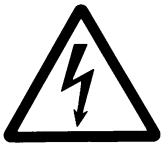
INSTALLATION, OPERATION and MAINTENANCE MANUAL

Three Phase Load Unbalance Alarm & Shorted SCR Alarm

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



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AMETEK®
HDR POWER SYSTEMS

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

George A. Sites
Vice President

GAS/be

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Page	Change	Revision	Date
last	1	**A**dded CE Declaration of Conformance and drawings	8-00
last	2	Added EMC to CE Declaration	11-00

NOTE: ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.

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ILLUSTRATIONS

Section 1 - DESCRIPTION

1-1 MODELS COVERED

This manual covers the Three Phase Load Unbalance Alarm and optional Shorted SCR Alarm. It can be used with any of the AMETEK HDR three-phase SCR Power Controllers..

1-2 GENERAL DESCRIPTION

The 3-Phase load Unbalance Alarm is a versatile, easy to use accessory for monitoring three phase currents. The alarm is available for both the zero-fired and phase-fired, 3-phase SCR power controls.

The unbalance alarm monitors three currents using three 5 amp current transformers (CTs). If the load currents become unbalanced by more than the preset percentage, a Form C relay is actuated. Diagnostic indicators are also provided to indicate operating conditions.

The load unbalance required to trigger an alarm is switch selectable and may be quickly reconfigured in the field. Typical usage requires no field calibration, although precision trimming adjustments are included to enhance the circuit's sensitivity if small current unbalances are to be detected under controlled conditions.

Five light emitting diodes (LEDs) are provided to give a visual indication of the board's operation.

An available Shorted SCR Alarm mounts directly to the Unbalance Alarm or can be used separately. This circuit monitors each of the 3 SCR pair's voltage drop and detects when an SCR is shorted. A Form C contact is actuated. Light Emitting Diodes indicate which SCR has failed.

1-3 APPLICATIONS

The 3-Phase Load Unbalance Alarm is a good method for detecting unbalanced loads in a normally balanced load whether the load configuration is Delta or Wye connected.

1-4 OPTIONS

Three options are available for the 3-Phase Load Unbalance Alarm: Shorted SCR Alarm, Mounting Panel and Current Transformers (CTs).

The Shorted SCR Alarm board is a "piggy-back" board that mounts on the Unbalance Alarm. It monitors the voltage drop across each of the three SCR pairs and determines if one is shorted. A Form C relay output is available for customer use.

The mounting panel is a must if the unbalance alarm board is to be mounted external of the SCR power control.

Current transformers are required for each of the three phases. Standard ratio current transformers with 5 amp secondaries will drive the load unbalance alarm board.

1-5 OPERATION

The circuit contains three True RMS current converters that output three DC voltages that represent the RMS AC currents. The logic circuit then selects the highest of the three load currents and computes a percentage of that current as determined by the DIP switch setting. The available settings are 97.5, 95, 92.5, 90, 87.5, 75 and 50%. The two lower currents are then compared to this alarm setpoint. If either, or both are below this alarm value, then the green LED associated with that line will go out and after a short delay, the red LED and relay will energize.

If the lower two currents are above the selected setpoint, then all three green LEDs will be on, indicating a normal condition, and the red alarm LED and relay will not be energized.

Since current must be present to determine whether the three currents are equal, the alarm must be disabled when the controller approaches very low power levels. When the highest current falls below 15 to 20% of the current transformer's rating, the alarm is disabled, the amber "Insufficient Current" LED lights, the red LED and relay are disabled and the status of the green LEDs is indeterminate.

Selecting an appropriate percentage of load unbalance using the DIP switches is the only setting most users will ever need to make and might best be illustrated by example.

EXAMPLE

Assume a 3-phase, 120 amp controller is being used to control 12 heating elements of equal size with 4 elements connected in parallel of each leg. Assume that the controller is set at approximately 100 amps per leg. Each of the four elements on each leg draw approximately 25 amps each so that the loss of one element will drop the current to 75 amps or 75% of full current. The easiest way to select the alarm setpoint is to pick the percentage that is

half way between 100% and 75%. In this case 87.5% would be appropriate.

