

**CONTROL
CONCEPTS
INC.**

**INSTALLATION MANUAL
2007-070901**

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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 SYSTEM No. 2007-070901 consists of four independent single-phase drivers. Each driver controls, with respect to dual 0/5 Vdc setpoints, the power applied to a load by phase-angle operation of a pair back-to-back SCRs.

Additional features of the driver include current limit, shorted SCR detection, over current trip, and retransmit signals representing load current and load voltage.

SPECIFICATIONS

CONTROL FUNCTION & PERFORMANCE	
PHASE-ANGLE	Variable firing angle of line voltage cycle
LOAD CONFIGURATION	Four independent single phase zones (Zones capable of running off separate phases)
LOAD TYPE	1. Resistive - constant (nickel chromium) 2. Resistive - variable (silicon carbide, molybdenum, graphite) 3. Transformer coupled
FEEDBACK TYPES	As Configured: 12KW Real Power Selectable*: RMS load voltage RMS load current External 0/5 Vdc or 100 uA * re-calibration may be required
LINE COMPENSATION	Controller will accept line voltage changes of +10% to -15%
CONTROL LINEARITY	Output linearity within 2% of span with respect to command signal
CONTROL RANGE	0 to 98% of supply voltage
ZERO AND SPAN	Potentiometers on the circuit boards allow zero and span adjustments of +/- 25% of span for run and idle and are factory calibrated.
RESET	1. Inhibit zone 2. Active low 3. Used to reset latched OCT alarm state
SOFT START	Ramp control loop, 200-500 msec typical
CURRENT	1. Limits maximum output RMS current 2. User adjustable from 20 to 105% of rated current via an on circuit potentiometer Factory calibrated at 105%
OVER CURRENT TRIP (Per Zone)	1. Inhibit zone 2. Illuminate OCT led 3. Activate c-form relay
LINE LOSS (Per Zone)	1. Reset zone 2. Ramp up to setpoint level
HEATSINK OVER TEMPERATURE @ 87° C (Global)	1. Inhibit all zones 2. Automatically resets
SHORTED SCR (Per Zone)	1. Illuminate SSCR led 2. Activated c-form relay
RETRANSMIT	1. (2) Output Channels per zone 2. Load Current: 0/5 Vdc = 0/15 Amps Load Voltage: 0/5 Vdc = 0/480 Volts

SPECIFICATIONS (Continued)

INTERFACE I/O	
DISCRETE LEDs (Per Zone)	1. Command - Green 2. Current - Green 3. OCT - Yellow 4. SSCR - Red
COMMAND INDICATOR	This green LED indicates that the gate drive is present
LOAD CURRENT INDICATOR	The intensity of this green LED is proportional to the load current
OVER CURRENT TRIP INDICATOR (OCT)	This amber LED, when illuminated, indicates the over current limit has been exceeded and the Over Current Trip relay has been energized. The SCR's will be prevented from turning on while this circuit is active. Reset by closure between Pins 9 & 10 or momentary power interruption.
SHORTED SCR INDICATOR (SSCR)	This red LED, when illuminated, indicates a shorted SCR.
OCT & SSCR CONTACT RATINGS	This OCT and SSCR circuits each control a relay which has form C contacts rated for 5 Amps at 120 Vac. The contacts are available on the command connector.

PERFORMANCE SPECIFICATIONS	
LINE VOLTAGE	480 Vac (Nominal) +10% -15%, Other voltages custom
LINE FREQUENCY	50 - 60 Hz
CURRENT RATING	I Continuous RMS - 25 Amps per zone Peak Surge - 600 Amps
MINIMUM HOLD/LATCH CURRENT	0.60 A RMS
SCR RATING	1200 V Peak forward & reverse
SCR PROTECTION	200 Volt / usec dv/dt protection 1000 V MOV peak voltage protection
RUN/IDLE CONTROL	A contact closure selects either the run command signal input or idle command signal input. See Command Connections section.
DEVICE PROTECTION	1. Control Circuit Fusing: FNQ-R-1/2 2. 120 Vac controller power: 3AG - .75 Amp SLO-BLO 3. Thermal: Integrated heat sink thermostat 4. Current Limit: 20% - 105% of continuous rating 5. Current Trip: 50% - 200% of continuous rating
POWER DISSIPATION	1.3 Watt per amp of load current per zone
GATE DRIVE	Optical coupled current source of 250 mA with a compliance of 10 V and duration of 60 electrical degrees
LINE 2	50 VA, #18 AWG wire
CONTROLLER VOLTAGE	120 Vac
CONTROLLER FREQUENCY	50 - 60 Hz
CONTROLLER VA	18.3 VA
ISOLATION	Signal to Line/Load: 2500 Vac min Line/Load to Ground: 2500 Vac min Line to Load: 1000 Vac min limited by MOV
ENCLOSURE PROTECTION RATING - INTERNATIONAL	IP20
SURROUNDING AIR OPERATING TEMPERATURE	0 - 50° C Flat Rated

SPECIFICATIONS (Continued)

HUMIDITY	5% to 95% non-condensing
RATED OPERATING ALTITUDE	Up to 1750m (6000ft) at rated current
CONTAMINANTS	CE Pollution Degree 2
STORAGE TEMPERATURE	-40 to 80° C
DIMENSIONS & MOUNTING	See Installation Drawings
WEIGHT	25.5 lbs
COOLING	Force air cooling
LINE/LOAD CONNECTIONS	Touch safe Phoenix grade compression lugs Rated 600 Volts, 57 Amps, 20 to 6 AWG wire
CONTROLLER CONNECTIONS	Touch safe Phoenix grade compression lugs Rated 300 Volts, 10 Amps, 30 to 14 AWG wire
OCT AND SSCR RELAYS	Form C contacts Rated 120 volts, 10 amps
INSULATION PROTECTION RATING	UL Protective Class I
3rd PARTY FIELD LABEL	Designed for UL compliance 3rd party to acquire field labeling
MEAN TIME BETWEEN FAILURE (MTBF)	50,000 Hours

INSTALLATION

COMMAND INPUTS:

The 2007-070901 has two command inputs per zone (RUN and IDLE) which are selected by a contact closure. A potentiometer, a DC voltage or a DC current may be used as a command signal into either input. These connections are made to the command connector as described below.

