A3Z
OPERATING MANUAL

TABLE OF CONTENTS

Introduction ..... p. 2
Features ..... p. 2
Description ..... p. 3
Theory of Operation..... p. 3
Installation..... p. 4
Electrical Connections..... p. 5
Options ..... p. 6
Warranty..... p. 6
Specifications ..... p. 7
Troubleshooting ..... p. 8
Ordering Codes..... p. 9
Wiring Diagrams ..... p. 10 - 18
Dimensional Drawings..... p. 19 - 28
CE Declaration of Conformity ..... p. 29



MADE IN USA

NRNT FILE # E350716

Avatar Instruments, Inc. 16587 Coastal Highway Lewes, DE 19958
Phone: (302) 703-6865 contact@avatarinstruments.com www.scrpower.com

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 throughout 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, cUL listed, CE Marked
- compact and light weight
- 100 % solid state circuitry
- over-rated SCR power modules
- over-sized heat sink
- full power ratings up to 50ºC (122ºF) 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^2T 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

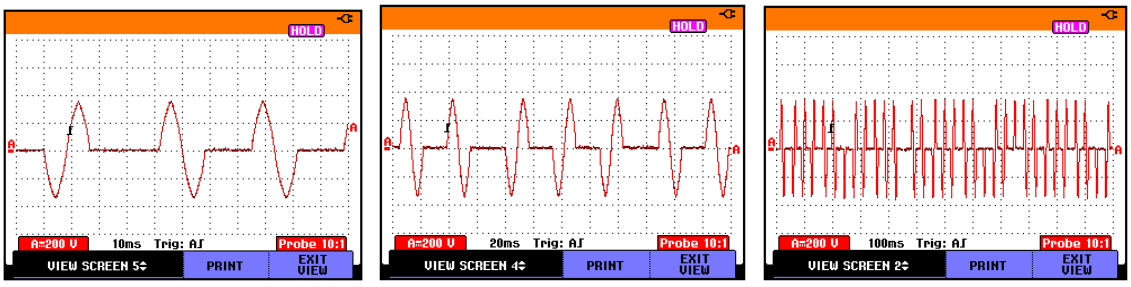
The A3Z is a proportional, zero voltage switched, two leg controlled, three phase power controller capable of delivering 0-99% of the applied line voltage to directly connected electric heaters. The A3Z **will not control** high inrush loads (tungsten lamps), transformers or motors. This is accomplished 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 I^2T 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. Solid state devices **are never "off"** unless you physically disconnect the incoming electrical power to the SCR.

**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. The ground/earth connection can be made to the A3Z chassis mounting point on heat sink / side panel.

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 50ºC. 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

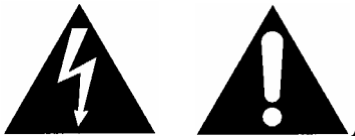
Example: **2 x 1.2 x 60 amps = 144 watts that the *power controller has to dissipate***

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. Fan cooled units should have fans on bottom facing up.

As a quick rule for spacing is take footprint measurement of SCR and use that as ideal spacing distance for SCR and other components.
Example; if the SCR is 12" x 12", space other objects 6" above, 6" below & 6" side to side for best heat dissipation. Plastic wire duct is an insulator and blocks air flow.

The dryer and cleaner, the better! Over time, a combination of moisture and contaminates 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).

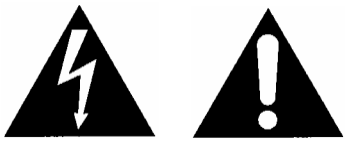
To reduce the risk of electrocution, **TURN ALL POWER OFF** to wires that will be connected to the power control before making any connections. The A3Z controller should be installed in a metal enclosure for protection against electrocution. Remember, solid state devices **are never "off"** unless you physically disconnect the incoming electrical power to the SCR. 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).

The I^2T Semiconductor fuses that are built into the SCR do **NOT** qualify as branch circuit protection. Separate branch circuit overcurrent protection is required. This overcurrent protection needs to be provided in accordance with both national and local codes of the inspecting authority.

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, loose connections, shorted load connections which 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 "-"). **Terminal torque is 5 In-Lbs for mA input block.**

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 I/O relay logic, trigger alarms or shut down a power contactor. See wiring diagram for thermostat wiring page 16.

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 that are separately mounted in panel by customer.

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
INPUT IMPEDANCE:…….300 ohms
4-20mA INPUT TERMINAL TORQUE RATING 5 In-Lbs

COOLING: 30-100 amp……... convection
150-1200 amp…….. fan(s) 120VAC
THERMOSTAT:…… 190ºF (fan cooled units only)
POWER DISSIPATION (Watts):……..2.4 x maximum current draw of heater load

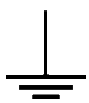
DIMENSIONS:…… see dimensional drawings

WEIGHT:	**NET**	**SHIPPING**
30 amp…….,.	7 lbs.	9 lbs.
40-60 amp…….	8 lbs.	11 lbs.
80-100 amp……...	13 lbs.	14 lbs.
150 amp…….	35 lbs.	53 lbs.
200-350 amp…….	38 lbs.	55 lbs.
600 amp…….	50 lbs.	75 lbs.
1200 amp……...	180 lbs.	250 lbs.

Wire Gauge and Torque Specifications for 90ºC Temp Wire			
Power Control Maximum Current Rating/ Circuit	Copper Wire Only MINIMUM AWG	Wire Lug Torque Spec. (IN-LBS.)	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	TW0: 600MCM-2
1200A	FOUR: MCM 350	375	FOUR: 600MCM-2

Figure 1

Ground wire should be mounted to chassis of SCR. The hardware used to mount SCR to back plate/enclosure can be used for ground lug. Size of the ground wire should be able to supply enough current capacity to match line and load power levels. Use copper wire only. Follow NEC NFPA 70 National Electrical Code.



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 were 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

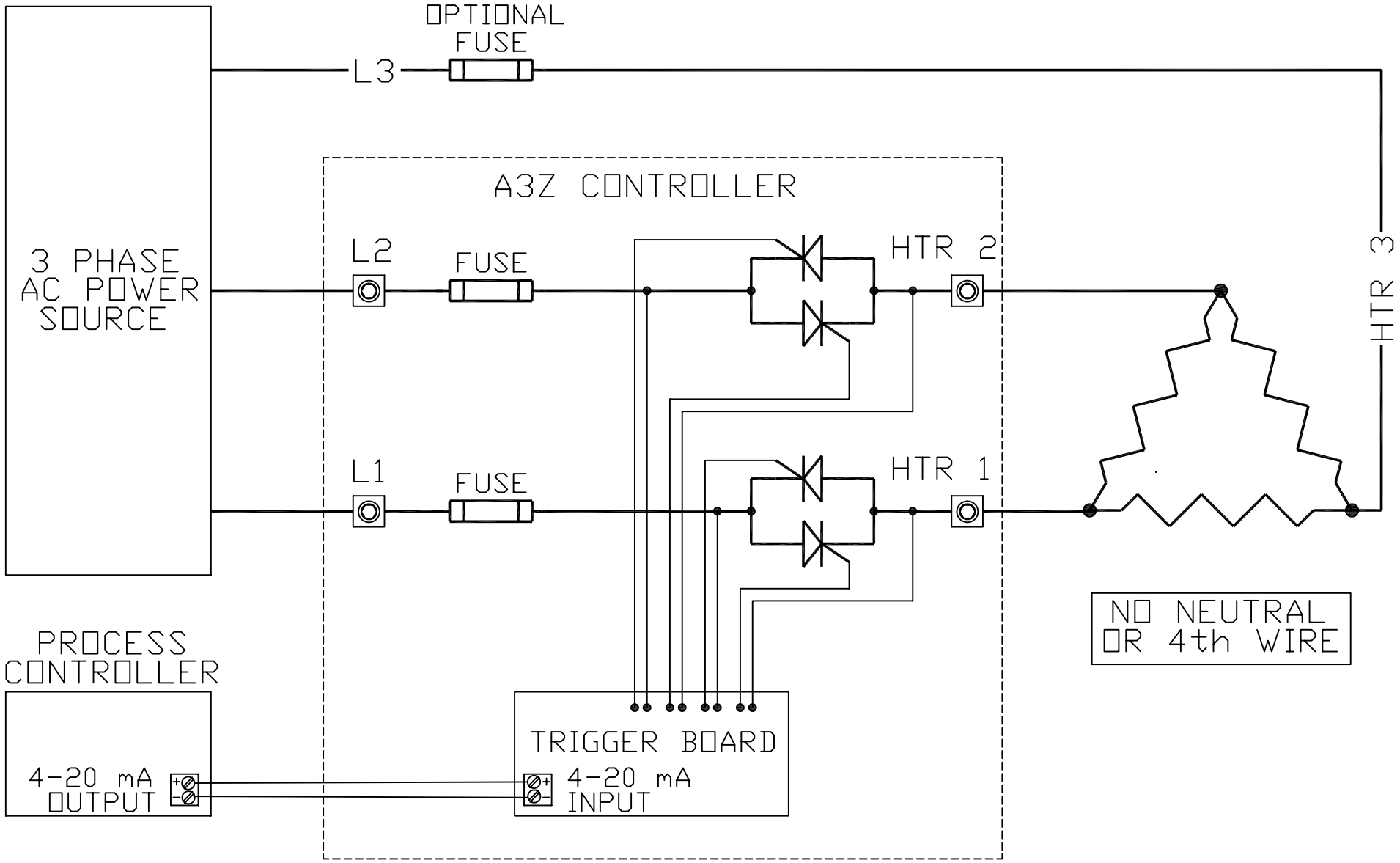
R Option

10-32 VDC on-off command signal (-R32)
120 VAC on-off command signal (-R120)

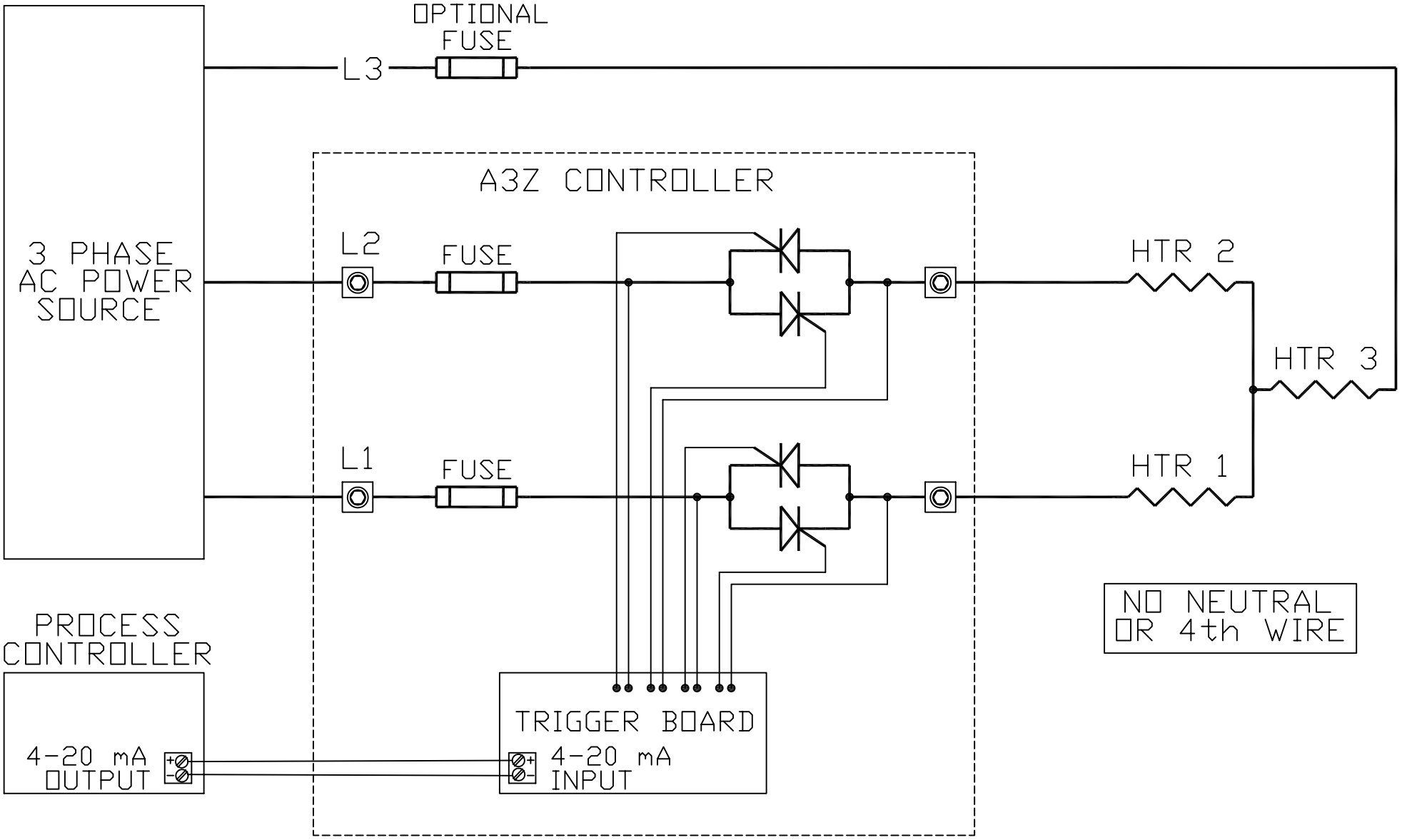
Thrid Leg Fuse Option (-3^{RD})