To estimate the exact function of the circuit, assume that the exact currents on the three legs are 100 amps, 99.5 amps, and 99 amps (using a precise, true RMS meter), The circuit will select the highest current, 100 amps, and compute 87.5% of that value, or 87.5% amps. If one element of the 99.5 amp leg opens, the current on that leg will fall to about 74.6 amps. Since this will be below the 87.5 amps alarm setpoint, the circuit will signal an alarm condition. The actual current on the low leg that will trigger an alarm can always be calculated by measuring the three leg currents and multiplying the highest current by the percentage selected by the DIP switch. The circuit constantly recalculates the allowable current unbalance. If the command signal drops so that the highest current is 50 amps, the allowable low current would be 87.5% of 50 amps, or 43.75 amps. If one of the four heating elements fails, the current on that leg will fall to about 37.5 amps (75% of 50 amps) and the alarm will be activated.

1-6 DIAGNOSTIC INDICATORS

Five diagnostic indicators are provided on the Unbalance Alarm to help determine the status of the load unbalance board. There are three green LEDs, one amber LED and one red LED. The three green LEDs indicate the three phase currents are above the alarm setpoint, the amber LED indicates that the line currents are insufficient to determine a load failure and the red LED indicates the alarm condition. Each LED is labeled on the board.

Four diagnostic indicators are provided on the Shorted SCR Alarm to help determine which SCR has failed. The three green LEDs indicate the failed SCR and the red LED indicates an alarm has taken place.

Section 2 - INSTALLATION

2-1 MOUNTING

If the unbalance alarm is used as an integral component in an SCR power control, no additional mounting requirements exist other than the current transformers (CTs) on some models; however, if the alarm is used in a stand-alone configuration, then the unit must be mounted by the user. In addition, a 24 VAC control transformer is supplied and must be mounted close by.

2-2 WIRING

If the alarm is integral to the power control, then the only user connections are to the relay output and the CT inputs. The line 1 current transformer connects to terminals 51 & 52, line 2 connects to terminals 53 & 54 and line 3 connects to terminals 55 & 56. The N.O. relay contacts are on terminals 58 & 59 and the N.C. relay contacts are on terminals 59 & 60.

For the stand-alone configuration, the 24 VAC transformer must be connected to terminals 70, 71, & 72 with the center tap on terminal 71. Once these connections are made, the board should be fully functional.

Section 3 - CALIBRATION

3-1 UNBALANCE LEVEL ADJUSTMENT

As mentioned before, the easiest way to select an appropriate DIP switch percentage is to calculate the percentage load drop that will result if one element opens, then pick a percentage half way between that percentage and 100%. The following table illustrates that calculation.

TABLE 1
DIP SWITCH SETTINGS

Number of Equal Elements/Leg	% Current Drop If One Opens	% Switch Used
1	100%	50%
2	50%	75%
3	33.3%	75 or 87.5%
4	25%	87.5%
5	20%	90%
6	16.7%	90 or 92.5%
7	14.3%	92.5%
8	12.5%	92.5%
9	11.1%	95%
10	10%	95%

CAUTION

If you are attempting to use a 3-phase current unbalance alarm with more than 3 or 4 heating elements, take special notice of the following section.

3-2 PRACTICAL IMPLICATIONS

Notice in the above chart that the drop in current and the needed alarm setpoint approaches 100% as the number of elements increase. You must be aware that there are a number of factors that could cause a current unbalance, or perceived unbalance, apart from the actual loss of one heating element. Those factors may be actual current unbalances caused by the physical realities of the application, or errors in measurement.

