

# **MODEL 1032A**

## **INSTALLATION & MAINTENANCE MANUAL**

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WARNING: The Control Concepts, Inc. power controllers use power thyristors to switch voltage to the connected load. Line voltage must be assumed at the output terminals at all times, even when the control signal has been removed and the load voltage appears to be off. It has been mandated by the National Electrical Code and the Occupational Safety and Health Act of 1970 that a physical disconnect be opened ahead of all remotely actuated controls before performing any maintenance work on the controller or its connected load.

### PROPRIETARY DATA

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## DESCRIPTION

The model 1032A is a single-phase, phase-angle, power controller with soft start and missing cycle detection.

Field selectable features include:

- Current or Voltage Feedback.

- Current or Voltage Limiting.

Field adjustable features include:

- Zero & Span Adjustments.

- Current/Voltage limiting.

Standard command signals are:

- 0 to 5Vdc, 0-10Vdc, 4/20mA or potentiometer.

- Other commands may be available, contact factory for details.

Standard line voltage inputs are:

- 120, 240, 480 or 575Vac.

- Other voltages may be available, contact factory for details.

Standard current ratings are:

- 10, 20, 30, 40 or 70 A, @ 50/60 hertz.

The model 1032A linearly controls, with respect to the command signal, the RMS value of the voltage or current applied to the load.

The controller has line voltage compensation, which, for a constant command signal, maintains constant load voltage or load current, independent of line or supply voltage variations.

Upon start-up or after power interruptions of one half cycle or more, the soft-start/missing cycle detection feature will set the load voltage to zero, and then increase the load voltage to the desired value at a predetermined rate. This feature prevents saturation of load transformers.

The current limit feature eliminates high inrush 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.

Voltage limiting allows the user to adjust the maximum voltage applied to loads that are voltage sensitive.

Electrical isolation of the circuit card and the heat sink is achieved by the use of a Solid State Relay module that is electrically isolated from the mounting plate, and which uses photo couplers to isolate the gate signals.

NOTE: Because of a gate disable pulse, necessary to prevent a half cycle misfire, the current feedback mode will cause "hiccuping" of the load current when the command signal calls for very small amounts of current.

