

MODEL 3337

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

MODEL 3337 TABLE OF CONTENTS

DESCRIPTION	1
SPECIFICATIONS	1
SPECIFICATIONS (Continued)	2
INSTALLATION	3
INSTALLATION DRAWINGS	4
INSTALLATION DRAWINGS (Continued)	5
LINE AND LOAD CONNECTIONS	6
COMMAND CONNECTOR	7
COMMAND CONNECTOR (Continued)	8
COMMAND CONNECTOR (Continued)	9
START-UP	10
ADJUSTMENTS	10
TROUBLE SHOOTING	11
MANUFACTURED BY	11
REPLACEMENT PARTS	12
MODEL No. IDENTIFICATION	13
THEORY OF OPERATION	14

DESCRIPTION

MODELS COVERED

This manual covers the model 3337 controller rated 200, 240, 280, 320, 500, 600 & 750 amps.

APPLICATIONS

The model 3337 provides control of three phase power to a variety of loads, including electric ovens, furnaces and kilns, environmental chambers, contactor replacement, resistance heating, platen heaters and extruders.

GENERAL DESCRIPTION

The model 3337 is a three-phase, three leg, zero cross power controller. The average output voltage is proportional to the command signal.

The model 3337 is not sensitive to phase rotation.

A jumper is provided for selecting between external, or average voltage internal feedback. Other jumpers select standard command signals.

SYNC-GUARD™ and TRANS-GUARD™ features are built into the model 3337.

The model 3337 has shorted SCR detection.

SPECIFICATIONS

These specifications apply over an ambient temperature of 0 to 55°C; supply voltage of 208, 240, 277, 380, 415, 480 or 575 Vac (+10% - 15%), 50/60 Hertz.

CONSTRUCTION	The firing circuit, gate drivers and all associated circuitry is laid out on a single Board. Three fast acting fuses, inside the controller, protect the SCRs from typical fault currents.										
CONTROL MODE	Model 3337 SCR power controller, linearly controls with respect to a command signal, the electrical power applied to three-phase resistive load by zero-cross operation of silicon controlled rectifiers (SCRs). The controller provides line voltage compensation which maintains the load power constant, independent of line voltage variations.										
FIRING MODE	3 leg distributed zero cross. Average load voltage is proportional to the command signal when using internal feedback.										
CONTROL RANGE	0 to 98% of supply voltage.										
CONTROL POWER	24 Vac + 20% - 15%. VA = 15										
DV/DT AND TRANSIENT VOLTAGE PROTECTION	DV/DT rating exceeds 200 volts per microsecond. DV/DT snubber circuit and MOVs are provided to protect against high frequency transients (dv/dt) and high voltage transients.										
SET POINTS	The command signal may be either a mA current, a DC voltage or a potentiometer. The 3337 provides electrical isolation of the command signals from the line and load voltages allowing grounded or ungrounded commands. The following command signal inputs are jumper selectable: <table> <tr> <td>Input Signal</td><td>Input Impedance</td></tr> <tr> <td>4/20 mA</td><td>249 Ohms</td></tr> <tr> <td>0-5 Vdc</td><td>500k Ohms</td></tr> <tr> <td>0-10 Vdc</td><td>200K Ohms</td></tr> <tr> <td>1K - 20K Pot</td><td>200K Ohms</td></tr> </table> (A 1K, 1/4 watt potentiometer is recommended for optimum linearity, up to 20K is permissible) The potentiometer is excited by 10Vdc, supplied by the circuit. Other ranges may be available. Check with factory for special applications. Plus or minus 200 Volt Peak isolation is provided for the 4/20 mA input by means of a high common mode voltage instrumentation amplifier.	Input Signal	Input Impedance	4/20 mA	249 Ohms	0-5 Vdc	500k Ohms	0-10 Vdc	200K Ohms	1K - 20K Pot	200K Ohms
Input Signal	Input Impedance										
4/20 mA	249 Ohms										
0-5 Vdc	500k Ohms										
0-10 Vdc	200K Ohms										
1K - 20K Pot	200K Ohms										
ENVIRONMENT	Operating temperature: 0 to 55°C (32 to 132° F). Storage temperature: -20 to 80°C (-4 to 176° F). Humidity: 0 to 95%, Non condensing.										
EXTERNAL FEEDBACK	0 to 5 Vdc feedback signal.										

SPECIFICATIONS (Continued)

