



Solutions for AC Drives

KIT 3628T Model M3628R

Storage Bank Discharger And Resistor Bank

Customer Reference Manual

Bonitron, Inc.
Nashville, TN



An industry leader in providing solutions for AC drives.

ABOUT BONITRON

Bonitron designs and manufactures quality industrial electronics that improve the reliability of processes and variable frequency drives worldwide. With products in numerous industries, and an educated and experienced team of engineers, Bonitron has seen thousands of products engineered since 1962 and welcomes custom applications.

With engineering, production, and testing all in the same facility, Bonitron is able to ensure its products are of the utmost quality and ready to be applied to your application.

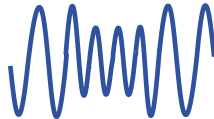
The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. A clear advantage Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

The sales and marketing teams work closely with engineering to provide up-to-date information and provide remarkable customer support to make sure you receive the best solution for your application. Thanks to this combination of quality products and superior customer support, Bonitron has products installed in critical applications worldwide.

AC DRIVE OPTIONS

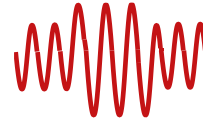
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable frequency drives and aid in reducing drive faults. Below is a sampling of Bonitron's current product offering.

WORLD CLASS PRODUCTS



Undervoltage Solutions

Uninterruptible Power for Drives
(DC Bus Ride-Thru)
Voltage Regulators
Chargers and Dischargers
Energy Storage



Overvoltage Solutions

Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives



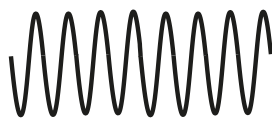
Common Bus Solutions

Single Phase Power Supplies
3-Phase Power Supplies
Common Bus Diodes



Portable Maintenance Solutions

Capacitor Formers
Capacitor Testers



Power Quality Solutions

12 and 18 Pulse Kits



Green Solutions

Line Regeneration

KIT 3628T & M3628R

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1. INTRODUCTION

1.1. WHO SHOULD USE THIS MANUAL

This manual is intended for use by anyone who is responsible for integrating, installing, maintaining, troubleshooting, or using this equipment with any capacitive energy storage system.

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the KIT 3628T capacitor storage bank discharger. It will provide the user with the necessary information to successfully install, integrate, and use the KIT 3628T in a capacitive energy storage system.

In the event of any conflict between this document and any publication and/or documentation related to the capacitive energy storage system, the latter shall have precedence.

1.3. MANUAL REVISION

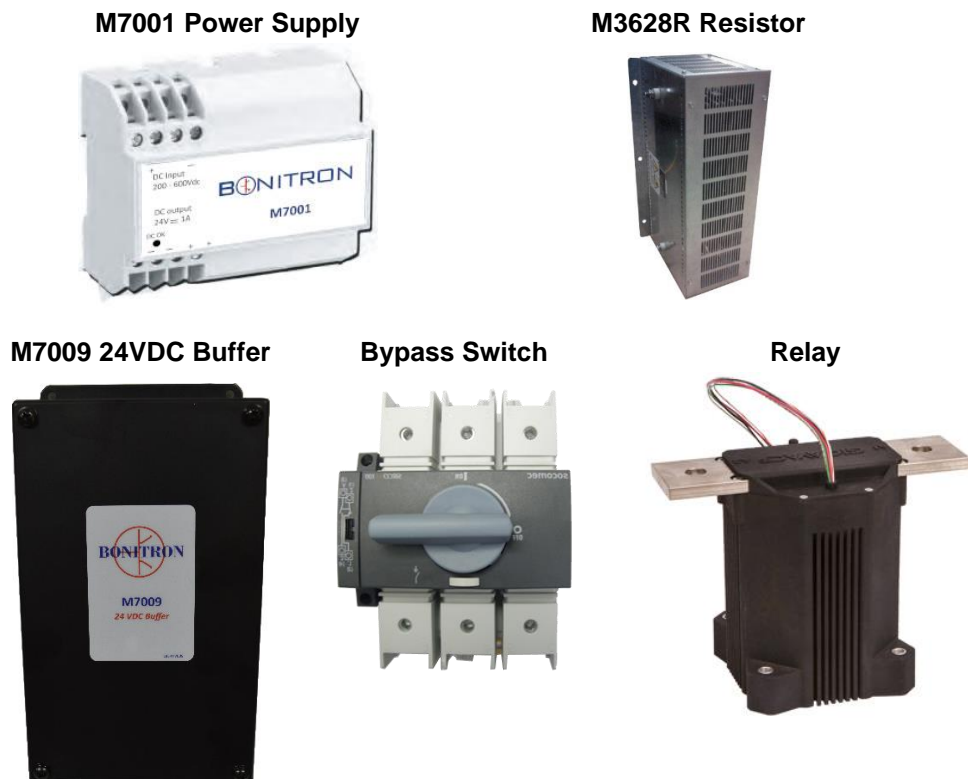
The initial release of this manual is Rev 00a.