## SPECIFICATIONS

|                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                       |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------|---------|----------|----------|-----------|---------|-----------|---------------|-----------|--------------------------------------------|--|
| <b>CONTROL MODE</b>                                                      | Single-phase, phase-angle, RMS or AVG value of the voltage or current applied to the load.                                                                                                                                                                                                                                                                                                            |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>COMMAND SIGNAL</b>                                                    | <table> <tr> <td><b>Command Signal</b></td><td><b>Input Resistance</b></td></tr> <tr> <td>4/20 mA</td><td>300 ohms</td></tr> <tr> <td>0/10 Vdc</td><td>200K ohms</td></tr> <tr> <td>0/5 Vdc</td><td>100K ohms</td></tr> <tr> <td>Potentiometer</td><td>200K ohms</td></tr> <tr> <td colspan="2">(1K recommended; 20K permissible 1/2 watt)</td></tr> </table>                                         | <b>Command Signal</b> | <b>Input Resistance</b> | 4/20 mA | 300 ohms | 0/10 Vdc | 200K ohms | 0/5 Vdc | 100K ohms | Potentiometer | 200K ohms | (1K recommended; 20K permissible 1/2 watt) |  |
| <b>Command Signal</b>                                                    | <b>Input Resistance</b>                                                                                                                                                                                                                                                                                                                                                                               |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| 4/20 mA                                                                  | 300 ohms                                                                                                                                                                                                                                                                                                                                                                                              |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| 0/10 Vdc                                                                 | 200K ohms                                                                                                                                                                                                                                                                                                                                                                                             |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| 0/5 Vdc                                                                  | 100K ohms                                                                                                                                                                                                                                                                                                                                                                                             |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| Potentiometer                                                            | 200K ohms                                                                                                                                                                                                                                                                                                                                                                                             |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| (1K recommended; 20K permissible 1/2 watt)                               |                                                                                                                                                                                                                                                                                                                                                                                                       |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>CONTROL RANGE</b><br><b>VOLTAGE FB MODE</b><br><b>CURRENT FB MODE</b> | <p>8 to 97% of line voltage, RMS or AVG, typical. Subject to limiting.</p> <p>0 to 100% of load current, RMS or AVG, typical. Subject to limiting.</p>                                                                                                                                                                                                                                                |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>LINEARITY</b>                                                         | RMS or AVG load current or voltage is linear within 2% of span of the command signal.                                                                                                                                                                                                                                                                                                                 |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>ZERO AND SPAN RANGE</b>                                               | User adjustable over a range of 20% of span.                                                                                                                                                                                                                                                                                                                                                          |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>CURRENT LIMIT RANGE</b>                                               | User adjustable over a range from 20% to 105% of rated current.                                                                                                                                                                                                                                                                                                                                       |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>VOLTAGE LIMIT RANGE</b>                                               | User adjustable over a range from 20% to 105% of rated voltage.                                                                                                                                                                                                                                                                                                                                       |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>ISOLATION</b>                                                         | <p>Dielectric strength input/line &amp; load voltage/heat sink: 2500 V (RMS)</p> <p>Maximum capacitance input to output: 8 pF.</p>                                                                                                                                                                                                                                                                    |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>COOLING</b>                                                           | Convection, with fins oriented vertically.                                                                                                                                                                                                                                                                                                                                                            |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>MOUNTING</b>                                                          | <p>Must be mounted on vertical surface with fins oriented vertically.</p> <p>Units may be mounted adjacent to each other.</p> <p>Heat sink is electrically isolated from control signal power.</p>                                                                                                                                                                                                    |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>LINE VOLTAGE</b>                                                      | 120, 240, 480 or 575 Vac, +10%, -20%, 50/60 Hz.                                                                                                                                                                                                                                                                                                                                                       |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>LOAD CURRENT</b>                                                      | 10, 20, 30, 40 or 70 Amps                                                                                                                                                                                                                                                                                                                                                                             |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>DIAGNOSTIC INDICATORS</b>                                             | <p>The intensity of the '<b>SSR DRIVE</b>' LED varies proportionally to the drive applied to the solid state relay module.</p> <p>The intensity of the '<b>LOAD CURRENT</b>' LED varies as a function of the load current.</p> <p>The '<b>LIMIT</b>' LED comes on when the limit (current or voltage) has been reached.</p> <p>These LEDs provide a quick and safe means to check the controller.</p> |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>PHYSICAL</b>                                                          | <p>Weight: 10 to 40 Amps: 5 lbs. max</p> <p>70 Amps: 9 lbs. max</p> <p>Dimensions: See installation drawings.</p>                                                                                                                                                                                                                                                                                     |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>ENVIRONMENT</b>                                                       | <p>Operating 0 to 55°C (32 to 131° F)</p> <p>Storage -40 to 80°C (-40 to 176° F)</p> <p>Humidity 0 to 95% Non-condensing.</p>                                                                                                                                                                                                                                                                         |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>DV/DT &amp; TRANSIENT VOLTAGE PROTECTION</b>                          | DV/DT rating exceeds 200 volts per microsecond. A snubber circuit and MOV are provided to protect against high frequency transients (dv/dt) and high voltage spikes.                                                                                                                                                                                                                                  |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>HEAT DISSIPATION:</b>                                                 | 1.5 watts per amp of SCR current.                                                                                                                                                                                                                                                                                                                                                                     |                       |                         |         |          |          |           |         |           |               |           |                                            |  |
| <b>RECOMMENDED FUSING</b>                                                | <p>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.</p> <p>Control Concepts, Inc. maintains an inventory of fuses and fuse holders for your convenience.</p>                                                                                                        |                       |                         |         |          |          |           |         |           |               |           |                                            |  |

## INSTALLATION

The controller must be mounted on a vertical surface such that the heat radiating fins are vertical. The controller should be located in an environment that will not exceed 55° C and is free of dust, dirt and moisture. If the environment exceeds 55° C, the current rating of the controller must be derated.

All wiring must be per local electrical codes. The supply and load terminals will accept copper wires from # 2 to #14.

The 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. (A common installation error is that of connecting the transformer to a different phase, or being connected across the SSR 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.

### NOTES:

Power 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.