DISSIPATION	Approx. 1.5 watts per amp of current per phase will be dissipated by controller.																								
GATE DRIVES	Optically coupled Triac drivers.																								
LINEARITY	Average load voltage is linear within 2% of span with respect to the command signal.																								
PHASE ROTATION	Model 3337 is not sensitive to phase rotation.																								
FRAME SIZES AND FUSING	The 200 Amp frame is fused at 250 Amps maximum. The 240 Amp frame is fused at 300 Amps maximum. The 280 Amp frame is fused at 350 Amps maximum. The 320 Amp frame is fused at 400 Amps maximum. The 500 Amp frame should be fused at 600 Amps maximum. The 600 Amp frame should be fused at 750 Amps maximum. The 700 Amp frame should be fused at 900 Amps maximum.																								
SCR I ² T and SURGE CURRENT RATING	<table><tr><td>Frame rating</td><td>SCR I²T rating @25°C</td><td>I_{TSM} Surge Current Rating @25°C</td></tr><tr><td>200 Amps</td><td>100,000A²s</td><td>4700A</td></tr><tr><td>240 Amps</td><td>145,000A²s</td><td>5400A</td></tr><tr><td>280 Amps</td><td>361,000A²s</td><td>8500A</td></tr><tr><td>320 Amps</td><td>405,000A²s</td><td>9000A</td></tr><tr><td>500 Amps</td><td>500,000A²s</td><td>10,000A</td></tr><tr><td>600 Amps</td><td>845,000A²s</td><td>13,000A</td></tr><tr><td>750 Amps</td><td>1,670,000A²s</td><td>20,000A</td></tr></table>	Frame rating	SCR I ² T rating @25°C	I _{TSM} Surge Current Rating @25°C	200 Amps	100,000A ² s	4700A	240 Amps	145,000A ² s	5400A	280 Amps	361,000A ² s	8500A	320 Amps	405,000A ² s	9000A	500 Amps	500,000A ² s	10,000A	600 Amps	845,000A ² s	13,000A	750 Amps	1,670,000A ² s	20,000A
Frame rating	SCR I ² T rating @25°C	I _{TSM} Surge Current Rating @25°C																							
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750 Amps	1,670,000A ² s	20,000A																							
SCR VOLTAGE RATING	1600 volts peak																								
SCR CONFIGURATION	6 inverse-parallel SCR switches In-Line, driving 3 or 4 wire wye or a delta load.																								
VOLTAGE COMPENSATION	The load power remains constant within 2% of span for line voltage changes of +10% and -15% variations.																								
LED INDICATORS	Command indicator. 3 shorted SCR indicators.																								
ZERO AND SPAN ADJUSTMENTS	Multi-turn potentiometers allow zero and span adjustments of ±25% of span.																								
ISOLATION	Isolation between power circuit, command signal and ground is greater than 2500 Vrms.																								
SHORTED SCR DETECTION	Shorted SCR detection is accomplished by measuring the Voltage across the SCR switch when the Gate Signal is off. A measurement of less than 24 Volts across the SCR switch indicates a shorted SCR. Non-latching form "C" relay contact closes when a shorted SCR is detected. The shorted SCR relay is rated at 120 Vac, with a 5 Amp resistive load. If an open line or open load results in zero voltage across an SCR switch, the shorted SCR detector will be energized.																								
SYNC-GUARD™	SYNC-GUARD™ reduces the possibility of two or more controllers operating synchronously, thereby reducing the possibility of all controllers being on and off simultaneously. The SYNC-GUARD™ feature provides a more uniform or continuous power demand and therefore reduces the variations in the supply voltage that can occur when multiple controllers operate synchronously. Up to ten controllers may be connected together for SYNC-GUARD™. Only one termination resistor should be connected in each group of controllers tied together in this way.																								
TRANS-GUARD™	The TRANS-GUARD™ feature eliminates the DC load voltage and current that can exist with zero-cross operation. The TRANS-GUARD™ feature therefore prevents saturation and over heating of supply transformers due to DC voltage which can occur on the transformer primary because of secondary DC currents.																								

INSTALLATION

Before mounting, determine that the transformer tap is set to a value corresponding to the supply voltage.

POWER CONNECTIONS:

Wire the controller in accordance with the electrical codes for the area in which it will be used. Connect the supply power and load as shown in the line and load connections. **NOTE:** The controller is not phase rotation dependent.

An oxide inhibitor such as Burndy Pentrox A, IlSCO De-OX, etc. should be used between electrical connections to insure good electrical contact.

The connectors, ILSCO No. CA6RP, are rated for use with wire sizes from 250MCM to 6ga. Type THWN or THNN wire is recommended.

500 - 750 controllers have a connector for 120 Vac power to operate the fan(s). It also provides power for the transformer which supplies 24Vac to the firing circuit.

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



RECOMMENDED TIGHTENING TORQUE FOR EDGE CARD CONNECTOR:	
WIRE SIZE (AWG)	TORQUE
14 TO 26GA	4.4 - 5.5 IN-LBS



RECOMMENDED TORQUE FOR FUSE CONNECTIONS		
FUSE SIZE	BOLT SIZE	TORQUE
71-100	1/4	96 IN-LBS
110-200	5/16	17 FT-LBS
225-400	3/8	30 FT-LBS
450-600	7/16	50 FT-LBS
601-800	1/2	75 FT-LBS
801-1200	9/16	110 FT-LBS

RECOMMENDED TORQUE FOR SCR MOUNTING	
BOLT SIZE	TORQUE
8-32	30 IN-LBS
10-32	49 IN-LBS
1/4-20	96 IN-LBS
RECOMMENDED TORQUE TO PROVIDE OPTIMUM PRESSURE ON THE BELLEVILLE WASHER.	

