

MODEL 3027

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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10 to 600 VOLTS
85 to 750 AMPS

LISTED 3L32 FILE No: E136219
INDUSTRIAL CONTROL EQUIPMENT

DESCRIPTION

The model 3027 SCR power controller, linearly controls, with respect to command signal, the electrical power applied to three-phase resistive loads by zero-cross operation of silicon controlled rectifiers (SCRs) which are connected in two of the three load leads.

The command signal may be a mA current, DC voltage or potentiometer signal. The 3027 provides electrical isolation of the command signals from the line and load voltages allowing either grounded or ungrounded commands. The controller also provides line voltage compensation which maintains the load power constant independent of line voltage variations.

Three fast acting fuses within the controller protect the SCRs from fault currents. These fuses can, in many situations, also be relied upon to protect the load from fault currents.

The 3027 controller has two unique features called "SYNC-GUARD™" and "TRANS-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. When using SYNC-GUARD™ feature 4/20mA control signals must be isolated.

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.

SPECIFICATION

CONTROL MODE:	Zero-cross, two-leg distributive power control to three-phase resistive loads.												
CURRENT RATING:	The "[AAA]A" term within the model number specifies the maximum continuous RMS current rating at the maximum operating ambient temperature of 55°C.												
COMMAND SIGNAL:	<table> <tr> <td>Input</td><td>Resistance</td></tr> <tr> <td>4/20mA</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	4/20mA	300 ohms	0/10 Vdc	240K ohms	0/5 Vdc	120K ohms	Potentiometer	240K ohms	(1K recommended, 20K permissible, 1/2 watt)	
Input	Resistance												
4/20mA	300 ohms												
0/10 Vdc	240K ohms												
0/5 Vdc	120K ohms												
Potentiometer	240K ohms												
(1K recommended, 20K permissible, 1/2 watt)													
POWER CIRCUIT:	Inverse parallel silicon controlled rectifiers (SCRs). Two leg control.												
OPERATING VOLTAGE:	208, 240 OR 480 Vac 50/60 Hertz +10 -15% Other voltages available - contact factory for details.												
ENVIRONMENT:	<table> <tr> <td>Operating</td><td>0 to 55°C</td></tr> <tr> <td>Storage</td><td>-40 to 80°C</td></tr> <tr> <td>Humidity</td><td>0 to 95% non - condensing</td></tr> </table>	Operating	0 to 55°C	Storage	-40 to 80°C	Humidity	0 to 95% non - condensing						
Operating	0 to 55°C												
Storage	-40 to 80°C												
Humidity	0 to 95% non - condensing												
ISOLATION:	Isolation between power circuit, command signal and ground is > 2500 Vrms.												
LINEARITY:	The load power is linear within 2% of span with respect to the command signal.												
VOLTAGE COMPENSATION:	The load power remains constant within 2% of span for line voltage changes of +10% and -15% variations.												
CONTROL RANGE:	0 to 99.5% of supply voltage.												
SCR VOLTAGE RATING:	85 to 175 Amps = 1600 volts peak 240 to 425 Amps = 1400 volts peak 500 to 750 Amps = 1600 volts peak.												
DV/DT AND TRANSIENT VOLTAGE PROTECTION:	DV/DT rating exceeds 200 V/usec. DV/DT snubber circuit and MOVs are provided to protect against high frequency transients (dv/dt) and high voltage transients.												
ZERO AND SPAN:	±20% of span.												
COMMAND INDICATOR:	An LED is turned on when the SCRs are turned on.												
HEAT DISSIPATION:	1.5 watt per amp of load current per leg.												

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.	

COMMAND CONNECTIONS

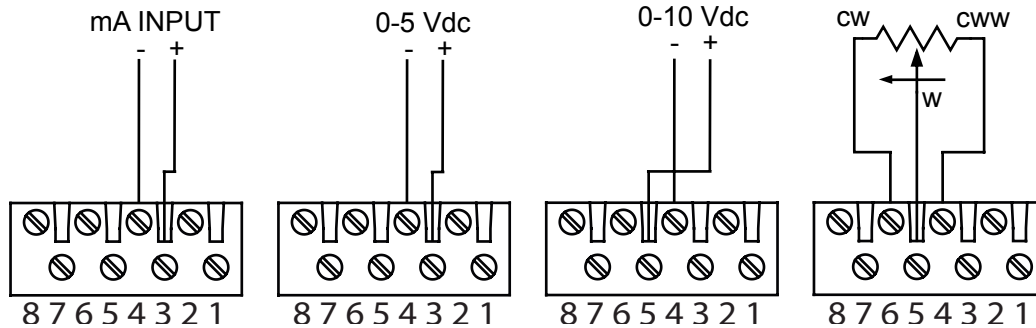
4/20mA: Common (-) to terminal P2-4 (CCW),
"+" input to terminal P2-3 (4/20mA)