Example: A3Z-48-60-3^{RD} is a zero voltage switched, three phase 2-leg, 480VAC, 60 Ampere SCR with a third leg fuse option.

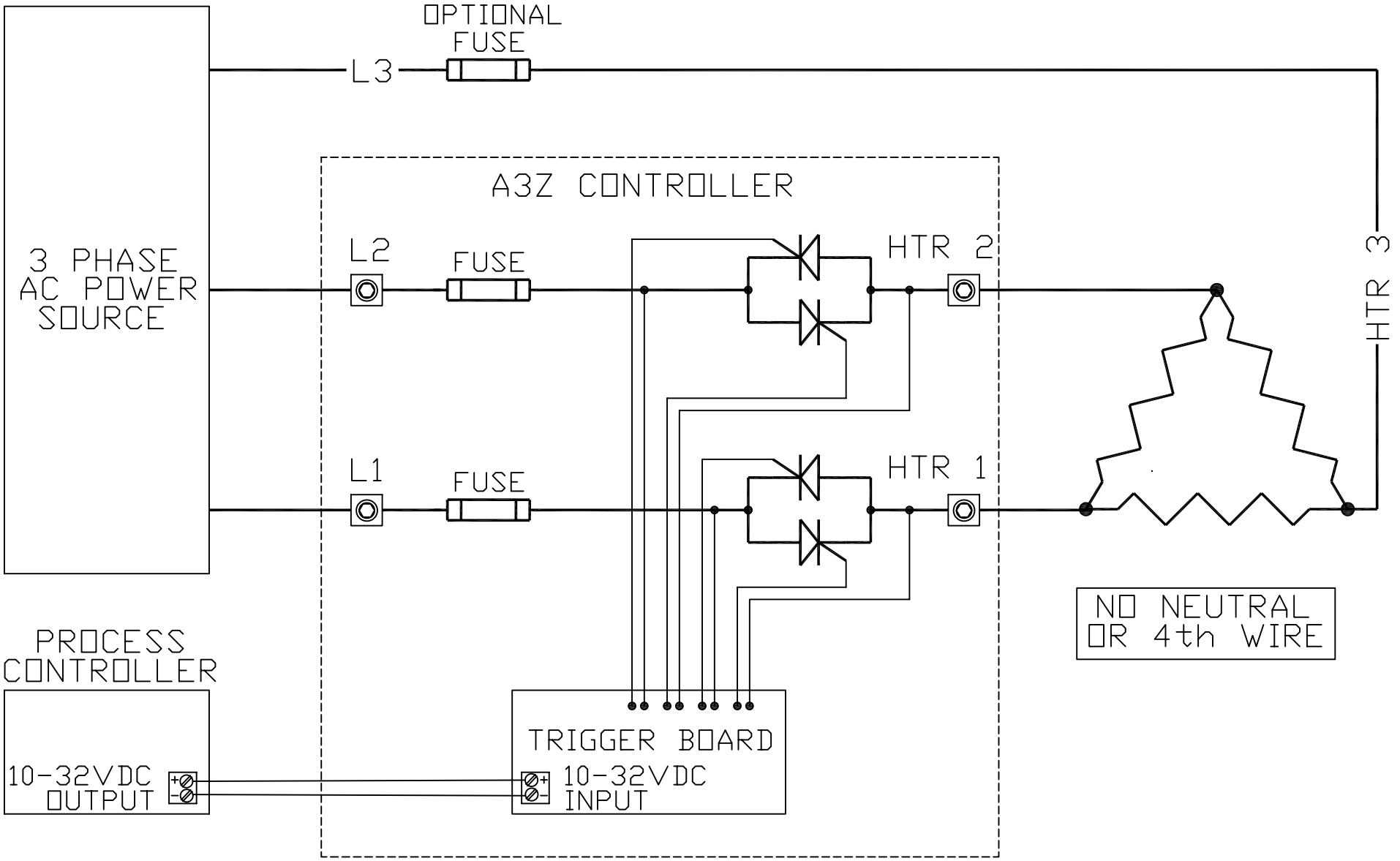
A3Z WIRING DIAGRAM
(3 WIRE 2 LEG DELTA LOAD)



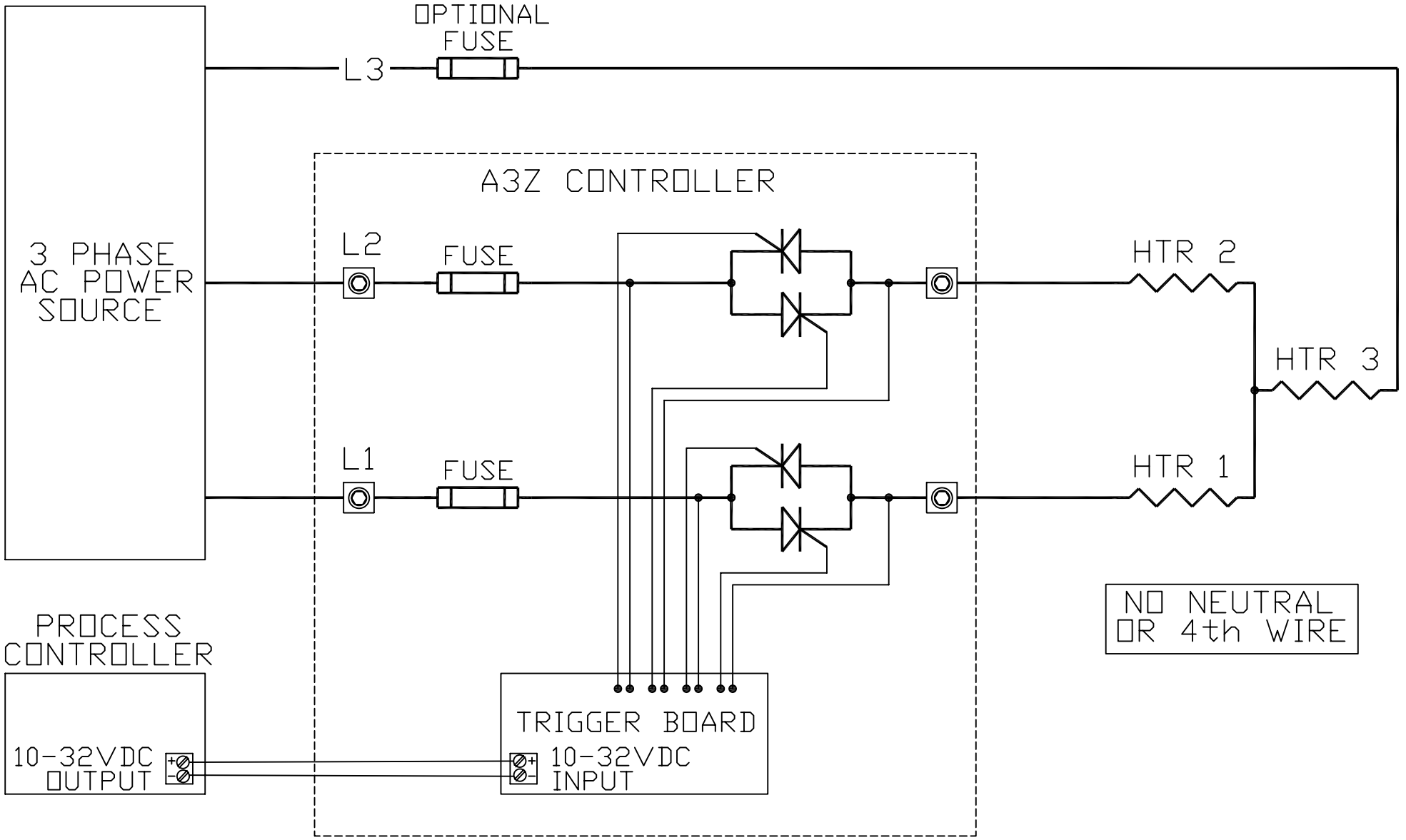
A3Z WIRING DIAGRAM
(3 WIRE 2 LEG WYE LOAD)



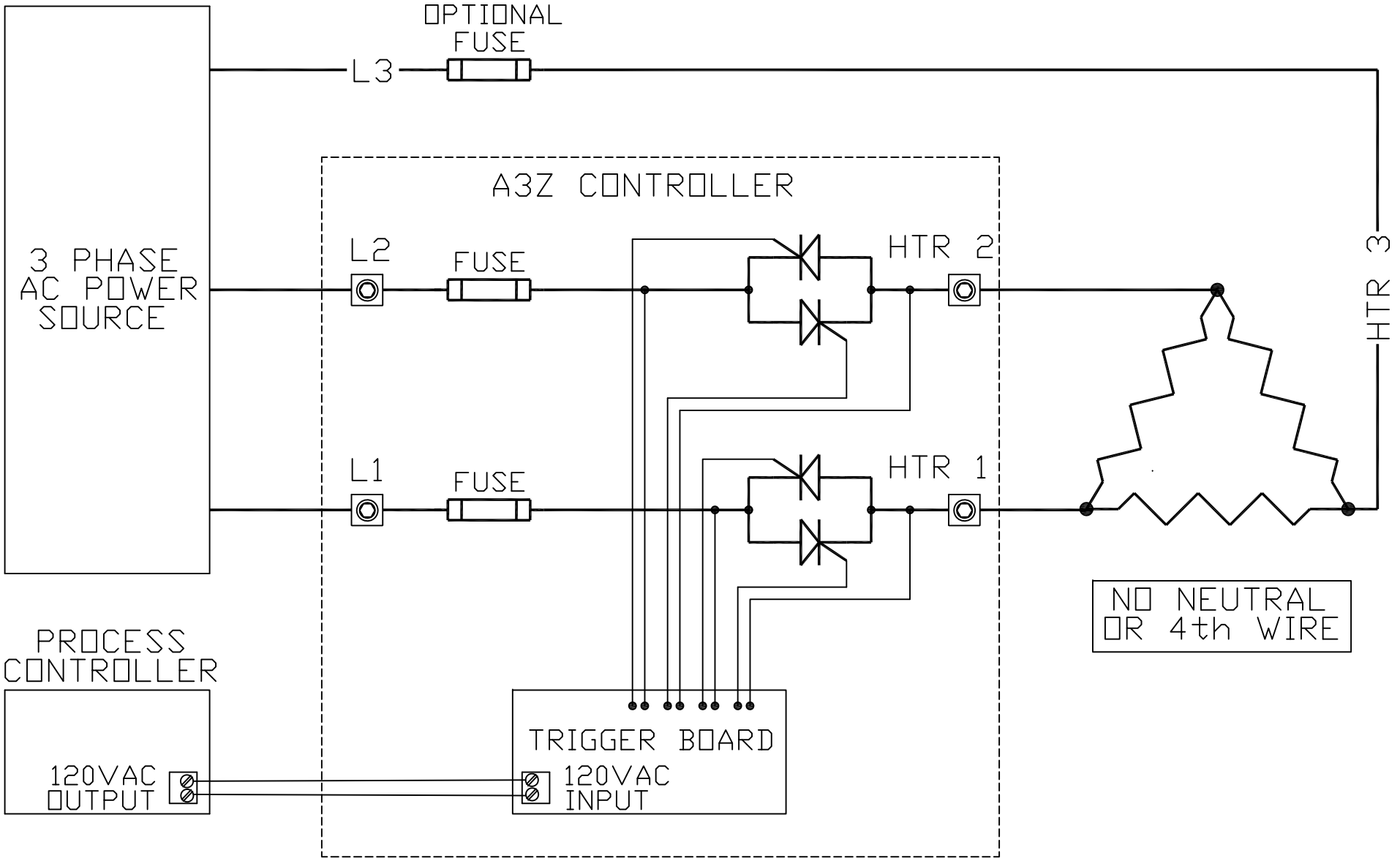
A3Z WIRING DIAGRAM "R32" OPTION
10-32VDC COMMAND INPUT SIGNAL
(3 WIRE 2 LEG DELTA LOAD)



