

---

**INSTALLATION, OPERATION and  
MAINTENANCE MANUAL**

**MODEL PF1 15, 25, 40 & 70 AMP  
SINGLE PHASE  
SOLIDSTATE RELAY (SSR) POWER CONTROLS**

---

UL/Cul FILE NUMBER – E151547  
CE – See last page of manual for CE Declaration of Conformity



**AMETEK HDR POWER SYSTEMS  
3563 INTERCHANGE ROAD  
COLUMBUS, OHIO 43204**

**TEL: 614-308-5500  
TOLL FREE: 1-888-PWR-CNTL (797-2685)  
FAX: 614-308-5506**



## SCR Power Controls/Systems & Power Supplies

Dear Client:

On behalf of all of AMETEK HDR's employees, I want to take this opportunity to "thank you" for purchasing an AMETEK HDR Power Systems' SCR Power Control.

We believe AMETEK HDR represents the best overall solution to your SCR Power Control needs in the industry today. We do this by providing a quality manufactured, reliable unit with fast, on-time delivery and a competitive price.

All of our employees are dedicated to your success. If you have any questions, comments or concerns, please call me toll free at 1-888-PWR-CNTL (797-2685).

Sincerely,

AMETEK HDR POWER SYSTEMS

A handwritten signature in cursive script that reads "George A. Sites".

George A. Sites  
Vice President

GAS/be

**REVISION PAGE**

<u>Page</u>	<u>Change</u>	<u>Revision</u>	<u>Date</u>
2	1	"@ 3VA. . . " in Paragraph 3 Added.....	5/5/92
3	1	"The 24VAC must be. . . " Paragraph 3-1 .....	5/5/92
4	1	"NOTE: The control power transformer. . . " .....	5/5/92
8	1	"NOTE: The control power transformer. . . " .....	5/5/92
9	1	"NOTE: Use a RMS voltmeter. . . " .....	5/5/92
10	1	"Erratic Output. . . " .....	5/5/92
Many	2	Added 70A Rating. . . " .....	4/14/93
Many	3	Totally Revised .....	12/01/95
Many	4	Revised for Scanner.....	10/96
Many	5	Rewritten for CE.....	8/00
17	6	Added EMC to CE Declaration.....	11/00

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.

## TABLE OF CONTENTS

<u>Para.</u>	<u>Title</u>	<u>Page</u>
<b>Section 1 - DESCRIPTION</b>		
1-1	Models Covered.....	1
1-2	General Description.....	1
1-3	Applications.....	1
1-4	Specifications.....	1
1-5	Options.....	2
1-6	Operation.....	2
<b>Section 2 - INSTALLATION</b>		
2-1	Mounting.....	4
2-2	Line/Load Power Wiring.....	4
2-3	Safety Issues.....	5
2-4	Options.....	7
<b>Section 3 - COMMAND SIGNAL CALIBRATION</b>		
3-1	Zero and Span Adjustments.....	13
3-2	Command Indicator.....	13
3-3	Remote Manual Control.....	13
3-4	Process Command Signal.....	13
<b>Section 4 - OPTIONS CALIBRATION</b>		
4-1	Current Limit.....	14
4-2	Overcurrent Trip.....	14
<b>Section 5 - MAINTENANCE</b>		
5-1	Environmental Concerns.....	15
5-2	Line/Load Power Connections.....	15
5-3	Troubleshooting Typical Symptoms.....	15
<b>Section 6 - SERVICE AND SPARE PARTS</b>		
6-1	Customer Service.....	16
6-2	Spare Parts.....	16
6-3	Warranty.....	16

## TABLES, ILLUSTRATIONS & DRAWING LIST

### TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1	Specifications the PF1 .....	1
2	%Output Voltage at Various Input Command Levels .....	3
3	Fusing Requirements <sup>5</sup>	
4	Minimum/Maximum Currents <sup>6</sup>	

### ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Line/Load Power Wiring .....	7
2	Outline and Mounting Dimensions 15 25 & 40A .....	8
3	Outline and Mounting Dimensions - 70A.....	9
4	Outline and Mounting Dimensions - Current Limit .....	10
5	Outline and Mounting Dimensions - Overcurrent Trip .....	10
6	24 VAC Transformer .....	11
7	Fuse Holder Dimensions .....	12

### DRAWING LIST

Outline & Mounting PF1 15 Thru 40A.....	M2710048
Outline & Mounting PF1 70A .....	M2710077
Schematic, PF1 15 Thru 40A.....	S2710048
Schematic, PF1 70A.....	S2710077
Schematic, PF1 Firing Circuit .....	S2080000
Assembly, PF1 Firing Circuit .....	S2080000

NOTE: If full size drawings are required, contact HDR inside sales and request the required drawing by the drawing number listed above

## Section 1 - DESCRIPTION

---

### 1-1 MODELS COVERED

This manual covers the PF1 models rated 15, 25, 40 & 70 amperes and its options.

### 1-2 GENERAL DESCRIPTION

The PF1 is a solid-state, single-phase, phase fired (PF) SCR power control which will operate on line voltages up to 600 VAC. It accepts most all standard process command signals and regulates the output voltage. Zero and Span Multi-turn potentiometers are provided to ease calibration. The PF1 utilizes an isolated base Solid-State-Relay (SSR) Module which contains two SCRs connected back to back. The firing circuit is based on a common phase firing integrated circuit which includes soft-start for loads which are inductive or have a large resistance change due to temperature or start-up. Terminals are provided to ease installation.

