

**CONTROL
CONCEPTS
INC.**

INSTRUCTION MANUAL

MODEL 1032

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 ordered 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 or 575Vac 50/60 hertz. The controllers can be obtained with current ratings of 10, 20, 30, 40 or 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 controlling 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 SCRs from its mounting plate, and which uses photo couplers to isolate the SCR gate signals.

MODEL No. IDENTIFICATION:

MODEL NUMBER: 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 A

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 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 105% 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.

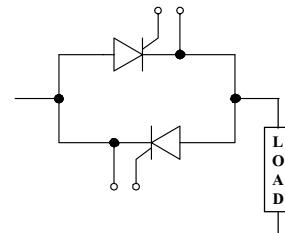


Figure 1A. Simplified diagram of an SCR controller

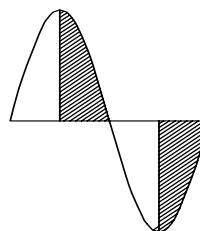


Figure 1B. SCR "ON" time, shown by shaded area, is varied to apply the desired load voltage.

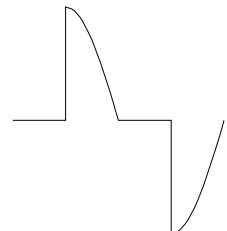


Figure 1C. Voltage waveform, as applied to load.

INSTALLATION:

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

Figures 6 & 7 on P. 6 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. See p. 9

TORQUE TABLE FOR USD CONNECTORS



Wire Size	Recommended Torque
10 -14 ga	35 in-lbs
8 ga	40 in-lbs
4 - 6 ga	45 in-lbs
2-3 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.

START UP:

Set the command to zero and apply system power. The load voltage should start at zero and should increase as the command signal is increased. The load voltage and current may be measured with any meter. Because of the non-sinusoidal wave-form applied by the SCRs, accurate 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 unless ordered with a specific current limit setting. Counter-clockwise rotation decreases the point at which current limit occurs.

CALIBRATION

The span and zero have been adjusted at the factory and should require no further adjustments. If adjustments become necessary, the following procedures should be used:
(see figure 8 on p. 8 for location of adjustments.)

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. 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.

To test for current limiting, rotate the current limit pot 1 turn counterclockwise. If the load current decreases, the current limit is controlling the output.

DIMENSIONS: 10 - 40 Amp Frame

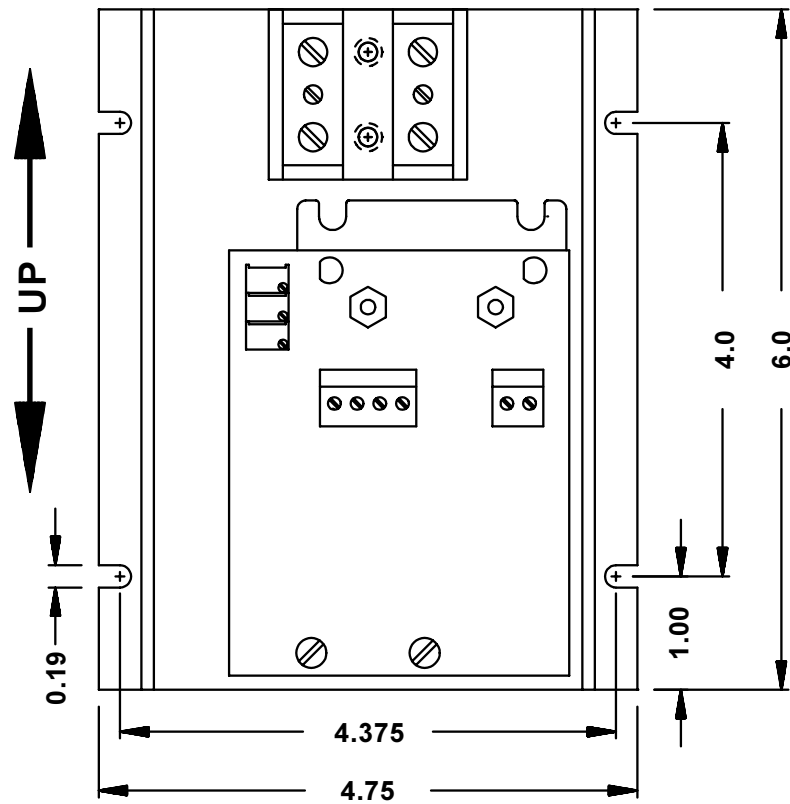


Figure 2. Mounting dimensions of 10 to 40 Amp model 1032.

