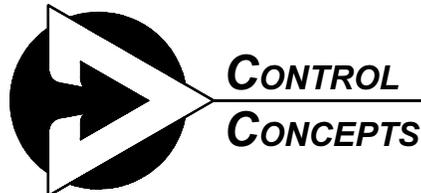


**CONTROL
CONCEPTS
INC.**

**INSTRUCTION MANUAL
MODEL 1032**



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DESCRIPTION:

The model 1032 is a single-phase phase-angle SCR power controller with features of field adjustable current limiting, soft-start and missing cycle detection. The controller can be obtained to accept command signals of 0-10Vdc, 0 to 5Vdc, 1-5mA, 4-20mA, or a potentiometer signal. Models are available for operation at 120, 208, 240, 377, 480 and 575Vac 50/60 hertz. The controllers can be obtained with current ratings of 10, 20, 30, 40 and 70 Amps.

The model 1032 linearly controls, with respect to the command signal, the RMS value of the voltage applied to the load. The controller also has line voltage compensation, which, for a constant command signal, maintains the load voltage constant, independent of line or supply voltage variations.

The soft-start and missing cycle detection features set the load voltage to zero on power interruptions of one half cycle or more, and then increases the load voltage to the desired value at a predetermined rate. This feature, on start up or after power failures, prevents saturation of load transformers. The feature also eliminates in-rush currents that can occur, due to loads with a low cold resistance.

Current limiting allows the user to adjust the maximum current the controller will apply to the load. This feature is desired when loads such as silicon carbide, molybdenum disilicide, or other materials in which the resistance changes with temperature and/or time.

Electrical isolation of the circuit card and the heat sink is achieved by the use of an SCR that electrically isolates the SCR's from its mounting plate, and which uses photo-couplers to isolate the SCR gate signals.

MODEL No. IDENTIFICATION:

MODELNUMBER: 1032-VV-AA-CS(-ILXX)

VV = Rated voltage

12= 120Vac

24= 240Vac (For 208 or 220 specify "SC208" or "SC220")

48= 480Vac (for 377 specify "SC38")

57= 575Vac

AA = Rated current capacity 10, 20, 30, 40 or 70 Amps

CS = Command Signal; The standard controller accepts a 0 to 5Vdc, a 0 to 10Vdc, or a potentiometer signal.

If the controller has been supplied as a 4/20mA input a "-4/20mA" designator will be included in the model number.

An appropriate shunt resistor (R47, see drawing # D1000532_3) will be added to the circuit to provide proper scaling.

Check with factory for other mA input ranges.

The term "ILXX" added to the model number implies that the *current limit* will be factory adjusted for the value specified by "XX". When the "ILXX" term is not included, the *current limit* will be factory set at 100% of the rated current.

THEORY OF OPERATION:

The heart of the 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 several thousand amperes. When a small signal is applied between the gate and cathode terminals, the SCR will turn on within 10-100 microseconds. 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. Since the SCR conducts in only one direction, two are placed back to back in an inverse parallel configuration to control AC current. (Figure 1A.)

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 1, B&C). 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.

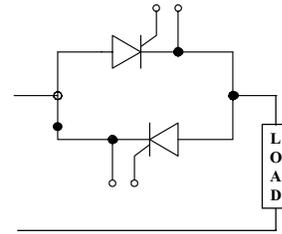


Figure 1A. Simplified diagram of an SCR controller

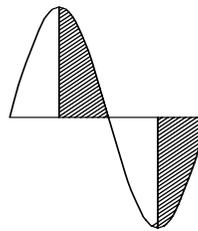


Figure 1B. SCR "ON" time, shown by shaded area, is varied to apply the desired load voltage.

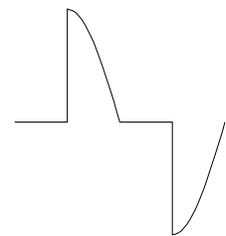


Figure 1C. Voltage waveform, as applied to load.