### 1-3 APPLICATIONS

The PF1 provides infinitely variable firing angles for precise control of single-phase power to resistive or loads with large resistance change (cold to hot). The PF1 may also be used on straight resistive loads as well, but the lower power factor and higher harmonics may present a problem to other equipment mounted nearby. A zero fired model would be a better choice. It is not recommended for use with transformer coupled loads. PF1's/SHPF1's with dual SCR modules (not SSRs) should be used.

### 1-4 SPECIFICATIONS

Specifications for the PF1 SCR Power Control are given in Table 1.

**Table 1**  
**Specifications for the PF1 15, 25, 40 & 70 Amp Models**

CONTROL METHOD - Phase firing of back to back SCRs.

VOLTAGE RATING - Up to 600 VAC, 1 Ph., 50/60 Hz.

CURRENT RATING - 15, 25, 40 & 70 Arms.

COMMAND SIGNAL - 4-20 ma, 0-5 VDC/0-10 VDC, Manual Control

ISOLATION - 2500 Vrms from line/load to command signal to ground.

LINEARITY - RMS output voltage is linear to command signal.

ADJUSTMENTS - Zero and Span, multi-turn.

AMBIENT TEMPERATURE - Operating, 0 - 50 °C; Storage, -10 - 70 °C.

AGENCY LISTING - UL/cUL Listed, CE Compliant

## 1-5 OPTIONS

Five options are available for the PF1 models: A fuse Kit, a 24 VAC Control Transformer, a Current Limit, an Overcurrent Trip and Heatsink Thermostats.

The Fuse Kit (Option FK) consists of a Semi-Conductor Fuse and a fuse block. It is the user's responsibility to mount this fuse kit.

The PF1 requires 24 VAC @ 3VA control power. Appropriate sized transformers (Option TX) are available with 120, 240, 400, 480 or 600 VAC primaries.

Current Limit (Option CL) is available for those loads that decrease in resistance with time.

Overcurrent Trip (Option OC) can be used on loads which have instantaneous shorts that are self healing; or, in some cases, it may be used as an "Electronic Fuse".

Heatsink Thermostats (Option NO or NC) provide a dry contact (either Normally Open (NO) or Normally Closed (NC)).

## 1-6 OPERATION

The PF1 controls power by the switching action of two SCRs connected in a back to back configuration. The gating of these SCRs is synchronized with the line frequency (either 50 or 60 HZ) by the Phase Control Integrated Circuit and the 24 VAC control voltage. This IC provides timing pulses along with a soft-start feature. The output may be adjusted by the on-board potentiometers or by a voltage or current signal from a process controller. Zero and Span controls allow the user to calibrate the SCR unit's output to the process command signal. Terminals are also available for connection a remote manual potentiometer.

<b>WARNING</b>
<b>Hazardous voltages exist at the power controller heat sinks and at the load at all times when the input voltage is connected. This condition exists even when the controller is set to delivery zero output.</b>

**NOTE: The 24 VAC control power must be of the same phase relationship as the power being controlled.**

Table 2 shows the % output voltage at various input command signal levels. The PF1 will maintain as

constant a power level to the heating elements as possible.

<b>TABLE 2 % OUTPUT VOLTAGE AT VARIOUS INPUT COMMAND LEVELS</b>	
<b>Ma Input</b>	<b>% Output Voltage</b>
4	0
5	10
6	30
7	41
8	53
9	59
10	64
11	68
12	71
13	76
14	80
15	85
16	88
17	91
18	95
19	98
20	100

NOTE: The % output voltage for any given command signal is affected by the exact setting of the zero and span potentiometers. Table 2 is intended to be used only as a comparative example.



## Section 2 - INSTALLATION

---

### 2-1 MOUNTING

Prior to mounting, verify the voltage and current rating of the PF1, the information is provided on the nameplate. Determine the mounting dimensions from the outline drawing located in Figures 2 & 3. Mount the PF1 with line/load terminals to the top so that airflow is upward through the heat sink fins. Ensure that airflow is unrestricted and mount the 24 VAC control transformer close by. The 24VAC must be phase referenced to the same power as the PF1.

### 2-2 LINE/LOAD POWER WIRING

Connect the line/load using appropriately sized and insulated wire/cable per NEC based on the voltage and current rating of the PF1. Torque the line/load power connections to 25 in-lbs. min. Refer to Fig. 1 for all additional connections.

**NOTE: 75 °C rated wire is required by UL for all power connections to the PF1.**

#### WARNING

**Branch circuit overcurrent protection is required to be provided in Accordance with the national and/or local code of the inspecting Authority or equivalent. If it is desired to protect the SCRs, fast Clearing semiconductor fuses must be added to the system. Table 3 Shows the fuse voltage, fuse current, fuse maximum 12T rating and Conditional short circuit current (CSCA) rating for each of the power Control's ratings.**

**TABLE 3**

<b>UNIT CURRENT</b>	<b>FUSE VOLTAGE</b>	<b>FUSE CURRENT</b>	<b>FUSE I2T</b>	<b>CSCA</b>
15	700	20	157	200,000
25	700	30	427	200,000
40	700	50	950	200,000
70	700	80	4085	200,000

**NOTE: The Conditioned Short Circuit Current (CSCA) rating is the maximum current the fuse can safely clear and this rating must be higher than the current the branch circuit can supply.**

### **2-3 SAFETY ISSUES**

The rated operational voltage of each power controller is shown on its nameplate, i.e. 120V, 240V, 400V, 480V, or 575V. The power controller is designed to operate between +10% and -15% of this rated operational voltage in an Over Voltage Category III environment.