Run/Idle:

A remote switch can be used, as shown in [Figure 6](#), to cause the controller to be controlled by either the run or idle inputs. Connecting terminal 10 (COM) to terminal 11 (RUN/IDLE) on the command connector causes the run signal input to be in control. Opening the connection between terminal 10 and terminal 11 causes the idle signal input to be in control.

COMMAND SIGNAL OPTIONS

Voltage:

A 0 to 5 Vdc signal may be used as the command signal by connecting the positive signal to terminal 13 (run), or terminal 15 (idle). Always connect negative (common) signal to terminal 14 (common). See [Figure 5](#) or [Figure 7](#).

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



POWER & SAFETY CONNECTIONS

Over Current Trip Relay:

Connections to the form C contacts of the over current relay are shown in [Figure 3](#). The contacts are rated for 5 Amps at 120 Vac and are intended for activating an alarm and/or removing power from the system by operating a contactor or a circuit breaker.

Over Current Trip Reset:

Momentary closure of a switch connected between terminals 9 and 10 on the command connector will reset the over current relay and will release the SCRs from the locked off state. The reset switch can also be used as an on off control. Closure of the switch causes the SCRs to be turned OFF on the next zero cross. When the switch is opened, the SCRs begin operation at zero conduction angle and slews at the soft start rate to the desired output. The Over Current Trip circuit may also be reset by a momentary interruption of the supply power.

Shorted SCR Relay:

Connections to the 5 Amp 120 Vac form C contacts are shown in [Figure 3](#). This relay energizes if an SCR fails in the shorted mode and is intended to activate an alarm and/or cause power to be removed from the system by operating a contactor or a circuit breaker.

INSTALLATION DRAWINGS

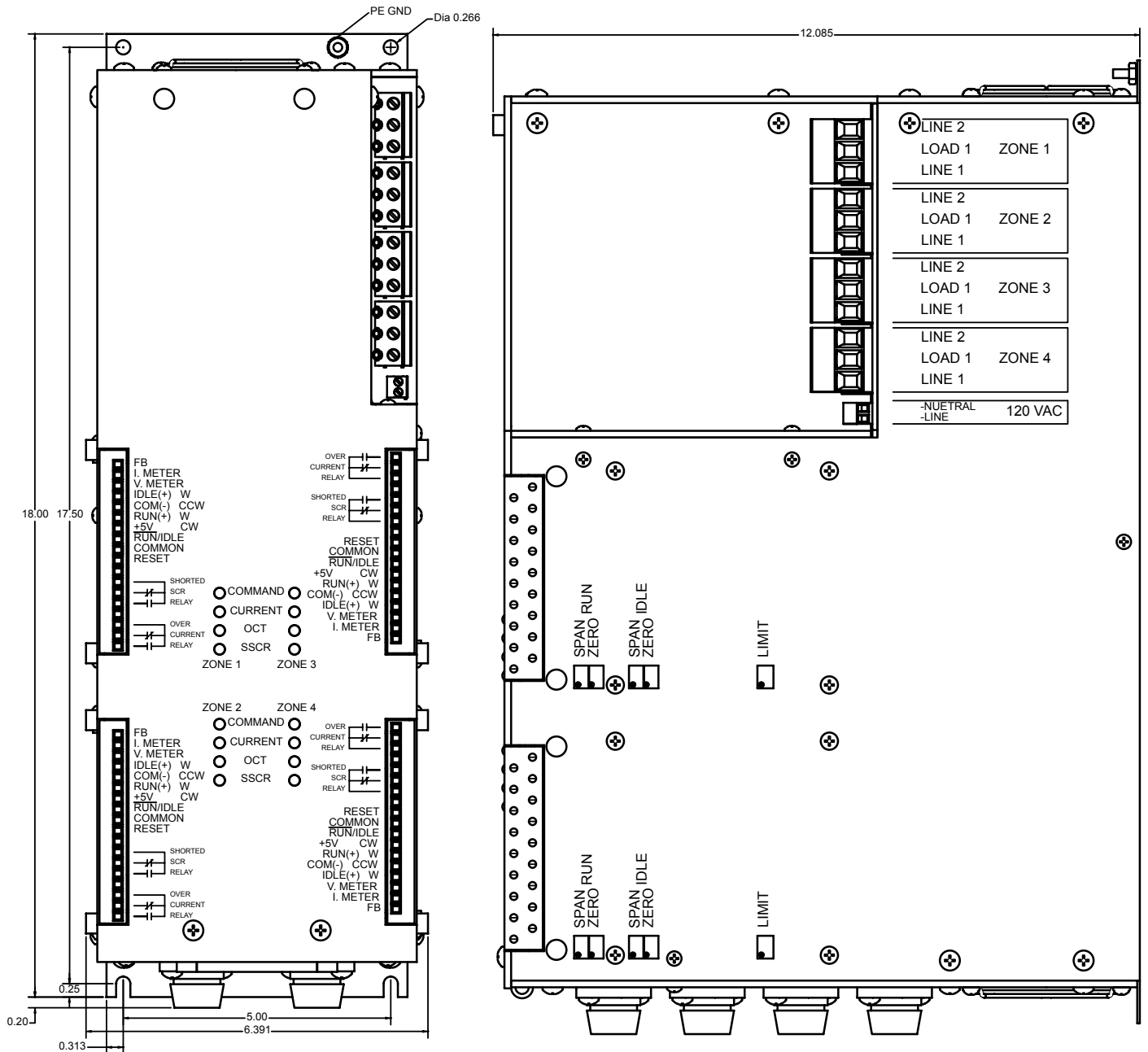


Figure 1. Installation drawing 2007-070901.

