Contents

Brief Operating Description: Longer Motor Life Starts with a Switch

For over 75 years, single-phase motors have utilized a mechanical centrifugal switch to switch the start circuit. Inherent characteristics of a mechanical device have made these switches prone to various problems, including tolerances, tolerance build-ups, mechanical fatigue, vibration and a host of others that can lead to switch failures and/or performance inconsistency.

Our challenge was to design a reliable solid-state switch to replace the mechanical switch and actuator mechanism that would duplicate the function of connecting and disconnecting the start circuit at particular speeds with the additional benefits of a solid-state device. After considerable research, we decided a successful electronic motor starting switch could be created by sensing the voltages present in the main and start windings.

Until the rotor of a single-phase motor begins to rotate, there is no coupling between its start winding and main winding. When the rotor begins to turn, the main winding induces flux in the rotor, which then induces a voltage in the start winding. The voltage induced in the start winding is directly proportional to motor speed.

In Stearns SINPAC Electronic Switches, the voltage across a motor's main winding and the voltage across its start winding are sampled and fed to a comparator. The logic circuitry is designed so that the electronic switch interrupts the start circuit current after the motor has accelerated to the speed at which cut out voltage is developed, generally 75 to 80% of synchronous motor speed. The logic circuitry then shuts down the switch's power stage, which consists of a triac or inverse parallel SCR's. This function is referred to as "cut out." When the start circuit is disconnected, the main winding field then drives the motor's rotor to its running speed.

If the motor encounters an overload, and the motor speed falls to approximately 50% of its synchronous speed, the SINPAC Switch automatically reconnects the motor's start circuit. This function is referred to as "cut in." Cut in detection circuitry constantly monitors start winding voltage. When the motor's speed falls to the cut in point, the detection circuit causes the control logic to energize the SINPAC Switch's power output stage. The motor then goes through its normal startup procedure, with the start circuit being switched out at a motor speed approximately 75 to 80% of synchronous speed.

SINPAC Switches are potted and completely sealed, making it impervious to dust, dirt and moisture. The unique speed sensing circuit provides a universal design which allows a few switches to work on most standard motor designs regardless of manufacturer.

Acceptance by Motor Manufacturers

US and foreign motor manufacturers have tested and retested the SINPAC Switch for reliability and quality. Today, many of these manufacturers have begun installing SINPAC Switches on their standard motor lines with more companies ready to make the changeover.

UL Recognition

Many SINPAC Switches have already been recognized under the Component Program of Underwriters Laboratories, Inc. (E-71115). In addition, all switches have internal surge protection which is tested according to IEEE C62.41 – 1991 Category A3.

CSA Certification LR-6254.

Typical Applications

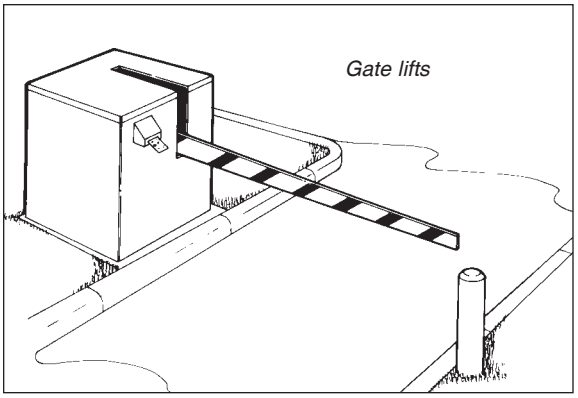
Stearns SINPAC Switches are ideal for applications requiring reliable switching of the start circuit in single-phase motors.

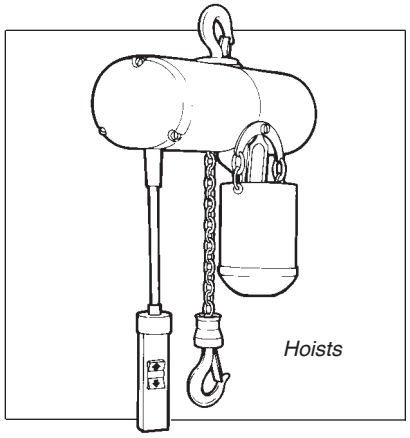
Mechanical switches are prone to various problems including mechanical fatigue, tolerances, tolerance build-ups and vibration which can lead to performance inconsistency.

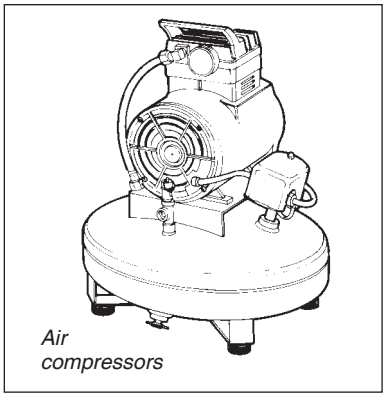
Electronic SINPAC Switches solve all those problems which reduce production downtime in hundreds of applications. Some of these applications are illustrated below:

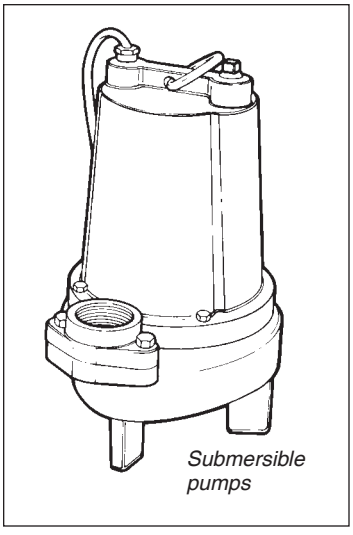
Some additional applications include:

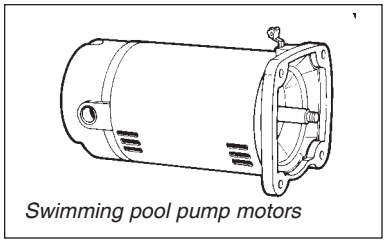
- Grain Dryers
- Water Equipment
- Power Tools
- Commercial Dryers
- Commercial Washing Machines
- Ice Makers
- Gas Pumps
- Floor Washers
- Bottle Washing Machines
- Floor Sanders
- Poultry Feeding Systems
- Fans, Blowers
- Grinding Machines
- Milking Machines
- Winches
- 50/60 Hz
- Hoists
- Paint Sprayers
- Vacuum Pumps
- Air Compressors
- Pressure Sprayers
- Vibrators
- Auger Drives
- Door Openers
- Sump Pumps
- Diaphragm Pumps
- Hermetic Motors
- Rotary Compressors
- Refrigeration Compressors
- Heat Pumps
- Jet Pumps
- Submersible Pumps
- Food Processing