SPECIFICATIONS											
Control Mode	Single-phase; Phase-angle; RMS value of the voltage applied to the load										
Command Signal	<table border="0"> <tr> <td>Signal</td> <td>Impedance</td> </tr> <tr> <td>0-5Vdc</td> <td>100K</td> </tr> <tr> <td>0-10Vdc</td> <td>200K</td> </tr> <tr> <td>1 to 20 K Pot.</td> <td>200K</td> </tr> <tr> <td>4-20mA;</td> <td>300 ohms</td> </tr> </table>	Signal	Impedance	0-5Vdc	100K	0-10Vdc	200K	1 to 20 K Pot.	200K	4-20mA;	300 ohms
Signal	Impedance										
0-5Vdc	100K										
0-10Vdc	200K										
1 to 20 K Pot.	200K										
4-20mA;	300 ohms										
Control Range	6 to 97% of line voltage, typical.										
Linearity	RMS load voltage is linear within 2% of span of the command signal.										
Zero and Span Adjustment	User adjustable over a range of 20% of span										
Current Limit Adjustment	User adjustable over a range from 20% to 110% of rated current										
Isolation	<table border="0"> <tr> <td>Dielectric strength input/line & load voltage/heatsink:</td> <td>2500 V_(RMS)</td> </tr> <tr> <td>Insulation resistance input/line & load voltage/heatsink:</td> <td>10¹⁰ ohms.</td> </tr> <tr> <td>Maximum capacitance input to output:</td> <td>8 pf</td> </tr> </table>	Dielectric strength input/line & load voltage/heatsink:	2500 V _(RMS)	Insulation resistance input/line & load voltage/heatsink:	10 ¹⁰ ohms.	Maximum capacitance input to output:	8 pf				
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Insulation resistance input/line & load voltage/heatsink:	10 ¹⁰ ohms.										
Maximum capacitance input to output:	8 pf										
Cooling	Convection										
Mounting	Must be mounted on vertical surface with fins vertical. Units may be mounted adjacent to each other. Heat sink is electrically isolated from circuit and power.										
Line voltage	120, 240, 480 & 575Vac +10%, -20% 50/60 Hertz Consult factory for other voltages.										
Load Current	10, 20, 30, 40 & 70 Amps A.C. 50/60 Hertz.										
Diagnostic Indicator	The intensity of an LED varies as a function of the command signal. This feature provides a quick and safe means to check controller operation										
Physical	Weight: 10 thru 40 amps: 5 lbs. max., 70 amps: 9 lbs. max. Dimensions: See installation drawings.										
Environment	Operating: 0 to 55°C (32 to 131°F) Storage: -40 to 80°C (-40 to 176°F) Humidity: 0 to 95% Non-condensing										
dv/dt & Transient Voltage protection	200 volts/usec minimum A dv/dt snubber and a metal oxide varistor (MOV) are provided to protect against high frequency transients (dv/dt) and voltage spikes.										
Heat dissipation	1.5 watt per amp of controlled current										
Recommended Fusing	Special semiconductor fuses are not required. It is recommended that the controller and load be protected with fast acting class "T" fuses such as Bussmann type JJS or JJJN fuses. Control Concepts maintains an inventory of fuses and fuse holders for your convenience.										

TIGHTENING TORQUE for the Line 1 & Load 1 connector	
AWG. SIZE	TORQUE
14 ga.	20 in. lbs.
12 ga.	20 in. lbs.
10 ga.	20 in. lbs.
8 ga.	20 in. lbs.
6 ga.	35 in. lbs.
4 ga.	35 in. lbs.
2 ga.	50 in. lbs.

NOTES:
Wiring should be installed per local electrical codes.
24 Volts AC must be supplied to the circuit board from the same phase being controlled.
The transformer supplied with this controller has a primary voltage close to or at the voltage which the controller was designed to control
The wiring from the transformer to the circuit board may be in the range of 18 to 24 gauge.