0 to 5 Vdc: Common to terminal 4 (CCW),
5Vdc to terminal P2-3 (0/5V).

0 to 10Vdc: Common to terminal P2-4 (CCW),
10Vdc to terminal 5 (W).

Potentiometer (1K to 20K resistance, 1/2 watt):
Clockwise to terminal P2-6 (CW)
Wiper to terminal P2-5 (W)
Counterclockwise to terminal P2-4 (CCW)

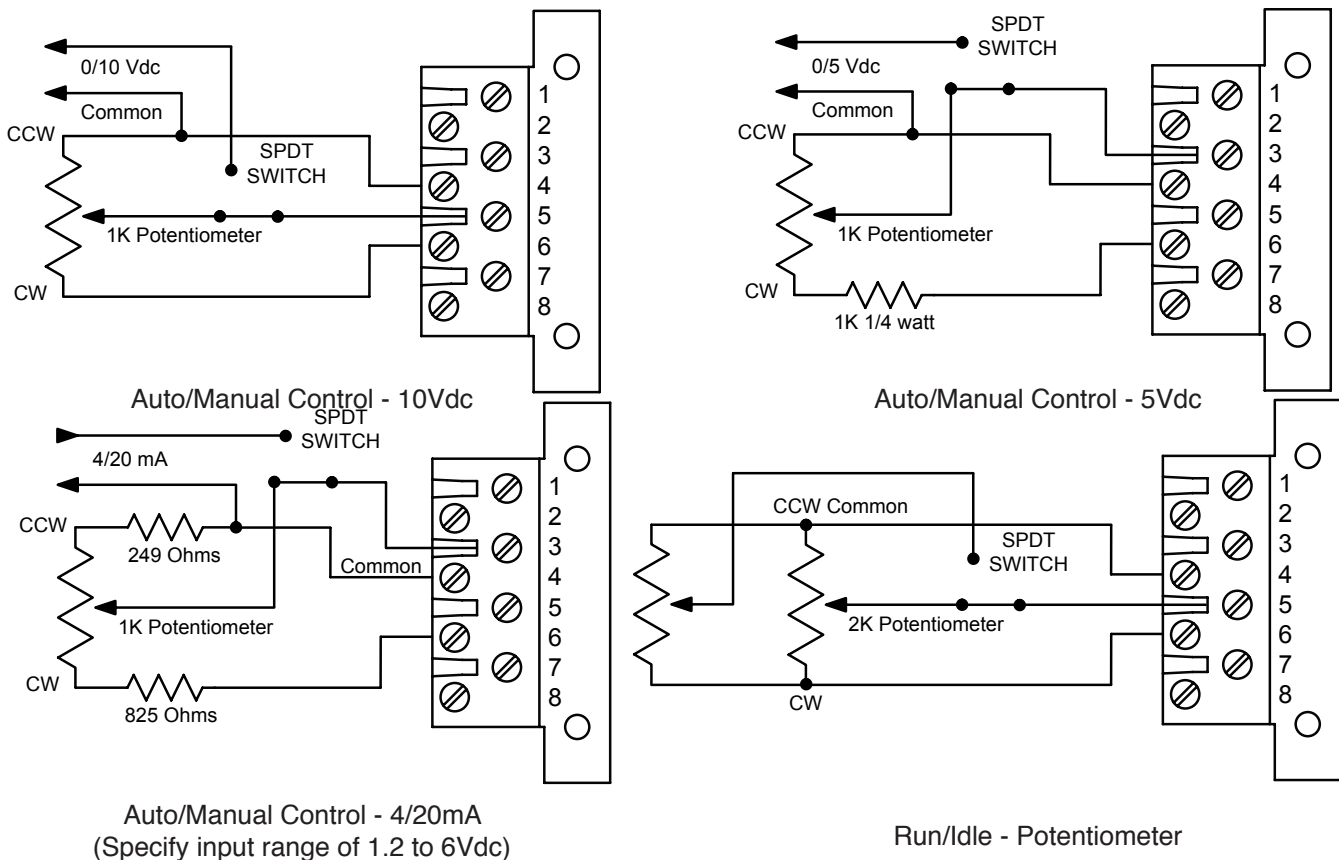
Note: If multiple controllers are controlled by one potentiometer, make the connections as described for one controller and connect terminal P2-4 (CCW) to terminal P2-4 (CCW) on all controllers, and terminal P2-5 (W) to terminal P2-5 (W) on all controllers.



