CONTROL CONCEPTS INC.

MODEL 1049
INSTRUCTION MANUAL

SINGLE-PHASE, PHASE-ANGLE
SCR CONTROLLER

DESCRIPTION:

The model 1049 is a single-phase, phase-angle SCR controller which linearly controls the voltage or current to a single-phase electrical load.
The command signal terminals are isolated from the line and load, and all are isolated from the heat sink.

Other features of the controller:

1. **Choice of command signal.** The 1049 can accept a variety of command signals including; 0 to 5 Vdc, 4 to 20 mA or a potentiometer. (A 1K pot is recommended, but up to 20K is permissible.) See figures 1, 2 & 3 on page 4 for details. Other commands may be available by special order.
2. **Current control capability.** The controller is shipped with current feedback only if requested at time of original order. This feature may be added later, if desired. A current transformer must be purchased and installed. Call the factory for more information. See figure 13 on page 9 for details.
3. **Remote RUN-STOP control.** Two terminals are provided on the command signal connector to permit this remote function. The user has a choice of normally closed or normally open contacts. The selection is made with a jumper on connector P6. See figures 4, 5 & 6 on page 5 for details.
4. **Dual line voltage.** The controller may be operated on 115 Vac -15/+10% or 230 Vac -15/+10%. The operating voltage may be selected on the circuit board. See figure 8 on page 7 for details.
5. **Optional output.** With 230 Vac input an option is available which will limit the output to 208 Vac.
6. **Average or True RMS control.** The user has the option to select the operating mode by moving a jumper on the control board. See figure 10 on page 8 for details.

INSTALLATION:

The controller must be mounted with the fins of the heatsink oriented vertically so that air may pass freely between them, thus providing cooling to the fins. Allow 2" space on top and bottom. Mounting dimensions are shown in figure 14 on page 10.
Be certain that the switch and jumper on the circuit board are set to their proper positions before applying voltage.
See figure 8 on page 7 for details.
It is recommended that a disconnect be installed in the line ahead of the controller.
Class "T" or semiconductor type fuses which are rated at about 125% of the maximum anticipated load current are recommended to protect the controller and the load.
Power is applied to the terminals marked **LINE 1** and **LINE 2**. The load may be connected to the **LOAD 1** and **LOAD 2** terminals.

Wire range; 18-12 AWG
Torque; 3.5 - 5.3 in.-Lbs.
Strip length; .39"

If the remote run-stop feature will not be used, place jumper on P6 to pin 2 only and make no connection to the run terminal (#6) on P8 (command connector).

THEORY OF OPERATION:

The heart of the SCR power controller is the SCR (Silicon Controlled Rectifier). The SCR has two states, ON and OFF, and allows current to flow in only one direction when turned on. Because the SCR allows current to flow in only one direction, two SCR's are connected in an "inverse parallel" configuration to control AC current.
When a small signal is applied between the gate and cathode terminals, the SCR will begin to conduct within 100 microseconds. (1/10,000 sec.) Once turned on, it will remain on until the current through it is reduced below a very low value.
In phase-angle control, each SCR of the back-to-back pair is turned on for a variable portion of the half-cycle that it conducts. Power is regulated by advancing or delaying the point at which the SCR is turned on within each half-cycle.

SPECIFICATIONS:

Control Mode	Single-Phase, Phase-angle SCR controller.
Command Signal:	Input Signal — Input Impedance 0/5 Vdc — 200 Kohms 4/20 mA — 249 ohms Potentiometer — 200 Kohms (1K, 1/4 watt potentiometer recommended for optimum linearity, 20K permissible.)
Control Range:	0 to 98% of line voltage.
Linearity:	Output will be linear within 0.5% RMS, 2% Avg. of span over entire range of control.
Zero & Span Adjustments:	Multi-turn potentiometers allow zero and span adjust-ments of ±25% of span. External feedback span adjust-ment is ±20%.
Supply Voltage	115 Vac -15% +10% or 230 Vac -15%, +10%. Switch selectable, single-phase, 50/60Hz.
Environment:	Operating temperature; 0 to 55°C (32 to 132°F). Storage temperature; -40 to 85°C (-40 to 176°F). Humidity; 0 to 95%, non-condensing.
Electrical Isolation	Control signal to supply and load voltage; 3750 Vpeak. Heatsink to supply and load voltage; 2500 Vpeak.
Cooling:	Convection cooling.
Status indicator:	The intensity of the green LED on the firing circuit is directly proportional to the level of command signal, and therefore proportional to the output signal.

