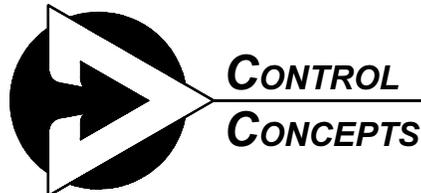


**CONTROL  
CONCEPTS  
INC.**

**INSTRUCTION MANUAL  
MODEL 3021A**



Distributed Worldwide By  
[www.mcgoff-bethune.com](http://www.mcgoff-bethune.com)  
1-800-303-4705  
+1-770-840-9811

## DESCRIPTION:

The model 3021A controller is a three-phase distributive zero-cross SCR controller. Distributive zero-cross control implies that the load voltage is switched on or off only when the instantaneous value of the sinusoidal supply voltage is zero and that the load power is controlled by varying the number of electrical cycles that power is applied to and removed from the load.

The controller is capable of accepting mA command signals, DC voltage signals, or it may be controlled by a potentiometer. The command signal input is isolated from the line and load voltages.

## THEORY OF OPERATION:

### THE SCR

The heart of the SCR power controller is the SCR (silicon controlled rectifier, sometimes referred to as a thyristor).

The SCR has two states, ON and OFF, and allows current to flow in only one direction when turned on. SCR's 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 between the gate and cathode terminals (Figure 1), 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.

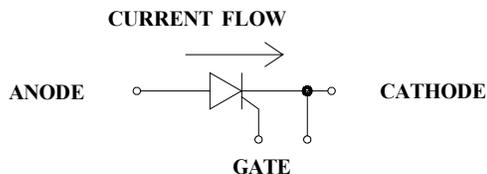


Figure 1. SCR Symbol.

Because the SCR allows current to flow in only one direction, two SCR's are connected in a "back to back" configuration to control AC current (Figure 2).

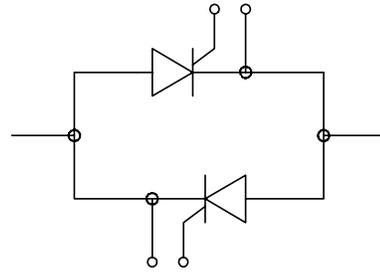


Figure 2. SCR AC Switch.

### ZERO-CROSS OPERATION

In zero-cross control, the load power is turned on or off only when the instantaneous value of the sinusoidal waveform is zero. Load power is controlled by switching the SCRs "on" for a number of complete electrical cycles, and then "off" for a number of complete electrical cycles. The circuit determines the ON versus the OFF time of the silicon controlled rectifiers (SCRs) such that the load power is linear with the command signal. The circuit at 50% power will cause the SCRs to be "on" for 3 cycles and "off" for 3 cycles. At higher power levels, the SCRs are ON for more cycles and OFF for 3 cycles. At lower power levels, the SCRs are ON for 3 cycles and OFF for more cycles. The SCRs are turned ON and OFF only at the beginning and end of each electrical cycle.

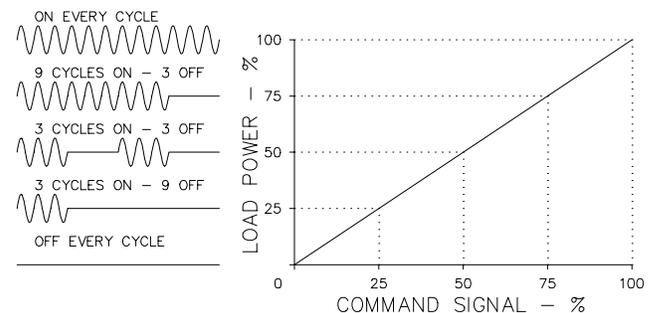


Figure 3. Distributive Control.

## INSTALLATION:

The controller must be mounted on a vertical surface with the fins oriented vertically such that air will flow over the heat dissipating fins. The plug-in connectors may be removed by pulling them straight away from the circuit board. For optimum performance of the controller, 24Vac must be supplied by a transformer which is connected to the same supply used to power the load.