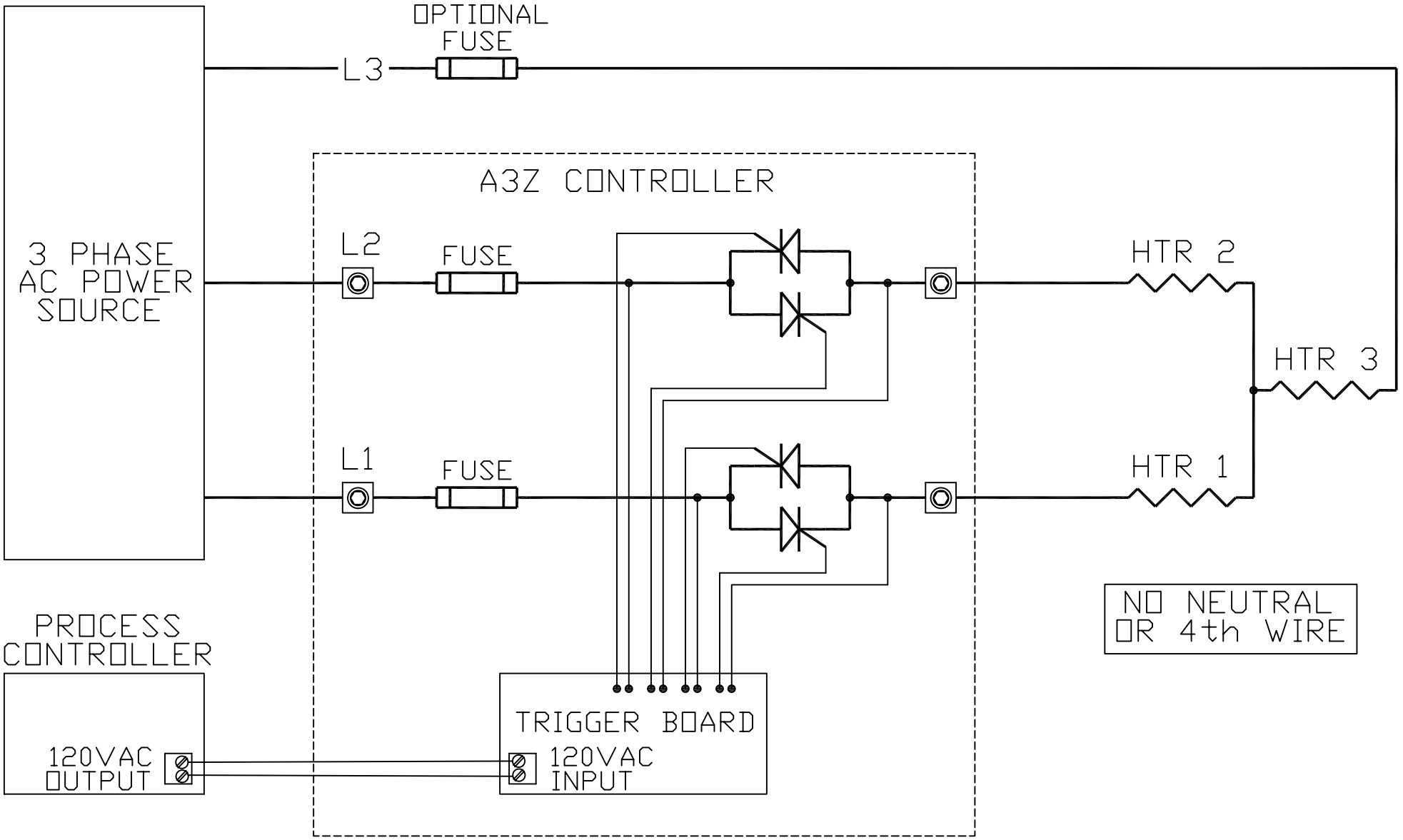
A3Z WIRING DIAGRAM "R32" OPTION
10-32VDC COMMAND INPUT SIGNAL
(3 WIRE 2 LEG WYE LOAD)



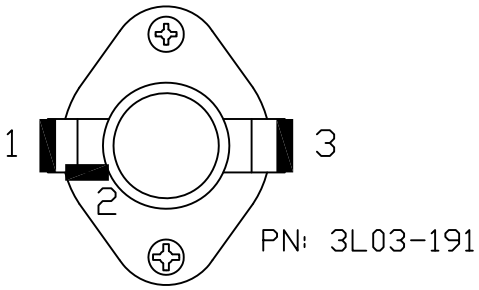
A3Z WIRING DIAGRAM "R120" OPTION
120VAC COMMAND INPUT SIGNAL
(3 WIRE 2 LEG DELTA LOAD)

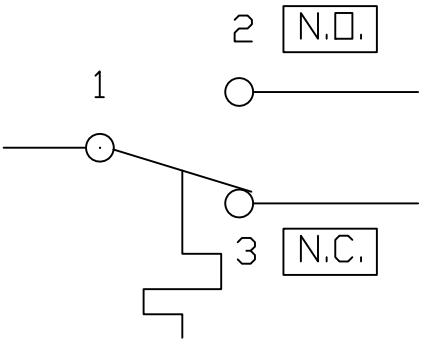


A3Z WIRING DIAGRAM "R120" OPTION
120VAC COMMAND INPUT SIGNAL
(WYE FIRED HEATERS)



OVERTEMPERATURE THERMOSTAT WIRING DIAGRAMS

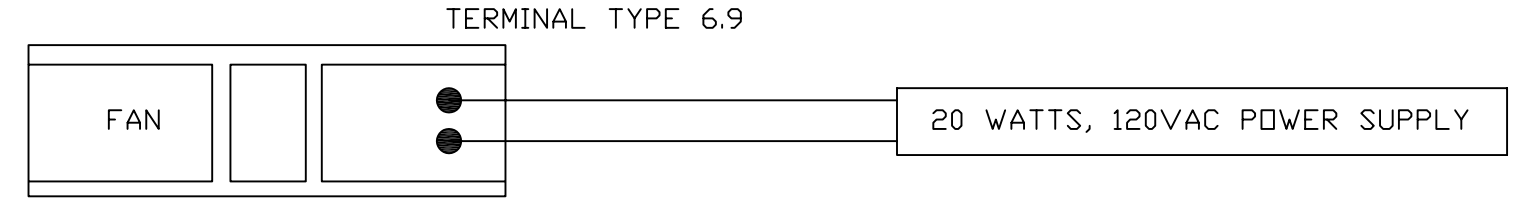




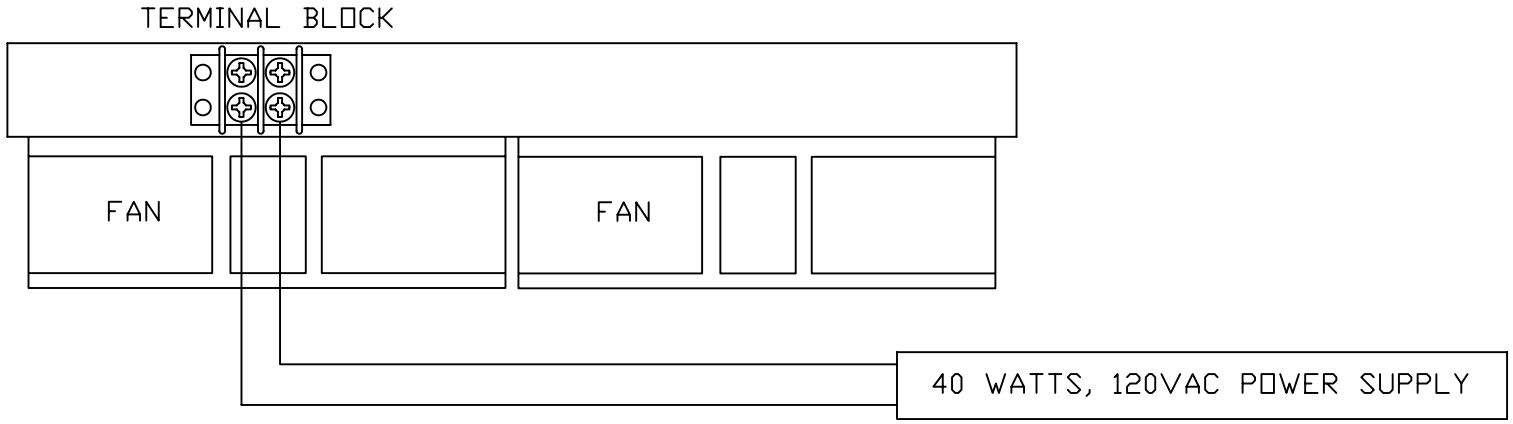
CONTACT RATINGS
1 & 2:
5.8A 120VAC
2.9A/240VAC
1 & 3:
10A/120VAC
5A/240VAC