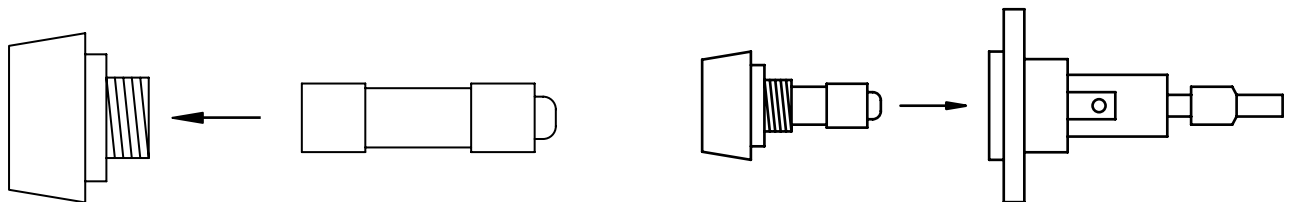


Figure 2.

ORIENTATION OF FUSE IN HOLDER

FNQ-R-1/2 fuse makes contact only when correctly installed.

Place flat end of fuse in cap, then insert into holder.

COMMAND CONNECTIONS

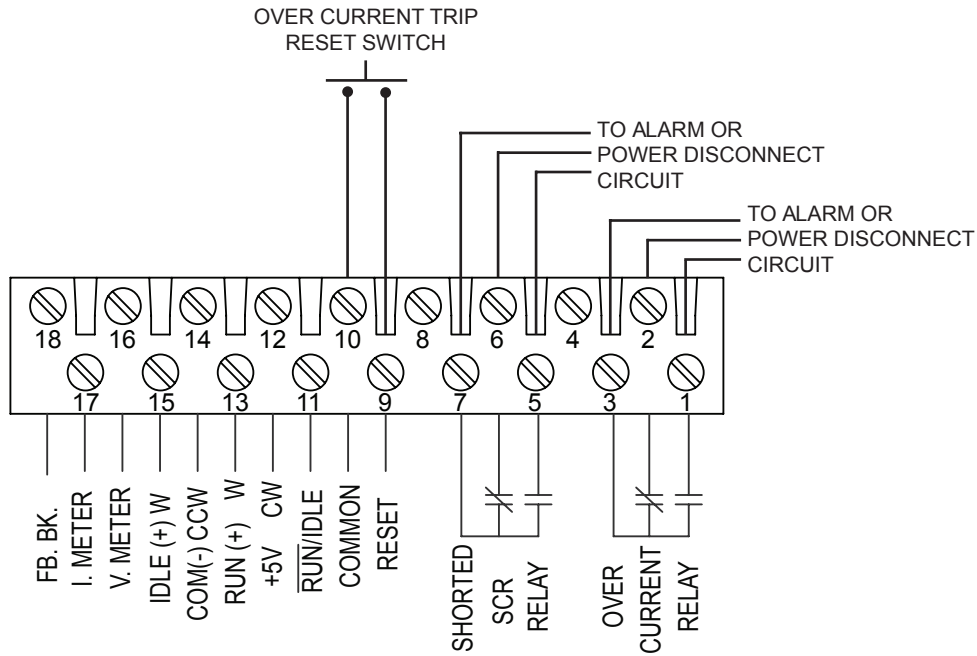


Figure 3. Voltage or current command connections

OVER CURRENT RELAY CONTACTS CHANGE STATE WHEN AN OVERCURRENT CONDITION OCCURS
SHORTED SCR RELAY CONTACTS CHANGE STATE WHEN AN SCR FAILS IN THE SHORTED MODE

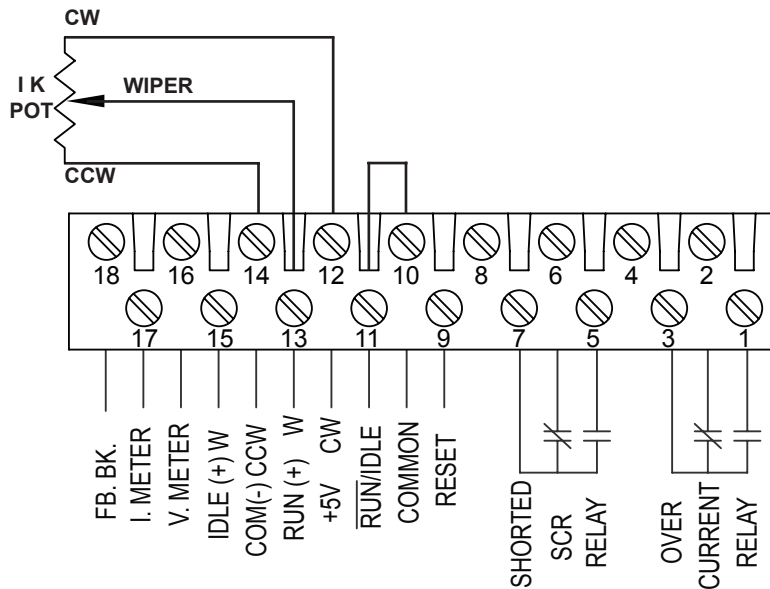


Figure 4. Single potentiometer applied to the run input connections.

(Terminals 10 & 11 must be connected to enable the run input.)

Effective 10/19/2007 the controller will be shipped with shorting jumper on pins 10 & 11.

COMMAND CONNECTIONS (Continued)