## ELECTRICAL CONNECTIONS:

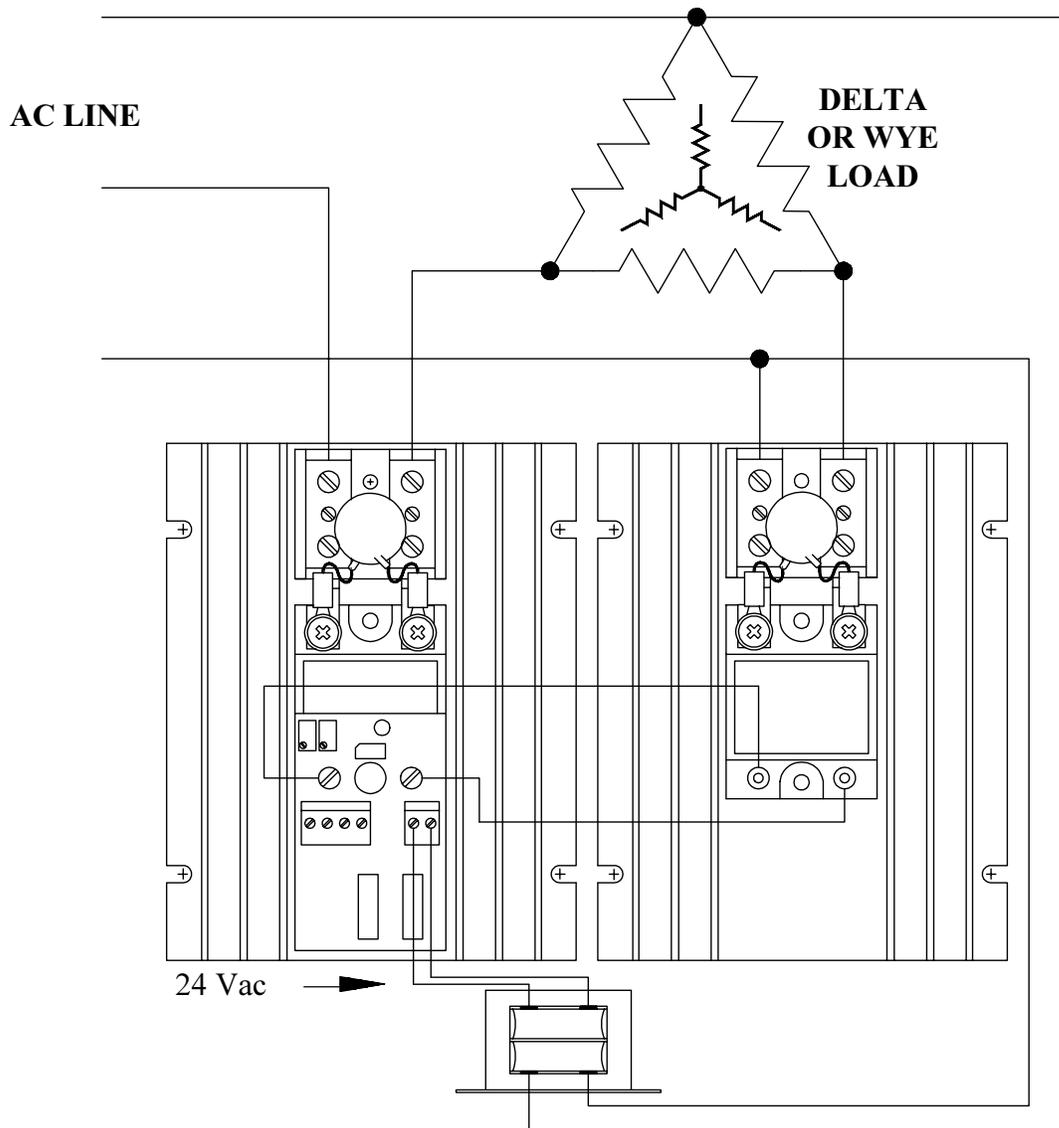


Figure 4. Electrical power connections.