**WARNING**

**Power control units are not suitable to provide isolation due to the use of semiconductors and other components that allow a small current to flow from line to load even when the unit is in the non-conducting mode.**

The minimum operational current and the maximum off state current for each unit is shown in Table 4.

The power controls described in this instruction manual are designed to operate in a pollution degree 2 environment.

**TABLE 4**

<b>UNIT CURRENT (A)</b>	<b>MINIMUM OPERATING CURRENT (ma)</b>	<b>MAXIMUM OFF CURRENT (ma)</b>
15	100	15
25	100	15
40	100	15
70	100	15



**HAZARDS EXIST**



**DANGEROUS VOLTAGES EXIST**

## 2-4 OPTIONS

If the PF1 was ordered with either the Current Limit or the Overcurrent Trip option then it should be mounted at this time. The Current Transformer should be mounted so the input line wire/cable passes through it and it is close enough for the plug-in cable assembly to reach the firing circuit.

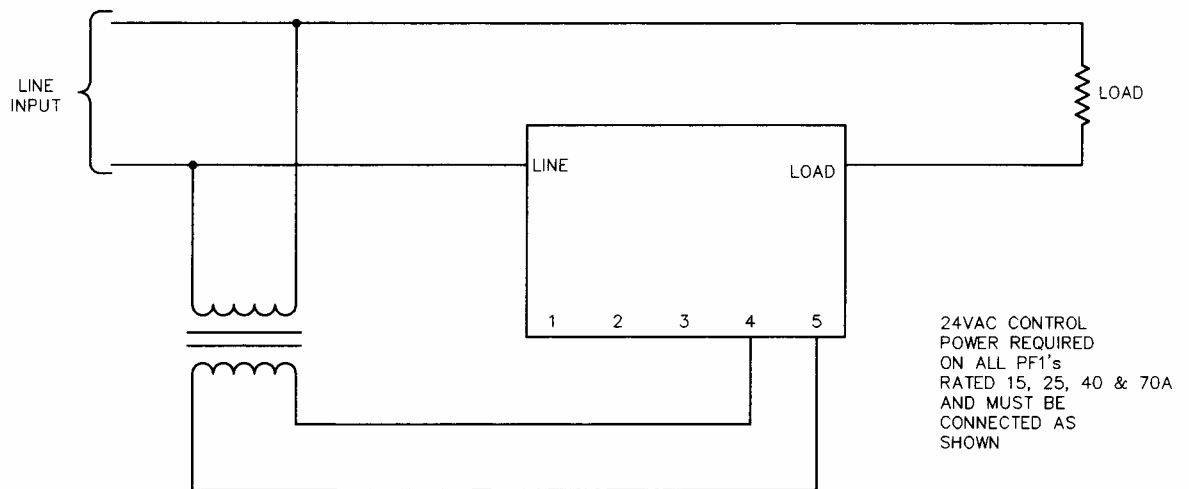
Refer to Figures 4 & 5 for dimensional information.

**NOTE: Do not connect the Current Limit or the Overcurrent Trip plug-in cable to the firing circuit until the Zero and Span controls have been adjusted.**

Both the Current Limit and the Overcurrent Trip options have been factory adjusted for nominal ratings. You may want to adjust these for your individual requirements. The Current Limit is adjustable from 50 to 125% of the unit's rating while the Overcurrent Trip is adjustable from 25 to 200% of its rating.

The Overcurrent Trip has a Form C relay output and provisions for a remote overcurrent reset push button. A momentarily closed contact resets the trip.

**Figure 1 – LINE/LOAD POWER WIRING**



NOTE: the control transformer must be referenced to the same phases as the PF1.