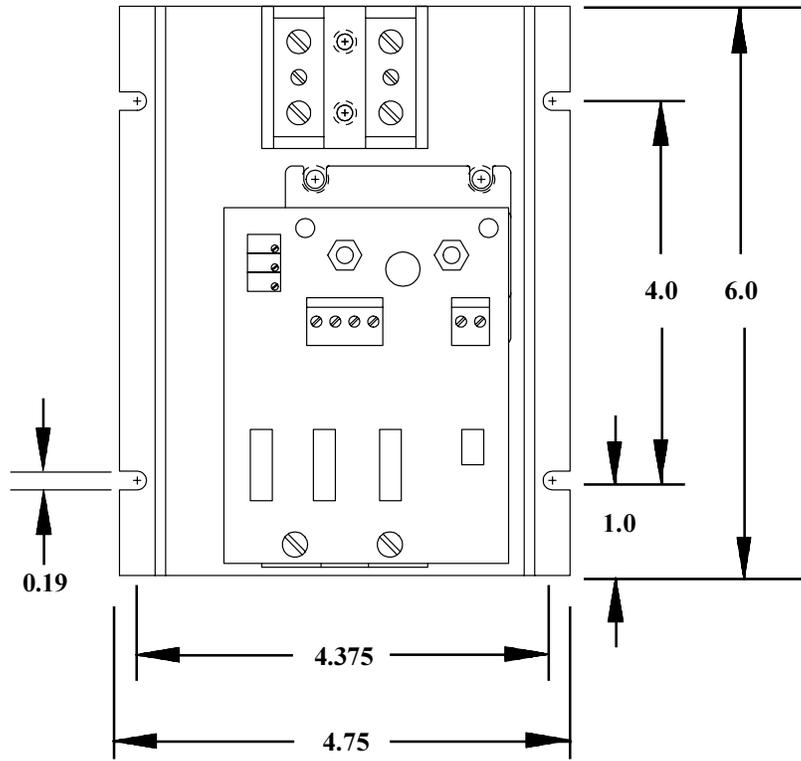


Figure 2. Top view of 10 to 40 Amp model 1032.

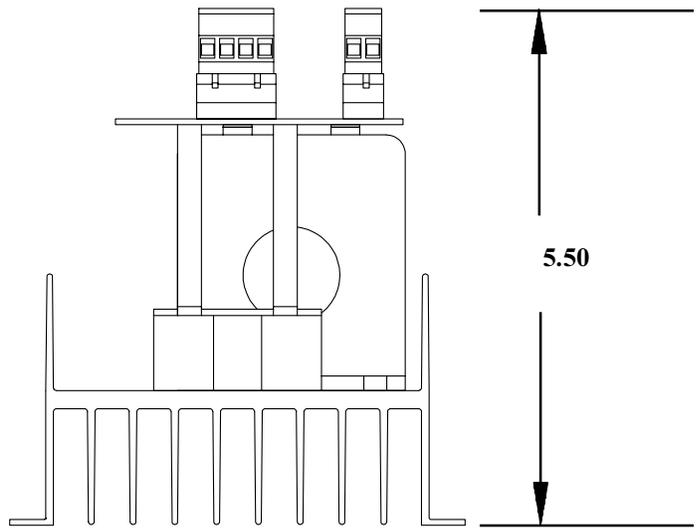


Figure 3. End view of 10 to 40 Amp model 1032.

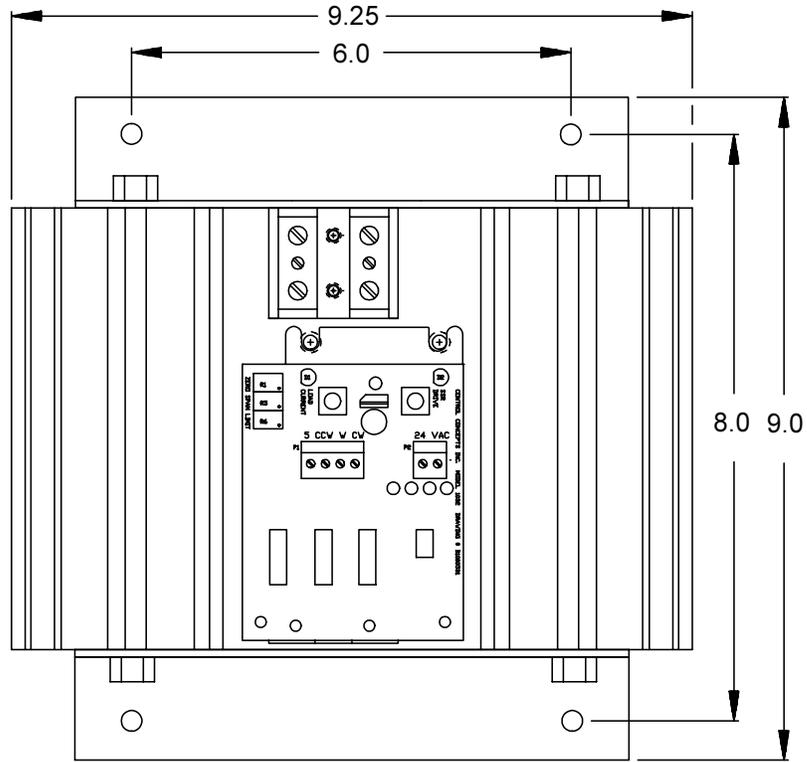


Figure 4. Top view of 70 Amp model 1032.

