

# **MODEL 2022**

## **INSTALLATION & MAINTENANCE MANUAL**

## CONTROL CONCEPTS, INC. 2 YEAR LIMITED WARRANTY

CONTROL CONCEPTS, INC. warrants that the products delivered will be as described in the sales order or contract.

CONTROL CONCEPTS, INC. warrants to the original user that CONTROL CONCEPTS, INC. products will be free from defects in materials and workmanship for a period of two (2) years after the date CONTROL CONCEPTS, INC. ships such products.

If any CONTROL CONCEPTS, INC. product is found to be defective in material or workmanship during the applicable warranty period, CONTROL CONCEPTS, INC.'s entire liability, and purchasers sole and exclusive remedy, shall be the repair or replacement of the defective product at CONTROL CONCEPTS, INC.'s election. CONTROL CONCEPTS, INC. shall not be liable for any costs or expenses, whether direct or indirect, associated with the installation, removal or re-installation of any defective product. All shipping and freight costs are the responsibility of the customer. CONTROL CONCEPTS, INC.'s limited warranty shall not be effective or actionable unless there is compliance with all installation and operating instructions furnished by CONTROL CONCEPTS, INC., or if the products have been modified or altered without the written consent of CONTROL CONCEPTS, INC., or if such products have been subject to accident, misuse, mishandling, tampering, negligence or improper maintenance. Any warranty claim must be submitted to CONTROL CONCEPTS, INC. in writing within the stated warranty period.

CONTROL CONCEPTS, INC.'s limited warranty is made in lieu of, and CONTROL CONCEPTS, INC. disclaims all other warranties, whether expressed or implied, including but not limited to any IMPLIED WARRANTY OF MERCHANTABILITY, ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, any implied warranty arising out of a course of dealing or of performance, custom or usage of trade.

CONTROL CONCEPTS, INC. SHALL NOT, UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, REVENUE OR BUSINESS) OR DAMAGE OR INJURY TO PERSONS OR PROPERTY IN ANY WAY RELATED TO THE MANUFACTURE OR THE USE OF ITS PRODUCTS. The exclusion applies regardless of whether such damages are sought based on breach of warranty, breach of contract, negligence, strict in tort, or any other legal theory, even if CONTROL CONCEPTS, INC. has notice of the possibility of such damages.

By purchasing CONTROL CONCEPTS, INC.'s products, the purchaser agrees to the terms and conditions of this limited warranty.

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

© Copyright 2020, Control Concepts, Inc. Chanhassen, MN 55317

The information and design disclosed herein are the property of Control Concepts, Inc. and may not be used, reproduced or disclosed in any form except as granted in writing by:

CONTROL CONCEPTS, INC  
8077 CENTURY BLVD  
CHANHASSEN, MN 55317  
PHONE: (952) 474-6200  
TOLL FREE: (800) 765-2799  
FAX: (952) 474-6070  
[www.cciipower.com](http://www.cciipower.com)

## **TABLE OF CONTENTS**

|                                                    |    |
|----------------------------------------------------|----|
| DESCRIPTION:.....                                  | 4  |
| FEATURES:.....                                     | 4  |
| THEORY OF OPERATION:.....                          | 4  |
| MODEL No. IDENTIFICATION:.....                     | 4  |
| SPECIFICATIONS:.....                               | 5  |
| INSTALLATION: .....                                | 6  |
| INSTALLATION DIMENSIONS:.....                      | 7  |
| POWER CONNECTIONS: .....                           | 8  |
| RECOMMENDED SPARE PARTS:.....                      | 8  |
| EXAMPLES OF COMMAND SIGNAL CONNECTIONS .....       | 9  |
| EXAMPLES OF MIXED COMMAND SIGNAL CONNECTIONS ..... | 10 |
| RUN - IDLE CONTROL CONNECTIONS .....               | 11 |
| ADJUSTMENTS .....                                  | 12 |
| TROUBLE SHOOTING: .....                            | 13 |
| TROUBLE SHOOTING: CONTINUED .....                  | 14 |
| TORQUE SPECIFICATIONS: .....                       | 14 |
| MANUFACTURED BY:.....                              | 14 |

## DESCRIPTION:

The model 2022 is a single-phase, phase-angle SCR power controller with two remotely selectable inputs.

The model 2022 accepts command signals of 0/5Vdc, 0/10Vdc or a potentiometer.

The model 2022 can be made to accept a 4/20mA current loop command with the addition of a resistor (R27 or R28) to the circuit. Contact factory for details.

The model 2022 controls the RMS voltage to the load proportional to the command signal, independent of line voltage changes.

## FEATURES:

**Soft-start:** This feature ramps the load voltage at start-up to the preset level at a time constant of 500mS.

**Missing cycle detection:** On power interruptions of one half cycle or more, this feature sets the load voltage to zero and then increases the load voltage to the preset level at a predetermined rate. This eliminates inrush currents that can occur due to loads with a low cold resistance.

**Dual command inputs:** Separate command signals may be connected to the **RUN** or **IDLE** inputs of the controller. Selection between command inputs is made by a remote contact or signal. The change becomes effective at the next zero-crossing of the line voltage.

**Power Level Transfer:** It may be undesirable to turn the load power completely off between periods of higher load power levels. Using the dual command input feature, a lower command signal may be selected, keeping the load power at a lower power level

**Mode LED:** This lamp when green, indicates that the **RUN** command input is active. When this lamp is orange, the **IDLE** input is active.

**Command LED:** This lamp indicates that a signal is being sent from the circuit to the SCR module. Because the model 2022 is a Phase-Angle controller, the intensity of the LED will be proportional to the RMS load voltage.

The command signals are electrically isolated from the line and load voltages and all are electrically isolated from the heat sink.

## CAUTION!

When using transformer coupled loads, It is recommended that the transformer be double voltage rated to avoid saturation.