## CONTROL SIGNAL CONNECTIONS:

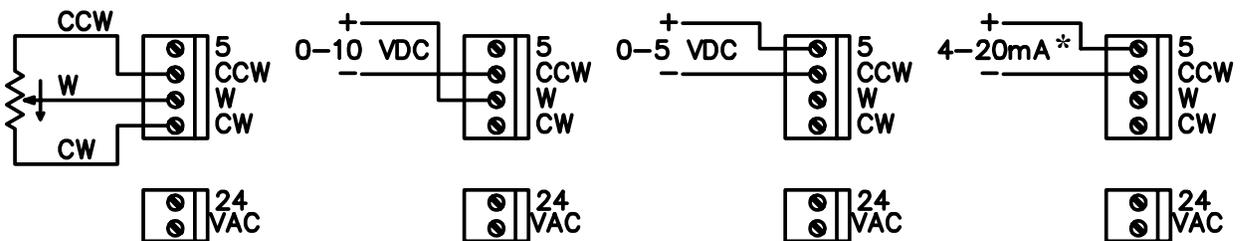
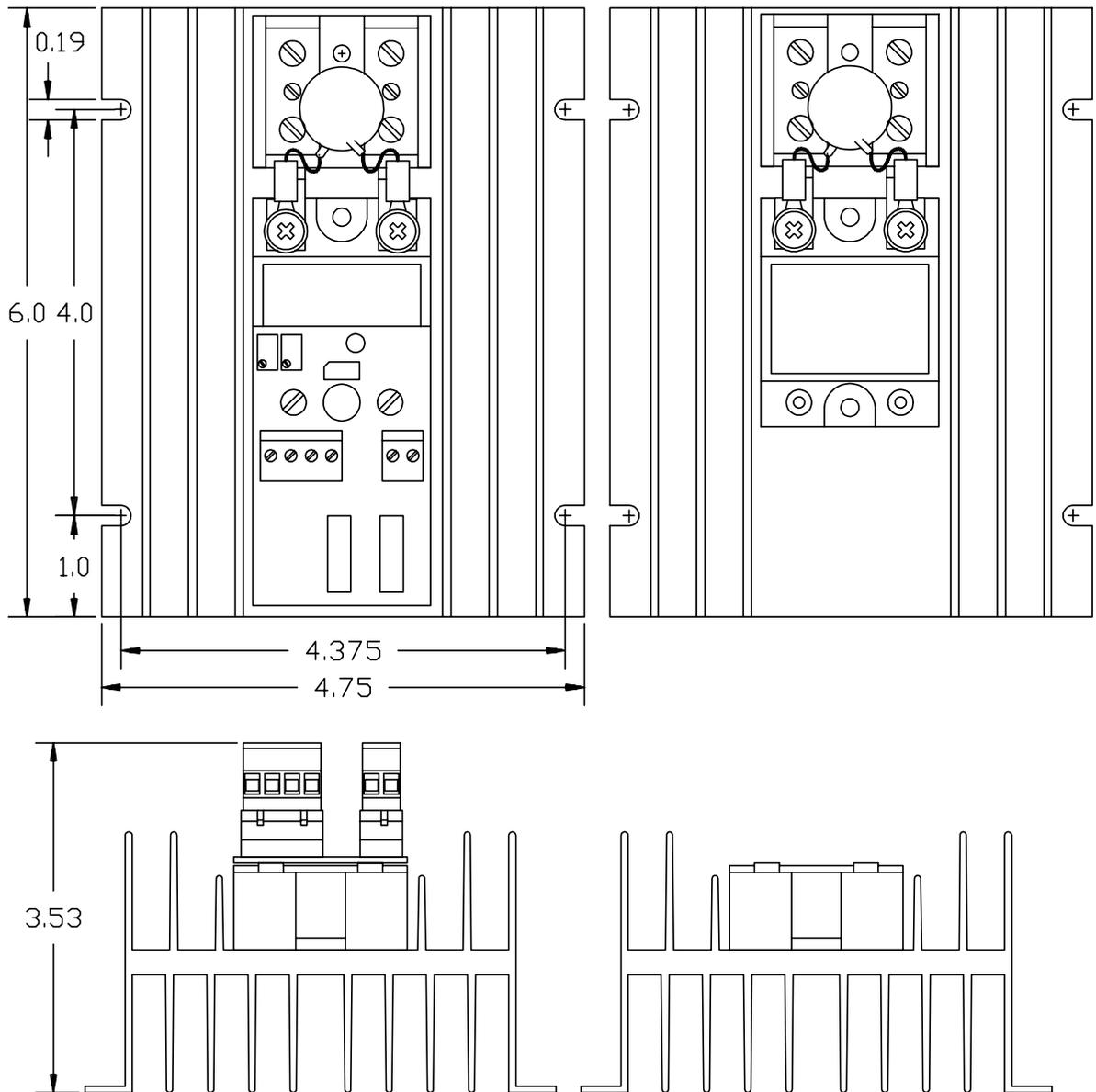


Figure 5. Command Signal inputs.

