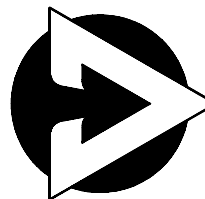


CONTROL CONCEPTS INC.

MODEL 1028A INSTRUCTION MANUAL



CONTROL
CONCEPTS

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DESCRIPTION:

The model 1028A is a phase-angle SCR power controller that controls, with respect to a command signal, the AC voltage which is applied to a single phase load. Control is accomplished by varying the time within each electrical half cycle that the supply voltage is applied to the load.

The model 1028A controller is intended for regulating the power applied to resistive loads and transformer coupled loads.

The 1028A is capable of accepting standard control signals such as; 4/20mA, 0-5 Vdc, 0-15 Vdc or a potentiometer. The command signal is isolated from the line and load voltage and all voltages and signals are isolated from the heatsink.

This controller may be ordered with average voltage or True RMS voltage feedback. Current feedback is not available on this model.

External feedback may be ordered as an option, please consult factory for information.

The controller is available with ratings of 208 to 575 Volts AC, at currents from 100 to 1000 Amps. Other voltages may be available, consult factory for information.

A metering output is accessible on the command connector which will provide a signal proportional to the percentage of load voltage. At nominal line voltage, 4.8Vdc at the metering output (pin 2 = com, pin 6 = +) will represent 100% controller output.

The model 1028A has soft start and missing cycle detection. On initiation of power, or if the supply power is interrupted, the load voltage is set to zero and increased to the desired value at a rate equal to a time constant of approximately 0.2 seconds. This feature reduces the possibility of saturating transformers used in the load, and reduces inrush currents when controlling loads with high hot to cold resistance ratios.

INSTALLATION:

The 100 amp 1028A controller does not have forced air cooling and therefore must be mounted on a vertical panel making sure that the fins are aligned vertically to allow air to pass freely through the fins.

The 150 Amp to 1000 Amp controllers are forced air cooled and may be mounted in any direction.

Drawings are included in this manual which give the mounting dimensions for each size of controller.

It is recommended that the load and controller be protected with fast-acting fuses such as Bussman "class T" fuses. Select a fuse with a rating about 125% of the maximum load current.

On frames with current ratings of 200 Amps or more, the control circuit transformer is protected with two 1/2 Amp fuses.

POWER CONNECTIONS:

The installation drawings in this manual show the electrical connections. The line and load connectors are rated for wire sizes from #6 to 250 MCM. The recommended torques as a function of wire size are:

Recommended tightening torque for the line and load connectors:	
AWG or Circular Mills	Torque
4 to 6ga	100 in-lbs
1 to 2ga	125 in-lbs
1/0 to 2/0ga	150 in-lbs
3/0 to 4/0ga	200 in-lbs
250 to 350mcm	250 in-lbs
500mcm	300 in-lbs

START-UP:

Set the command signal to zero and apply power to the controller. The load voltage should increase as the command signal is increased. The load voltage may be measured with any meter capable of measuring AC line Voltage. However, because of the nonsinusoidal waveform applied to the load, a True RMS meter should be used to obtain accurate values.

MODEL NUMBER:

1028A-[FB]-[VOLTS]V-[AMPS]A-[CS]

1028A Specifies a Single-Phase, Phase-Angle, controller.

"[FB]" Substitute **A** for Average Voltage feedback.
Substitute **V** for RMS Voltage feedback.

"[Volts]" Specify; Supply Voltage.
Common choices are; 208 Vac, 240 Vac, 277 Vac, 380 Vac, 415 Vac, 480 Vac & 575 Vac.

"[Amps]" Specify; Maximum Load Current.
Frame sizes are 100 Amps, 150 Amps, 200 Amps, 250 Amps 300 amps, 380 amps, 425 Amps, 500 Amps, 600 Amps, 750 Amps & 1000 Amps.

"[CS]" Specify, **C**ommand **S**ignal.
Common choices are: 0 to 15 Vdc, 0 to 5 Vdc, 1 to 5 Vdc 4/20mA & Potentiometer.

Ordering Examples;

1028A - V - 480V - 750A - 0/5 Vdc.

This model number specifies a Single-Phase, Phase-Angle, controller with RMS voltage feedback, for 480 volt operation at 750 Amps maximum load current and accepts a 0 to 5 Vdc command signal.