**Figure 2 - OUTLINE AND MOUNTING DIMENSIONS - 15, 25 & 40A**

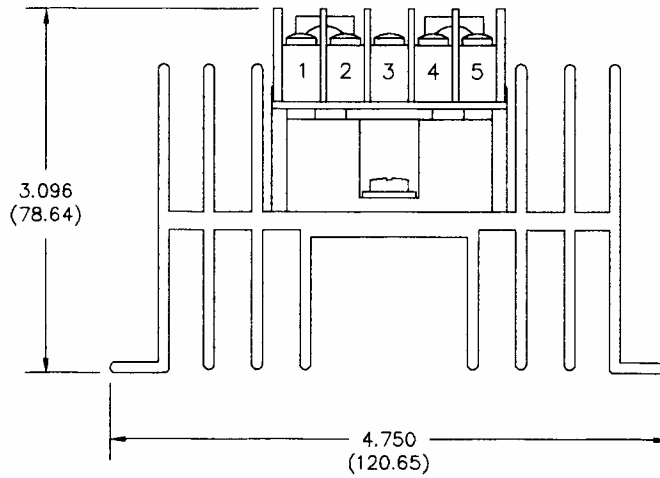
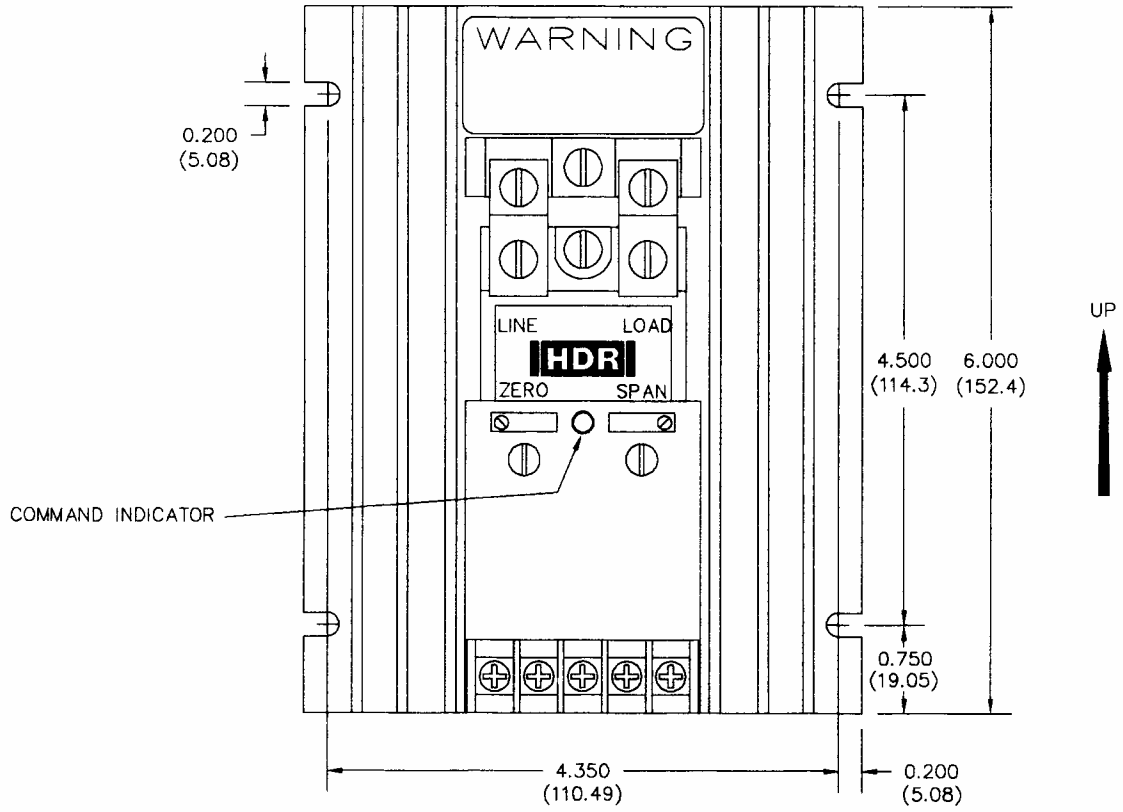