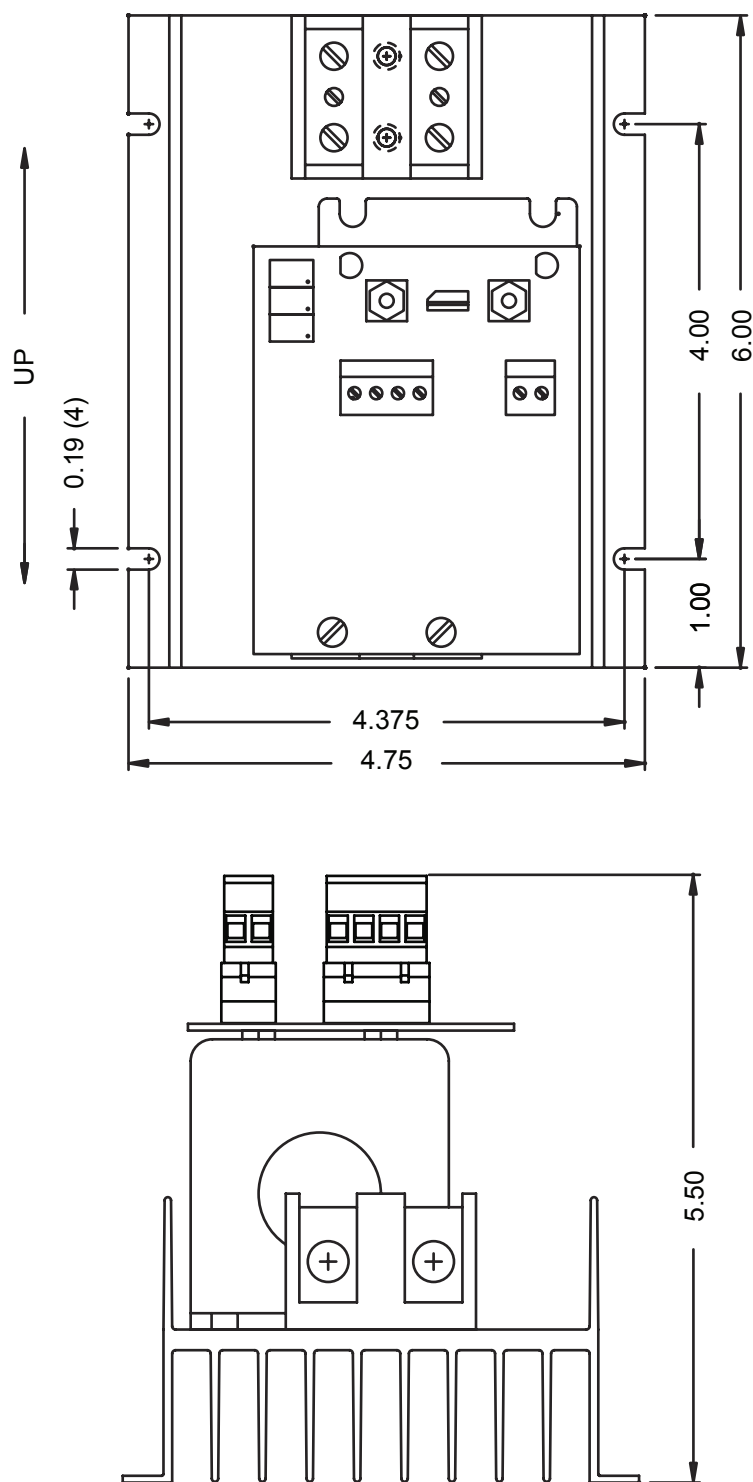
| RECOMMENDED TIGHTENING TORQUE<br>USD CONNECTORS: |                  |
|--------------------------------------------------|------------------|
| WIRE SIZE (AWG)                                  | TORQUE           |
| <b>14 - 10 GA</b>                                | <b>35 IN-LBS</b> |
| <b>8 GA</b>                                      | <b>40 IN-LBS</b> |
| <b>4 - 6 GA</b>                                  | <b>45 IN-LBS</b> |
| <b>2 - 3 GA</b>                                  | <b>50 IN-LBS</b> |



| RECOMMENDED TIGHTENING TORQUE<br>FOR GREEN CONNECTOR: |                   |
|-------------------------------------------------------|-------------------|
| WIRE SIZE (AWG)                                       | TORQUE            |
| <b>12 TO 26GA</b>                                     | <b>5.0 IN-LBS</b> |