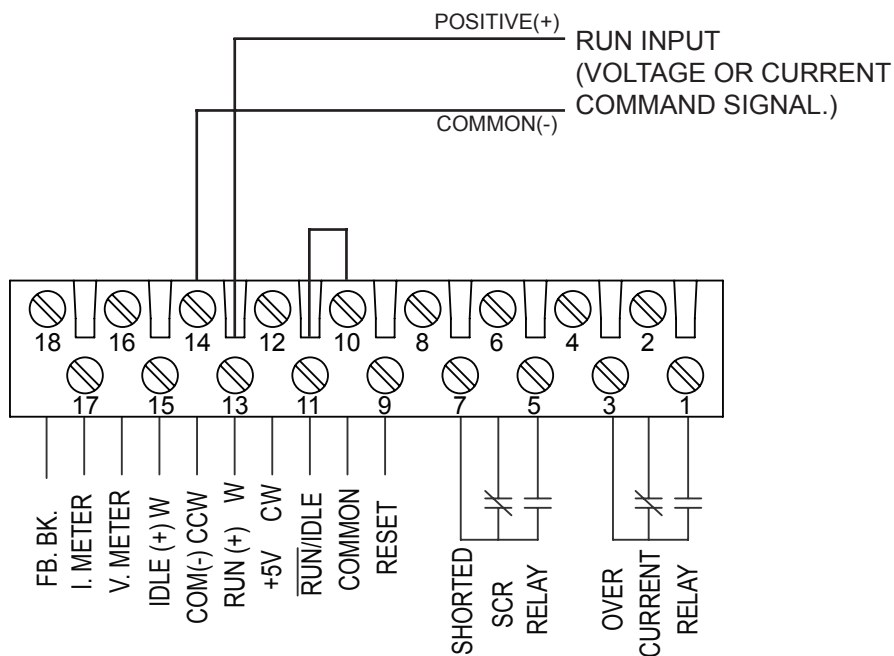


Figure 5. Single voltage or mA current applied to the run input connections
(Terminals 10 & 11 must be connected to enable the run input.)

Effective 10/19/2007 the controller will be shipped with shorting jumper on pins 10 & 11.

IDLE POTENTIOMETER

RUN POTENTIOMETER

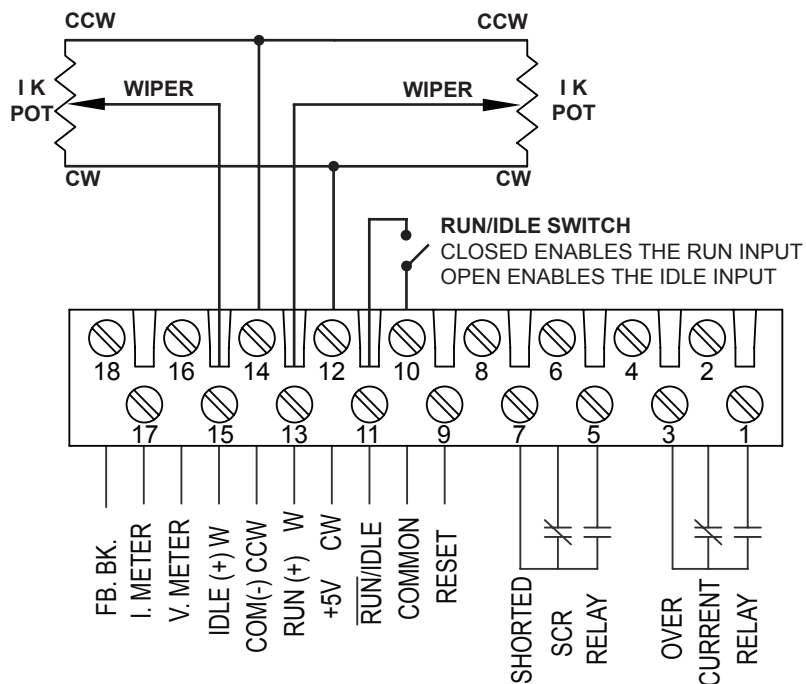


Figure 6. Run and Idle potentiometer connections.

COMMAND CONNECTIONS (Continued)

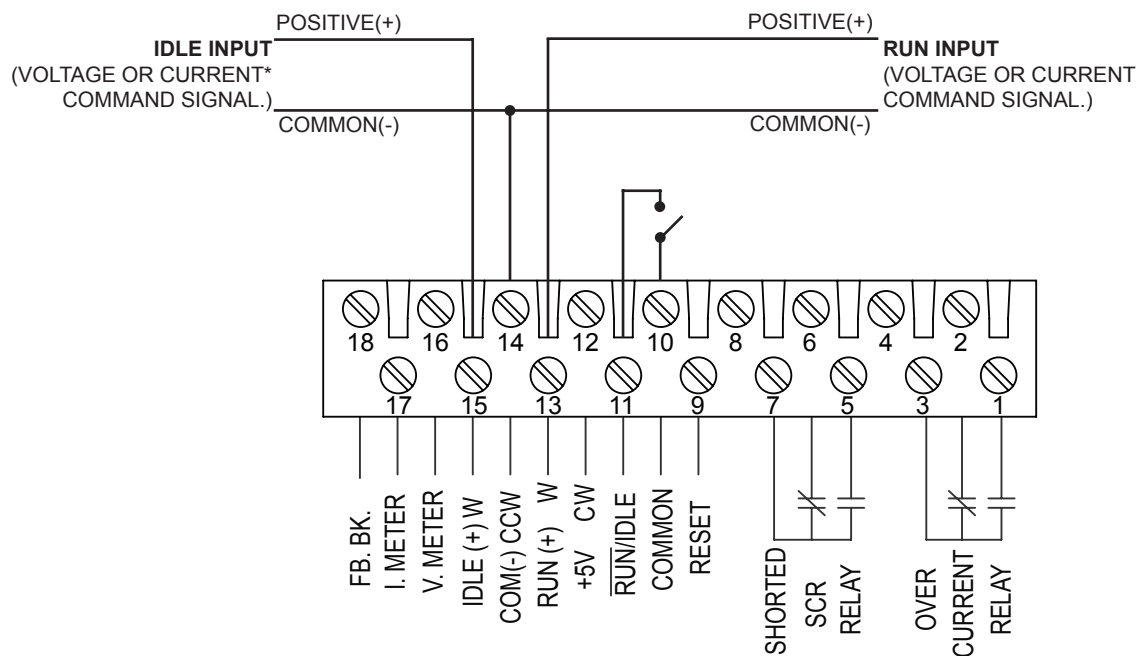


Figure 7. Run and Idle voltage or current connections.

* If it is desired to use a current command in both the Run and Idle command input, the signals must either be common sourcing, or they must be isolated from one another. Contact factory for details.