Actual current unbalances always exist. Since 3-phase power controllers turn on each leg for identical amounts of time, the voltage output unbalance will track any line voltage unbalance. Better controllers compensate for average line voltage fluctuations,

but not voltage unbalances. If there is a 5% unbalance in line voltages, the voltage output of the controller will have a 5% unbalance; and since current is directly proportional to voltage (with identical load impedances), the output currents will have a 5% unbalance. This factor alone is one of the most significant when one considers how many heating elements to monitor with one unbalance alarm circuit. The line voltages may be fairly well balanced at one part of the day when the alarm is originally tested, but you must take into consideration the maximum line voltage unbalance over a period of days, weeks and months.

The actual resistances of all of the heating elements must be considered. How well matched are the resistances when new? How much change will occur with age and when new elements are combined with old at a later time? How much change is created if equal elements are operated with equal voltages, but at different temperatures (due to unequal thermal load)?

The above factors are dominant, but some additional error will always be introduced by any measuring circuit. The absolute accuracy and linearity of the current transformers and the measuring electronics used will introduce some error.

Under fixed conditions, all types of errors can be trimmed out using the three gain potentiometers, P1, P2 and P3. The output of the three true RMS converters can be measured using a precise DC digital meter at test points TP1, TP2 and TP3 referenced to circuit common (terminal 64). Since the current is represented by a DC voltage at this point, any precision DC meter can be used. When a 5 amp current transformer is operating at full load on each input, the voltage at each test point will be about 3.01 VDC. If there is any difference in this voltage, it can be trimmed out by increasing the gain of the two lower signals to match the highest signal. The potentiometers allow an increase of up to 16% on the measured signal. Under the most controlled conditions, the circuit could be used up to the maximum switch setting of 97.5%.

NOTE: Under normal usage, the gain potentiometers, P1, P2 and P3, should always be fully counter-clockwise. On a new board, always verify that the potentiometers are full counter-clockwise when setting the DIP switches. Only adjust these potentiometers if you are measuring the test points and trimming out current errors under controlled conditions.

If you are only using 3 or 4 heating elements per leg, these factors are less significant compared to the large current change when one heater opens. As the number of heaters increase, it becomes increasingly important to consider all of these factors.

If you are attempting to monitor a large number of heaters using a very sensitive setting, the above factors could either cause a false alarm, or prevent the loss of one heater element from being detected.

If a large number of heaters need to be monitored, but it is impractical to control all of the above factors, one alternative is to use on 3-phase unbalance alarm for each set of 3 or 4 heaters.

3-3 OPTIONAL SHORTED SCR ALARM

The Shorted SCR Alarm, as mentioned, is a piggy-back board and does not require any calibration. Four LEDs are provided to help you determine the operation of the SCRs. Three green LEDs are lit when the SCRs are not shorted. If an SCR shorts, the respective green LED will go out and the red alarm LED will light and the Form C relay will energize. The relay output is on terminals 81 (N.O.), 82 (Common) and 83 (N.C.). These are the only customer connections.

The Shorted SCR Alarm can be used with or without the Unbalance Alarm.

Section 4 - MAINTENANCE

4-1 ENVIRONMENTAL CONCERNS

Always verify that the three phase load unbalance alarm is mounted in a clean, dust free environment. Clean the printed circuit board periodically so no dust and/or dirt accumulates on the unit. Conductive dust and/or dirt can cause shorts or arcing, which can cause damage to the unit.

4-2 STATIC PRECAUTIONS WHEN SERVICING

When servicing the 3-phase unbalance alarm's printed circuit board (PCB), damage can occur due to static electricity. Always use a wrist strap grounded through a 1 megohm resistor. Transport the PCB in a static shielding bag. Caution in handling the PCB can help prevent any further damage to the PCB.

If you are not familiar with static precautions, consult the factory for additional details.

4-3 TROUBLESHOOTING TYPICAL SYMPTOMS

If it appears to be false tripping, refer to Section 3-2 on practical implications. If no solution is found, return the unit to the factory.

Section 5 - SERVICE AND SPARE PARTS

5-1 CUSTOMER SERVICE

If you have operational problems which cannot be resolved using this manual, please contact the Power Products Service Department at AMETEK HDR. Our normal work hours are 8:00 a.m. to 5:00 p.m., U.S.A. EASTERN TIME ZONE, Monday through Friday.