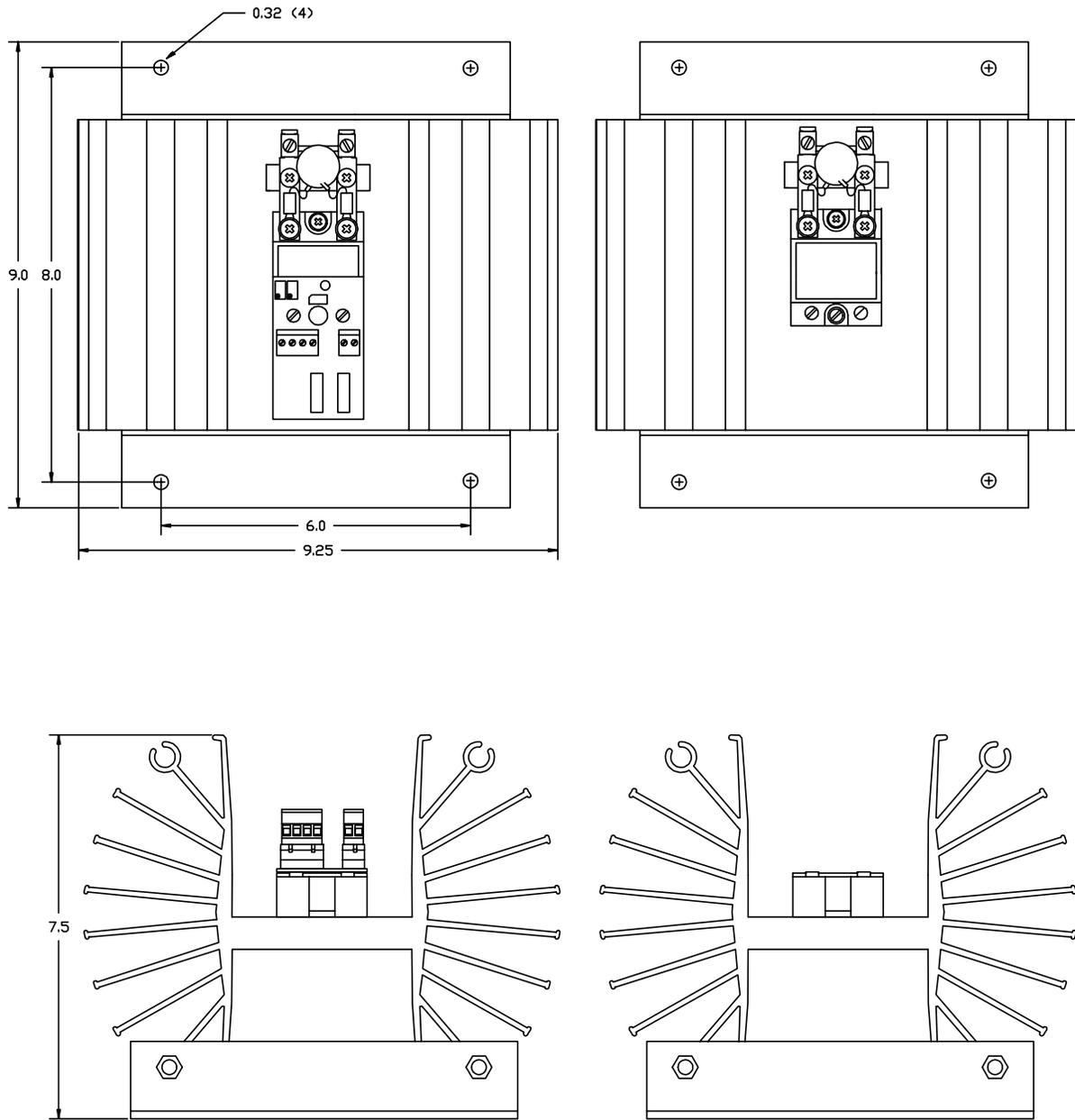
\* Valid only when ordered as an option.