1028A - A - 575V - 425A - 4/20mA.

This model number specifies a Single-phase, Phase-Angle, controller with Average voltage feedback, for 575 Volt operation at 425 Amps maximum load current and accepts a 4/20mA command signal.

Consult factory for information concerning External Feedback, operation at line voltages other than those specified above and special command signals.

THEORY OF OPERATION:

THE SCR

The heart of the SCR power controller is the SCR (silicon controlled rectifier, also 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. SCRs can remain in the off state even though the applied potential may be several thousand volts. In the on state, they can pass current up to several thousand amperes. When a small signal is applied between the gate and cathode terminals, the SCR will turn on within 10-100 micro-seconds. Once turned on, it will remain on, until the current through it is reduced below a very low value, referred to as the holding current.

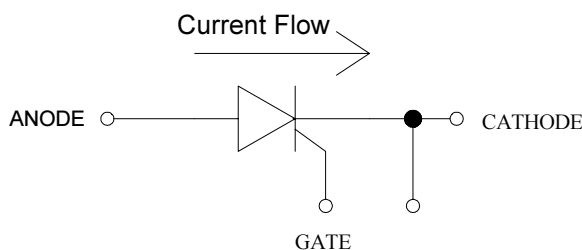


Figure 1. SCR symbol

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 3).

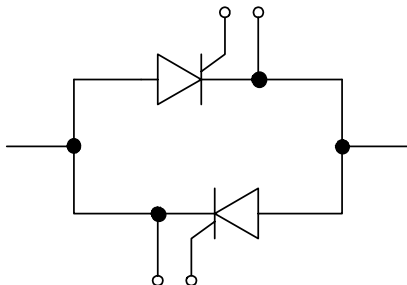


Figure 2. "AC Switch"

PHASE-ANGLE

In phase-angle control, each SCR of the back-to-back pair is turned on for a variable portion of the half-cycle that it conducts (Figure 4). Power is regulated by advancing or delaying the point at which the SCR is turned ON within each half cycle. Light dimmers are an example of phase-angle control.

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.

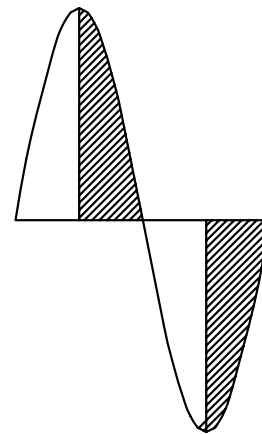


Figure 3. SCR "ON" time, shown by shaded area, is varied to apply the desired load voltage.

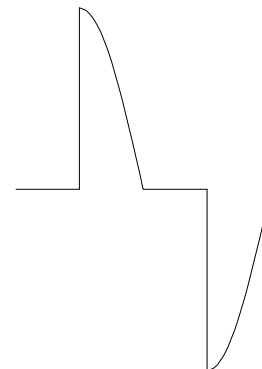


Figure 4. Power is regulated by advancing or delaying the point at which the SCR's are turned on.

SPECIFICATIONS:

The following specifications apply over an ambient temperature range of 0 to 55C and a supply voltage of 85% to 110% of the nominal supply voltage rating.