TELEPHONE: 1-888-797-2685 OR 614-308-5500.
Our answering machine will answer after hours and we will return your call the next working day.

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

5-2 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.

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Figure 1 – Block Diagram

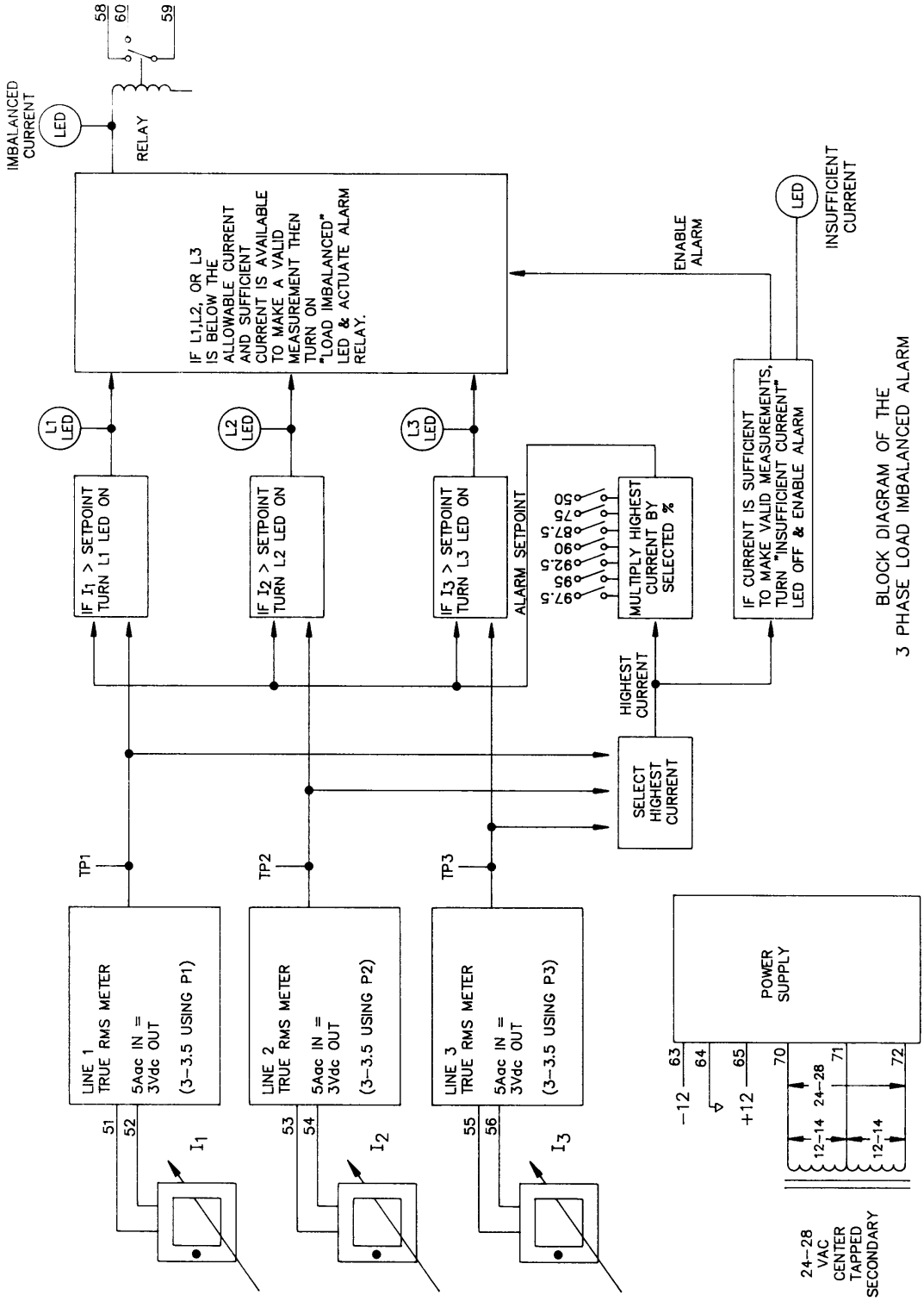


Figure 2 – Stand-Alone Wiring Diagram

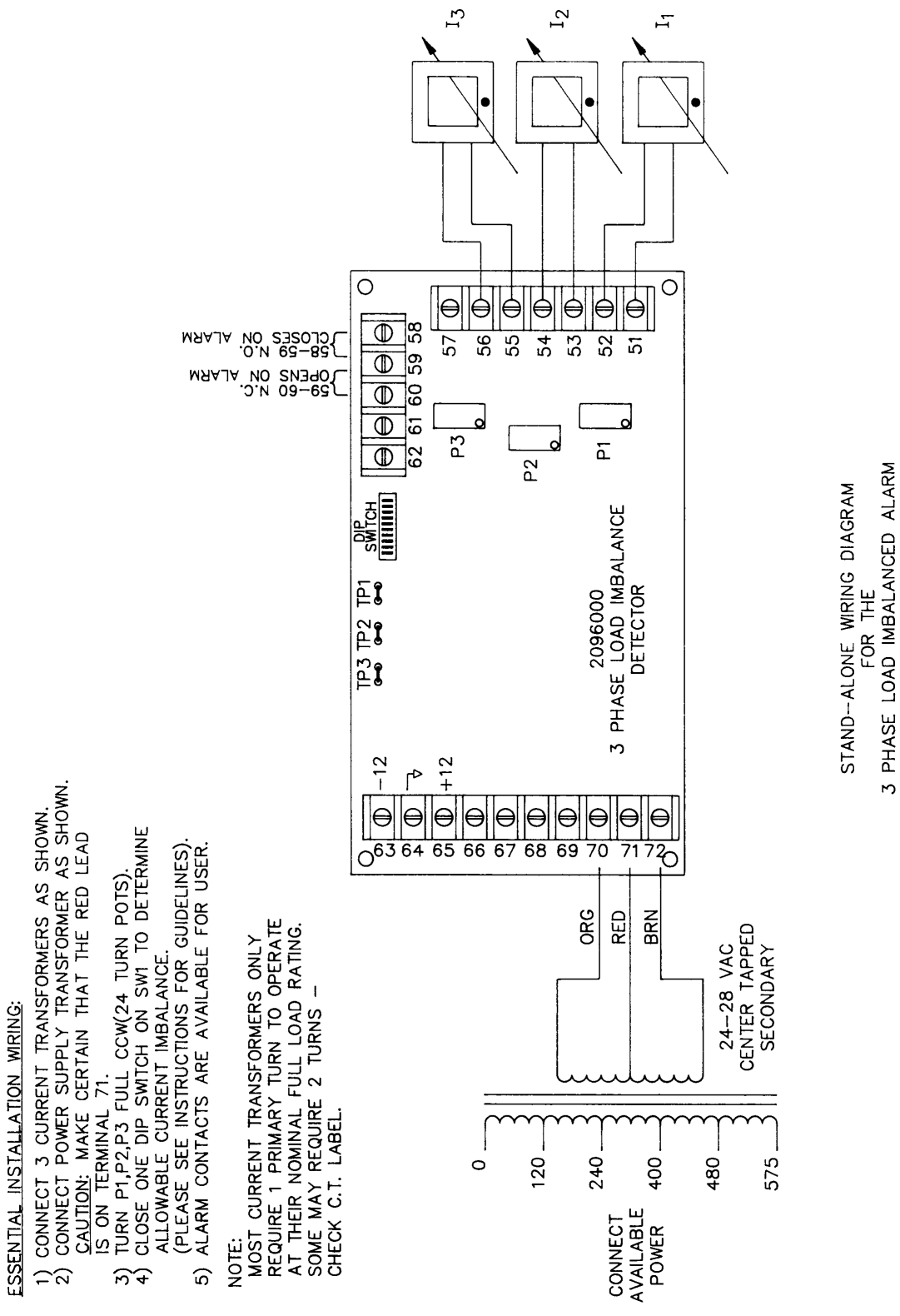