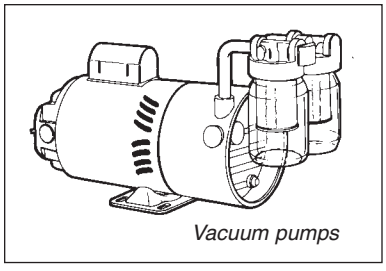

Gate lifts

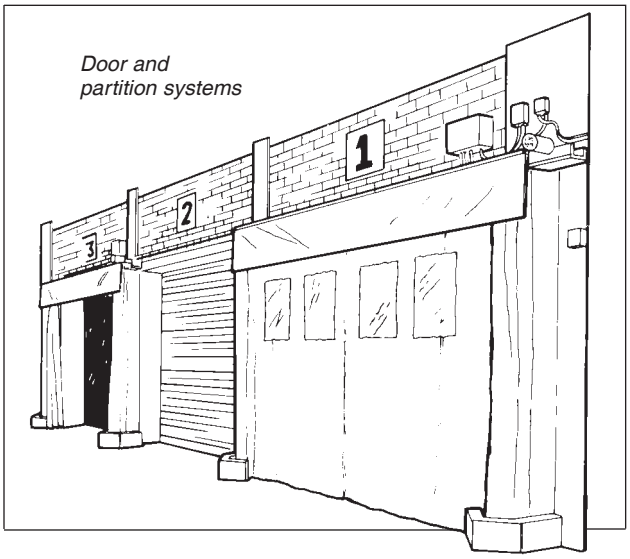

Hoists


Air compressors

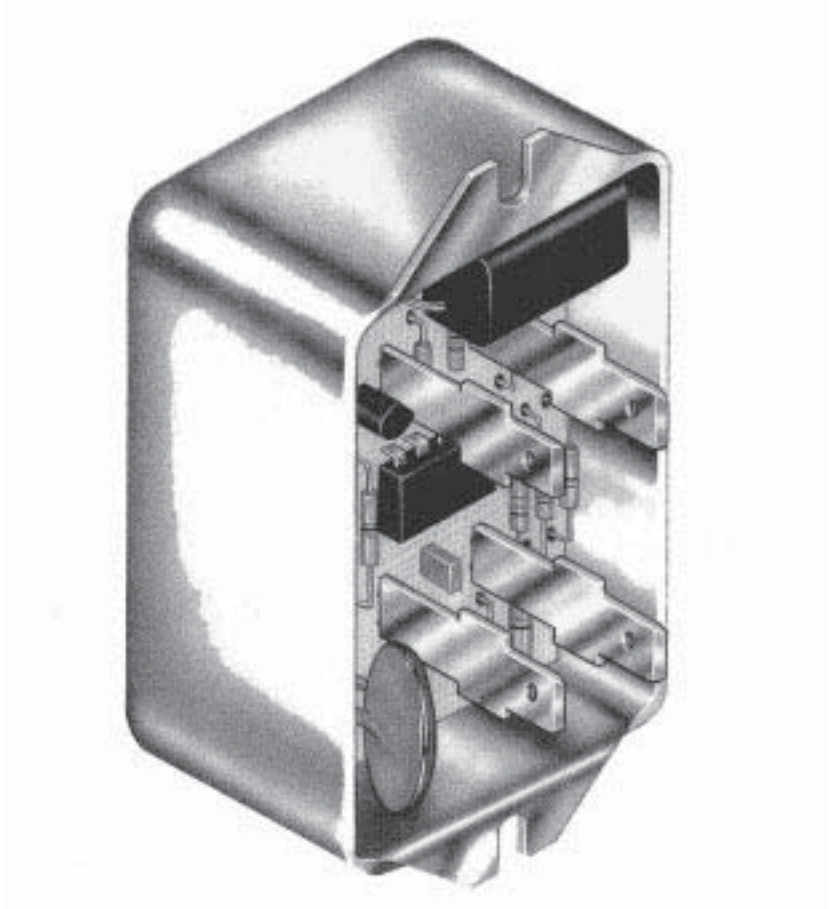

Submersible pumps


Swimming pool pump motors


Vacuum pumps



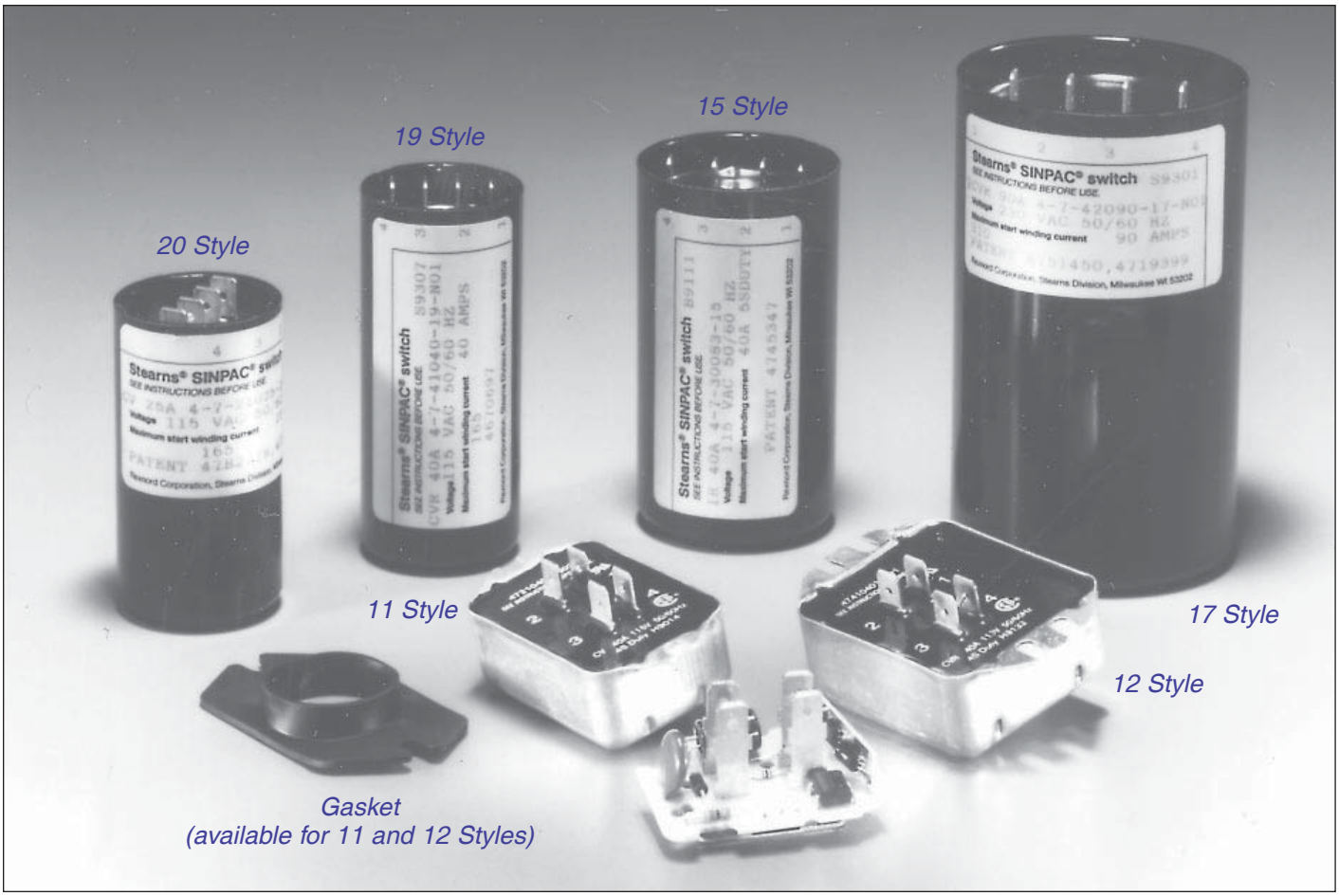
Design Features



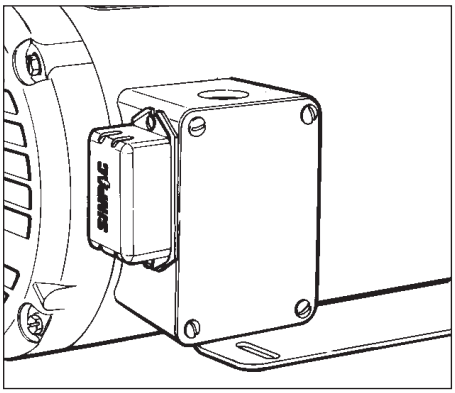
- *Speed Sensitive*
  SINPAC Switches duplicate mechanical switch performance. They cut out the start circuit at approximately 80% of synchronous speed*. This means no degradation in motor performance and no confusing and cumbersome time or current selection criteria to consider, since SINPAC Switches are not load sensitive. It also means there will be less stress on the starting capacitor due to over voltage.
- *Restart Capability*
  When motor speed drops below 50% of synchronous speed, the start circuit is reconnected to reinitiate starting torque.
- *Accepted by Motor Manufacturers*
  Stearns SINPAC Switches have been tested with favorable results and are available from most single-phase motor manufacturers.
- *Transient Protection*
  Transient protection tested per IEEE C62.41 – 1991Category A3.
- *Line Voltage Compensation*
  No modifications or changes are required for line voltage variations. SINPAC Switches will operate in areas susceptible to *brown-outs* or low voltage due to long wiring runs.
- *Electrically Protected Design*
  SINPAC Switches are designed to filter out electrical noise, so there is no concern of random switch malfunctions.
- *UL Recognition and CSA Certification*
  Testing has been completed and approval has been obtained on most sizes and will be obtained on the balance of the product line. SINPAC Switches can be used with confidence in their safety and acceptance.
- *Completely Solid-State*
  With no moving parts, SINPAC Switches have no physical constraints to affect their operation. Can be used on new or existing motors.
  No wearing parts means high cycling. No shaft extension required. Not restricted by motor vibration or overspeed. No arcing contacts due to restart during motor coastdown.
- *Universal Design*
  SINPAC Switches will work on 2, 4, 6 or more pole motors of any manufacturer. This reduces motor manufacture and repair shop selection time and switch inventory. It also means that foreign and obsolete motors can be easily retrofitted with SINPAC Switches.
- *Environmentally Protected*
  SINPAC Switches are immune to moisture, dust, shock, vibration or overspeed. The switch will not limit motor performance due to environmental conditions.
- *Stearns Reliability*
  Years of experience in the motor industry, first with brakes and now with speed sensing switches, means you can depend on Stearns SINPAC Switches to solve switching problems.
- *Unlimited Mounting Locations*
  SINPAC Switches offer a variety of external and internal conduit box mountings and external endbell mountings. These mountings are not affected by the motor position (shaft up or shaft down). SINPAC Switches can also be mounted at locations remote from the motor.
- *Reduced Installation Time*
  Easy accessible terminals and mounting, reduce the amount of time required to install SINPAC Switches.
- *Integral Design*
  SINPAC Switches can reduce the length of the motor when designed as an integral part of the motor.

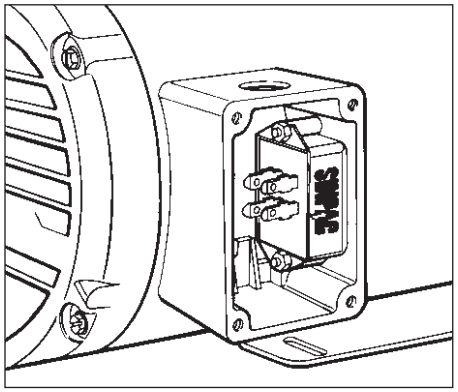
*Contact factory for questions on specific switch/motor performance.

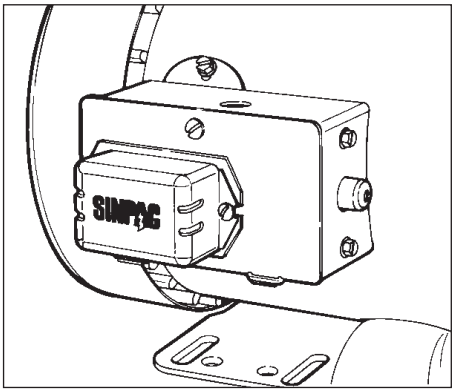
Models

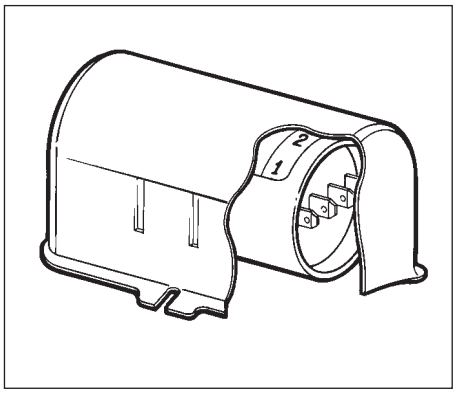


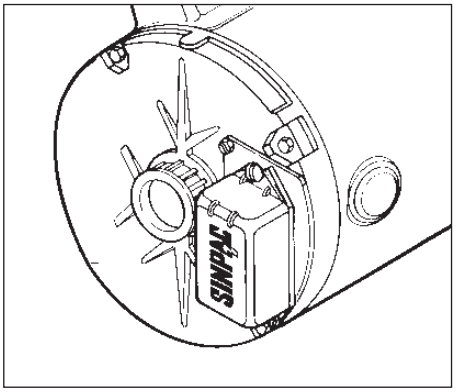
Mounting Options

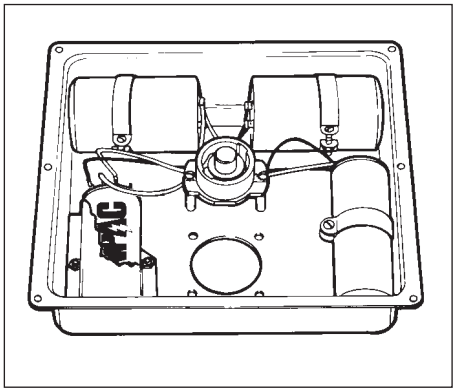












SINPAC Switch Ordering and Identification Information

SINPAC Electronic Switch Catalog Numbering System

CV-16-165 – Each stock electronic series switch is uniquely specified by an alphanumerical catalog number. For most standard SINPAC Electronic Switches, the catalog identifies a particular switch, including voltage, series, current rating, and cut out or cut in voltage. The first position indicates the start circuit voltage (*blank* equals 115 volts and *2* equals 230 volts). The next characters specify the series or type of motor on which the switch should be used. The next numeric characters specify the maximum current which the switch can handle. The next numeric grouping specifies cut out voltage for capacitor start, capacitor start/capacitor run, and instant reversing switches and cut in voltage for the PV Switches. The Table shown on Page 6 provides information for selecting appropriate catalog number when ordering a Stearns electronic switch.

For example, when ordering a capacitor start, 16 amp switch with 165 volt cut out, catalog number would be CV-16-165 as follows:

CV – 16 – 165

Start Winding Voltage
blank = 115, ***2*** = 230

Cut Out Voltage (Cut In PV)

Maximum Current Rating

Series
CVR = Capacitor Start and Capacitor Start/Capacitor Run Motors, ***PV*** = Split Phase Only,
CV - Capacitor Start Only, ***VR*** = Capacitor Start/Capacitor Run Only, ***IR*** = Capacitor Start Instant Reverse

Each Stearns SINPAC Electronic Switch is uniquely specified by a 12-digit alphanumeric part number. For most standard SINPAC Electronic Switches, the last 10 positions identify the specific switch, including series, voltage, option, current, enclosure, agency recognition, cut in or cut out voltages. For example, when ordering capacitor start, 16 amp SINPAC Electronic Switch, the switch would be specified as shown.

The following examples and tables provide information for selecting the appropriate 12-digit part number when ordering a Stearns SINPAC Electronic Switch.

4–7–21016–11–UO1

Electronics

6 = Switchpac (6 switches)
7 = SINPAC Switch

1 = PV Series - Split Phase Only
2 = CV Series - Capacitor Start Only
3 = Made-To-Order (MTO)*
4 = CVR Series - Capacitor Start and Capacitor Start/Capacitor Run
5 = IR Series - Capacitor Start Only
6 = Timer - Fixed Timer Split Phase or Capacitor Start
7 = VR Series - Capacitor Start/ Capacitor Run Only

1 = 115 Start Circuit Voltage
2 = 230 Start Circuit Voltage

O = Standard
A = Inductor

Amps (max. current)
12, 16, 25, 35, 40, 50, 55, 70, 80 or 90

Package Style
11 = Metal Can 2.48 x 1.38 x .81
12 = Metal Can 2.67 x 1.78 x .86
15 = Capacitor Case 1.822 dia. x 3.372 long
16 = Metal Can 2.75 x 2.0 x 1.125
17 = Capacitor Case 2.572 dia. x 4.372 long
19 = Capacitor Case 1.447 dia. x 3.372 long
20 = Capacitor Case 1.447 dia. x 2.760 long
21 = Board Only

U = UL Recognized, ***N*** = Not UL

230 V SINPAC Switch
C = 260 VCO, ***O*** = 310 VCO, ***E*** = 410 VCO
H = 400 mS Timing Interval, 60 V Cut In
M = 340 VCO, ***S*** = 350 VCO
T = 600 mS Timing Interval, 60 V Cut In

115 V SINPAC Switch
A = 130 VCO, ***B*** = 147 VCO, ***O*** = 165 VCO
O = 400 mS Timing Interval, 30 V Cut In
D = 180 VCO
F = 400 mS Timing Interval, 10 V Cut In
J = 155 VCO Hybrid 6B
K = 165 VCO Hybrid 6
L = 130 VCO 15 VCI
P = 800 mS Timing Interval, 30 V Cut In
R = 115 VCO
T = 600 mS Timing Interval, 10 V Cut In
V = 210 VCO
W = 200 mS Timing Interval, 30 V Cut In
Y = 200 mS Timing Interval, 10 V Cut In

1 = Standard, ***2*** = Standard, ***K*** = Kit

*__NOTE:__ For part numbers beginning with 473 (these are OEM specials), the remaining digits of this numbering system do not apply.

Overview of Standard Product Offering

Series	Typical Max. Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)			Switch Rating & Permissible Maximum Start Circuit Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Pkg. Style	Catalog Page
		115 Volts	115/230 Volts	230 Volts								
PV Series – for Split Phase Motors Only	1/3	8	8/4		16	115	PV-16-10	4-7-11016-11-UF1	–	10	11	8-9
	1/3	8	8/4		16	115		4-7-11016-20-UF1	–	10	20	8-9
	1/3	8	8/4		16	115	PV-16-10	4-7-11016-11-UO1	–	30	11	8-9
	1/3	8	8/4		16	115		4-7-11016-20-UO1	–	30	20	8-9
	1/2			8	16	230	2PV-16-60	4-7-12016-11-NH1	–	60	11	8-9
	1/2	12	12/6		25	115	PV-25-10	4-7-11016-11-UF1	–	10	11	8-9
	1/2	12	12/6		25	115		4-7-11016-20-UF1	–	10	20	8-9
	1/2	12	12/6		25	115	PV-25-30	4-7-11016-11-UO1	–	30	11	8-9
	1/2	12	12/6		25	115		4-7-11016-20-UO1	–	30	20	8-9
CV Series – for Capacitor Start Motors Only	1/2	8	8/4		16	115	CV-16-130	4-7-21016-11-UA1	130	30	11	10-11
	1/2	8	8/4		16	115		4-7-21016-20-UA1	130	30	20	10-11
	1/2	8	8/4		16	115		4-7-21016-11-UB1	147	37	11	10-11
	1/2	8	8/4		16	115		4-7-21016-20-UB1	147	37	20	10-11
	1/2	8	8/4		16	115	CV-16-165	4-7-21016-11-UO2	165	37	11	10-11
	1/2	8	8/4		16	115		4-7-21016-20-UO1	165	37	20	10-11
	1	6	12/6		25	115	CV-25-130	4-7-21025-11-UA1	130	30	11	10-11
	1	6	12/6		25	115		4-7-21025-20-UA1	130	30	20	10-11
	1	6	12/6		25	115		4-7-21025-11-UB1	147	37	11	10-11
	1	6	12/6		25	115		4-7-21025-20-UB1	147	37	20	10-11
	1	6	12/6		25	115	CV-25-165	4-7-21025-11-UO2	165	37	11	10-11
	1	6	12/6		25	115		4-7-21025-20-UO1	165	37	20	10-11
	2	20	20/10		40	115	CV-40-130	4-7-21040-11-UA1	130	30	11	10-11
	2	20	20/10		40	115		4-7-21040-20-UA1	130	30	20	10-11
	2	20	20/10		40	115		4-7-21040-11-UB1	147	37	11	10-11
	2	20	20/10		40	115		4-7-21040-20-UB1	147	37	20	10-11
	2	20	20/10		40	115	CV-40-165	4-7-21040-11-UO2	165	37	11	10-11
	2	20	20/10		40	115		4-7-21040-20-UO1	165	37	20	10-11
	3	25	25/12.5		50	115	CV-40-130	4-7-21050-11-UA1	130	30	11	10-11
	3	25	25/12.5		50	115		4-7-21050-20-UA1	130	30	20	10-11
	3	25	25/12.5		50	115		4-7-21050-11-UB1	147	37	11	10-11
	3	25	25/12.5		50	115		4-7-21050-20-UB1	147	37	20	10-11
	3	25	25/12.5		50	115	CV-40-165	4-7-21050-11-UO2	165	37	11	10-11
	3	25	25/12.5		50	115		4-7-21050-20-UO1	165	37	20	10-11
VR Series – for Capacitor Start/Capacitor Run Motors Only	1/2	8	8/4		16	115	VR-16-130	4-7-71016-12-UA1	130	30	12	12-13
	1/2	8	8/4		16	115		4-7-71016-19-NA1	130	30	19	12-13
	1/2	8	8/4		16	115		4-7-71016-12-UB1	147	37	12	12-13
	1/2	8	8/4		16	115		4-7-71016-19-NB1	147	37	19	12-13
	1/2	8	8/4		16	115	VR-16-165	4-7-71016-12-UO1	165	37	12	12-13
	1/2	8	8/4		16	115		4-7-71016-19-NO1	165	37	19	12-13
	2	20	20/10		40	115	VR-40-130	4-7-71040-12-UA1	130	30	12	12-13
	2	20	20/10		40	115		4-7-71040-19-NA1	130	30	19	12-13
	2	20	20/10		40	115		4-7-71040-12-UB1	147	37	12	12-13
	2	20	20/10		40	115		4-7-71040-19-NB1	147	37	19	12-13
	2	20	20/10		40	115	VR-40-165	4-7-71040-12-UO1	165	37	12	12-13
	2	20	20/10		40	115		4-7-71040-19-NO1	165	37	19	12-13
	3	25	25/12.5		50	115	VR-50-130	4-7-71050-12-UA1	130	30	12	12-13
	3	25	25/12.5		50	115		4-7-71050-19-NA1	130	30	19	12-13
	3	25	25/12.5		50	115		4-7-71050-12-UB1	147	37	12	12-13
	3	25	25/12.5		50	115		4-7-71050-19-NB1	147	37	19	12-13
	3	25	25/12.5		50	115	VR-50-165	4-7-71050-12-UO1	165	37	12	12-13
	3	25	25/12.5		50	115		4-7-71050-19-NO1	165	37	19	12-13