Control Mode:	Single-phase, in line, phase-angle controller.
Command Signal:	Input signal 4/20mA 0-5Vdc 0-15 Vdc Potentiometer (1K, 1/4watt pot recommended for optimum linearity, 20K permissible) The potentiometer is excited by 15Vdc, supplied by the circuit. Other ranges may be available. Check with factory for special applications Input Impedance: 300 ohms 100K ohms 300K ohms 100K ohms
Control Range:	0 to 97% of line voltage.
Linearity:	Output will be linear within 0.5% of span over entire range of control.
Zero and Span Adjustments:	Multi-turn potentiometers allow zero and span adjustments of $\pm 25\%$ of span.
Cooling:	Convection cooling on 100 amp unit. Forced air cooling on all others.
Dissipation:	Approximately 1.5 watts per amp of current will be dissipated by the controller.
Supply Voltage:	208, 240, 277, 380, 415, 480, or 575Vac, Single-phase, @ 50/60 Hertz. Consult factory for other operating voltages.
Frame Size:	The "[AMPS]A" Term in the model number specifies the maximum RMS current rating at the maximum operating temperature of 55°C.
Environment:	Operating temperature 0 to 55C (32 to 132F). Storage temperature: -40 to 85C (-40 to 176F). Humidity: 0 to 95%, non-condensing.
Electrical Isolation:	Heat sink to supply and load voltages; 2500 volts peak. Control or command signal to supply and load voltage; 1500 volts peak.
LED Indicator:	<i>The COMMAND indicator.</i> The intensity of this LED is proportional to the command signal, and is therefore proportional to the voltage to the load.
Weight:	100 and 150 Amp controllers: - 15 Pounds All others: - 25 Pounds
Voltage meter output:	A filtered 0 to 5 Vdc signal. 1 Volt out per 100 Volts to load.
External feedback:	When factory installed, a 0 to 50uA signal (derived from the load) may be used for external feedback into the controller. See figure 9, Pg. 7.
Electrical connections:	Aluminum compression lugs for power connections are provided for use with aluminum or copper wire from 6 ga. to 250 MCM. A small connector is used for line 2 connection. See figs. 17 & 18.

BOARD LAYOUT AND SIGNAL CONNECTION:

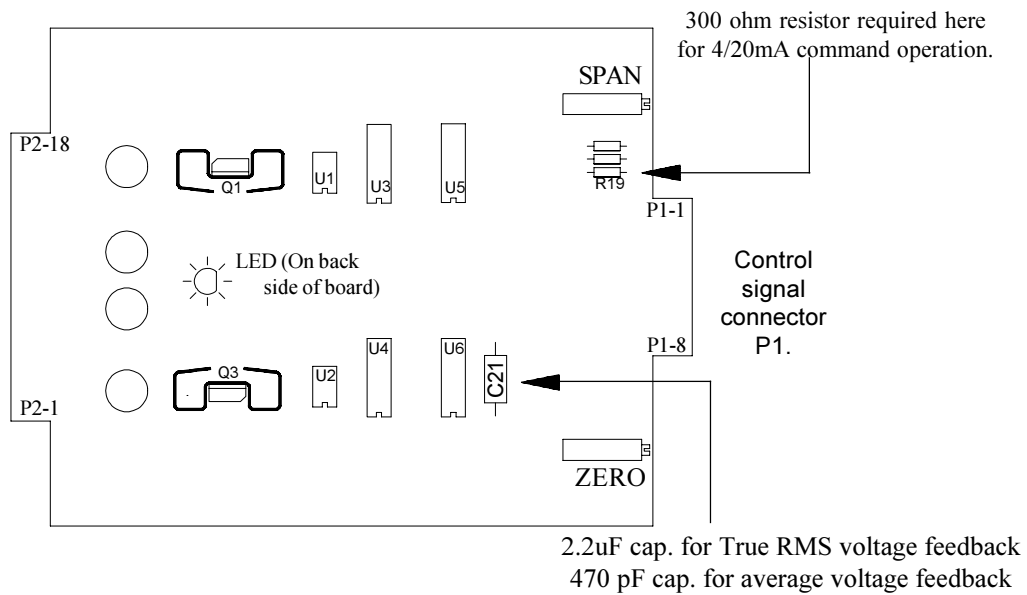


Figure 5. Layout of 1028A firing circuit board, component side shown.

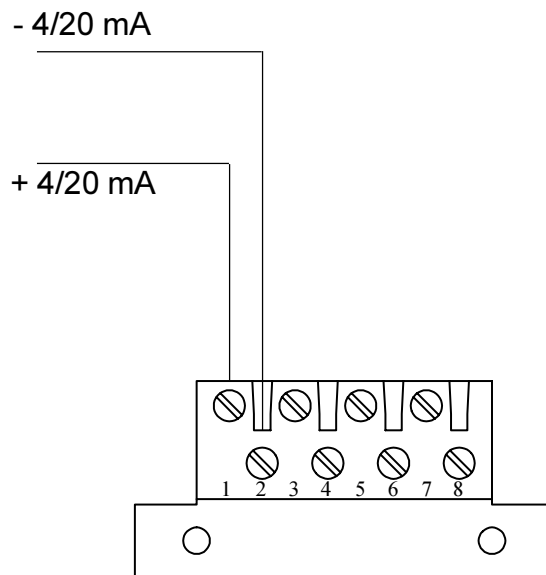


Figure 6. Wiring a 4 to 20mA signal to the command connector.