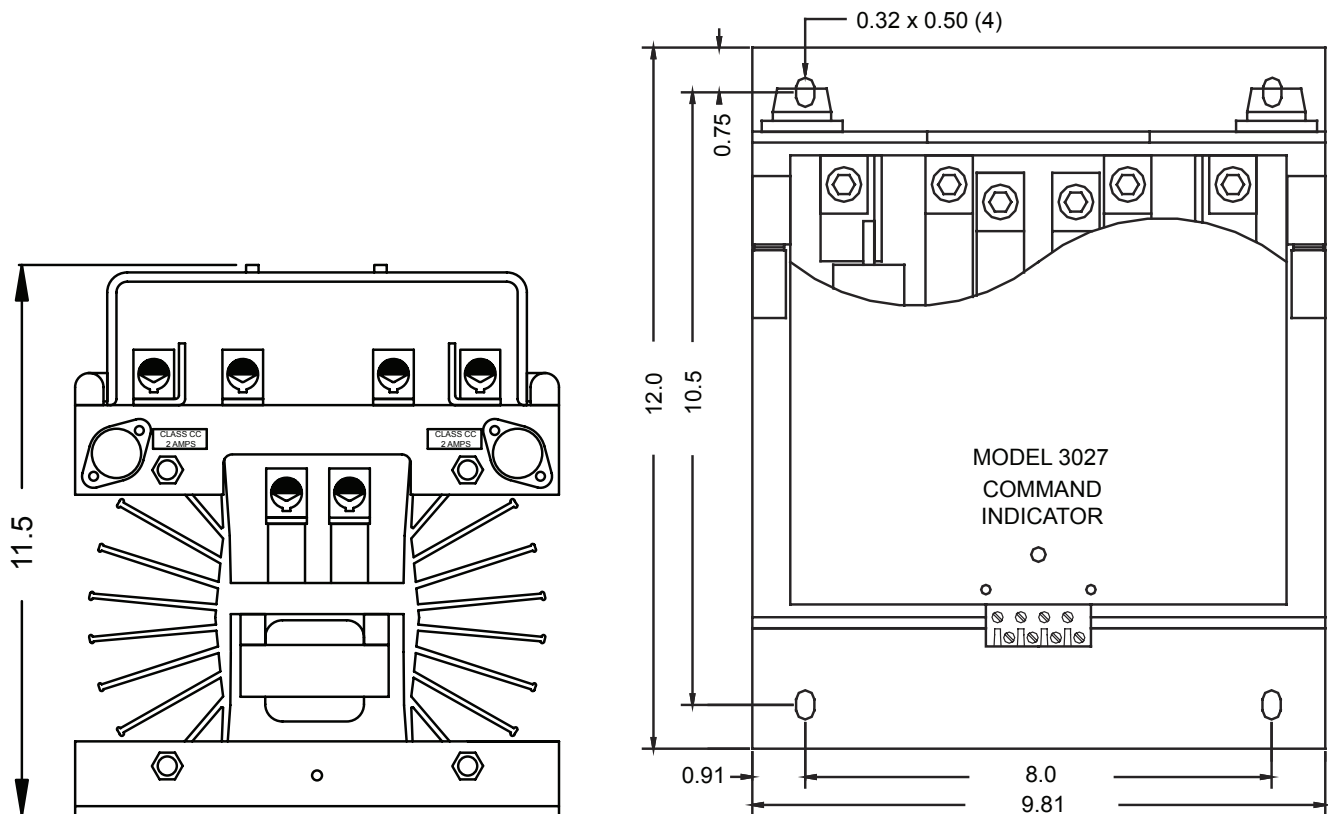
AUTO/MANUAL & RUN IDLE CONTROL:

Several circuits by which auto/manual control can be implemented are shown. The SCR controller can be switched from a "RUN" command to an "IDLE" command by use of a manual switch or other automatic switching devices.