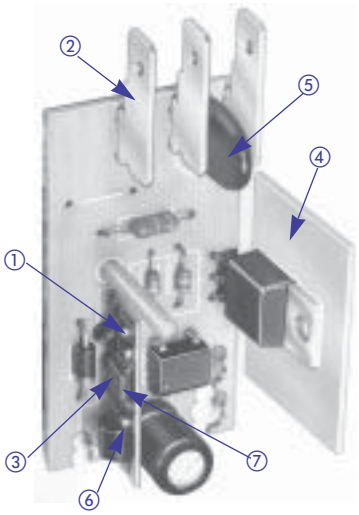
Series	Typical Max. Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)			Switch Rating & Permissible Maximum Start Circuit Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Pkg. Style	Catalog Page
		115 Volts	115/230 Volts	230 Volts								
CVR Series – for Capacitor Start/Capacitor Run Motors Only	3-5	50	50/25		80	115	CVR-80-130	4-7-41080-15-NA1	130	30	15	14-15
	3-5	50	50/25		80	115	CVR-80-147	4-7-41080-15-NB1	147	37	15	14-15
	3-5	50	50/25		80	115	CVR-80-165	4-7-41080-15-NO1	165	37	15	14-15
2CV Series – for Capacitor Start Motors Only	3			17.5	35	230	2CV-35-260	4-7-22035-15-UC1	260	70	15	16-17
	3			17.5	35	230	2CV-35-310	4-7-22035-15-UO1	310	70	15	16-17
	5			25	50	230	2CV-50-260	4-7-22050-15-UC1	260	70	15	16-17
	5			25	50	230	2CV-50-310	4-7-22050-15-UO1	310	70	15	16-17
2VR Series – Capacitor Start and Capacitor Start/Capacitor Run Motors Only	3			17.5	35	230	2VR-35-260	4-7-72035-15-UC1	260	70	15	16-17
	3			17.5	35	230	2VR-35-310	4-7-72035-15-UO1	310	70	15	16-17
	5			25	50	230	2VR-50-260	4-7-72050-15-UC1	260	70	15	16-17
	5			25	50	230	2VR-50-310	4-7-72050-15-UO1	310	70	15	16-17
2CVR Series – for Capacitor Start and Capacitor Start/Capacitor Run Motors Only	7.5			35	70	230	2CVR-70-260	4-7-42070-17-UC1	260	70	17	18-19
	7.5			35	70	230	2CVR-70-310	4-7-42070-17-UO1	310	70	17	18-19
	10			45	90	230	2CVR-70-260	4-7-42090-17-UC1	260	70	17	18-19
	10			45	90	230	2CVR-70-310	4-7-42090-17-UO1	310	70	17	18-19
IR Series – for Instant Reverse Capacitor Start Motors Only	1/2	12	12/6		25	115	IR-25-130	4-7-51025-15-UA1	130	30	15	20-21
	1/2	12	12/6		25	115	IR-25-147	4-7-51025-15-UB1	147	33	15	20-21
	1/2	12	12/6		25	115	IR-25-165	4-7-51025-15-UO1	165	37	15	20-21
	2	20	20/10		40	115	IR-25-130	4-7-51040-15-UA1	130	30	15	20-21
	2	20	20/10		40	115	IR-25-147	4-7-51040-15-UB1	147	33	15	20-21
	2	20	20/10		40	115	IR-25-165	4-7-51040-15-UO1	165	37	15	20-21

PV and 2PV Series for 115 Vac, 230 Vac or 115/230 Vac Dual Voltage Split Phase Motors

Basic Operation

The PV Series SINPAC uses a pulse sampling technique to monitor RPM-sensitive information (induced voltage) across the motor start winding. After the initial timing period, solid-state logic will sample the induced voltage across the start winding and will repeat this sequence until the voltage across the start winding is above the cut-in reference value. The SINPAC logic circuit continues to monitor the RPM-sensitive information (induced voltage) on the start winding. If the SINPAC logic detects that the motor RPM drops below a certain point, it automatically recloses the solid-state switch reconnecting the start winding. Both the initial timing period and cut-in reference value can be modified to meet specific applications.

The PV Series SINPAC is available in three current ratings: 16, 25 and 40 amps.



① ***Electrically Protected.*** Designed to filter out electrical noise, so there is no concern of random switch malfunction.

② ***Reduced Installation Time.*** Easy accessible 1/4 inch terminals and mounting, reduce the amount of time required to install SINPAC Switches or to change out mechanical switches.

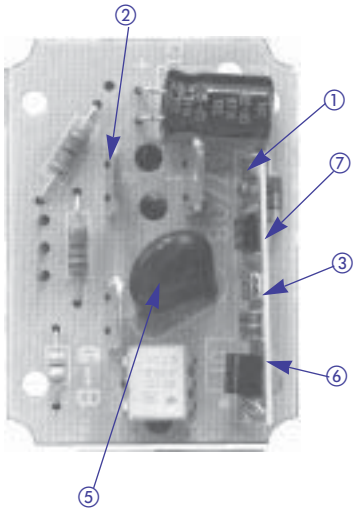
③ ***Restart Capability.*** When motor speed drops below 50% of synchronous speed, the start winding is brought back into the circuit to reinitiate starting torque.

④ ***Soldered Heat Sink.*** High cycling.

⑤ ***Transient Protection.*** Transient protection tested per IEEE C62.41 - 1991 Category A3.

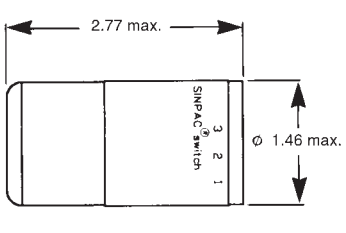
⑥ ***Universal Design.*** 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

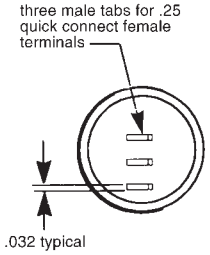
⑦ ***Line Voltage Compensation.*** No modifications or changes are required for line voltage variations. SINPAC Switches will operate in areas susceptible to *brown-outs* or low voltage due to long wiring runs.

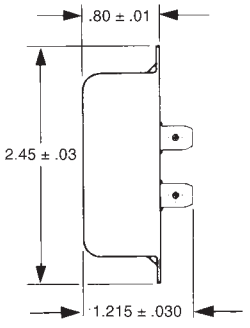


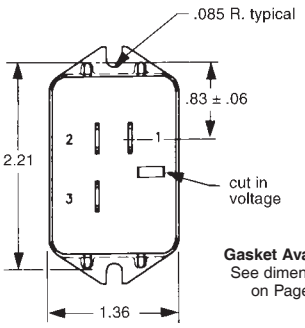
ADDITIONAL FEATURES

- **Capacitor Shape.** Makes for easy mounting under a motor doghouse (20 package style).
- **Environmentally Protected.** Immune to moisture, dust, dirt, shock and vibration.
- **UL and Canadian UL Recognition** (on 115 Vac models).
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact. Low warranty.
- **Silent Operation** - no switch noise
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 115 Vac SINPAC Switch: 90-130 Vac. For dual voltage motor equipped with center-tapped main winding: 90-130 Vac or 180-265 Vac.









Gasket Available
See dimensions on Page 9

Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Timing Interval* (sec.)	Cut In Voltage Typical	Package Style
	115 Volts	115/230 Volts							
1/3	8	8/4	16	115	PV-16-10	4-7-11016-11-UF1	.4	10	11
1/3	8	8/4	16	115	–	4-7-11016-20-UF1	.4	10	20
1/3	8	8/4	16	115	PV-16-30	4-7-11016-11-UO1	.4	30	11
1/3	8	8/4	16	115	–	4-7-11016-20-UO1	.4	30	20
1/2	–	8	16	230	2PV-16-60	4-7-12016-11-NH1	.4	60	11
1/2	12	12/6	25	115	PV-25-10	4-7-11025-11-UF1	.4	10	11
1/2	12	12/6	25	115	–	4-7-11025-20-UF1	.4	10	20
1/2	12	12/6	25	115	PV-25-30	4-7-11025-11-UO1	.4	30	11
1/2	12	12/6	25	115	–	4-7-11025-20-UO1	.4	30	20
3/4	20	20/10	40	115	PV-40-30	4-7-11040-11-UO1	.4	30	11
3/4	20	20/10	40	115	–	4-7-11040-20-UO1	.4	30	20

*NOTE FOR PV SWITCH APPLICATIONS: Please contact the factory for special sampling time intervals or cut in voltage. Standard sample time interval is .04 seconds.

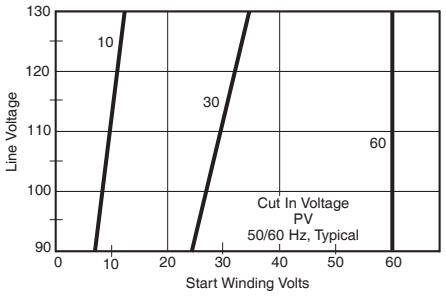
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start winding current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

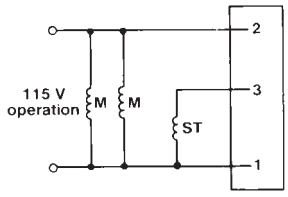
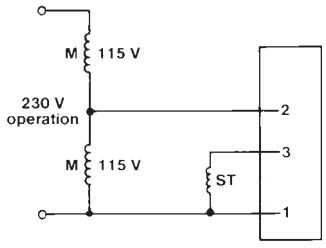
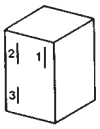
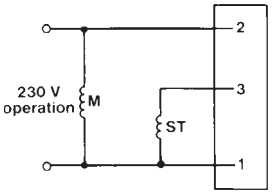
1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches (start) circuit voltage rating.
3. Selection can be based on actual measurement of start winding current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start winding current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut in reference voltage between 70% to 85% of motors synchronous speed.
   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage across the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

Line Voltage Compensation Chart

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start winding out of the circuit. Your motor with a SINPAC Switch must generate a voltage that is 20% greater than the switch cut in reference voltage to assure cut out of the start winding. Refer to charts below.

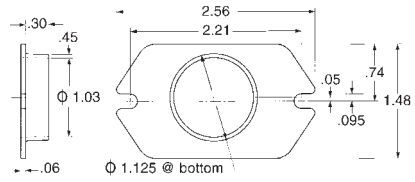


Wiring Diagram

Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
PV-16 PV-25 PV-40 *Connect to Split Phase Motors*			
2PV-16 *Connect to Split Phase Motors*		*Not Applicable*	

M – Motor main winding, **ST** – Motor start winding

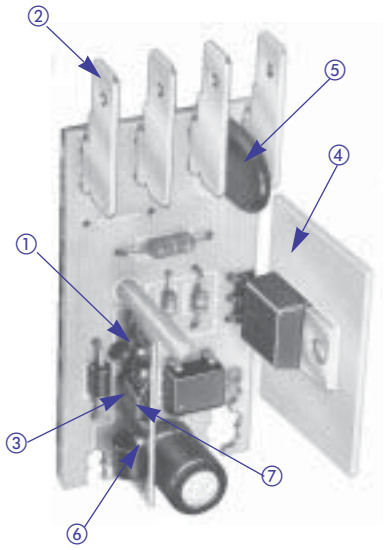
Gasket



CV Series for 115 Vac or 115/230 Vac Dual Voltage Capacitor Start Motors

Basic Operation

Capacitor start motor require a method to extract speed data from the voltage across the motor start winding. By comparing the start winding RPM-sensitive voltage with the main AC input voltage (which serves as a reference voltage), the switch determines when the start circuit should be energized. The electronic switch interrupts the start circuit current after the motor has accelerated to the cut out speed, and reconnects the start circuit whenever the motor speed has fallen to cut in speed (usually about 50% of synchronous motor speed).



① ***Electrically Protected.*** Designed to filter out electrical noise, so there is no concern of random switch malfunction.

② ***Reduced Installation Time.*** Easy accessible 1/4 inch terminals and mounting, reduce the amount of time required to install SINPAC Switches or to change out mechanical switches.

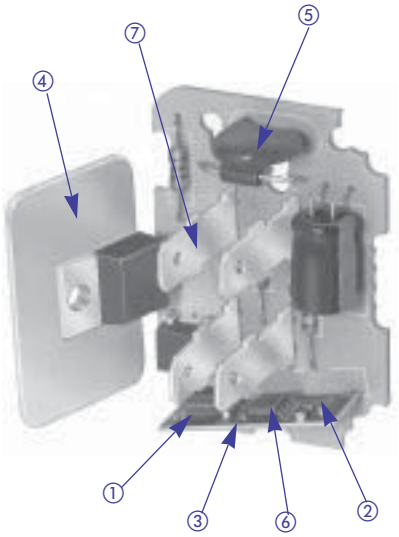
③ ***Restart Capability.*** When motor speed drops below 50% of synchronous speed, the start circuit is reconnected to reinitiate starting torque.

④ ***Soldered Heat Sink.*** High cycling.

⑤ ***Transient Protection.*** Transient protection tested per IEEE C62.41 - 1991 Category A3.

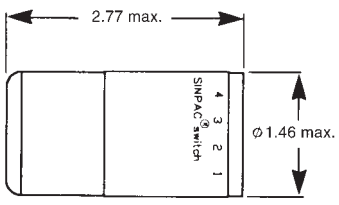
⑥ ***Universal Design.*** 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

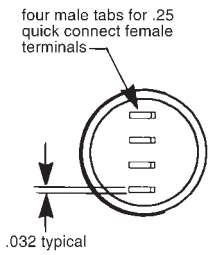
⑦ ***Line Voltage Compensation.*** No modifications or changes are required for line voltage variations. SINPAC Switches will operate in areas susceptible to *brown-outs* or low voltage due to long wiring runs. It also means there will be less stress on the starting capacitor due to over voltage.

