

## Product Bulletin

# KLIXON SP SERIES Refrigeration Package



### Key Features/Benefits

- Applicable to fractional horsepower compressors used in refrigerators, freezers, water coolers, dehumidifiers, vending machines, and similar refrigeration applications.
- Utilizes ceramic PTC (Positive Temperature Coefficient) pill materials to energize/de-energize motor start windings.
- Readily available for 120 and 220 volt applications.
- Available with 1/8", 1/4" and 3/16" termination.
- Allows direct mounting of the run capacitor in the 5SP model.
- Provides significant installed cost savings opportunities by requiring fewer components to attach to the compressor, particularly the 5SP which features a run capacitor mount for easy assembly.
- Eliminates run capacitor wiring harness in 5SP models.
- Eliminates terminal cover.

### Product Overview

The Texas Instruments SP Refrigeration Package, including the 4SP and 5SP, is a compact motor starter and motor protector package. The SP serves as a combination control which:

1. Uses industry leading 4TM motor protector
2. Performs the PTC solid state starter function
3. Replaces the compressor terminal cover
4. Available for both RSIR and RSCR applications
5. 5SP eliminates the need of wiring harness for a run capacitor

The SP unit plugs directly onto the compressor terminal pins. This provides installed cost savings opportunities through the elimination of the terminal cover and a reduction in assembly labor as well as the elimination of the run capacitor wiring harness in the 5SP model.

### Quality and Performance

#### PTC Reliability

- High reliability solid state motor starter
- Life cycle: minimum 500,000 cycles at maximum rated current/voltage conditions
- 100% electrically tested twice
- Dissipates less than 2 watts under normal operating conditions

#### 4TM Reliability

- Life cycle: designed to achieve a minimum of 10,000 electrical cycles
- Minimum 15 day locked rotor testing