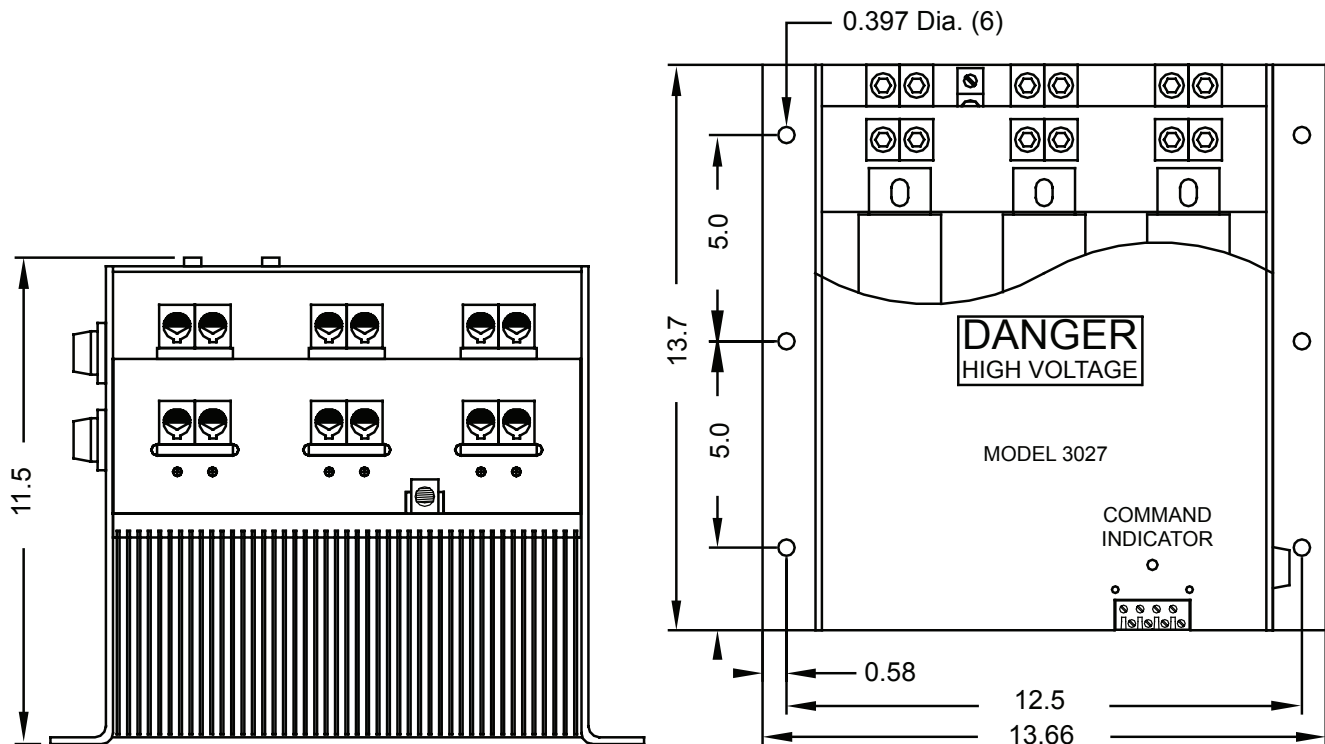
Shielded wiring is not required. It is recommended that the control wire not be placed adjacent to the power wiring.