SIGNAL CONNECTIONS:

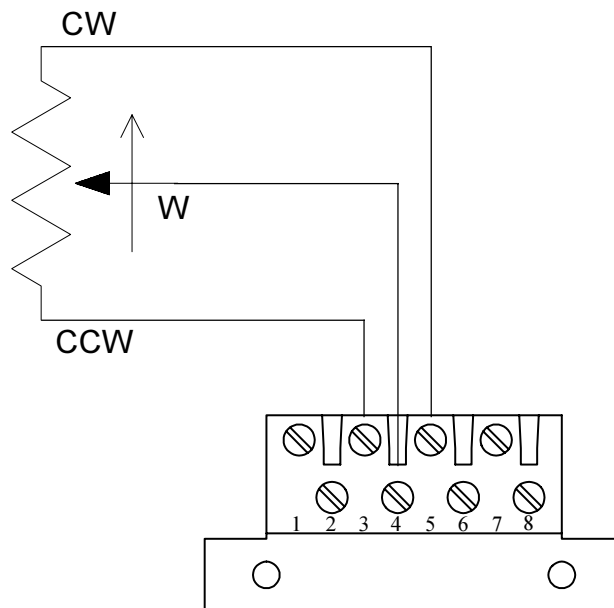


Figure 7. Wiring a potentiometer to the command connector.

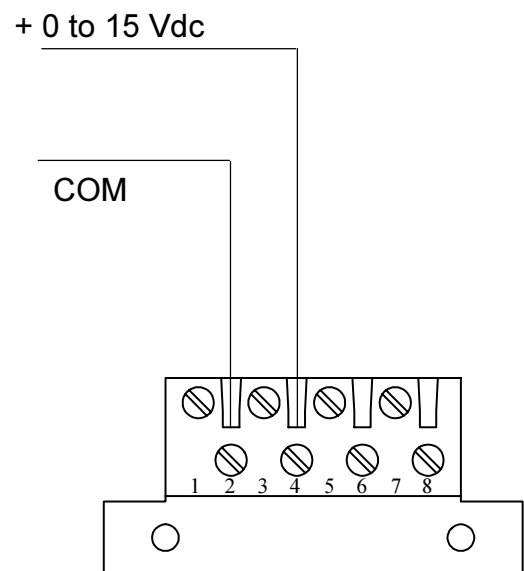
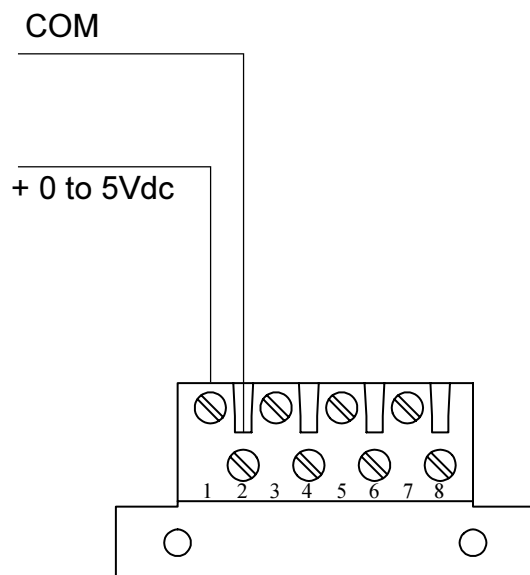


Figure 8a & 8b. Wiring a voltage control signal to the command connector.

SIGNAL CONNECTIONS:

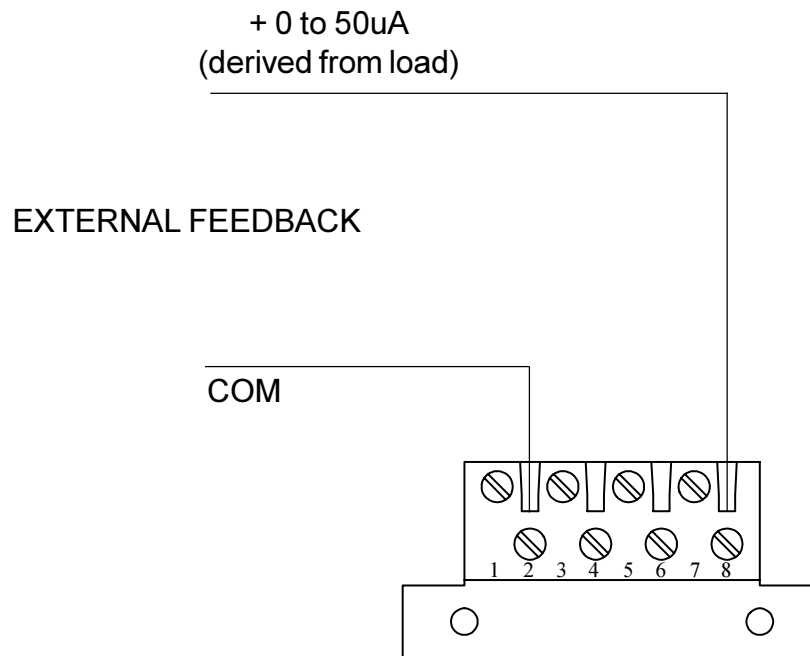


Figure 9. Wiring external feedback to the command connector.

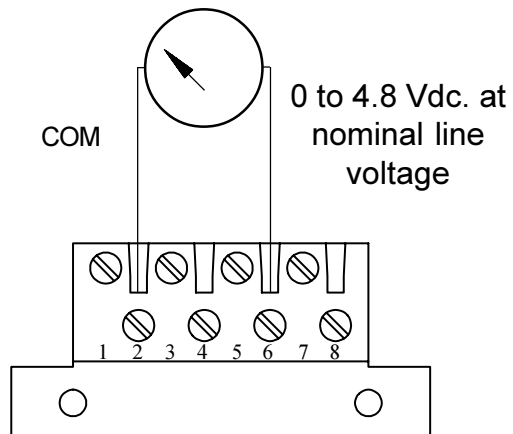


Figure 10. Wiring a meter to the command connector.

INSTALLATION DRAWINGS:

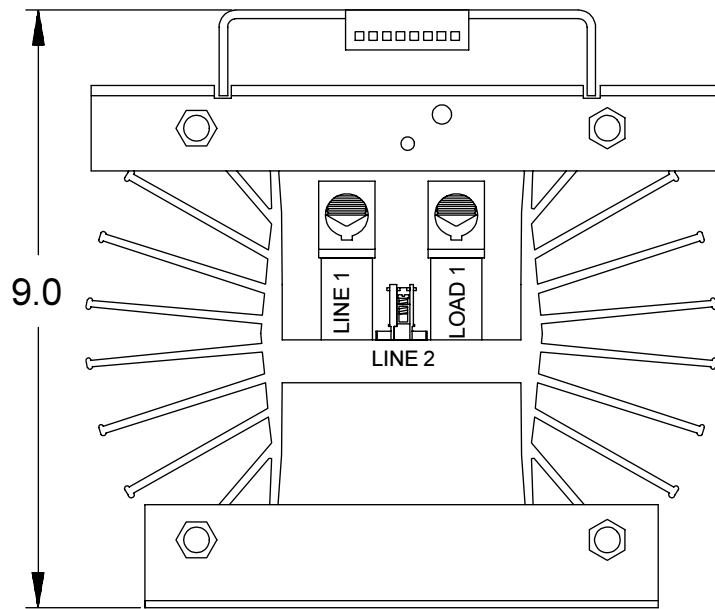


Figure 11. End view showing location of electrical connections.

