

MODEL 1600-PM2 & 1600-PM3

INSTALLATION & MAINTENANCE MANUAL

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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.

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

PROPRIETARY DATA

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DESCRIPTION

The models 1600-PM2 and 1600-PM3 are high efficiency, two SSR and three SSR stand alone controllers.

One or two model 1600-PM2 (2 SSR's) may be installed at the end of a Control Concepts model 1600-PM6 to be cooled by the fan on the 1600-PM6 (to take advantage of the forced air cooling). A maximum of 10 solid state relays (including the 6 on the 1600-PM6) may be rated up to 70 Amps each when installed this way.

One 1600-PM3 (3 SSR's) may be placed at the end of a Control Concepts model 1600-PM6 (to take advantage of the forced air cooling). A maximum of 9 solid state relays (including the 6 on the 1600-PM6) may be rated up to 70 Amps each when installed this way.

When used alone, the Control Concepts model 1600-PM2 may be rated at 10 to 40 Amps maximum (each SSR position). The Control Concepts model 1600-PM3 may be rated up to 30 Amps maximum (each SSR position).

A fan kit (PKF41 or PKF42) is available to cool the 1600-PM2 and the 1600-PM3 to increase the load current ratings of the units when desired.

A number of firing circuits are available for use on the models 1600-PM2 and 1600-PM3.

See table 1 for current ratings for assorted configurations of heat sinks. Contact factory for more information.

SPECIFICATIONS

CURRENT RATINGS FOR VARIOUS CONFIGURATIONS			
UNIT	WITH PKF41 FAN KIT	WITHOUT FAN	MOUNTED AT END OF PM5
One PM2	70 AMPS MAX	40 AMPS MAX	70 AMPS MAX
One PM3	70 AMPS MAX	30 AMPS MAX	70 AMPS MAX
Two PM2's	70 AMPS MAX	NOT RECOMMENDED	70 AMPS MAX
3 to 5 PM2's	70 AMPS MAX	NOT RECOMMENDED	NOT RECOMMENDED
2 to 3 PM3's	70 AMPS MAX	NOT RECOMMENDED	NOT RECOMMENDED
More than 5 PM2's	NOT RECOMMENDED	NOT RECOMMENDED	NOT RECOMMENDED
More than 3 PM3's	NOT RECOMMENDED	NOT RECOMMENDED	NOT RECOMMENDED

INSTALLATION

Controllers without fans must be mounted on a vertical surface such that the heat radiating fins are vertical and located in an environment that will not exceed 55°C and that is protected from dirt and dust. Controllers with fans can be mounted in any direction.

RECOMMENDED TIGHTENING TORQUE
USD CONNECTORS:



WIRE SIZE (AWG)	TORQUE
14 - 10 GA	35 IN-LBS
8 GA	40 IN-LBS
4 - 6 GA	45 IN-LBS
2 - 3 GA	50 IN-LBS

RECOMMENDED TIGHTENING TORQUE
FOR GREEN CONNECTOR:



WIRE SIZE (AWG)	TORQUE
12 TO 26GA	5.0 IN-LBS

INSTALLATION DRAWINGS

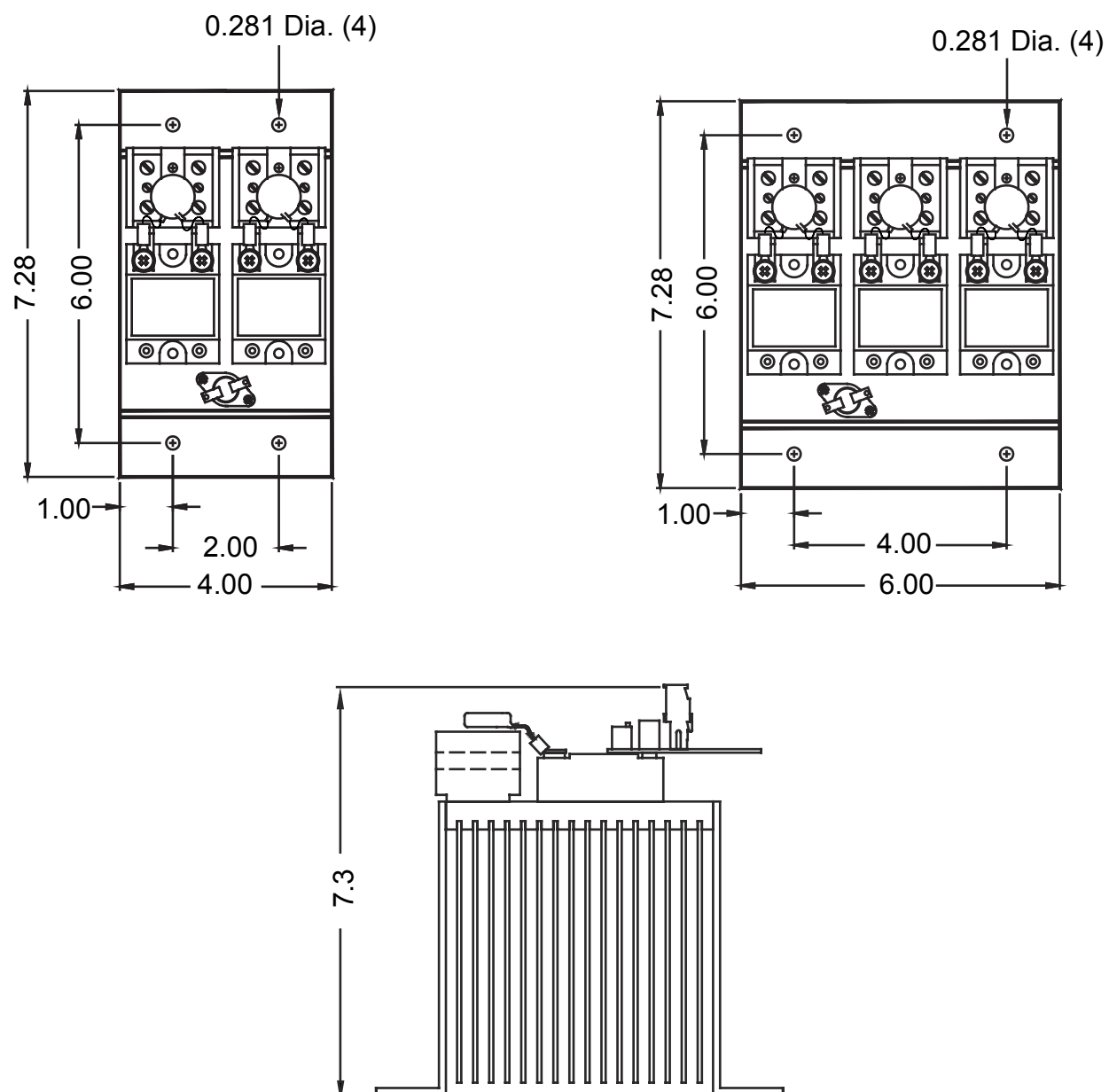


Figure 1. Installation dimensions for the models 1600-PM2 & 1600-PM3

INSTALLATION DRAWINGS (Continued)

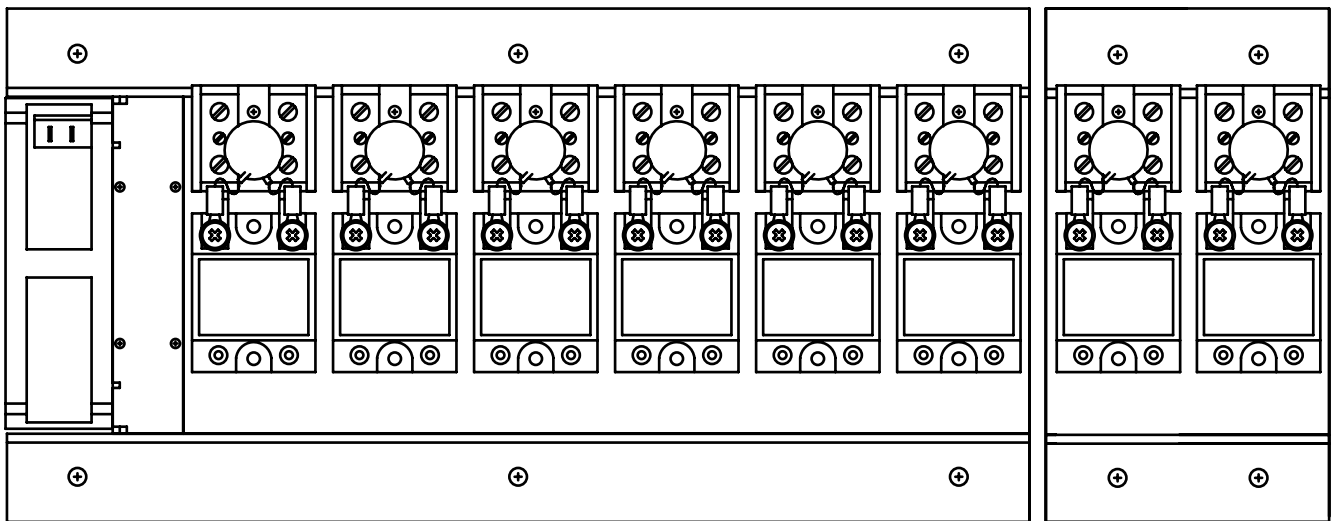


Figure 2. Model 1600-PM2 controller shown at end of 1600-PM6.