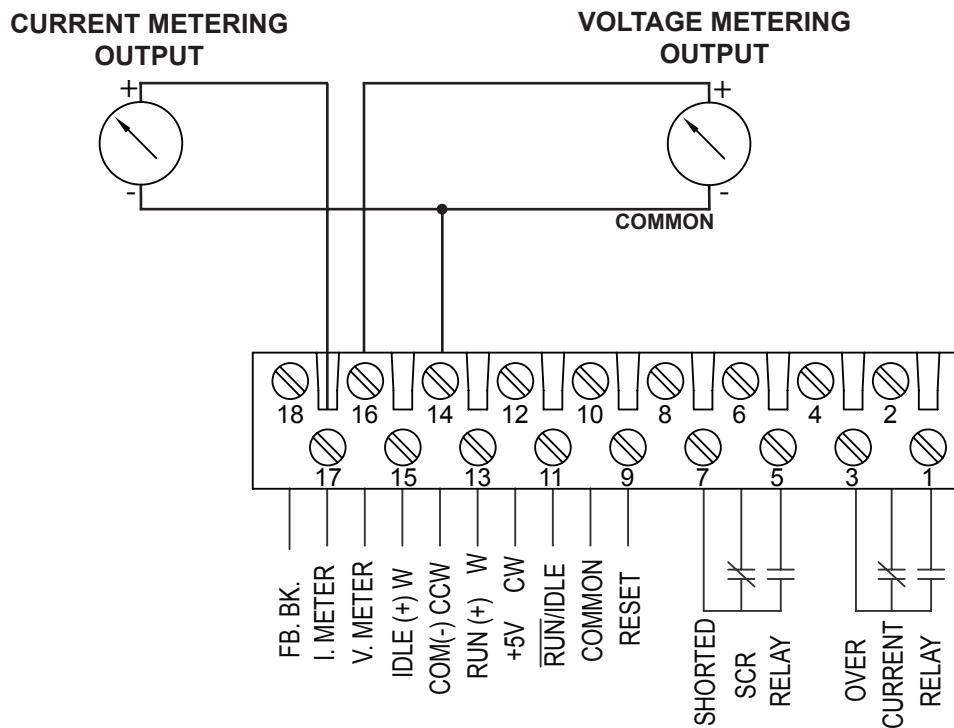


Figure 8. Output metering connections.

COMMAND CONNECTIONS (Continued)

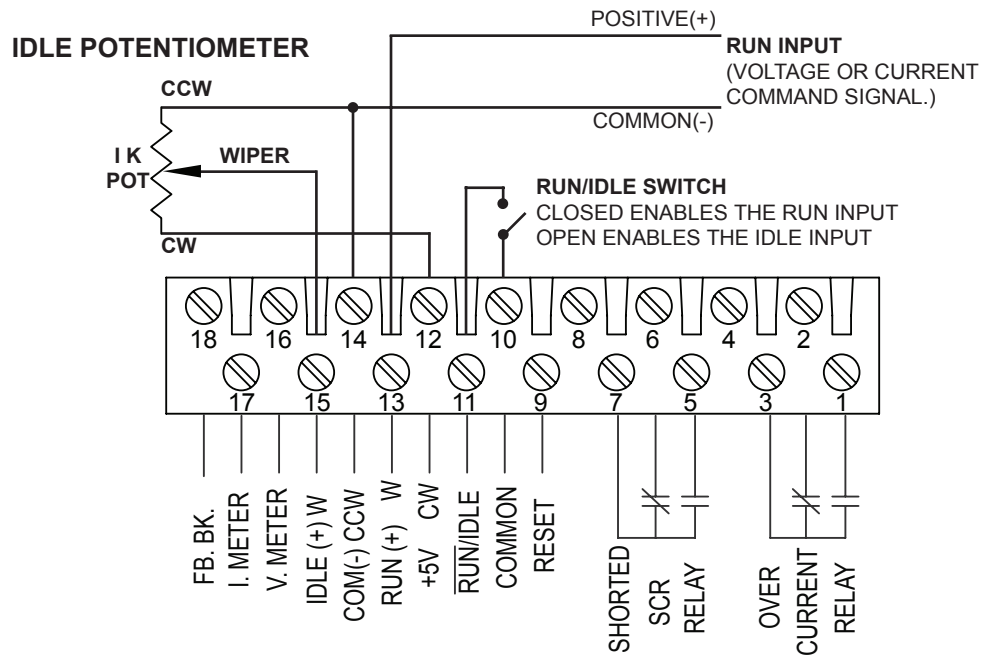


Figure 9. Combination command-signal/potentiometer input connections.
(This is the most common use of a run/idle control.)

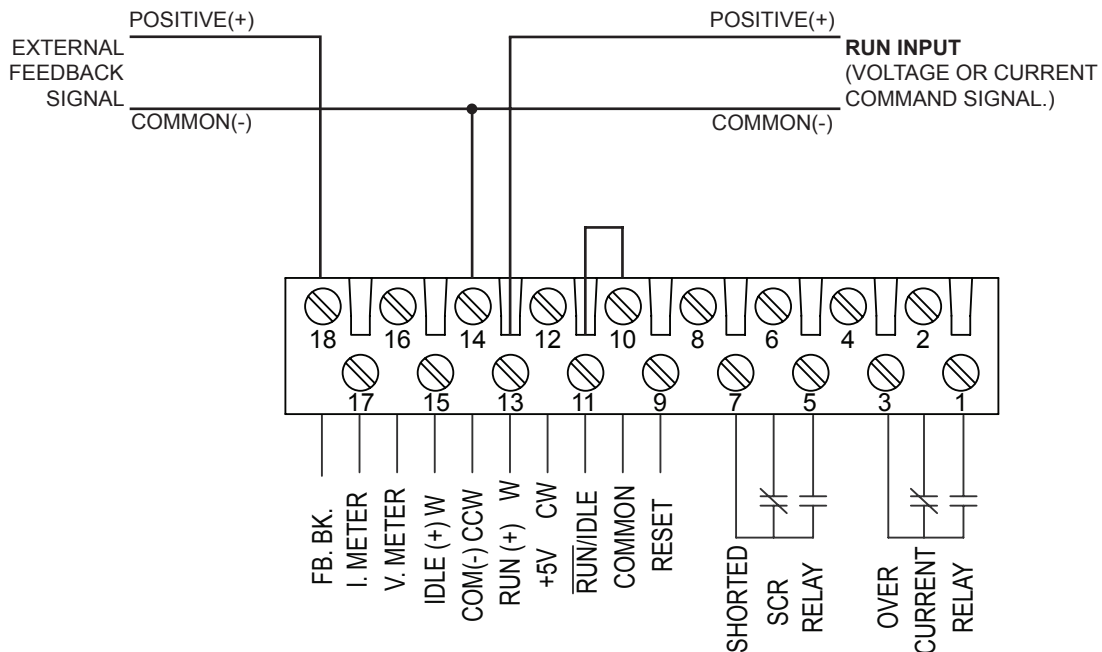


Figure 10. External feedback with signal applied to run input connections.
0 - 5 Vdc or 0 - 50uA external feedback.