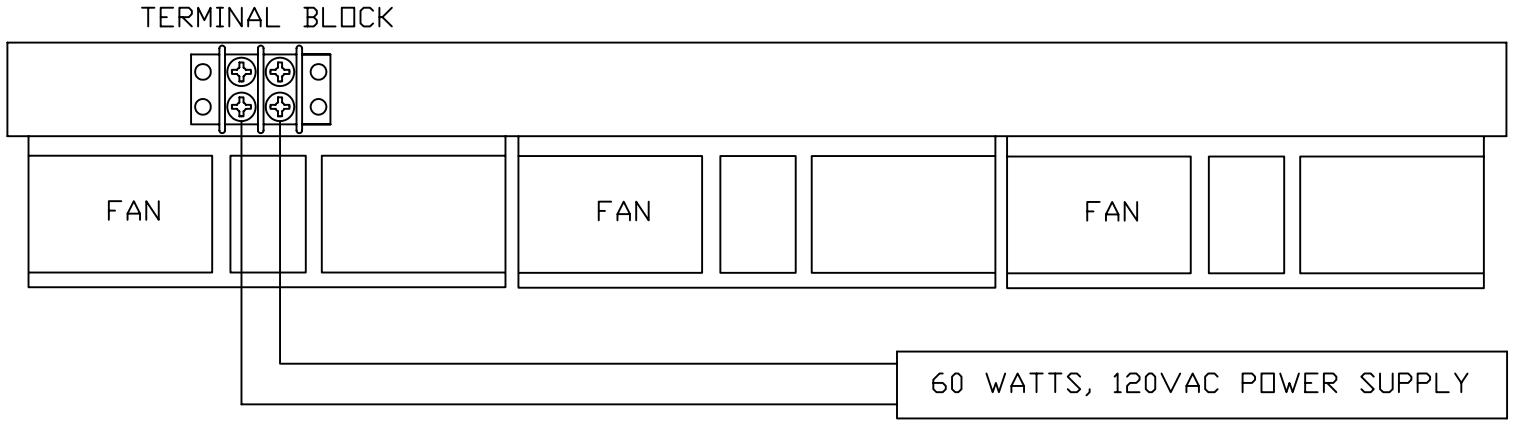
OPEN: 190F
CLOSE: 170F

FAN WIRING DIAGRAMS
100 thru 600 AMPS

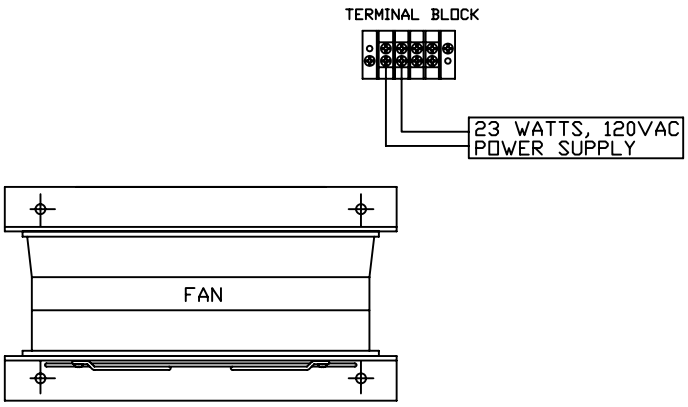


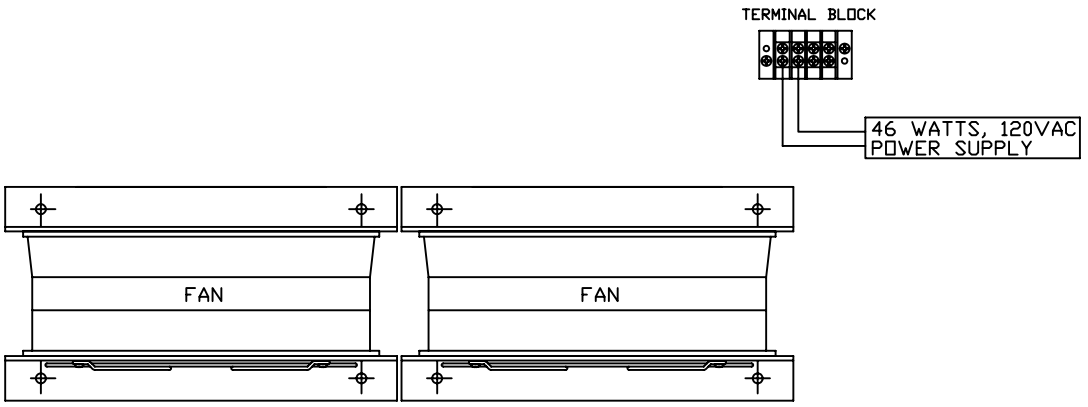
WARNING!
Fans MUST be ON when SCR power controller is on! Power to fans must be applied before or coinciding with the turn on of line voltage to the SCR power controller. *Failure to do so will damage SCRs and other components.*



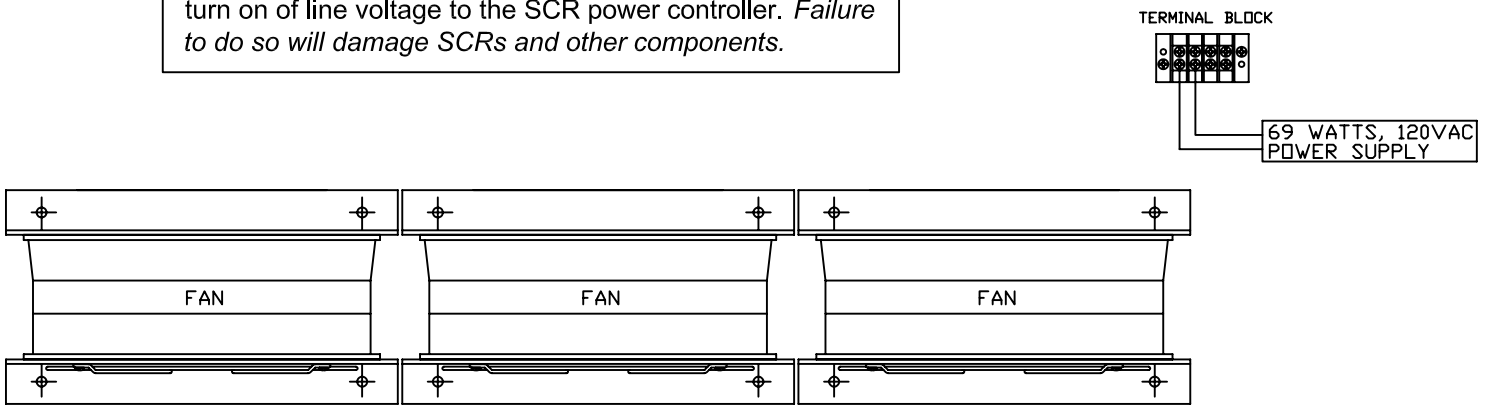


FAN WIRING DIAGRAMS
1200 AMPS

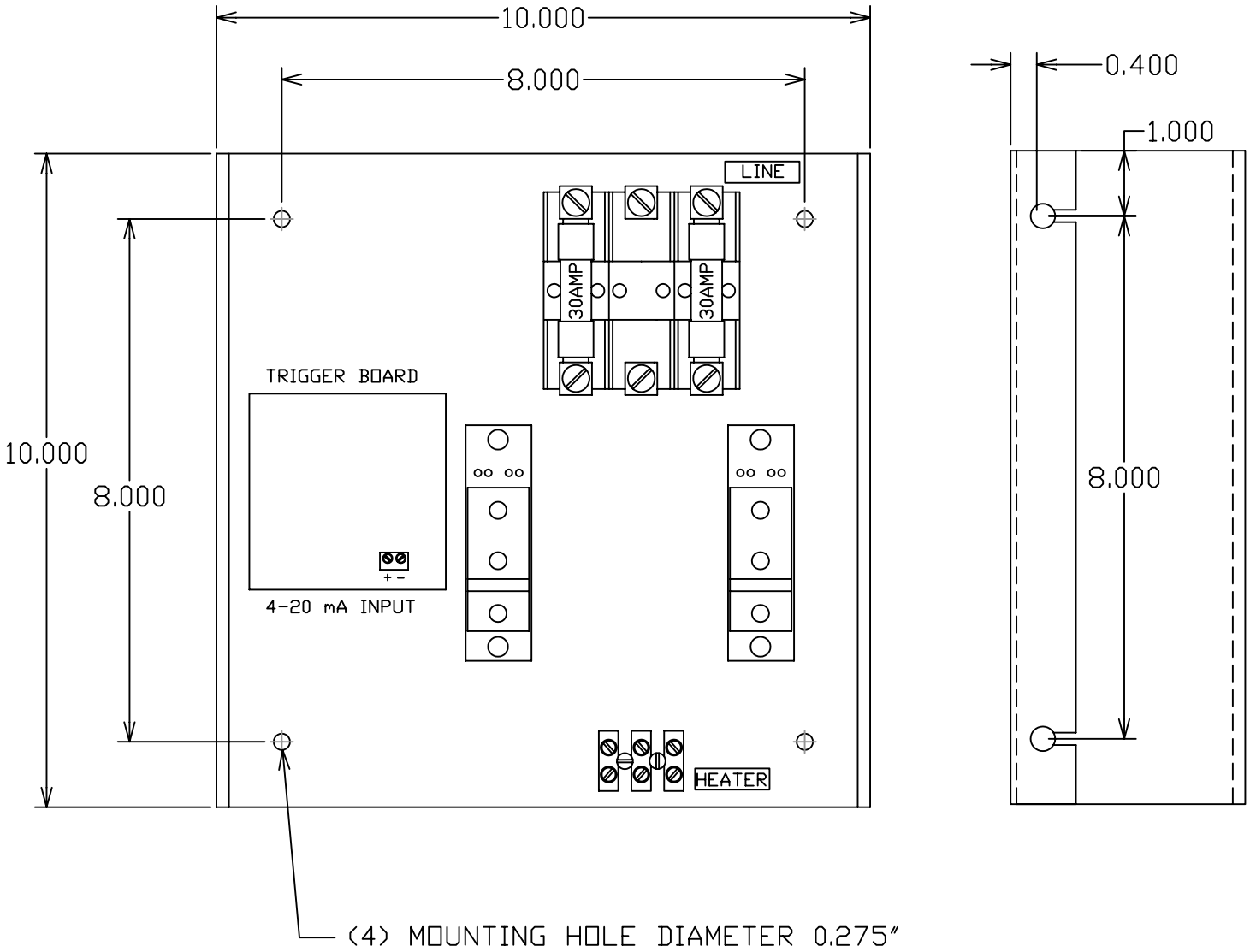


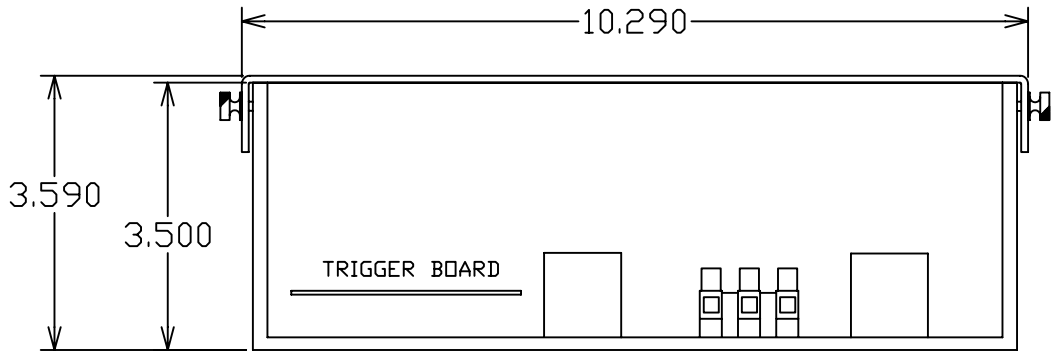


WARNING!
Fans MUST be ON when SCR power controller is on! Power to fans must be applied before or coinciding with the turn on of line voltage to the SCR power controller. *Failure to do so will damage SCRs and other components.*