INSTALLATION DRAWINGS

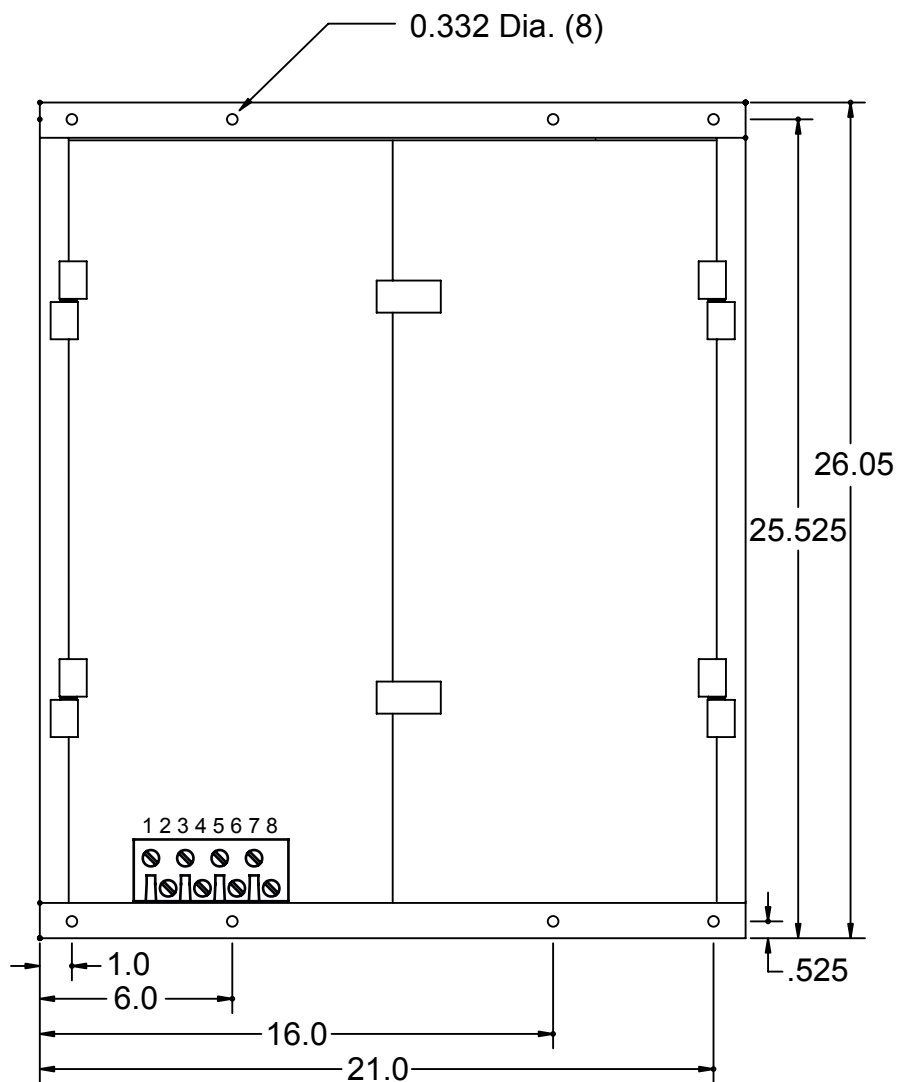
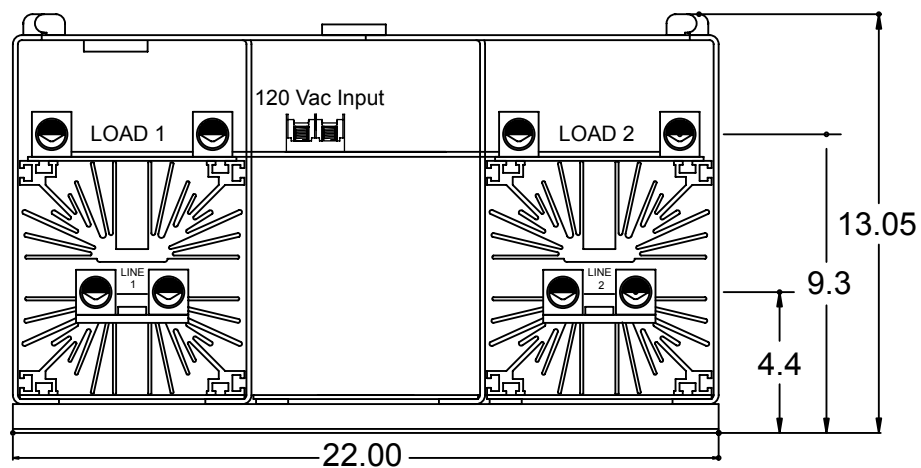


85, 145 & 175 Amp Controller
(145 & 175 Amp units have forced air cooling.)