Figure 3 - OUTLINE AND MOUNTING DIMENSIONS - 70A

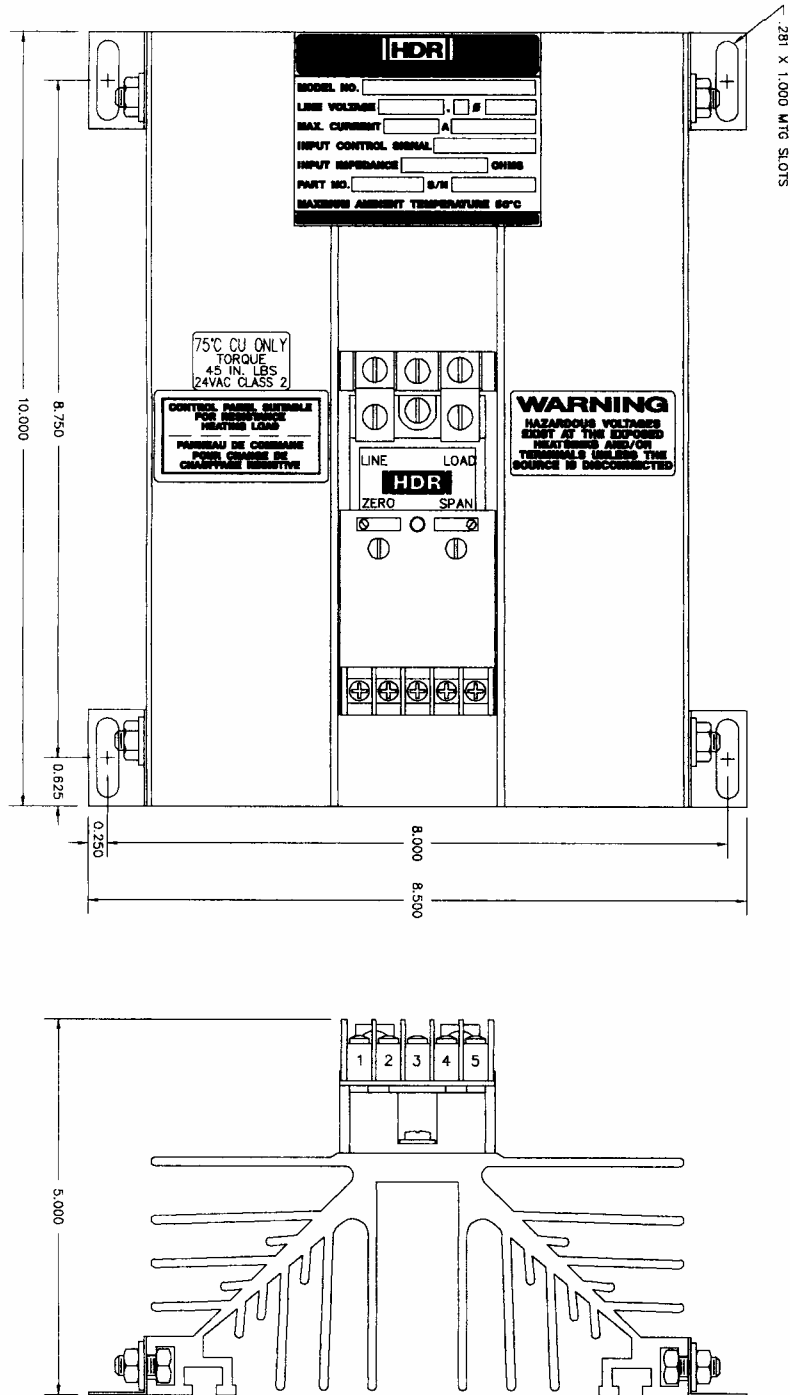


Figure 4 - OUTLINE AND MOUNTING - CURRENT LIMIT

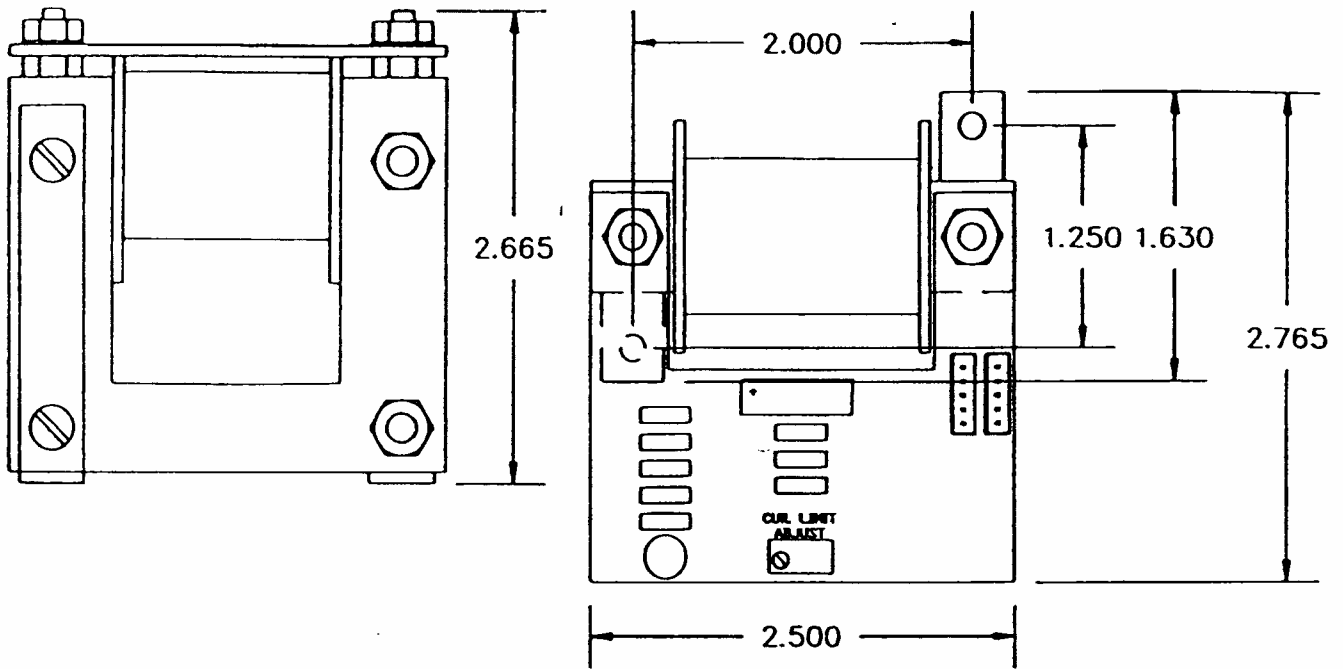