INSTALLATION DRAWINGS

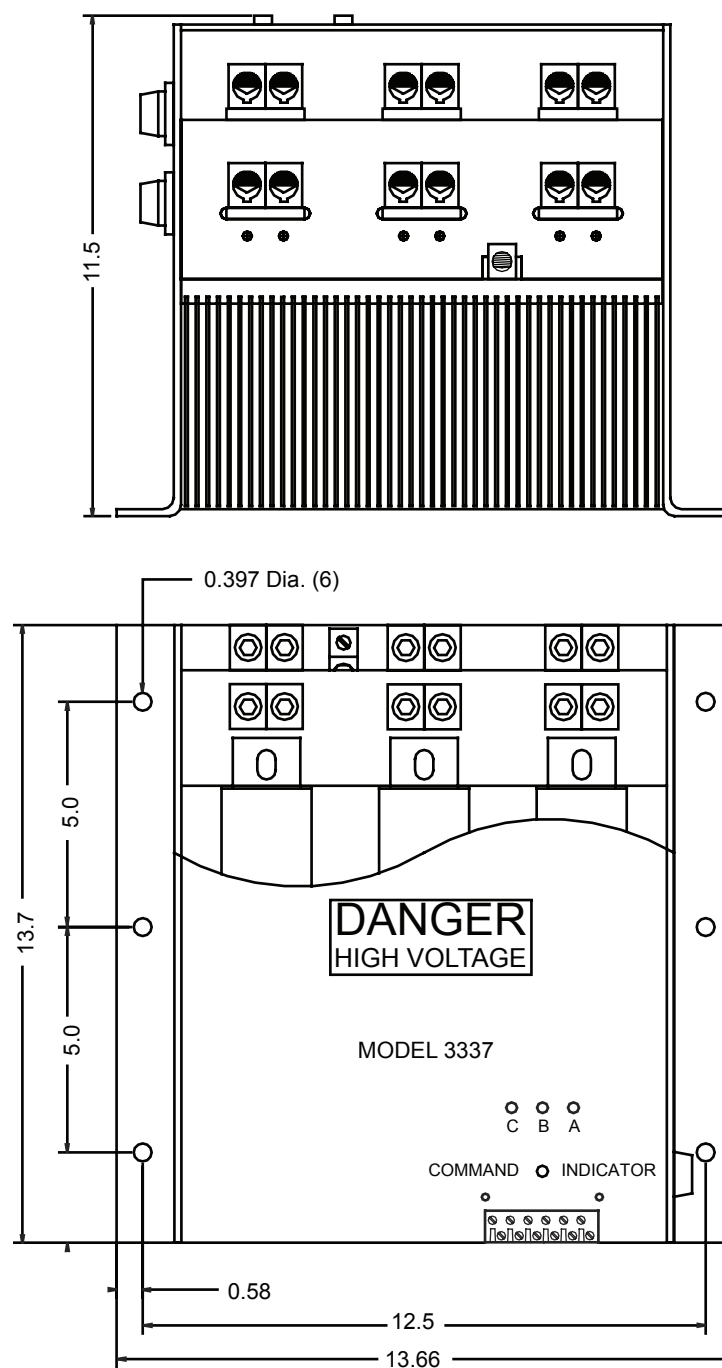


Figure 1. Mounting dimensions for Model 3337 - 200 to 320 Amp.
(All dimensions +/- 0.1 inches)

INSTALLATION DRAWINGS (Continued)