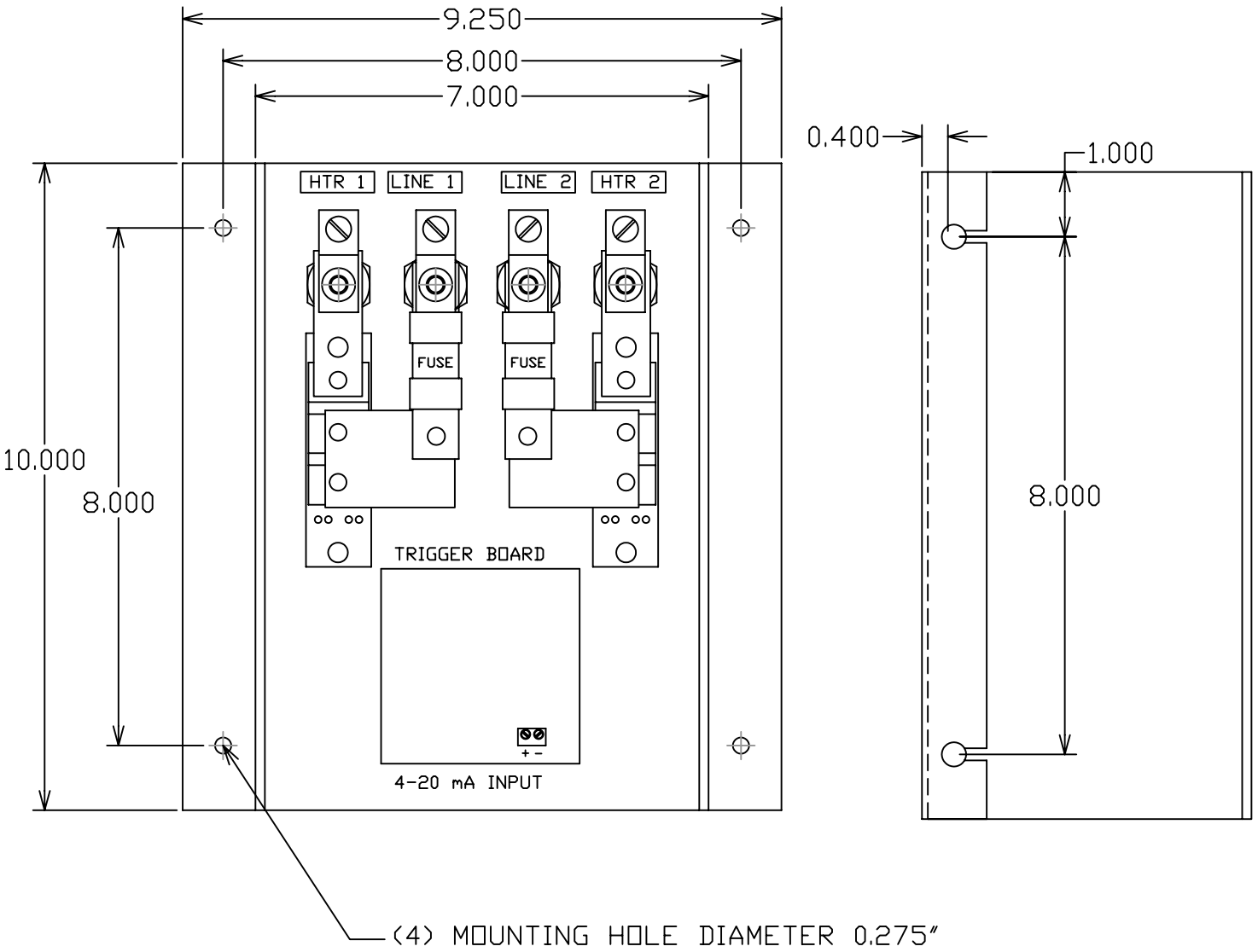
PHYSICAL DIMENSIONS
A3Z - 30 AMP

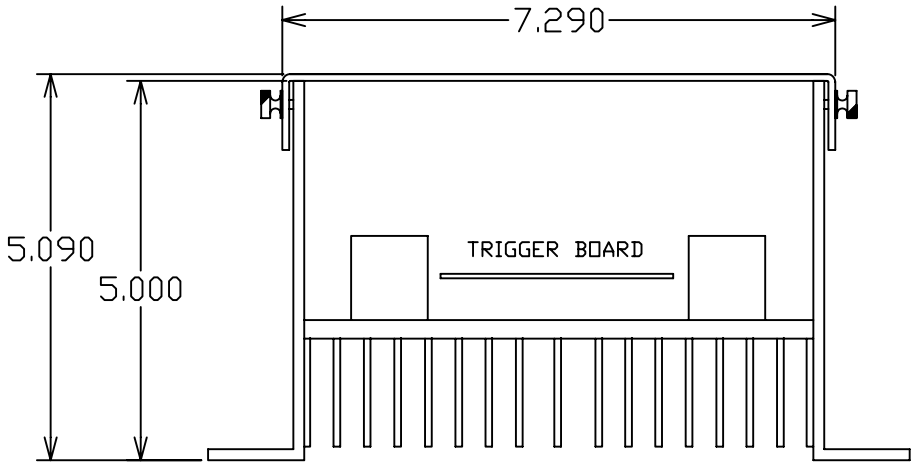




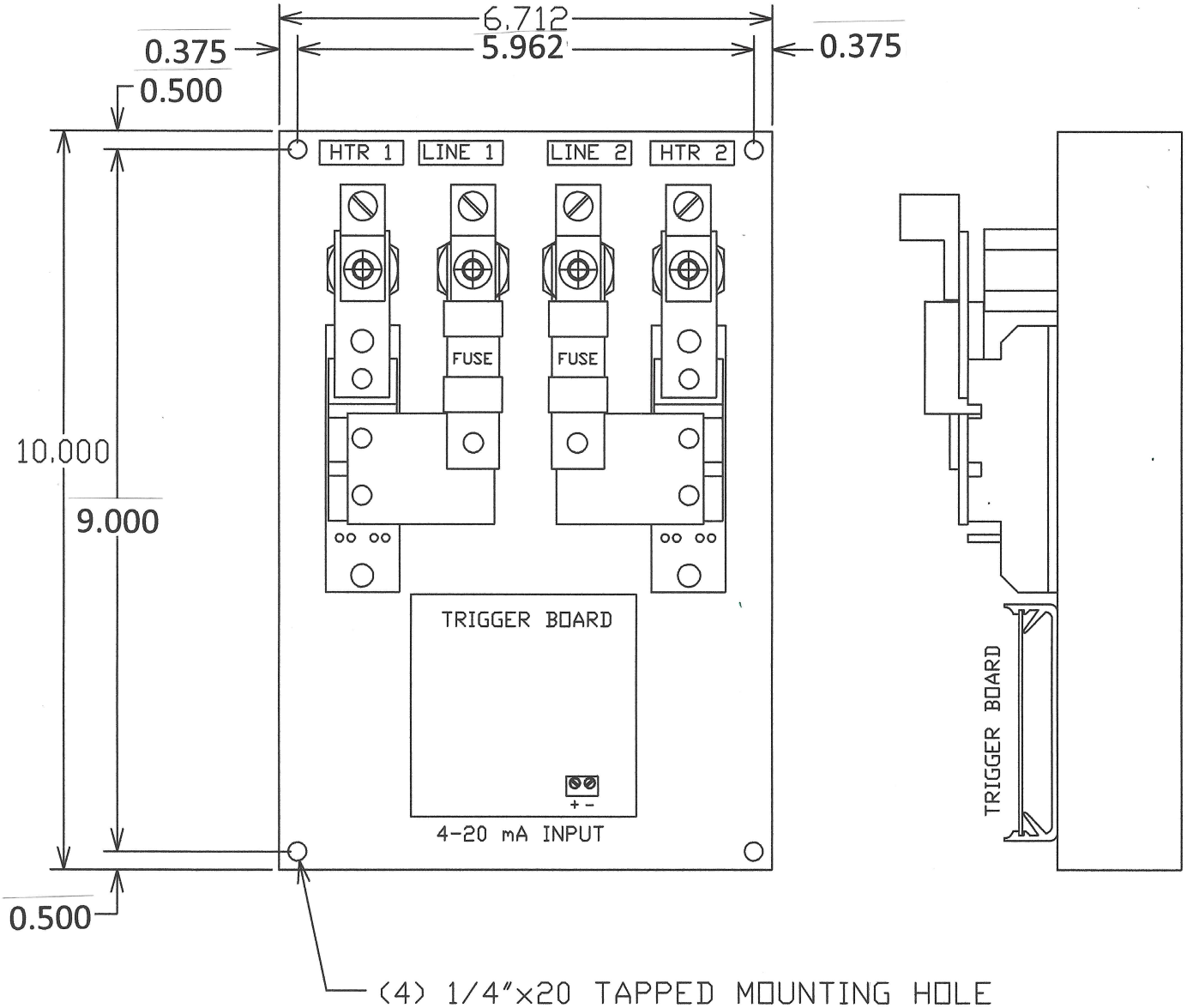
PHYSICAL DIMENSIONS

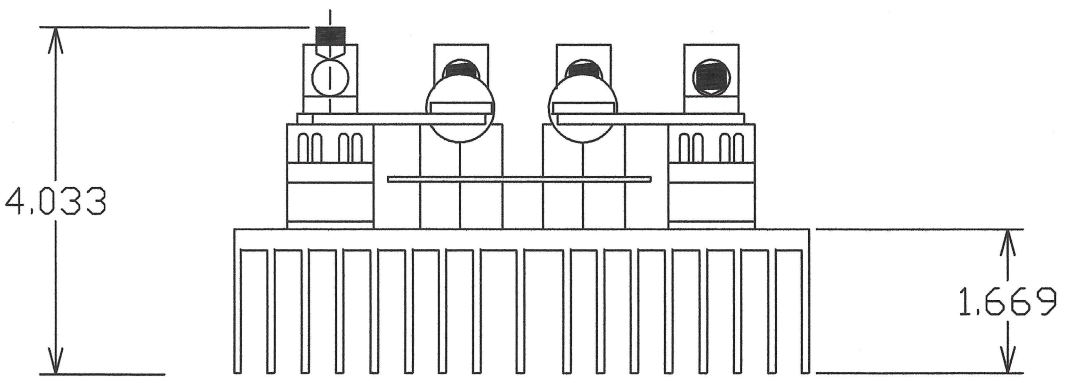
A3Z - 40 & 60 AMP





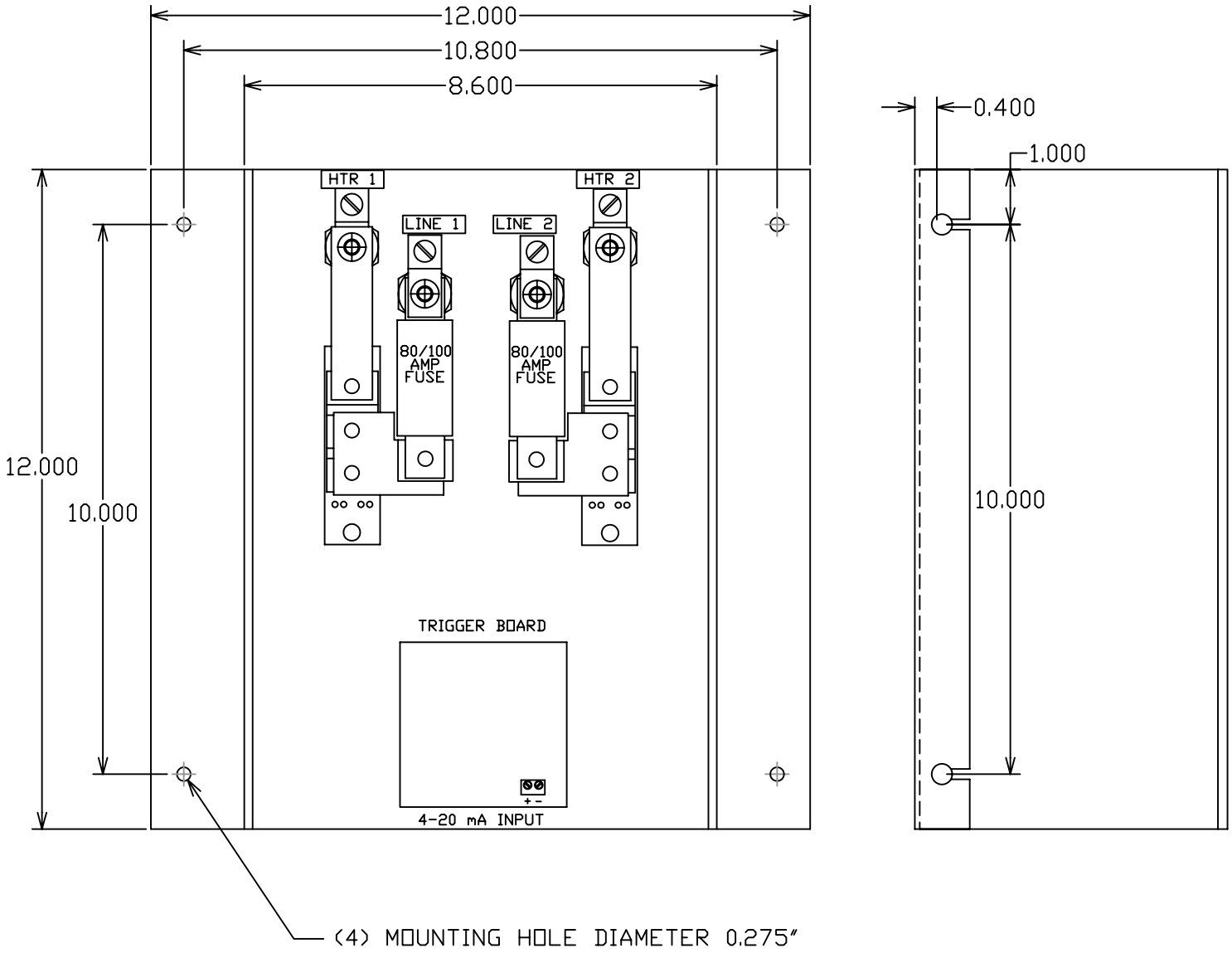
PHYSICAL DIMENSIONS
A3Z - 40 & 60 AMP
THROUGH-HOLE MOUNTING (-TH)