(Terminals 10 & 11 must be connected to enable the run input.)

Effective 10/19/2007 the controller will be shipped with shorting jumper on pins 10 & 11.

CONNECTIONS

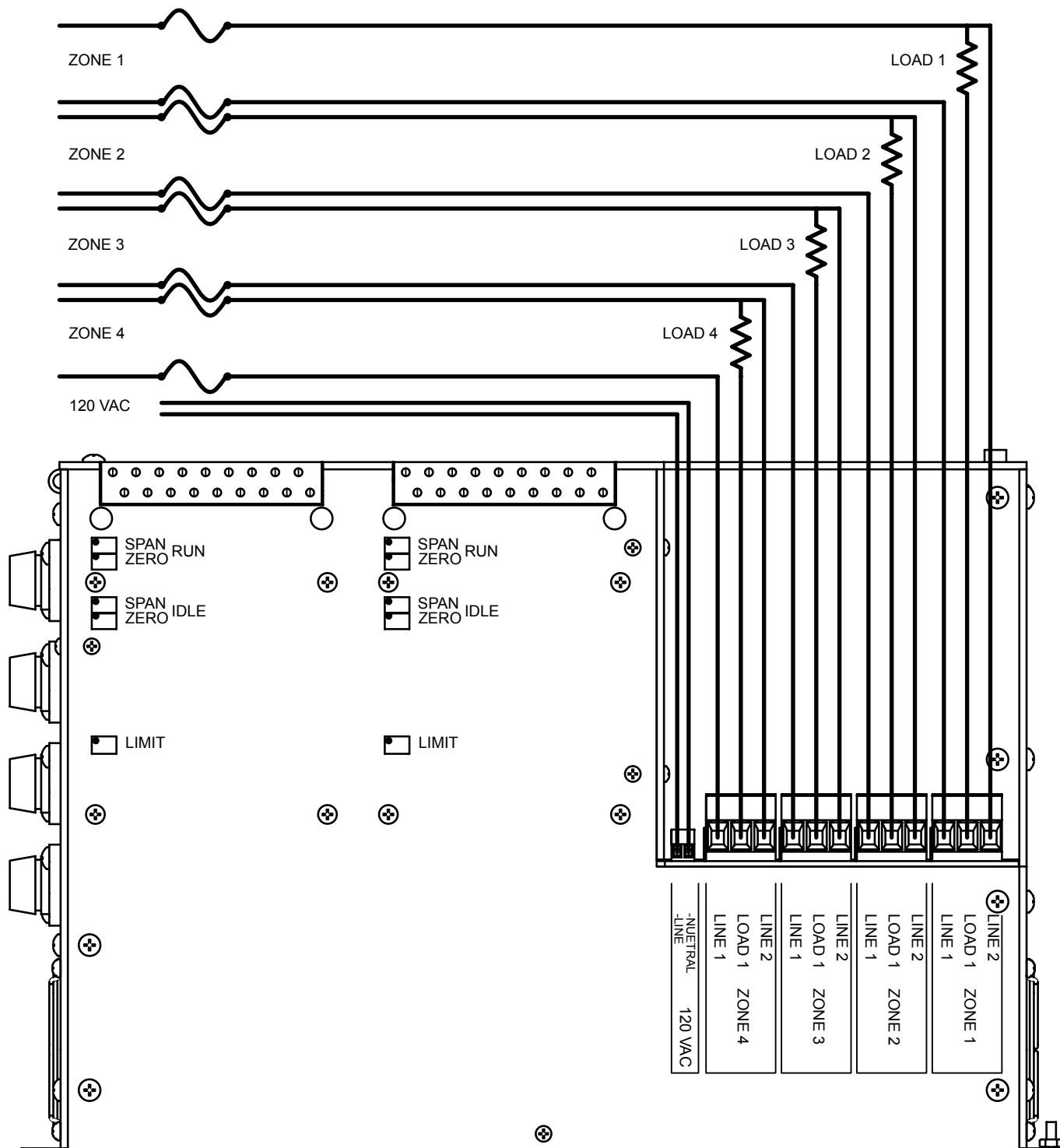


Figure 11. Power Path.

RECOMMENDED TIGHTENING TORQUE FOR POWER CONNECTIONS:	
WIRE SIZE (AWG)	TORQUE
14 TO 30GA	4.4 IN-LBS



RECOMMENDED TIGHTENING TORQUE FOR LINE/LOAD CONNECTIONS:	
WIRE SIZE (AWG)	TORQUE
6 TO 20GA	10.6 IN-LBS



FEEDBACK SELECTION

Connector P2 on the circuit board allows the selection of feedback type. (See [Figure 13](#)).

Power feedback is factory calibrated. Adjustments may be necessary if other feedback selection is made. True RMS is the default voltage feedback mode. Average voltage feedback mode may be requested when ordering the controller.

Voltage feedback may be selected by placing the jumper across pins P2-4 and P2-7. (VFB)

Current feedback may be selected by placing the jumper across P2-3 and P2-8. (IFB)

Power feedback may be selected by placing the jumper across P2-5 and P2-6. (PFB)

External feedback may be connected between terminals P1-14 (Common) and P1-18 (FD. BK.) on the command connector (See [Figure 14](#)).

A 0-5Vdc signal may be used for external feedback when the jumper is placed across pins P2-2 and P2-9 (EXT).

A 0-100uA signal may be used for external feedback when the jumper is placed across pins P2-1 and P2-10 (SJ).

Average voltage and True RMS voltage are of the feedforward technique.