Double voltage rating means that the primary rating of the transformer be double the maximum voltage output of the controller. The secondary rating of the transformer should be double the maximum desired load voltage. For example: If the output is 0-120V with a 12V load, use a 240 to 24V transformer.

## THEORY OF OPERATION:

The model 2022 is a phase-angle controller, which means that the load voltage is controlled by turning the appropriate SCR on for a portion of each electrical half cycle as shown in figure 1.0.

At 50% command signal the on time of each SCR in the inverse parallel pair, and therefore the voltage across the load, is shown by the waveform "E<sub>L</sub>".

As the load voltage is increased, the SCRs are turned on earlier in the cycle. As the load voltage is decreased, the SCRs are turned on later in cycle.

The load voltage can be varied with infinite resolution from 0 to nearly 100 percent of the line voltage.

Circuit tolerances may limit the maximum load voltage to about 97% of the supply voltage.

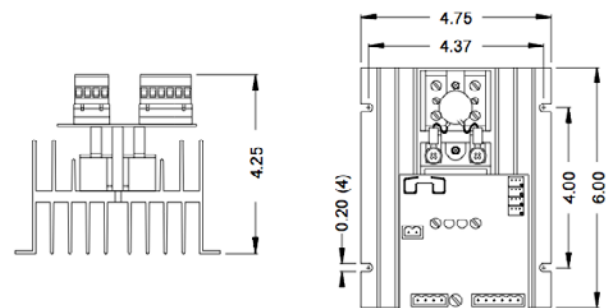


Figure 1. Phase angle control at 50% power

## MODEL No. IDENTIFICATION:

### MODEL NUMBER:

**2022-VV-AA-[FC]-[LT]-R(x)-I(x)**

**VV** = Rated voltage:

**12** = 120 Vac.

**24** = 240 Vac.

**48** = 480Vac.

**57** = 570Vac.

**AA** = rated amps:

**10, 20, 30, 40, or 70** amps

**[FC]** = (optional) To order firing circuit only.

**[LT]** = (optional) controller less transformer.

**R** = Specifies **RUN** Command Signal.

**x = POT.** = 1K Potentiometer.

**0/10V** = 0 to 10 Vdc command signal.

**0/5V** = 0 to 5 Vdc command signal.

**4/20mA** = 4 to 20 mA command signal.

**I** = Specifies **IDLE** Command Signal.

**x = POT.** = 1K Potentiometer.

**0/10V** = 0 to 10 Vdc command signal.

**0/5V** = 0 to 5 Vdc command signal.

**4/20mA** = 4 to 20 mA command signal.

Consult factory for special command options.

Example: 2022-12-10-R0/5V-Ipot

This specifies a 2022 controller, 120 Vac input, 10 Amp max. load current, accepting a 0 to 5Vdc run command and using a potentiometer for the idle command.

## SPECIFICATIONS:

|                                          |                                                                                                                                                                                                                                                                                                                      |        |                 |        |      |         |      |               |      |                 |          |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|--------|------|---------|------|---------------|------|-----------------|----------|
| <b>Control Mode:</b>                     | Single-phase; Phase-angle; RMS value of the voltage applied to the load.                                                                                                                                                                                                                                             |        |                 |        |      |         |      |               |      |                 |          |
| <b>Command Signal:</b>                   | <table> <tr> <td>SIGNAL</td><td>INPUT IMPEDANCE</td></tr> <tr> <td>0/5Vdc</td><td>100K</td></tr> <tr> <td>0/10VDC</td><td>200K</td></tr> <tr> <td>Potentiometer</td><td>200K</td></tr> <tr> <td>4/20mA (option)</td><td>249 Ohms</td></tr> </table>                                                                  | SIGNAL | INPUT IMPEDANCE | 0/5Vdc | 100K | 0/10VDC | 200K | Potentiometer | 200K | 4/20mA (option) | 249 Ohms |
| SIGNAL                                   | INPUT IMPEDANCE                                                                                                                                                                                                                                                                                                      |        |                 |        |      |         |      |               |      |                 |          |
| 0/5Vdc                                   | 100K                                                                                                                                                                                                                                                                                                                 |        |                 |        |      |         |      |               |      |                 |          |
| 0/10VDC                                  | 200K                                                                                                                                                                                                                                                                                                                 |        |                 |        |      |         |      |               |      |                 |          |
| Potentiometer                            | 200K                                                                                                                                                                                                                                                                                                                 |        |                 |        |      |         |      |               |      |                 |          |
| 4/20mA (option)                          | 249 Ohms                                                                                                                                                                                                                                                                                                             |        |                 |        |      |         |      |               |      |                 |          |
| <b>Control Range:</b>                    | 0 to 97% of line voltage.                                                                                                                                                                                                                                                                                            |        |                 |        |      |         |      |               |      |                 |          |
| <b>Linearity:</b>                        | RMS load voltage is linear within 2% of span of the command signal.                                                                                                                                                                                                                                                  |        |                 |        |      |         |      |               |      |                 |          |
| <b>Zero and Span Adjustments:</b>        | User adjustable over range of $\pm 20\%$ of span.                                                                                                                                                                                                                                                                    |        |                 |        |      |         |      |               |      |                 |          |
| <b>Isolation:</b>                        | Dielectric strength input/line & load voltage/heatsink 4000V <sub>(RMS)</sub> .<br>Insulation resistance input/line & load voltage/heatsink $10^{10}$ ohms.<br>Maximum capacitance input to output 8pf.<br>Isolation test voltage between the Emitter and Detector of the MODE selector optocoupler is 120 Volts DC. |        |                 |        |      |         |      |               |      |                 |          |
| <b>Cooling:</b>                          | Natural convection over extruded heatsink fins.                                                                                                                                                                                                                                                                      |        |                 |        |      |         |      |               |      |                 |          |
| <b>Mounting:</b>                         | Must be mounted on vertical surface with fins vertical. Units may be mounted adjacent to each other. Heat sink is electrically isolated.                                                                                                                                                                             |        |                 |        |      |         |      |               |      |                 |          |
| <b>Line voltage:</b>                     | 120, 240, 480 or 575Vac $\pm 10\%$ , -15%, 50/60 Hertz.                                                                                                                                                                                                                                                              |        |                 |        |      |         |      |               |      |                 |          |
| <b>Diagnostic Indicator:</b>             | The intensity of an LED varies as a function of the command signal. Feature provides a quick and safe means to check controller operation.                                                                                                                                                                           |        |                 |        |      |         |      |               |      |                 |          |
| <b>Physical:</b>                         | Weight: 10 thru 40 amp 2 lbs , 70 amp, 6 lbs.<br>Dimensions: Refer to installation drawing.                                                                                                                                                                                                                          |        |                 |        |      |         |      |               |      |                 |          |
| <b>Environment:</b>                      | Operating: 0 to 55°C (32 to 131°F)<br>Storage: -40 to 80°C (-40 to 176°F)<br>Humidity: 0 to 95% Non-condensing                                                                                                                                                                                                       |        |                 |        |      |         |      |               |      |                 |          |
| <b>dV/dT &amp; Transient Voltage:</b>    | 200 volts/usec minimum.<br>A dv/dt snubber and a metal oxide varistor (MOV) are provided to protect against high frequency transients (dv/dt) and voltage spikes.<br>See SCR ratings on page 4.                                                                                                                      |        |                 |        |      |         |      |               |      |                 |          |
| <b>Dissipation:</b>                      | 1.5 watts per amp of controlled current.                                                                                                                                                                                                                                                                             |        |                 |        |      |         |      |               |      |                 |          |
| <b>Recommended Fusing:</b>               | 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.                                           |        |                 |        |      |         |      |               |      |                 |          |
| <b>Circuit Board Power Requirements:</b> | 24 Volts AC, 5VA. Powered by external transformer.                                                                                                                                                                                                                                                                   |        |                 |        |      |         |      |               |      |                 |          |

## INSTALLATION:

The controller must be mounted on a vertical surface such that the heat radiating fins are vertical. It should be located in an environment that will not exceed 55°C and should be protected from dirt and dust. See page 4 for dimensions, and page 5 for electrical hookup.

### NOTES:

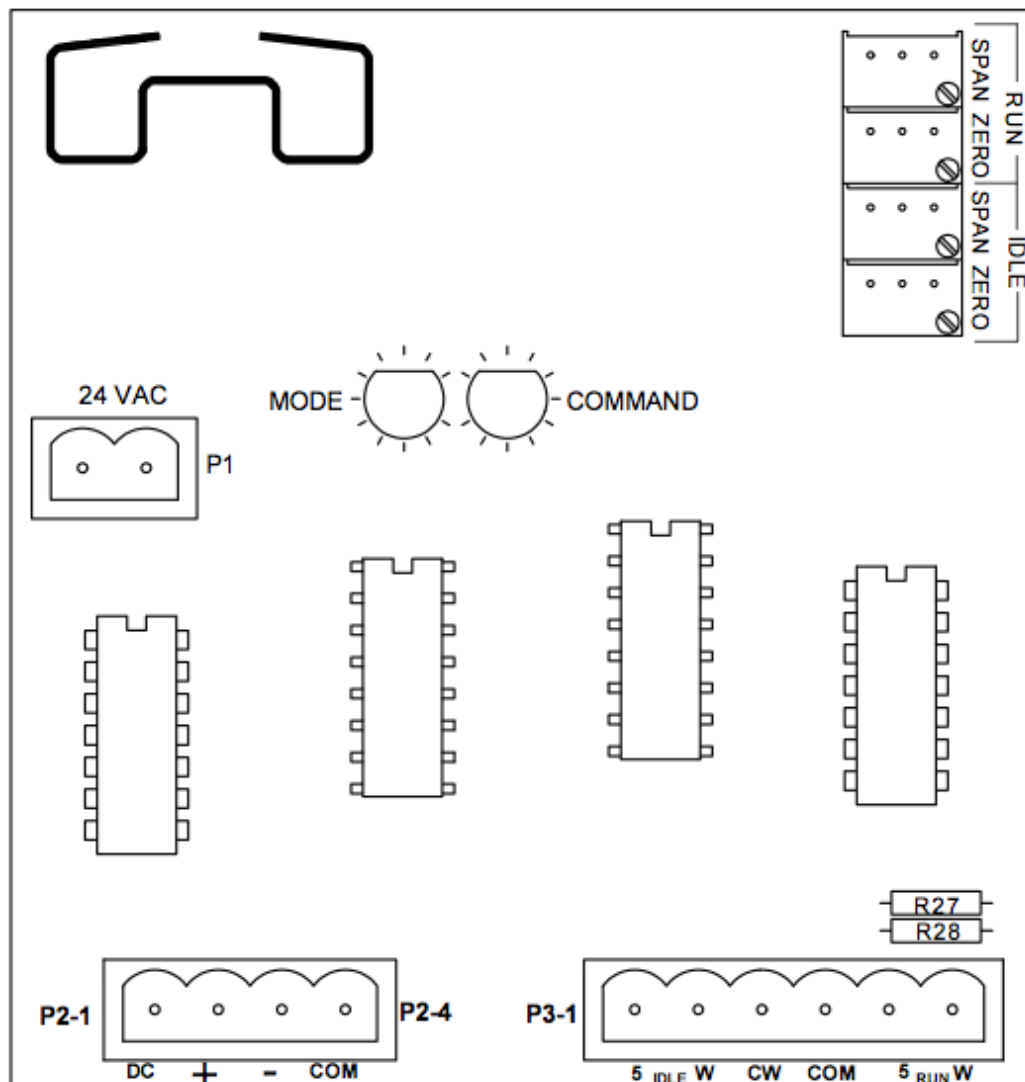
1. The wiring must be per local and national electrical codes.
2. The circuit transformer for each controller must be connected to the same supply as the controller and it's load. See electrical diagram on page 5.
3. **A fuse with a rating of no more than 1/4 Amp is recommended for protection of the control transformer.**
4. It is recommended that the controller and the load

be protected with fast acting class "T" fuses such as described in the list on page 5.

TORQUE TABLE FOR  
USD CONNECTORS

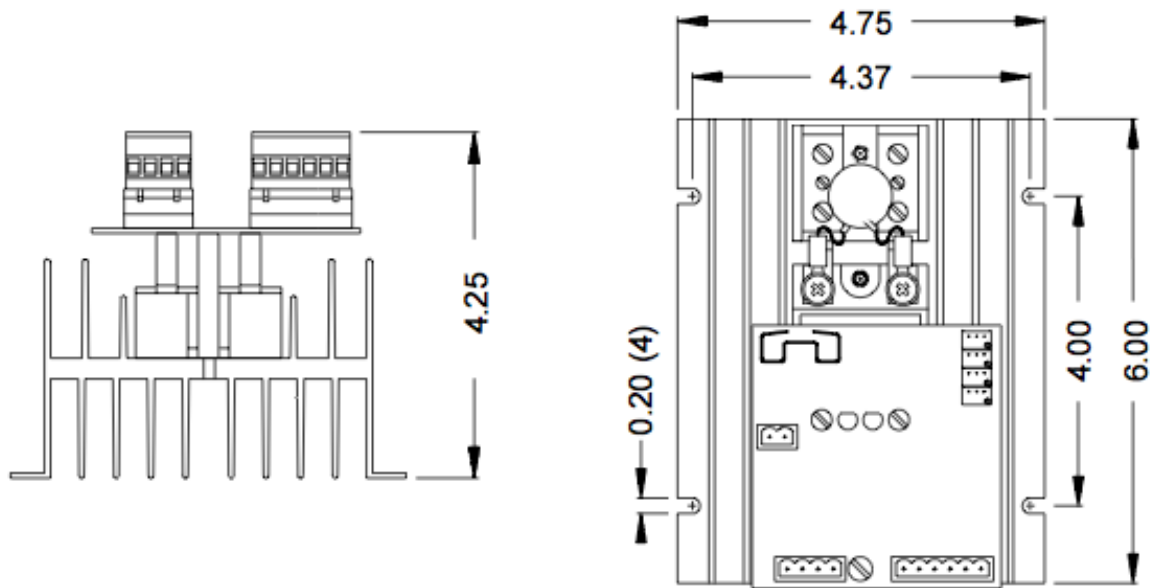


| Wire Size | Recommended Torque |
|-----------|--------------------|
| 10 -14 ga | 35 in-lbs          |
| 8 ga      | 40 in-lbs          |
| 4 - 6 ga  | 45 in-lbs          |
| 2 - 3 ga  | 50 in-lbs          |

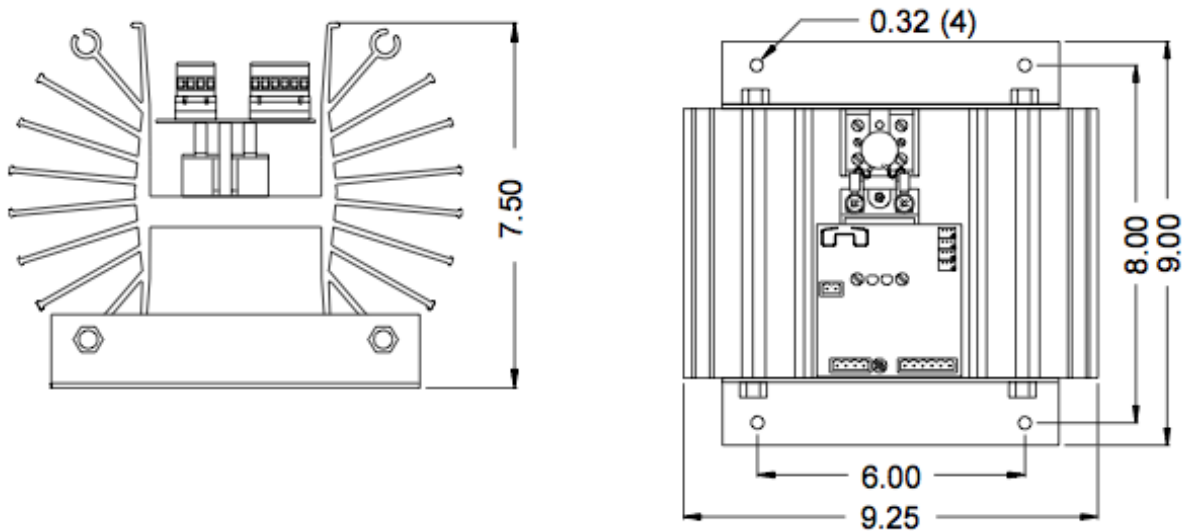


**Figure 2.** Model 2022 circuit board showing location of connectors and adjustment pots.

## INSTALLATION DIMENSIONS:



**Figure 3.** Installation dimensions of 10, 20, 30 & 40 Amp controller.



**Figure 4.** Installation dimensions of 70 Amp controller.

| SURGE CURRENT RATINGS    |                 |                                     |                            | KW     |        |        |        |        |
|--------------------------|-----------------|-------------------------------------|----------------------------|--------|--------|--------|--------|--------|
| Continuous<br>RMS rating | RMS<br>1 Second | Peak<br>1 cycle<br>(Non-Repetitive) | I <sup>2</sup> t<br>rating | 120Vac | 240Vac | 277Vac | 480Vac | 575Vac |
| 10                       | 22              | 140                                 | 81                         | 1.20   | 2.40   | 2.77   | 4.80   | 5.75   |
| 20                       | 40              | 250                                 | 260                        | 2.40   | 4.80   | 5.54   | 9.60   | 11.50  |
| 30                       | 80              | 625                                 | 1620                       | 3.60   | 7.20   | 8.31   | 14.40  | 17.25  |
| 40                       | 150             | 1000                                | 4150                       | 4.80   | 9.60   | 11.08  | 19.20  | 23.00  |
| 70                       | 150             | 1000                                | 4150                       | 8.40   | 16.80  | 19.39  | 33.60  | 40.25  |

## POWER CONNECTIONS:

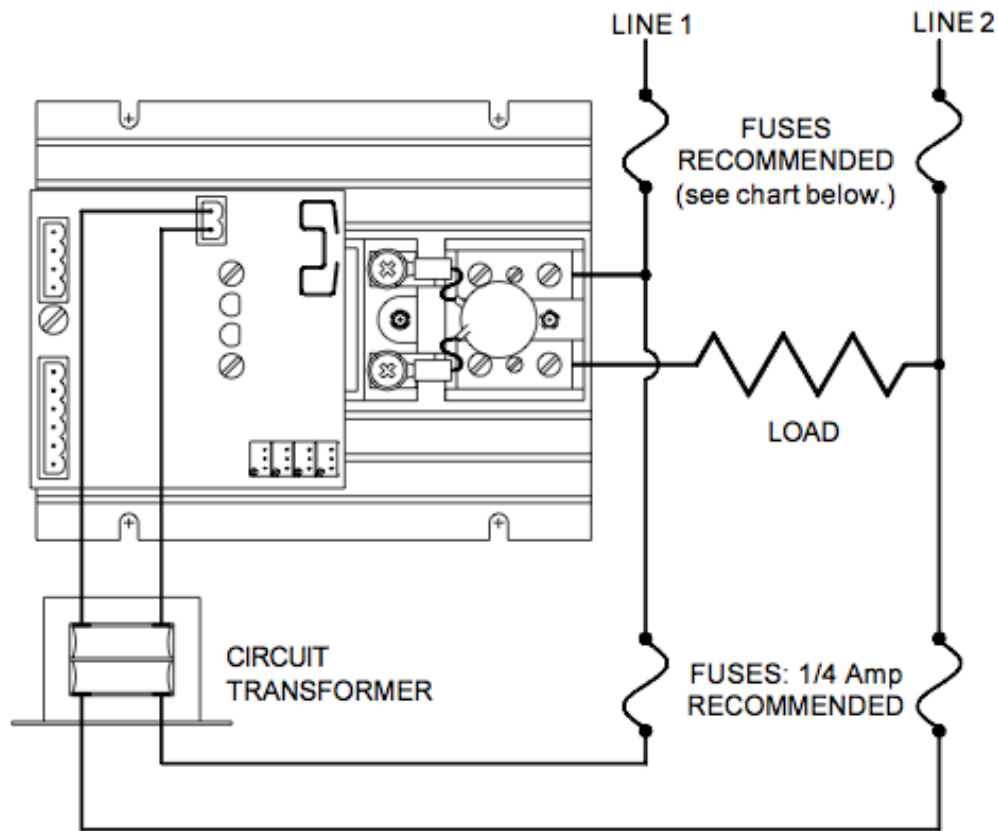
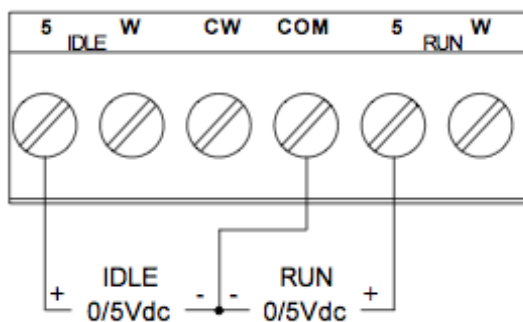


Figure 5. Load, power and transformer connection of the 2022 controller.

## RECOMMENDED SPARE PARTS:

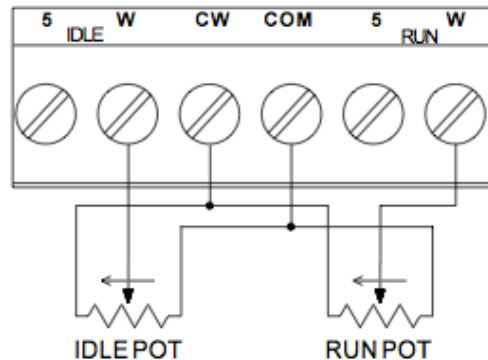
| MODEL:     | SCR-MOV<br>MODULE<br>CCI PART # | FUSES          |            | FUSEHOLDERS    |            |
|------------|---------------------------------|----------------|------------|----------------|------------|
|            |                                 | CCI PART #     | BUSSMANN # | CCI PART #     | BUSSMANN # |
| 2022-12-10 | 1652-12-10                      | 42110-0430-315 | JJN-15     | 43112-0430-330 | T30030-2CR |
| 2022-12-20 | 1652-12-20                      | 42110-0430-325 | JJN-25     | 43112-0430-330 | T30030-2CR |
| 2022-12-30 | 1652-12-30                      | 42110-0430-335 | JJN-35     | 43112-0430-360 | T30060-2CR |
| 2022-12-40 | 1652-12-40                      | 42110-0430-350 | JJN-50     | 43112-0430-360 | T30060-2CR |
| 2022-12-70 | 1652-12-70                      | 42110-0430-390 | JJN-90     | 43112-0430-410 | T30100-2CR |
| 2022-24-10 | 1652-24-10                      | 42110-0430-315 | JJN-15     | 43112-0430-330 | T30030-2CR |
| 2022-24-20 | 1652-24-20                      | 42110-0430-325 | JJN-25     | 43112-0430-330 | T30030-2CR |
| 2022-24-30 | 1652-24-30                      | 42110-0430-335 | JJN-35     | 43112-0430-360 | T30060-2CR |
| 2022-24-40 | 1652-24-40                      | 42110-0430-350 | JJN-50     | 43112-0430-360 | T30060-2CR |
| 2022-24-70 | 1652-24-70                      | 42110-0430-390 | JJN-90     | 43112-0430-410 | T30100-2CR |
| 2022-48-10 | 1652-48-10                      | 42110-0460-315 | JJS-15     | 43112-0460-330 | T60030-2CR |
| 2022-48-20 | 1652-48-20                      | 42110-0460-325 | JJS-25     | 43112-0460-330 | T60030-2CR |
| 2022-48-30 | 1652-48-30                      | 42110-0460-335 | JJS-35     | 43112-0460-360 | T60060-2CR |
| 2022-48-40 | 1652-48-40                      | 42110-0460-350 | JJS-50     | 43112-0460-360 | T60060-2CR |
| 2022-48-70 | 1652-48-70                      | 42110-0460-390 | JJS-90     | 43112-0460-410 | T60100-2CR |
| 2022-57-10 | 1652-57-10                      | 42110-0460-315 | JJS-15     | 43112-0460-330 | T60030-2CR |
| 2022-57-20 | 1652-57-20                      | 42110-0460-325 | JJS-25     | 43112-0460-330 | T60030-2CR |
| 2022-57-30 | 1652-57-30                      | 42110-0460-335 | JJS-35     | 43112-0460-360 | T60060-2CR |
| 2022-57-40 | 1652-57-40                      | 42110-0460-350 | JJS-50     | 43112-0460-360 | T60060-2CR |
| 2022-57-70 | 1652-57-70                      | 42110-0460-390 | JJS-90     | 43112-0460-410 | T60100-2CR |

## EXAMPLES OF COMMAND SIGNAL CONNECTIONS



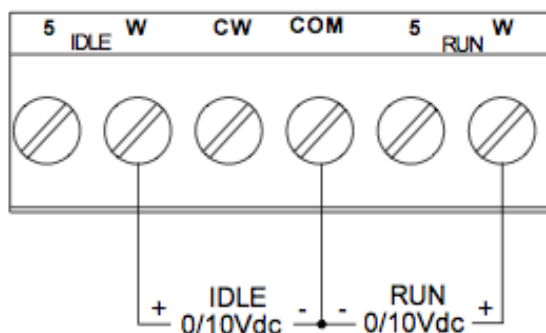
Using two 0/5 Volt DC command signals to control the model 2022. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

**Figure 6.** Using two 0/5Vdc command signals.



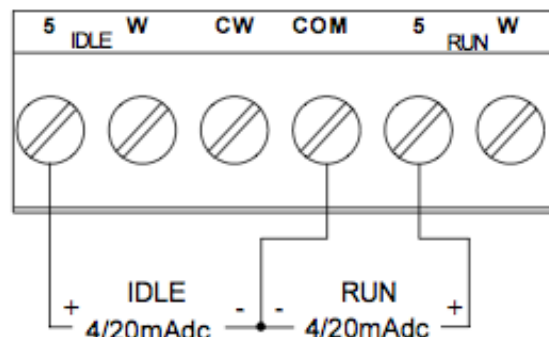
Using two potentiometers to control the model 2022. The potentiometers may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

**Figure 7.** Using two command potentiometers.



Using two 0/10 Volt DC command signals to control the model 2022. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

**Figure 8.** Using two 0-10Vdc command signals.

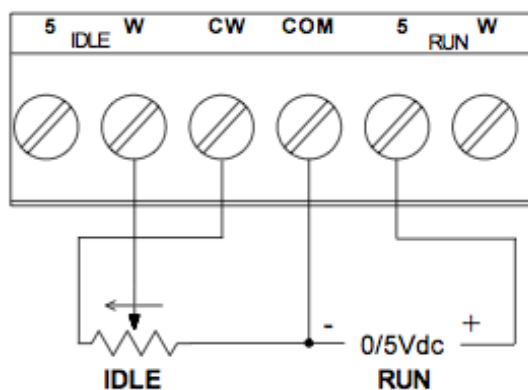


Using two 4/20 mA DC command signals to control the model 2022. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details. Resistor R27 and R28 must be present on the circuit board for the current loop. See page 3 for location of R27 and R28 resistors.

**Caution!** When using dual 4/20mA current loop commands, it is necessary to isolate the current loop signals. (See page 11.)

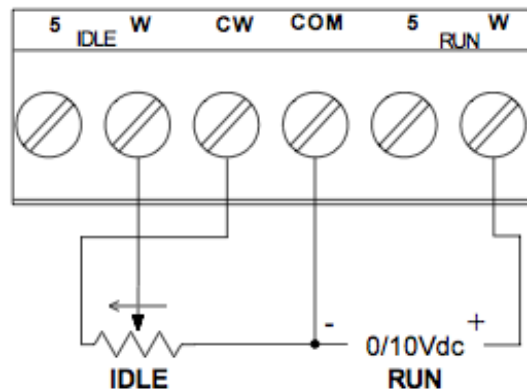
**Figure 9.** Using two 4/20mA DC command signals.

## EXAMPLES OF MIXED COMMAND SIGNAL CONNECTIONS



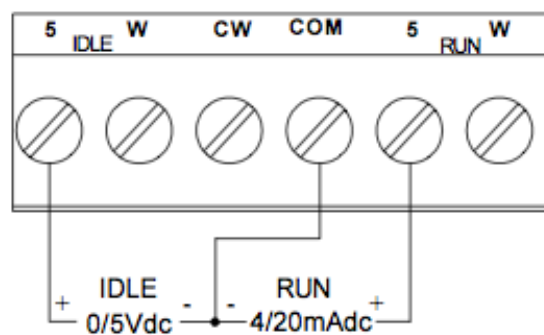
Using mixed command signals to control the model 2022. A combination of potentiometer and 0/5Vdc command signals is shown. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

**Figure 10.** Using a pot for the **IDLE** command and 0/5 Volt DC for the **RUN** command.



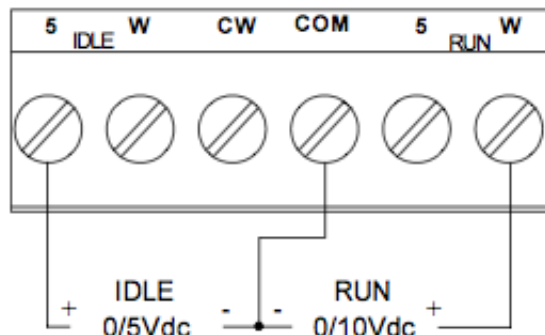
Using mixed command signals to control the model 2022. A combination of potentiometer and 0/10Vdc command signals is shown. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

**Figure 11.** Using a pot for the **IDLE** command and 0/10 Volt DC for the **RUN** command.



Using mixed command signals to control the model 2022. A combination of 0/5Vdc and 4/20mA command signals is shown. R27 (249 ohms) must be in place for the current loop. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

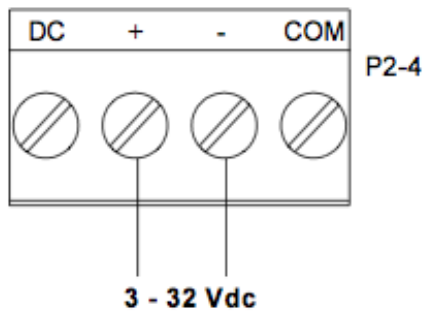
**Figure 12.** Using 0/5 Vdc for the **IDLE** command and 4/20mA for the **RUN** command.



Using mixed command signals to control the model 2022. A combination of 0/5Vdc and 0/10Vdc command signals is shown. The command signals may be set at different levels. The **IDLE** command signal is active with no signal or contact closure present on the P2 **RUN-IDLE** control connector. To select the **RUN** command signal, a contact closure or a signal must be present at the P2 **RUN-IDLE** connector. See page 8 for details.

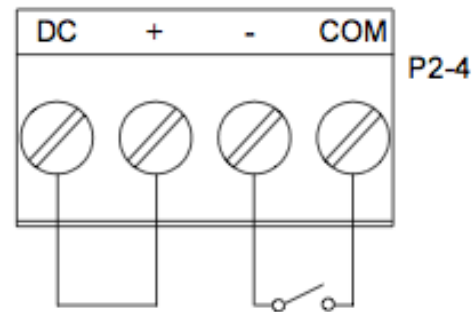
**Figure 13.** Using 0/5 Vdc for the **IDLE** command and 0/10Vdc for the **RUN** command.

## RUN - IDLE CONTROL CONNECTIONS



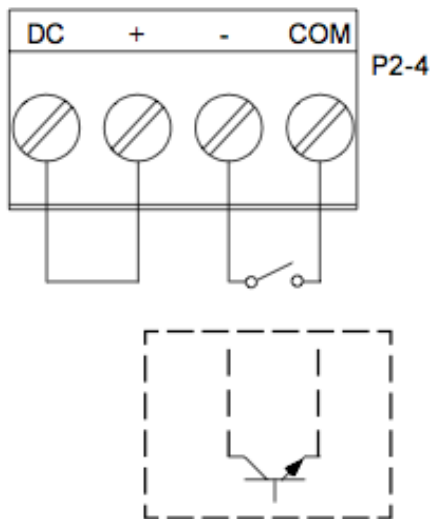
A logic or external DC signal may be used to control the **RUN-IDLE** command input. This is a bipolar input which means that the DC signal has no polarity discrimination. A signal in the 3/32Vdc range will cause the **RUN** input to be active. With a signal of less than 1 Vdc, the **IDLE** command input will always be selected. The input impedance of this circuit is approximately 5Kohms.

**Figure 14.** Voltage control of **RUN-IDLE** option.



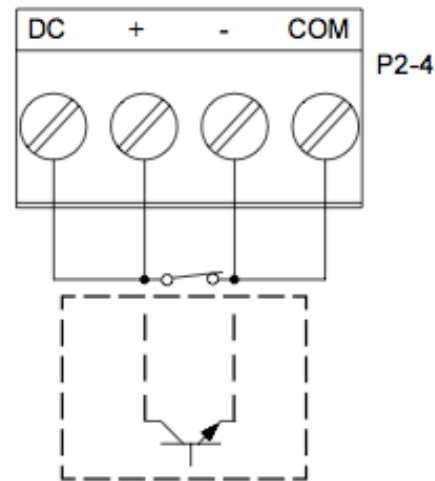
When a simple **RUN - IDLE** switch control device is desired, connect pin P2-1 to P2-2 and connect a pair of contacts between pins P2-3 and P2-4 as shown. With shorted contacts, the **RUN** input will be active. Open contacts will cause the **IDLE** input to be enabled

**Figure 15.** Switch control of **RUN-IDLE** option.



The **RUN - IDLE** control may be controlled by a solid state circuit, if that circuit contains an NPN transistor which can be connected across pins P2-3 and P2-4 in place of the switch as shown above. This type of control causes the **RUN** input to be enabled when P2-3 and P2-4 are connected.

**Figure 16.** External control of **RUN-IDLE** option.



When it is necessary to use a reverse **RUN - IDLE** contact control (open to enable **RUN**), connect pin P2-1 to P2-2 and connect P2-3 to P2-4. Use a switch or similar device connected to pins P2-2 and P2-3 as shown. When P2-2 and P2-3 are shorted, the **IDLE** input will be enabled.

**Figure 17.** Open contacts to enable the **RUN** input.

## ADJUSTMENTS

### ZERO AND SPAN POTENTIOMETER ADJUSTMENTS

The zero and span pots were calibrated at the factory.

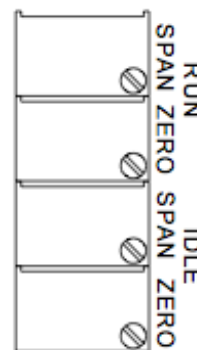
If it becomes necessary to readjust any of these pots, please use the procedure described here to achieve proper operation of your controller.

A load capable of drawing at least one Amp must be applied to the controller for proper operation and calibration.

**NOTE:** Voltage and/or current measurements should be taken with meters that provide True RMS readings for maximum linearity and accuracy due to the chopped waveforms provided by the SCR controller.

The 2022 controller has line voltage compensation, therefore if the supply voltage is above the nominal rating, the controller will supply the nominal rated voltage to the load. For example, if a controller calibrated for 240 volt operation is supplied from a 260 volt supply and the maximum command signal is applied, the controller will supply 240 volts to the load. This effectively eliminates the effects of line voltage changes.

1. Cause the control signal to set the **RUN-IDLE** control to the **RUN** condition. (See page 8 for information on **RUN-IDLE** control.)
2. Apply a command signal to the **RUN** input. (See page 6 for examples.)
3. Set the command signal to the minimum level and adjust the **RUN ZERO** potentiometer so that the voltage across the load is just zero. (Clockwise rotation of both the span and zero potentiometer will increase the load voltage)
4. Set the command signal to the maximum level and adjust the **RUN SPAN** potentiometer so that the desired maximum voltage is measured Across the load.
5. Because the **ZERO** and **SPAN** adjustments may interact, it is recommended that steps 3 and 4 be repeated.
6. Cause the control signal to set the **RUN-IDLE** control to the **IDLE** condition. (See page 8 for information on **RUN-IDLE** control.)
7. Apply a command signal to the **IDLE** input. (See page 6 for examples.)
8. Set the command signal to the minimum level and adjust the **IDLE ZERO** potentiometer so that the voltage across the load is just zero. (Clockwise rotation of both the span and zero potentiometer will increase the load voltage)
9. Set the command signal to the maximum level and adjust the **IDLE SPAN** potentiometer so that the desired maximum voltage is measured across the load.
10. Because the **ZERO** and **SPAN** adjustments may interact, it is recommended that steps 8 and 9 be repeated.



## 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. Except for voltage and current measurements, remove power before attempting to service this equipment.

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.

### **ELECTRICAL MEASUREMENTS SHOULD BE MADE BY QUALIFIED PERSONNEL ONLY.**

|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NOTES:</b>                                 | <p>Two LED's are located on the controller circuit board.</p> <p>The 'MODE' LED is GREEN when the <b>RUN</b> command is active. It is ORANGE when the <b>IDLE</b> command is active.</p> <p>The 'COMMAND' LED is green and can be used to aid in determining problems. The "COMMAND" LED varies in intensity proportional to the command signal and is therefore proportional to the load voltage.</p> <p>Unless otherwise noted, the term 'LED' in the paragraphs below refers to the 'COMMAND' LED.</p> <p>To insure correct operation of the SCR's, the load must be capable of drawing at least one amp.</p> <p>A circuit board with the same specifications may be substituted for a questionable circuit to help identify the location of the problem.</p> <p>When replacing circuit boards do not remove wires from the plug-in connectors.</p> <p>Control Concepts has field service engineers who can help to determine the cause of controller problems. Please call (952) 474-6200 with any questions you may have.</p> |
| <b>SYMPTOMS</b>                               | <b>POSSIBLE CAUSES:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>NO LOAD POWER:<br/>Command LED is OFF:</b> | <p>Check wiring per diagram on page 5.</p> <p>Determine that a command signal is present, and that it is connected to the active input.</p> <p>If the command signal is connected to the RUN input, check for 3 or more volts across P2-2 to P2-3.</p> <p>Determine that the mode LED is on. (green or orange).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>NO LOAD POWER:<br/>Command LED is ON:</b>  | <p>Check wiring per diagram on page 5.</p> <p>Measure voltage across line &amp; load terminals. If the measurement is the same as the line voltage, the SCR is likely bad.</p> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## TROUBLE SHOOTING: CONTINUED

| SYMPTOMS                                                                                | POSSIBLE CAUSES:                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LOAD POWER WILL NOT GO TO ZERO: LED is OFF:</b>                                      | <p>Remove connector P3 (Command input) from circuit board. If the load power goes to zero, check command wiring and level. If the Load Voltage is small, the ZERO pot may need to be adjusted.</p> <p>Remove circuit board wiring to connector. If load power still exists replace SCR.</p>                                                                                                                                                    |
| <b>MAXIMUM LOAD VOLTAGE CANNOT BE OBTAINED:</b>                                         | <p>Determine that the primary of the circuit transformer is connected across the same line as the controller and load.</p> <p>Determine that the command signal will go to maximum.</p> <p>Determine that the command signal is connected to the active command input. If the command signal is connected to the RUN input, check for 3 or more volts across P2-2 to P2-3.</p>                                                                 |
| <b>LOAD VOLTAGE SNAPS ON:</b>                                                           | Determine that the circuit transformer is connected to the same phase as the controller and load.                                                                                                                                                                                                                                                                                                                                              |
| <b>LOAD POWER IS MAXIMUM AND CANNOT BE REDUCED: LED is OFF:</b>                         | <p>Remove 24Vac power (connector P1) from the circuit board. If the load power still exists, replace the SCR Module.</p> <p>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.</p>                                                                                                                                                               |
| <b>RUN AND IDLE LOAD POWER IS THE SAME REGARDLESS OF DIFFERENCES IN COMMAND SIGNAL.</b> | <p>When using dual current loop command signals, the signals must be isolated from one another. The negative side of the signals are tied together on the terminal strip. When multiple current loops share a common power supply, chances are, the positive side of the loops are common.</p> <p>This situation could cause the current loop signals to look the same to the controller, even though they may be at different set-points.</p> |

## TORQUE SPECIFICATIONS:

### 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          |

## MANUFACTURED BY:



# CONTROL CONCEPTS

TEL: (952) 474-6200  
FAX: (952) 474-6070

(800) 765-2799  
www.ccipower.com

8077 Century Blvd  
Chanhassen, MN 55317, USA