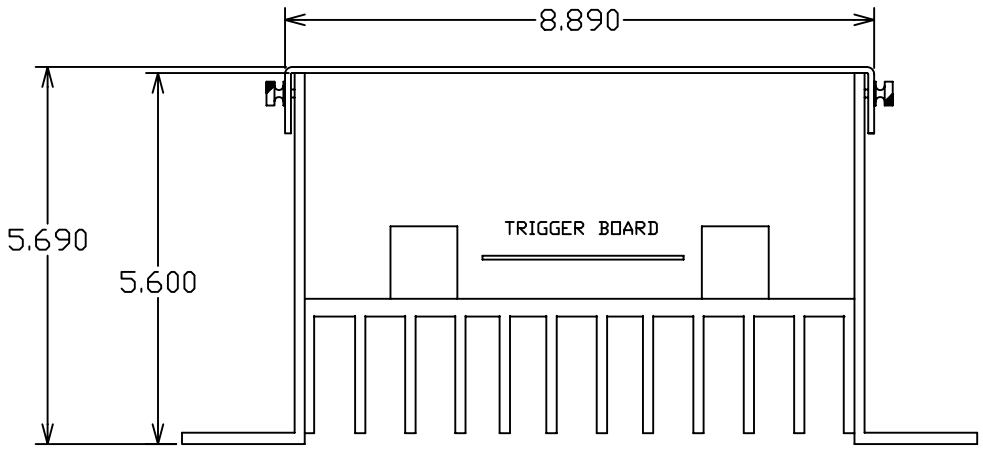




Page 21

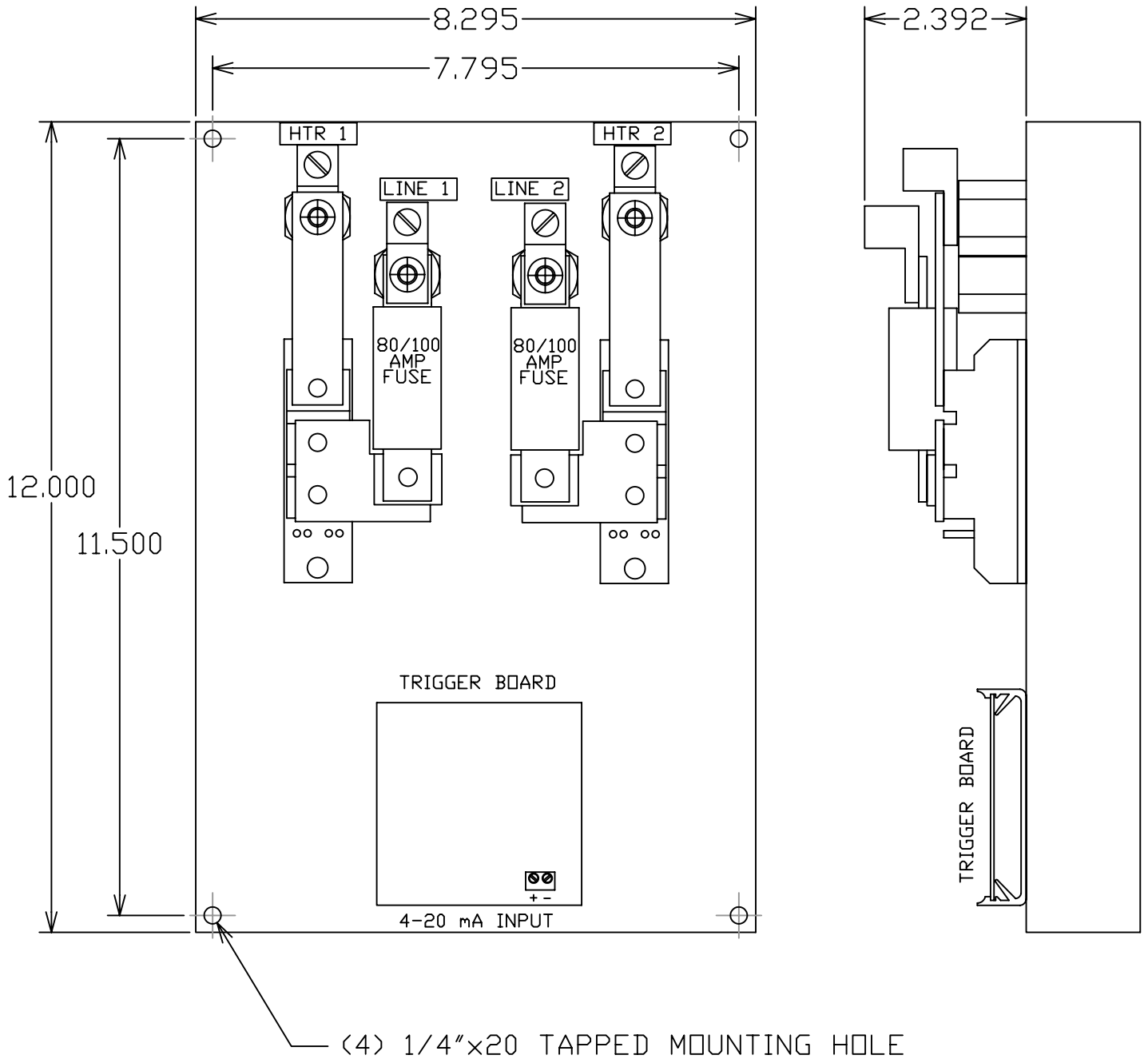
PHYSICAL DIMENSIONS
A3Z - 80 & 100 AMP

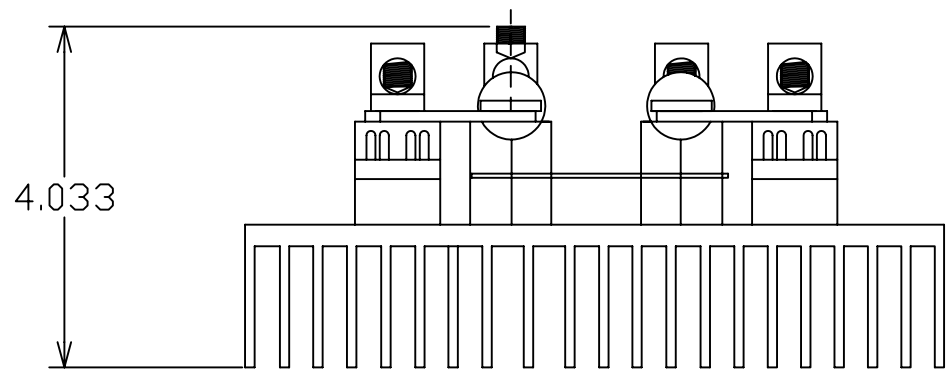




PHYSICAL DIMENSIONS

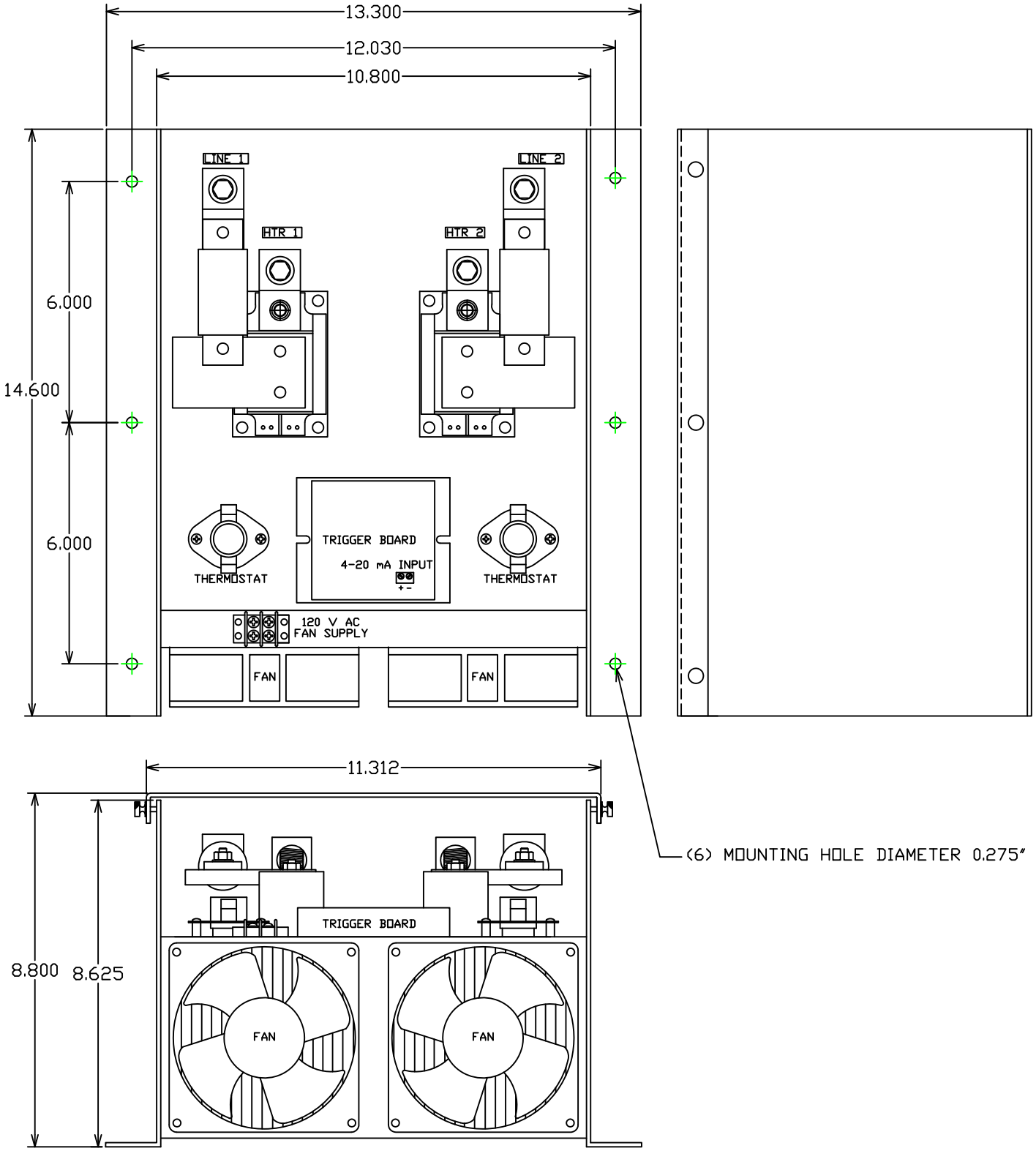
A3Z - 80 & 100 AMP
THROUGH-HOLE MOUNTING (-TH)





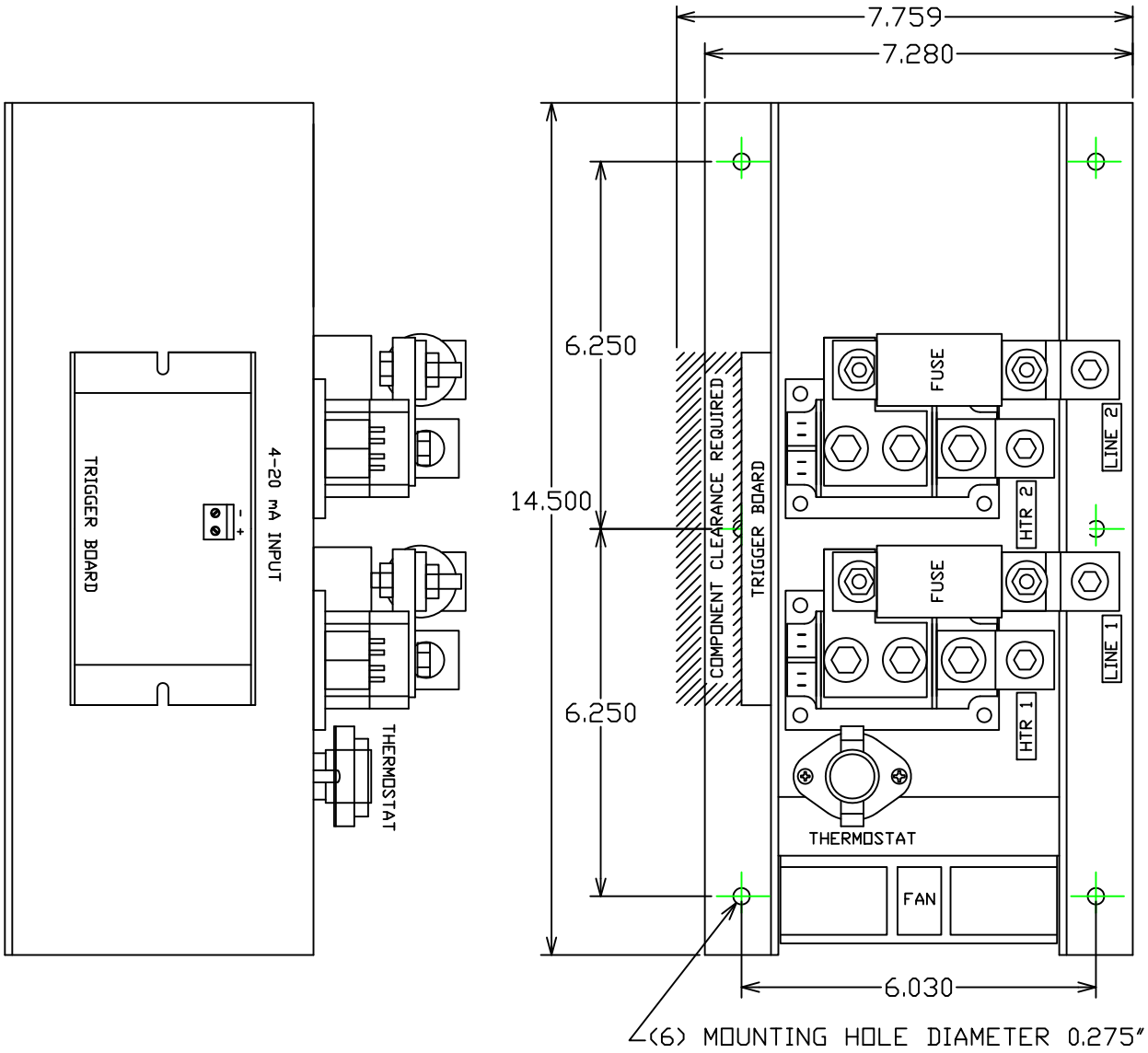
PHYSICAL DIMENSIONS

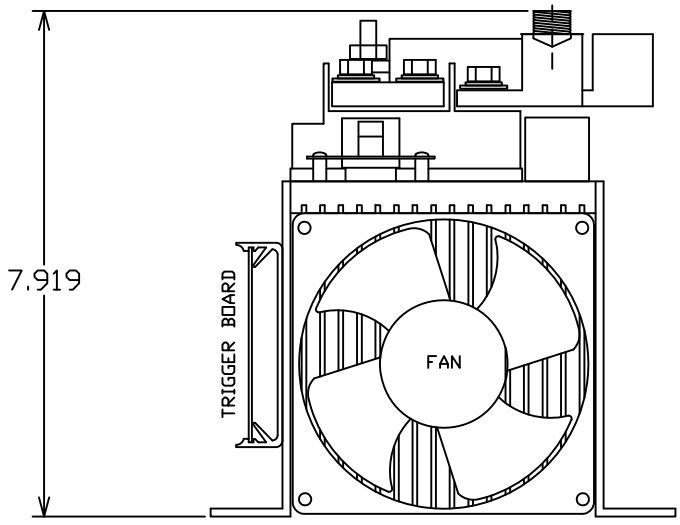
A3Z - 150, 200, 225 & 250 AMP



PHYSICAL DIMENSIONS

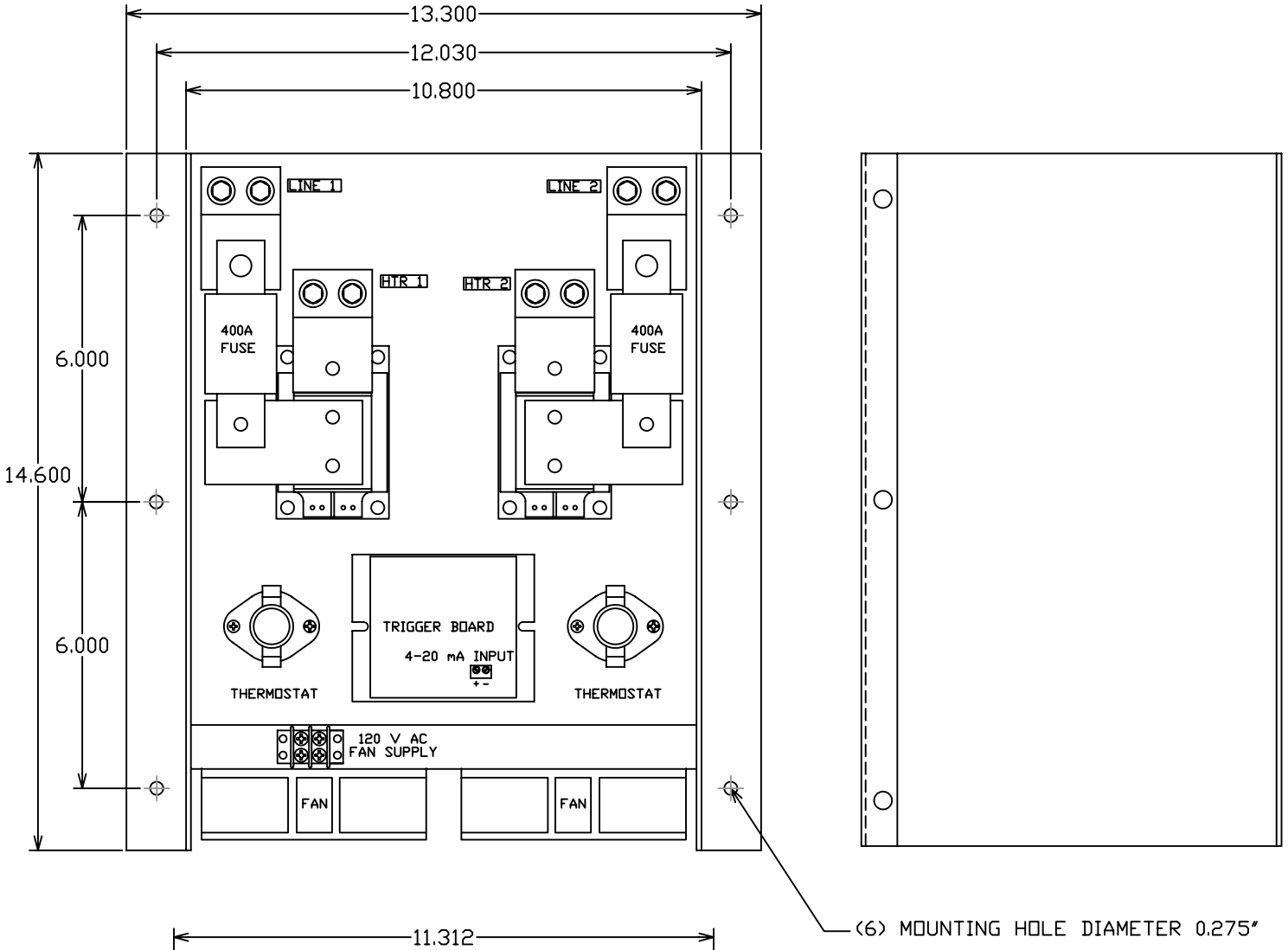
A3Z - 150 & 200 AMP- COMPACT (-C)

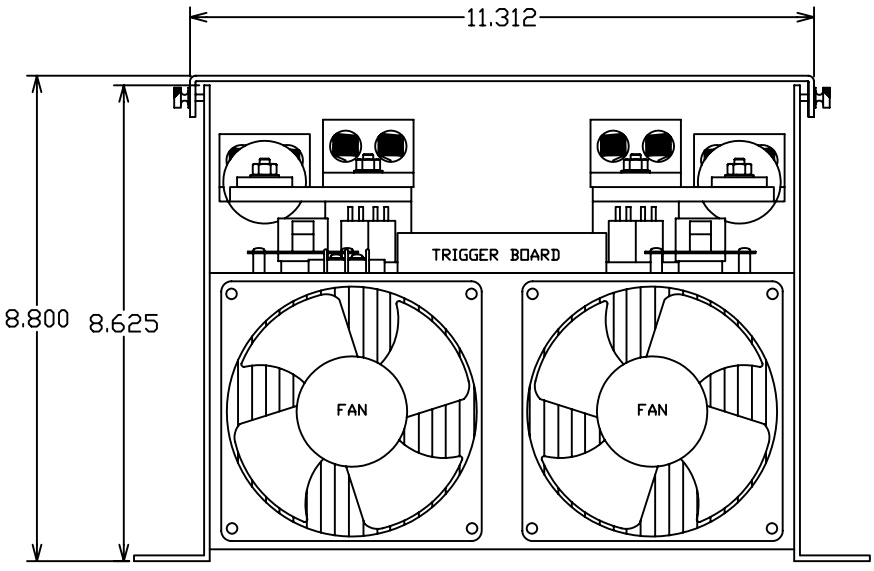




PHYSICAL DIMENSIONS

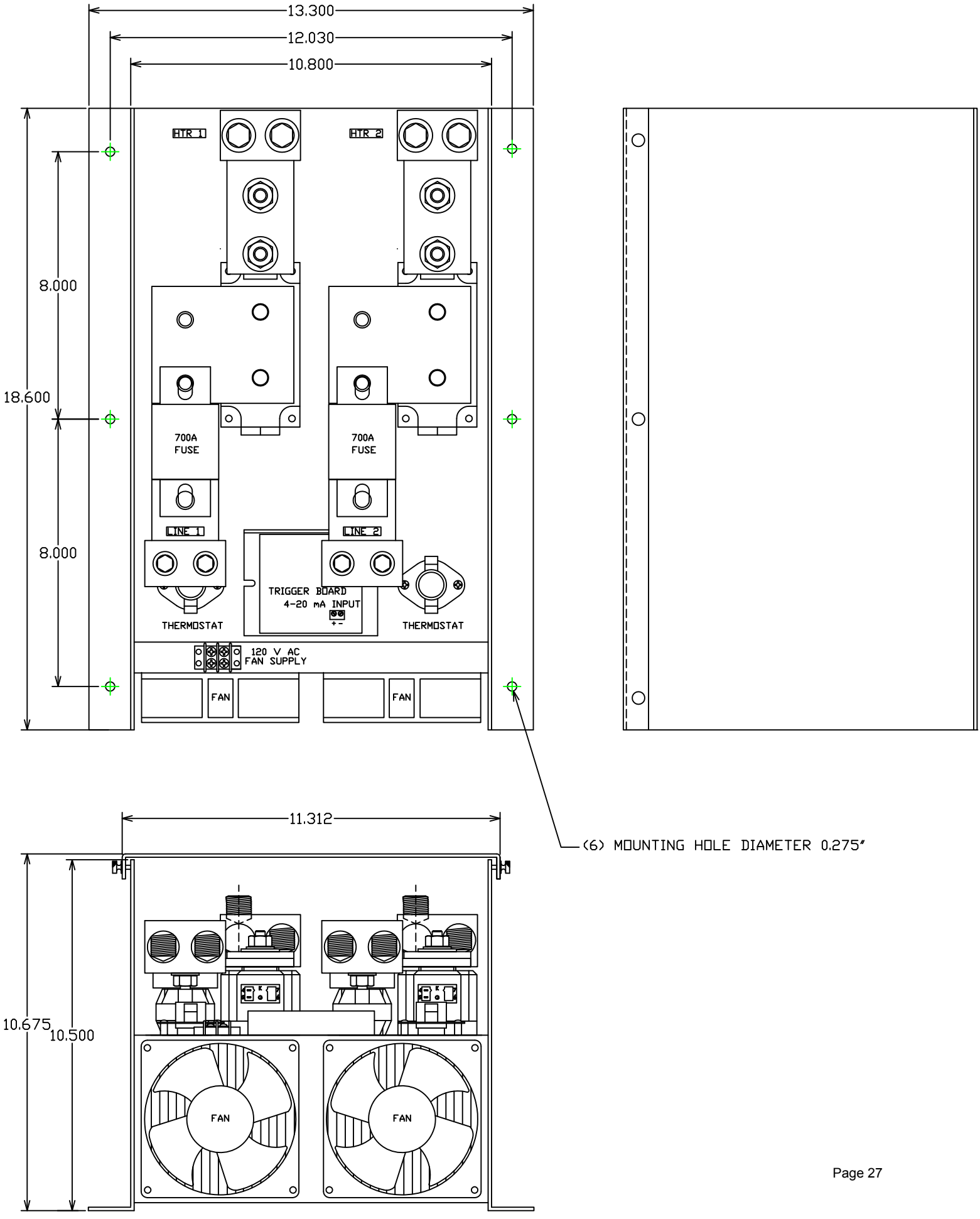
A3Z - 350 AMP



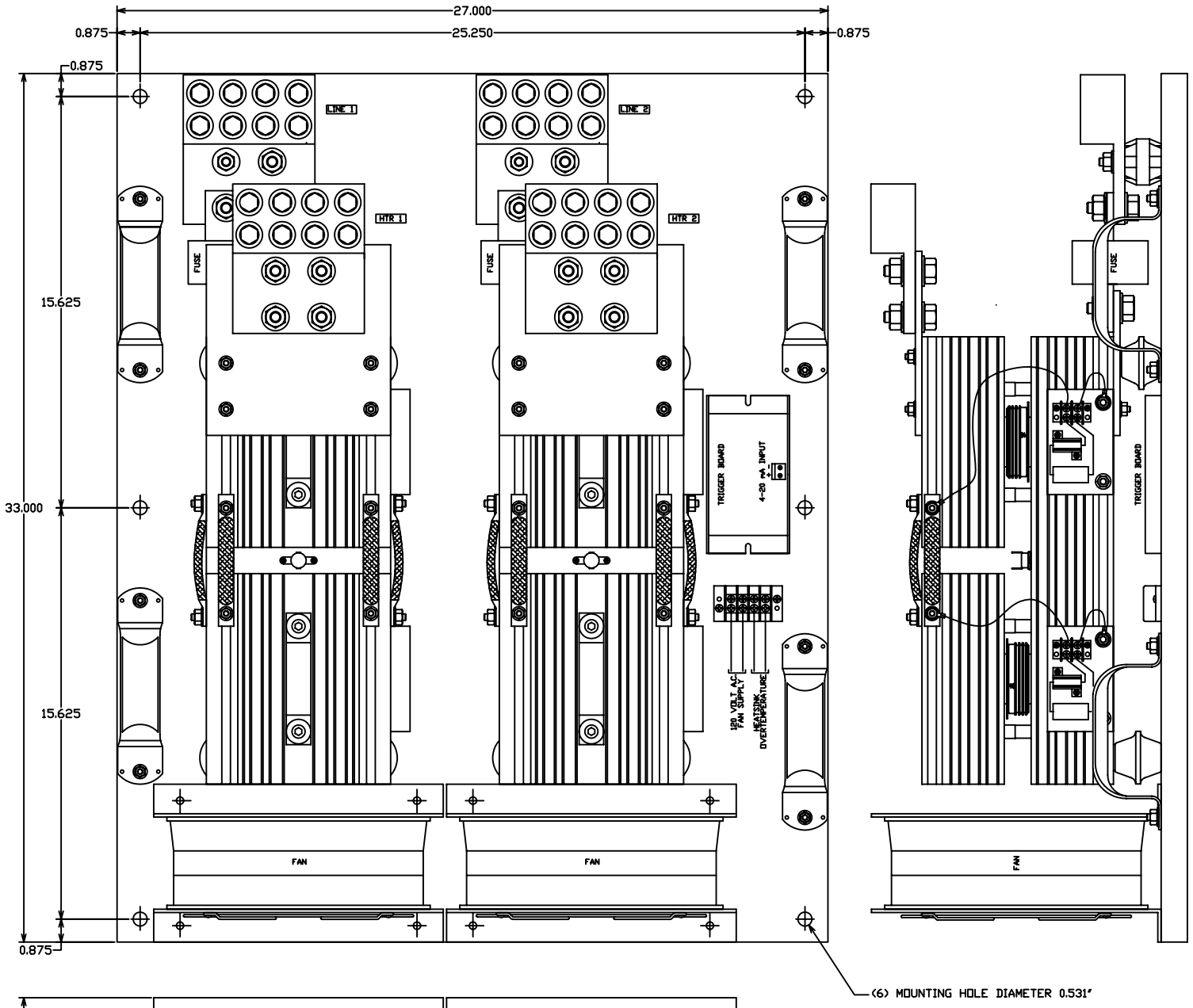


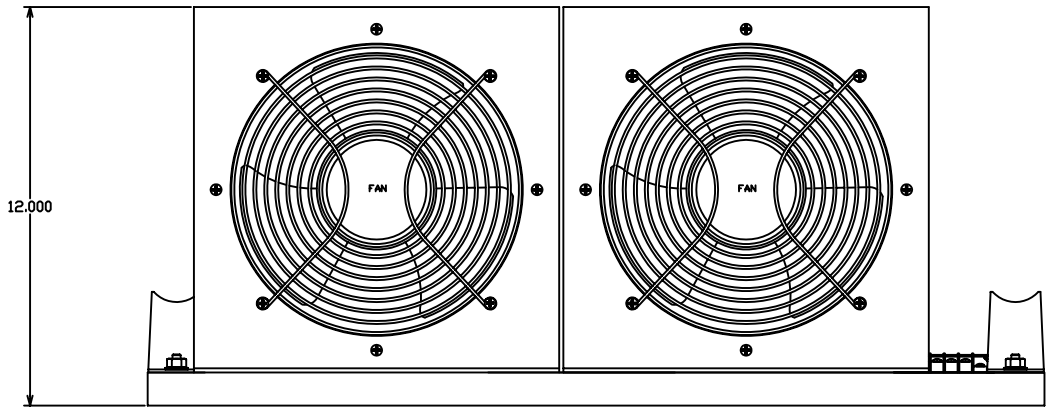
PHYSICAL DIMENSIONS

A3Z - 600 AMP



PHYSICAL DIMENSIONS
A3Z - 1200 AMP





16587 Coastal Highway
Lewes, DE 19958
Phone 302-703-6865
Fax 302-703-6876

Declaration of Conformity

Avatar Instruments A Series SCR Power Controller

CE

Avatar Instruments, Inc.
16587 Coastal Highway
Lewes, DE 19958 USA

Declares that the following product A Series SCR Power Controllers

Model Numbers, voltage and current ratings:
A1P, A3P, A1Z, A3Z, A6Z - (12, 24, 27, 38, 48, or 60) – (30, 40, 60, 80, 100, 150, 200, 225, 250, 350, 500, 600 A)
Models available in Single Phase, Three Phase 2 leg control or Three Phase 3 leg control
All applicable options

Classification:	Electric Power Control, Utilization Categories AC-51, AC-55b, AC-56a Installation Category III, Pollution degree 2
Rated Voltage	24 to 480 Vac, 24 to 600 Vac
Frequency:	45 or 65 Hz

Environmental Rating: IP00 for mounting inside an enclosure

Meets the essential requirements of the European Union Directives by using the relevant standards show below to indicate compliance.

2014/30/EU Electromagnetic Compatibility Directive

EN 60947-4-1: 2019	Low Voltage Switchgear and Control gear: Part 4-1
EN 60947-4-3: 2020	Low Voltage switchgear and control gear Part 4-3: Contactors and motor-starters – AC semiconductor controllers and semiconductor contactors for non-motor loads
CISPR 11:2015	Limits and methods of measurement of electromagnetic disturbance characteristics (EMC) of industrial, scientific and medical (ISM) radio-frequency equipment, Amendment 1:2016

Third party testing conducted by Washington Laboratories, LTD.

Washington Laboratories, LTD
4840 Winchester Boulevard
Frederick, MD 21703

16587 Coastal Highway
Lewes, DE 19958
Phone 302-703-6865
Fax 302-703-6876

EN 60947-4-1: 2019:

IEC 61000-4-2:2008	Electrostatic discharge immunity
IEC 61000-4-3:2006	Radiated, radio frequency electromagnetic field immunity
IEC 61000-4-4:2004	Electrical fast-transient / burst immunity
IEC 61000-4-5:2006	Surge immunity
IEC 61000-4-6:2008	Immunity to conducted disturbances induced by radio-frequency fields
IEC 61000-4-11:2004	Voltage dips, short interruptions and voltage variations immunity

CISPR 11 Group 2, Class A

CISPR11 2015, A1 2016
CISPR11 2009, A1 2010

EN 55011 Radiated Emissions & Conducted Emissions – Radio-frequency disturbance characteristics – Limits and methods of measurement.

CAUTION: This equipment not intended for use in residential or medical environment.

For use in Class B environments, additional external filtering on power lines is **required.** Shielded cables may also be needed.

For use with Phase Angle Control, additional external filtering is **required** to pass Class A conducted Emissions. A Schaffner filter series FN3270-H or equivalent should be used as a line input filter with model A1P & A3P Phase Angle Fired SCRs.

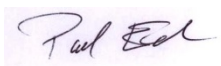
A Schaffner FN2080-16-06 was installed at the AC power input during testing to be CISPR32 CE Class B compliant.

Contact Schaffner EMC, Inc. to find the proper filter for your specific application. Schaffner EMC Phone (USA) 732-225-9533, www.schaffner.com

Name of Authorized Representative: Paul Evalds

Title of Authorized Representative: President

Place of Issue: Lewes, Delaware USA
Date of Issue: March 2, 2022



Signature of Authorized Representative

www.avatarinstruments.com

CUSTOMER NOTES:



Avatar Instruments, Inc. 16587 Coastal Highway Lewes, DE 19958
Phone: (302) 703-6865 contact@avatarinstruments.com www.scrpower.com