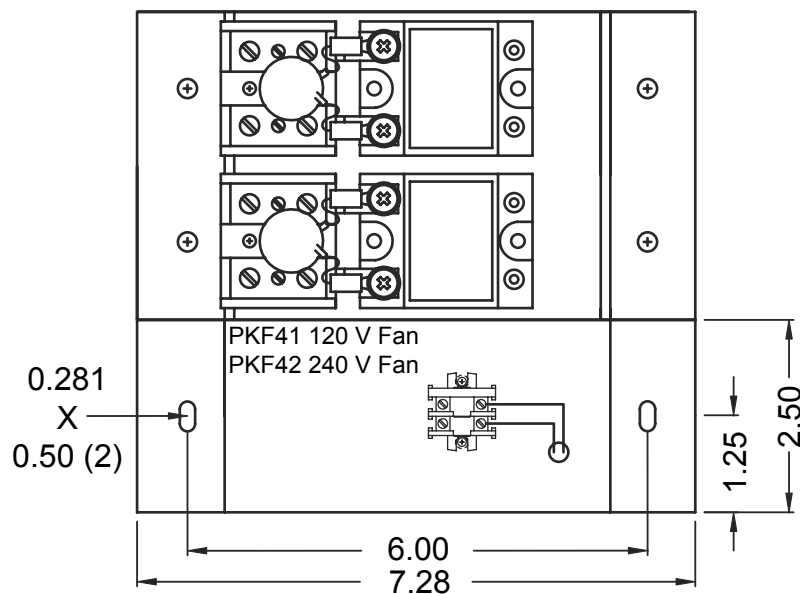


Figure 3. Model 1600-PM2 controller being cooled by PKF41 (or PKF42) fan kit. Because of the forced air cooling, this assembly may be oriented in any direction. Units without a fan must be mounted with the heatsink fins oriented vertically so air may flow through by convection.

ELECTRICAL CONNECTIONS (PM2)

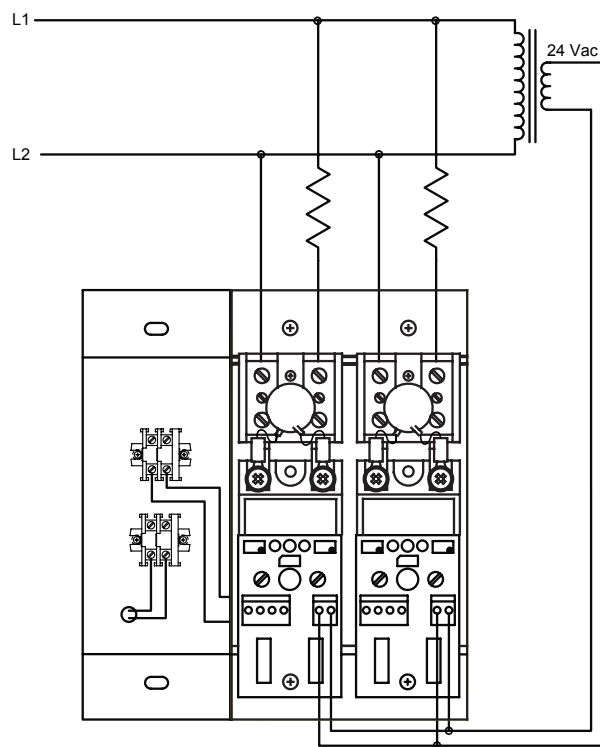


Figure 4. Single Phase electrical connection.
Zero-Cross or Phase-Angle.
Shown with optional fan kit.