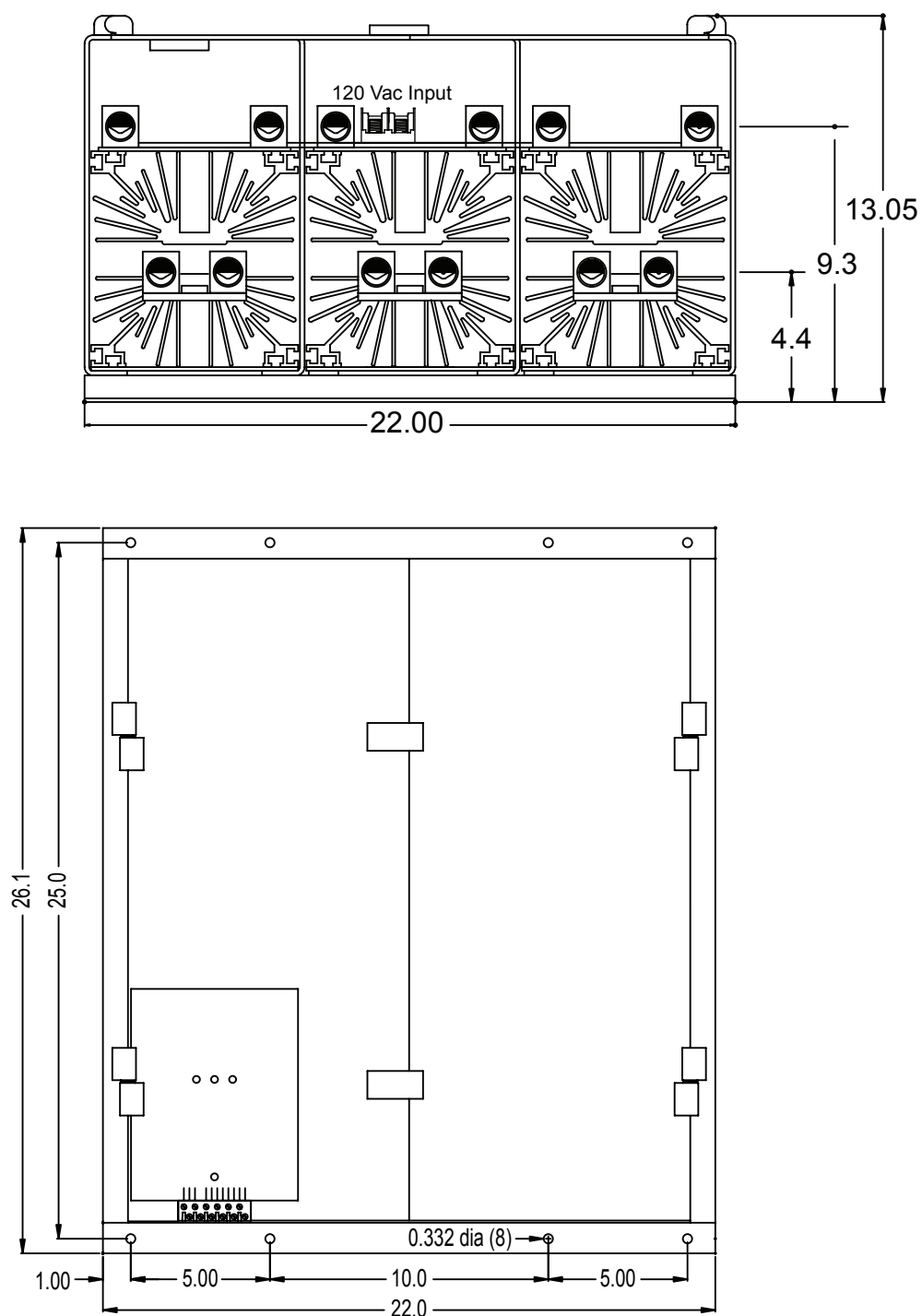
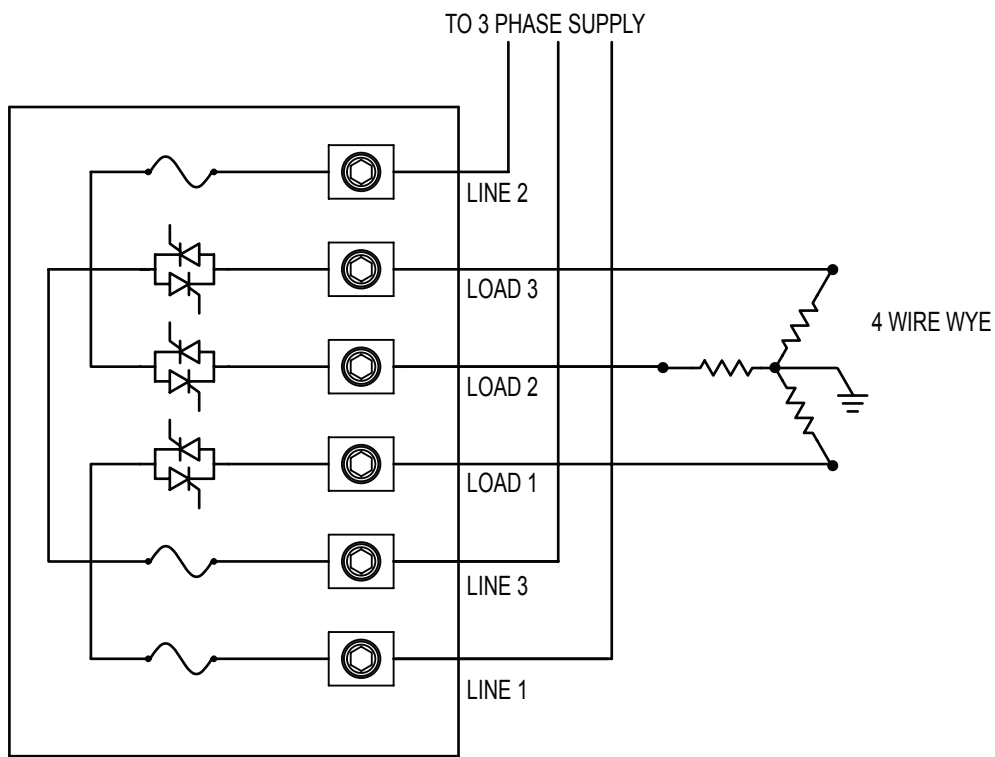
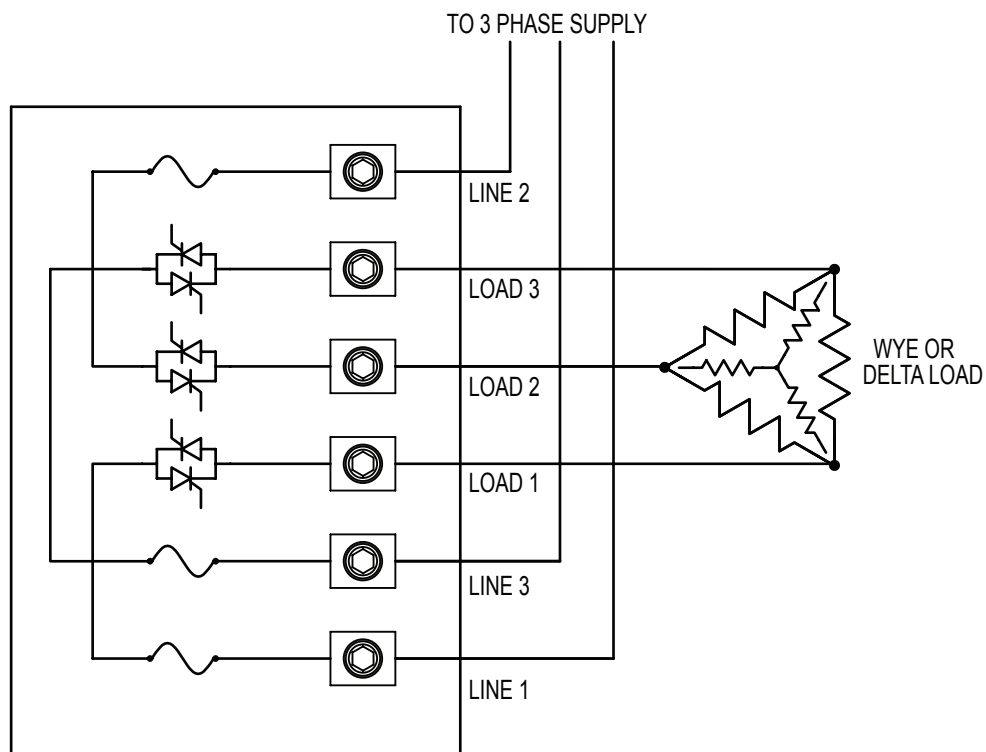


Figure 3. Mounting dimensions for Model 3337 - 500 to 750 Amp.

LINE AND LOAD CONNECTIONS



Power Connections for 200, 240, 280, 320, 500, 600 & 750 Amp controllers.
Fuses are only present on 200 - 320 Amp controllers.
2 Lugs per connection.