Additions to the KIT 3628T product offerings were made in Rev 01a.








Updated table 6-2 in Rev 01b.

Updated section 4.1 in Rev 01c.

Figure 1-1: KIT 3628T



1.4. SYMBOL CONVENTIONS USED IN THIS MANUAL AND ON EQUIPMENT

	<p>Earth Ground or Protective Earth</p>
	<p>AC Voltage</p>
	<p>DC Voltage</p>
 <p>DANGER!</p>	<p>DANGER: Electrical hazard - Identifies a statement that indicates a shock or electrocution hazard that must be avoided.</p>
 <p>DANGER!</p>	<p>DANGER: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.</p>
 <p>CAUTION!</p>	<p>CAUTION: Identifies information about practices or circumstances that can lead to property damage, or economic loss. Attentions help you identify a potential hazard, avoid a hazard, and recognize the consequences.</p>
 <p>CAUTION!</p>	<p>CAUTION: Heat or burn hazard - Identifies a statement regarding heat production or a burn hazard that should be avoided.</p>

2. PRODUCT DESCRIPTION

Capacitors are taking the place of batteries as the preferred method of storing energy for many industrial applications that experience short term power outages. One major advantage capacitors have over batteries is that the energy can be completely drained for safer maintenance and shipping. The downside is that the capacitors can take a significant amount of time to self-discharge. It is for this purpose Bonitron developed the KIT 3628T capacitor discharger.

KIT 3628T is a combination of a relay, 24V power supply, and 24V backup module. In conjunction with an appropriately sized M3628R discharge resistor. The system will discharge an attached capacitor bank to below 50V in 1 minute. Automatic discharge can be set up using an aux contact on the cabinet disconnect switch or breaker, or manual discharge can be triggered locally or remotely via PLC control.

KIT 3628T is available in voltages up to 1000 VDC, and in peak currents up to 600 amps. Complementary M3628R resistors are available up to 4000 kJ, and can be paralleled for faster discharge times or for larger energy banks.

2.1. RELATED PRODUCTS

M3460 SERIES RIDE-THRU MODULES

Voltage regulators used for sag or outage protection of higher power systems.

M3534 SERIES RIDE-THRU MODULES

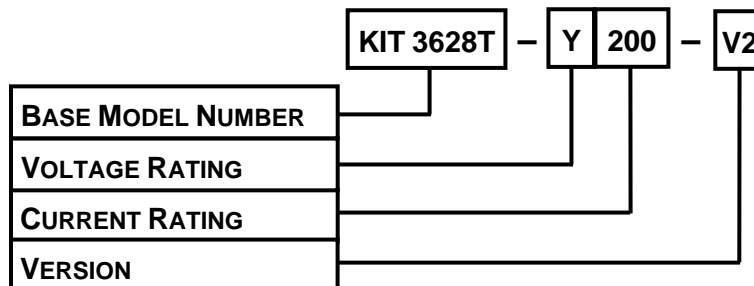
Voltage regulators used for sag or outage protection of lower power systems.

M3528 BATTERY AND ULTRACAPACITOR CHARGERS

Chargers for high voltage storage strings.

2.2. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown for KIT 3628T



BASE MODEL NUMBER

The base model number for all storage bank discharger kits is KIT 3628T.

SYSTEM VOLTAGE RATING

The system voltage rating indicates the nominal voltage of the system the KIT 3628T is intended to be a part of.