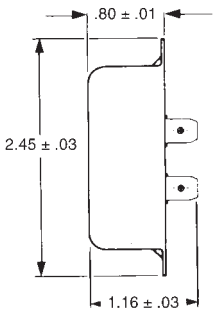


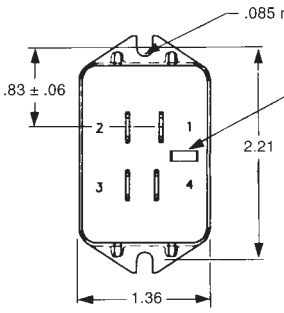
ADDITIONAL FEATURES

- **Capacitor Shape.** Makes for easy mounting under a motor doghouse (20 package style).
- **Environmentally Protected.** Immune to moisture, dust, dirt, shock and vibration.
- **UL and Canadian UL Recognition** (also CSA Certification on 11 package).
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact. Low warranty.
- **Silent Operation** - no switch noise
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 115 Vac SINPAC Switch: 90-130 Vac. For dual voltage motor equipped with center-tapped main winding: 90-130 Vac or 180-265 Vac.









Gasket Available
See dimensions on Page 11

Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	115/230 Volts							
1/2	8	8/4	16	115	CV-16-130	4-7-21016-11-UA1	130	30	11
1/2	8	8/4	16	115	–	4-7-21016-20-UA1	130	30	20
1/2	8	8/4	16	115	CV-16-147	4-7-21016-11-UB1	147	37	11
1/2	8	8/4	16	115	–	4-7-21016-20-UB1	147	37	20
1/2	8	8/4	16	115	CV-16-165	4-7-21016-11-UO2	165	37	11
1/2	8	8/4	16	115	–	4-7-21016-20-UO1	165	37	20
1	12	12/6	25	115	CV-25-130	4-7-21025-11-UA1	130	30	11
1	12	12/6	25	115	–	4-7-21025-20-UA1	130	30	20
1	12	12/6	25	115	CV-25-147	4-7-21025-11-UB1	147	37	11
1	12	12/6	25	115	–	4-7-21025-20-UB1	147	37	20
1	12	12/6	25	115	CV-25-165	4-7-21025-11-UO2	165	37	11
1	12	12/6	25	115	–	4-7-21025-20-UO1	165	37	20
2	20	20/10	40	115	CV-40-130	4-7-21040-11-UA1	130	30	11
2	20	20/10	40	115	–	4-7-21040-20-UA1	130	30	20
2	20	20/10	40	115	CV-40-147	4-7-21040-11-UB1	147	37	11
2	20	20/10	40	115	–	4-7-21040-20-UB1	147	37	20
2	20	20/10	40	115	CV-40-165	4-7-21040-11-UO2	165	37	11
2	20	20/10	40	115	–	4-7-21040-20-UO1	165	37	20
3	25	25/12.5	50	115	CV-50-130	4-7-21050-11-UA1	130	30	11
3	25	25/12.5	50	115	–	4-7-21050-20-UA1	130	30	20
3	25	25/12.5	50	115	CV-50-147	4-7-21050-11-UB1	147	37	11
3	25	25/12.5	50	115	–	4-7-21050-20-UB1	147	37	20
3	25	25/12.5	50	115	CV-50-165	4-7-21050-11-UO2	165	37	11
3	25	25/12.5	50	115	–	4-7-21050-20-UO1	165	37	20

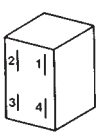
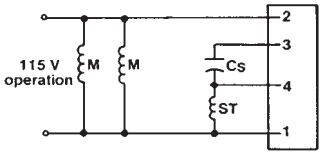
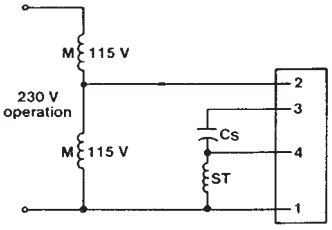
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start capacitor current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches (start) circuit voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut out reference voltage between 70% to 85% of motors synchronous speed.

   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage across the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

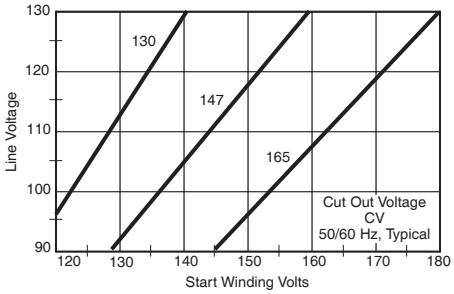
Wiring Diagram

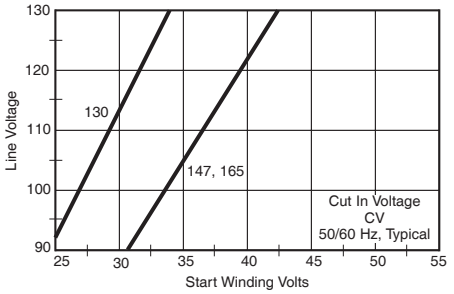
Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
CV-16 CV-25 CV-40 CV-50 *Connect to Capacitor Start Motors*	 		

Cs – Start Capacitor, **M** – Motor main winding, **ST** – Motor start winding

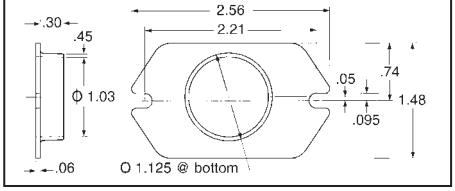
Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage that is 20% greater than the switch cut out voltage to assure cut out of the start capacitor. Refer to charts below.





Gasket

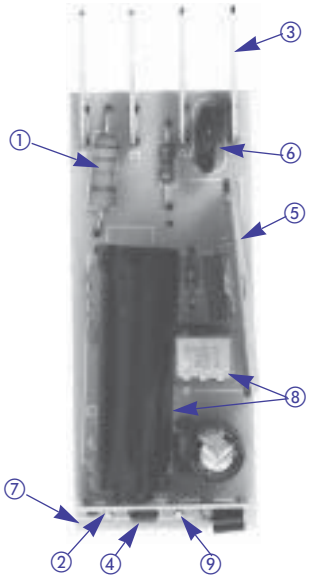


VR Series for 115 Vac or 115/230 Vac Dual Voltage Capacitor Start/Capacitor Run Motors

Basic Operation

Capacitor start/capacitor run motors provide continuous voltage sensing information which can be used to extract speed data from the voltage across the motor start winding. By comparing this start winding RPM-sensitive voltage to the main AC input voltage (which serves as a reference voltage), the switch determines when the start circuit should be de-energized. The electronic switch interrupts the start circuit current after the motor has accelerated to the cut out voltage (speed), and reconnects the start circuit whenever the speed sensitive circuit senses the motor voltage (speed) has decreased to a preselected cut in voltage (RPM) level.

Capacitor start/capacitor run motors exhibit current transients and higher voltages across the start switch. These electrical stresses occur due to the switching of the two capacitors (start and run) that are connected in parallel during motor start and may have different voltages at time of restart. These stresses occur at restart with both mechanical and electronic start switches. The VR switch features circuitry designed to eliminate the effects of these conditions.



① ***Bleeder Resistor.*** Increases start capacitor life.

② ***Electrically Protected.*** Designed to filter out electrical noise, so there is no concern of random switch malfunction.

③ ***Reduced Installation Time.*** Easy accessible 1/4 inch terminals and mounting, reduce the amount of time required to install SINPAC Switches or to change out mechanical switches.

④ ***Restart Capability.*** When motor speed drops below 50% of synchronous speed, the start circuit is reconnected to reinitiate starting torque.

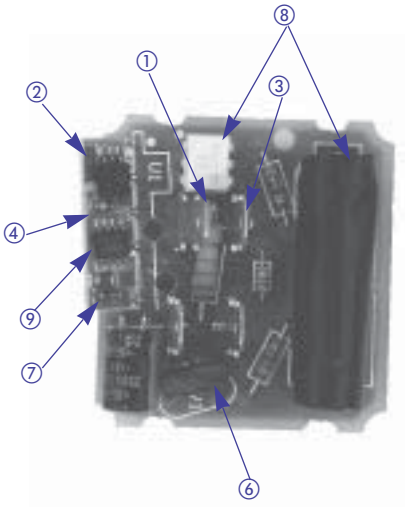
⑤ ***Soldered Heat Sink.*** High cycling.

⑥ ***Transient Protection.*** Transient protection tested per IEEE C62.41 - 1991 Category A3.

⑦ ***Universal Design.*** 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

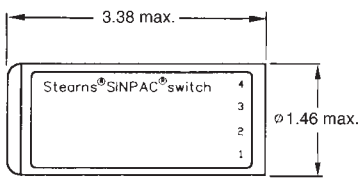
⑧ ***Zero Voltage Detection Logic/Inductor.*** Current spiking due to run capacitor no longer a problem.

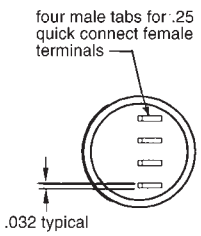
⑨ ***Line Voltage Compensation.*** No modifications or changes are required for line voltage variations. SINPAC Switches will operate in areas susceptible to *brown-outs* or low voltage due to long wiring runs. Line voltage compansation results in less stress on the starting capacitor due to overvoltage.

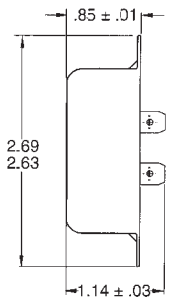


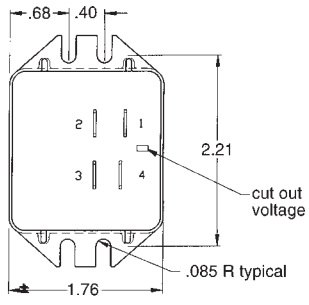
ADDITIONAL FEATURES

- **Capacitor Shape.** Makes for easy mounting under a motor doghouse (19 package style).
- **Environmentally Protected.** Immune to moisture, dust, dirt, shock and vibration.
- **UL and Canadian UL Recognition for VR-12** - pending for VR-19 package.
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact. Low warranty.
- **Silent Operation** - no switch noise
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 115 Vac SINPAC Switch: 90-130 Vac. For dual voltage motor equipped with center-tapped main winding: 90-130 Vac or 180-265 Vac.









Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	115/230 Volts							
1/2	8	8/4	16	115	VR-16-130	4-7-71016-12-UA1	130	30	12
1/2	8	8/4	16	115	–	4-7-71016-19-NA1	130	30	19
1/2	8	8/4	16	115	–	4-7-71016-12-UB1	147	37	12
1/2	8	8/4	16	115	–	4-7-71016-19-NB1	147	37	19
1/2	8	8/4	16	115	VR-16-165	4-7-71016-12-UO1	165	37	12
1/2	8	8/4	16	115	–	4-7-71016-19-NO1	165	37	19
2	20	20/10	40	115	VR-40-130	4-7-71040-12-UA1	130	30	12
2	20	20/10	40	115	–	4-7-71040-19-NA1	130	30	19
2	20	20/10	40	115	–	4-7-71040-12-UB1	147	37	12
2	20	20/10	40	115	–	4-7-71040-19-NB1	147	37	19
2	20	20/10	40	115	VR-40-165	4-7-71040-12-UO1	165	37	12
2	20	20/10	40	115	–	4-7-71040-19-NO1	165	37	19
3	25	50/25	50	115	VR-50-130	4-7-71050-12-UA1	130	30	12
3	25	50/25	50	115	–	4-7-71050-19-NA1	130	30	19
3	25	50/25	50	115	–	4-7-71050-12-UB1	147	37	12
3	25	50/25	50	115	–	4-7-71050-19-NB1	147	37	19
3	25	50/25	50	115	VR-50-165	4-7-71050-12-UO1	165	37	12
3	25	50/25	50	115	–	4-7-71050-19-NO1	165	37	19

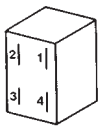
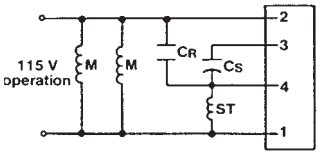
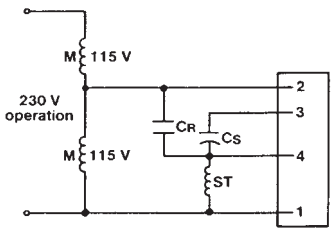
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start capacitor current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches auxiliary (start) circuit voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut out reference voltage between 70% to 85% of motors synchronous speed.

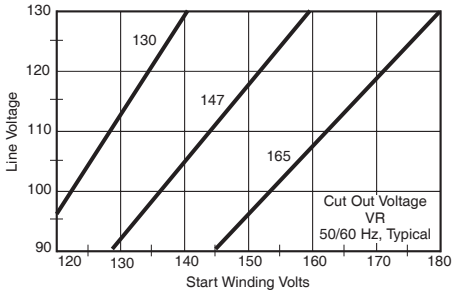
   SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage across the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

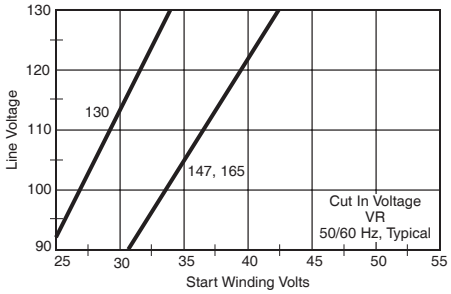
Wiring Diagram

Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
VR-16 VR-40 VR-50 *Connect to Capacitor Start/ Capacitor Run Motors*	 		

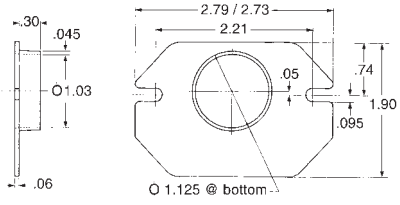
Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage greater than the switch reference voltage to assure cut-out of the start capacitor. Refer to charts below.





Gasket



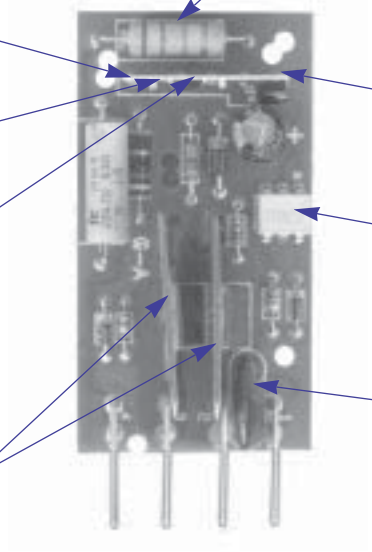
CVR Series for 115 Vac or 115/230 Vac Dual Voltage Capacitor Start and Capacitor Start/Capacitor Run Motors

Basic Operation

Capacitor start/capacitor run motors and capacitor start motors provide continuous voltage sensing information which can be used to extract speed data from the voltage across the motor start winding. By comparing this start winding RPM-sensitive voltage to the main AC input voltage (which serves as a reference voltage), the switch determines when the start circuit should be de-energized. The electronic switch interrupts the start circuit current after the motor has accelerated to the cut out voltage (speed), and reconnects the start circuit whenever the speed sensitive circuit senses the motor voltage (speed) has decreased to a preselected cut in voltage (RPM) level.

