valve Override Mode
Write Single Coil (0x05)	Manual Valve Control	Bit 0 = Manual Valve Enabled Flag	0 = Disabled, 1 = Enabled. The Manual Valve duration Bit is read-only.
Write Single Register (0x06)	Setpoints	Same as above.	The max number of registers written at a time is 1. The limits can be seen above in the 'Read Holding Register' definition.

5. Kelvin II Features

5.1. Pumpdown Feature

The Kelvin II will initiate a pumpdown when Auxiliary Temperature sensor terminals are shorted. If desired, this temperature connection could be set up as a dry contact. When a pumpdown is desired the contact should be closed. The pumpdown will be ended when the short is removed provided that there are no sensor alarms.

5.2. Manual Valve Position Feature

The Kelvin II has the ability to manually control the valve. To enable this manual control via the local or remote displays simply open the setpoint menu and edit the 'SPoS' setpoint. When the value is displayed for this setpoint the user is manually controlling the valve. The valve position can be changed by rotating the knob clockwise or counterclockwise. There is an inactivity timer of 60 minutes while in manual control. The timer is reset each time the user moves the valve. The manual control of the valve is ended when the user presses the knob to go back to displaying 'SPoS' or a timeout has been reached.

6. Kelvin II Alarms

The Kelvin II has 4 alarms. The following table lists the possible alarms and the text that is seen on the controller. The controller's alarm status can be viewed via MODBUS, Network Master, and local and remote displays.

Table 5 Alarms

Alarm Text	Meaning
NoAL	No Alarms active
PSAL	Pressure Sensor alarm
TSAL	Tout Sensor alarm
HSAL	High Superheat alarm
LSAL	Low Superheat alarm

Normally, on the process value screens, the process value text alternates with its value. When an alarm is activated the alarm status "-AL-" screen is added to the rotation to make the user aware that an alarm has been activated. The Alarm Status menu display item ALS, will show the active alarms shown in Table 5.

7. Kelvin II Display Networking

The Kelvin II displays can be set up to access other Kelvin II controllers on the network. The controller's current 'CADr' value can be determined by pressing down the button on the display while viewing a process value. To enable the display network the 'CADr' setting MUST be set to a unique nonzero value with the RJ-45 connector on the side of the controller DISCONNECTED.

After 'CADr' has been set, an 'End' screen is added just before the 'SuPH' process value. Pressing the button on the display while viewing the 'End' screen brings up a menu allowing the selection of other Kelvin II controllers connected to the display network. Turning the knob allows the selection of other Kelvin II controllers based on their appropriate 'CADr' address. The local controller is listed as 'LocL' by a local display. Note: the remote display always includes the 'End' screen since it must be able to view any controller on the display network.

8. Kelvin II Factory Reset

A factory reset can be performed by holding the button down on the local or remote displays for 5 seconds when power is first applied. If using a local display the display will show 'FrSt' while the factory reset is being performed and then automatically connect to the local controller.

If using a remote display the display will show 'FrSt' and switch to a menu that allows the selection of the controller to reset. To perform a factory reset, select the controller with the appropriate 'CADr' value. The display should show '----' while the reset is being performed. When finished performing factory resets turn the knob counterclockwise until 'ESC' is shown on the display. Pressing the button while 'ESC' is shown on the display exits the factory reset menu and should automatically connect to a controller on the display network.

Table 6 Replacement Parts

Part Number	Description
952560	Kelvin II without display
952561	Kelvin II with local display
952562	Kelvin II Remote panel display
952662	Temperature Sensor Assembly
952795	Well Sensor Kit
953091	Pressure Transducer 150 psig with cable
952995	Pressure Transducer 150 psia with cable
952740	Pressure Transducer 300 psig with cable for R-410A applications only
952504	Pressure Transducer 500 psig with cable for R-477 applications only



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