Table 2-1: System Voltage Ratings for KIT 3628T

RATING CODE	MAXIMUM DC VOLTAGE
Y	1000 VDC

KIT 3628T & M3628R

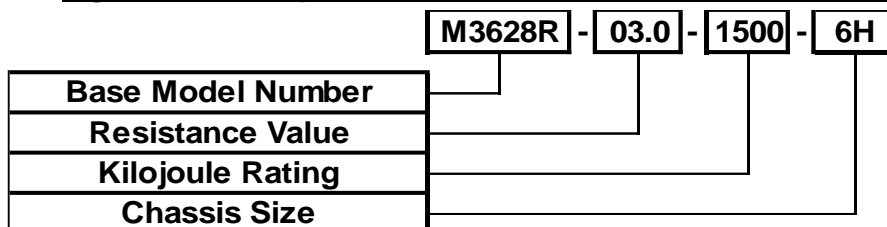
CURRENT RATING

The current rating indicates the rated instantaneous peak current for the KIT 3628T, which is equal to the DC storage bus voltage divided by the M3628R resistance. For example, a 600 Amp peak KIT 3628T is designated by a code of **600**.

VERSION

The current version indicates the makeup of the kit. Latest version code is **V2**.

Figure 2-2: Example of Part Number Breakdown for M3628R



BASE MODEL NUMBER

The base model number for all M3628 resistor banks is **M3628R**.

RESISTANCE VALUE

The resistance value indicates the value of the M3628R resistor bank in ohms. For example, a 3 ohm resistor bank is **03.0**.

KILOJOULE RATING

The kilojoule rating indicates the energy rating of the M3628R resistor bank in kilojoules. For example, a resistor bank rated at 1500 kilojoules is **1500**.

CHASSIS SIZE

The chassis size indicates the chassis used for the M3628R. It is determined by the kilojoule rating of the M3628R.

Table 2-2: Chassis Sizes for M3628R

CHASSIS SIZE	M3628R KILOJOULE RATINGS
6T	350 kJ
6H	750 - 2000 kJ
10H	3000 kJ
14H	4000 kJ

2.3. GENERAL SPECIFICATIONS

Table 2-3: KIT 3628T General Specifications

PARAMETER	SPECIFICATION
Capacitor Bank Voltage	190-1000 VDC
Peak Current	200-600 ADC
Operating Temperature	-20 to +50°C
Storage Temperature	-20 to +65°C
Humidity	Below 85% non-condensing
Altitude	Below 5000m

Table 2-4: M3628R General Specifications

PARAMETER	SPECIFICATION
Energy Rating	350-4000 kilojoules maximum
Duty Cycle	1 discharge at rated joules every 60 minutes with no forced air, or 1% duty cycle at full voltage
Operating Ambient Temperature	-20 to +50°C
Storage Temperature	-50° to +100°C
Humidity	Below 90% non-condensing
Altitude	Below 1000m without derating

2.4. GENERAL PRECAUTIONS AND SAFETY WARNINGS



- **HIGH VOLTAGES MAY BE PRESENT!**
- **NEVER ATTEMPT TO OPERATE THIS PRODUCT WITH THE ENCLOSURE COVER REMOVED!**
- **NEVER ATTEMPT TO SERVICE THIS PRODUCT WITHOUT FIRST DISCONNECTING POWER TO AND FROM THE UNIT.**
- **ALWAYS ALLOW ADEQUATE TIME FOR RESIDUAL VOLTAGES TO DRAIN BEFORE OPENING THE ENCLOSURE.**
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS INJURY OR DEATH!**



- **CERTAIN COMPONENTS WITHIN THIS PRODUCT MAY GET HOT DURING OPERATION.**
- **ALWAYS ALLOW AMPLE TIME FOR THE UNIT TO COOL BEFORE ATTEMPTING SERVICE ON THIS PRODUCT.**
- **INSTALLATION AND/OR REMOVAL OF THIS PRODUCT SHOULD ONLY BE ACCOMPLISHED BY A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE OR EQUIVALENT REGULATIONS.**
- **BEFORE ATTEMPTING INSTALLATION OR REMOVAL OF THIS PRODUCT, BE SURE TO REVIEW ALL SYSTEM DOCUMENTATION FOR PERTINENT SAFETY PRECAUTIONS.**
- **NO USER-SERVICEABLE PARTS ARE CONTAINED WITHIN THIS PRODUCT. INOPERABLE UNITS SHOULD BE REPLACED OR RETURNED FOR REPAIR.**

ANY QUESTIONS AS TO APPLICATION, INSTALLATION OR SERVICE SAFETY SHOULD BE DIRECTED TO THE EQUIPMENT SUPPLIER.