MODEL NUMBER:

1049 - (FB) - (VVV)V - (AA)A - (CS)

Where:

(FB) = type of feedback
choices:
A = Average
V = True RMS
I4 = Current Feedback, 4 Amps maximum

(vvv) = output voltage selection
choices:
120/208
120/240

(AA) = maximum current rating
20 amps

(cs) = command signal
choices:
0/5 Vdc
4/20 mA
POT (1 to 20K Potentiometer)

Examples:

1049 - V - 120/208V - 20A - 4/20mA specifies a single-phase, phase angle controller with true RMS control, maximum output of 120 or 208 Vac up to 20 Amps, controlled by a 4/20mA loop command signal.

1049 - A - 120/240V - 20A - 0/5Vdc specifies a single-phase, phase angle controller with average control, maximum output 120 or 230 Vac up to 20 Amps, controlled by a 0/5 Vdc command signal.

1049 - I4A - 120/240V - 20A - POT specifies a single-phase, phase angle controller with maximum 4 Amp current feedback, maximum output 120 or 230 Vac up to 20 Amps, controlled by a potentiometer.

ADJUSTMENTS

A true RMS meter will provide the greatest accuracy when the controller is in RMS mode. An Average responding meter should be used when the controller is in AVERAGE mode.

THE FOLLOWING pot adjustments CAN BE MADE WITHOUT REMOVING THE LID.

ZERO & SPAN POTS

The controller, when shipped, is calibrated for True RMS output. No further adjusment is required. If Average output is desired, the jumpers P3 & P4, (IFB-VFB) must be set for voltage feedback; (VFB (1-2) Position) and the ZERO & SPAN pots must be recalibrated.

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1. With minimum control signal (0 Volts or 4mA), adjust the ZERO pot for no output at the load terminals.
2. With control signal set at 90%, (4.5 Vdc for 0 to 5 Vdc signal, or 18.4 mA for 4 to 20 mA loop.) adjust the SPAN pot for 90% of desired maximum Voltage output at the load terminals.
3. Because the ZERO and SPAN pots interact, steps 1 and 2 may have to be repeated.

EXTERNAL FEEDBACK SPAN POT

This adjustment is valid only if a current transformer is installed.

This adjustment must be made after the ZERO and SPAN adjusment has been completed.

This adjustment works best if the load is capable of drawing more than the desired maximum current.

1. Be certain that the P3 & P4 (IFB-VFB) jumpers are in the IFB (1-2) position.
2. With control signal set at maximum, adjust the EXTERNAL FEEDBACK SPAN pot so that the measured output current is just at the desired level.

20KHZ POT

This has been calibrated at the factory. Misadjustment of this pot could cause erratic operation, overheating of the controller and may void your warranty.

MANUFACTURED BY:

CONTROL CONCEPTS

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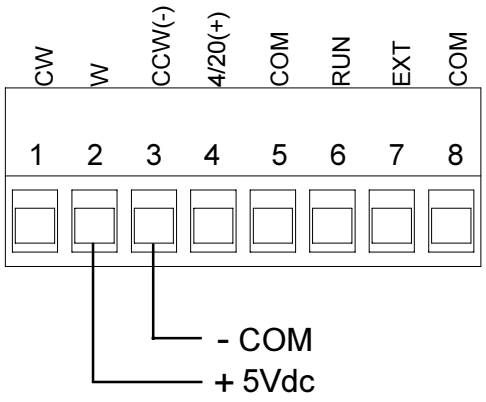
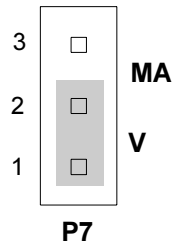
8077 Century Blvd
Chanhassen, MN 55317, USA

CONTROL CONNECTIONS:

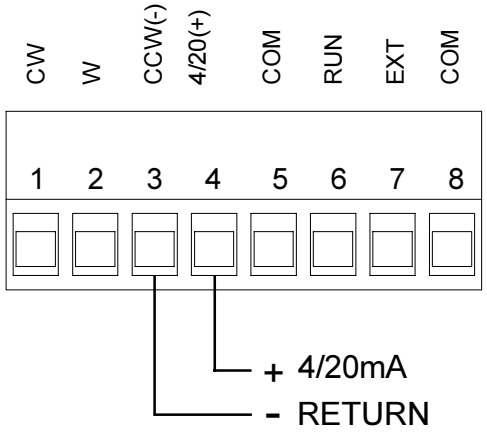
BE CERTAIN THAT POWER HAS BEEN REMOVED FROM THE CONTROLLER BEFORE REMOVING THE LID.

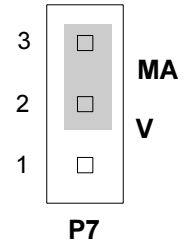




To enable a voltage command signal input, the jumper on P7 must be across pins 1 & 2.

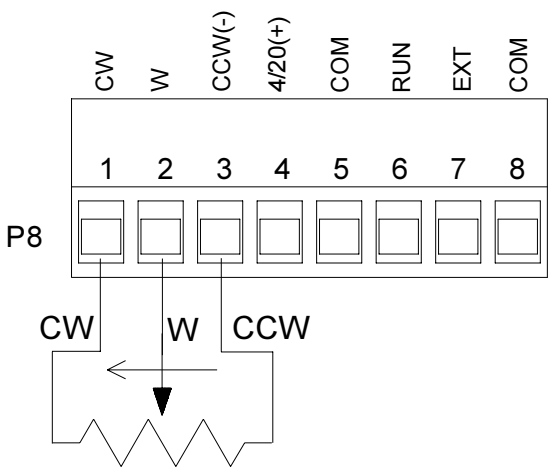
Figure 1. Connecting a 0 to 5 Vdc command signal input.

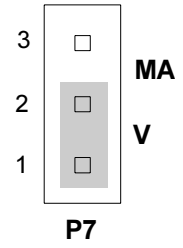




To enable a current command signal input, the jumper on P7 must be across pins 2 & 3.

Figure 2. Connecting a 4 to 20 mA command signal input.



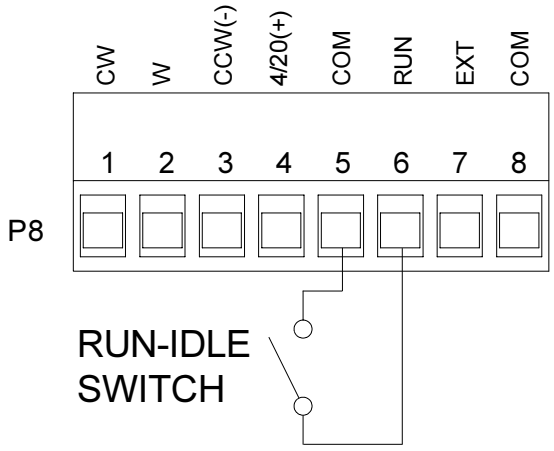


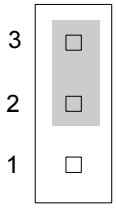
To enable a potentiometer command signal input, the jumper on P7 must be across pins 1 & 2.

Fig. 3. Connecting a potentiometer as a command signal control.

CONTROL CONNECTIONS:

BE CERTAIN THAT POWER HAS BEEN REMOVED FROM THE CONTROLLER BEFORE REMOVING THE LID.

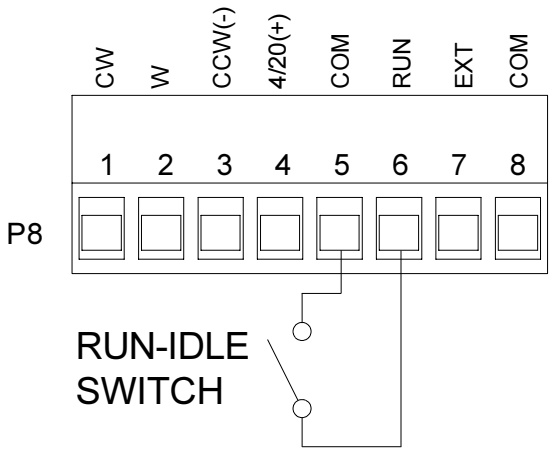


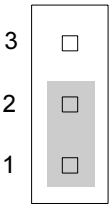


P6: CLOSED

When the jumper on P6 is in the **CLOSED** position, the run command input will be active low. Therefore, the run terminal must be tied to the com. terminal to enable the output.