Figure 5 - OUTLINE AND MOUNTING - OVERCURRENT TRIP

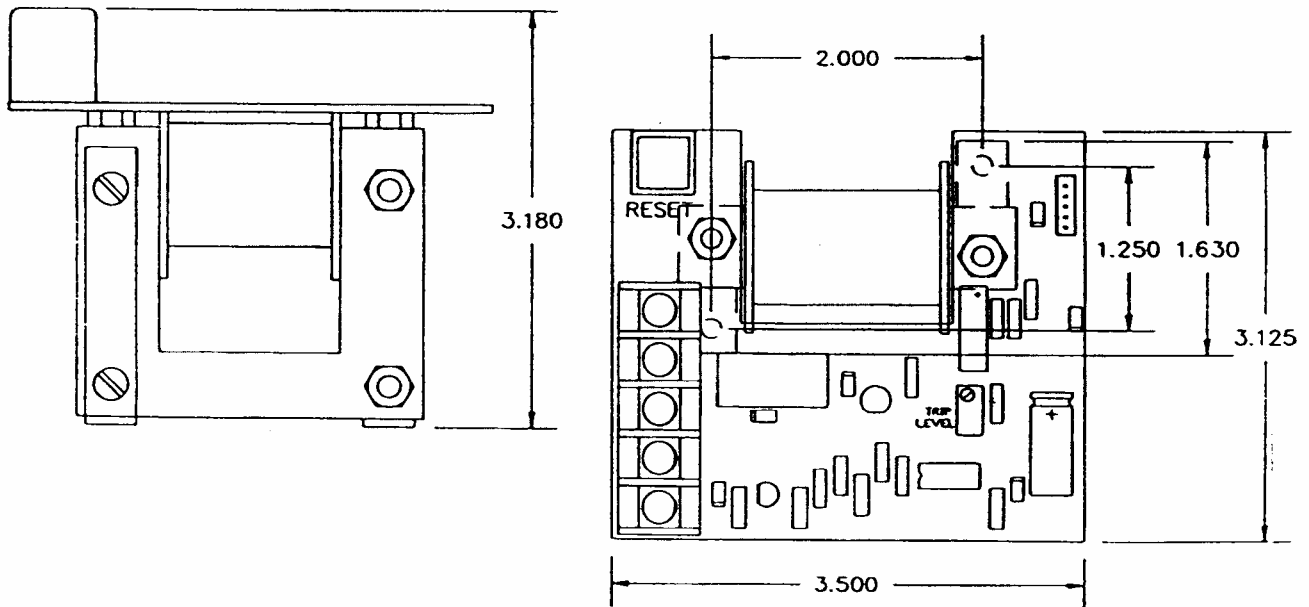
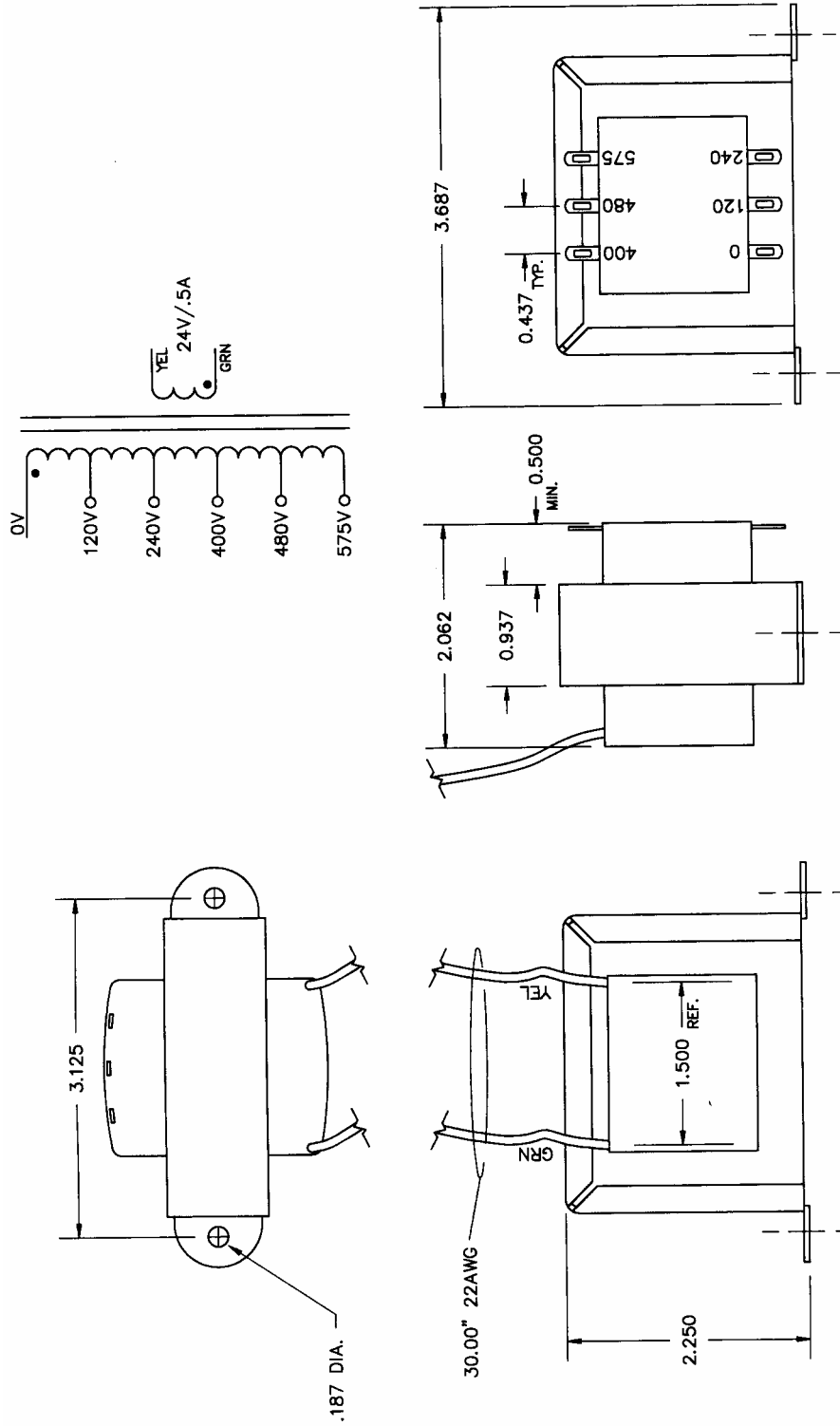
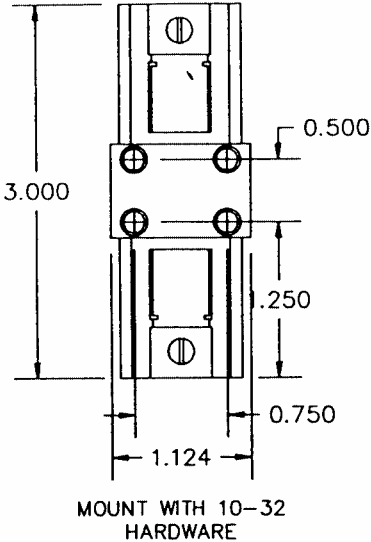