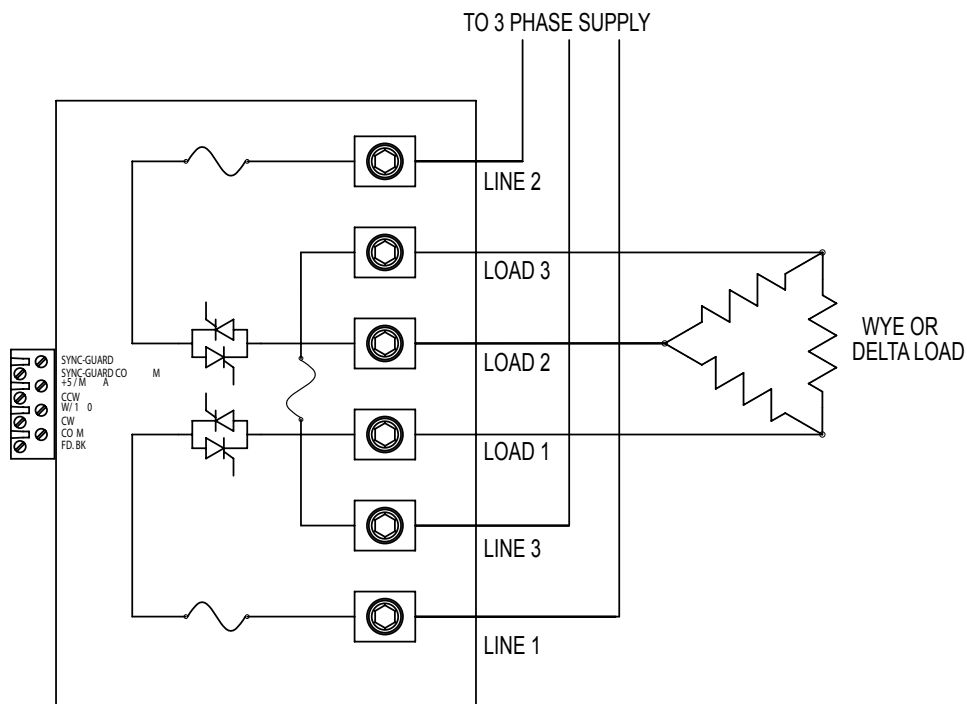
240, 295, 370 & 425 Amp Controller

INSTALLATION DRAWINGS (Continued)