Figure 4. Connecting a run-idle Switch.

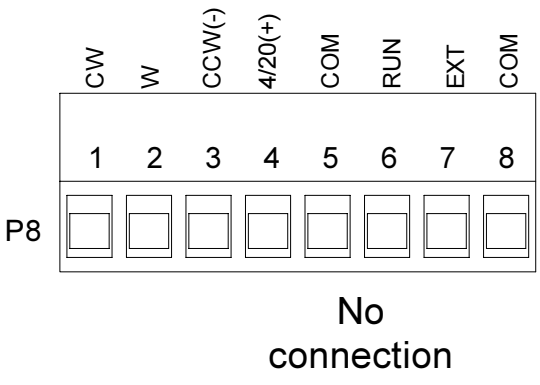


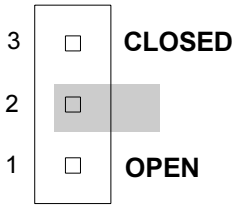


P6: OPEN

When the jumper on P6 is in the **OPEN** position, the run command input terminal will be active high. Therefore, the run terminal must be tied to the com. terminal to disable the output.

Figure 5. Connecting a run-idle Switch.





P6: DISABLED

If the RUN-STOP feature is not desired, place the jumper on center pin only, as shown.

Figure 6. Disabling the run-stop feature.

INSTALLATION:

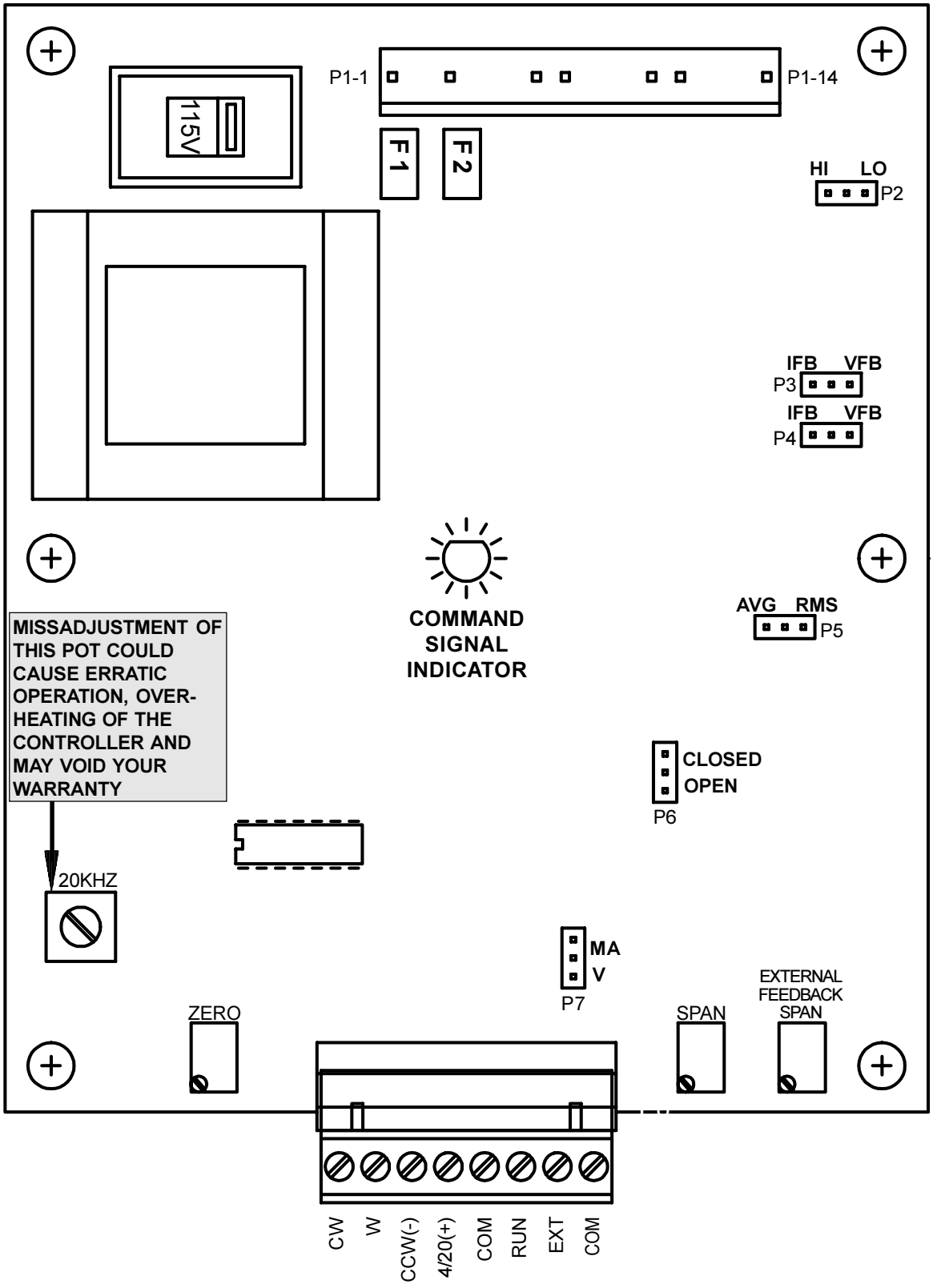


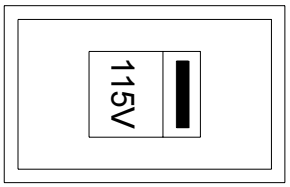
Figure 7. Firing circuit board layout. (Top view.)

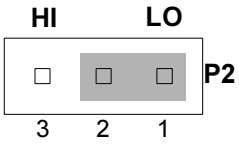
INSTALLATION:

BE CERTAIN THAT POWER HAS BEEN REMOVED FROM THE CONTROLLER BEFORE REMOVING THE LID.

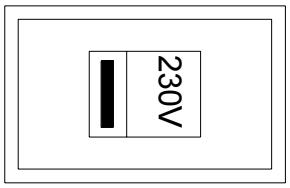
JUMPER CONNECTIONS:

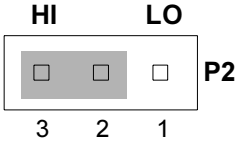
P2: HI - LO.





When the unit is controlling 110 - 130 Vac, this jumper must be in the **LO** position (1 - 2).

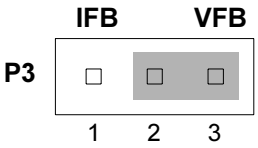


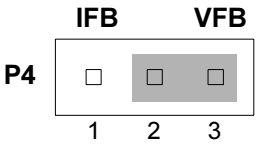


When the unit is controlling 208 - 240 Vac, the jumper must be in the **HI** position (2 - 3). (Note that 208 Vac is a special order.)

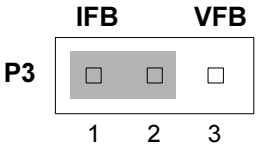
Figure 8. Line voltage selection.

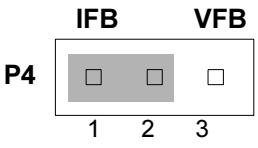
P3 & P4: VFB - IFB.





When it is desired that the output Voltage is controlled by the command signal, **BOTH** of the jumpers must be in the **VFB** position (2 - 3).





When it is desired that the output Current is controlled by the command signal, **BOTH** of the jumpers must be in the **IFB** position (1 - 2). See Fig. 14 on page 9 for installation of current transformer.

Figure 9. Current - Voltage control selection.

INSTALLATION:

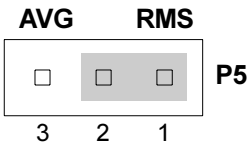
BE CERTAIN THAT POWER HAS BEEN REMOVED FROM THE CONTROLLER BEFORE REMOVING THE LID.

JUMPER CONNECTIONS: (CONTINUED)

P5: AVG - RMS.

When the jumper is in the **RMS** position (1 - 2), the RMS output of the controller will respond proportionally to the command signal.