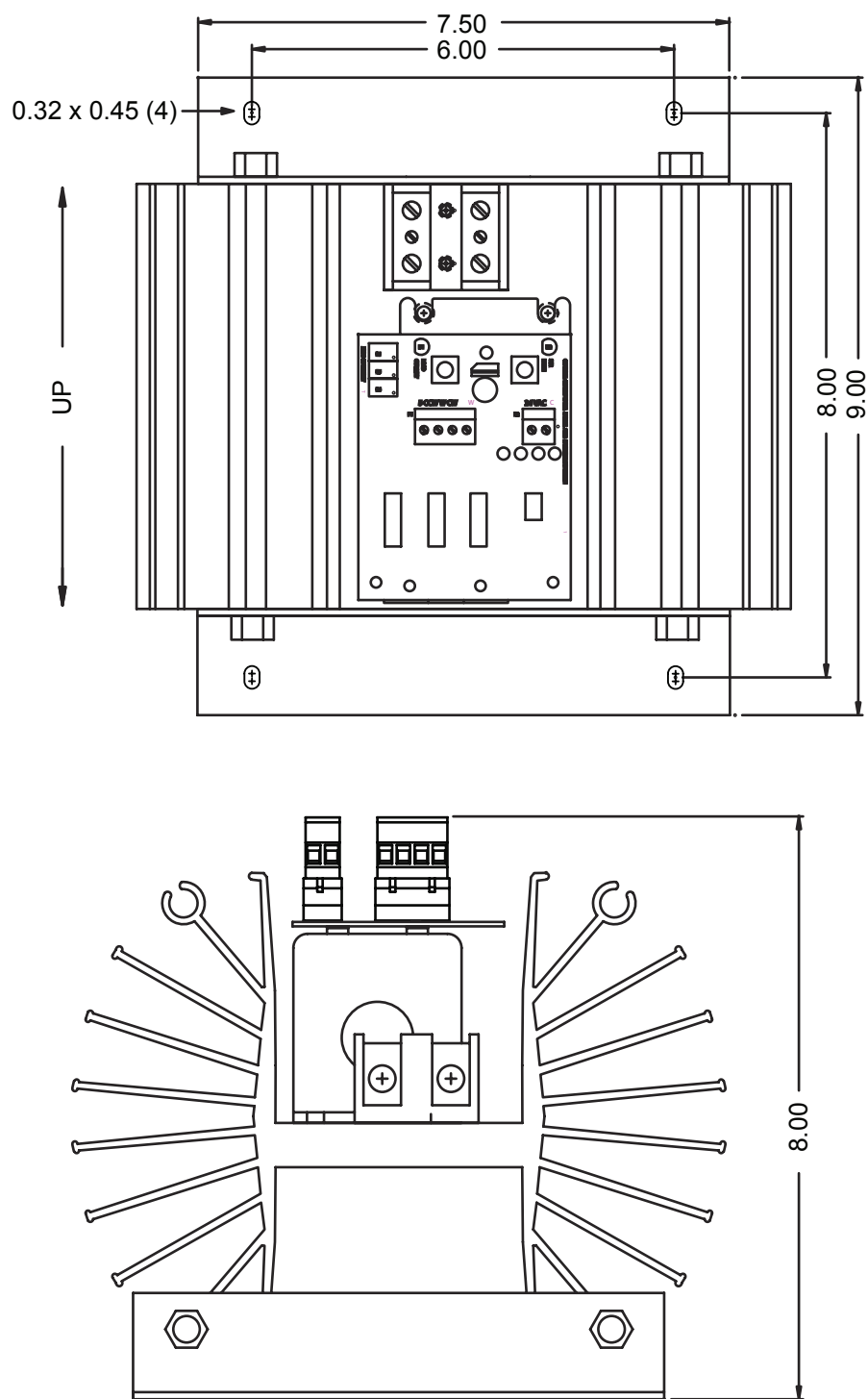


## INSTALLATION DRAWINGS



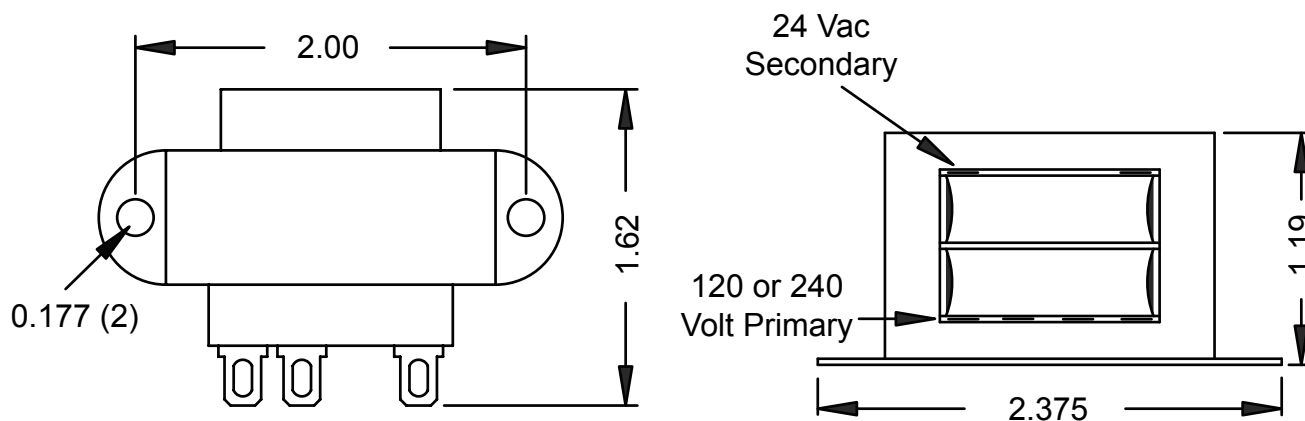
**Figure 1.** Mounting dimensions of 10 - 40 Amp model 1032A.