Figure 6 – 24 Vac TRANSFORMER

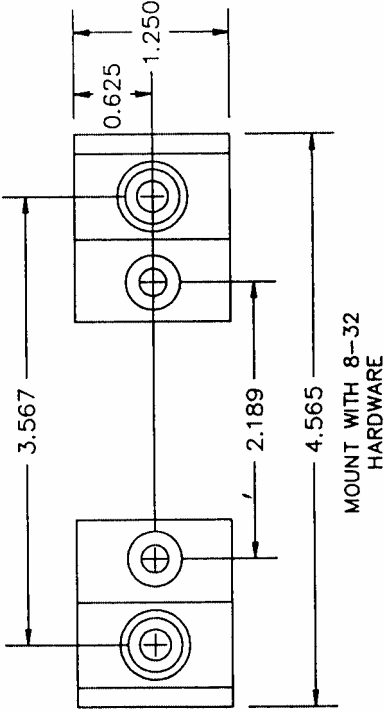




**Figure 7 – FUSE BLOCK DIMENSIONS**



**15/25 AMP**



**40/70 AMP**

## Section 3 - COMMAND SIGNAL CALIBRATION

---

### 3-1 ZERO AND SPAN ADJUSTMENTS

The Zero potentiometer has both positive and negative voltages available making it usable as a manual or zero control. By turning the Zero control clockwise the unit's output voltage will increase proportionally to the adjustment. Turning it counter-clockwise will decrease or zero the output for any non-zero based command signal.

The Span potentiometer is used to adjust the maximum output. It will adjust for either a remote manual control or a command signal input. Clockwise adjustment increases the output while counter-clockwise adjustment decreases the output. Due to some interaction between controls, it may be necessary to repeat these adjustments.

### 3-2 COMMAND INDICATOR

The Command Indicator is a green Light Emitting Diode (LED) located between the Zero and Span controls. The intensity of this LED will vary with the output of the unit. The intensity will be brighter with higher outputs and dimmer with lower outputs.

### 3-3 REMOTE MANUAL CONTROL

Start with the Zero Control set approximately at mid rotation and the Span Control set at minimum (counter-clockwise). Connect a 5K ohm remote manual control to terminals 1 (CCS), 2 (Wiper) and 3 (CW). With the unit energized and the manual control fully counter-clockwise, adjust the Zero Control until the unit is just off. Next turn the manual control fully clockwise and adjust the Span Control until the desired output voltage is reached. This procedure may have to be repeated since some interaction between the Zero and Span Controls exist.

### 3-4 PROCESS COMMAND SIGNAL

This procedure is similar to the Remote Manual Control procedure. Start with the Zero Control set approximately at mid rotation and the Span Control set at minimum. Connect the Command Signal to terminals 1 (-) and 2 (+) and then energize the unit. With the Command Signal at minimum, adjust the Zero Control so the unit is just off (zero output voltage) then with the Command Signal at full output, adjust the Span Control so the output voltage is at the desired level. Repeating this procedure may be necessary due to some interaction between the Zero and Span Controls.

## Section 4 - OPTIONS CALIBRATION

---

**NOTE: The Zero and Span Controls should be adjusted prior to connecting or adjusting either the Current Limit or the Overcurrent Trip. The Current Limit and Overcurrent Trip options have been factory set, if the adjustments have not been changed, then the following adjustments may not be needed. The current transformer may need more than one (1) primary turn. See note below.**

### 4-1 CURRENT LIMIT (OPTION CL)

Prior to energizing the PF1, adjust the Current Limit control fully clockwise. Next with the PF1 operating at full output and the proper load connected turn the Current Limit control counter-clockwise until the desired maximum output is attained.

**NOTE: Current transformer wiring:  
15A unit requires 3 primary turns.  
25A unit requires 2 primary turns.  
40A unit requires 1 primary turn.  
70A unit requires 1 primary turn.**

### 4-2 OVERCURRENT TRIP (OPTION OC)

As with the Current Limit, insure that the Overcurrent Trip control is fully clockwise. With the PF1 operating at full current adjust the Overcurrent Trip control counter-clockwise until the unit shuts off. Readjust the control clockwise a small amount and press the Reset button. The Overcurrent Trip should be adjusted properly at this point.

The Overcurrent relay output (Form C) and a remote reset input is included on the overcurrent trip option. The normally open (N.O.) contact is on terminals 2 & 3 and the normally closed (N.C.) contact is on terminals 1 & 2. A remote reset pushbutton (N.O.) may be connected to terminals 4 & 5.

**NOTE: Make the following changes:  
15A unit remove R1 & R2.  
25A unit remove R2.  
40A unit no change.  
70A unit no change.**

NOTE: Use a RMS ammeter to monitor the output current. Some load must be present when making adjustments.

## Section 5 - MAINTENANCE

---

### 5-1 ENVIRONMENTAL CONCERNS

Always verify that the PF1 is mounted in a clean, dust free environment. Clean the heat sink and printed circuit board periodically so no dust and/or dirt accumulates on the unit. Dust and/or dirt on the heat sink fins can prevent proper airflow causing overheating of the semiconductors. Conductive dust and/or dirt can cause shorts or arcing which can cause damage to the unit.

### 5-2 LINE/LOAD POWER CONNECTIONS

Periodically turn the power off to the PF1 and check for corrosion and tightness of the power connections. If any corrosion is evident, clean the cable and connector and reconnect making sure to tighten to 25 in-lbs.