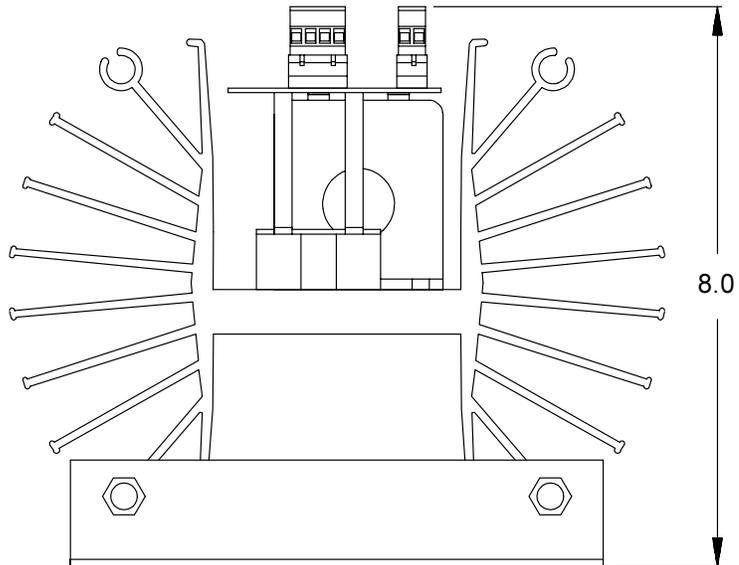


Figure 5. End view of 70 amp model 1032.

INSTALLATION:

The controller must be mounted on a vertical surface such that the heat radiating fins are vertical, as shown on fig. 2 (p. 3) & fig 4 (p. 4). The controller should be located in an environment that will not exceed 135°F and which is free of dust, dirt and moisture.

Figures 3.0 & 4.0 on page 5 show power and control connections. All wiring must be per local electrical codes. The supply and load terminals will accept aluminum wire from #2 to #8 and copper wires from #2 to #14.

The control transformer supplied with the controller provides 24Vac to the circuit. This transformer must be connected to the same electrical phase from which the controller and load are connected. One transformer can be used to operate up to 6 controllers, providing all controllers are connected to the same phase. (A common installation error is that of connecting the transformer to a different phase, or being connected across the SCR module, rather than from the power supply.

It is recommended that the controller and the load be protected with fast acting fuses such as the JJN and JJS, class "T", series of fuses manufactured by the Bussmann Company.

START UP:

Set the command to zero and apply system power. The load voltage should be zero and should increase as the command signal is increased. The load voltage and current may be measured with any meter. However, because of the non-sinusoidal wave-form applied by the SCRs, accurate RMS voltage measurements can only be made with true RMS meters.

ADJUSTMENTS:

Zero: (Factory set to provide zero load voltage when a zero command signal is applied) The zero potentiometer is used to adjust the controller to provide zero load voltage when the command is zero.

Span: (Factory set to provide 100% output with 100% command) The span determines the load voltage for a given command input.

Current Limit: (Factory set at 105% of rated current) Clockwise rotation increases the point at which current limit occurs.

The span and zero have been adjusted at the factory and should require no further adjustments.

If adjustments are required, the following procedures should be used: (see figure 6 on page 6)

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

Note: Loads with variable resistance may cause the current limiting feature to limit the output of the controller, which would appear as though the span is not adjusted properly. Rotate the current limit pot 1 turn counterclockwise. If the load current decreases the current limit is controlling the output.