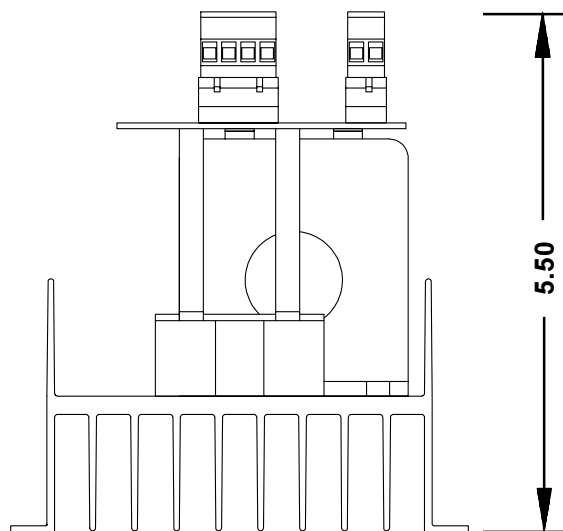


Figure 3. End view of 10 to 40 Amp model 1032.

DIMENSIONS: 70 Amp Frame

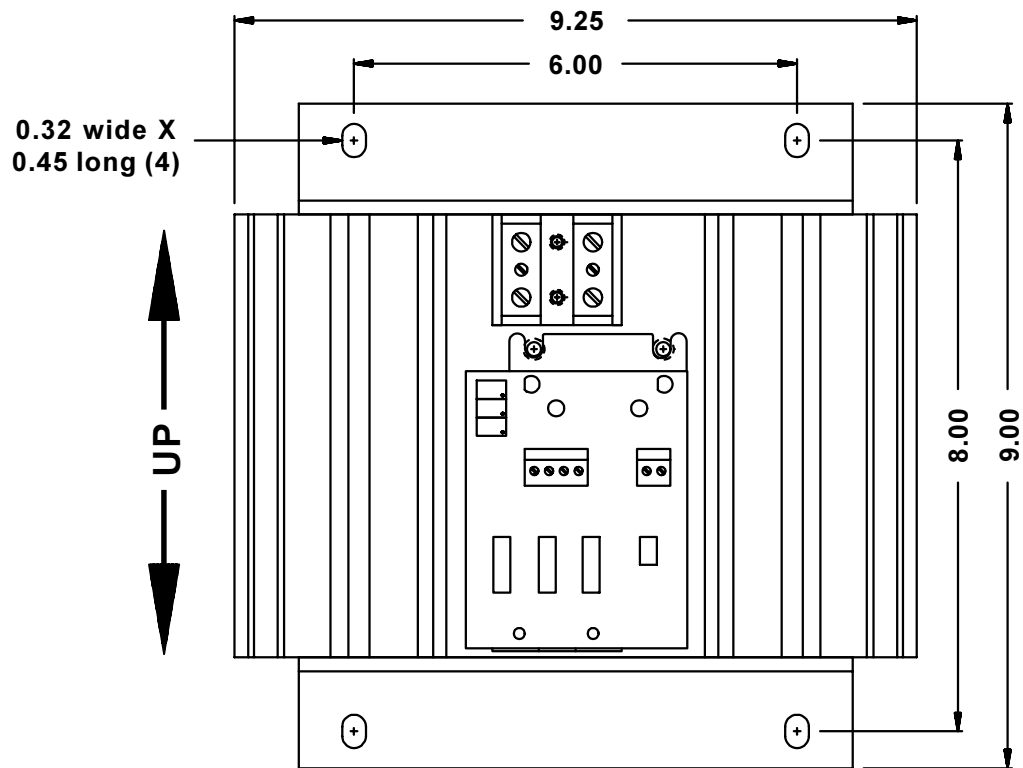


Figure 4. Mounting dimensions of 70 Amp model 1032.