COMMAND CONNECTOR

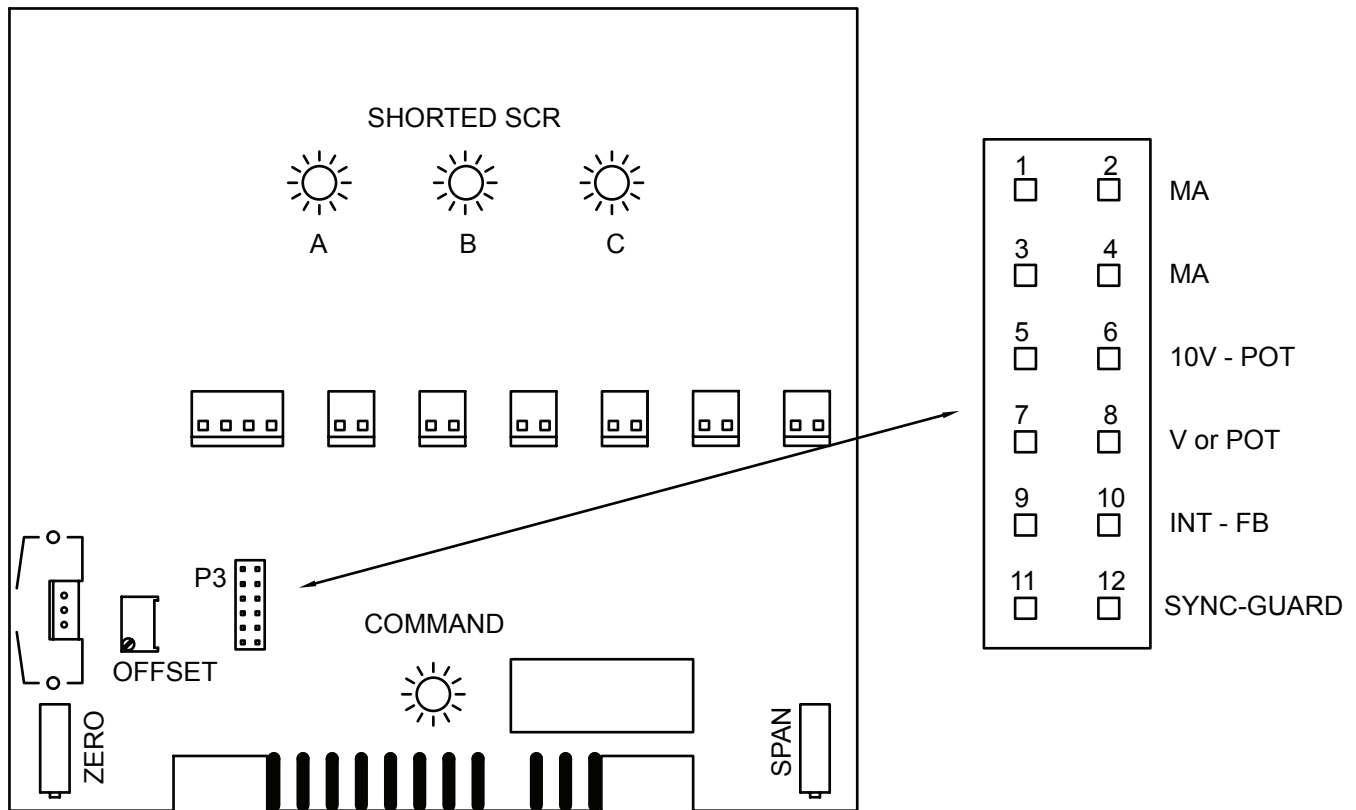


Figure 7. Model 3337 board with P3 jumper location and position settings.
LEDs are installed on the backside of the board.

Command Connections are jumper positions 1 - 8 (Figures 9 - 11).
Feedback and Sync-Guard are jumper positions 9 - 12 (Figures 12 - 13).

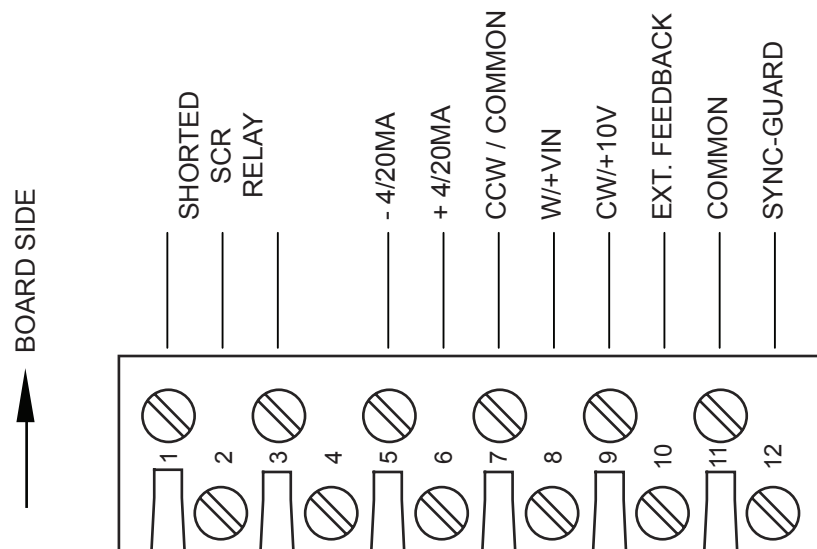


Figure 8. Model 3337 Command Connector.

COMMAND CONNECTOR (Continued)

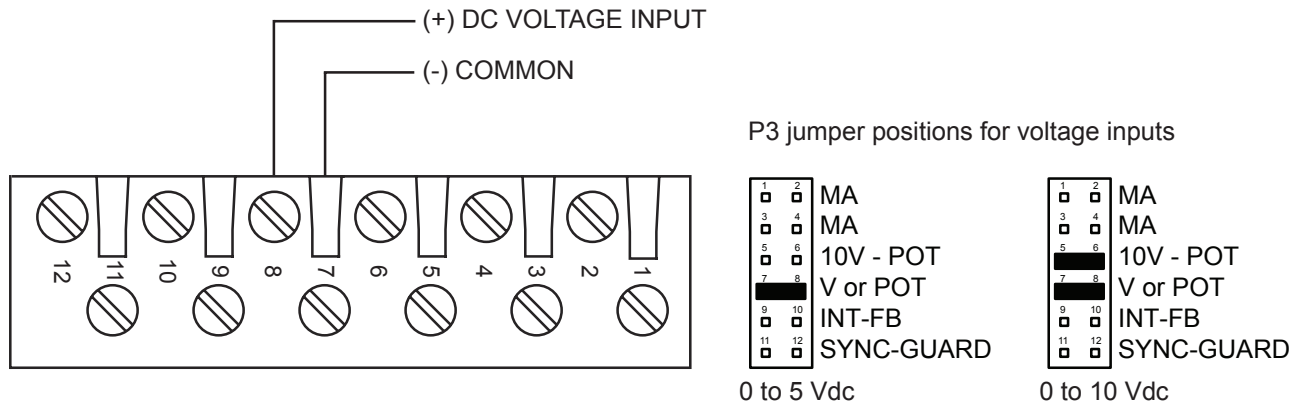


Figure 9. Connections for a voltage command signal.