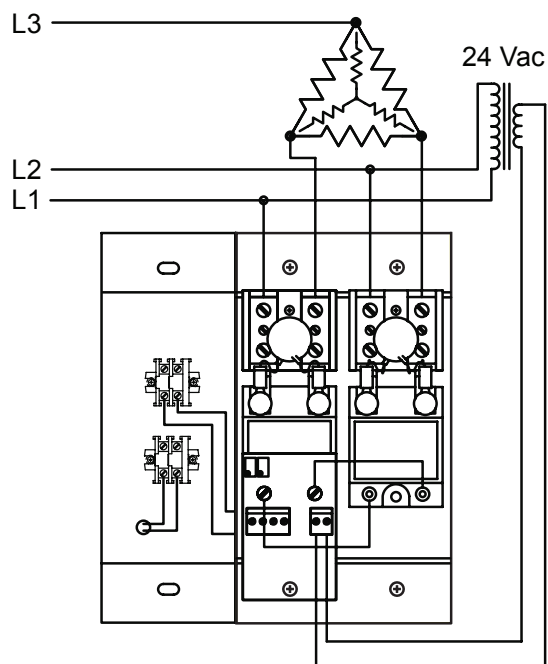


Figure 5. 2-Leg DELTA/bye electrical connections.
Zero-Cross only.
Shown with optional fan kit.

ELECTRICAL CONNECTIONS (PM3)

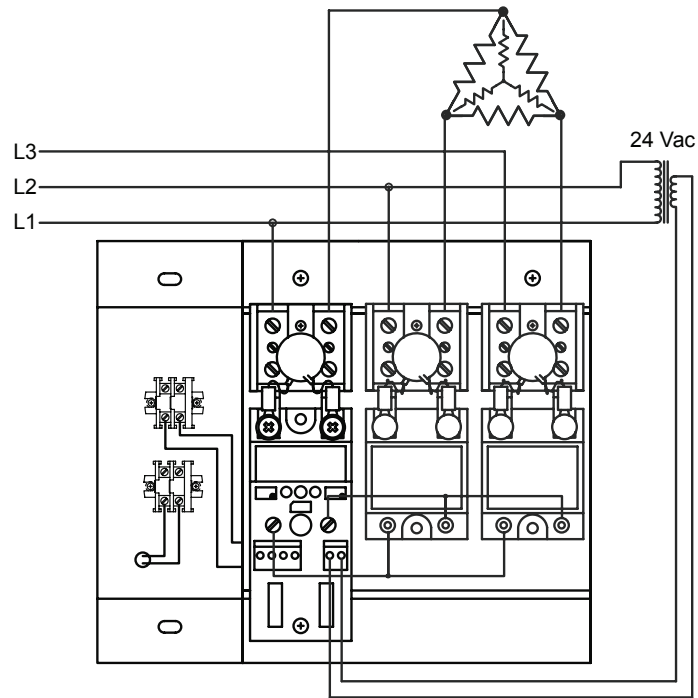


Figure 6. 3-Leg DELTA/wye electrical connections.
Zero-Cross only. Shown with optional fan kit.

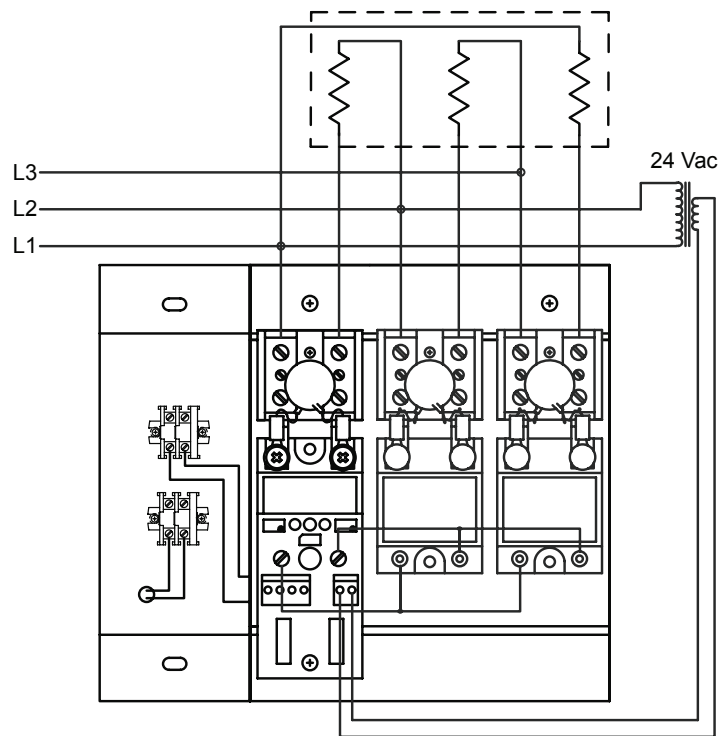


Figure 7. Inside delta electrical connection.
Zero-Cross only. Shown with optional fan kit.

