

### Introduction to Silicon Controlled Rectifier (SCR) Power Controllers

#### Features and Benefits of SCRs

- \* **High reliability**  
Because the SCR power controller is a solid-state device, it provides virtually limitless, trouble-free operation with a minimum of maintenance.
- \* **Infinite resolution**  
Power, current or voltage can be controlled from zero to 100% with infinite resolution.
- \* **Extremely fast response**  
The SCR controller can toggle-load power on and off rapidly, providing the means to respond quickly to command, load and power supply changes.

#### The SCR

The SCR has two states, *On* and *Off*, and allows current to flow in only one direction. An SCR unit is composed of two SCRs arranged to control AC power. SCRs can remain in the off state even though the applied potential may be several thousand volts; in the on state, they can pass several thousand amperes. When a small signal is applied the SCR will turn on in 10-100 microseconds. Once turned on it will remain on until the current through it is reduced below a very low value called the holding current.

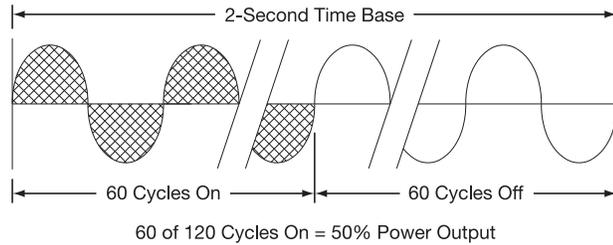
Basically, an SCR power controller consists of the following:

- Semiconductor power devices (SCRs and diodes)
- A control circuit normally referred to as the firing circuit
- A means to dissipate the generated heat
- Protective circuits (fuses and transient suppressors)

**True Power Regulation / Current Limit** It uses output voltage, current, conduction angle, phase shift, and power factor to monitor and regulate the output. It will provide output power that is constant, regulated and linear to the command signal. This option includes an RMS current limit (adjustable from 35 to 125% of the unit's rating) and has a 0-5 VDC output that is proportional to the load power.

**Over-Current Trip** Tempco's over-current trip is peak current sensing. The circuit will shut down the SCR within a half-cycle of AC current. It includes an automatic or manual reset that allows the user to select the reset mode after an alarm. A relay output is available for alarming or shutdown. Adjustable from 100 to 300% of the unit's rating.

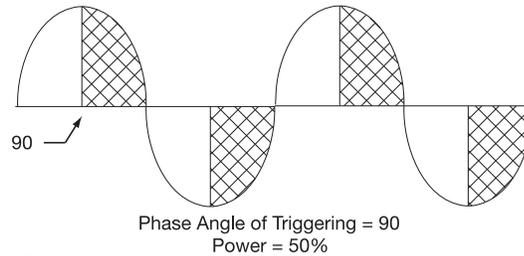
**RMS Current Regulation / Over-Current Trip** It will hold the output current constant regardless of the load resistance, based upon the command signal input. This option includes an RMS current trip adjustable from 35 to 125% of the unit's rating.



#### Distributive Zero-Cross Control

The term zero-cross or synchronous operation of SCRs is derived from the fact that the SCRs are turned on only when the instantaneous value of the AC sinusoidal waveform is zero. Zero-cross controllers can provide two rather distinctively different types of control: time proportioning control, and distributive control.

The Distributive Control Technique combines power pulses of short duration to obtain the exact power level proportional to the command signal or setpoint.



#### Phase-Angle Control

In phase-angle control the SCR unit is turned on at a certain phase angle of the AC power supply that provides the correct percentage of power. Power is regulated by advancing or delaying the point at which the SCR is turned on within each half cycle. Shown is an example of this for 50% power output.

Phase-angle control provides a very fine resolution of power and is used to control fast responding loads such as tungsten-filament lamps or loads in which the resistance changes as a function of temperature. Phase-angle control is required if the load is transformer-coupled or inductive.

Phase-angle controllers are typically more expensive than zero-cross controllers because the phase-angle circuit requires more sophistication than a zero-cross circuit. Phase-angle control of three-phase power requires SCRs in all three legs and is appreciably more expensive than zero-cross control, which only requires SCRs in two of the three legs.

#### Optional (SCR) Features

**RMS Current Limit / Over-Current Trip** The output current can be adjusted to automatically limit or clamp the maximum RMS current available from the SCR power control. It is settable from 35 to 125% of the unit's rating. This option includes an RMS current trip adjustable from 35 to 125% of the unit's rating.

**Over-Temperature Thermostat** These are bi-metal snap action thermostats that open or close when the heat sink's temperature exceeds its maximum operating temperature. Standard on all SCR power controls starting at 90 Amps. Specify NO or NC when ordering, or a NO thermostat will be included.

**Load Unbalance Alarm** The unbalance alarm monitors and compares the current in each of the three phases. If the current deviates more than the setpoint allows, an alarm relay is actuated.

**SCR Module Failure Alarm** This option monitors the voltage drop across each of the SCRs. Since most SCRs fail shorted (zero voltage drop) this is the most accurate method to detect a failed SCR module. A relay output is provided.