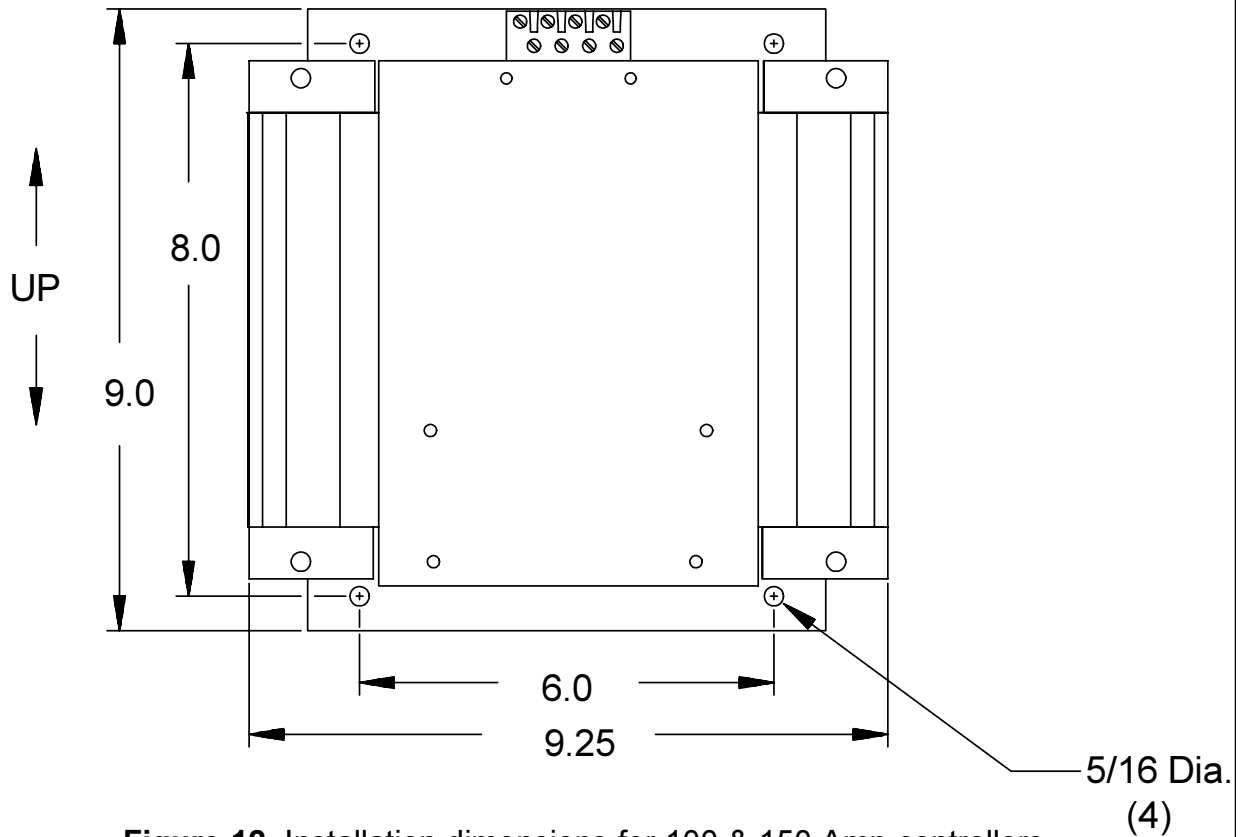


Figure 12. Installation dimensions for 100 & 150 Amp controllers.
150 amp controller has a fan. (Not shown.)

INSTALLATION DRAWINGS:

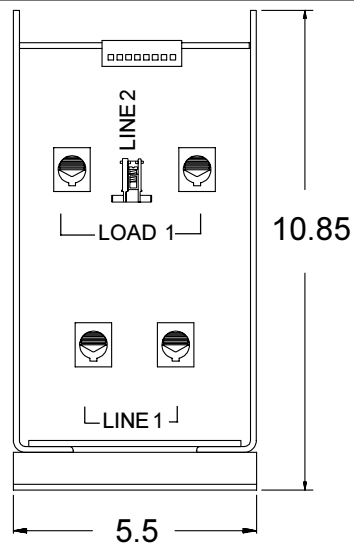


Figure 13. End view of 200 - 450 Amp controller showing electrical connections.