### 5-3 TROUBLESHOOTING TYPICAL SYMPTOMS

Any one of the following symptoms usually indicate a problem with the PF1:

- 1. Symptom** - No output.  
**Cause** - Open fuse or no 24 VAC control power.  
**Solution** - Disconnect the input power and check the fuse, replace the fuse if faulty. If the fuse checks ok, verify the 24 VAC control power on terminals 4 & 5. If neither of these solve the problem, contact the factory.
- 2. Symptom** - Full output regardless of command signal input.  
**Cause** - Shorted SSR module or defective firing circuit.  
**Solution** - Readjust the zero and span controls. If this does not help, disconnect the input power and remove the firing circuit. Re-energize, if the output is on full, replace the SSR module. If the output is off, then most likely the firing circuit is defective. Consult the factory.
- 3. Symptom** - The unit is not variable fro 0 to full output.  
**Cause** - Defective firing circuit.  
**Solution** - If neither of the first two symptom/solutions are the answer, order a replacement firing circuit from the factory.

## Section 6 - SERVICE AND SPARE PARTS

---

### 6-1 CUSTOMER SERVICE

If you have operational problems which cannot be resolved using this manual, please contact the Service Department at AMETEK HDR. Our normal work hours are 8 a.m. to 3:30 p.m., U.S.A. EASTERN TIME ZONE, Monday through Friday.

**TELEPHONE:** 1-888-PWR-CNTL (797-2685) OR 614-308-5500.

Our answering machine at 614-308-5500 will answer after hours and we will return your call the next working day.

**FAX:** 614-308-5506. 24 hours per day automatic answering.

### 6-2 SPARE PARTS

Inside Sales should be contacted for any spare parts orders whether routine or emergency during normal working hours. All after hours requirements should be called in on our 614-308-5500 answering machine. Please have as much information available as possible pertaining to the model number, serial number, order number and parts required. A purchase order number should be available.

### 6-3 WARRANTY

AMETEK HDR warrants that the equipment delivered will be free from defects in workmanship and material for a period of five years from the date of shipment. AMETEK HDR will repair or replace, at AMETEK HDR's option, any part found defective during proper and normal use, provided that written notice of the nature of the defect is received by AMETEK HDR within the five year warranty period and that the customer returns the part to AMETEK HDR freight paid both ways. This warranty is not transferable by the initial end user.

AMETEK HDR MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED (INCLUDING, WITHOUT LIMITATION, MERCHANTABILITY, FITNESS FOR PURPOSE, OR AGAINST INFRINGEMENT OF ANY PATENT) EXCEPT AS EXPRESSLY PROVIDED HEREIN.

THE REMEDY OF REPAIR OR REPLACEMENT IS CUSTOMER'S SOLE AND EXCLUSIVE REMEDY AND WILL SATISFY ALL OF AMETEK HDR'S LIABILITIES, WHETHER BASED ON CONTRACT, NEGLIGENCE, TORT, PRODUCT LIABILITY, STRICT LIABILITY, OR OTHERWISE. IN NO WAY WILL AMETEK HDR BE LIABLE FOR INCIDENT OR CONSEQUENTIAL DAMAGES, NOR IN ANY EVENT SHALL HDR'S LIABILITY EXCEED THE UNIT PRICE OF ANY DEFECTIVE PRODUCT OR PART.

**EC DECLARATION OF CONFORMITY**

**WE:**           **AMETEK HDR POWER SYSTEMS**  
3563 Interchange Road  
Columbus, Ohio 43204 - USA

**Declare under our sole responsibility that the products listed below and bearing the CE label:**

**Type:**   SCR power controllers with the following model designations and current ratings:

ZF1, ZF2, ZF3, PF1, PF3 - 15, 25, 40, 60, 70, 90, 120, 180,  
225, 350, 500, 650, 800, 1000 and 1200A.  
SHZF1, SHPF1 - 15, 30, 40, 60, 70, 90 and 120A  
SHZF2, SHZF3, SHPF3 - 15, 25, 30, 60, 90, 120, 180 and 225A  
SCZF1, SCPF1 - 15, 25, 40 and 65A  
All applicable options

**To which this declaration relates is in conformity with the technical requirements of the following documents:**

<b>Title:</b>	Low-voltage switchgear and controlgear	<b>No.</b>	IEC 947-5-1
		<b>Year:</b>	1990-03
	Low Voltage Directive	<b>No.</b>	IEC 73/23/EEC
		<b>Year:</b>	1973-02
	Degrees of protection provided by enclosures (IP Code):	<b>No.</b>	IEC 529-2nd Edition
		<b>Year:</b>	1989-11
	Electromagnetic Compatibility (EMC)	<b>No.</b>	IEC 89/336/EEC
		<b>Year:</b>	1989-05

<p style="text-align: center;"><b>Warning</b> All phase-fired (PF) controllers will require line filters and possibly shielded cables to meet the EMC requirements.</p>
---

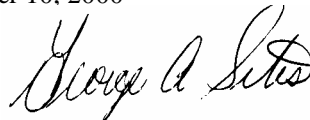
(Environmental protection classification IP00 - for mounting inside an enclosure)

**Note:**           Characteristics are according to mfg specifications.

**Name:**   George A. Sites

**Title:**     Vice President

**Date:**    November 10, 2000



**Signature:**

Declaration written in accordance with I.S.O. - IEC/22 Guide