ELECTRICAL CONNECTIONS (PM3) (Continued)

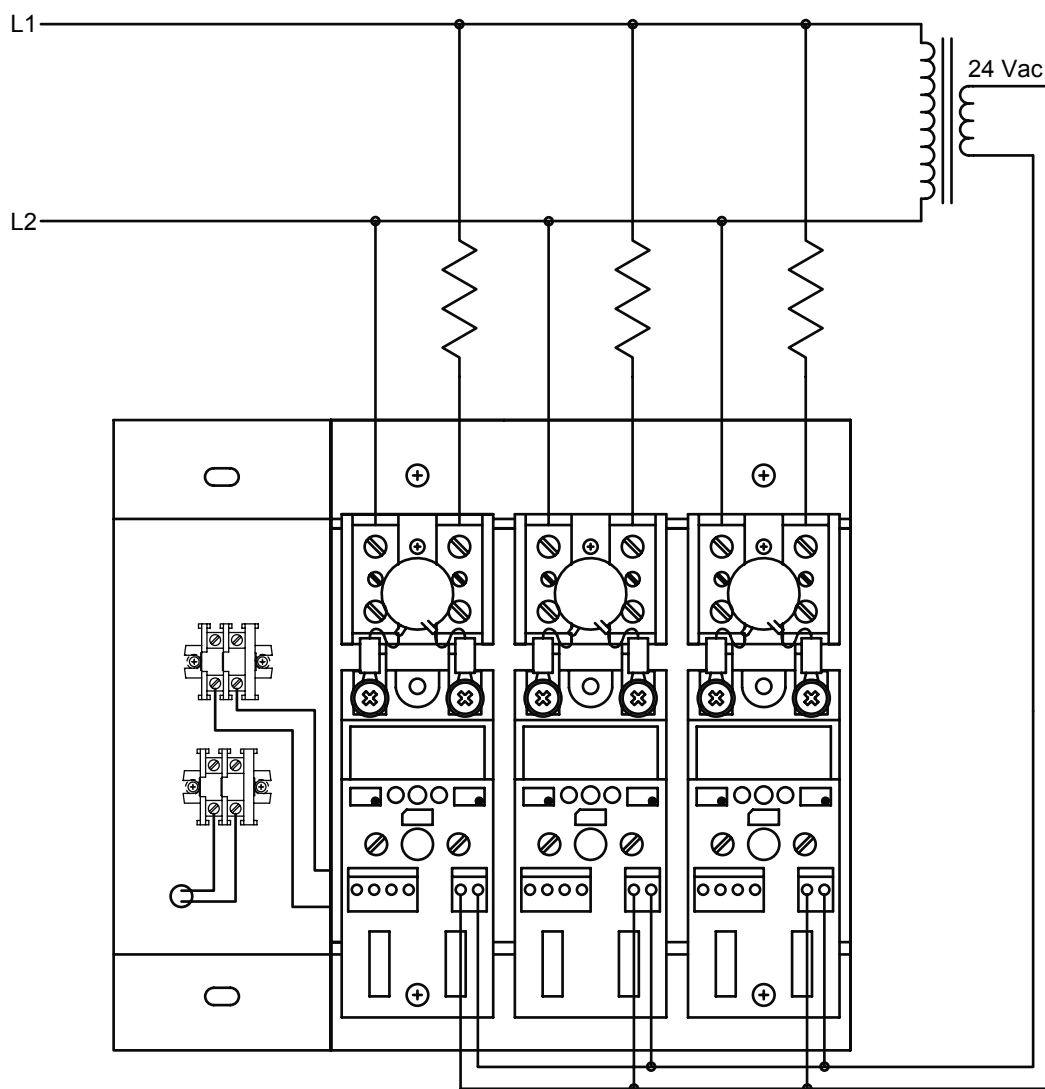


Figure 8. Single Phase electrical connection.
Zero-Cross or Phase-Angle.
Shown with optional fan kit.