ADJUSTMENTS

The I Span and V Span pots and Power Span and Power Zero pots are sealed at the factory. They are identified with an X in [Figure 12](#). Under no circumstances should adjustment of these four pots be attempted.

The setting of each of these potentiometers is critical to the proper operation of the controller.

The potentiometers labeled Run Span, Run Zero, Idle Span & Idle Zero have been calibrated at the factory and readjustment should not be necessary.

The zero pots are adjusted to provide zero output when the command signal is at minimum. The span pots are adjusted to provide full output when the command signal is at maximum.

If it is determined that the adjustment should be changed, the following procedure should be followed:

It is assumed that the load is resistive and can draw at least one or more amps.

Run Zero and Run Span:

Determine that pin P1-11 (Run/Idle) is electrically connected to pin P1-10 (Common). Make sure that the command signal is connected between the Run input P1-13 (Run/Wiper) and P1-14 (Common).

1. Set the command signal to minimum and adjust the Run zero potentiometer until the output is zero.
2. Set the command signal to maximum and adjust the Run span potentiometer until the output is at the desired maximum value.
3. The span and zero adjustments may interact, making it necessary to repeat steps 1 and 2.

Idle Zero and Idle Span:

Remove the electrical connection from between P1-11 (Run/Idle) and P1-10 (Common). Make sure that the command signal is connected between the Idle input P1-15 (Idle/Wiper) and P1-14 (Common). Repeat steps 1,2 and 3 (above) on the idle zero and span potentiometers.

It is important that meters capable of accurately measuring the output of the controller be used.

True RMS meters should be used for accurate measurements of True RMS Voltage, Current or Power (RMS Volts times RMS current into a resistive load).

Average responding meters should be used for measurements of;
Average AC Voltage or DC voltage.

Current Limit:

(The current limit pot is factory set at 105% of rated current unless specified differently by the (IL) term in the model Number.)

Proper calibration of the current limit feature requires a True RMS current meter.

If it becomes desirable to reset the current limit level:

1. Rotate the current limit pot fully counter- clockwise. (This is a multiple turn pot.)
2. Carefully increase the command signal to maximum.
3. Slowly rotate the current limit pot in a clockwise direction until the desired load current is reached.

If it is suspected that the current limit adjustment is causing the output of the controller to be lower than desired, rotate the current limit pot clockwise. If the load voltage increases, the current limit adjustment has been controlling the output. Follow the steps above to set current limit to the desired level.

OVER CURRENT TRIP:

This potentiometer has been factory set at 150% of rated frame current. For optimum protection, the customer may wish to reduce the level at which Over Current Trip occurs.

1. Adjust command signal to maximum.
2. Slowly rotate the Over Current Trip pot counterclockwise until the Over current Trip occurs.
3. Rotate the Over Current Trip pot about 1/2 turn clockwise.
4. Reset the Over Current Trip circuit.

ADJUSTMENTS (Continued)

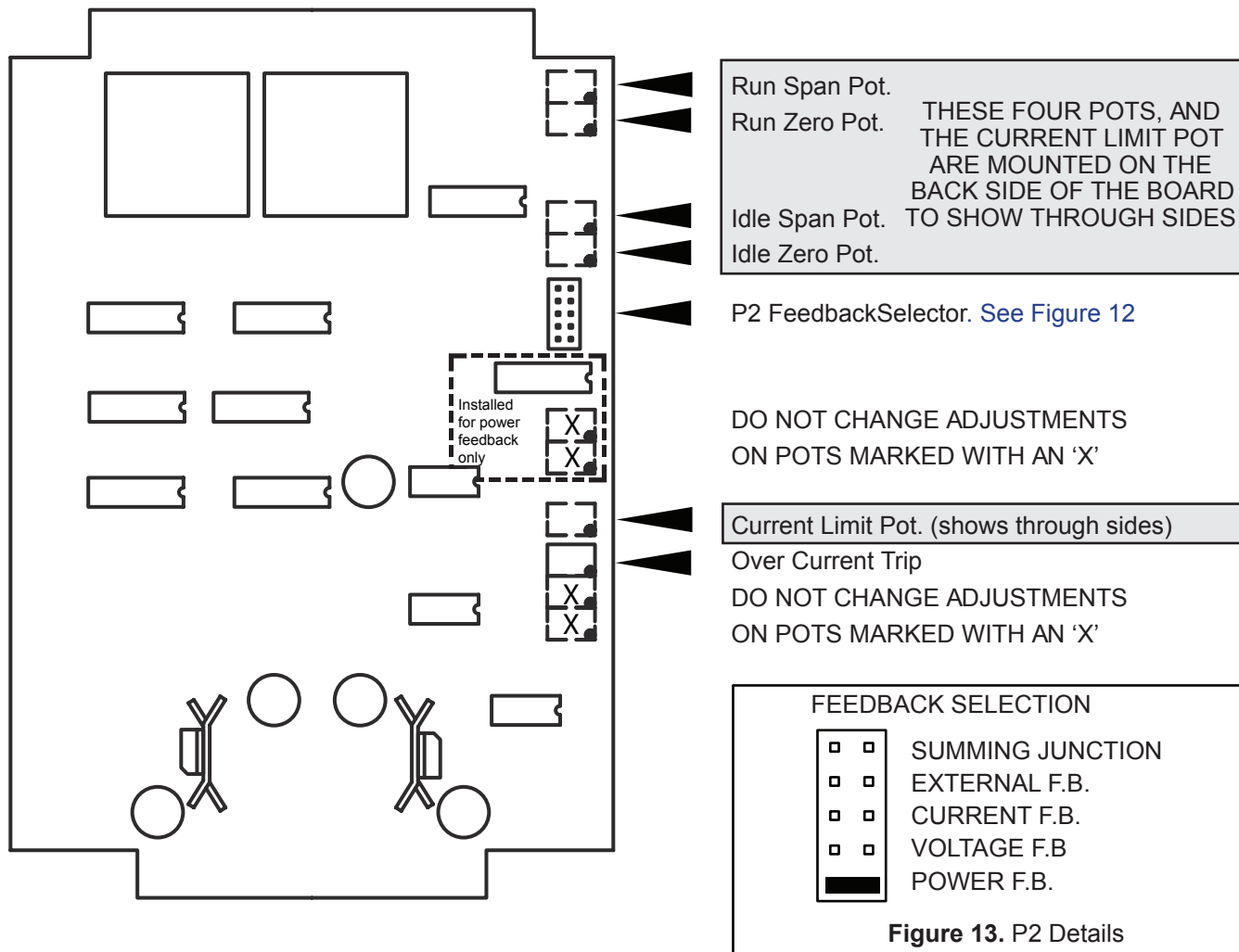


Figure 12. Circuit board showing adjustment locations.