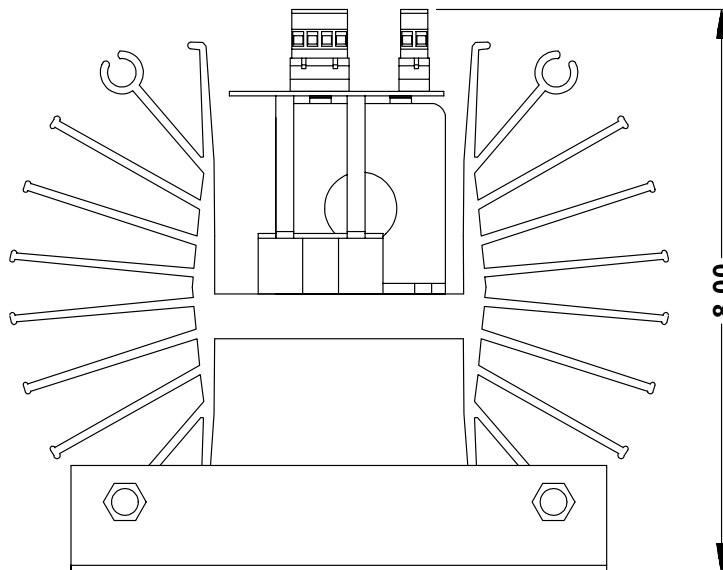
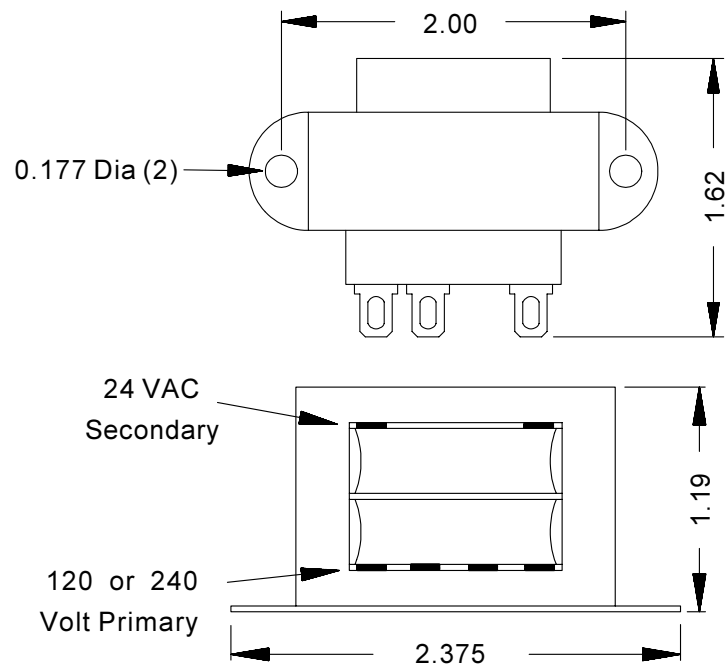
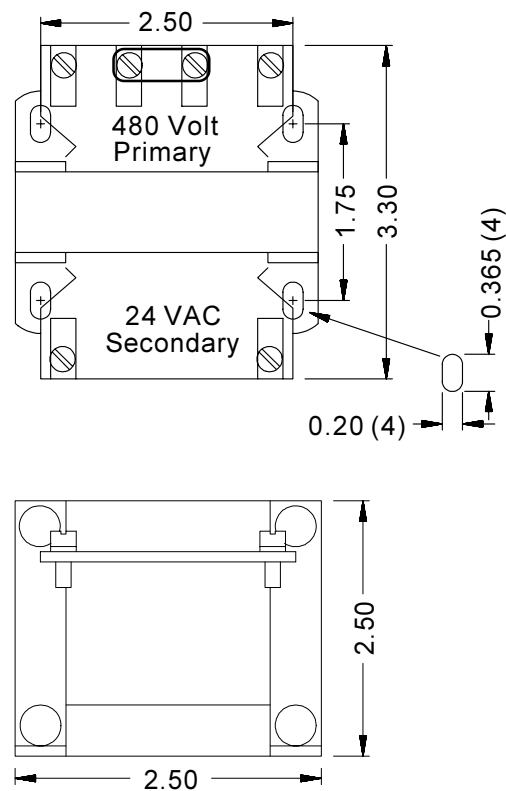


Figure 5. End view of 70 amp model 1032.