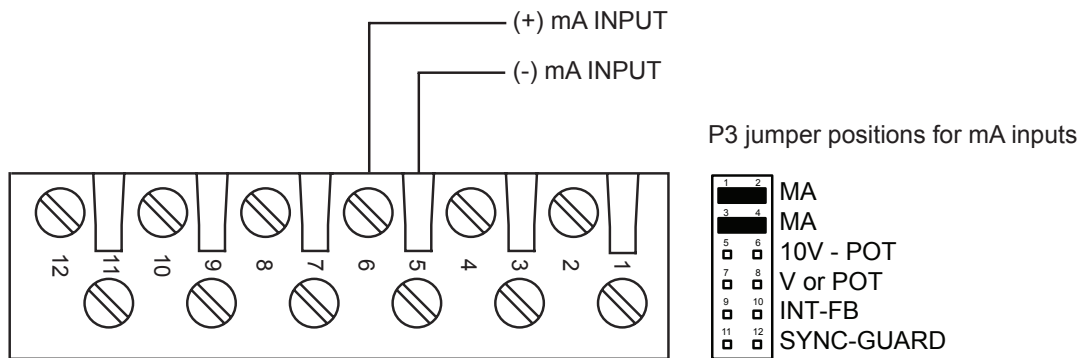


Figure 10. Connections for a mA command signal.

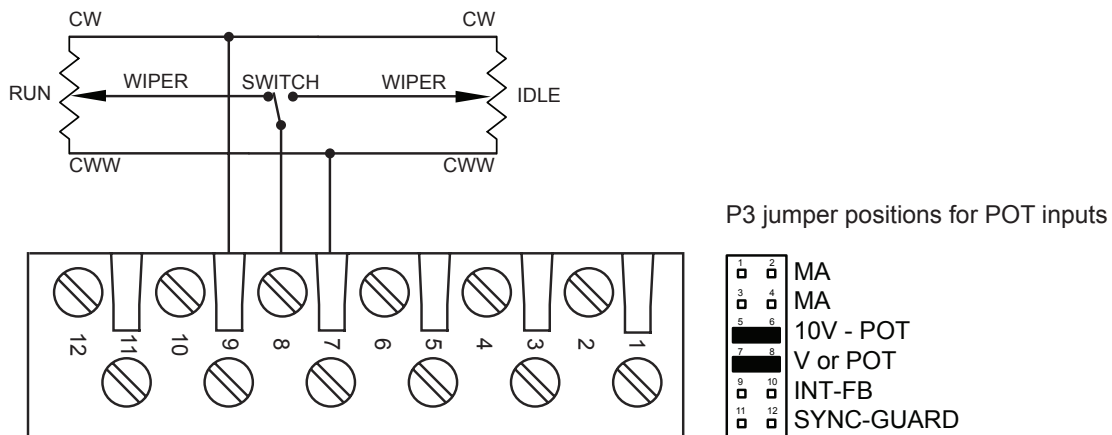


Figure 11. Connections for using pots as RUN/IDLE command control.
Eliminate idle pot and switch for run only command.

Note: If multiple controllers are controlled by one potentiometer, make the connections as shown above for one controller. Then connect terminal 7 of all controllers together and connect terminal 8 of all controllers together. Two potentiometers (2K minimum resistance) are required for run/idle control. Switch the appropriate potentiometer wiper to the controller. Shielded wire is not required but it is recommended that the control wire not be placed adjacent to power wiring.

COMMAND CONNECTOR (Continued)

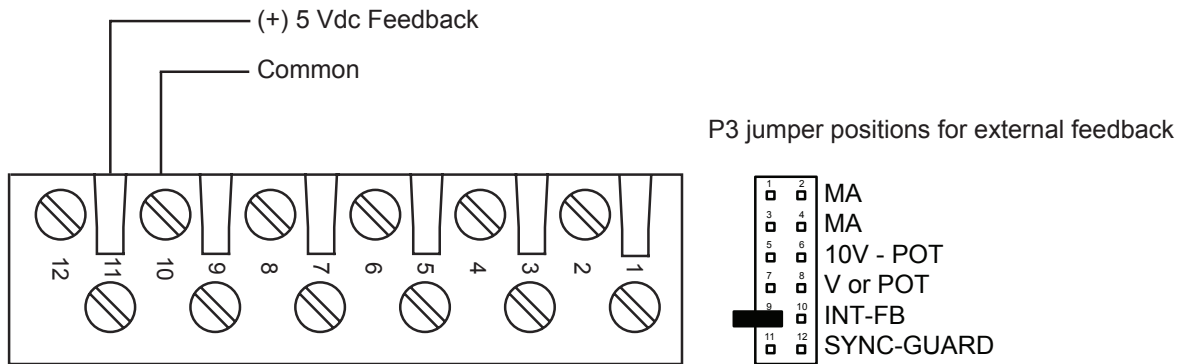


Figure 12. External feedback is a 0 to 5 Volts D.C. signal representing the variable to be controlled. For example; Power, Current, Voltage, ETC. The jumper from pins 9 & 10 need to be removed for external feedback.