#### Agency Certified

- UL/CUL recognized: File SA3745
- IEC/ENEC Certified: File 2014531.01

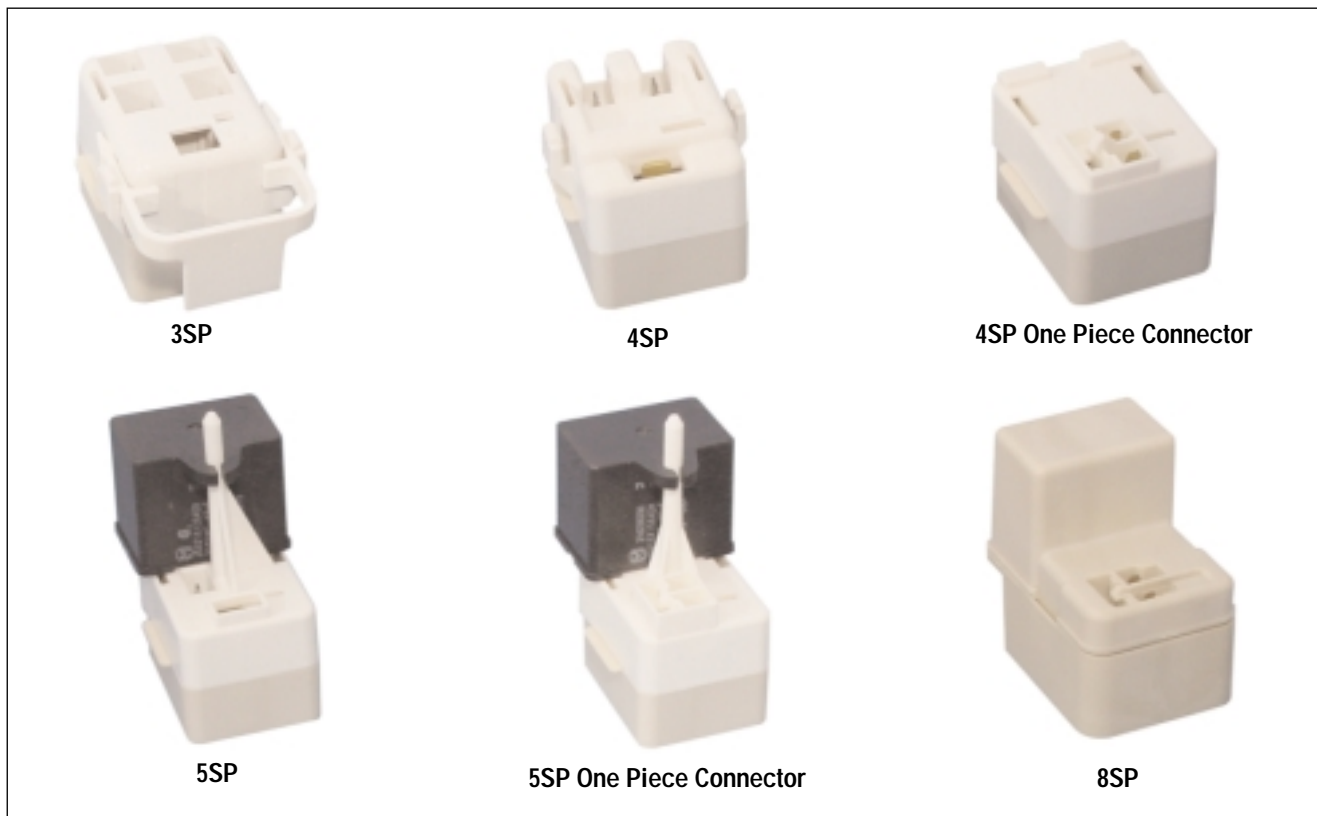
### Convenience

- Fits most existing compressor terminal fences
  - Eliminates retooling
- Elimination of 4TM reapplication in most cases
  - Easy product conversion
- 5SP allows for flexibility in run capacitor size and shape
  - Can accommodate various capacitors
- 4SP and 5SP one piece connector design allows for simultaneous disconnect
- Optional 3/16" continual anti-miswire features or 1/8" one piece simultaneous disconnect termination

## Electrical Component Assembly

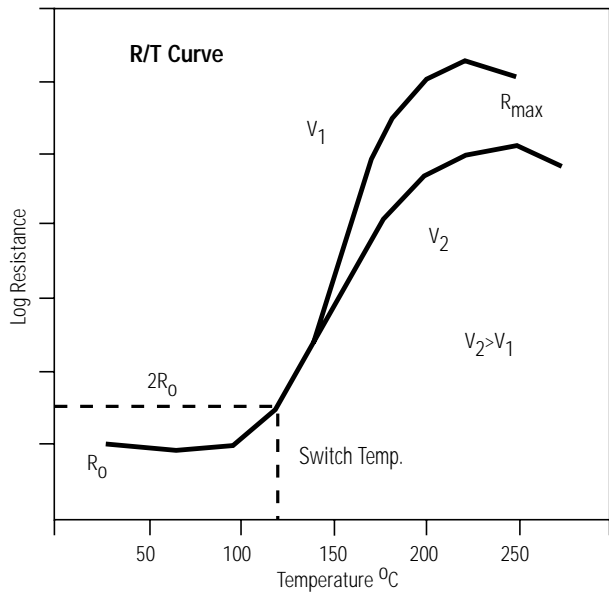


## SP Models

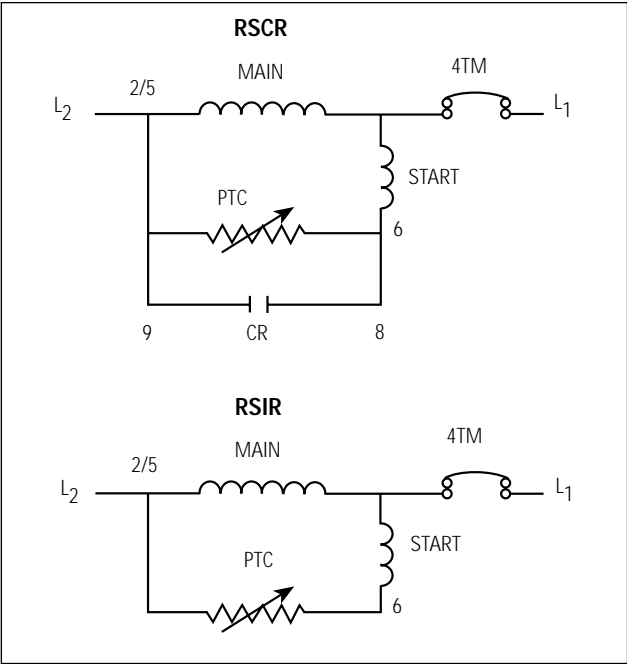


PTC Performance

When power is first applied to the compressor via the SP, the PTC pill is in the low resistance state. Current flows through the PTC pill to the start windings, causing a beneficial phase angle shift between start and main windings, and resulting in an increase in the starting torque. The current flow through the PTC pill causes self-heating and it switches to the high resistance state, resulting in low power dissipation while the compressor is running.