DIMENSIONS: Transformers



120/240 VOLT PRIMARY TRANSFORMER



480 VOLT PRIMARY TRANSFORMER

ELECTRICAL CONNECTIONS:

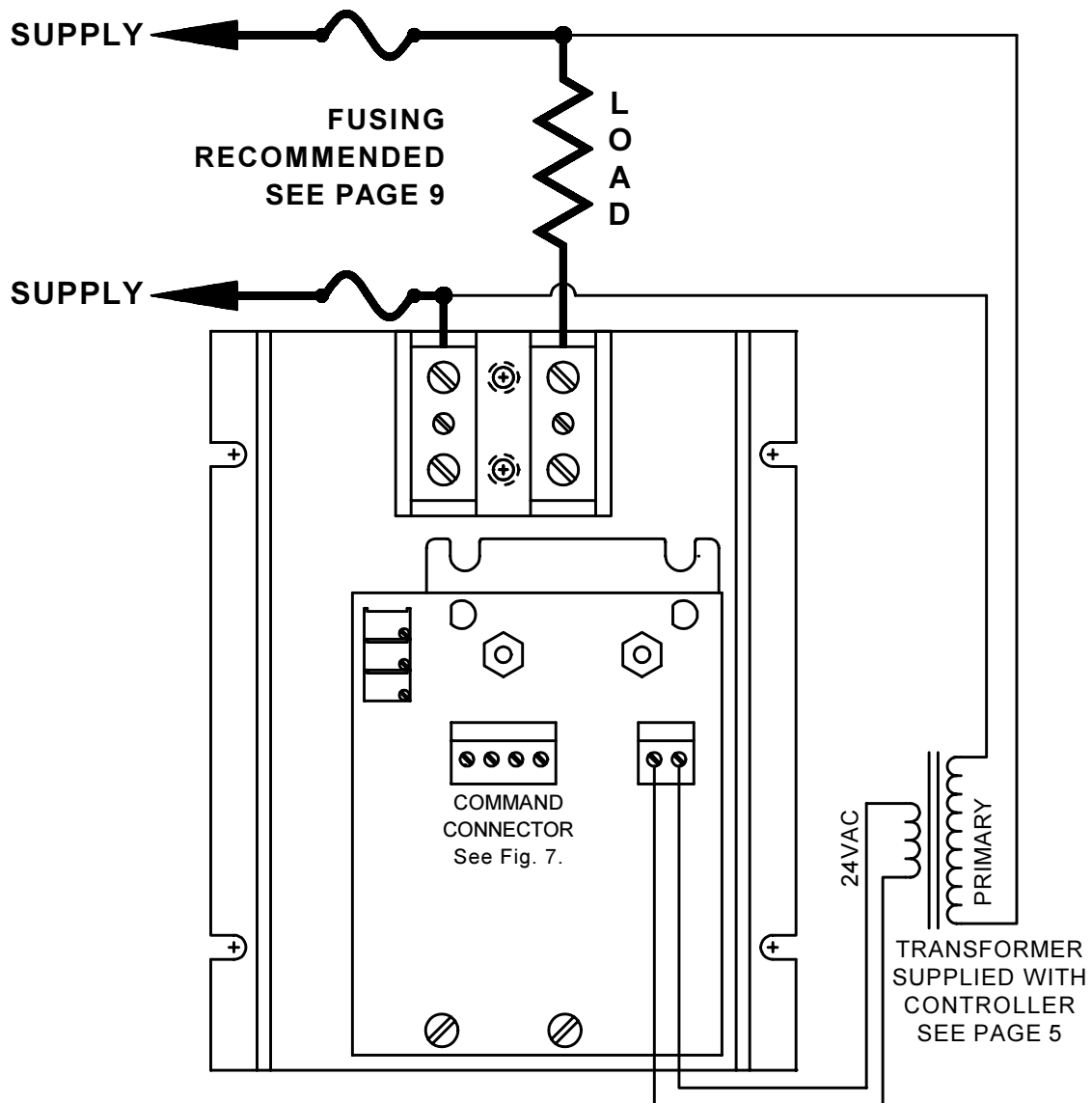


Figure 6. Power :Connections

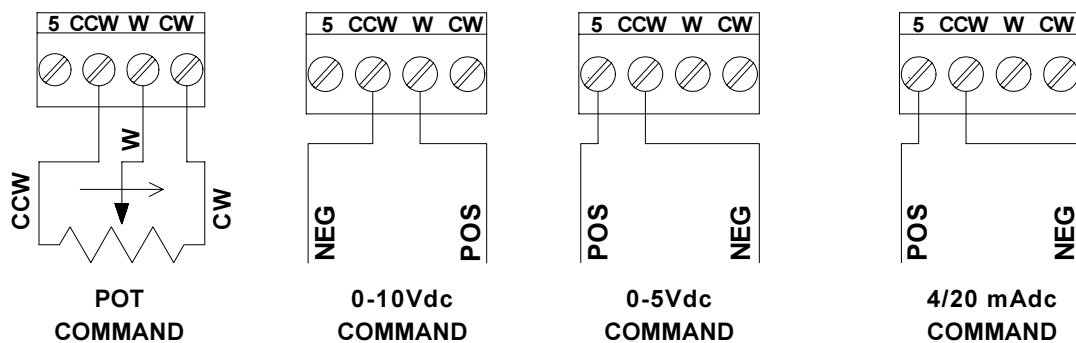


Figure 7. Signal Connections

SPECIFICATIONS											
Control Mode	Single-phase; Phase-angle; RMS value of the voltage applied to the load										
Command Signal	<table> <tr> <th>Signal</th><th>Impedance</th></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 Adj.	User adjustable over a range of 20% of span										
Current Limit Adj.	User adjustable over a range from 20% to 110% of rated current										
Isolation	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										
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 Indicators	The intensity of the ' SSR DRIVE ' LED varies proportionally to the Voltage applied to the load. The intensity of the ' LOAD CURRENT ' LED varies as a function of the load current. These LED's provide 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, pages 3 & 4.										
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 JJN fuses. Control Concepts maintains an inventory of fuses and fuse holders for your convenience.										

TROUBLE SHOOTING:

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.

Two LED's on the circuit board may be used to aid in determining problems with the controller.

The '**SSR DRIVE**' LED varies in intensity proportional to the drive signal to the Solid State Relay and is proportional to the load voltage.

The '**LOAD CURRENT**' LED varies in intensity proportional to the current through the load. If the load current reaches the current limit setting, the intensity of the '**LOAD CURRENT**' LED will no longer increase and the load current will remain fixed.

THE FOLLOWING ARE SYMPTOMS AND POSSIBLE SOLUTIONS:

NO LOAD POWER:

The '**LOAD CURRENT**' LED is not on, the intensity of the '**SCR DRIVE**' LED can be varied:

Determine that the load is wired correctly to the controller. 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.

If a replacement SCR module is ordered, specify the voltage, current rating and serial number of the failed unit.

MAXIMUM LOAD VOLTAGE CANNOT BE REACHED:

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

This problem could be caused by the primary being connected across the load and line connection at the controller, or across a different phase than the controller and load. (Fig. 6 on P. 6.)

The current limit feature may prevent maximum line voltage from being applied to the load. To determine if the current limit feature is preventing full voltage from being applied to the load, rotate the potentiometer labeled "**LIMIT**" 1 turn counter-clockwise. If the load voltage decreases, the load current is being limited.

LOAD POWER IS MAXIMUM AND CANNOT BE REDUCED:

'SCR DRIVE' LED is on:

Determine that the command signal is zero. To do this, remove the command signal connector. If the LED remains on, the circuit card has likely failed.

'SCR DRIVE' LED is off:

Remove the 24Vac power connector. If the load still has power, the SSR module has probably failed.

To determine if the SSR module is shorted, remove the line and load connections and measure the resistance across the line and load terminals of the controller. If the resistance is less than 10,000 ohms, the SCR module has probably failed. If a replacement SCR module is ordered, specify the voltage, current rating and serial number of the controller.

Load voltage snaps on:

Determine that the primary of the circuit transformer is connected across the same phase as the controller and load. (See figure 6 on page 6.)