ELECTRICAL CONNECTIONS (PM3) (Continued)

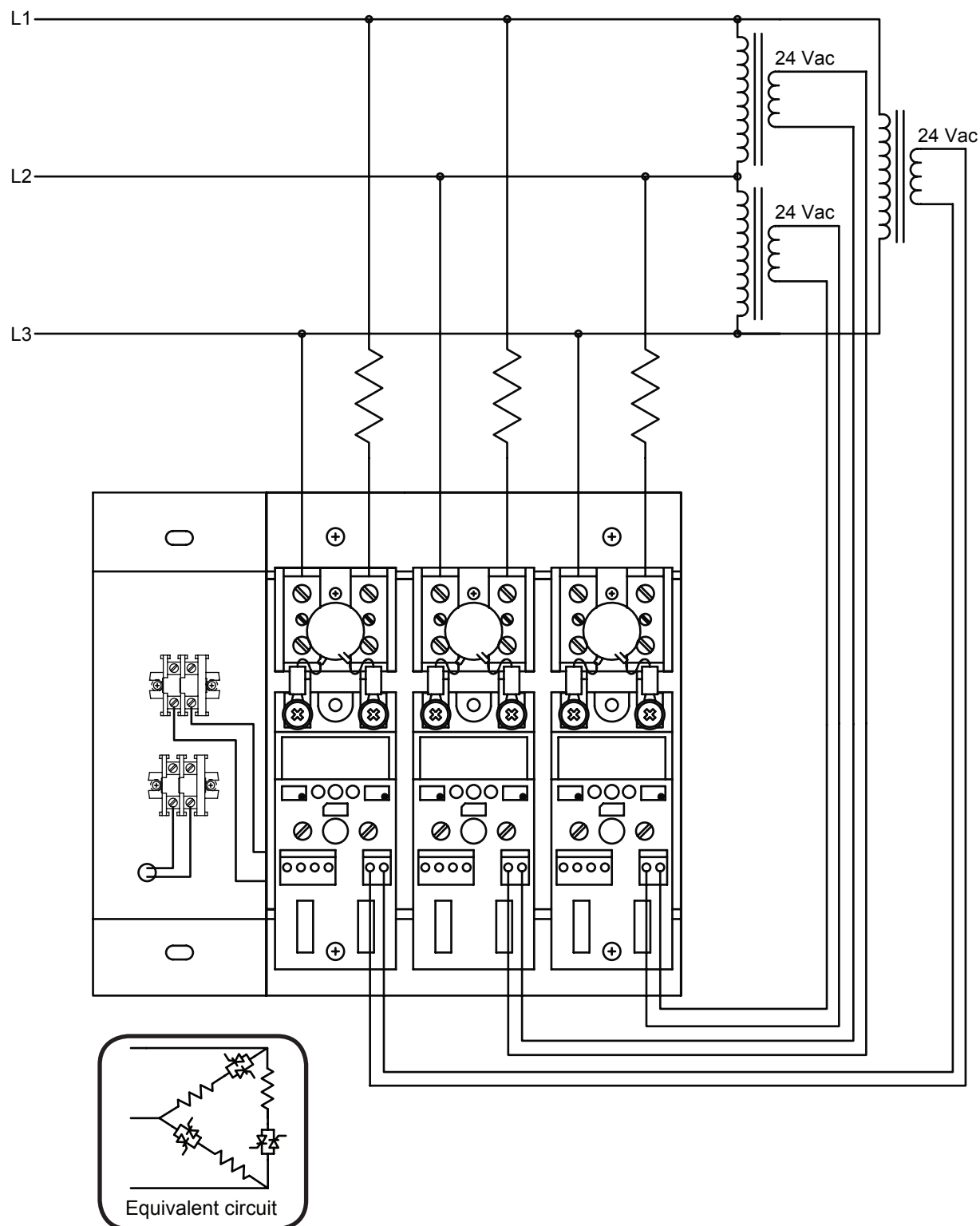
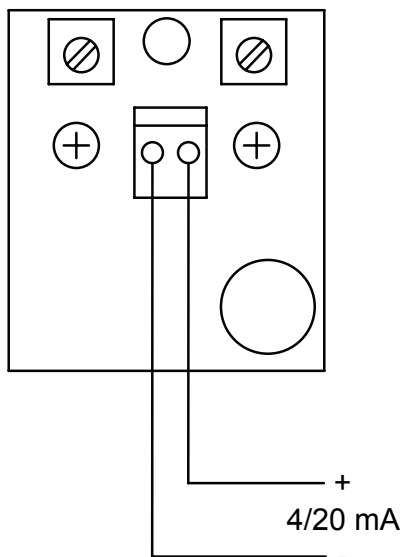