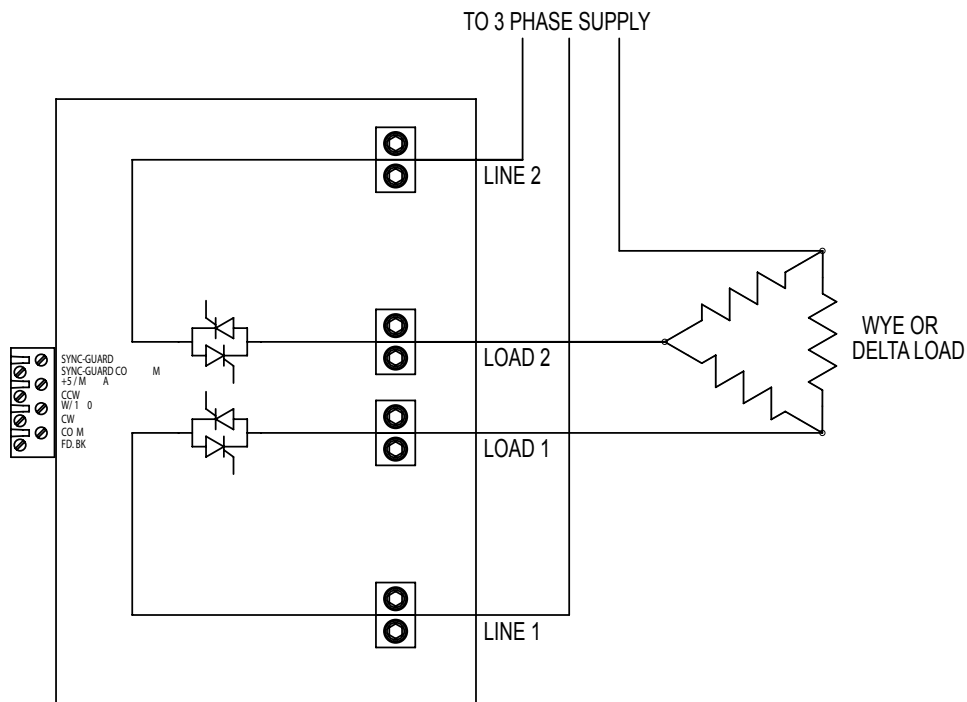


500, 600, 750 Amp Controller

LINE AND LOAD CONNECTIONS

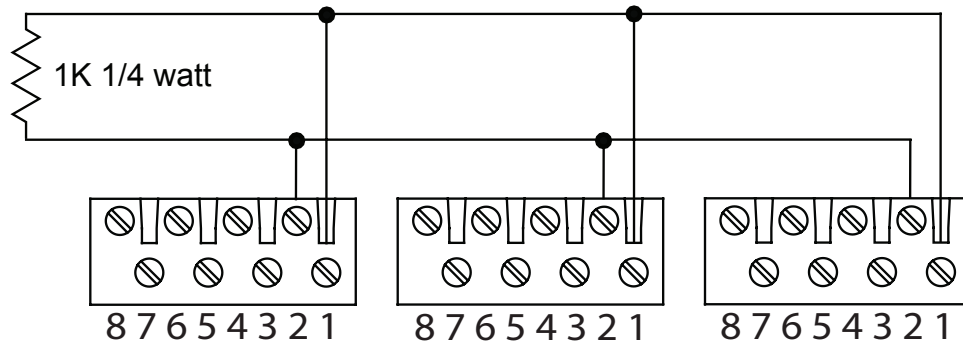


Power Connections for 85 - 425 Amp controllers.
1 lug per connection on 85, 145 & 175 Amp controllers.
2 lugs per connection on larger units.



Power Connections for 500, 600 & 750 Amp controllers.
2 lugs per connection.

SYNC-GUARD CONNECTIONS



The Sync-Guard feature is implemented by connecting all terminals labeled 1 in parallel and all terminals labeled 2 in parallel and by connecting a 1K resistor as shown across the connection made to terminals 1 & 2. (This circuit is electrically isolated from the line and load voltages.) A maximum of 8 controllers regardless of the current ratings can be connected in this manner.

STARTUP

CAUTION: Portions of the electronic circuit and other parts of the controller are at line voltage.

USE EXTREME CAUTION
TO AVOID ELECTRICAL SHOCK

Before applying power, determine that the transformer tap is set at a value corresponding to the supply 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 just remains on continuously. See Adjustments instructions for further details.

ADJUSTMENTS

ZERO: The zero potentiometer is used to adjust the controller to provide load voltage when the command signal is zero. This is factory calibrated and requires no adjustment.

SPAN: The span potentiometer is used to adjust the controller to provide desired maximum load voltage when the command signal is maximum. This is factory calibrated and requires no further adjustment.

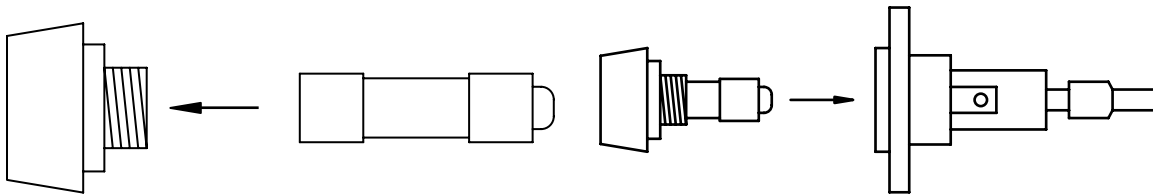
The zero and span adjustments for a given input or output will interact. If adjustments become necessary, the following procedure should be followed.

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.