Capacitor start/capacitor run motors exhibit current transients and higher voltages across the start switch. These electrical stresses occur due to the switching of the two capacitors (start and run) that are connected in parallel during motor start and may have different voltages at time of restart. These stresses occur at restart with both mechanical and electronic start switches. The CVR switch has additional circuitry to eliminate the effects of these conditions.

Environmentally Protected. Immune to moisture, dust, dirt, shock and vibration.



Universal Design. 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

Start Capacitor Discharge Resistor. Increase start capacitor life.

Speed Sensitive (cut in)

Line Voltage Compensation. Operating voltage 190 to 260 Vac.

Zero Crossing Logic. Current spiking due to run capacitor no longer a problem.

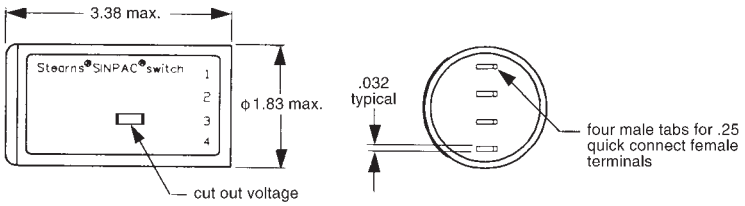
Electrically Protected. Designed to filter out electrical noise, so there is no concern of random switch malfunction.

Transient Protection. Transient protection tested per IEEE C62.41 - 1991 Category A3.

Soldered Heat Sink. High cycling.

ADDITIONAL FEATURES

- **Capacitor Shape.** Makes for easy mounting under a motor doghouse.
- **Environmentally Protected.** Immune to moisture, dust, dirt, shock and vibration.
- **Silent Operation** - no switch noise
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact. Low warranty.
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 115 Vac SINPAC Switch: 90-130 Vac. For dual voltage motor equipped with center-tapped main winding: 90-130 Vac or 180-265 Vac.



Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	230 Volts							
3-5	50	–	80	115	CVR-80-130	4-7-41080-15-NA1	130	50	15
3-5	50	–	80	115	CVR-80-147	4-7-41080-15-NB1	147	45	15
3-5	50	–	80	115	CVR-80-165	4-7-41080-15-NO1	165	50	15

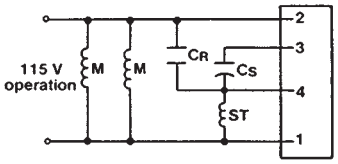
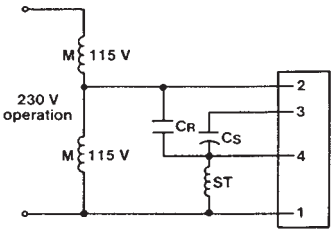
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start capacitor current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches auxiliary (start) winding voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut out reference voltage between 70% to 85% of motors synchronous speed.

   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage across the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

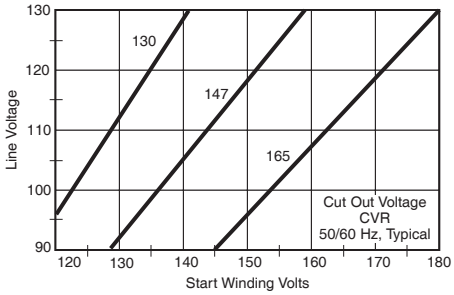
Wiring Diagram

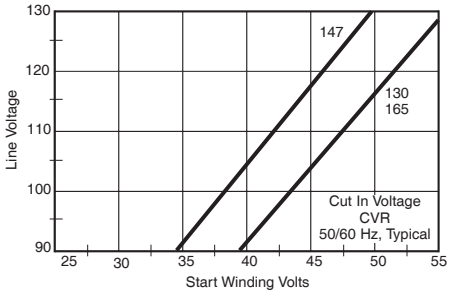
Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
CVR-80 *Connect to Capacitor Start/ Capacitor Run Motors*			

C_S– Start capacitor, **M** – Motor main winding, **C_R** – Run capacitor, **ST** – Motor start winding

Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage greater than the switch cut out voltage to assure cut out of the start capacitor. Refer to charts below.





2CV and 2VR Series for 230 Vac Capacitor Start and Capacitor Start/Capacitor Run Motors

Basic Operation

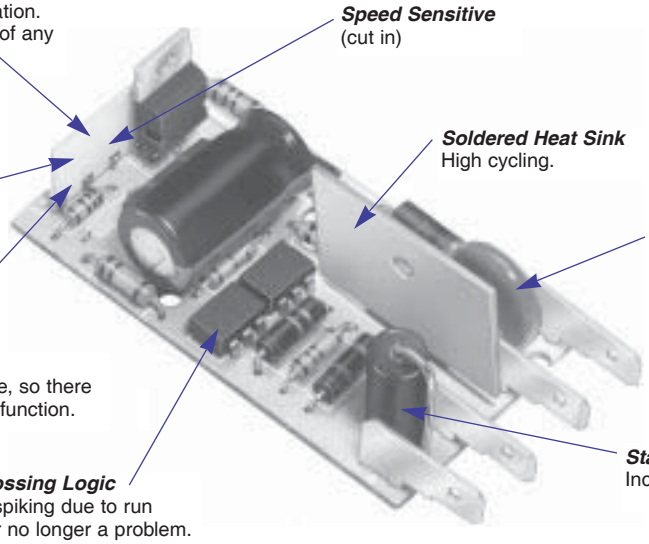
Capacitor start/capacitor run motors and capacitor start motors provide continuous voltage sensing information which can be used to extract speed data from the voltage across the motor start (auxiliary) winding. By comparing this start (auxiliary) winding RPM-sensitive voltage to the main AC input voltage (which serves as a reference voltage), the switch determines when the start circuit should be de-energized. The electronic switch interrupts the start circuit current after the motor has accelerated to the cut out speed, and reconnects the start circuit whenever the motor speed has decreased to a preselected cut in RPM level.

Capacitor start/capacitor run motors exhibit current transients and higher voltages across the start switch. This electrical stress is due to the voltage differential which may exist between the start and run capacitors at the instant of switch closure. This stress phenomenon occurs with both mechanical and electronic type start switches. SINPAC Switches have voltage detection circuitry to minimize the effects of these conditions.

Environmentally Protected
Immune to moisture, dust, dirt, shock and vibration.

Universal Design. 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

Speed Sensitive
(cut in)



Soldered Heat Sink
High cycling.

Line Voltage Compensation
Operating voltage 190 to 260 Vac.

Transient Protection
Transient protection tested per IEEE C62.41 - 1991 Category A3.

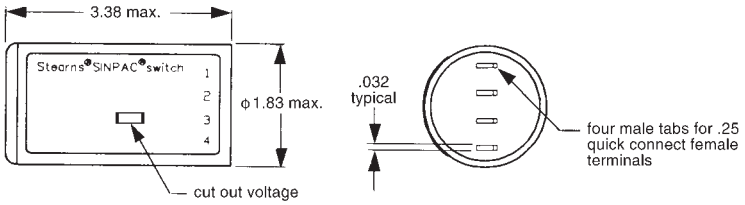
Electrically Protected
Designed to filter out electrical noise, so there is no concern of random switch malfunction.

Start Capacitor Discharge Resistor
Increase start capacitor life.

Zero Crossing Logic
Current spiking due to run capacitor no longer a problem.

ADDITIONAL FEATURES

- **Silent Operation** - no switch noise
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact.
- **Optional inductor for heavy duty operation.**
- **Ambient 40° to 65°C.**
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 230 Vac SINPAC Switch: 190-255 Vac.
- **UL Recognition and CSA Certification.**



Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	230 Volts							
3	–	17	35	230	2CV-35-260	4-7-22035-15-UC1	260	70	15
3	–	17	35	230	2CV-35-310	4-7-22035-15-UO1	310	70	15
5	–	25	50	230	2CV-50-260	4-7-22050-15-UC1	260	70	15
5	–	25	50	230	2CV-50-310	4-7-22050-15-UO1	310	70	15
3	–	17	35	230	2VR-35-260	4-7-72035-15-UC1	260	70	15
3	–	17	35	230	2VR-35-310	4-7-72035-15-UO1	310	70	15
5	–	25	50	230	2VR-50-260	4-7-72050-15-UC1	260	70	15
5	–	25	50	230	2VR-50-310	4-7-72050-15-UO1	310	70	15

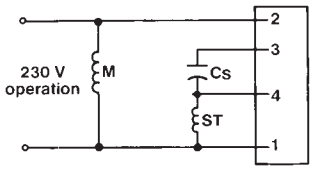
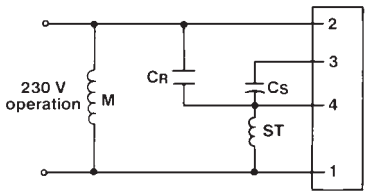
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start capacitor current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches auxiliary (start) circuit voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut out reference voltage between 70% to 85% of motors synchronous speed.

   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage on the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

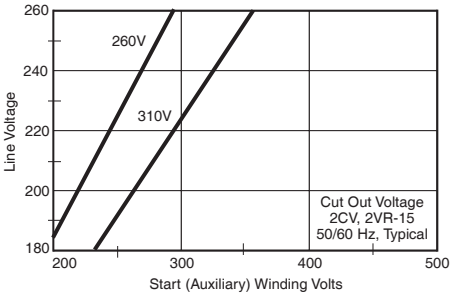
Wiring Diagram

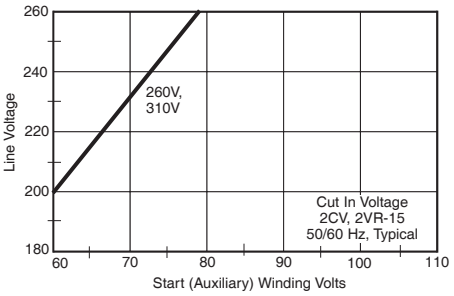
Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
2CV-35 2CV-50 *Connect to Capacitor Start Motors*	230 Volts 	*Not Applicable*	
2VR-35 2VR-50 *Connect to Capacitor Start/ Capacitor Run Motors*		*Not Applicable*	

C_S– Start capacitor, **M** – Motor main winding, **C_R** – Run capacitor, **ST** – Motor start winding

Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage greater than the switch cut out voltage to assure cut out of the start capacitor. Refer to charts below.





2CVR Series for 230 Vac Capacitor Start and Capacitor Start/Capacitor Run Motors

Basic Operation

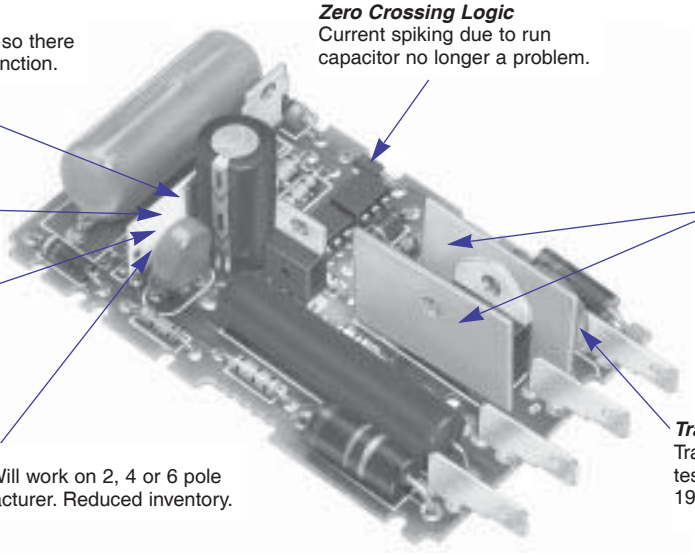
Capacitor start/capacitor run motors and capacitor start motors provide continuous voltage sensing information which can be used to extract speed data from the voltage across the motor start (auxiliary) winding. By comparing this start (auxiliary) winding RPM-sensitive voltage to the main AC input voltage (which serves as a reference voltage), the switch determines when the start circuit should be de-energized. The electronic switch interrupts the start circuit current after the motor has accelerated to the cut out voltage (speed), and reconnects the start circuit whenever the motor voltage (speed) has decreased to a preselected cut in RPM level.

Capacitor start/capacitor run motor exhibit current transients and higher voltages across the start switch. These electrical stresses occur due to the switching of the two capacitors (start and run) that are connected in parallel during motor start and may have different voltages at time of restart. These stresses occur at restart with both mechanical and electronic start switches. The CVR switch has additional circuitry to eliminate the effects of these conditions.

Environmentally Protected
Immune to moisture, dust, dirt, shock and vibration.

Electrically Protected
Designed to filter out electrical noise, so there is no concern of random switch malfunction.

Zero Crossing Logic
Current spiking due to run capacitor no longer a problem.



Line Voltage Compensation
Operating voltage 190 to 260 Vac.

Soldered Heat Sink
High cycling.

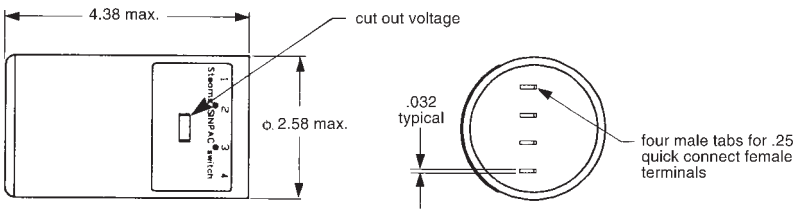
Speed Sensitive
(cut in)

Universal Design
50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

Transient Protection
Transient protection tested per IEEE C62.41 - 1991 Category A3.

ADDITIONAL FEATURES

- **Silent Operation** - no switch noise
- **Completely Solid-State with No Moving Parts.** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact.
- **Optional inductor for heavy duty operation.**
- **Ambient 40° to 65°C.**
- **Operating Temperature:** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- **Operating Voltage:** 230 Vac SINPAC Switch: 190-255 Vac.



Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	230 Volts							
7½	–	35	70	230	2CVR-70-260	4-7-42070-17-NC1	260	70	17
7½	–	35	70	230	2CVR-70-310	4-7-42070-17-NO1	310	70	17
10	–	45	90	230	2CVR-90-260	4-7-42090-17-NC1	260	70	17
10	–	45	90	230	2CVR-90-310	4-7-42090-17-NO1	310	70	17

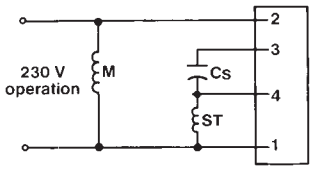
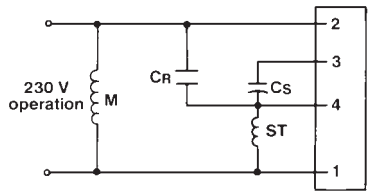
Selection

Motor hp ratings are typical. For an accurate selection procedure, measure start circuit current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches auxiliary (start) circuit voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55°C.
5. To assure proper motor operation, the voltage across the start (auxiliary) winding must reach the SINPAC Switch cut out voltage reference between 70% to 85% of motors synchronous speed.