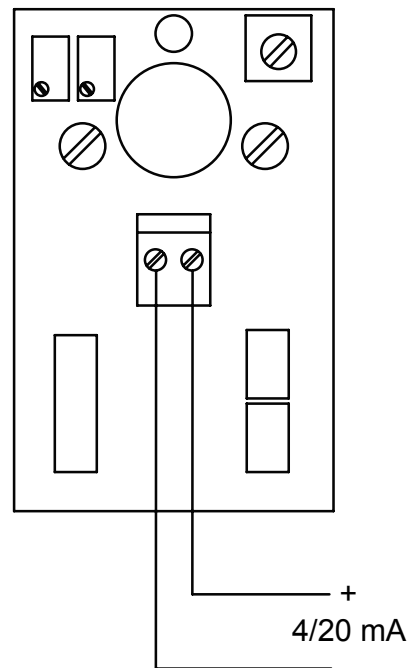
Figure 9. Inside delta connection. When using Phase-Angle control, the circuit transformer must be connected across the same phase as the corresponding SCR and load. Failure to do so, will cause erratic operation of the controller. This does not apply to the Zero-Cross control. Shown with optional fan kit.

FIRING CIRCUITS

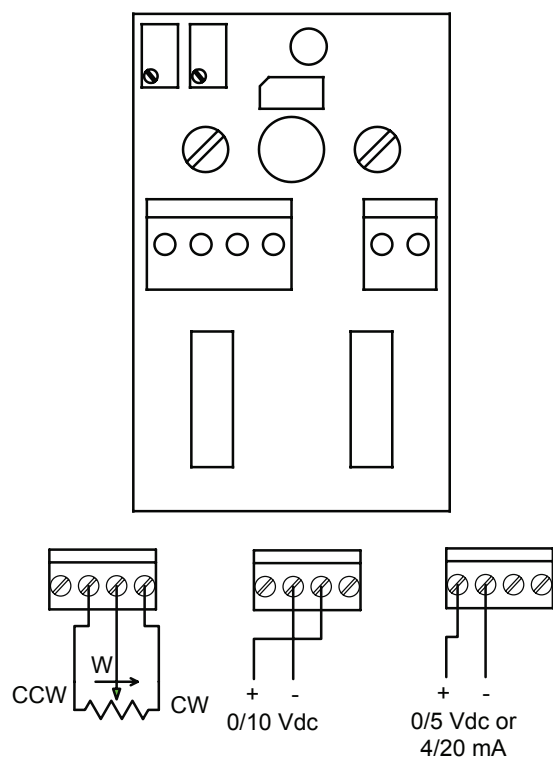
1020-FC (Zero Cross)



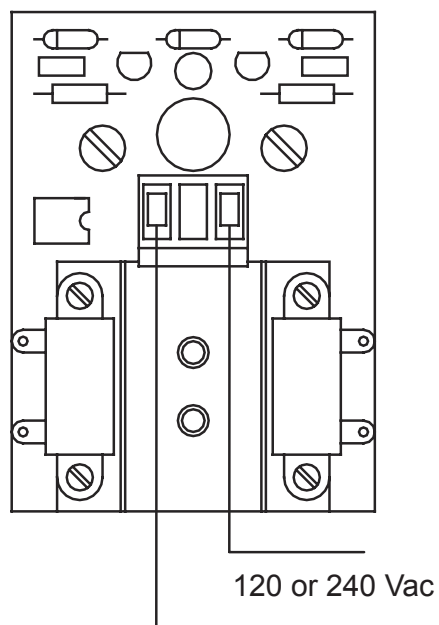
1023-FC (Zero Cross)



1021A-FC (Zero Cross)



1026-FC (Zero Cross)



THEORY OF OPERATION

THE SCR

The heart of the Control Concepts, Inc. power controller is the SCR (silicon controlled rectifier, sometimes referred to as a thyristor). The SCR has two states, ON and OFF, and allows current to flow in only one direction when turned on. SCRs can remain in the off state even though the applied potential may be up to 1600 volts.

In the on state, they can pass several thousand amperes. When a small signal is applied between the gate and cathode terminals, the SCR will turn on within 10-100 microseconds.

Once turned on, it will remain on until the current through it is reduced below a very low value, referred to as the holding current.

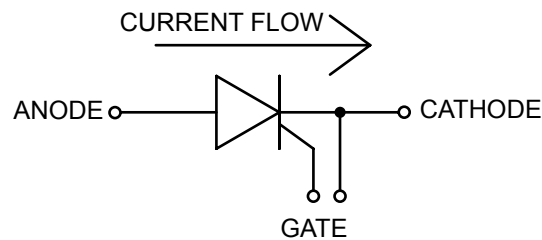


Figure 10. SCR symbol

Zero-Cross: (synchronous)

The term Zero-Cross, when describing the operation of an SCR, is derived from the fact that the SCR is turned on only when the instantaneous value of the sinusoidal waveform is zero. In Zero-Cross operation, power is applied for a specific number of continuous cycles and then removed for a specific number of cycles to achieve the desired load power in the same manner as power would be controlled with a mechanical switching device. Unlike mechanical switches, the SCR has no inherent wear out mode, therefore the frequency of the on-off power cycles can be extremely fast, providing better process control and extended heater life.