MODEL:	SCR MODULE	RECOMMENDED CLASS "T" FUSES		FUSE KITS INCLUDES FUSE & HOLDER
	CCI PART #	CCI PART #	BUSSMAN #	CCI PART #
1032-12-10	1612-12-10-T	42110-0430-315	JJN-15	FK\32T15
1032-12-20	1612-12-20-T	42110-0430-325	JJN-25	FK\32T25
1032-12-30	1612-12-30-T	42110-0430-335	JJN-35	FK\32T35
1032-12-40	1612-12-40-T	42110-0430-350	JJN-50	FK\32T50
1032-12-70	1612-12-70-T	42110-0430-390	JJN-90	FK\32T90
1032-24-10	1612-24-10-T	42110-0430-315	JJN-15	FK\32T15
1032-24-20	1612-24-20-T	42110-0430-325	JJN-25	FK\32T25
1032-24-30	1612-24-30-T	42110-0430-335	JJN-35	FK\32T35
1032-24-40	1612-24-40-T	42110-0430-350	JJN-50	FK\32T50
1032-24-70	1612-24-70-T	42110-0430-390	JJN-90	FK\32T90
1032-48-10	1612-48-10-T	42110-0460-315	JJS-15	FK\62T15
1032-48-20	1612-48-20-T	42110-0460-325	JJS-25	FK\62T25
1032-48-30	1612-48-30-T	42110-0460-335	JJS-35	FK\62T35
1032-48-40	1612-48-40-T	42110-0460-350	JJS-50	FK\62T50
1032-48-70	1612-48-70-T	42110-0460-390	JJS-90	FK\62T90
1032-57-10	1612-57-10-T	42110-0460-315	JJS-15	FK\62T15
1032-57-20	1612-57-20-T	42110-0460-325	JJS-25	FK\62T25
1032-57-30	1612-57-30-T	42110-0460-335	JJS-35	FK\62T35
1032-57-40	1612-57-40-T	42110-0460-350	JJS-50	FK\62T50
1032-57-70	1612-57-70-T	42110-0460-390	JJS-90	FK\62T90