   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage across the start (auxiliary) winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

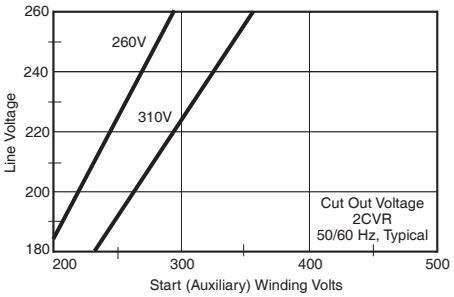
Wiring Diagram

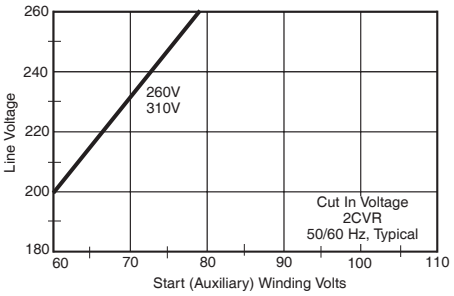
Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
2CVR-70 2CVR-90 *Connect to Capacitor Start Motors*	230 Volts 	*Not Applicable*	
2CVR-70 2CVR-90 *Connect to Capacitor Start/ Capacitor Run Motors*		*Not Applicable*	

C_S– Start capacitor, **M** – Motor main winding, **C_R** – Run capacitor, **ST** – Motor start winding

Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage that is 20% greater than the switch cut out voltage to assure cut out of the start capacitor. Refer to charts below.





IR Series for Instant Reversing 115 Vac or 115/230 Vac Dual Voltage Capacitor Start Motors

Basic Operation

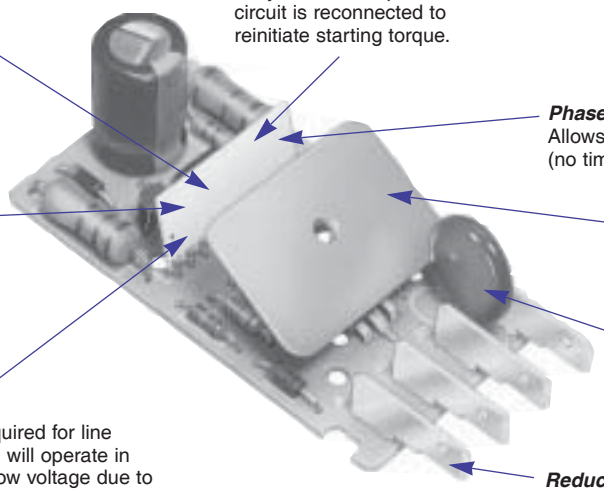
Bidirectional motors - those that can rotate in either direction – are of two classes: *1. Reversing motors*, which can change from full speed in one direction to full speed in the opposite direction. *2. Reversible motors*, which can be reversed only when the motor is not running, or is running below cut out speed. Some motor manufacturers distinguish between quick reversing and instant reversing. A quick reversing motor requires a time delay of approximately 1/25th of a second or more for the switching circuitry to react. An instant reversing motor requires absolutely no time delay. The standard SINPAC Switch can be used on reversible and reversing motors. The SINPAC IR Series Switch provides the function of a direction sensing centrifugal switch and makes a reversible capacitor start motor into an instant reversing motor.

In order to reverse a single-phase motor, it is necessary to reverse the polarity of either the start or main winding, but not both at the same time. The reversal of the winding is accomplished with an external reversing switch or contactor that is not part of the SINPAC Switch. SINPAC Instant Reverse Switch is not dependent upon how quickly the user operates the reversing switch, but only that the reversing switch did change states, i.e., forward to reverse, or vice versa. The SINPAC Switch detects the change in the phase shift between the main and start windings, and the logic circuit instantly actuates the starting switch, causing the start circuit to be reconnected to line voltage. This connection causes the motor to decelerate and then reaccelerate in the opposite direction. The SINPAC IR Series Switch interrupts the start circuit current after the motor has accelerated to the cut out speed, and reconnects the start circuit whenever the circuit senses the motor speed has fallen to cut in speed (usually about 50% of synchronous motor speed).

Electrically Protected. Designed to filter out electrical noise, so there is no concern of random switch malfunction.

Restart Capability. When motor speed drops below 50% of synchronous speed, the start circuit is reconnected to reinitiate starting torque.

Environmentally Protected. Immune to moisture, dust, dirt, shock and vibration.



Phase Comparator Logic: Allows Instant Reverse operation (no time delay).

Universal Design 50/60 Hz operation. Will work on 2, 4 or 6 pole motors of any manufacturer. Reduced inventory.

Soldered Heat Sink High cycling.

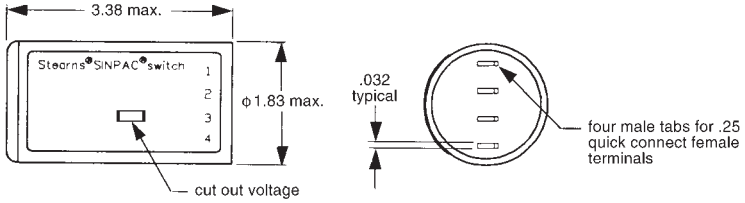
Transient Protection Transient protection tested per IEEE C62.41 - 1991 Category A3.

Line Voltage Compensation No modifications or changes are required for line voltage variations. SINPAC Switches will operate in areas susceptible to *brown-outs* or low voltage due to long wiring runs. It also means there will be less stress on the starting capacitor due to over voltage.

Reduced Installation Time. Easy accessible 1/4 inch terminals and mounting, reduce the amount of time required to install SINPAC Switches or to change out mechanical switches.

ADDITIONAL FEATURES

- ***UL recognition and CSA certification.***
- ***Completely solid-state with no moving parts.*** SINPAC Switches have no physical constraints to affect their operation. No wearing parts mean high cycling, no arcing contact. Low warranty
- ***Silent operation*** - no switch noise
- ***Operating Temperature:*** -40°C to 65 °C (-40 °F to 149°F) [for operation between 65°C and 85°C (149°F and 185°F), consult factory.]
- ***Operating Voltage:*** 115 Vac SINPAC Switch: 90-130 Vac. For dual voltage motor equipped with center-tapped main winding: 90-130 Vac or 180-265 Vac.



Dimensions are for estimating only. Drawings for customer reference are available upon request.

Typical Maximum Motor hp	Typical Full Load Motor Nameplate Current Rating (amps)		Switch Rating and Permissible Maximum Start Capacitor Current (amps)	Start Circuit Voltage	Catalog Number	Part Number	Cut Out Voltage Typical	Cut In Voltage Typical	Package Style
	115 Volts	115/230 Volts							
1/2	12	12/6	25	115	IR-25-130	4-7-51025-15-UA1	130	30	15
1/2	12	12/6	25	115	IR-25-147	4-7-51025-15-UB1	147	33	15
1/2	12	12/6	25	115	IR-25-165	4-7-51025-15-UO1	165	37	15
2	20	20/10	40	115	IR-40-130	4-7-51040-15-UA1	130	30	15
2	20	20/10	40	115	IR-40-147	4-7-51040-15-UB1	147	33	15
2	20	20/10	40	115	IR-40-165	4-7-51040-15-UO1	165	37	15

Selection

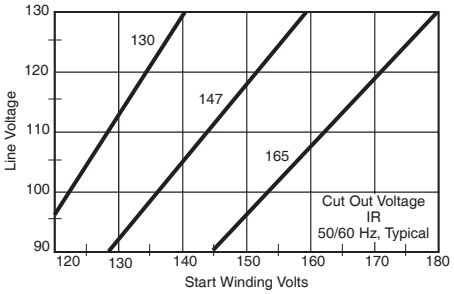
Motor hp ratings are typical. For an accurate selection procedure, measure start circuit current during a normal start or at locked rotor and select a SINPAC Switch with higher maximum current rating than that measured.

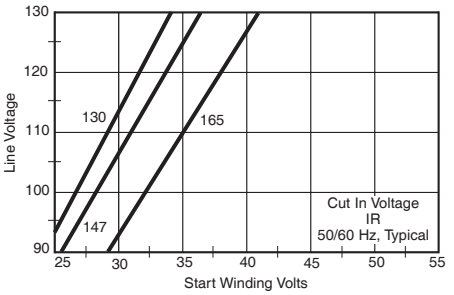
1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches (start) circuit voltage rating.
3. Selection can be based on actual measurement of start capacitor current or two times the motor nameplate FLA rating.
4. Switch current rating must match or exceed the motor start capacitor current requirements. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications.
   b) Long acceleration time.
   c) High ambients: Greater than 55° C.
5. To assure proper motor operation, the voltage across the start winding must reach the SINPAC Switch cut out voltage reference between 70% to 85% of motors synchronous speed.

   Caution: SINPAC Switches are line voltage compensated. Changes in the line voltage will not effect system operation unless an overload condition causes reduced running speed, along with reduced voltage on the start winding.
6. Higher current switches can be used in place of lower rated switches of the same series.

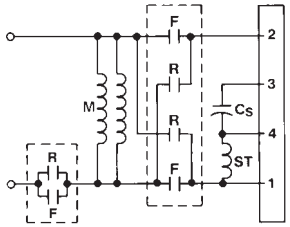
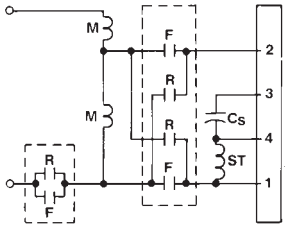
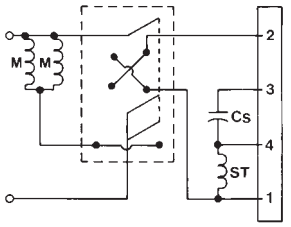
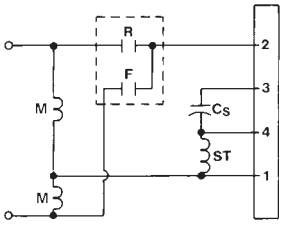
Line Voltage Compensation Charts

Induced voltage across the start winding is directly proportional to motor speed and line voltage. All SINPAC Switches use this voltage to switch the start capacitor out of the circuit. Your motor with a SINPAC Switch must generate a voltage that is 20% greater than the switch cut out voltage to assure cut out of the start capacitor. Refer to charts below.





Wiring Diagram

Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
IR-25 IR-40 *Connect to Instant Reverse Start Motors*	115 Volts 1 2 3 4	**115 Volt Operation Dual Voltage Motor Using Two Full Voltage 2 or 3 Pole Single-Phase Reversing Contactors with Mechanical Interlock** *(Electrical Interlock Optional)*  Reversing contacts are not part of SINPAC Switch.	**230 Volt Operation Dual Voltage Motor Using Two Full Voltage 2 or 3 Pole Single-Phase Reversing Contactors with Mechanical Interlock** *(Electrical Interlock Optional)*  Reversing contacts are not part of SINPAC Switch.
		 Drum switch is not part of SINPAC Switch.	 Reversing contacts are not part of SINPAC Switch.

C_S– Start capacitor, **M** – Motor main winding, **ST** – Motor start winding, **F** – Forward, **R** – Reverse

Installation Instructions for SINPAC Switches

UL Recognition

Most SINPAC Switches are recognized under the component program of Underwriters Laboratories E-71115. In addition, all switches have an internal surge protection which meets UL-244A Specification and CSR Certification LR-6254, and are tested to the requirement of IEEE C62.41-1991, Category A3.

Construction

SINPAC Switches are potted and completely sealed making them impervious to dust, dirt and moisture. It can be **immersed in electric grade oil** as used in submersible pumps. The unique speed sensing circuit provides a universal design which allows a few switches to work in most standard single-phase motor applications regardless of nature.

Operation

The Stearns SINPAC Switch samples the voltage across the motor start winding (terminals 1 and 4) then it is fed into a comparator. The SINPAC Switch interrupts the start capacitor current (between terminals 2 and 3) after the motor has accelerated to a speed in which the cut out voltage has been reached, generally 75% to 80% of synchronous motor speed. A triac or inverse parallel SCRs provides the function referred to as cut out. Once the start circuit is cut out the main winding accelerates the motor rotor up to its running speed. When an overload drops the motor speed to approximately 50% of synchronous speed the switch automatically reconnects the motor start circuit. The SINPAC Switch constantly monitors the start or auxiliary winding for cut in voltage and will reconnect the start circuit once cut in voltage is reached.

Selection Procedure

CAUTION: SINPAC Switches are line voltage compensated. Changes in the line voltage within ±10% of nominal 115 or 230 Vac will not affect system operation. Operation of the motor at line voltages less than -10% of nominal can result in reduced motor running speeds and failure of the SINPAC Switch to disconnect the start circuit.

1. Be sure switch series matches motor type.
2. Be sure switch voltage rating matches the motor start circuit voltage.
3. Selection should be based on actual measurement of start circuit current.
4. SINPAC Switch current rating must **meet or exceed** the motor start circuit current requirement. Always select a SINPAC Switch with the next higher current rating for:
   a) High cycling applications: Stop and start rates greater than 4 times/minute.
   b) Long acceleration times: Greater than 5 seconds.
   c) High ambients: Ambients greater than 55°C.

   Note: Higher rated current switches can be used in place of lower rated switches within the same series.
5. The motor must generate a voltage across the start or auxiliary winding that is 20% greater than the SINPAC Switch cut out/cut in voltage rating.

Capacitor Start and Capacitor Start/Capacitor Run Motors

To determine the most appropriate SINPAC Switch cut out voltage rating for the particular motor application, the voltage across the motor start or auxiliary winding must be measured. This may be accomplished in the following manner:

1. Prepare the motor wiring for connection of the SINPAC Switch as shown in the *Wiring Diagrams for SINPAC Switches* section of this publication. Secure the motor to a firm mounting surface.
2. Connect the lead wire that is to be connected to SINPAC Switch terminal #2 securely to the lead wire that is to be connected to SINPAC Switch terminal #3.
3. Connect an AC voltmeter across the lead wires that are to be connected to SINPAC Switch terminals #1 & #4.
4. Apply power to the motor. Observe and record the voltage across the motor start or auxiliary winding, as indicated by the AC voltmeter, with the motor operating near synchronous speed.

CAUTION: Measurement of the start or auxiliary winding voltage must be done quickly to prevent damage to the start capacitor, motor winding or SINPAC Switch!

5. Multiply the measured voltage by 0.8 (80%). Select a SINPAC Switch having a cut out voltage rating equal to or less than this number.