## INSTALLATION DRAWINGS (Continued)

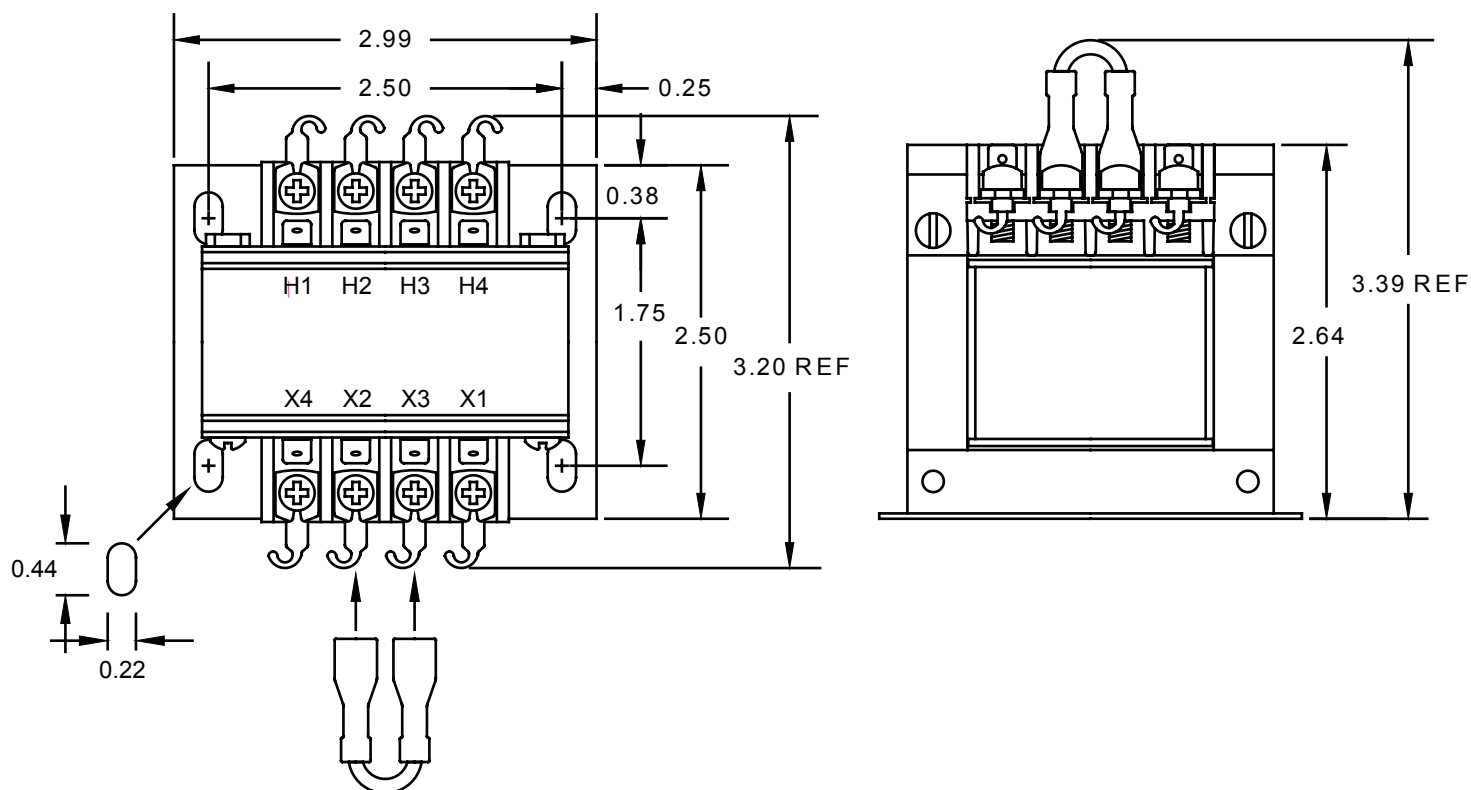


**Figure 2.** Mounting dimensions of 70 Amp model 1032A.

## INSTALLATION DRAWINGS (Continued)

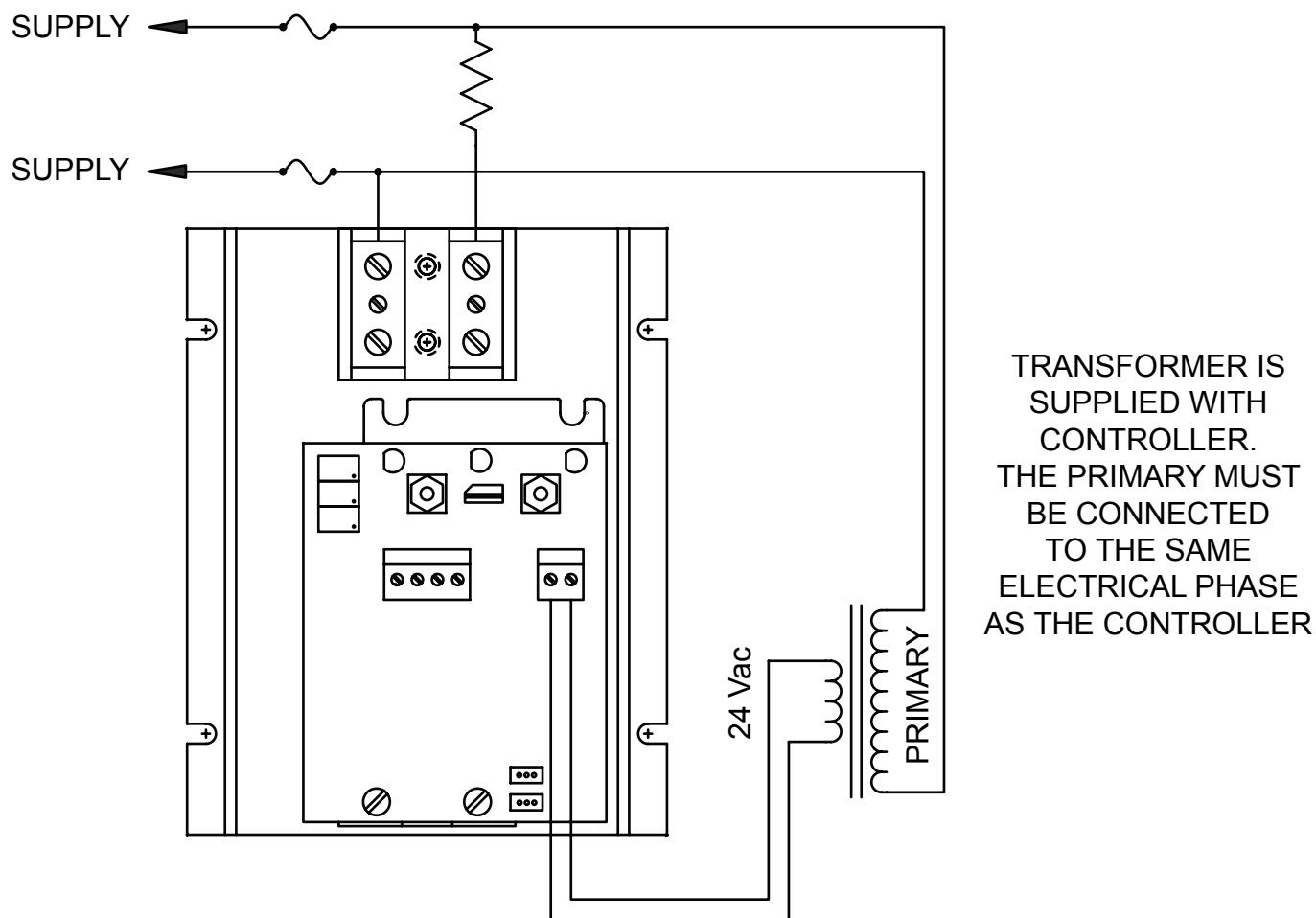


**Figure 3.** 120/240 Volt Primary Transformer.

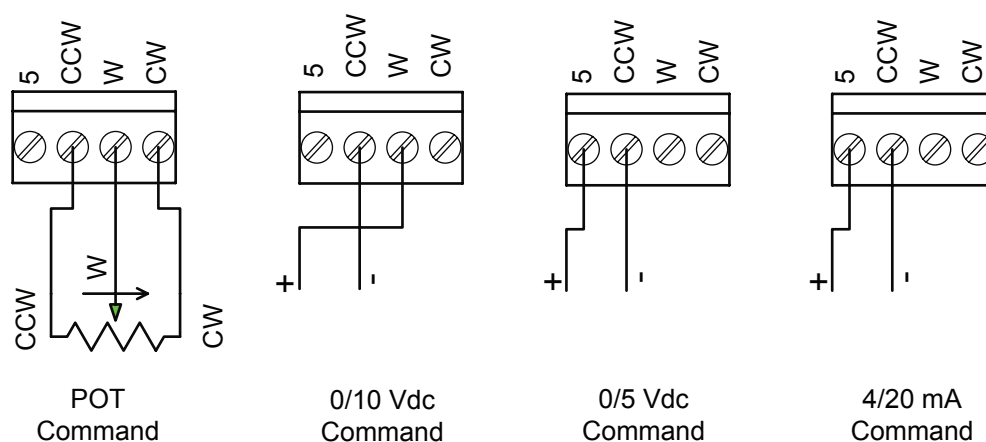


**Figure 4.** 480 Volt across H1 and H4 of Primary.  
Jumper across X2 and X3 to create 24 Vac on Secondary.

## ELECTRICAL CONNECTIONS



**Figure 5.** Power Connections.



**Figure 6.** Signal Connections.

## CIRCUIT BOARD

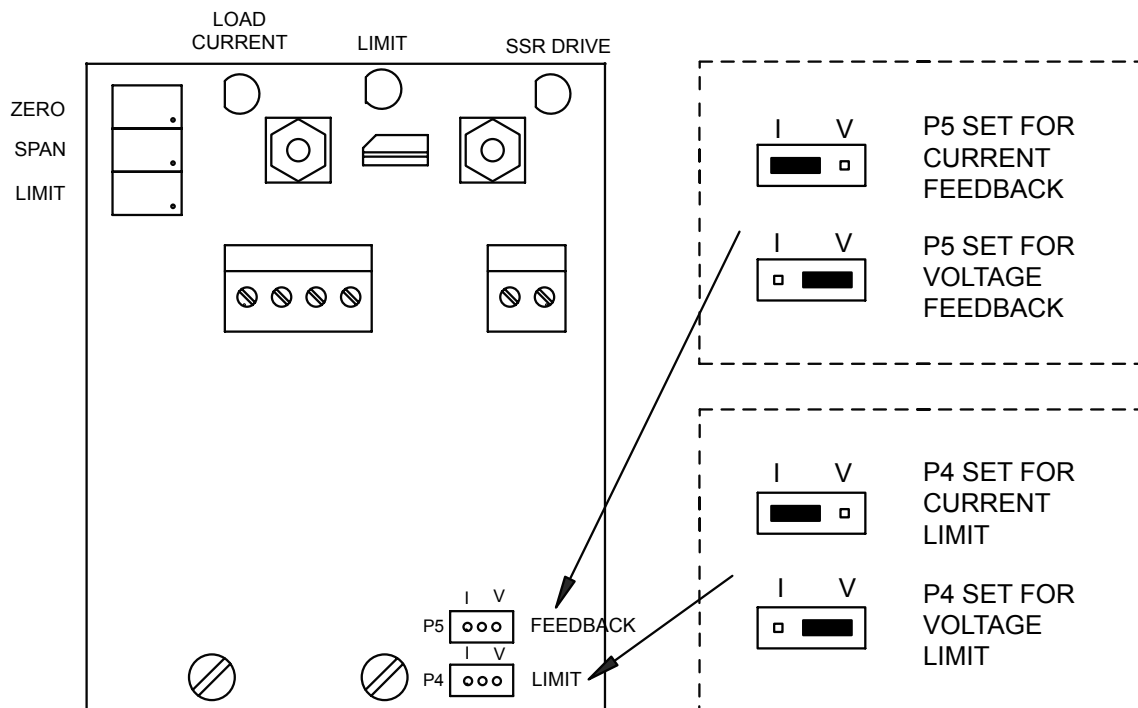


Figure 7. 1032A User interface components.

## 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. Because of the non-sinusoidal wave-form applied by the SSRs, accurate measurements can only be made with true RMS meters.

## ADJUSTMENTS

Determine that the jumpers on P4 and P5 are in the desired positions for the limit and feedback.