The SYNC-GUARD™ feature is implemented by connecting all #11 terminals together, and all #12 terminals together. Up to 10 controllers, regardless of the current ratings, can be connected in this manner. A jumper is left in place from P3-11 to P3-12 on any one of the controllers, the other controllers must have this jumper removed. The unused jumper may be stored as shown below. This jumper connects a 1K load resistor in the SYNC-GUARD™ circuit, only one is necessary. Do not remove jumpers from other pins.

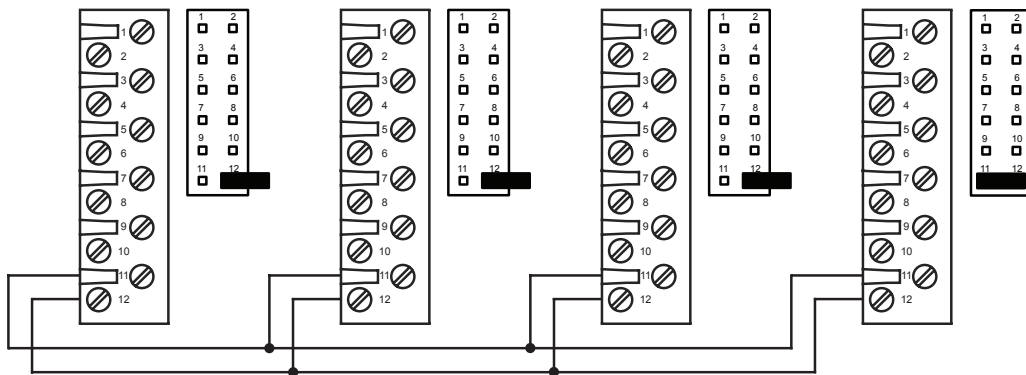


Figure 13. Connecting units together for sync guard.

A relay with form "C" contacts rated at 120 Vac @ 5A is located on the circuit board. These contacts could be used to cause an alarm to signal personnel and/or operate a contactor which removes power from the circuit.

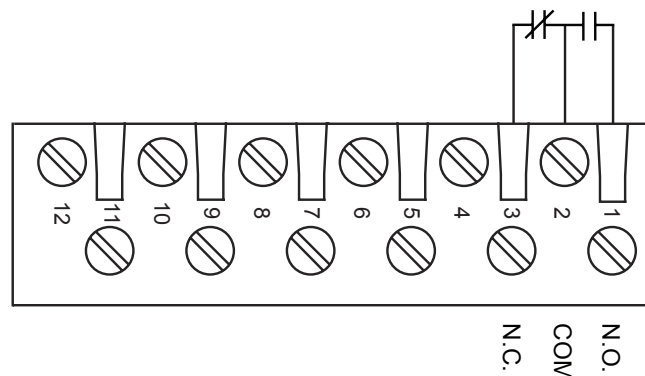


Figure 14. Connections for shorted SCR detection relay.

START-UP

USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK
Portions of the circuit board and the controller are at line voltage.

Set the command signal to minimum and apply system power. The command indicator light should be off and no power should be applied to the load. Slowly increase the command signal. The command indicator should blink on and off proportional to the magnitude of the command signal and load power should increase.

If the command indicator blinks on and off with no command signal, adjust the "zero" potentiometer until the indicator no longer turns on. If the command indicator blinks when the maximum command signal is applied, adjust the "span" potentiometer until the indicator blinks once every 5 seconds.

ADJUSTMENTS

DO NOT ATTEMPT TO ADJUST THE OFFSET POTENTIOMETER.
THIS ADJUSTMENT IS MADE AT THE FACTORY AND IS CRITICAL TO
PROPER OPERATION OF THE CONTROLLER WITH 4/20 mA COMMANDS.

The zero and span pots are factory set, and should not require further adjustment.

The zero and span adjustments for a given input or output will interact. If adjustments become necessary, the following procedure should be followed.

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. Repeat steps 1 and 2 until no further adjustment is necessary.

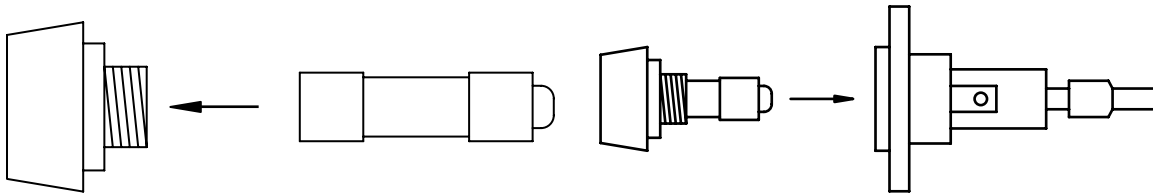
NOTE:

THE COMMAND LED WILL BLINK ONCE EVERY FIVE SECONDS, DURING MAXIMUM SIGNAL, WHILE THE CIRCUIT IS TESTING FOR A SHORTED SCR.

REPLACEMENT PARTS

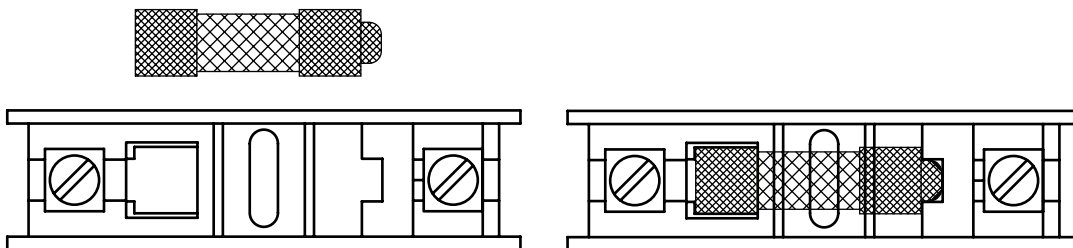
FRAME SIZE IN AMPS (A)	LOAD FUSE	SCR	CONTROL TRANSFORMER FUSE
200	42110-0460-425	SCR-TT170	42130-0460-210
240	42110-0460-430	SCR-TT170	42130-0460-210
280	42110-0460-435	SCR-TT250	42130-0460-210
320	42110-0460-440	SCR-TT250	42130-0460-210
500	N/A	SCR/T600-14*	42130-0460-210
600	N/A	SCR/T760-14*	42130-0460-210
750	N/A	SCR/Z1400-14*	42130-0460-210

* Because of critical assembly requirements, it is recommended that replacement of SCRs on 500 Amp and larger controllers be done at the factory. If you desire to try it yourself, request a copy of our technical bulletin concerning replacement of SCR's on the 3337 controller.