Capacitor Start and Capacitor Start/Capacitor Run Motors

Measured Voltage	Voltage Across SINPAC Switch Terminals 1 & 2	Cut Out Voltage Rating
>200V	115V	165V
176-200V	115V	147V
150-175V	115V	130V
<150V	115V	*
>492V	230V	410V
370-492V	230V	310V
300-369V	230V	260V
<300V	230V	*

*Consult factory

Split Phase Motors

To determine the most appropriate SINPAC Switch cut in voltage rating for the particular motor application, the voltage across the motor start winding must be measured. This may be accomplished in the following manner:

1. Prepare the motor wiring for connection of the SINPAC Switch as shown in the *Wiring Diagrams for SINPAC Switches* section of this publication. Secure the motor to a firm mounting surface.
2. Insulate the lead wire that is to be connected to SINPAC Switch terminal #2.
3. Connect an AC voltmeter across the lead wires that are to be connected to SINPAC Switch terminals #1 & #3.
4. Apply power to the motor. Carefully rotate the motor shaft to initiate rotation. Observe and record the voltage across the motor start winding, as indicated by the AC voltmeter, with the motor operating near synchronous speed.
5. Multiply the measured voltage by 0.8 (80%). Select a SINPAC Switch having cut in voltage rating closest to this number.

Split Phase Motors

Measured Voltage	Voltage Across SINPAC Switch Terminals 1 & 2	Cut In Voltage Rating
>40V	115V	30V
15-40V	115V	10V
<15V	115V	*
>70V	230V	60V
<70V	230V	*

*Consult factory

Caution: Application of 230 Vac to the line input terminals (1 and 2) of a 115 Vac rated SINPAC Switch will result in immediate switch failure. The switch may rupture and emit smoke.

Important

Please read these instructions carefully before installing, operating, or servicing your SINPAC Switch. Failure to comply with these instructions could cause injury to personnel and/or damage to property if the switch is installed or operated incorrectly. For definition of limited warranty/liability, contact Rexnord Corporation, Stearns Division, 120 North Broadway, Milwaukee, Wisconsin 53202, (414) 272-1100.

Initial Inspection and Handling

Upon receipt, check for package damage. Note any signs of damage on appropriate shipper forms. Upon opening package, if concealed damage is found, immediately file a claim with carrier.

Check the label to verify that data conforms to specifications of ordered switch and the connection diagram agrees with labeling.

Caution

1. Installation and servicing must be made in compliance with all local safety codes including Occupational safety and Health Act (OSHA). All wiring and electrical connections must comply with the National Electric Code (NEC) and local electric codes in effect.
2. To prevent an electrical hazard, disconnect power source before working on the motor. If power disconnect point is out of sight, lock disconnect in the *off* position and tag to prevent accidental application of power.
3. Make certain power source conforms to the requirements specified on the SINPAC Switch nameplate.
4. Installation and servicing should be performed only by qualified personnel familiar with the operation of the SINPAC Switch.
5. Determine what type of start switch the motor presently has:
   a) Externally mounted electronic switch – go to Step 6.
   b) Internally mounted electronic switch – go to Step 6.
   c) Externally or internally mounted mechanical switch – it is not necessary to remove the existing centrifugal switch actuating mechanism, but if feasible, it should be removed as it is no longer needed, and can cause future mechanical problems in the motor should the mechanism fail. Follow the manufacturers recommendation when removing the shaft end bearing, if necessary, to take off the centrifugal actuator.
6. Remove the existing electronic switch. Determine the existing wiring diagram. Mark the existing wires and determine which wires can be reused for installation of the SINPAC Switch. Select a location in the motor conduit box or endbell for mounting the SINPAC Switch.

   If a metal enclosure version of SINPAC Switch is being used, the switch with SINPAC Switch gasket may be mounted on an external mounting surface such as the exterior of the conduit box. Plastic enclosure versions of the SINPAC Switch should be mounted internally, within the conduit box, or externally, under a capacitor housing.

   IMPORTANT: SINPAC Switch in a metal enclosure must have the metal enclosure grounded.

   The temperature at the mounting location should not exceed 65°C (149°F). (2CVR temperature should not exceed 55°C.)

   TEFC/TENV motors require external mounting of SINPAC Switch.
7. Refer to motor manufacturer's wiring diagram to aid in identifying terminal locations for the start winding switch, start winding, start and run capacitors (if needed) and AC line.
8 Connect the SINPAC circuit per the connection diagram (on Pages 24-25 or 26-27) using insulated terminals. If the connections are made incorrectly, the result will be no starting torque and possible damage to the circuit and/or motor.

   CAUTION: Be sure that appropriate insulation is used between the terminals of the switch and the body of the motor or conduit box.

   If mounted external to motor, always use gasket supplied with kit.
9. DO NOT USE a Variac to gradually increase the voltage to the motor starting circuit when SINPAC Switch is installed.
10. Reassemble the motor with SINPAC Switch installed, so as to not damage lead wires.
11. If the motor fails to start or the start winding does not cut out properly, see *Troubleshooting Guide* (Page 29).
12. Hipot test procedures:

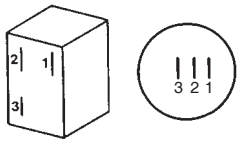
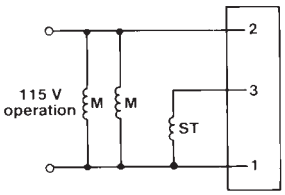
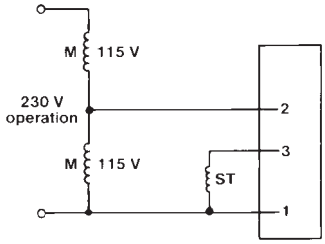
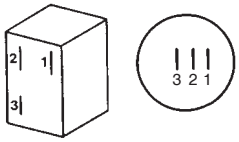
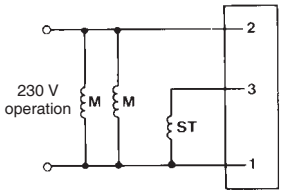
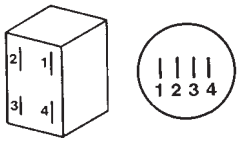
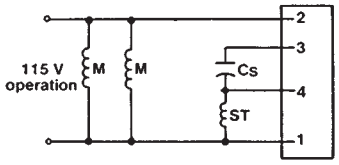
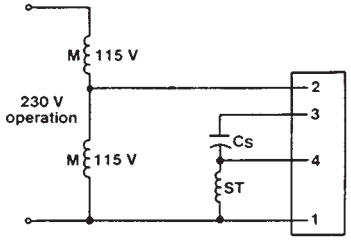
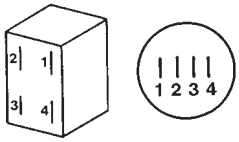
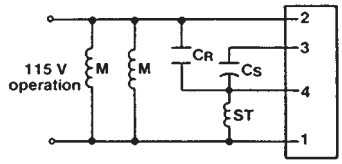
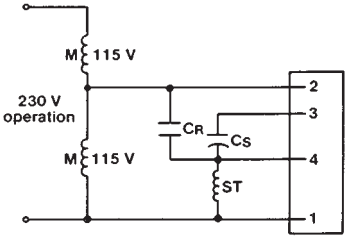
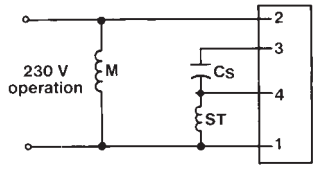
    Motors 250 Volts or Less and 1/2 Horsepower or Less

    The motor, equipped with SINPAC Switch, shall be tested for dielectric withstand (hipot), by the application of a 1200 volt sinusoidal potential, in the range of 40-70 Hz, for 1 second. During the test, each lead of the primary motor wiring, accessible at the connection board or conduit box, are to be connected together and to one terminal of the test equipment, and the second test equipment terminal is to be connected to the accessible dead metal.

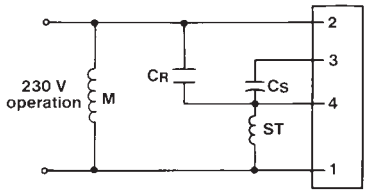
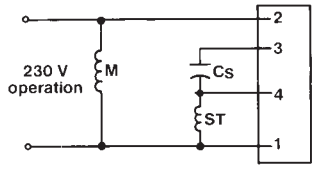
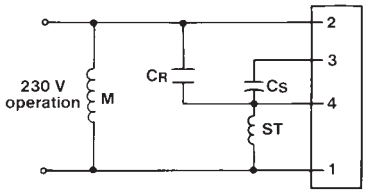
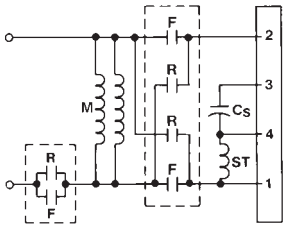
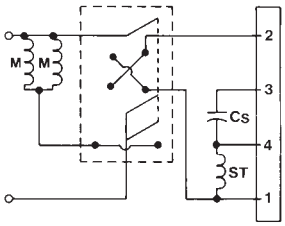
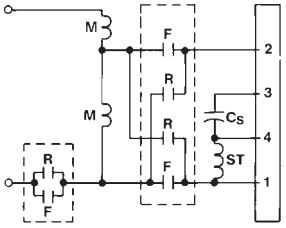
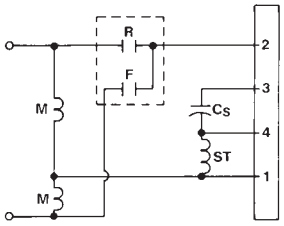
    Motors 250 Volts or Less and More Than 1/2 Horsepower

    The motor, equipped with SINPAC Switch, shall be tested for dielectric withstand (hipot), by the application of an 1800 volt sinusoidal potential, in the range of 40-70 Hz, for 1 second. During the test, each lead of the primary motor wiring, accessible at the connection board or conduit box, are to be connected together and to one terminal of the test equipment, and the second test equipment terminal is to be connected to the accessible dead metal.
13. **CAUTION**: The terminals of the SINPAC Switch should not be used as the junction for this field wiring.

Wiring Diagrams for SINPAC Switches

Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
PV-16 **PV-25** **PV-40** *Connect to Split Phase Motors Only*	115 Volts 		
2PV-16 *Connect to Split Phase Motors Only*	230 Volts 	*Not Application*	
CV-16 **CV-25** **CV-40** **CV-50** *Connect to Capacitor Start Motors Only*	115 Volts 		
VR-16 **VR-40** **VR-50** **CVR-80** *Connect to Capacitor Start/Capacitor Run Motors*	115 Volts 		
2CV-35 **2CV-50** *Connect to Capacitor Start Motors Only*	230 Volts 	*Not Application*	

C_S – Start Capacitor, **M** – Motor Main Winding, **C_R** – run Capacitor, **ST** – Motor Start Winding

Catalog Number	SINPAC Switch Rating	115 Volt 50/60 Hz Motor Operation	230 Volt 50/60 Hz Motor Operation
2VR-35 **2VR-50** *Connect to Capacitor Start/Capacitor Run Motors*	230 Volts 	*Not Application*	
2CVR-70 **2CVR-90** *Connect to Capacitor Start Motors*	230 Volts 	*Not Application*	
2CVR-70 **2CVR-90** *Connect to Capacitor Start/Capacitor Run Motors*	230 Volts 	*Not Application*	
IR-25 **IR-40** *Connect to Instant Reverse Capacitor Start Motors Only*	115 Volts 	**115 Volt Operation Dual Voltage Motor Using Two Full Voltage 2 or 3 Pole Single-Phase Reversing Contactors with Mechanical Interlock** *(Electrical Interlock Optional)*  Reversing contacts are not part of SINPAC Switch.  Drum switch is not part of SINPAC Switch.	**230 Volt Operation Dual Voltage Motor Using Two Full Voltage 2 or 3 Pole Single-Phase Reversing Contactors with Mechanical Interlock** *(Electrical Interlock Optional)*  Reversing contacts are not part of SINPAC Switch.  Reversing contacts are not part of SINPAC Switch.

C_S – Start Capacitor, **M** – Motor Main Winding, **C_R** – run Capacitor, **ST** – Motor Start Winding

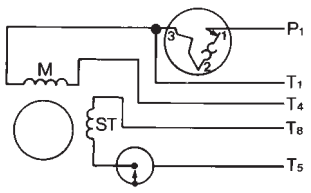
Wiring Diagrams

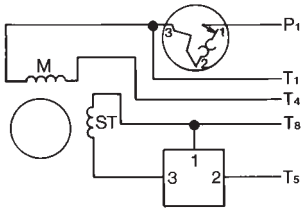
Split Phase Motors

1. Disconnect the mechanical switch lead which is connected to the start winding and reconnect this lead to SINPAC Switch terminal three (3).
2. Disconnect other mechanical switch lead marked T5 and reconnect this lead to SINPAC Switch terminal two (2).
3. Join SINPAC Switch terminal one (1) with motor lead T8.

Use on only the following model series:
PV-16, PV-25
PV-40 & 2PV-16

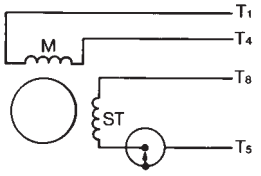
Single Voltage with Thermal Protection

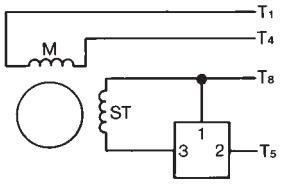




	L1	L2	Join
Counterclockwise rotation	P1	T4, T5	T1, T8
Clockwise rotation	P1	T4, T8	T1, T5

Single Voltage without Thermal Protection





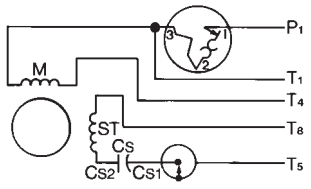
	L1	L2
Counterclockwise rotation	T1, T8	T4, T5
Clockwise rotation	T1, T5	T4, T8

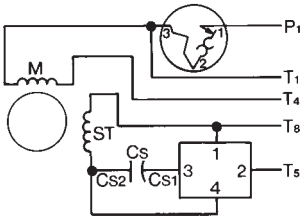
Capacitor Start Motors

1. Disconnect the mechanical switch lead (CS1) which is connected to the start capacitor and reconnect this lead to SINPAC Switch terminal three (3).
2. Disconnect other mechanical switch lead marked T5 and reconnect this lead to SINPAC Switch terminal two (2).
3. Join SINPAC Switch terminal one (1) with motor lead T8.
4. Join SINPAC Switch terminal four (4) with the lead off the start winding and start capacitor. (Labeled in the connection diagram as CS2.)