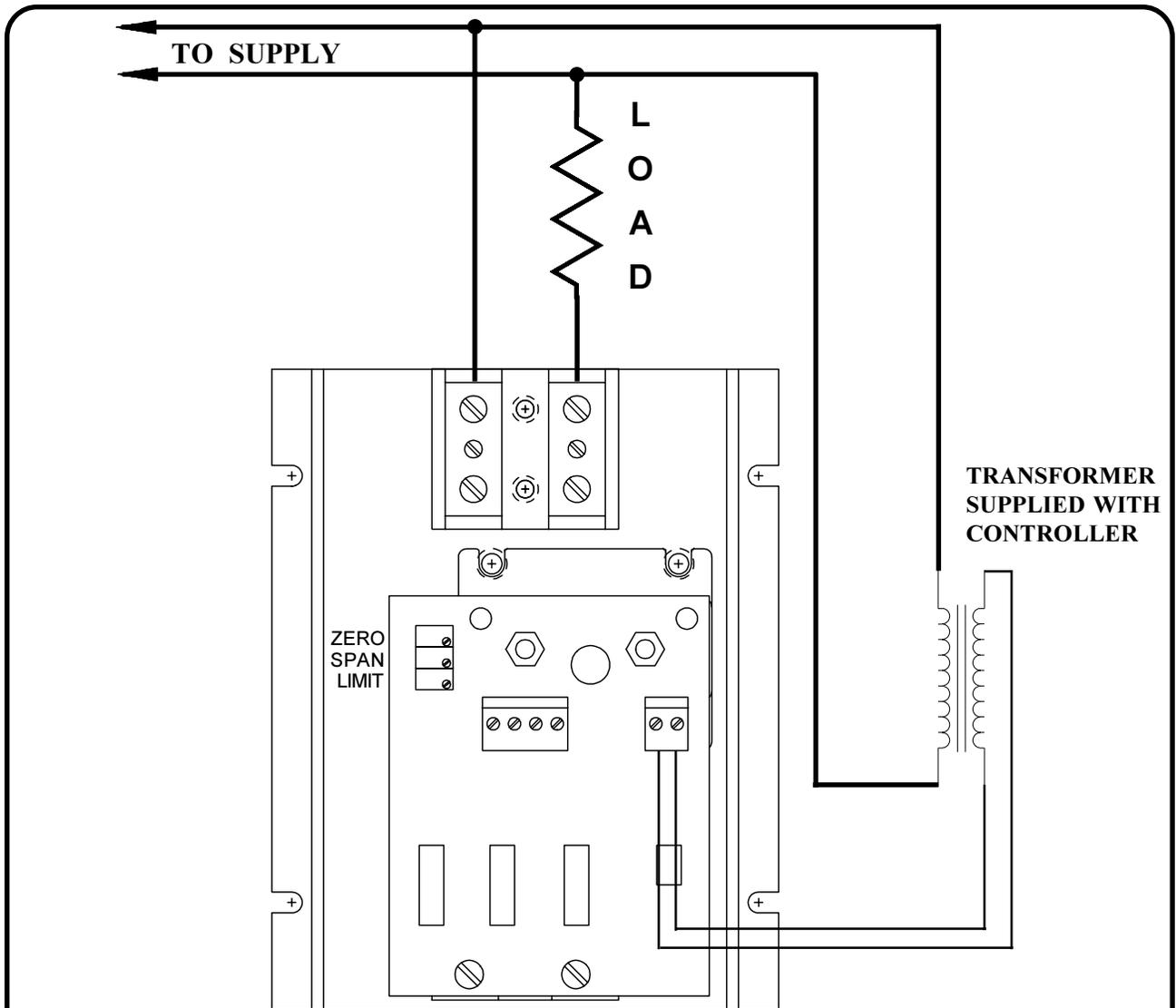


Figure 6. Power Connections

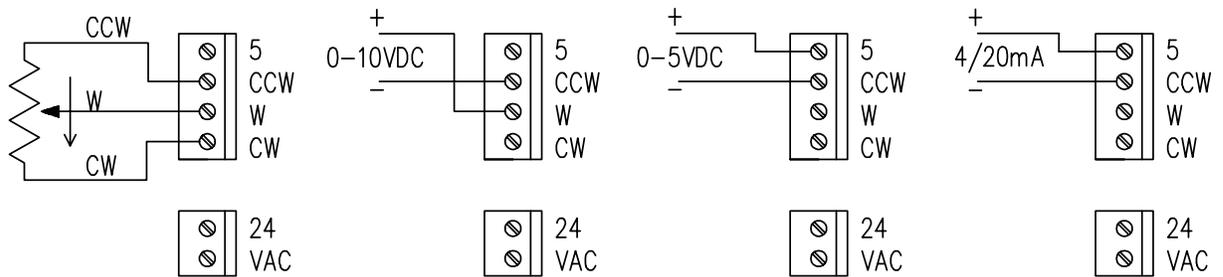


Figure 7. Signal Connections

TROUBLE SHOOTING:

Control Concepts has field service engineers who can aid in determining the cause of controller problems.

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:

THE LED IS NOT ON:

Determine that the command signal is applied to the controller. Determine that 24 volts is applied to the circuit.

THE 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 and current rating of the controller, and the serial number of the failed unit.

MAXIMUM LOAD VOLTAGE CAN NOT BE OBTAINED:

Determine that the primary of the circuit 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 connection at the controller. NOTE: The current limit may prevent line voltage from being applied to the load. To determine if the current limit is preventing full voltage, rotate the potentiometer labeled "limit" 1 turn clockwise. If the load voltage increases, the load current and therefore the load voltage is being limited.

LOAD POWER IS MAXIMUM AND CAN NOT BE REDUCED:

LED IS ON:

Determine that the command signal can be adjusted to zero. Also remove the plug in connection to remove the command signal. If the LED is not off, the circuit card has probably failed.

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 failed as a short, measure the resistance across the line and load terminals of the SCR with the line and load connections removed. If the resistance is less than 10,000 ohms, the SCR module has probably failed. NOTE: if a replacement SCR module is ordered, specify the voltage and current rating of the controller, and the serial number of the failed controller.

LOAD VOLTAGE SNAPS ON:

Determine that the primary of the circuit transformer is connected to the same supply as the controller and load.

SPARE CIRCUIT BOARD:

When ordering spare or replacement circuit card

Specify: 1032-FC

(If the command is a milliamp signal or a special voltage range, specify the range when ordering).

See page 5 for numbers for spare SCR modules and recommended fuses.

REFERENCE DRAWINGS:

Schematic	D1000532A1
Transformer Inst. Dwg.	AS1401

MANUFACTURED BY:

