



## A3Z OPERATING MANUAL

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NRNT FILE # E350716

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## INTRODUCTION

Congratulations on your purchase of an Avatar A3Z series power control. This manual was designed to assist you in installing, operating and maintaining your new power control in a safe manner. Upon reading and following the instructions in this manual, you will be rewarded many years of trouble free service from your new A3Z. If reading manuals is not for you, it is essential that you at least read the captions followed by the safety warnings; they are located through out the manual and are very easy to identify.



indicates important installation, operating, servicing instructions



indicates dangerous voltage present and risk of electric shock

## FEATURES

- UL 508 listed, CE pending
- compact and light weight
- 100 % solid state circuitry
- over-rated SCR power modules
- over-sized heat sink
- full power ratings up to 50°C (122°F) ambient temperature
- optically isolated 4-20 mA input standard
- variable time base provides high resolution control
- electrically isolated chassis and heat sinks to 600 Amps
- gold alodined chassis and heat sink
- I<sup>2</sup>T fusing and MOV protection on all power SCR's
- SanRex, SemiKron, International Rectifier and Fairchild semiconductors
- double sided FR4 VO-94 rated glass epoxy PCB's

## DESCRIPTION

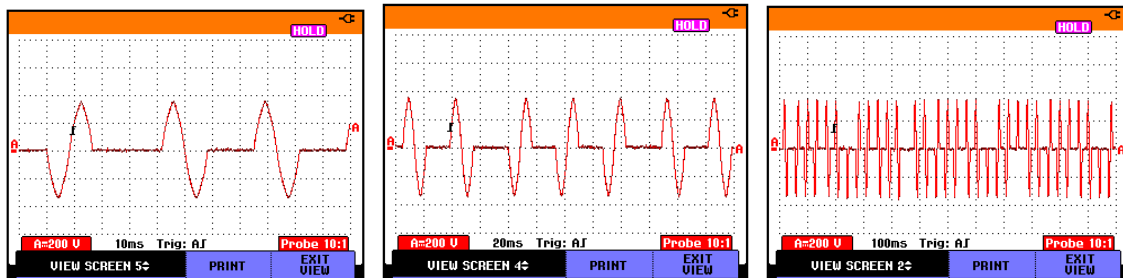
The A3Z is a proportional, zero voltage switched, two leg controlled, three phase power controller capable of delivering 0-99% of the applied line voltage to directly connected electric heaters. It will not control high inrush loads (tungsten lamps), transformers or motors. This is accomplished by time proportionally switching SCR's on and off. Modular construction allows for simple and solderless field serviceability. There are four field replaceable items:

- printed circuit board
- fuses
- SCR packages
- MOV's (metal oxide varistors)

## THEORY OF OPERATION

The standard input signal (4-20mA) is applied to the blue input terminal block, processed and fed to optical couplers. The output of each opto coupler controls its respective SCR. An IPT fuse connected in series with the input provides over current protection in the event of external wiring shorts, or too large of a heater load. Additionally, a MOV (metal oxide varistor) is connected in parallel with each SCR, providing voltage spike protection to the controller.

**Zero voltage switching** controls proportionally turn on and off each full cycle of the power line. By varying the number of AC power line cycles, the SCR provides power to the heaters. With a variable time base, the optimum number of cycles turned on/off is achieved. This method produces less RFI line noise than phase angle fired SCRs. Power factor is 100%, while harmonic distortion is limited. Charts below, left and center show 25% power output using variable time based zero voltage switching. The chart on the right shows 50% output.



Avatar Instruments variable time base SCR firing. Note how half cycles can be turned on and off providing 0.08 second resolution on 60Hz power lines.

## INSTALLATION



**WARNING: FIRE HAZARD!!** Even the best electronic components CAN FAIL SHORTED, KEEPING FULL POWER ON! Provide a completely SEPARATE (redundant) OVER TEMPERATURE SHUTDOWN MEANS to switch power off if safe temperature is exceeded.



**WARNING: HIGH VOLTAGE!!** This control must be installed in a GROUNDED enclosure. Provide a safety interlock on door to remove power before gaining access to device.



This controller must be installed by a qualified electrician in accordance with any and all local and national electric codes including NEC and any other applicable codes.

First things first, do you have the proper controller for your application? Check the Avatar serial tag and verify the correct voltage/ ampere ratings and input control signal for your application.

After verifying you have the proper controller, the next most important item is adequate cooling/ ventilation. All Avatar power controllers are rated to deliver full power to their respective load(s) at an ambient temperature not to exceed 50°C. Use this formula to calculate the minimum size enclosure required.

**number of SCR's X 1.2 VOLTS X MAXIMUM HEATER CURRENT = TOTAL WATTS DISSIPATED**

***example: 2 x 1.2 x 60 amps = 144 watts that the power controller has to dissipate***

Heat is the worst enemy to any electrical device, including power controllers. Orient heat sink fins and chassis channel in a vertical position, providing adequate air flow above and below unit. The cooler the unit operates, the longer it will provide seamless, reliable service.

The dryer and cleaner, the better! Over time, a combination of moisture and contaminants will lead to failure due to corrosion and insulation breakdown (arcing and sparking). If the controller absolutely must be installed in a harsh and corrosive environment, it is recommended that an air conditioned NEMA 4X or similar type of environmentally sealing enclosure be used during installation.

## ELECTRICAL CONNECTIONS



Again, this work must be performed by a qualified electrician and in accordance with any and all local and national codes that may apply. Please refer to the wiring diagrams (pgs. 10 - 18).



To reduce the risk of electrocution, **TURN ALL POWER OFF** to wires that will be connected to the power control before making any connections. The A3Z controller be installed in a metal enclosure for protection against electrocution. 1200 amp controller heat sinks **are on line voltage!!**

### **AC POWER INPUT:**

Power input (AC MAINS) is connected to lugs labeled "LINE 1" and "LINE 2"(see fig. 1 for correct wire size and torque specs.) Line 3 is directly connected to third leg of heater load.

### **LOAD CONNECTION:**

Load connections are equally simple; connect the load/ heater to lugs labeled "HTR 1" and "HTR 2" (see fig. 1 for correct wire size and torque specs).

**NOTE:** For open delta or 4 wire "wye" connected loads use Avatar model A6Z, 3 phase, 3 leg, 6 SCR control.

The A3Z is capable of driving unbalanced loads, but it is highly recommended to equally **BALANCE LOADS BETWEEN ALL THREE PHASES** (to provide consistent tracking between all three phases).

Check heater resistance to insure heater current will not exceed fuse ratings. Controllers DO NOT blow fuses - excess heater current does. Check for heater wiring shorts, shorted load connections will instantly blow expensive fuses.

### **INPUT CONTROL SIGNAL:**

Connect the control signal to the blue terminal block labeled "4-20mA INPUT" observing proper polarity (positive to "+" and negative to "-").

### **THERMOSTAT for FAN FAILURE:**

On all Avatar SCR Controls 150 Amps and above, fans are used to cool the SCR heat sinks. Avatar mounts a Snap-disc thermostat to the heat sink. If the fan fails, air is blocked or a safe ambient temperature is exceeded, the thermostat will activate. This thermostat can be used to break 4-20mA input signal, trigger alarms or shut down a power contactor. See wiring diagram for thermostat wiring (pgs. 16, 17 and 18).

## OPTIONS

**"R"** RELAY OPTION: For 10-32 VDC or 120VAC Signal Input to turn A3Z into On/Off controller, use "R" relay option. Call out as **"-R32"** or **"-R120"**

**"R/S"** SLAVE OPTION: To slave A3Z to another SCR control, use RELAY/SLAVE Option. Call Out as **"-RS"** to part number. Also inform Avatar of the line/trigger voltage you intend to use.

For manual control use Avatar model **MAP**. Isolated Potentiometer 4-20mA signal card.

For LINEAR 0-5 or 0-10 VDC Analog Signal use Avatar MAI milliamp interface card.

**MAI-05V** takes a 0-5VDC signal input and outputs 4-20mA.

**MAI-10V** takes a 0-10VDC signal input and outputs 4-20mA.

For third Leg Fusing add **"-3RD"** to part number. All fuses come mounted to chassis w/lugs. Higher amp fuse (over 100A) come with block & lugs.

## WARRANTY

All Avatar Instruments products carry a full five year, warranty from date of purchase, parts and labor warranty against component failure and defects in workmanship. In the event your controller fails to perform properly, **contact Avatar to obtain a return authorization number**. Controllers sent to Avatar for warranty service that have no apparent defect will be treated as a standard repair and a \$50.00 charge will be applied. Avatar will repair or replace any unit that failed due to defective parts or assembly. This warranty DOES NOT cover damage due to shipping, abuse, misapplication or operation beyond specified rating. Furthermore, fuses and improperly fused SCR's are NOT COVERED by this warranty. Avatar is not responsible for any subsequent or other damage experienced in use of this device.

## SPECIFICATIONS

INPUT VOLTAGE:..... see model description  
 OUTPUT VOLTAGE:..... 0-99% of input voltage  
 CURRENT CAPACITY:.....see model description  
 CONTROL SIGNAL:.....4-20mA @ 6 volts DC  
 4-20mA INPUT TERMINAL TORQUE RATING 5 in-lbs  
 INPUT IMPEDANCE:.....300 ohms

POWER DISSIPATION (Watts):.....2.4 x maximum current  
 COOLING: 30-100 amp.....convection  
           150-1200 amp.....fan(s) 120VAC  
 THERMOSTAT:..... 190°F (fan cooled units only)  
 DIMENSIONS:.....see dimensional drawings  
 WEIGHT:

	<b>NET</b>	<b>SHIPPING</b>
30 amp.....	7 lbs.	9 lbs.
40-60 amp.....	8 lbs.	11 lbs.
80-100 amp.....	13 lbs.	14 lbs.
150 amp.....	19 lbs.	30 lbs.
200-350 amp.....	38 lbs.	48 lbs.
600 amp.....	48 lbs.	69 lbs.
1200 amp.....	180 lbs.	230 lbs.

<b>Wire Gauge and Torque Specifications for 90°C Temp Wire</b>			
Power Control Maximum Current Rating/ Circuit	Copper Wire Only MINIMUM AWG	Wire Lug Torque Spec. (lbs./in.)	Lug Size
30A	10AWG	35	10 AWG
40A	8AWG	40	1/0 - 14
60A	6AWG	45	1/0 - 14
80A	4AWG	45	1/0 - 14
100A	3AWG	50	1/0 - 14
150A	1AWG	180	250MCM - 6
200A	3/0 AWG	250	250MCM - 6
225A	3/0 AWG	250	250MCM - 6
250A	4/0 AWG	250	250MCM - 6
350A	TWO: 4/0 AWG	250	TWO: 250MCM-6
600A	TWO: MCM 350	325	TWO: 600MCM-2
1200A	FOUR: MCM 350	375	FOUR: 600MCM-2

fig. 1

## TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE	POSSIBLE SOLUTION
Heaters do not heat up	no power to A3Z	verify correct input voltage between the three "LINE" lugs on A3Z.
	blown fuses in A3Z	check for heater and wiring shorts, check current rating on heaters and replace fuses as necessary. will blow fuses on tungsten lamps or transformers
	no control signal to A3Z	verify 4-20mA signal is hooked up correctly (positive to "+" and negative to "-") on the source and A3Z.
	defective heaters	check for output voltage between the three "HTR" lugs. If voltage is present, check wiring to the heaters and the actual heaters
	defective source	measure the output of the source (temperature controller, PLC, etc.) by placing a milliamp meter in SERIES with the signal wires.
Heaters on one leg are on all the time, others 25- 50%	short to ground, sneak path in between lines	Heater or power wires are shorted to ground. Third leg (uncontrolled) is conducting. Use amp probe to find where current draw is going. Use meg-ohm meter to find short to ground or in between lines.
Heaters are on full all the time	incorrect source signal	verify 4-20mA signal varies from 4-20mA
	shorted SCR's in controller	with power applied, measure voltage drop across "LINE 1" and "HTR 1", if voltage reading is less than one volt, the associated SCR is bad. Perform same test on "LINE 2" to "HTR 2"
Process will not stabilize, control signal oscillates	incorrect temperature control tuning, slow temperature sensing	re-tune temperature control, use faster sensor, place sensor closer to process



## A3Z SERIES SCR POWER CONTROLLERS

### ORDERING CODES

**A3Z** - \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_  
          **Voltage**    **Amperes**        **Options**        **Options**

#### VOLTAGE DESIGNATIONS

(48) 120-480 VAC 50/60Hz\*

(60) 575-600 VAC 50/60Hz

\*The A3Z-48-xxx replaces all older versions with lower voltage designations.

#### LOAD IN AMPS:

30, 40, 60, 80, 100, 150

200, 225, 250, 350, 600, 1200

#### OPTIONS:

**Thru-hole Mount (only on 40, 60, 80 & 100 Amp units). Add – TH to part number.**

**Specify if you need RTV for NEMA 4/4X**

#### R Option

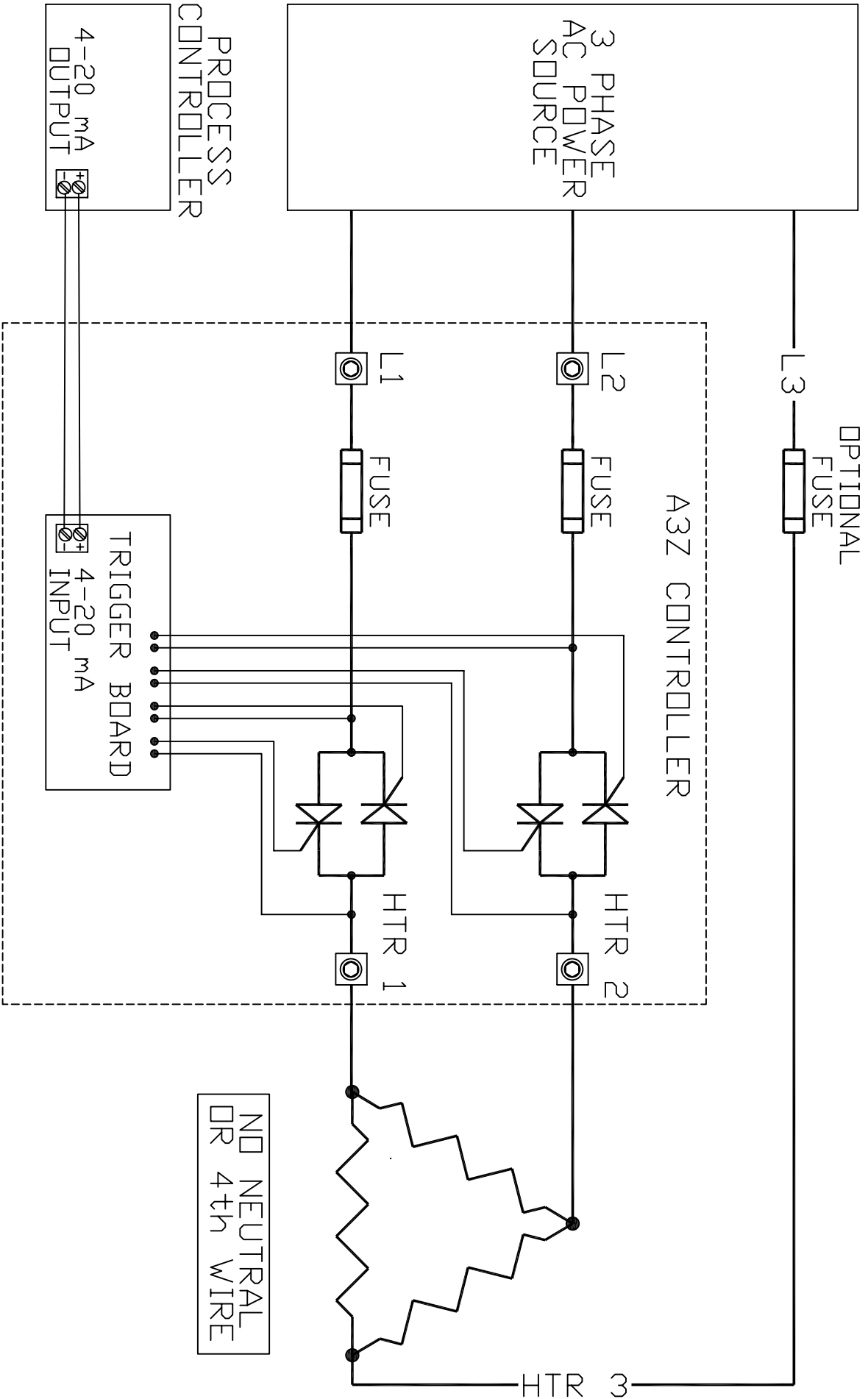
10-32 VDC on-off command signal (-R32)

120 VAC on-off command signal (-R120)

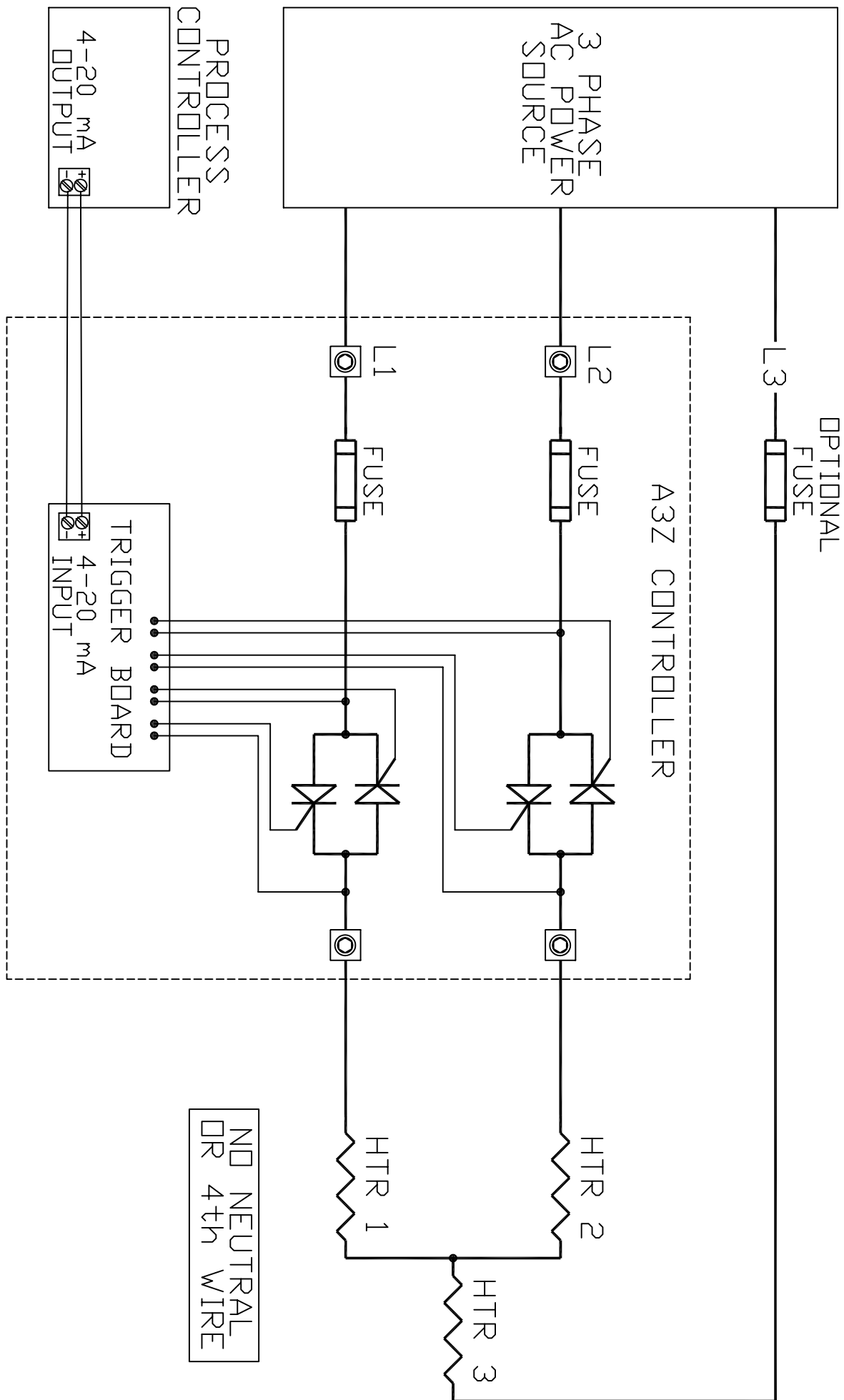
#### Thrid Leg Fuse Option (-3<sup>RD</sup>)

**Example:** A3Z-48-60-3<sup>RD</sup> is a zero voltage switched, three phase 2-leg, 480VAC, 60 Ampere SCR with a third leg fuse option.

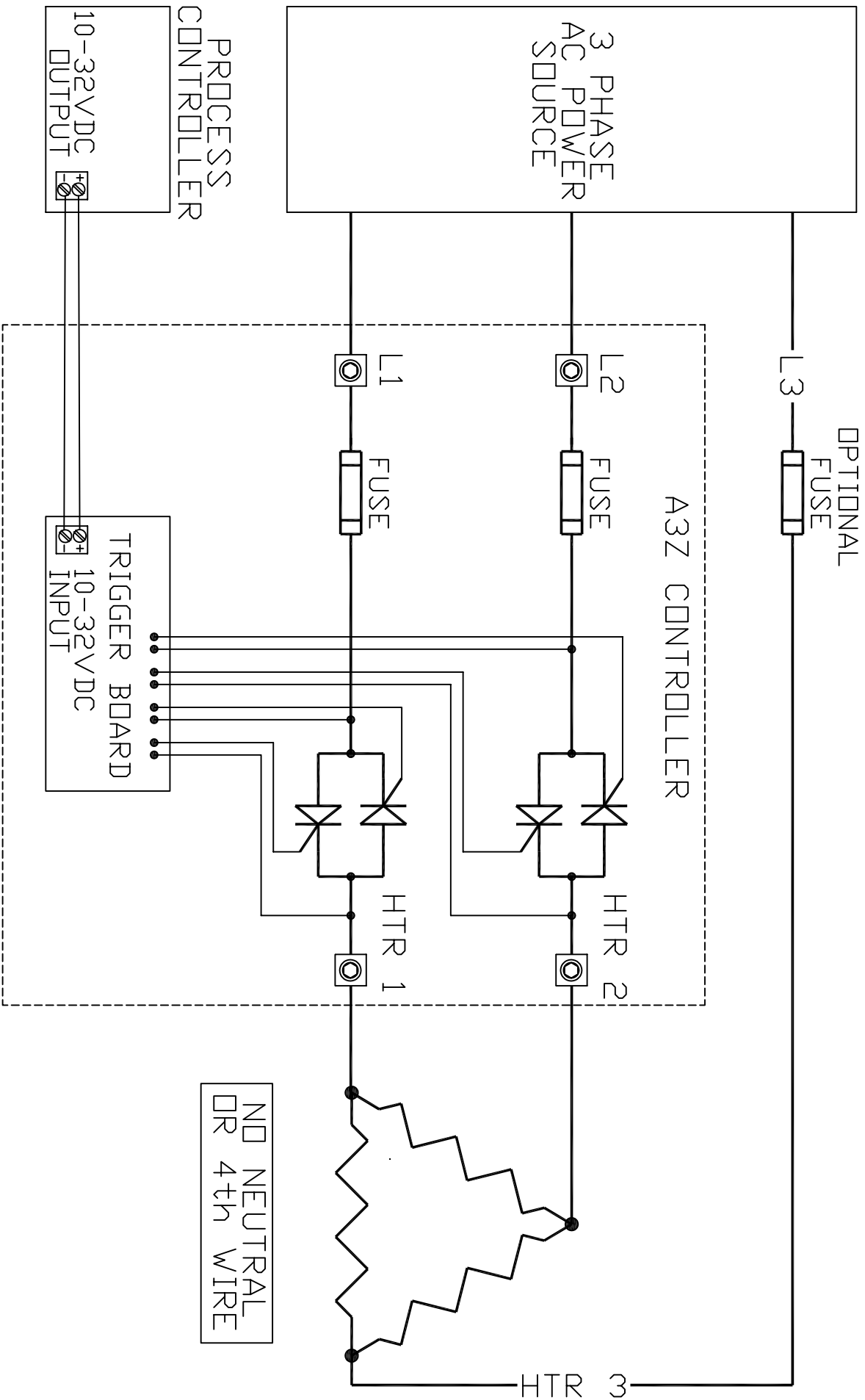
# A3Z WIRING DIAGRAM (3 WIRE 2 LEG DELTA LOAD)



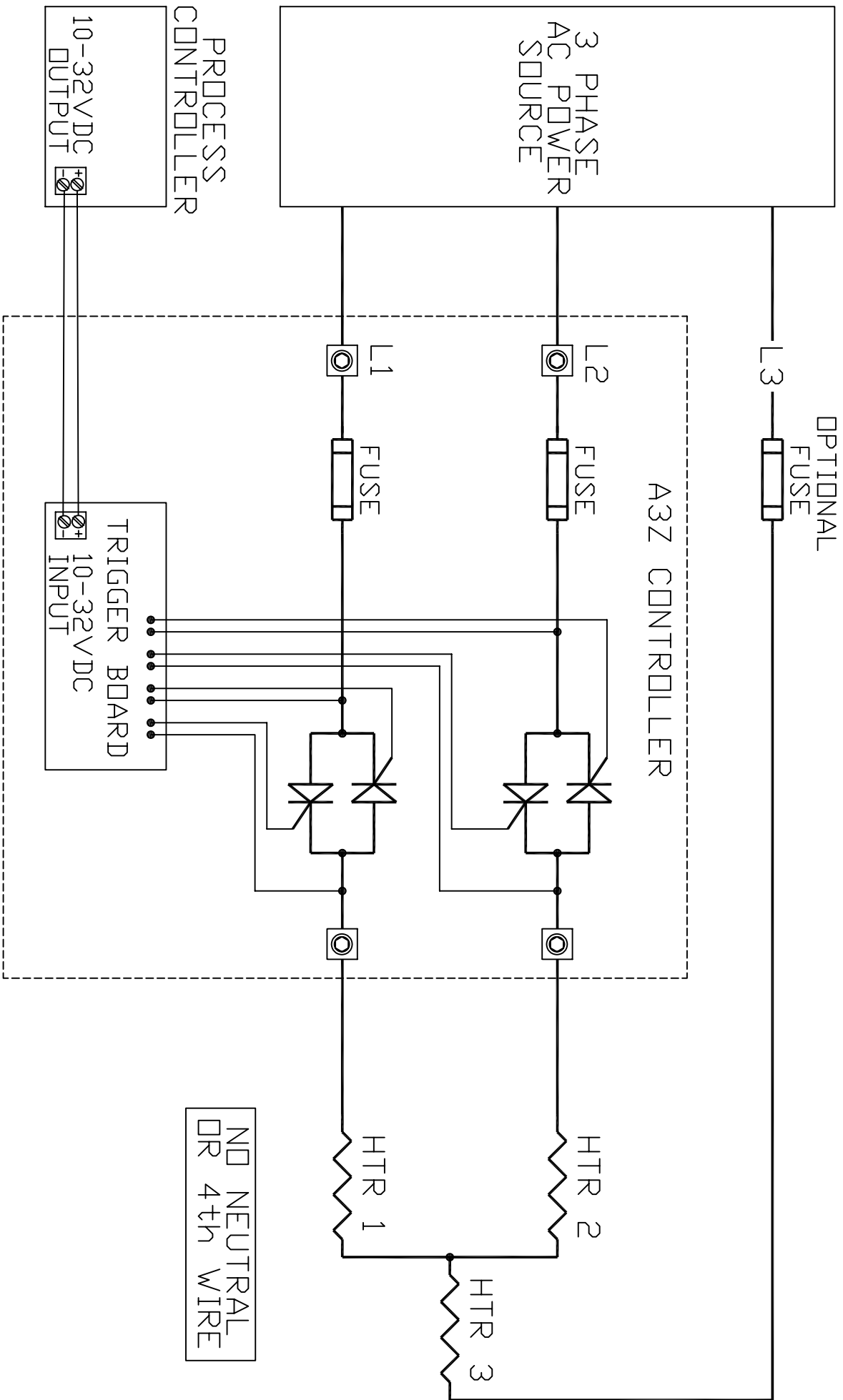
# A3Z WIRING DIAGRAM (3 WIRE 2 LEG WYE LOAD)



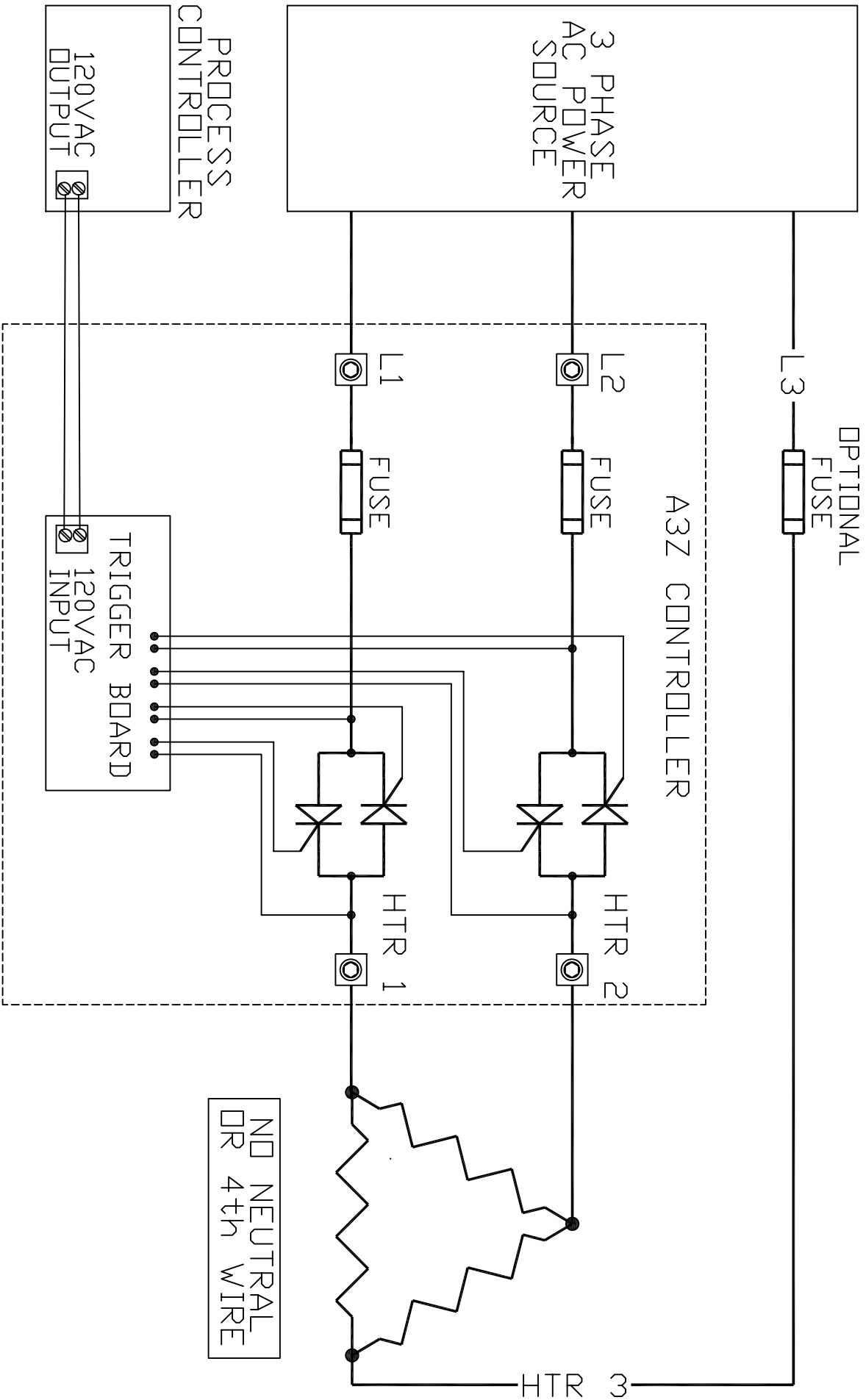
**A3Z WIRING DIAGRAM "R32" OPTION  
10-32VDC COMMAND INPUT SIGNAL  
(3 WIRE 2 LEG DELTA LOAD)**



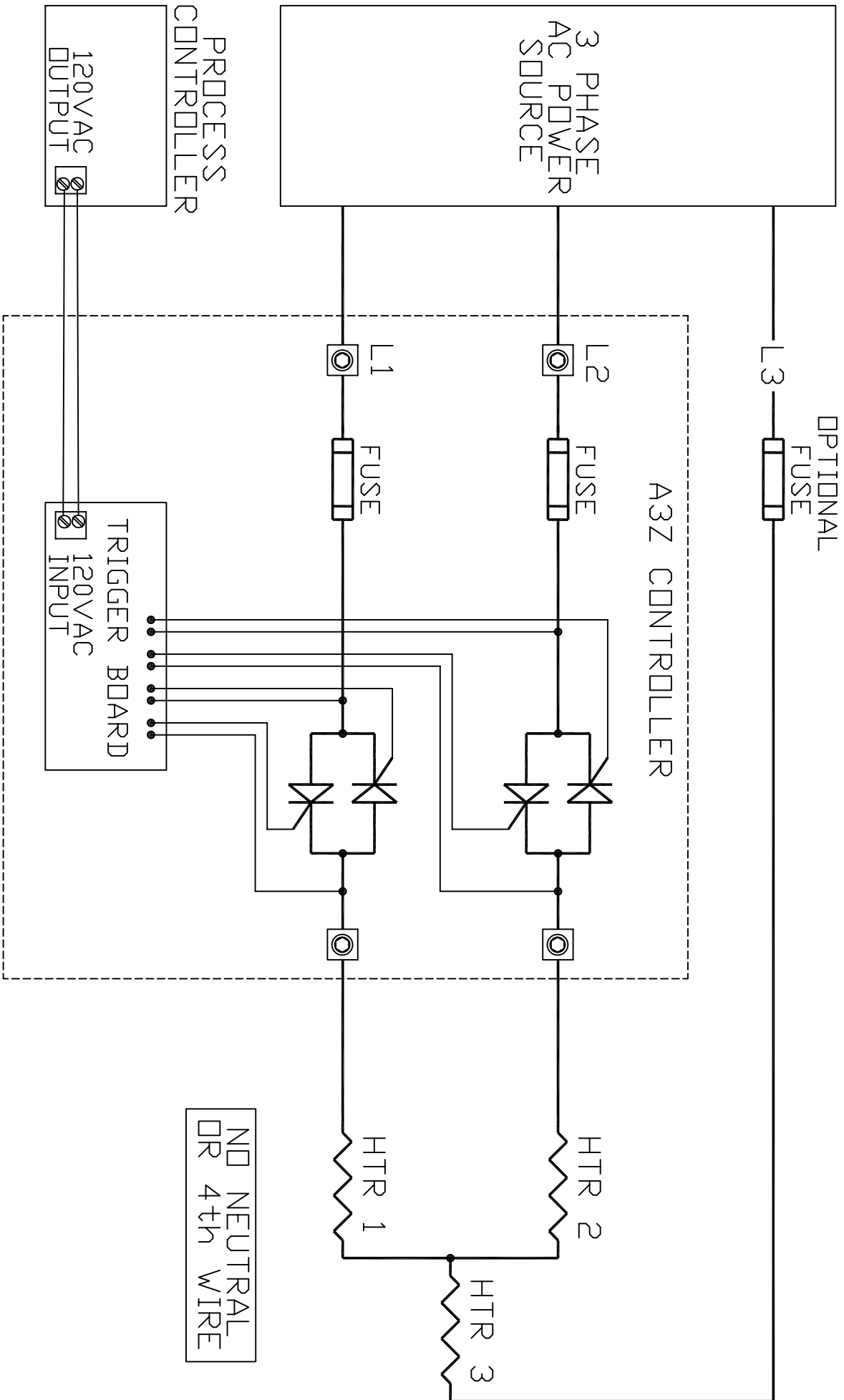
# A3Z WIRING DIAGRAM "R32" OPTION 10-32VDC COMMAND INPUT SIGNAL (3 WIRE 2 LEG WYE LOAD)



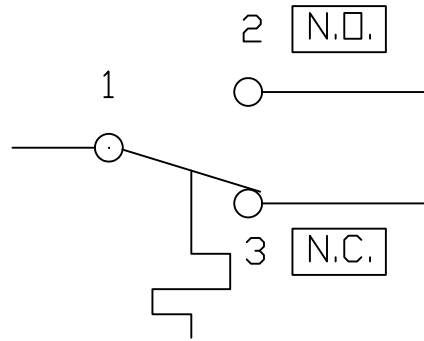
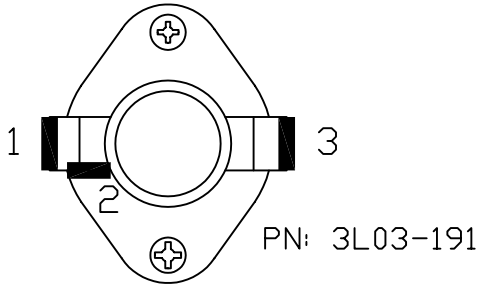
**A3Z WIRING DIAGRAM "R120" OPTION  
120VAC COMMAND INPUT SIGNAL  
(3 WIRE 2 LEG DELTA LOAD)**



# A3Z WIRING DIAGRAM "R120" OPTION 120VAC COMMAND INPUT SIGNAL (WYE FIRED HEATERS)



# OVERTEMPERATURE THERMOSTAT WIRING DIAGRAMS

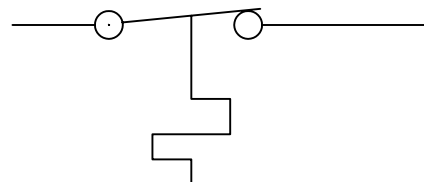
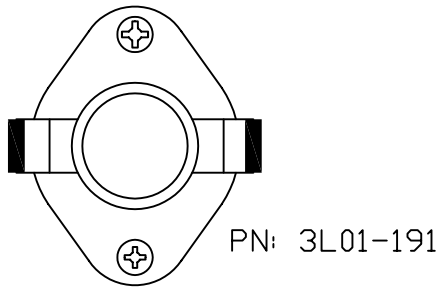


## CONTACT RATINGS

1 & 2:  
5.8A 120VAC  
2.9A/240VAC

1 & 3:  
10A/120VAC  
5A/240VAC

OPEN: 190F  
CLOSE: 170F



CONTACT RATING:  
10A/120VAC  
5A/240VAC

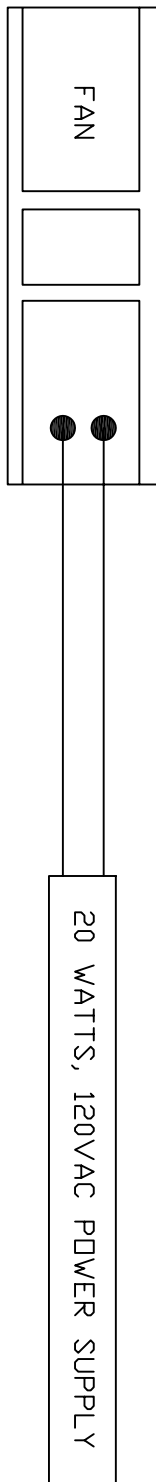
OPEN: 190F  
CLOSE: 170F



# FAN WIRING DIAGRAMS

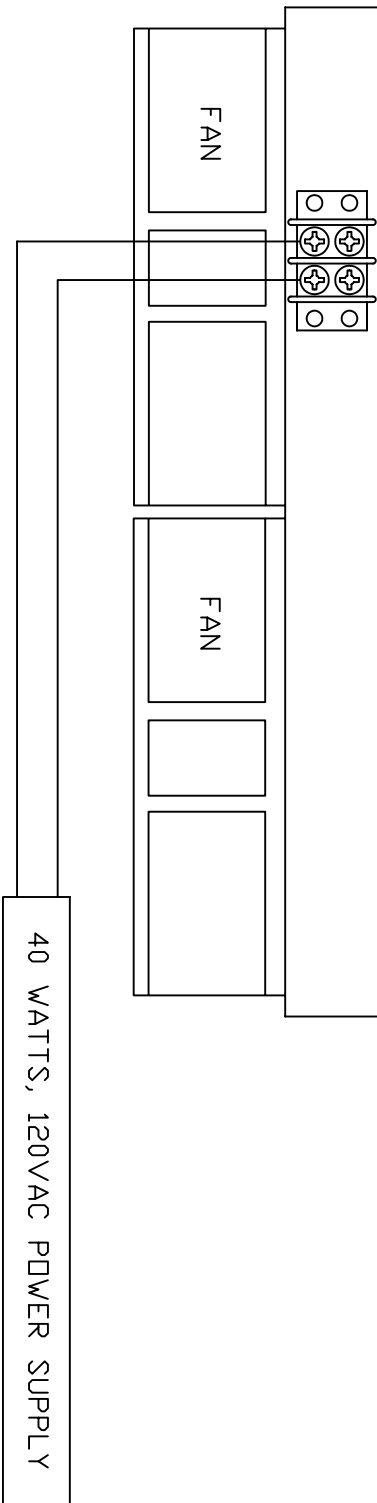
## 100 thru 600 AMPS

TERMINAL TYPE 6.9

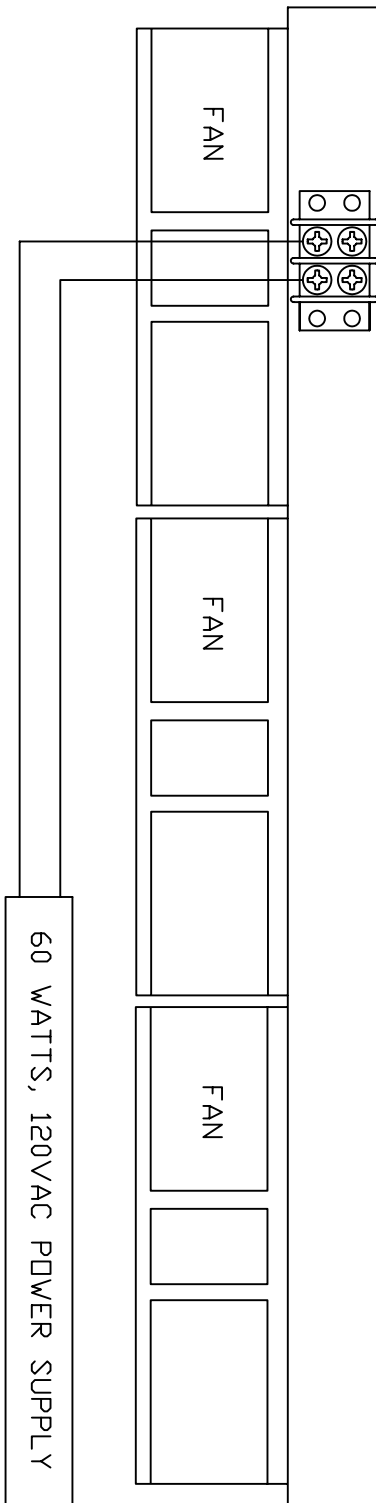


**WARNING!**  
Fans MUST be ON when SCR power controller is on!  
Power to fans must be applied before or coinciding with the turn on of line voltage to the SCR power controller. *Failure to do so will damage SCRs and other components.*

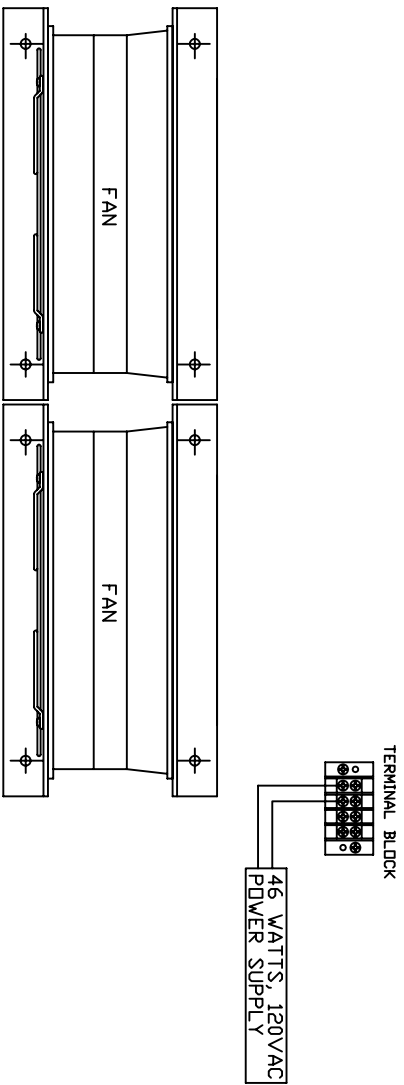
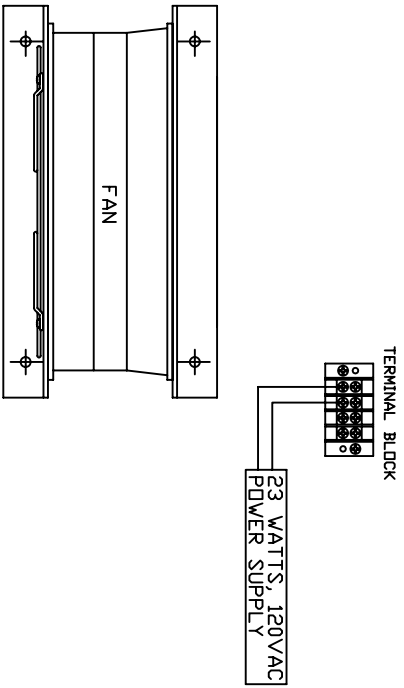
TERMINAL BLOCK



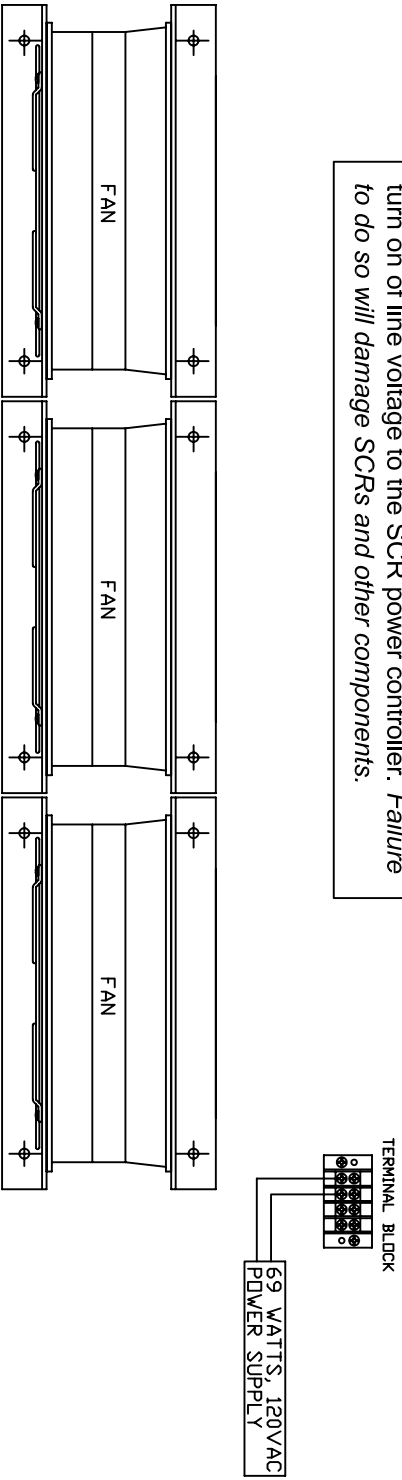
TERMINAL BLOCK



# FAN WIRING DIAGRAMS 1200 AMPS

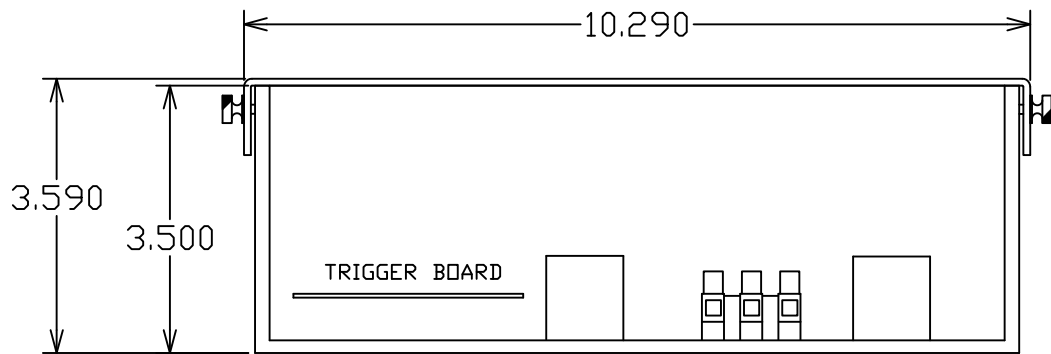
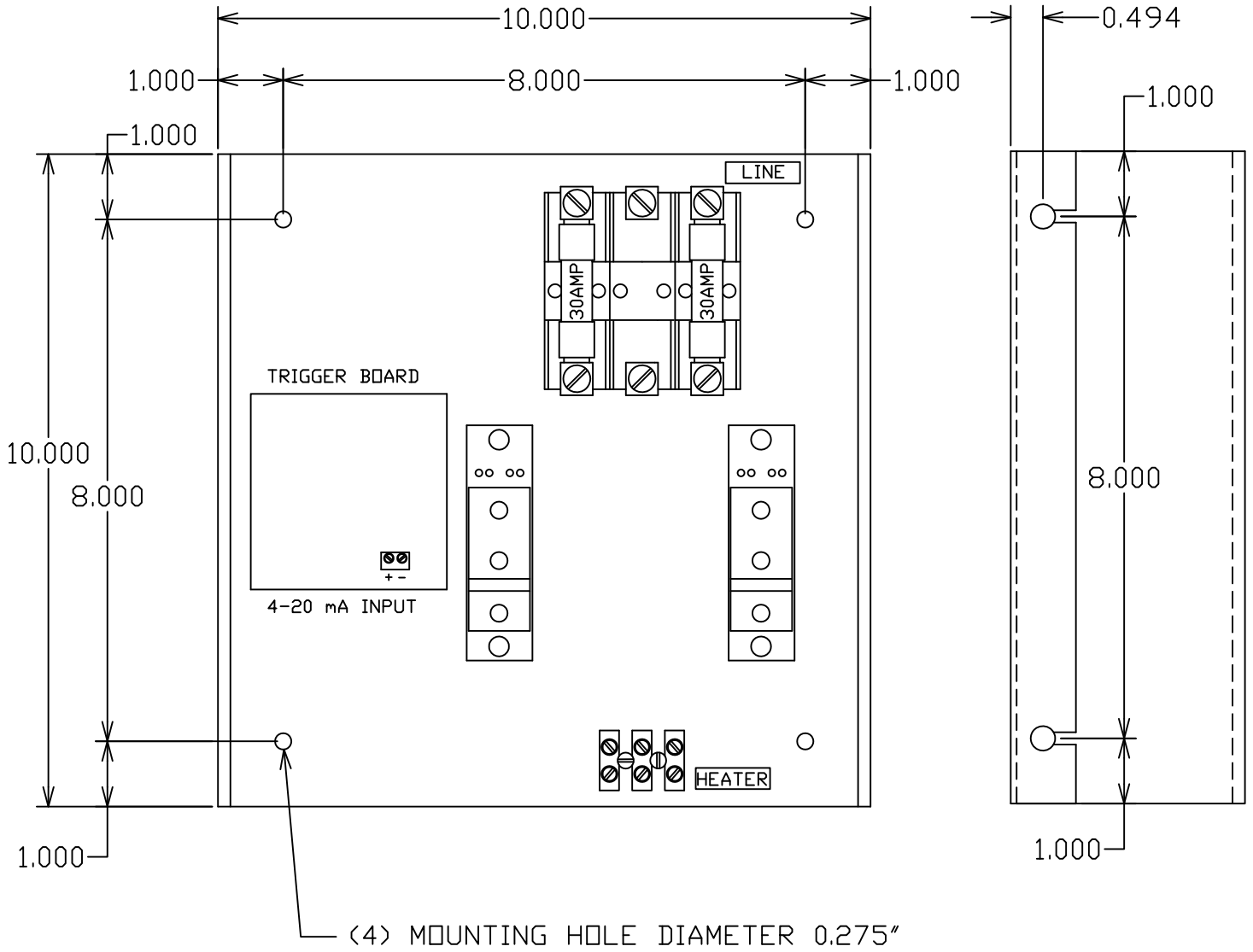


**WARNING!**  
Fans **MUST** be ON when SCR power controller is on!  
Power to fans must be applied before or coinciding with the turn on of line voltage to the SCR power controller. *Failure to do so will damage SCRs and other components.*



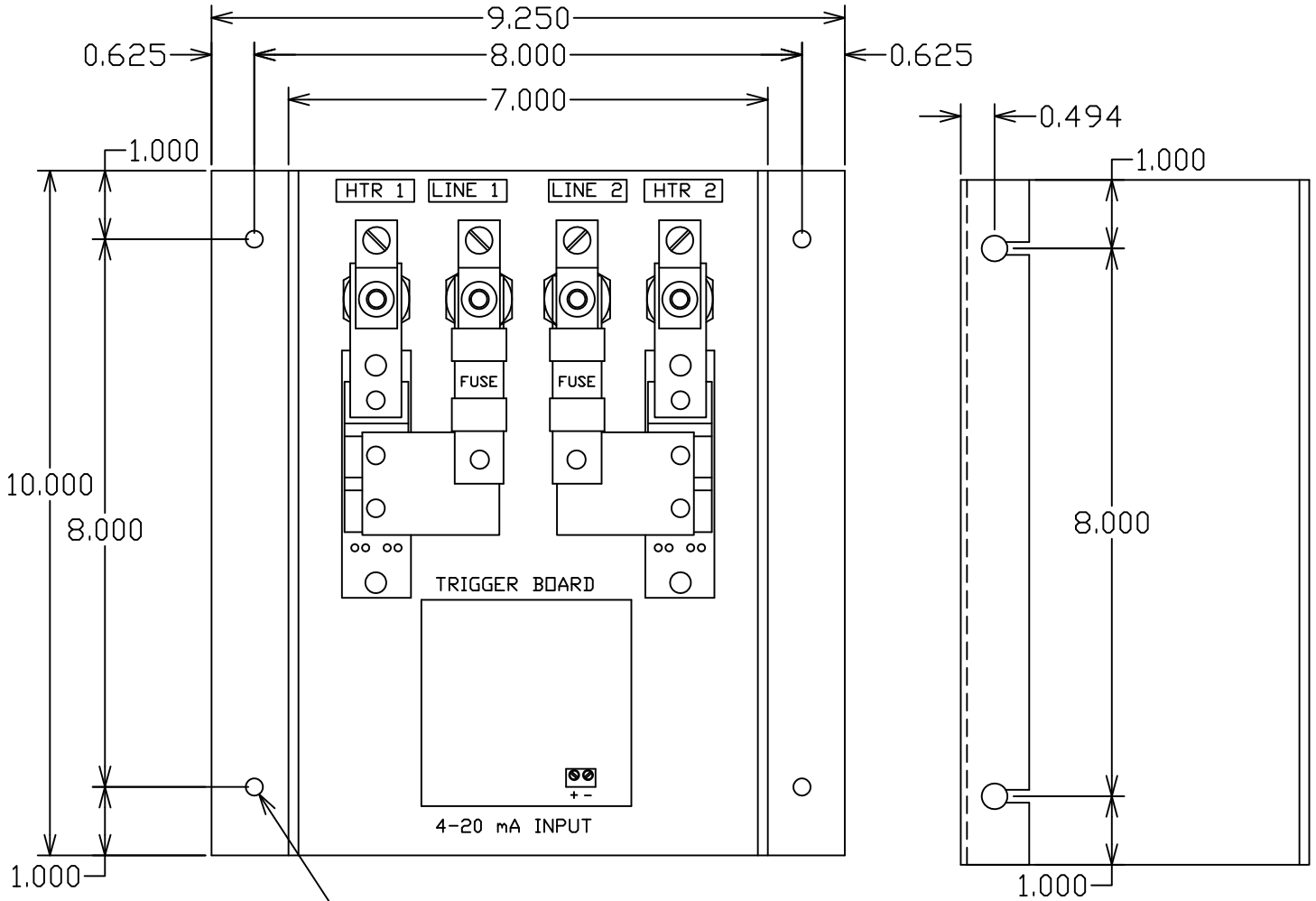
# PHYSICAL DIMENSIONS

## A3Z - 30 AMP

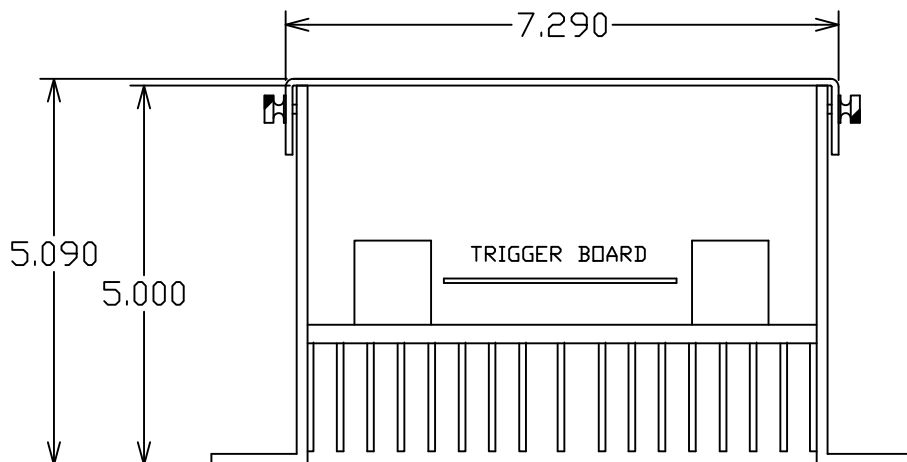


# PHYSICAL DIMENSIONS

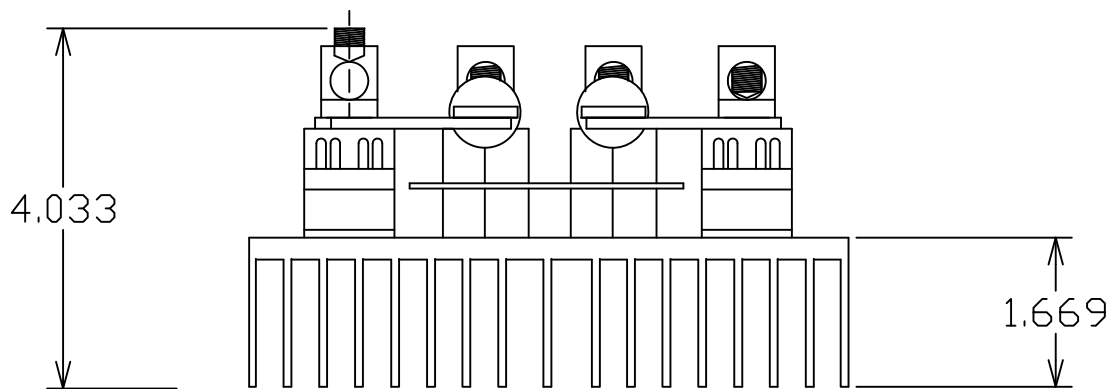
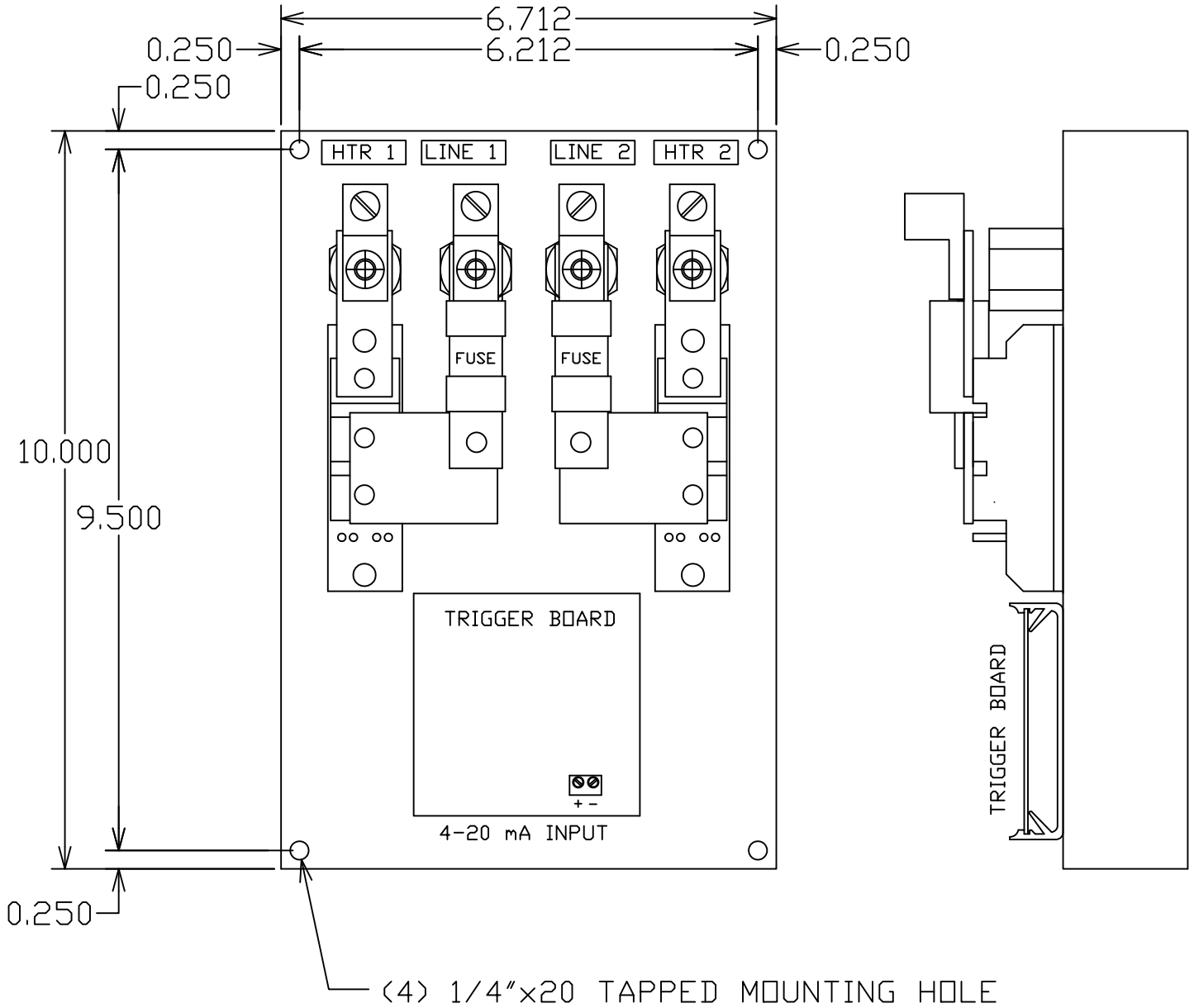
## A3Z - 40 & 60 AMP



(4) MOUNTING HOLE DIAMETER 0.275"

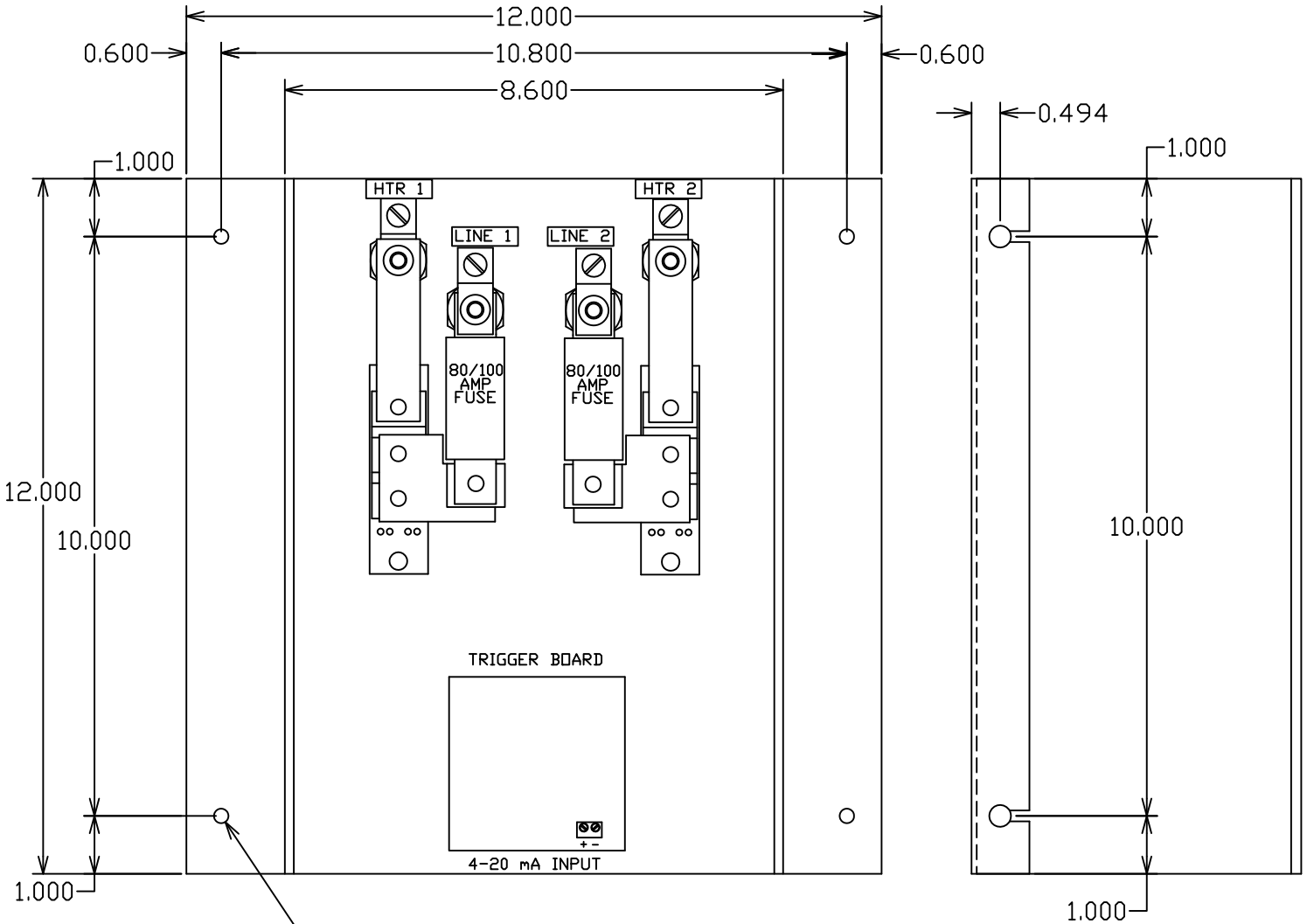


**PHYSICAL DIMENSIONS**  
**A3Z - 40 & 60 AMP**  
**THROUGH-HOLE MOUNTING (-TH)**

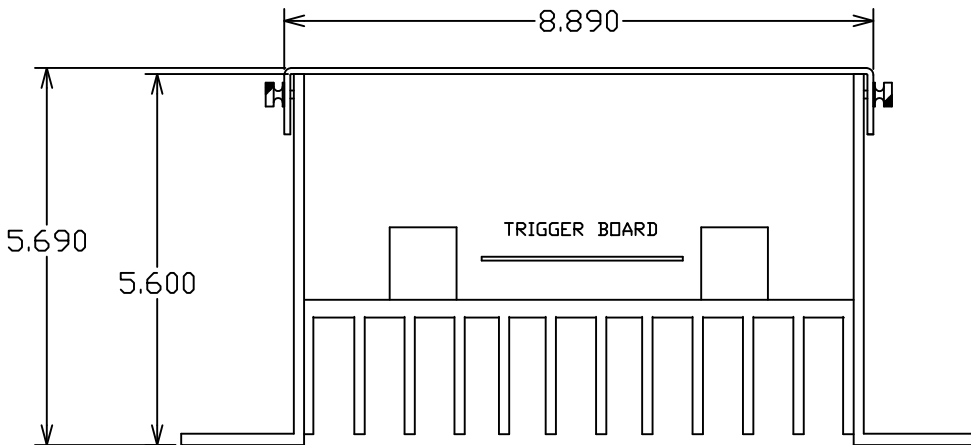


# PHYSICAL DIMENSIONS

## A3Z - 80 & 100 AMP

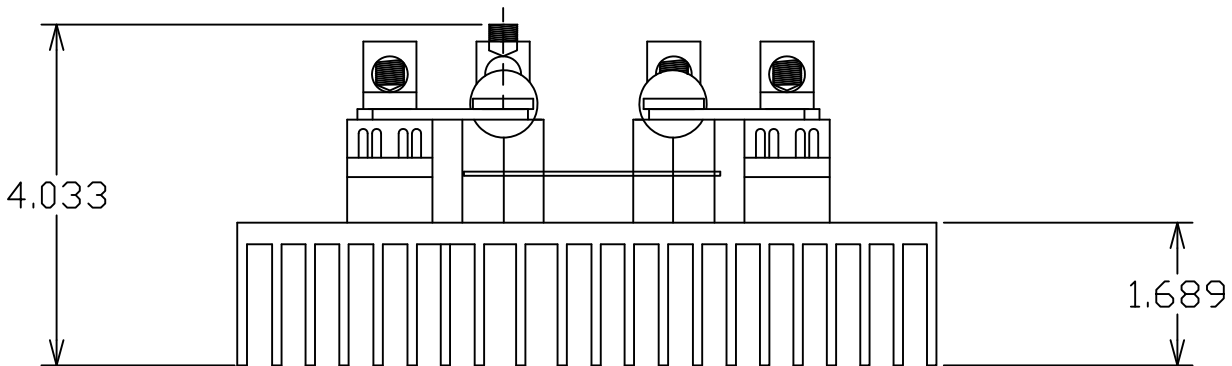
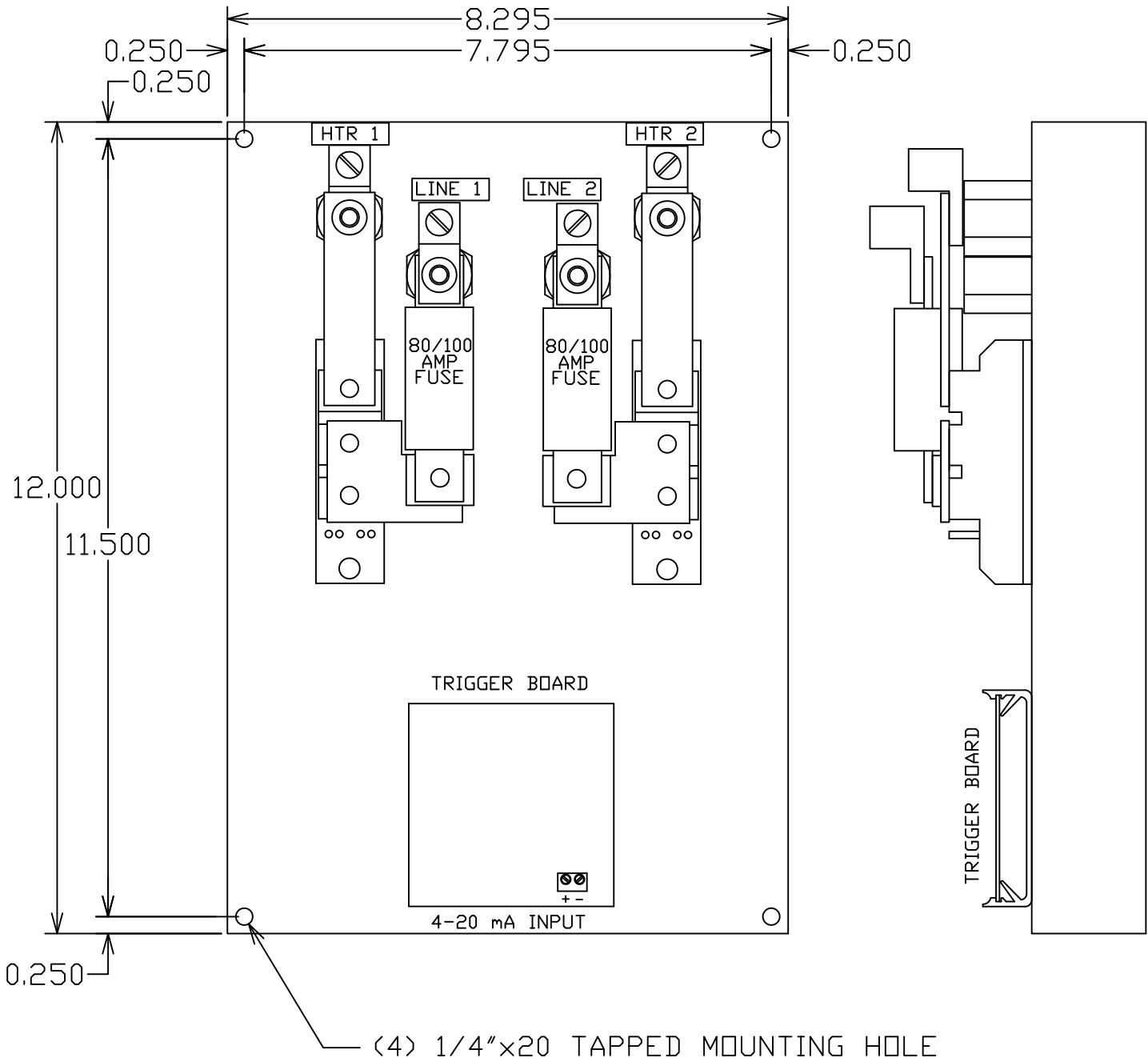


(4) MOUNTING HOLE DIAMETER 0.275"



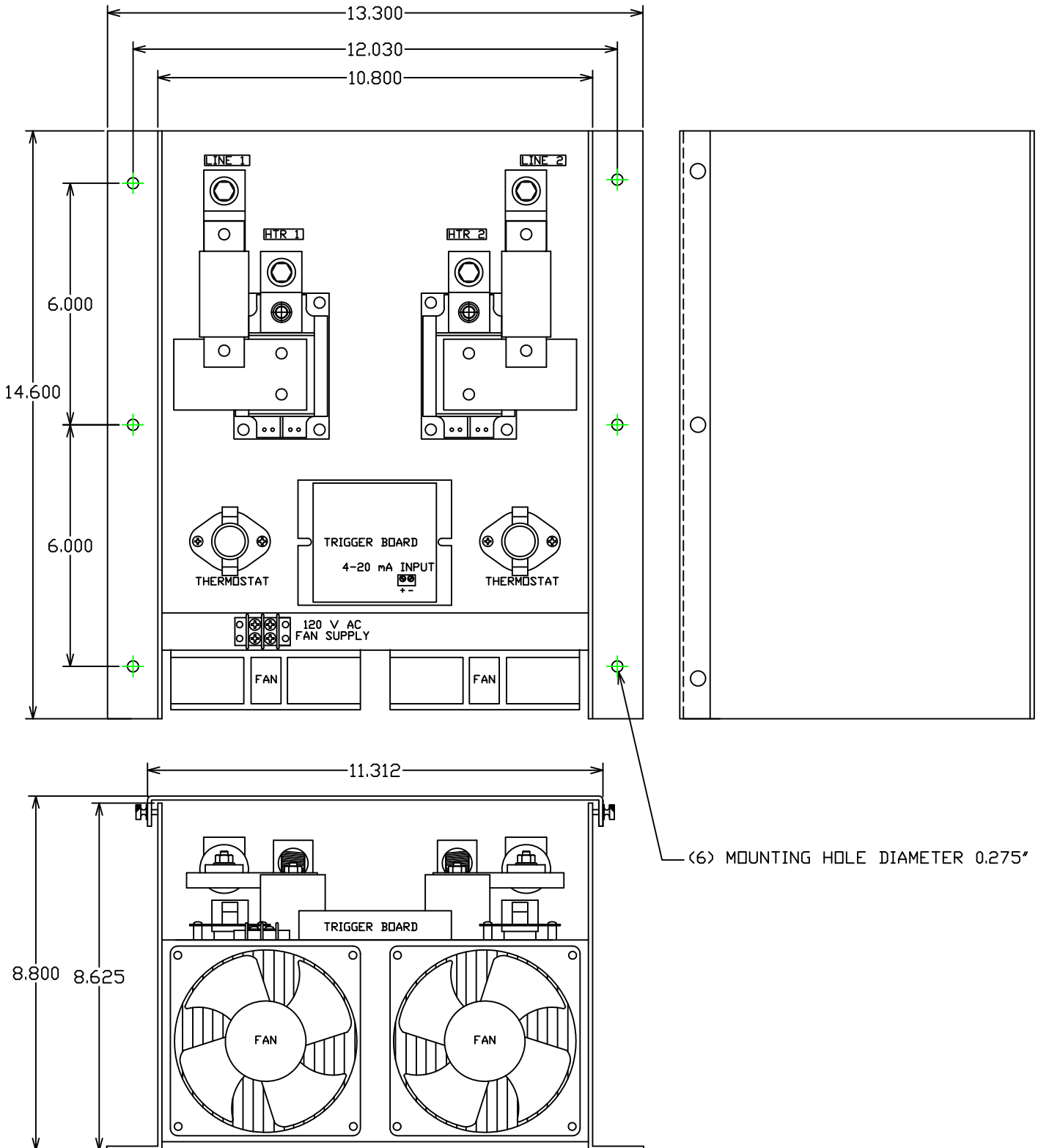
# PHYSICAL DIMENSIONS

## A3Z - 80 & 100 AMP THROUGH-HOLE MOUNTING (-TH)



# PHYSICAL DIMENSIONS

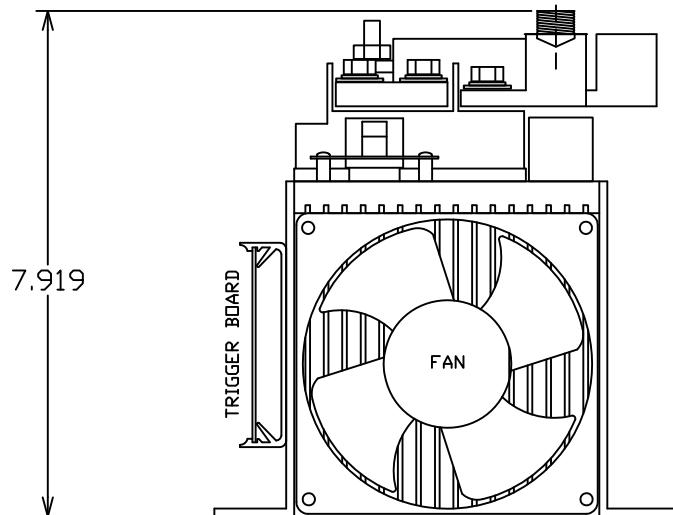
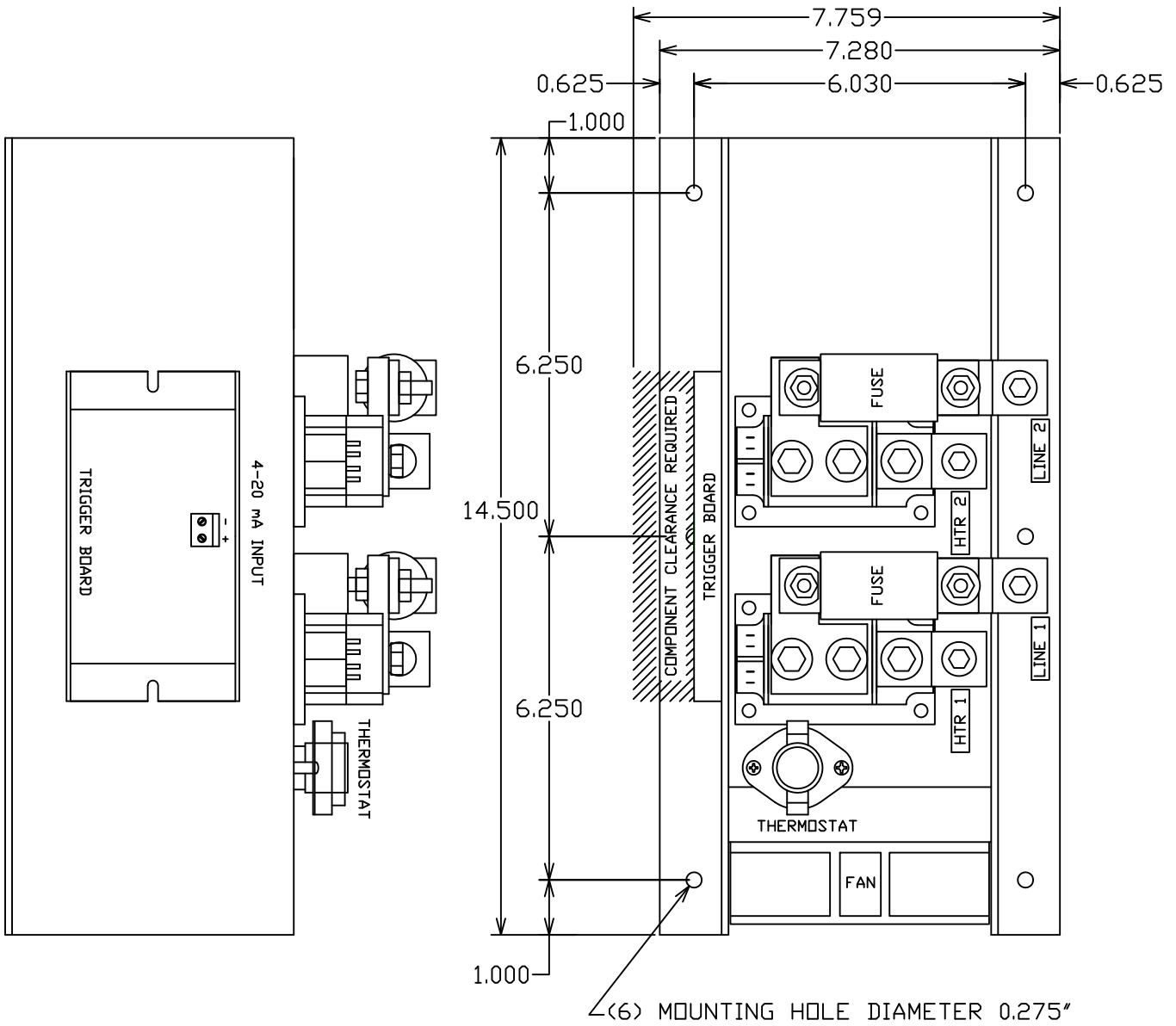
## A3Z - 150, 200, 225 & 250 AMP





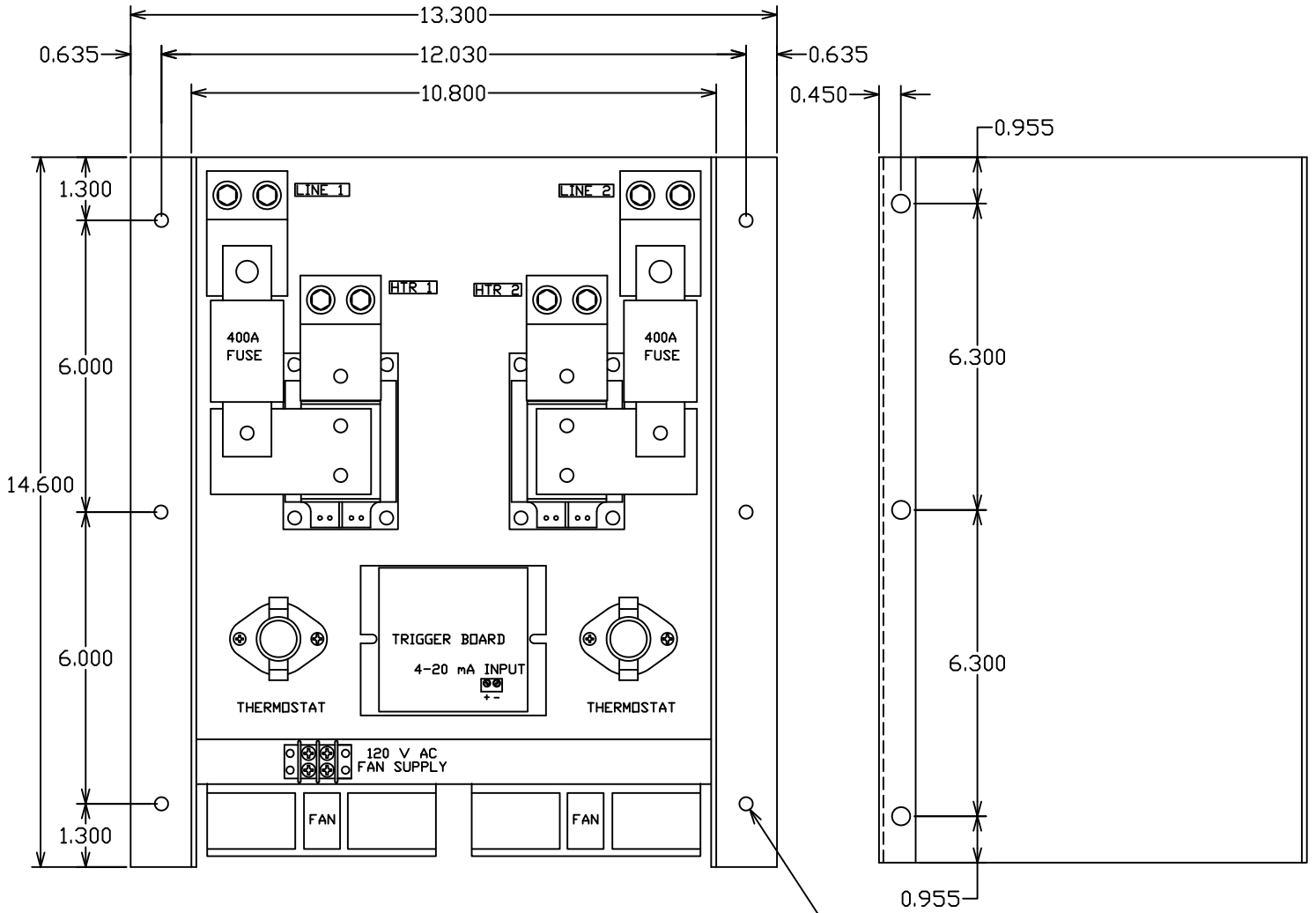
# PHYSICAL DIMENSIONS

## A3Z - 150 & 200 AMP- COMPACT (-C)

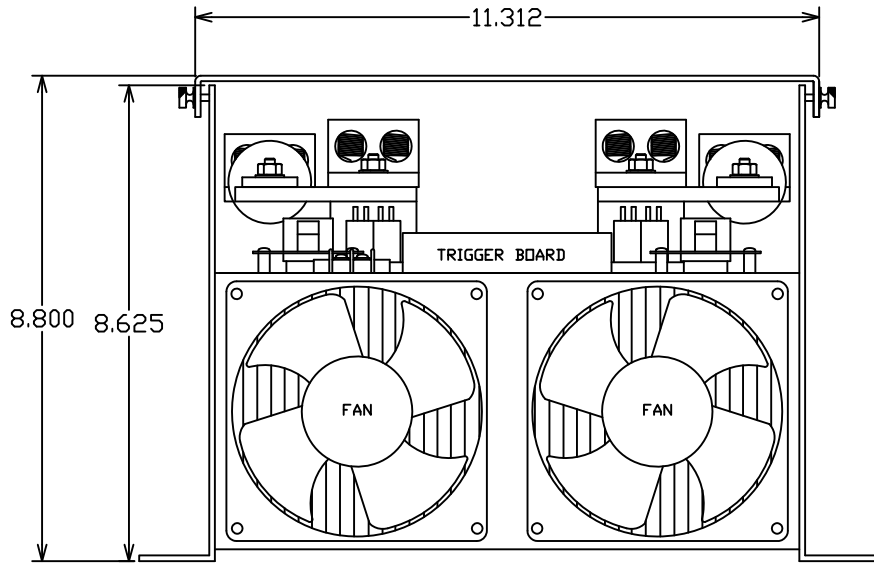


# PHYSICAL DIMENSIONS

## A3Z - 350 AMP

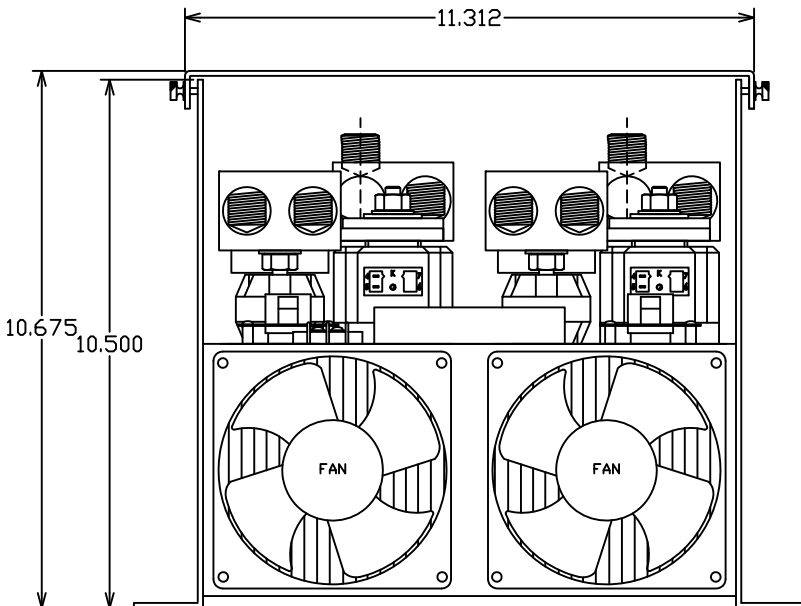
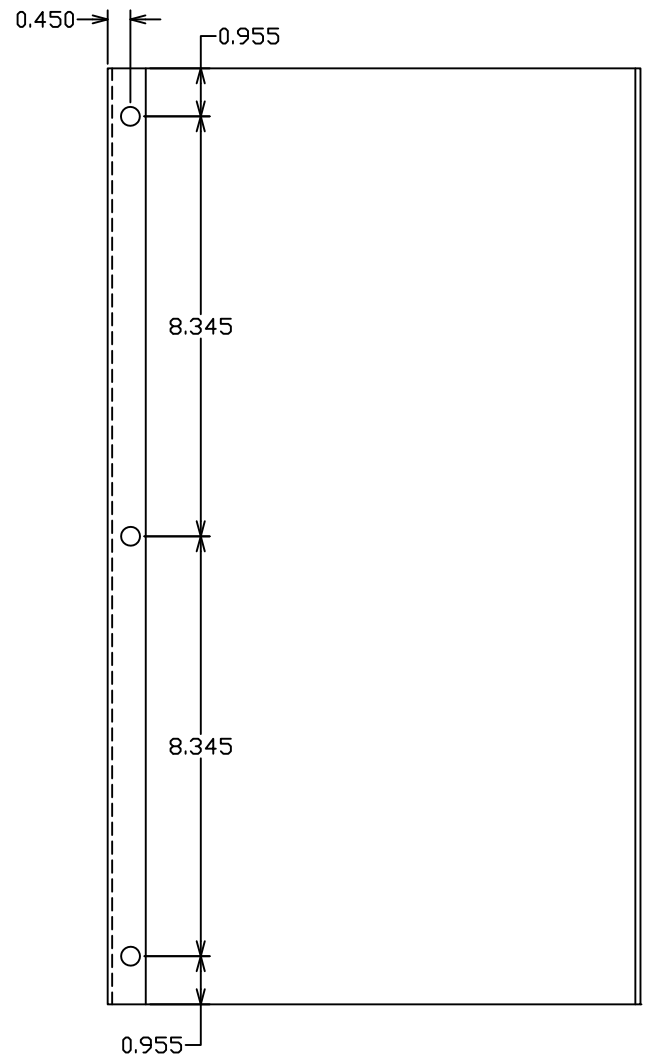
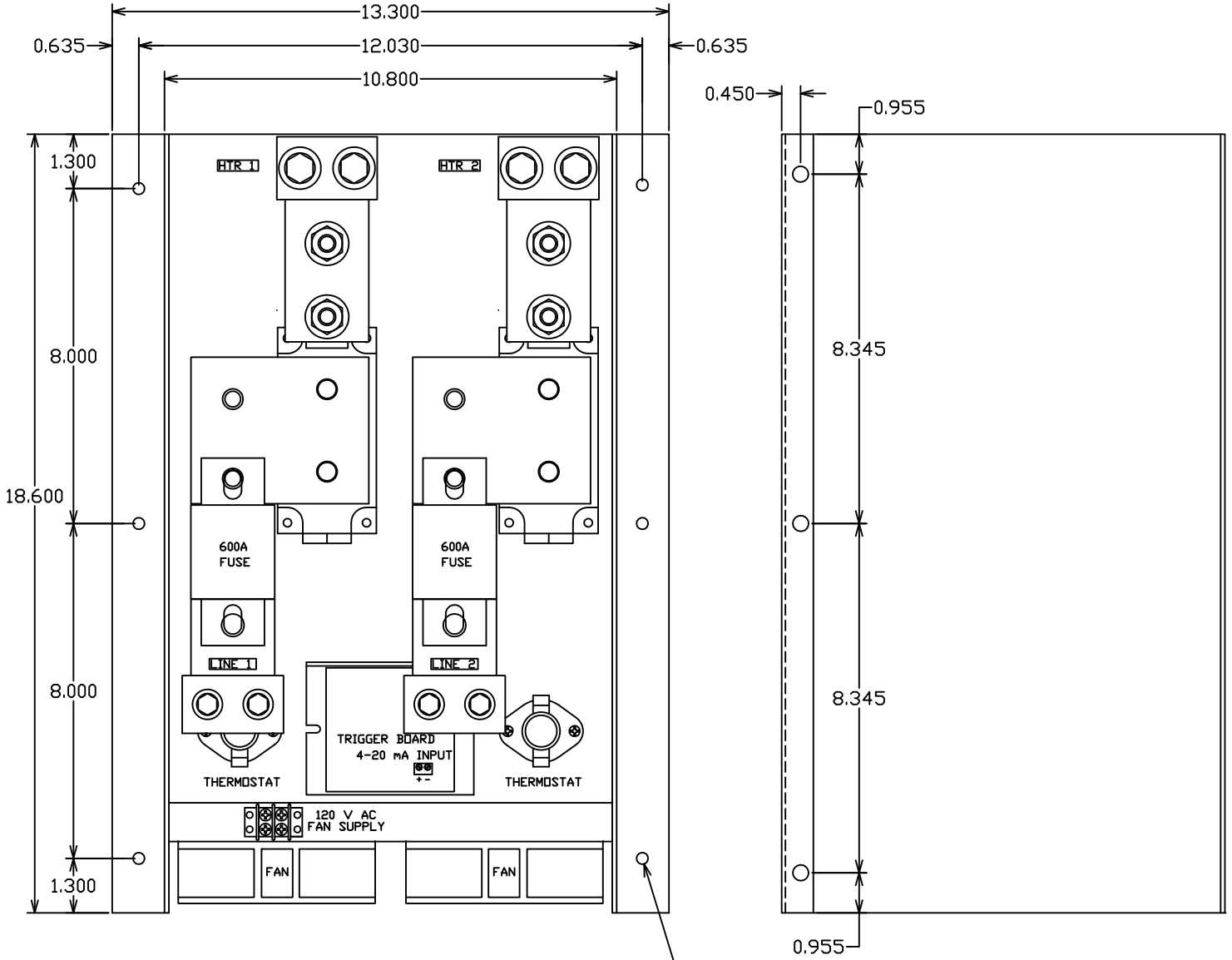


(6) MOUNTING HOLE DIAMETER 0.275"



# PHYSICAL DIMENSIONS

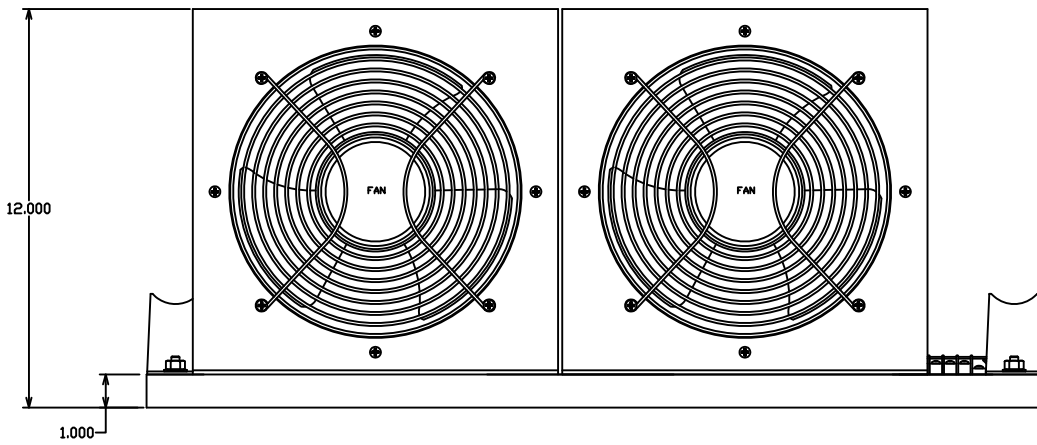
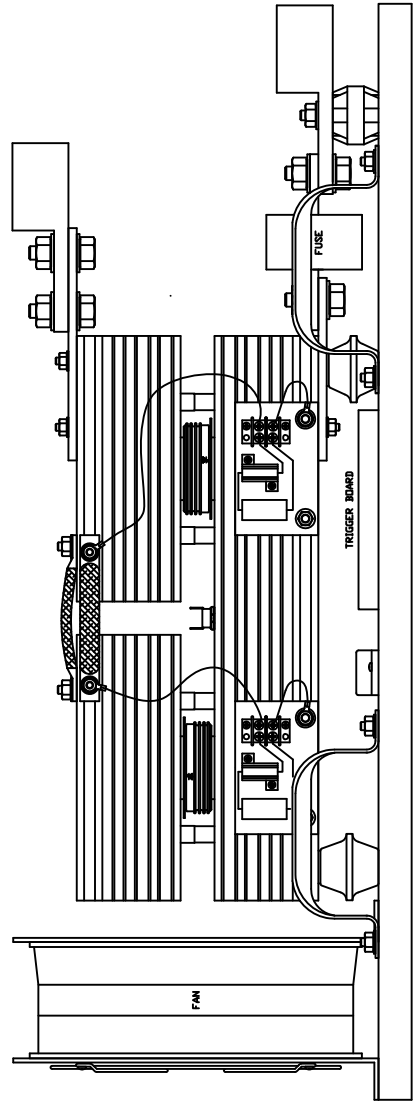
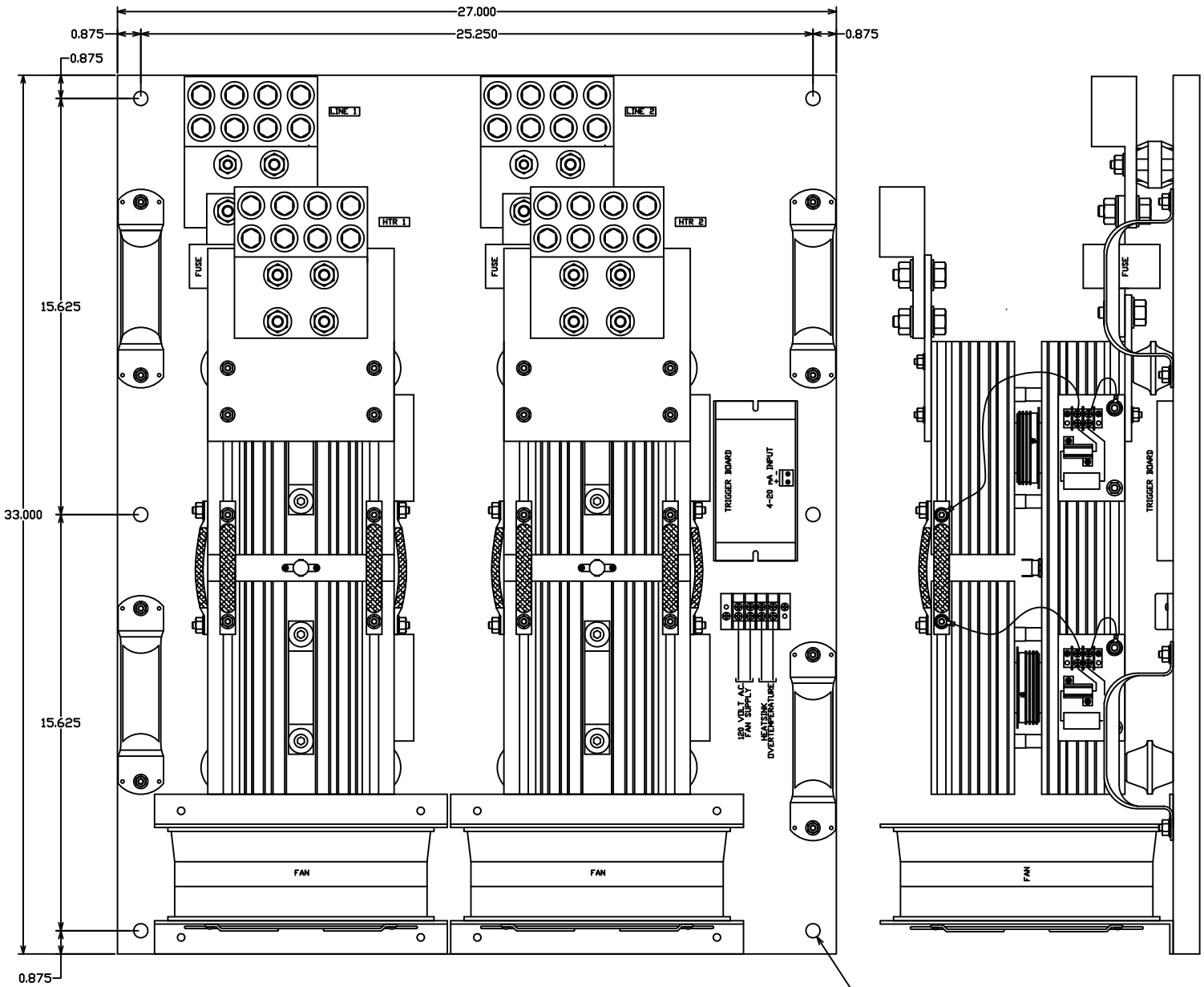
## A3Z - 600 AMP



(6) MOUNTING HOLE DIAMETER 0.275"

# PHYSICAL DIMENSIONS

## A3Z - 1200 AMP



(6) MOUNTING HOLE DIAMETER 0.531"