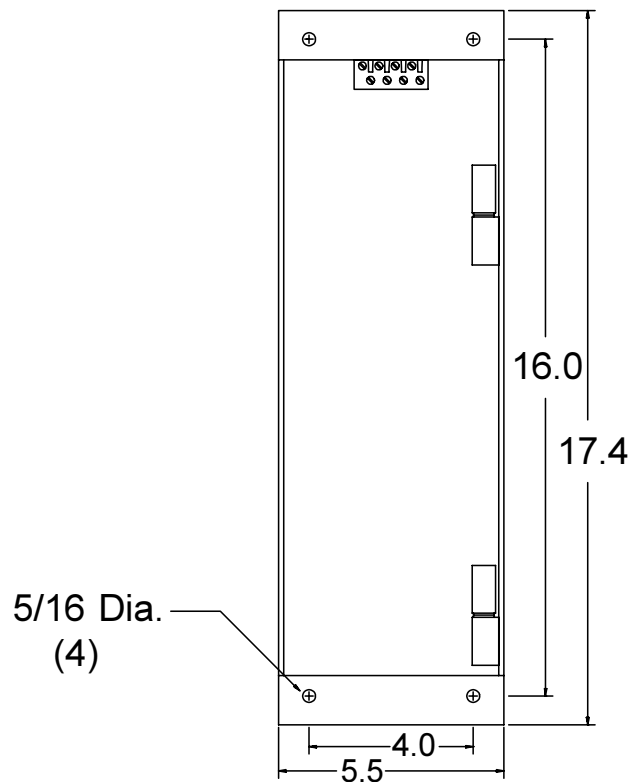


Figure 14. Top view of 200 - 450 Amp controller.

INSTALLATION DRAWINGS:

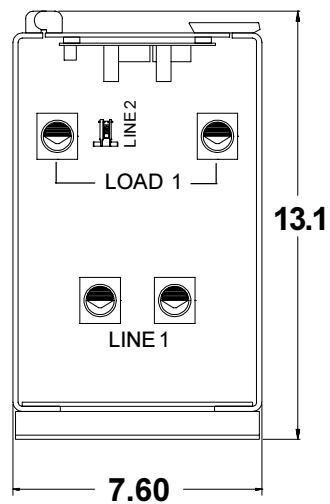


Figure 16. End view of 500 - 1000 Amp controller showing electrical connections.

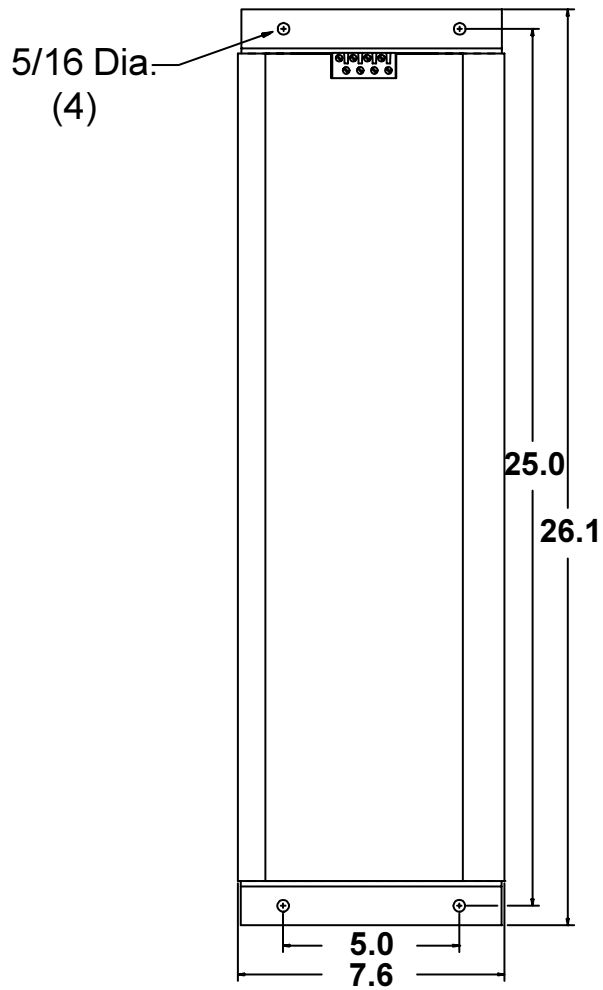


Figure 15. Top view of 500 - 1000 Amp controller.