The unit is shipped from the factory with the jumper in the **RMS** position



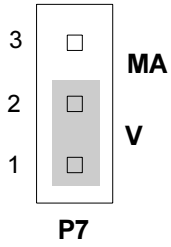
When the jumper is in the **AVG** position (2 - 3), the average output of the controller will respond proportionally to the command signal.

After moving this jumper, the ZERO and SPAN pots may need to be recalibrated. See the adjustments column on page 3 for instructions.

Figure 10. Average or True RMS output control.

P7: V - MA.

To enable the voltage or potentiometer command signal input, the jumper must be in the V position (1 - 2).



To enable the current command signal input, the jumper must be in the MA position (2 - 3).

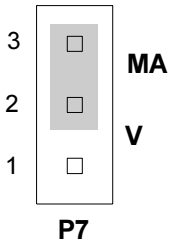


Figure 11. Voltage - current command select.

INSTALLATION:

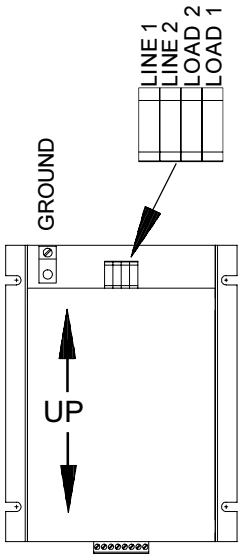
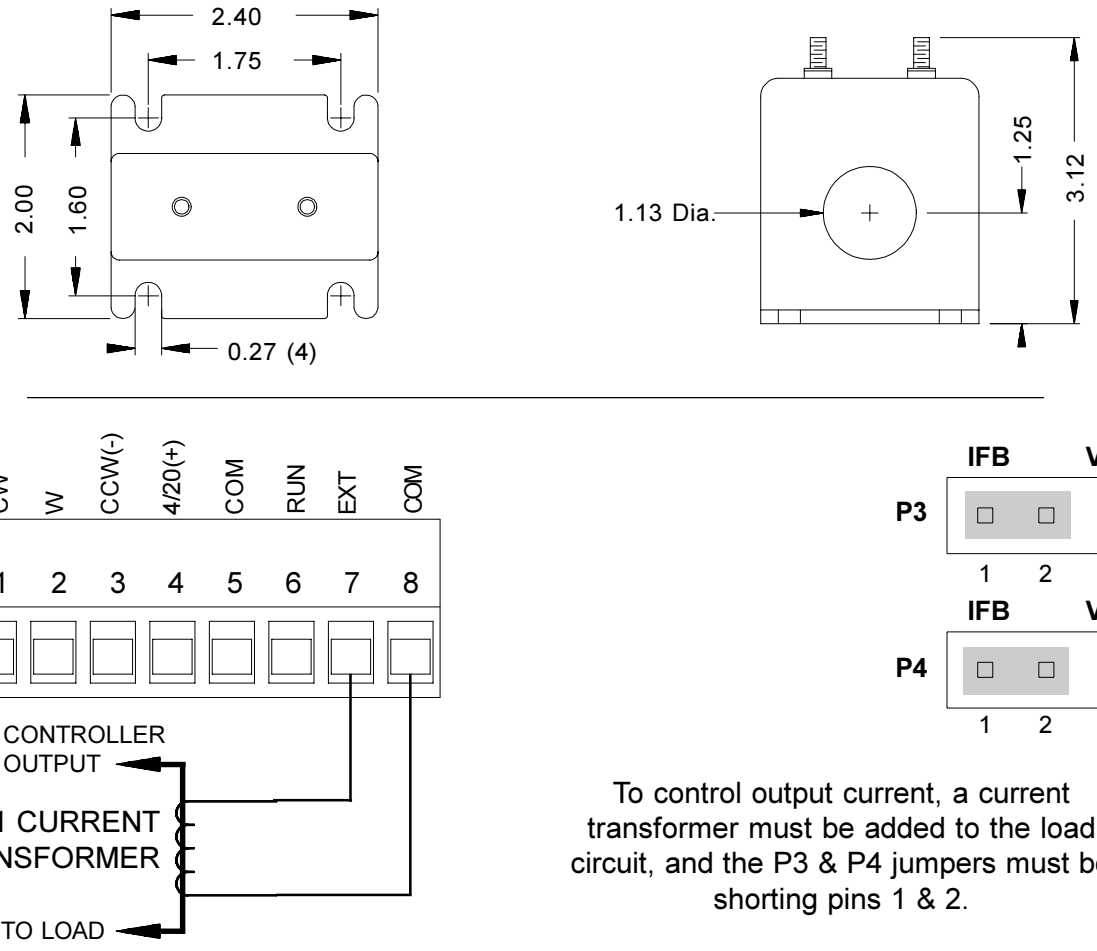


Figure 12. Connections to the LINE - LOAD terminals.



To control output current, a current transformer must be added to the load circuit, and the P3 & P4 jumpers must be shorting pins 1 & 2.

Figure 13. Installing and connecting a current transformer.

INSTALLATION DRAWINGS:

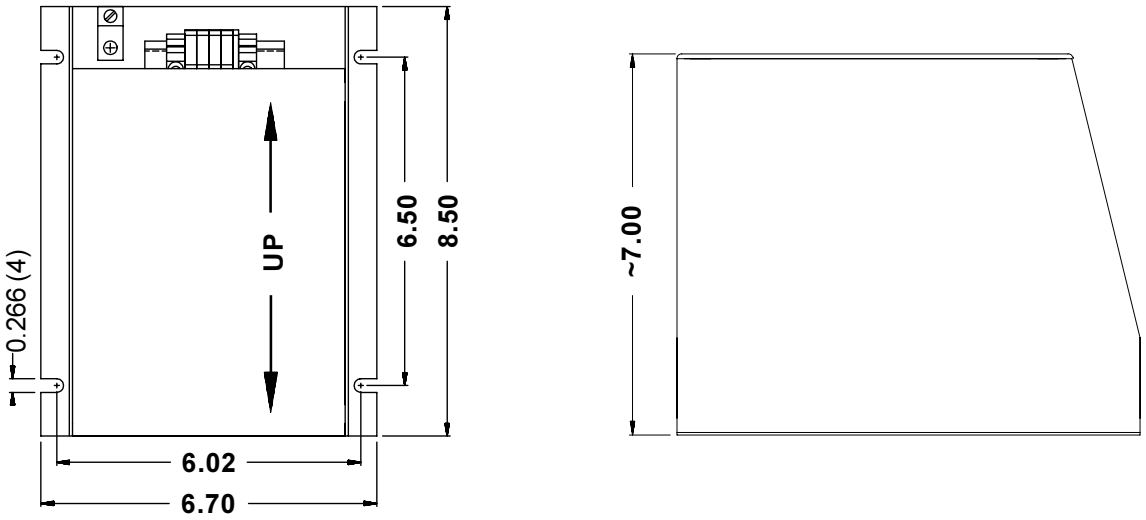


Figure 14. Dimensions

TROUBLESHOOTING:

FOLLOWING ARE SYMPTOMS AND POSSIBLE CAUSES.

NO OUTPUT AT STARTUP .

1. Check for 5V on command connector P8 between pin 1 (CW) and pin 3 (CCW).
   IF 5 Vdc is not detected;
   Is power connected and and present between LINE 1 and LINE 2 terminals on power connector?
   Is the voltage switch in the correct position?
   Have the fuses cleared?
2. Check connector P7 for position of jumper for desired command input.
3. Check command signal wiring. (See page 8.)
4. Check position of jumper on P6 (Closed - open) connector.
5. Check position of 115-230 switch on circuit board. See page 7.)
   If 230 Vac is applied to unit with switch in 115 position, the solder-in fuses on circuit board may be cleared. Return unit to factory for service.

FULL COMMAND: HALF OUTPUT

On 230 Volt unit, P2 jumper may be in "LOW" position.

HALF COMMAND: FULL OUTPUT

On 115 Volt unit, P2 jumper may be in "HIGH" position.

NO OUTPUT: LED "ON"

Check for bad connection.
Check that connector P1 is seated properly.
Substitute circuit board if a similar one is available.

FULL OUTPUT: LED OFF

Likely that SCR is shorted.

HALF OUTPUT: LED OFF

Likley that SCR driver is bad. Unplug connector P1 and retry.
Substitute circuit board if a similar one is available.