Use on only the following model series:
CV-16
CV-25
CV-40
CV-50
VR-16
VR-40
VR-50
CVR-80
IR-25
IR-40
2CV-35
2CV-50
2CVR-70
2CVR-90

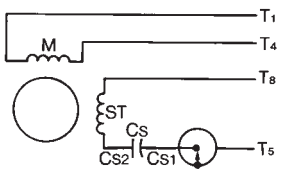
Single Voltage with Thermal Protection

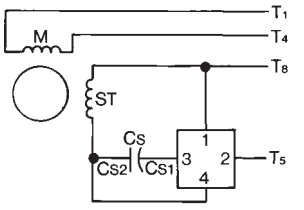




	L1	L2	Join
Counterclockwise rotation	P1	T4, T5	T1, T8
Clockwise rotation	P1	T4, T8	T1, T5

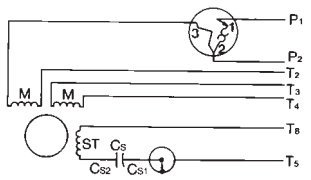
Single Voltage with Thermal Protection

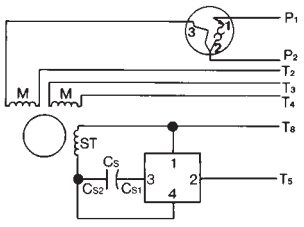




	L1	L2
Counterclockwise rotation	T1, T8	T4, T5
Clockwise rotation	T1, T5	T4, T8

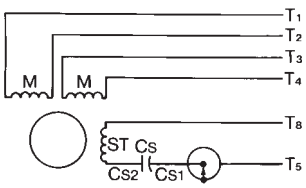
Dual Voltage with Thermal Protection

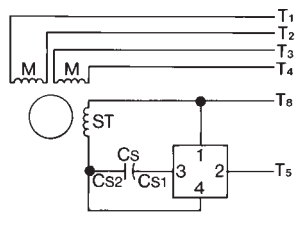




		L1	L2	Join	Join
Higher name-plate voltage	Counterclock-wise rotation	P1	T4	P2,T8	T2,T3 & T5
	Clockwise rotation	P1	T4	P2,T5	T2,T3 & T8
Lower name-plate voltage	Counterclock-wise rotation	P1	T2,T4 & T5	P2,T3 & T8	–
	Clockwise rotation	P1	T2,T4 & T8	P2,T3 & T5	–

Dual Voltage without Thermal Protection





		L1	L2	Join
Higher name-plate voltage	Counterclock-wise rotation	T1	T4,T5	T2,T3 & T8
	Clockwise rotation	T1	T4,T8	T2,T3 & T5
Lower name-plate voltage	Counterclock-wise rotation	T1,T3 & T8	T2,T4 & T5	–
	Clockwise rotation	T1,T3 & T5	T2,T4 & T8	–

SYMBOL KEY: M = Main winding, ST = Start winding, CS = Start capacitor, CR = Run capacitor, CS1 = Lead between SINPAC Switch terminal three (3) and start capacitor (CS), CS2 = Lead between SINPAC Switch terminal four (4), start capacitor (CS) and start winding (ST)

EASY STEPS		WIRING OF MOTOR EQUIPPED WITH MECHANICAL SWITCH	EASY WIRING OF MOTOR EQUIPPED WITH SINPAC ELECTRONIC SWITCH	MOTOR LEAD WIRE NUMBERING

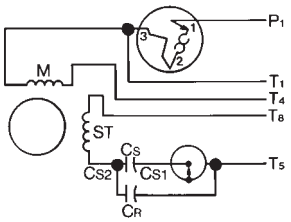
Capacitor Start/ Capacitor Run Motors

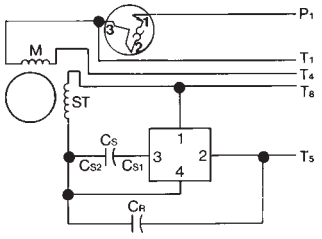
1. Disconnect the mechanical switch lead (CS1) which is connected to the start capacitor and reconnect this lead to SINPAC Switch terminal three (3).
2. Disconnect other mechanical switch lead marked T5 and reconnect this lead to SINPAC Switch terminal two (2).
3. Join SINPAC Switch terminal one (1) with motor lead T8.
4. Join SINPAC Switch terminal four (4) with the lead off the start winding, start capacitor and run capacitor. (Labeled in the connection diagram as CS2.)
5. Make sure the other side of the run capacitor is connected to the motor lead T5 along with SINPAC Switch terminal two (2).

Use on only the following model series:

VR-16
VR-40
VR-50
CVR-80
2VR-35
2VR-50
2CVR-70
2CVR-90

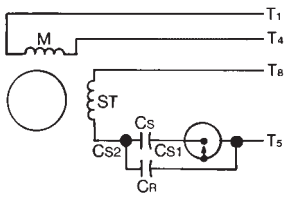
Single Voltage with Thermal Protection

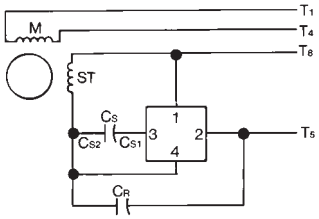




	L1	L2	Join
Counterclockwise rotation	P1	T4, T5	T1, T8
Clockwise rotation	P1	T4, T8	T1, T5

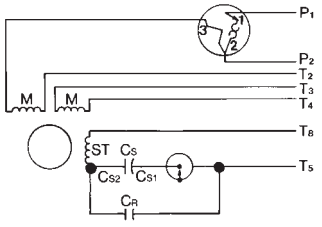
Single Voltage without Thermal Protection

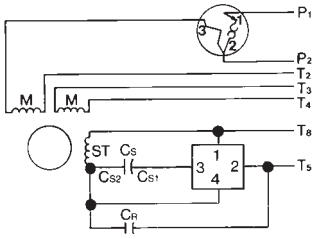




	L1	L2
Counterclockwise rotation	T1, T8	T4, T5
Clockwise rotation	T1, T5	T4, T8

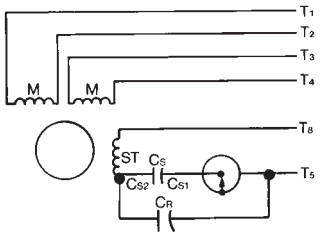
Dual Voltage with Thermal Protection

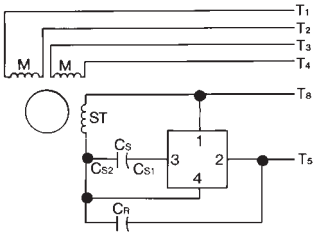




		L1	L2	Join	Join
Higher name-plate voltage	Counterclock-wise rotation	P1	T4	P2,T8	T2,T3 & T5
	Clockwise rotation	P1	T4	P2,T5	T2,T3 & T8
Lower name-plate voltage	Counterclock-wise rotation	P1	T2,T4 & T5	P2,T3 & T8	–
	Clockwise rotation	P1	T2,T4 & T8	P2,T3 & T5	–

Dual Voltage without Thermal Protection





		L1	L2	Join
Higher name-plate voltage	Counterclock-wise rotation	T1	T4,T5	T2,T3 & T8
	Clockwise rotation	T1	T4,T8	T2,T3 & T5
Lower name-plate voltage	Counterclock-wise rotation	T1,T3 & T8	T2,T4 & T5	–
	Clockwise rotation	T1,T3 & T5	T2,T4 & T8	–

SYMBOL KEY: M = Main winding, ST = Start winding, CS = Start capacitor, CR = Run capacitor, CS1 = Lead between SINPAC Switch terminal three (3) and start capacitor (CS), CS2 = Lead between SINPAC Switch terminal four (4), start capacitor (CS) and start winding (ST)

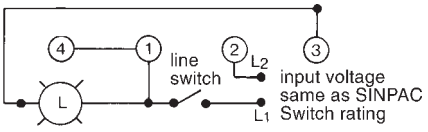
Procedure for Checking SINPAC Switches

1. Disconnect the SINPAC Switch from the motor and measure the resistance between terminals 2 and 3. If the resistance is less than 500K, the SINPAC Switch has been shorted or damaged, and must be replaced. If the resistance is infinite, the switch may not be damaged.

   CAUTION: Do not use megger to test motor circuit with SINPAC Switch. Proceed to Step 3 if you have a PV switch.

2. If resistance across SINPAC terminal 2 and 3 is greater than 500K and you have a capacitor start, instant reverse, or capacitor start/capacitor run SINPAC Switch, use Diagram 1.

Diagram 1



115 V SINPAC Switch – 115 V incandescent light (L) (at least 25 watts) and 115 Vac power source.

230 V SINPAC Switch – 230 V incandescent light (L) or two 115 V incandescent light (L) (at least 25 watts) in series and 230 Vac power source.

a) Connect one line of AC power to terminal 1 through a line switch.

b) Connect incandescent light (L) between terminals 1 and 3 of SINPAC Switch.

c) Jumper terminals 1 and 4 of SINPAC Switch.

d) Connect other line of AC power to terminal 2 of SINPAC Switch.

Note 1: Apply rated AC voltage to the SINPAC Switch.

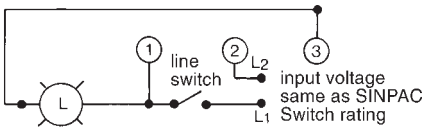
Note 2: The incandescent light (L) will illuminate if the SINPAC Switch is operable.

Note 3: If the incandescent light (L) fails to illuminate, the SINPAC Switch has been damaged and must be replaced.

Note 4: Turn off voltage and disconnect the SINPAC Switch.

3. If resistance across SINPAC terminal 2 and 3 is greater than 500K and you have a split phase SINPAC Switch, use Diagram 2.

Diagram 2



a) Connect one line of AC power to terminal 1 through a line switch.

b) Connect a (25 watt) incandescent light (L) between terminals 1 and 3 of SINPAC Switch.

c) Connect other line of AC power to terminal 2 of SINPAC Switch.

Note 1: Apply rated AC voltage to the SINPAC Switch.

Note 2: If the incandescent light (L) begins to blink after 1/2 second, the SINPAC Switch is operable.

Note 3: If the incandescent light (L) fails to illuminate or stays illuminated, the SINPAC Switch has been damaged and must be replaced. Both test must be performed and passed to indicate a minimally good switch.

Note 4: Turn off power and disconnect the SINPAC Switch.

Troubleshooting Guide

Symptom	Possible Cause	Procedure for Checking	Corrective Action
Motor fails to start.	Incorrect connection of SINPAC Switch.	De-energize. Check the wiring and connection diagram.	Reconnect properly.
	Start capacitor open or shorted.	De-energize motor, discharge, and check capacitor.	Replace capacitor.
	Thermal overload opened.	Check thermal overload. Check motor and SINPAC Switch wiring.	Wait until cool down. Check/replace thermal overload. Correct motor and SINPAC Switch wiring.
	Motor not free to rotate.	Check for jam or obstruction.	Remove obstruction.
	AC line voltage too low.	Measure line voltage at the motor terminals.	Increase voltage.
	No line voltage.	De-energize, check AC line fuses. Check wiring and connection diagram.	Replace fuses as required and apply AC line voltage.
	Start winding open.	De-energize and disconnect. Measure the resistance of the start winding.	Check the start winding. Motor may have to be rewound. Infinite resistance would show an open winding or loose connection.
	Motor hipot tested with switch installed without motor and SINPAC Switch leads tied together.	See *Procedure* to check SINPAC Switch (Page 28)	Replace switch and hipot motor, with installed SINPAC Switch, by tying all motor and SINPAC Switch leads together.
	SINPAC Switch damaged (open circuit).	See *Procedure* to check SINPAC Switch (Page 28)	Replace SINPAC Switch after checking all of the above possible causes
	SINPAC Switch, if it has a metal enclosure, is not grounded.	Check continuity between SINPAC Switch metal case and ground.	Ground metal case.
Motor starts, but switch fails to cut out when cut out speed is reached.	Current in the start winding is above rating of SINPAC Switch.	Remove switch and check the current of the start winding. See *Procedure* to check SINPAC Switch (Page 28).	Replace SINPAC Switch, if damaged.
	Wrong series SINPAC Switch installed — 115 V SINPAC Switch connected to 230 V start winding.	Consult selection chart — Measure voltage across wires connected to terminals 1 and 2.	Change switch — Check SINPAC Switch for damage and replace with correct switch.
	Start capacitor shorted.	De-energize motor, discharge and check the capacitor.	Replace capacitor.
	Start winding induced voltage is too low when motor reaches desired cut out speed. The voltage is due to the low winding-ratio of certain old style motors, foreign motors, converted motors, and special motor designs.	Perform SINPAC Switch Selection *Procedure* as described on Page 28.	Select proper SINPAC Switch.
	AC line voltage too low.	Measure the AC line voltage across the motor terminals.	Increase the AC line voltage.
	Start winding damaged.	De-energize and check the start winding.	Rewind motor.
	Mismatch of motor and load. Motor cannot reach cut out speed.	Check the load and motor characteristics.	Reduce load. Replace the motor with an appropriately larger sized motor.
	Incorrect connection of SINPAC Switch for capacitor start motors.	De-energize and check the connection diagram. Be sure that terminal 4 of switch is connected to the junction of the start capacitor and start winding (Pages 24-27).	Correct wiring.
	Damaged SINPAC Switch.	See *Procedure* to check SINPAC Switch (Page 28).	Replace SINPAC Switch after checking all of above possible causes.
	SINPAC Switch exposed to excessive temperature.	Check the operating ambient temperature of SINPAC Switch. It should be less than 80°C (185°F).	Change mounting location of switch. SINPAC Switches can be remotely mounted.
Upon overload, the start winding is not reenergized (no cut in)	Wrong switch installed. (PV Series switch on capacitor start motor.)	Consult selection chart.	Install correct switch.
Motor worked properly for many cycles of operations (days, weeks, months, years), then failed.	Start capacitor failure on capacitor start or cap. start/cap. run motors.	De-energize motor and check capacitor and SINPAC Switch.	Replace start capacitor and SINPAC Switch as appropriate.
	Switch failure.	See *Procedure* to check SINPAC Switch. Also check start capacitor (Page 28).	Replace switch.
Premature start capacitor failures.	High cycle rate. Excessive motor temperature.	De-energize motor and check start capacitor and SINPAC Switch.	Connect a 15,000 ohm, 2 watt bleeder resistor across the start capacitor(s).
			If a single start capacitor was originally installed, replace with two start capacitors of twice the capacitance valve and same voltage rating as the original and connected in series.
Instant reverse motor, upon rapid reverse, will not reverse direction.	Wrong switch installed. CV or VR Series installed instead of instant reverse SINPAC Switch.	Ensure that instant reverse SINPAC Switch was installed to replace any mechanical instant reversing switch.	Install SINPAC instant reverse switch.