**The zero and span potentiometers are factory set, and generally do not require further adjustment.**

If adjustments become necessary, the following procedure should be followed.

If you are using RMS feedback, you must use a true RMS meter for these measurements.

1. Set the command signal to minimum and adjust the zero potentiometer until the output is zero. If this pot is set incorrectly, the output of the controller may not be linear with respect to the command signal, or, the controller may be unable to shut off completely.
2. Set the command signal to maximum and adjust the span potentiometer until the output is at the desired maximum value. If this pot is set incorrectly, the output of the controller may not be linear with respect to the command signal, or, the controller may be unable to reach full output.
3. The span and zero adjustments may interact, therefore it may be necessary to repeat steps 1 and 2.

Current Limit restricts the increase of load current beyond a set level. Counter-clockwise rotation decreases the current at which limiting occurs. When Limit LED is lit the selected limit has been reached.

Voltage Limit restricts the increase of load voltage beyond a set level. Counter-clockwise rotation decreases the voltage at which limiting occurs. When Limit LED is lit the selected limit has been reached.

Note: Loads with variable resistance may cause the current limiting feature to limit the output of the controller. This would appear as though the SPAN is not adjusted properly.

## 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. 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.

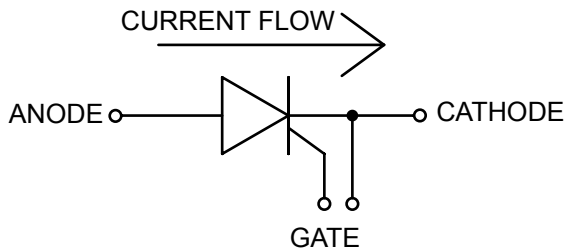


Figure 8. SCR symbol

Because the SCR allows current to flow in only one direction, two SCR's are connected in an inverse parallel (back to back) configuration to control AC current.