ELECTRICAL HOOKUP:

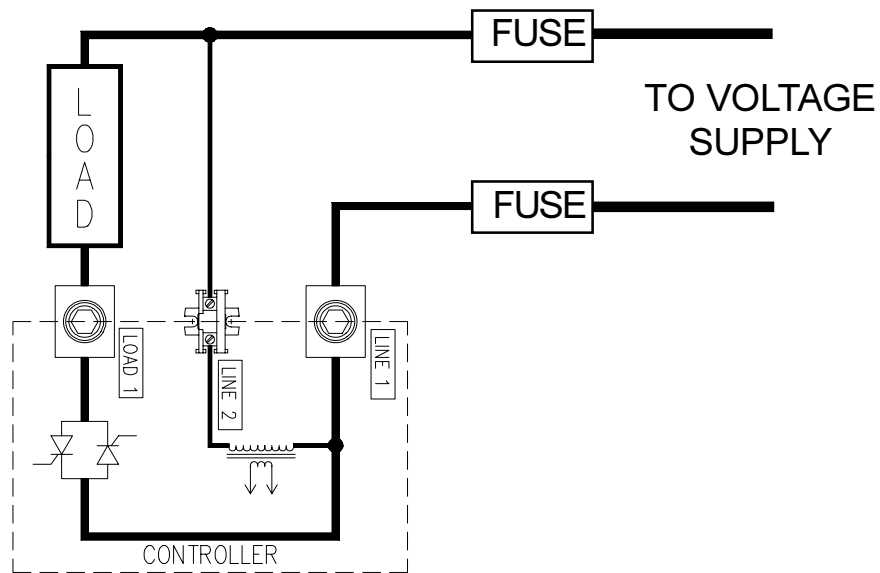


Figure 17. Power path

RECOMMENDED SPARE PARTS:

CONTROL CIRCUIT:

1028A-(FB)-(CS)-FC *

See page 2 for explanation of model number.

* - FC indicates calibrated circuit board only.

CONTROL CIRCUIT FUSE: (200 Amps & up)

600Volt 1/2 Amp Bussmann type FNQ-R-1/2

SCR MODULE:

CURRENT RATING (Amps)	CCI PART NUMBER
100	28325-0395-516
150	28325-0395-516
200	28000-0424-516
250	28000-0434-516
300	28000-0449-516
380	28011-0460-516
425	28011-0476-516
500	28011-0460-516
600	28011-0476-516
750	28011-0514-516
1000	28013-0518-516

Contact factory for other components if required.

Control Concepts stocks a complete line of replacement parts.

TROUBLE SHOOTING:

CAUTION: PORTIONS OF THE PRINTED CIRCUIT BOARD ARE AT LINE VOLTAGE POTENTIAL AS ARE OTHER PARTS OF THE CONTROLLER. USE EXTREME CARE TO AVOID ELECTRICAL SHOCK.

The command indicator light provides a convenient method of determining the general location of problems, should they occur. The intensity of the command indicator is proportional to the command signal and therefore should be proportional to the load voltage. Correct operation of the command indicator proves that the command signal is applied and that the majority of the circuit is operating correctly. Note: The SCRs must have a load current of at least 1 amp to insure correct operation.

The following are some symptoms and steps to locate problems:

NO LOAD VOLTAGE:

Determine that the command light changes intensity as the command signal is changed.

If the command indicator light is not on, determine that a command is applied.

If the command indicator light is on, check the load fuses and system voltage.

On the 200 Amp & higher frame sizes, check the control transformer fuses.

Although it is not likely, both SCRs may have failed open.

LOAD VOLTAGE WILL NOT GO TO ZERO:

If the load voltage is small, try to adjust the zero potentiometer. It is possible that a circuit failure could cause the same symptoms.

If the load voltage will not go to zero with the circuit card removed from the controller, an SCR has failed.

If the load voltage does go to zero when the circuit card is removed, the circuit card has probably failed.

FULL VOLTAGE CANNOT BE OBTAINED:

If the maximum obtainable load voltage is approximately 70% of the supply, the problem is likely a circuit card failure.

Although it is not likely, one SCR in the SCR module may have failed open.

ADJUSTMENTS:

The zero and span potentiometers have been factory calibrated and should not require adjustment.

The zero pot. adjusts the controller to provide zero load voltage when the command is zero.

The span pot determines the load voltage for a given command input.

Should it become necessary to adjust the zero and span pots, use the following procedure:

1. Set the command signal to minimum and adjust the zero pot until the output is zero.
2. Set the command signal to maximum and adjust the span pot until the output is at the desired maximum value.
3. The span and zero pot may interact, it may be necessary to repeat steps 1 and 2.

REFERENCE DRAWING:

C1000732 - Schematic

MANUFACTURED BY:



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