# INSTALLATION DRAWINGS:



**Figure 6.** Model 3021A - 10, 20, 30 AND 40 AMPS.  
(BOTH ASSEMBLIES REQUIRED)

# INSTALLATION DRAWINGS:



**Figure 7. Model 3021A - 70 AMPS  
(BOTH ASSEMBLIES REQUIRED)**

## TROUBLE SHOOTING:

Control Concepts has field service engineers who can aid in determining the cause of controller problems. Please call with any problems or questions you may have.

### CAUTION:

High voltage exists on the supply and load terminals of this controller and may exist on other equipment located near the controller. Use extreme caution to avoid electrical shock.

The LED located on the controller circuit can be used to aid in determining problems. This LED varies in intensity proportional to the command signal and therefore should be proportional to the load voltage.

### THE FOLLOWING ARE SYMPTOMS AND POSSIBLE CAUSES:

**NO LOAD POWER AND LED IS NOT ON:** Determine that the command signal is applied to the correct terminals on the circuit board. (See Fig. 5, Page 2.) Make sure that 24 Volts AC is applied to the circuit. If another circuit board is available, a substitution may show whether the circuit board is at fault.

**NO LOAD POWER; LED INTENSITY CAN BE VARIED:** Determine that all fuses are "OK". If the voltage across the SCR module is equal to the line voltage the SCR module has probably failed. NOTE: If a replacement SCR module is ordered, specify the voltage, current rating and serial number of the failed controller.

### LOAD POWER IS MAXIMUM AND CANNOT BE REDUCED:

**LED IS OFF:** Remove the 24Vac plug in connector. If the load still has power, the SCR module has probably failed as a short, allowing full power to be applied to the load. To determine if the SCR module has shorted, remove power and then the line and load connections. Measure the resistance across the line and load terminals on the SCR module. If the resistance is less than 10,000 ohms, the module has failed. NOTE: If a replacement SCR module is ordered, specify the voltage, current rating and serial number of the failed controller.

**LED IS ON:** Determine that the command signal is adjusted to zero, or pull out the 4 terminal connector to remove the command signal. If the LED does not go off, the circuit card has probably failed.

**MAXIMUM LOAD VOLTAGE CANNOT BE OBTAINED:** Determine that the primary of the 24Vac transformer is connected to the same supply as the controller and load. Typically, this problem is caused by the primary being connected across the load and line connections on the controller. Measure the 24 Vac supply at the circuit board.

## SPECIFICATIONS:

**CURRENT RATING** The (LOAD CURRENT) term within the model number specifies the maximum continuous RMS current rating at a 55°C maximum operating temperature.

COMMAND SIGNAL	Input Resistance
0 to 5 Vdc	100K
0 to 10 Vdc	200K
4/20 mA	300 ohms
Potentiometer	200K

(1K, 1/2 watt pot. recommended, 20K maximum permissible.)

**ISOLATION:** 2500 Vrms input signal to load and line voltages.

**CONTROL MODE:** Zero-cross, distributive.

**LINE VOLTAGE COMPENSATION:** The average load voltage remains constant within 2% over line voltage changes of +10% to -15%.

**FUSES:** It is recommended that the controller and the load be protected with fast acting fuses such as the JJJ and JJS, class "T", series of fuses. Contact Control Concepts for price and delivery information.

## MODEL No. IDENTIFICATION:

**3021A-(VOLTAGE)-(LOAD CURRENT)-(XX)**

**(VOLTAGE)** = Rated operating voltage

12 = 120 Vac

24 = 240 Vac

48 = 480 Vac

**(LOAD CURRENT)** = Current applied to load at 100% command signal.

**(XX)** = Command signal: 0 to 5 Vdc, 0 to 10 Vdc, 4 to 20mA or potentiometer.

## REFERENCE DRAWINGS:

B1000359B1

Schematic

AS1401

Transformer Inst. Dwg.

## MANUFACTURED BY:

