

# **MODEL 3869**

## **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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## MODEL 3869 TABLE OF CONTENTS

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DESCRIPTION	1
SPECIFICATIONS	2
INSTALLATION	3
INSTALLATION DRAWINGS	4
CONNECTIONS	5
CIRCUIT BOARD REFERENCE	6
COMMAND CONNECTIONS	6
COMMAND CONNECTIONS (Continued)	7
ADJUSTMENTS	8
TROUBLE SHOOTING	8
TROUBLE SHOOTING (Continued)	9
SPARE PARTS	9
MODEL NUMBER IDENTIFICATION	10

## DESCRIPTION

The Model 3869 is a DC power controller that linearly controls (with respect to a command signal), the voltage applied to a load, by phase-angle operation of 6 SCR's in a 3 phase rectifier bridge configuration. A free-wheeling diode is included across the output.

### Features of the 3869 controller include:

#### 1. Run or idle input selection.

A remote switch can be used to select either of two input commands.

#### 2. Run-standby operation.

Closure of a remote switch enables the controller.

#### 3. Selectable slew rate.

Slew rate is the time required for output to change 62%, given a step change of the command. A fast or slow rate can be selected by a switch on the circuit board. The slow rate provides better stability and accuracy. The fast rate is used in applications requiring the output to change rapidly.

#### 4. Voltage metering output.

A DC voltage (1 volt = 100 volts) proportional to the average value of the load voltage.

#### 5. Phase rotation sensing.

The controller is not phase rotation sensitive.

#### 6. User selectable input ranges.

Dip switches allow the user to select input commands of 0/5 Vdc, 0/10 Vdc, 4/20 mA or potentiometer.

#### 7. "Line-OK" LED.

Line OK light will be on when all three phases are present. The circuit will not operate if the line-OK led is not on.

#### 8. Gate drive indicators.

An LED on each gate drive indicates that a signal is applied to turn the SCR on.

#### 9. Low circuit power requirements.

Single phase 24 volt circuit power is provided by an on board transformer powered from the 3 phase supply.

## SPECIFICATIONS

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

<b>COMMAND MODE:</b>	Three-phase, phase-angle 6 SCR full-wave converter.												
<b>RUN/IDLE CONTROL:</b>	Closure allows control with "RUN" input. Switch voltage: 10 Vdc. Switch current: 1 mAdc. Dry contact switch recommended.												
<b>RUN/IDLE COMMAND SIGNAL IMPEDANCE:</b>	<table border="0"> <tr> <td>Input</td> <td>Resistance</td> </tr> <tr> <td>4/20 mA</td> <td>300 ohms</td> </tr> <tr> <td>0/10 Vdc</td> <td>240K ohms</td> </tr> <tr> <td>0/5 Vdc</td> <td>120K ohms</td> </tr> <tr> <td>Potentiometer</td> <td>240K ohms</td> </tr> <tr> <td colspan="2">(1K recommended; 20K permissible 1/2 watt)</td> </tr> </table>	Input	Resistance	4/20 mA	300 ohms	0/10 Vdc	240K ohms	0/5 Vdc	120K ohms	Potentiometer	240K ohms	(1K recommended; 20K permissible 1/2 watt)	
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4/20 mA	300 ohms												
0/10 Vdc	240K ohms												
0/5 Vdc	120K ohms												
Potentiometer	240K ohms												
(1K recommended; 20K permissible 1/2 watt)													
<b>OPERATING VOLTAGE:</b>	120, 240, 480 Volts AC. +/- 10%, 50/60 Hz, 3 phase. Other voltages may be available, consult factory.												
<b>DC OUTPUT VOLTAGE:</b>	The output voltage is variable from 0 to approximately 1.4 times the input voltage.												
<b>MAXIMUM CONTINUOUS DC CURRENT RATING:</b>	300 - 400 Amps depending on model number.												
<b>AMBIENT TEMPERATURE:</b>	<table border="0"> <tr> <td>Operating</td> <td>0 to 55°C</td> </tr> <tr> <td>Storage</td> <td>-40 to 80°C</td> </tr> </table>	Operating	0 to 55°C	Storage	-40 to 80°C								
Operating	0 to 55°C												
Storage	-40 to 80°C												
<b>POWER DISSIPATION:</b>	Approximately 100 watts, plus 2 watts per amp of DC current.												
<b>ZERO AND SPAN:</b>	Potentiometers on the circuit board allow zero and span adjustments of +/- 25% of span, for the run and idle.												
<b>VOLTAGE METERING:</b>	Voltage output for remote indication of 1 Vdc = 100 Volts load voltage. Load impedance must be 1000 Ohms or greater. Provided between terminals P7-1 (MTR) and P7-2 (COM).												
<b>INTERNAL FEEDBACK:</b>	Average value of load voltage is linear within 2 percent of command signal. Average feedback is used for DC controllers.												
<b>RUN SWITCH:</b>	Closure between terminals 3 & 4 enables output.												
<b>ELECTRICAL CONNECTIONS:</b>	Aluminum compression lugs for line and load connections are provided for use with either aluminum or copper wire from 6 ga to 250 thousand circular mills (250 MCM).												
<b>'LINE OK' INDICATOR:</b>	An LED indicates when all three phases are present on the AC line input terminals.												
<b>'GATE DRIVE' INDICATOR(S):</b>	An LED in each gate driver circuit indicates when a signal is being applied to each of the SCR pairs.												
<b>LINE PHASE SENSING:</b>	The 3869 controller is not phase rotation sensitive.												
<b>SCR AND DIODE RATINGS:</b>	Peak Inv. Volts: 1600 Volts. Maximum single cycle current surge: 105,200 Amps.												
<b>SCR PROTECTION:</b>	DV/DT rating 200V/microsecond. SCR's are protected from high voltage transients by a metal oxide varistor. A free wheeling diode is connected across the DC output.												
<b>THERMAL PROTECTION: (Optional)</b>	The contacts of a single pole thermostat open if the heatsink temperature exceeds 87°C. (Controller can be ordered with normally open contacts. Contacts are rated for 120 Volt, 15 Amp resistive.)												
<b>SCR GATE DRIVE:</b>	Optical coupled 250 mA current source duration is 60 electrical degrees.												
<b>RAMP RATE:</b>	Selected by a switch on the circuit board (#1 on the dip switch), the ramp rate is approximately 0.08 seconds in the OFF (fast) position and approximately 0.5 seconds in the ON (ramp) position.												

## INSTALLATION

### MOUNTING:

The model 3869 is forced air cooled and therefore may be mounted in any direction. The controller should be protected from dust and dirt, and must be located in an environment that does not exceed 55°C.

### LINE VOLTAGE CONNECTIONS:

The 3869 controller is designed to operate on 120, 240 or 480 Volts, 3 phase. Unless otherwise noted by model number.

### FEEDBACK CONNECTION:

A jumper is located on the command connector between pins 6 & 8 or 7 & 8. It's location is dependent upon choices made when ordering the 3869. Do not move this jumper. Call factory for more information.

### POWER CONNECTIONS:

The connectors are rated for use with wire sizes from 250MCM to a #6. Type THWN or THNN wire is recommended. It is also recommended that an oxide inhibitor such as Brundy Pentrox A, or IlSCO De-OX be used on all power connectors to insure good electrical conductivity.

### RAMP RATE:

Position 1 on the dip switch allows the selection of FAST (open) or RAMP (closed). The controller is shipped from the factory with this switch in the RAMP (closed) position.

### METERING OUTPUT:

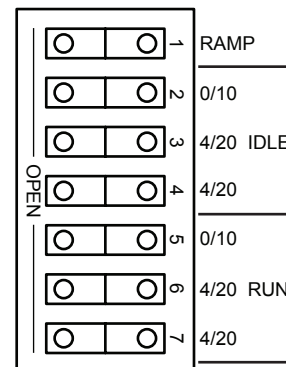
The metering output is scaled to equal 1 volt per 100 Volts of load voltage.

### COMMAND INPUT:

Position the DIP switches as shown below to select the desired command signal.

Command Signal		Switch Number					
		2	3	4	5	6	7
IDLE	0/5 Vdc	O	O	O			
IDLE	0/10 Vdc	X	O	O			
IDLE	4/20 mA	O	X	X			
IDLE	POT.	X	O	O			
RUN	0/5 Vdc				O	O	O
RUN	0/10 Vdc				X	O	O
RUN	4/20 mA				O	X	X
RUN	POT.				X	O	O

X = CLOSED    O = OPEN

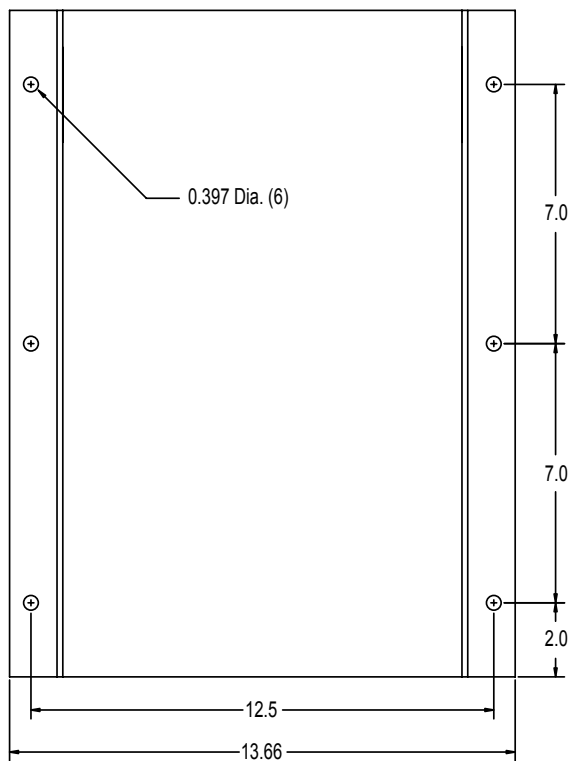
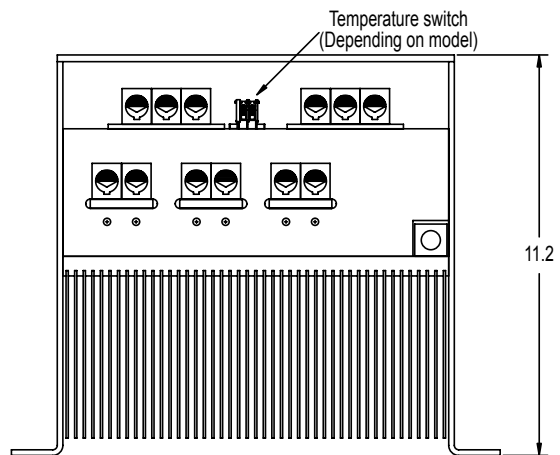


Potentiometers used for the run or idle command are supplied with 10 Vdc between terminals CW and CCW. The wiper of the idle pot connects to 'IW'. The wiper of the run pot connects to 'RW'. The 'RUN' command controls the output when terminals 3 & 4 are connected.

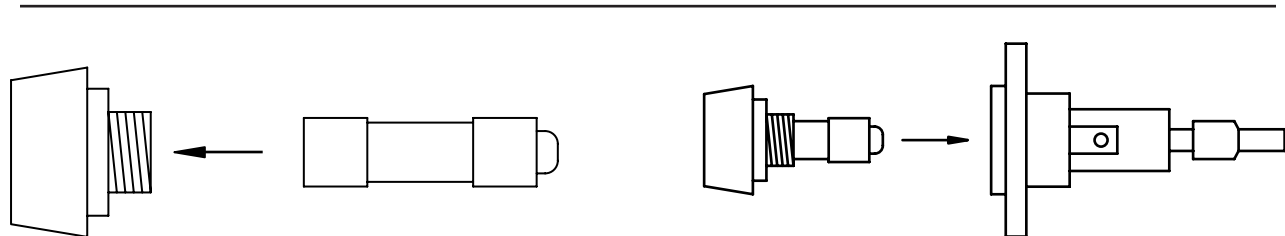
RECOMMENDED TIGHTENING TORQUE FOR THE LINE AND LOAD CONNECTORS:	
WIRE SIZE (AWG) OR CIRCULAR MILLS	TORQUE
<b>4 TO 6GA</b>	<b>100 IN-LBS</b>
<b>1 TO 2GA</b>	<b>125 IN-LBS</b>
<b>1/0 TO 2/0GA</b>	<b>150 IN-LBS</b>
<b>3/0 TO 4/0GA</b>	<b>200 IN-LBS</b>
<b>250 TO 350MCM</b>	<b>250 IN-LBS</b>
<b>500MCM</b>	<b>300 IN-LBS</b>

Wire the controller in accordance with the electrical codes for the area in which it will be used.

# INSTALLATION DRAWINGS



**Figure 1.** Mounting Dimensions.



**Figure 2.**  
**ORIENTATION OF FUSE IN HOLDER**  
 Fuse makes contact only when correctly installed.  
 Place flat end of fuse in cap, then insert into holder.

# CONNECTIONS

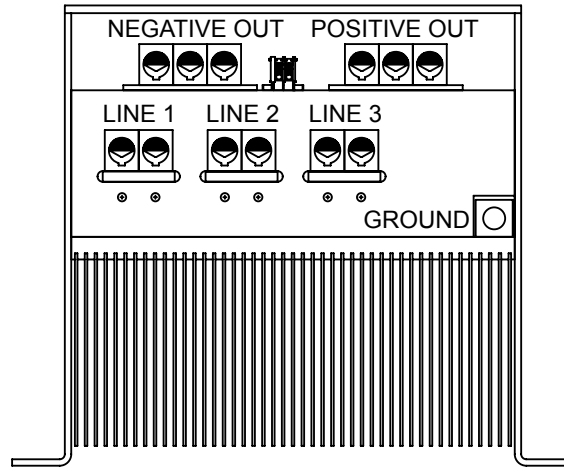


Figure 3. Electrical Connections.

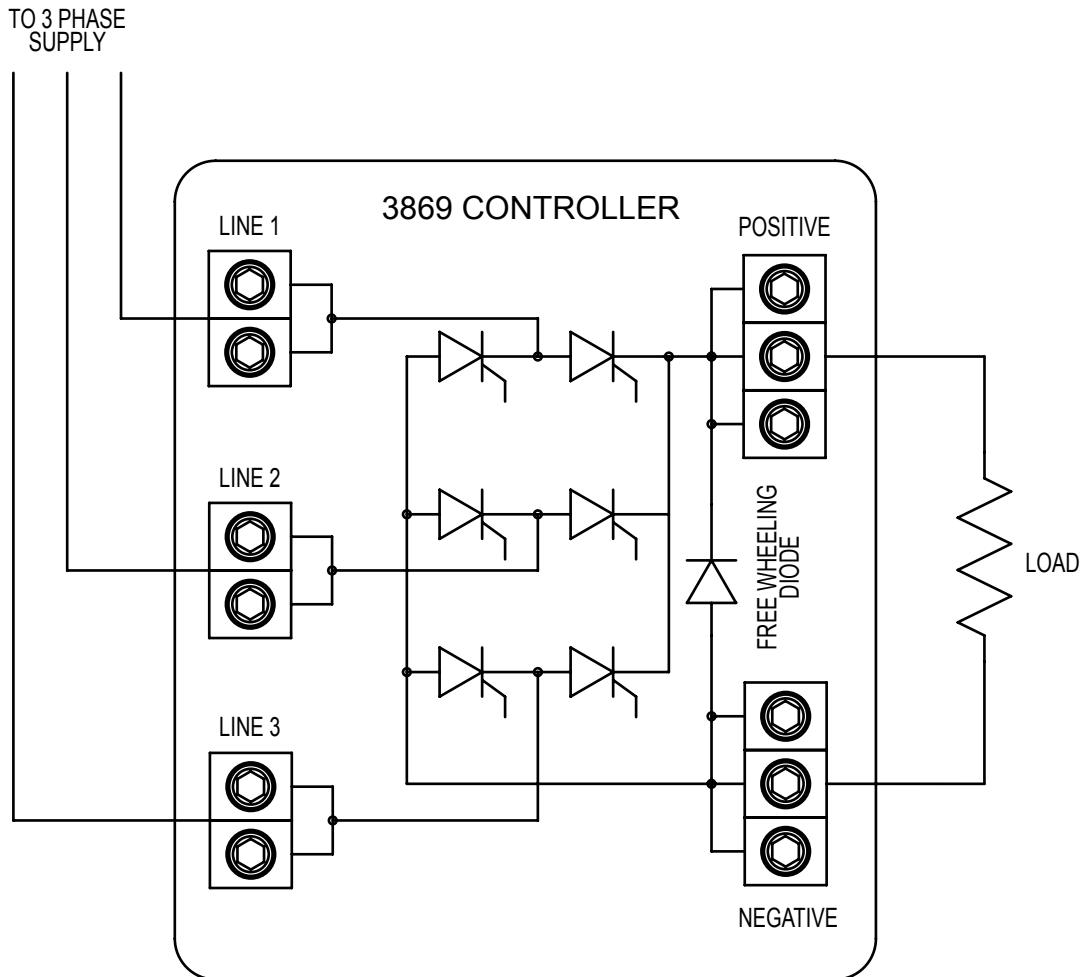


Figure 4. Line and Load Connections.



# CIRCUIT BOARD REFERENCE

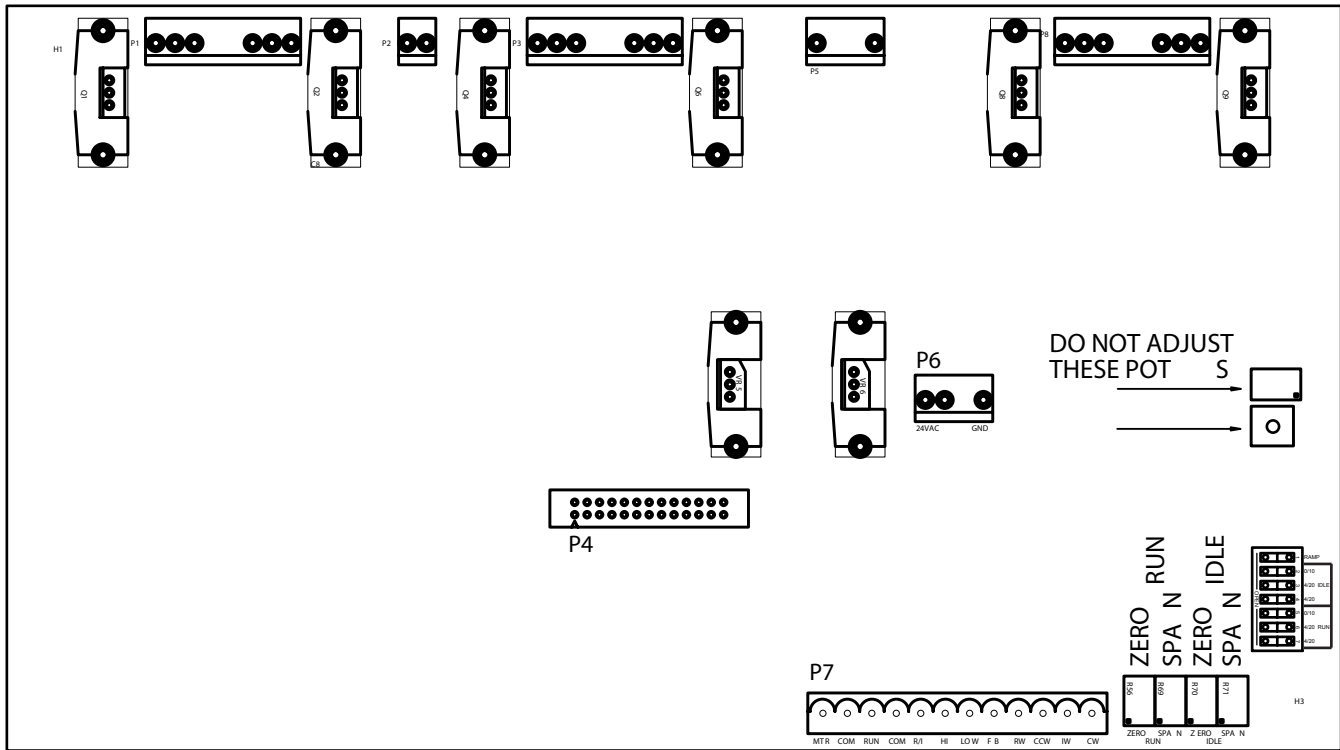


Figure 5. 3869 Board Layout.

# COMMAND CONNECTIONS

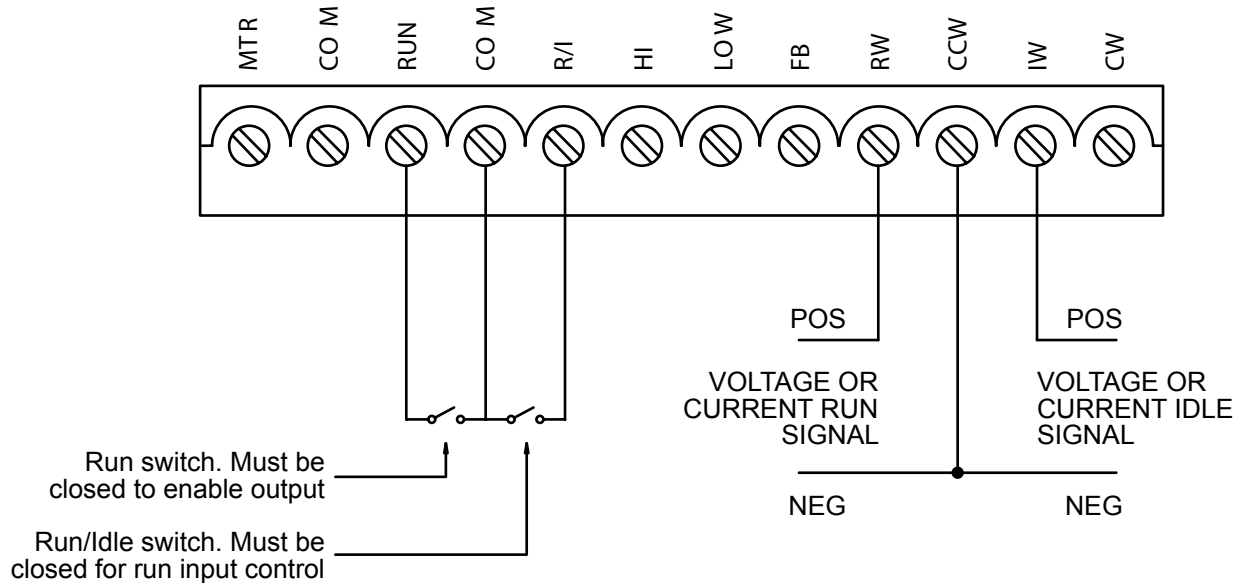


Figure 6. Voltage and Current commands.

## COMMAND CONNECTIONS (Continued)

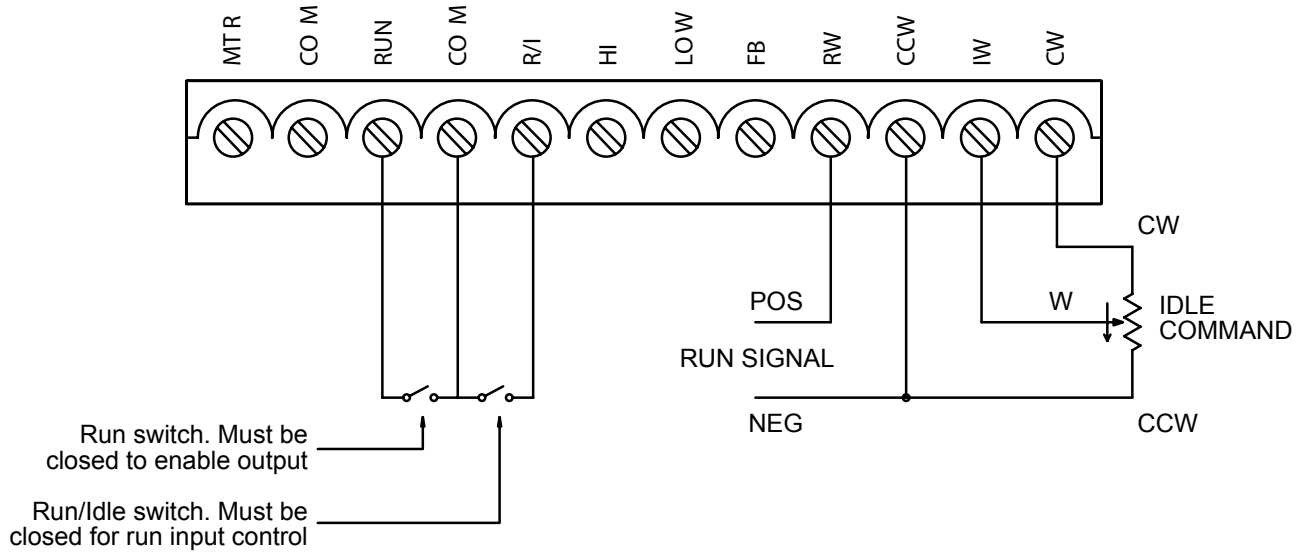


Figure 7. Potentiometer Idle command.

### Feedback connection:

A jumper is located on the command connector between pins 6 & 8 or 7 & 8. Its location is dependent upon choices made when ordering. DO NOT move the location of the jumper.

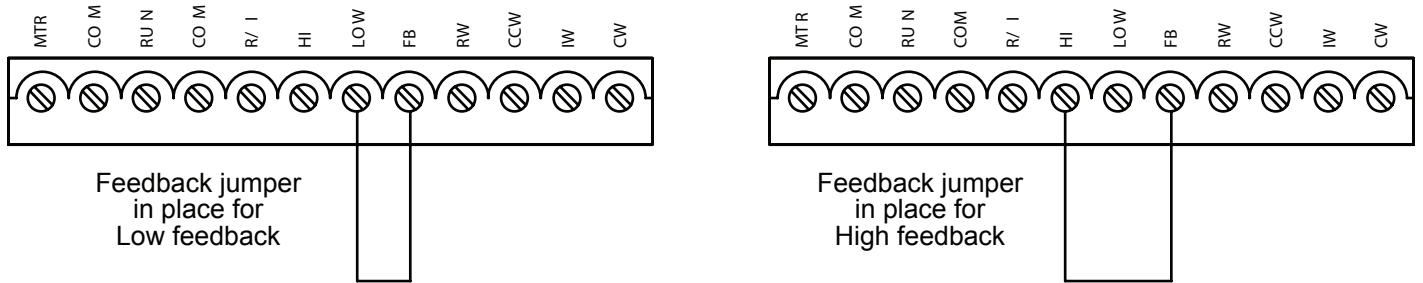


Figure 8. Feedback Jumper

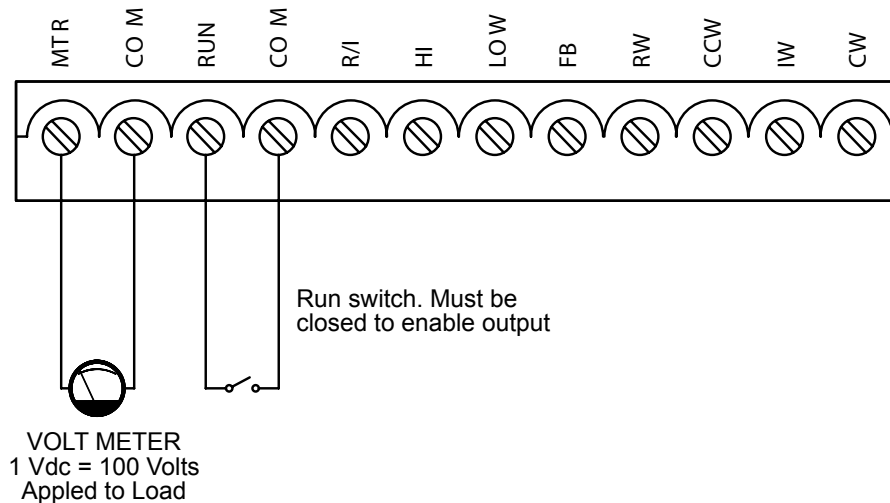


Figure 9. Voltage metering output.

## ADJUSTMENTS

**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.

Close enable switch between terminals P7-3 & P7-4.

Select RUN or IDLE switch between terminal P7-4 & P7-5. Use the span and zero pots labeled for the command.

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.

It is recommended that the user DOES NOT attempt to adjust the VSPAN and NULL potentiometers on the circuit board. Contact factory if these are suspected to be misadjusted.

## TROUBLE SHOOTING

When making electrical measurements on a DC controller, an average responding meter should be used for greatest accuracy. The controller must have a load capable of drawing at least 1 amp to operate properly. A circuit board with the same specifications may be substituted for a questionable circuit to help identify the location of the problem.

When replacing or exchanging circuit boards, do not remove jumpers or wires from the plugin connector. Be sure to set the switches for the input ranges and ramp to the same positions. 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.

SYMPTOMS	POSSIBLE CAUSES
'LINE OK' LED IS NOT ON	<p><b>LINE VOLTAGE NOT APPLIED.</b> Determine that power is applied to the controller by measuring 10 volts between CW and CCW on the command input connector. Check for blown fuse in one or both of the fuse holders on the back panel of the controller.</p> <p><b>MISSING PHASE.</b> One or more phases missing.</p> <p><b>INCORRECT WIRING TO THE CONTROL POTENTIOMETER.</b> A common problem on new installations is that of the wiper of the potentiometer being connected to the CW or CCW terminal on the circuit. This could short out the power supply on the circuit board. Check your wiring carefully.</p> <p><b>POOR CONNECTIONS.</b> Check that the frame wiring connectors are plugged fully onto the circuit board connectors.</p> <p><b>BLOWN FUSE.</b> One or more line fuses may have cleared. Test for line voltage between all line connectors.</p>
'LINE OK' LED IS ON GATE LED'S OFF	<p><b>RUN SWITCH NOT CLOSED.</b> The run switch connected between terminals P7-3(RUN) and P7-4(COM) must be closed or a jumper must be in place.</p> <p><b>NO COMMAND SIGNAL PRESENT.</b> Determine that a command (set point) signal is present.</p> <p><b>INCORRECT COMMAND WIRING.</b> On new installations, check all command wiring and confirm that polarities are correct.</p> <p><b>WRONG INPUT SELECTED.</b> The command signal is being fed to the run input and the run/idle switch is not closed. If only one command signal will be used, confirm that it is connected to the active command input terminals.</p>

## TROUBLE SHOOTING (Continued)

SYMPTOMS	POSSIBLE CAUSES
LOAD POWER AT MAXIMUM	<p><b>FEEDBACK JUMPER MISSING.</b> A jumper located on the command connector should be between pins 6 &amp; 8 or 7 &amp; 8. It's location is dependent upon choices made when ordering the 3869. This jumper may have been removed by mistake. Call factory for more information.</p> <p><b>COMMAND SIGNAL ERROR.</b> Remove the command signal wires from terminals P7-9(RW) through P7-11(IW). If the load power returns to zero, there is a problem with the command signal or the wiring in the command circuit. Determine that the range switches are configured correctly for the type of command signal being used.</p> <p><b>SHORTED SCR.</b> With the power removed from the circuit, and the load(s) disconnected from the load terminals, measure for a short between the line and load terminals on each phase. This measurement will locate a bad SCR. Replace if defective.</p> <p><b>PROBLEM ON THE CIRCUIT BOARD.</b> Swap circuit boards (if one is available), to determine where the problem may exist.</p>
LOAD POWER WILL NOT REACH MAXIMUM	<p><b>INSUFFICIENT COMMAND SIGNAL.</b> Determine that the command signal will reach maximum and that the proper switches are closed on the input range selector switch.</p> <p><b>FEEDBACK JUMPER IN WRONG LOCATION.</b> A jumper located on the command connector should be between pins 6 &amp; 8 or 7 &amp; 8. It's location is dependent upon choices made when ordering the 3869. This jumper may have been changed to wrong location by mistake. Call factory for more information.</p> <p><b>INSUFFICIENT LINE VOLTAGE.</b> Measure the line voltage from phase to phase on the line and load terminals and at the load. If the voltage is correct at the load terminals but not at the load, check the load wiring or external load fuses.</p> <p><b>SPAN OR ZERO POTS MISADJUSTED.</b> Check the procedure for these adjustments.</p> <p><b>FAULTY GATE DRIVER OR OPEN LEAD TO SCR.</b> One or more of the LED's, (located next to the gate drivers) not lighting, indicates a faulty gate driver or open lead. One or more of the LED's remains lighted when others are out, indicates a faulty circuit board.</p>

## SPARE PARTS

Description	CCI Part Number
300 Amp Controller SCR	28355-0416-516
400 Amp Controller SCR	28355-0425-514
Free Wheeling Diode	20052-0426-512
Fuse	42130-0460-210
For additional parts contact factory.	

## MODEL NUMBER IDENTIFICATION

3869-(V)-(O)-(RUN)-(IDLE)-(FC)-(TS)

3869 Specifies a three phase, phase-angle, 6 SCR.

(V) = Specifies the line voltage:  
 12-300 = 120 Vac line, 300 Amp DC frame.  
 24-300 = 240 Vac line, 300 Amp DC frame.  
 48-300 = 480 Vac line, 300 Amp DC frame.

(O) = Specifies Output Voltage when the command signal is at 100%. Contact factory for information.

(RUN) = Run command:  
 R 0/10V = 0 to 10 Volts Run command.  
 R 0/5V = 0 to 5 Volts Run command.  
 R 4/20mA = 4 to 20 milliamps Run command.  
 R POT = 1k to 20k Run potentiometer.

(IDLE) = Idle command:  
 I 0/10V = 0 to 10 Volts Idle command.  
 I 0/5V = 0 to 5 Volts Idle command.  
 I 4/20mA = 4 to 20 milliamps Idle command.  
 I POT = 1k to 20k Idle potentiometer.

(FC) = Firing Circuit: (Optional)  
 Firing circuit only. Contact factory for information.

(TS) = Thermostat: (Optional)  
 TS87C = 87°C normally closed contacts. (for external use, contacts are wired to a terminal block.)  
 TS87CNO = 87°C normally open contacts. (for external use, contacts are wired to a terminal block.)

Contact factory for information on options.

For example;  
**3869-12-300-125Vdc-R0/5V-IPOT-TS87C** specifies a 3869 controller with the following specs:  
 120 Vac line, 300 Amp DC frame, 125VDC output at 100% command signal, it will accept; 0/5 V run command, a potentiometer idle command with an optional 87°C normally closed thermostat.



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