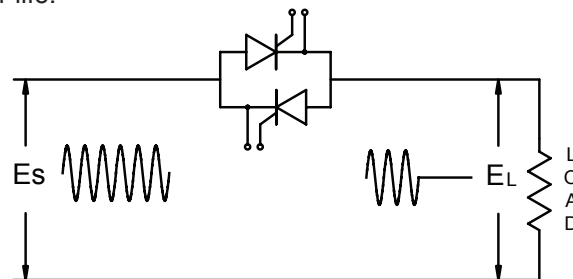


Figure 11. Zero Cross Control

Phase-Angle (random)

Load voltage is phase-angle controlled by turning the appropriate SCR on for a portion of each electrical half cycle. The waveform shown as E_L represents the "ON" time of the SCRs in each half cycle and therefore represents the voltage waveform applied to the load. The load voltage can be varied with infinite resolution from 0 to 100% of the supply voltage by varying the time the SCRs are on within each electrical half cycle. Circuit tolerances limit the maximum load voltage to about 97% of the supply voltage.

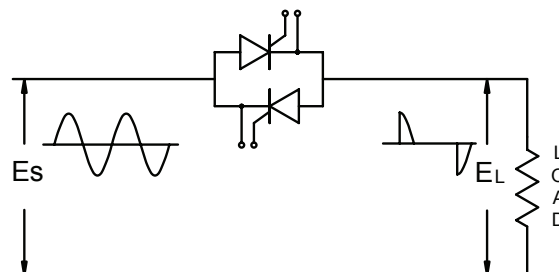
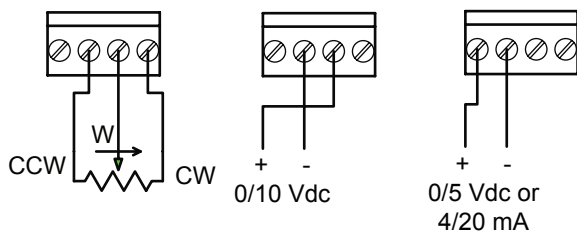
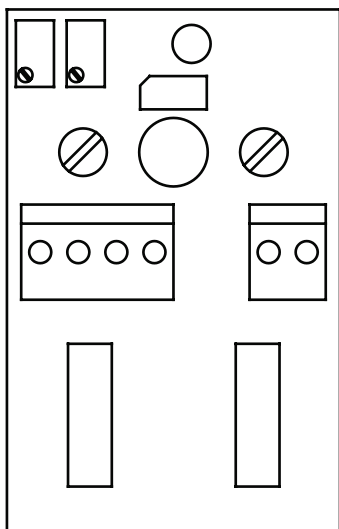


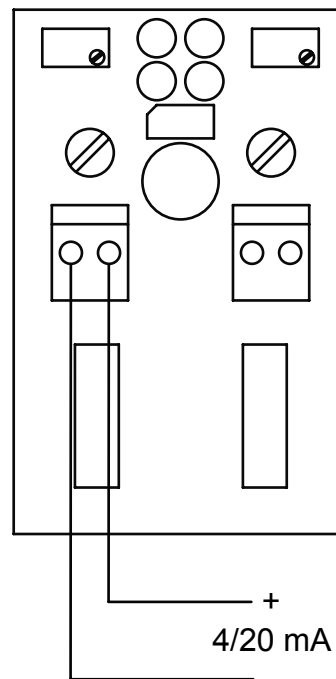
Figure 12. Phase-Angle Control

FIRING CIRCUITS (Continued)

1022-FC (Phase angle)



1025-FC (Phase angle)



REFERENCE MATERIAL

Instruction manual(s) from the following, as applicable:

Instructions manual	-	Model 1020
Instructions manual	-	Model 1021A
Instructions manual	-	Model 1022 - 1025
Instructions manual	-	Model 1023
Instructions manual	-	Model 1026

Instructions manual	-	Model 3020
Instructions manual	-	Model 3320
Instructions manual	-	Model 3021A
Instructions manual	-	Model 3321A

MANUFACTURED BY



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