Figure 3 – 24 Vac Control Transformer

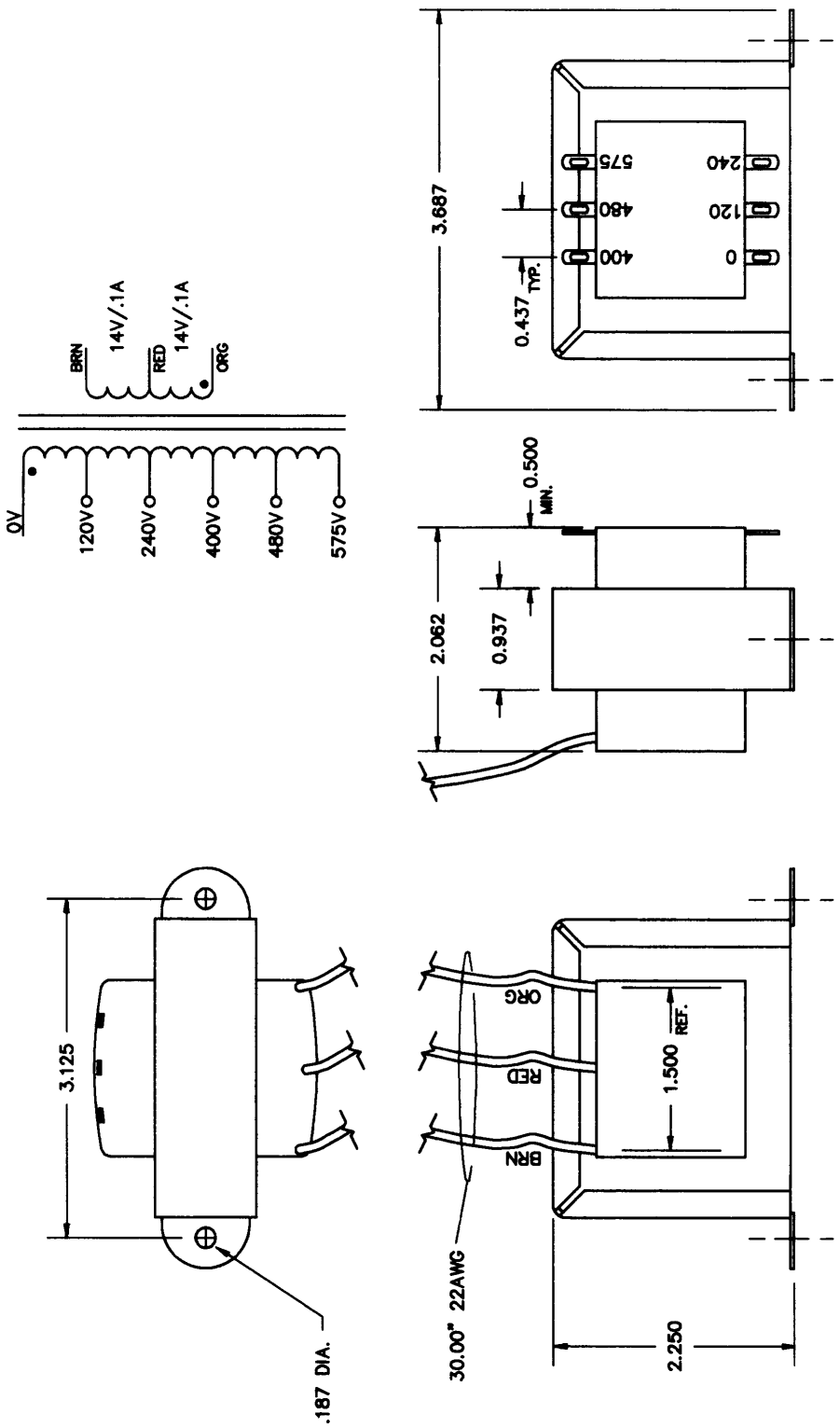
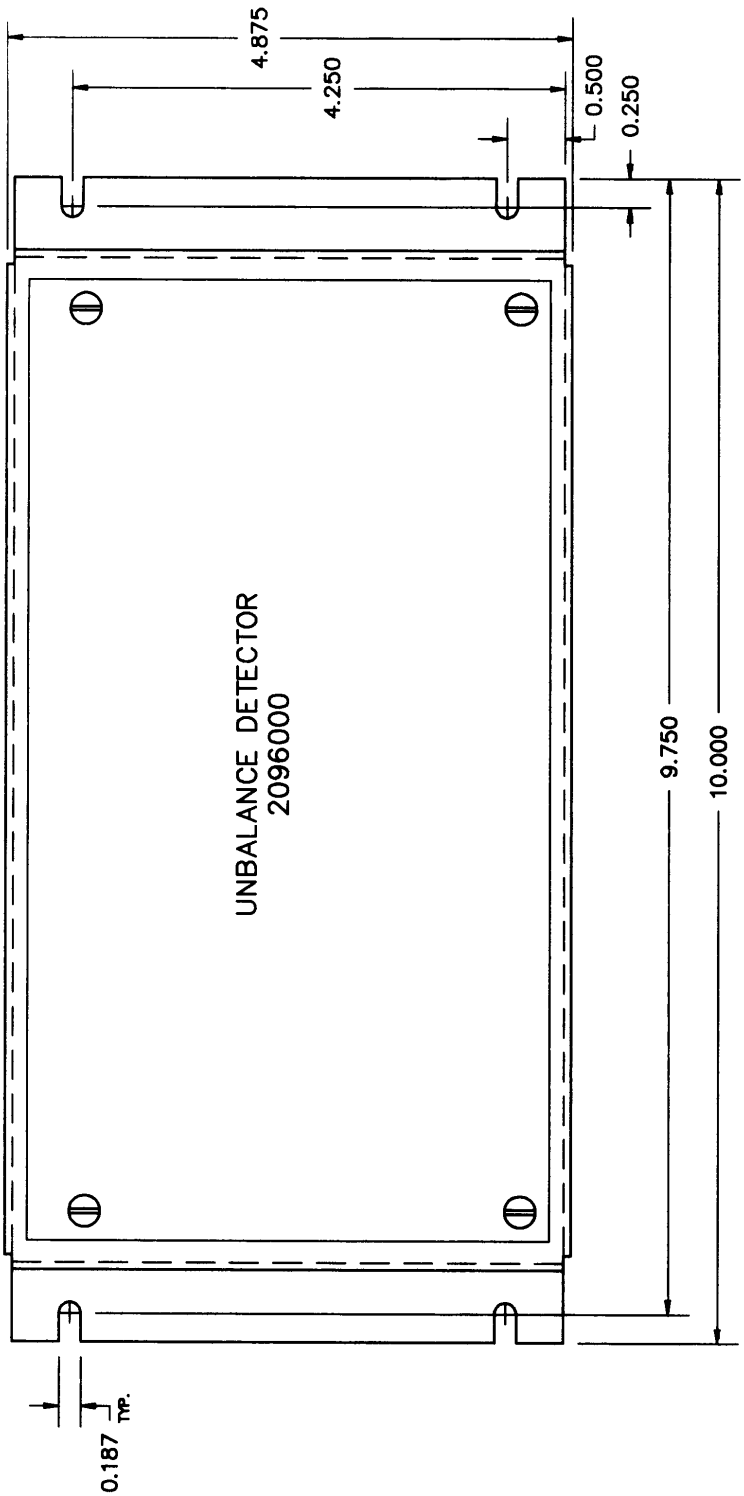


Figure 4 – Stand-Alone Outline Dimensions



AMETEK®
HDR POWER SYSTEMS

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:

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

Warning
All phase-fired (PF) controllers will require line filters and possibly shielded cables to meet the EMC requirements.

(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