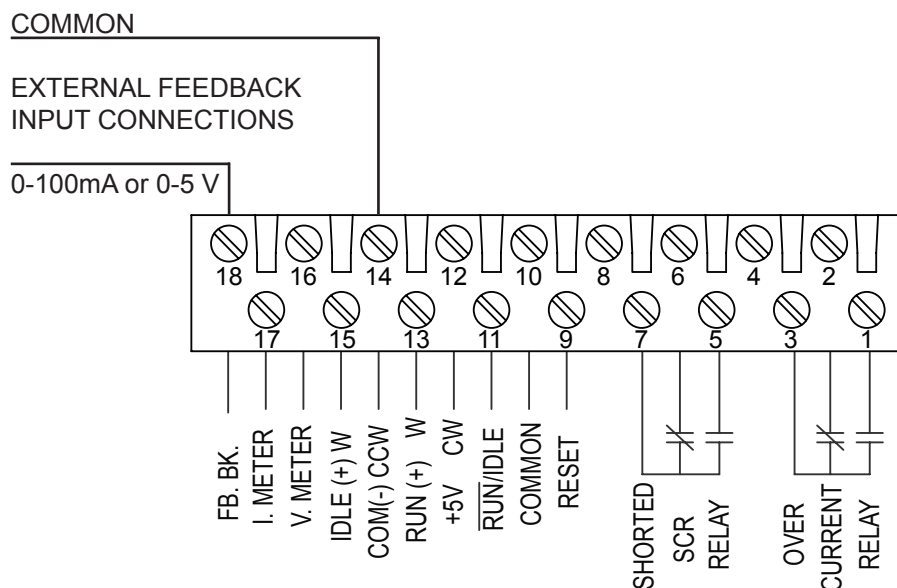


Figure 14. External feedback connections.

TROUBLESHOOTING

CAUTION: HIGH VOLTAGES ARE PRESENT ON THIS CONTROLLER AND ON PORTIONS OF THE PRINTED CIRCUIT BOARD. USE EXTREME CARE TO AVOID ELECTRICAL SHOCK.

Notes: The LED's provide a convenient method of determining the general location of controller problems. The **LOAD** LED indicates that 10% or more of rated load current is present. The intensity of the **LOAD** LED should increase as the command signal is increased. The **COMMAND** LED indicates the presence of gate drive. The **O.C.T.** LED is a fault indicator to warn that an Over Current condition has occurred, the O.C.T. relay is energized and the SCR's are prevented from turning on. The **SHORTED SCR** LED is a fault indicator to warn that one or more SCR's may be shorted.

NO LOAD VOLTAGE:

- Determine that the Command LED lights when the command signal is increased from zero.

If the command LED will not light.

- Make sure that the 120 Vac is connected to controller.
- Determine that the following conditions exist: (Measure voltages at screw terminals to ensure good electrical connections.)
- Determine if **OVER CURRENT TRIP** LED is ON.
- Voltage between COM (Pin 14) and +5CW (Pin 12) must be 5 Volts ± 1 . If not; Circuit is not powered or command connections are shorting out supply.
- Determine that line voltage exists between Line 1 and Line 2 terminals.
- Determine that fuses on controller are OK.

Voltage or potentiometer inputs.

- Determine that voltage from COM (pin 14) to IDLE (W) or RUN (W) changes from 0 to 5 Vdc as command is changed from zero to 100%.

If the command LED can be made to light:

- Determine that the load fuses are OK and that the load has continuity. Load continuity (including load fuses can be confirmed by determining that the supply voltage exists between Line 1 and Load 1 terminals when the command signal is zero.

LOAD VOLTAGE WILL NOT GO TO ZERO:

If RMS value of the load voltage is greater than 10 percent of the supply voltage.

- Determine **SHORTED SCR** LED status while varying the command signal.
- With power removed and the load disconnected from terminal Load 1 the resistance between terminals Line 1 and Load 1 should be greater than 100K ohms.
- If the resistance between Line 1 and Load 1 is less than 100K ohms the SCR module has failed.
- If the shorted SCR led is ON & the resistance between Load 1 and Line 1 is greater than 1000 ohms, the failure is likely associated with the circuit board. Determine by removing the circuit board and applying power.
- Determine that the supply to line 2 and the load are connected to the same supply.

If the RMS value of the load voltage is less than 10 percent of the supply voltage.

- Determine that the command signal is correct. Adjust the zero and span potentiometers to achieve the desired output. (Note: The Zero and span potentiometers are factory set. Adjustment should be made with caution.

FULL VOLTAGE CANNOT BE OBTAINED:

- Determine that the control signal is at maximum.
- Determine that the controller is not in current limit. Decrease the current limit by rotating the current limit potentiometer counterclockwise, the controller is in current limit if the load voltage decreases.
- If the problem occurs on initial start up, determine that line 2 and the load are connected to the same supply.

MANUFACTURED BY



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REPLACEMENT PARTS

**ITS RECOMMENDED THAT THE CONTROLLER AND LOAD
BE PROTECTED BY 600 VOLT, CLASS 'T' FUSES:**

TO ORDER A SPARE SCR MODULE*		TO ORDER CLASS 'T' FUSES	
SCR Thermal Pad	28375-0334-516 69000-0001-3	FNQ-R-1/2	42130-0460-205
* When ordering a SCR replacement module, both the SCR and Thermal Pad are required.			

REPLACEMENT FUSE FOR 120 VAC

Fuse Type	CCI Part No.
3AG - .75 A	42101-0425-175