ORIENTATION OF FUSE IN HOLDER FOR 200 - 320 AMP

Fuse makes contact only when correctly installed.
Place flat end of fuse in cap, then insert into holder.



ORIENTATION OF FUSE IN HOLDER FOR 500 - 750 AMP

Fuse makes contact only when correctly installed.
Note: 500, 600 & 750 Amp controllers do not have line load fuses.

THEORY OF OPERATION

In zero-cross control, load power is turned on or off only when the instantaneous value of the sinusoidal waveform is zero. Load power is controlled by switching the SCRs "on" for a number of complete electrical half-cycles and then "off" for a number of complete electrical half-cycles.

Because of the TRANS-GUARD™ feature, the 3337 always applies an odd number of "on" half cycles and an even number of "off" half cycles. The following tabulation shows the number of "on" and "off" electrical half-cycles of power that are applied to load to achieve the percentage of load power indicated. The percentage of load power is equal to the ratio of the number of electrical half-cycles that power is applied to the total number of electrical half-cycles.

LOAD POWER				
10%	25%	50%	75%	85%
5 on	5 on	9 on	17 on	23 on
46 off	14 off	8 off	6 off	4 off
5 on	5 on	7 on	19 on	23 on
44 off	16 off	8 off	6 off	4 off
				23 off
				4 off
				23 on
				4 off
				23 on
				4 off
				21 on
				4 off
Table 1. Percentage of ON-OFF time				

From the above tabulation, it can be seen that power is applied for 16 out of 32 electrical half-cycles to achieve 50% load power and that power is applied for 136 out of 160 electrical half-cycles to obtain 85% power. When operated with a 60 hertz supply, the sequence of on and off cycles repeats every 0.266 seconds at 50% and every 1.33 seconds at 85% power. Note that even though it takes 1.33 seconds to obtain precisely 85% power, the load power during the 23 on and 4 off cycles is 23/27 or 85.185% power and that this cycle is repeated every 0.225 seconds.

MODEL No. IDENTIFICATION

3337	_____	3337 - [vvv]V - [aaa]A - [xx] - [FC] - [SC]
	Specifies a three-phase, three leg SCR controller.	
[vvv]V	_____	
	Specifies the line voltage. Choices are: 208, 240, 277, 380, 415, 480 or 575 Vac. Consult factory for other voltages.	
[aaa]A	_____	
	Specifies the continuous RMS load current rating. Choices are: 200, 240, 280, 320, 500, 600 or 750 Amps. Note: Customer must provide 120 Volts AC to 500 to 750 Amp units for fans.	
[xx]	_____	
	Specifies the type of command signal the controller has been calibrated to operate with. Voltages: 0/5Vdc or 0/10Vdc. Current: 4/20mA. Potentiometer, 1K recommended, 20K maximum.	
[FC]	_____	
	Specifies a replacement firing circuit only. This term is omitted if ordering complete controller.	
[SC]	_____	
	Specifies special calibration. This term is omitted if standard calibration is desired.	

For example, **3337-480V-280A-4/20mA** specifies a three phase 3337 controller built to operate on a 480 volt line, 280 amps maximum continuous load and operate with a command signal of 4/20mA.

TROUBLE SHOOTING

CAUTION:
USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK.
DO NOT ATTEMPT TO OPERATE THE CONTROLLER WITH THE
CATHODE OR GATE LEADS REMOVED

SYMPTOMS	POSSIBLE CAUSES
No load power and command indicator does not function.	1. Determine that line voltage is present on line input terminals. 2. Check fuses. 3. Determine that the command signal is present. 4. Determine that 10 Vdc $\pm$ 0.5V is present between terminal 7 and terminal 9 on the input connector. a. If the voltage is greater than 11 Vdc, the circuit board has probably failed. b. If the voltage is less than 9 Vdc, the circuit board or transformer has probably failed. (Check that correct transformer tap has been selected.) c. If the voltage is zero, check to see if a power transformer fuse is blown.
No load power and command indicator functions correctly.	1. Remove system power and visually inspect circuit board for damage. 2. It is unlikely that all SCR modules have failed. 3. Check load connections and load fuses. 4. Check that gate connector is plugged in and properly seated.
Partial load power and command indicator is off.	1. Remove system power and remove circuit board from the controller. Reapply system power. If no load voltage exists with the circuit board removed, the circuit board has failed. 2. If voltage still exists across load, one or more SCR's has failed.
Full load power and command indicator is on. No SSCR indicator on. Command signal is less than maximum.	1. (A convenient method to apply zero command is to remove the input connector from the controller.) If the command indicator remains on with zero command signal the circuit board has failed. 2. Missing external feedback signal with jumper P3-9 to P3-10 removed.
Full load power can not be obtained and command indicator is on.	1. Check the fuse between line 3 and load 3. 2. Visually inspect the circuit board for damage. 3. With the command signal at maximum the voltage between the corresponding line and load terminals should be less than 5 Vac. SCR modules which have a voltage greater than 5 volts have probably failed.
One or more shorted SCR indicators are on.	1. SCR associated with that phase is shorted. 2. Faulty load wiring. 3. Blown fuse. 4. With power off, remove the firing circuit. Reapply power. One or more SCR's have failed if load voltage exists.

MANUFACTURED BY



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

8077 Century Blvd
Chanhassen, MN 55317, USA