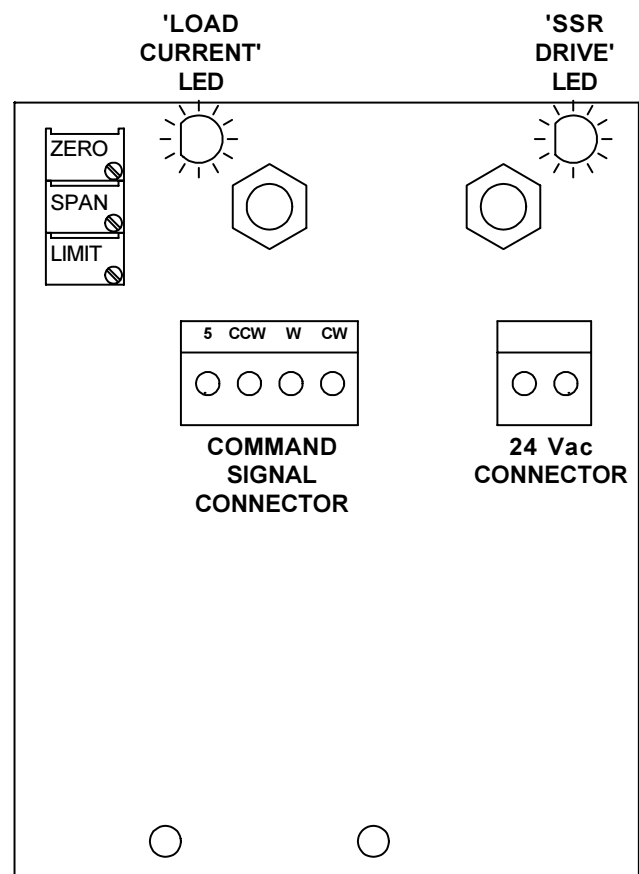


Figure 8. 1032 Board Layout.

ORDERING PARTS:

Firing Circuit, Specify: 1032-FC
(Include the command range when ordering).

See below for numbers for spare SCR modules and recommended fuses. If a replacement SCR module is ordered, specify the voltage, current rating and serial number of the failed unit.

REFERENCE DRAWINGS:

Schematic D1000532A1

Transformer Inst. Dwg. Page 5

REPLACEMENT PARTS:

RECOMMENDED REPLACEMENT SCR:		RECOMMENDED FUSES (typical) (Alternative fuse size is 125% of max. load current)		
MODEL:	ASSEMBLY PART No. *	CCI PART #	BUSSMAN #	CCI FUSEKIT **
1032-12-10	1652-12-10	42110-0460-315	JJS-15	FK\62T15
1032-12-20	1652-12-20	42110-0460-325	JJS-25	FK\62T25
1032-12-30	1652-12-30	42110-0460-335	JJS-35	FK\62T35
1032-12-40	1652-12-40	42110-0460-350	JJS-50	FK\62T50
1032-12-70	1652-12-70	42110-0460-390	JJS-90	FK\62T90
1032-24-10	1652-24-10	42110-0460-315	JJS-15	FK\62T15
1032-24-20	1652-24-20	42110-0460-325	JJS-25	FK\62T25
1032-24-30	1652-24-30	42110-0460-335	JJS-35	FK\62T35
1032-24-40	1652-24-40	42110-0460-350	JJS-50	FK\62T50
1032-24-70	1652-24-70	42110-0460-390	JJS-90	FK\62T90
1032-48-10	1652-48-10	42110-0460-315	JJS-15	FK\62T15
1032-48-20	1652-48-20	42110-0460-325	JJS-25	FK\62T25
1032-48-30	1652-48-30	42110-0460-335	JJS-35	FK\62T35
1032-48-40	1652-48-40	42110-0460-350	JJS-50	FK\62T50
1032-48-70	1652-48-70	42110-0460-390	JJS-90	FK\62T90

* The assembly includes the SCR relay, a thermal conductive pad, an MOV and an instruction sheet.

** The fuse kit includes two fuses of appropriate rating for the frame size, and a fuseblock.

Control concepts recommends that fuses be rated at 120 to 125% of maximum load current.

MANUFACTURED BY:



TEL: (952) 474-6200 (800) 765-2799
FAX: (952) 474-6070 www.ccipower.com

8077 Century Blvd
Chanhassen, MN 55317, USA