Electrical Schematics

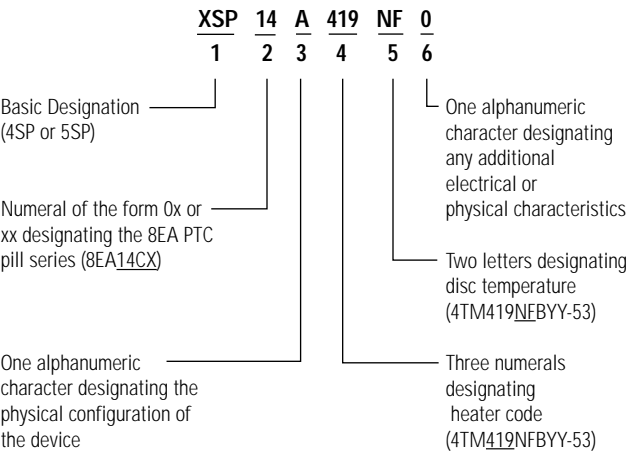


Common PTC Electrical Rating

SP Series	Application Voltage	$V_{max}I_{max}$	Nominal Resistance (Ohms)	Heat Capacity $mC_p$
14CX	120	180 / 12	$5.0 \pm 20\%$	1.40
15CX	120	200 / 12	$6.8 \pm 20\%$	1.40
16CX	120	200 / 10	$10 \pm 20\%$	1.40
17CX	240	300 / 7	$22 \pm 20\%$	1.40
18CX	240	355 / 6	$33 \pm 20\%$	1.40
19CX	240	250 / 8	$15 \pm 20\%$	1.40
20CX	240	400 / 5	$4.7 \pm 20\%$	1.40

For other ratings contact TI.

Combo Coding System



\*For specific physical or electrical characteristics of the device please contact Texas Instruments directly

## PTC Motor Starter Application Procedure

### Step 1: Assemble Data Required for New Applications

	Example
RO Resistance .....	5.0 Ohms
Max. Volt ( $V_{max}$ ) .....	162 VAC
Max. Current (In Rush) .....	8 AMP
Switch Time of Motor .....	>0.5 Sec @ 8 AMP Ambient 25°C
Motor Type .....	RSCR
Reset Time .....	<80 Sec @ Nom. Volt Ambient 25°C
Test Requirements .....	• 250K Cyclesv@ Max. Operational Conditions • 300 Hrs. @ Max. Volt +10%

**Step 2:** Select PTC pill based on resistance and maximum operating conditions.

(See electrical rating on previous page).

**Step 3:** Select 8EA physical configuration based on motor type.

(See terminal configurations on previous page).

### Step 4: Switch Time Calculation

The amount of time required for PTC to switch into its high resistance state can be approximated as follows:

Equation	Example
Time (Sec) = $\frac{MCP (T_S - T_A)}{I^2 R}$	$R = 5 \text{ Ohms } (R = 5 \times .8 = 4)$
$MCP = \text{Heat Capacity}$ (Watt-Sec/°C)	$I = 8 \text{ Amps}$
$T_S = \text{Switch Temperature } (°C)$	$T_S = 120°C$
$T_A = \text{Ambient Temperature } (°C)$	$T_A = 25°C$
$I = \text{Inrush Current (Amps-Rms)}$	$MCP = 1.60$
	$1.60 (95)$
	Time (Sec) = $(8^2) (4)$
	Switch Time = 0.59 Sec.
$R = \text{Initial Device Resistance}$ Under Voltage (Use $R_0 \times 0.8$ )	

Theoretical Calculated PTC Switch Time  
Should be  $\geq$  Time Required to Start Motor

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## Glossary

$R_0$	– Measured resistance value at 25°C $\pm 2°C$ voltage of 2.0 volts.
Cooldown Time	– Time required for the PTC resistance to return to two times the initial value ( $2R_0$ )
Curie Point (Switch Temp.)	– Temperature obtained with a resistance value of two times ( $2R_0$ ) the minimum resistance value ( $R_0$ )
$V_{max}$	– Maximum operating voltage which may be applied across the PTC continuously at the ambient temperature specified and in a steady high resistance state.
$V_r$	– Application rated supplied voltage/ 120 or 240 VAC (below $V_{max}$ )
$I_{ss}$	– Steady state current remaining at maximum operating voltage.
$I_{max}$	– Maximum operating current.

## Application Notes

1. The surface and terminals of the SP device and its components can reach high temperatures under normal running conditions. Any material in contact with the SP device and its terminals, including wire and quick-connect receptacle plastic insulation, should have a minimum temperature rating (RTI) of 105°C. Adequate spacing should be provided to insulate lower-rated materials from this heat source.
2. The SP device and its components should be protected from potential sources of liquid, such as the evaporator tray and water connections.
3. Certain materials, such as chlorine (Cl) containing gases, can degrade the characteristics of the SP device and its components. The SP device and its components should not be exposed to Sulphur (S) or chlorine (Cl) containing gases, and must be kept away from materials that can generate them. In particular, avoid the use of polyvinyl chloride (PVC) insulation in contact with the SP device and its terminals.

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