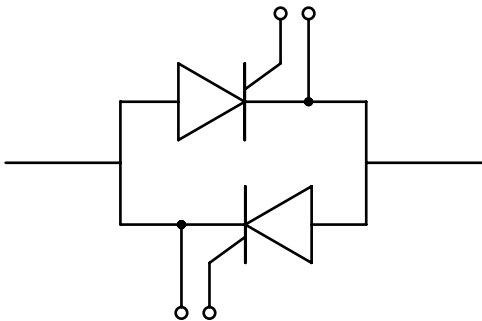


Figure 9. "AC Switch"

### PHASE-ANGLE OPERATION

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. 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.

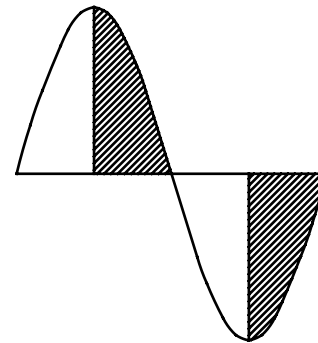


Figure 10. SCR "ON" time, shown by shaded area, is varied to apply the desired load voltage

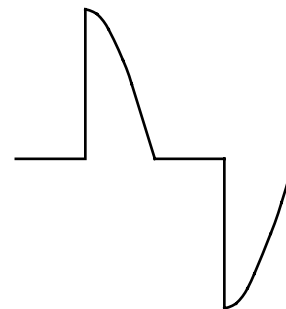


Figure 11. Power is regulated by advancing or delaying the point at which the SCR's are turned on.

## REPLACEMENT PARTS

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

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

\*\*The fuse kit includes two fuses of appropriate rating for the frame size, and a fuseblock. CCI recommends fuses rated at 120-125% max load current.

## MODEL No. IDENTIFICATION

**1032A-VV-AA-CS-ILXX-VLXXX**

Basic Model Number \_\_\_\_\_

**VV** = Rated voltage \_\_\_\_\_

**12** = 120 Volts AC  
**24** = 240 Volts AC (for 208 Volts or 220 Volts specify "SC208" or "SC220")  
**48** = 480 Volts AC (for 380 Volts or 415 Volts specify "SC380" or "SC415")  
**57** = 575 Volts AC

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

**CS** = Command Signal \_\_\_\_\_

**0/5V** = 0 to 5Vdc  
**0/10V** = 0 to 10Vdc  
**POT** = 1 to 20K potentiometer.  
**4/20mA** = 4 to 20mA  
 (Other Command Signal ranges may be available. Check with factory).

**ILXX** = Current Limit: (optional) \_\_\_\_\_

XX = The maximum RMS value at which the limiter will hold the load current.

**VLXXX** = Voltage Limit (optional) \_\_\_\_\_

XXX = The maximum RMS value at which the limiter will hold the load voltage.

## TROUBLE SHOOTING

**CAUTION:** High voltage exists on the line and load terminals of this controller, and may exist on other equipment located near the controller.

Use extreme caution to avoid electrical shock.

Three LEDs 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 or voltage reaches the limit setting, the intensity of the '**LOAD CURRENT**' LED will not get brighter.

The '**LIMIT**' LED will light if the current or voltage limit has been reached. The jumper P4 determines if the controller is in current or voltage limit.

**The following are symptoms and possible solutions:**

### **NO LOAD POWER:**

The 'LOAD CURRENT' LED is not on, the intensity of the 'SSR 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 SSR module is equal to the line voltage, the SSR module has probably failed.

If a replacement SSR 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 line and load connections at the controller, or across a different phase than the controller and load.

The limit feature may prevent desired voltage from being applied to the load. The **LIMIT** LED will light if the limit (current or voltage) has been reached.

### **LOAD VOLTAGE SNAPS ON:**

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

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

#### **'SSR 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. If a replacement circuit card is ordered, specify the voltage rating, current rating and serial number of the controller.

#### **'SSR DRIVE' LED is off:**

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

To confirm that 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 SSR module has likely failed.

If a replacement SSR module is ordered, specify the serial number, and voltage and current ratings of the controller.

### **LOAD CURRENT LED IS BLINKING:**

#### **This applies to the current feedback mode only!**

The 1032A includes a gate disable which does not allow the firing circuit to turn the SSR on in the last few degrees of the AC sine wave. This prevents a possible misfire into the next half cycle.

If the command signal calls for the SSR to turn on in this region, the controller will rapidly turn on and off. This is due to the command signal / feedback relationship. Since the controller is not allowed to turn on, it will phase up out of the disabled region then immediately turn off because the feedback is too high compared to the command signal.

This hiccup action will continue to happen until the command signal is great enough to bring the controller out of the disabled area.

## MANUFACTURED BY



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