REPLACEMENT PARTS

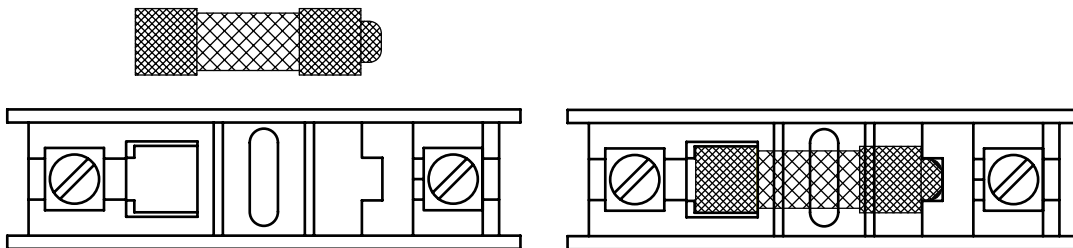
FRAME SIZE IN AMPS (A)	LOAD FUSE	SCR	CONTROL TRANSFORMER FUSE
85	42110-0460-411	SCR/TT91-14	42130-0460-210
145	42110-0460-417	SCR/TT91-14	42130-0460-210
175	42110-0460-420	SCR/TT132-14	42130-0460-210
240	42110-0460-430	SCR/TT161-14	42130-0460-210
295	42110-0460-435	SCR/TT161-14	42130-0460-210
370	42110-0460-445	SCR/TT210-14	42130-0460-210
425	42110-0460-450	SCR/TT250-14	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 3027 controller.



ORIENTATION OF FUSE IN HOLDER FOR 85 - 425 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 3027 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 NUMBER IDENTIFICATION

3027 - [VVV]V - [AAA]A - CS[XXX] - SC[XXX]

[VVV]V

Operating voltage. 10 to 110V, 120V, 208V, 240V, 277V, 380V, 415V, 480V or 575V.
Other voltages may be available.
Please consult factory for information.

[AAA]A

The maximum continuous RMS current rating.
5A, 145A, 175A, 240A, 295A, 370A, 425, 500, 600 or 750 Amps.

CS[XXX]

(Optional) . If this term is left blank, the controller will accept a potentiometer input or a 0 to 5 Vdc or a 0 to 10 Vdc command signal.
When included, this term specifies the type of special command signals the controller has been factory calibrated to operate with.
Use a one (1) K potentiometer for maximum linearity.
Up to Twenty (20) K ohms is permissible.

SC[XXX]

(Optional) term, if shown, specifies special calibrations.

For example, the number **3027-480V-85A-4/20mA** specifies a model 3027 controller with 480 volt operation, 85 amps continuous current rating, and requires a 4/20mA command signal.

FIRING CIRCUIT BOARD

3027 - FC - CS[XX]

FC = replacement firing circuit board.

CS[xx] = command signal required. (Potentiometer, 0 to 5Vdc. 0 to 10Vdc or 4/20mA. Other command signal inputs may be available, consult factory for details.)

TROUBLE SHOOTING

DO NOT ATTEMPT TO OPERATE THE CONTROLLER WITH THE CATHODE OR GATE LEADS REMOVED

The following are possible symptoms and procedures that may help.

No load power, command indicator does not function.

1. Check main fuses.
2. Check transformer fuses.
3. Determine that the command signal is present.
4. Determine that 10 Vdc is present between terminal 6 and terminal 4 on the input connector. If the voltage is greater than 11 Vdc the circuit board has probably failed. If the voltage is less than 9 Vdc the circuit board or transformer has probably failed. (Check that correct transformer tap is selected.)

No load power: command indicator functions correctly.

1. Remove system power and visually inspect circuit board for damage.
2. It is unlikely that both SCR modules have failed.
3. Check load connections and load fuses.

Partial or full load power, command indicator off.

One or both SCRs may have failed. Remove system power and remove circuit board from the controller. Reapply system power. An SCR or both SCR's have failed if load voltage exists. If the voltage between the line 1 and load 1 terminals is zero, or the voltage between the line 2 and load 2 terminals is zero, the SCR connected between those terminals has failed. If no load voltage exists with the circuit board removed, the board has failed.

Full load power, command indicator is on.

Check that the command signal is zero and correctly connected. (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. If the command indicator goes off, the problem is likely in the command signal or wiring.

Full load power cannot be obtained, command indicator 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 2 vdc. SCR modules which have a voltage greater than 2 volts have probably failed.

MANUFACTURED BY



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