3. INSTALLATION INSTRUCTIONS

The KIT 3628T is intended to be part of a larger variable frequency drive system and will require different hardware for interconnection based on the installation. An appropriate enclosure may need to be provided to protect personnel from contact and the system from damage. The enclosure may also need to protect the equipment from the installation environment.

Please read this manual completely before designing the drive system or enclosure layout to ensure all required elements are included.

3.1. ENVIRONMENT

The maximum ambient operating temperature of the KIT 3628T should not exceed 50°C. Temperatures above this can cause overheating during operation.

The M3628R discharge resistor is designed to dissipate energy in the form of heat and can cause overheating of other components in the system if not cooled properly.

Non-condensing, filtered air may be required to cool the system. This is especially true if the M3628R is mounted inside the enclosure.

3.2. UNPACKING

Inspect the shipping crate of the KIT 3628T for damage.

Notify the shipping carrier if damage is found.

3.3. MOUNTING

Mounting dimensions can be found in Section 6.

The M3628R should be mounted with a clearance of 4 inches on each side with no equipment mounted above the resistor. Connection wires should not be above the resistor elements.

3.4. WIRING AND USER CONNECTIONS

Review this entire Section before attempting to wire the KIT 3628T.

3.4.1. POWER WIRING



**ENSURE THAT ALL STORAGE BANK MODULES ARE DISCONNECTED AND LOCKED OUT BEFORE ATTEMPTING SERVICE OR INSTALLATION.
FAILURE TO HEED THIS WARNING MAY RESULT IN SERIOUS INJURY OR DEATH!**

This section provides information pertaining to the field wiring connections of the KIT 3628T and M3628R. Actual connection points and terminal numbers of the storage capacitors will be found in the documentation provided with the drive system.

Be sure to review all pertinent AC drive system documentation as well as the connection details listed below before proceeding.

Table 3-1: M7001 Wiring Connections

TERMINAL DESIGNATION	FUNCTION	CONNECTION	WIRING SPECIFICATION	TORQUE
190-1000 VDC (+-)	Capacitor Voltage Input	M4 Screw Terminal	10-24 AWG	6 lb-in
24 VDC (+-)	24 VDC Output		10-24 AWG	

Table 3-2: M7009 Wiring Connections

TERMINAL DESIGNATION	FUNCTION	CONNECTION	WIRING SPECIFICATION	TORQUE
24 VDC (+-)	24 VDC Input/Output	Cage Clamp	16-24 AWG	2.2 lb-in

Table 3-3: HX241 Relay Wiring Connections

TERMINAL DESIGNATION	FUNCTION	CONNECTION	TORQUE
X1 & X2	Coil Input	20 AWG	N/A
A1 & A2	Normally Open Contacts	M8 Stud	90 lb-in

Table 3-4: HX460 Relay Wiring Connections

TERMINAL DESIGNATION	FUNCTION	CONNECTION	TORQUE
X1 & X2	Coil Input	22 AWG	N/A
T1 & T2	Normally Open Contacts	Busbar	N/A

The total wiring distance between the capacitor bank, KIT 3628T relay, and M3628R should not be longer than 50 feet. Wire in the discharge path can be sized for 2/3 of the peak discharge current (V_{dc}/R).

Ensure correct polarity for the connection between M7001 and M7009, and the connection between the capacitor bank and M7001. Failure to do so can cause severe damage to the system.



ALWAYS MEASURE DC VOLTAGES AND FOLLOW PROPER PRECAUTIONS TO ENSURE THEY ARE AT SAFE LEVELS BEFORE MAKING CONNECTIONS.

Figure 3-1: KIT 3628T-Y200-V2 (200A) Typical Wiring

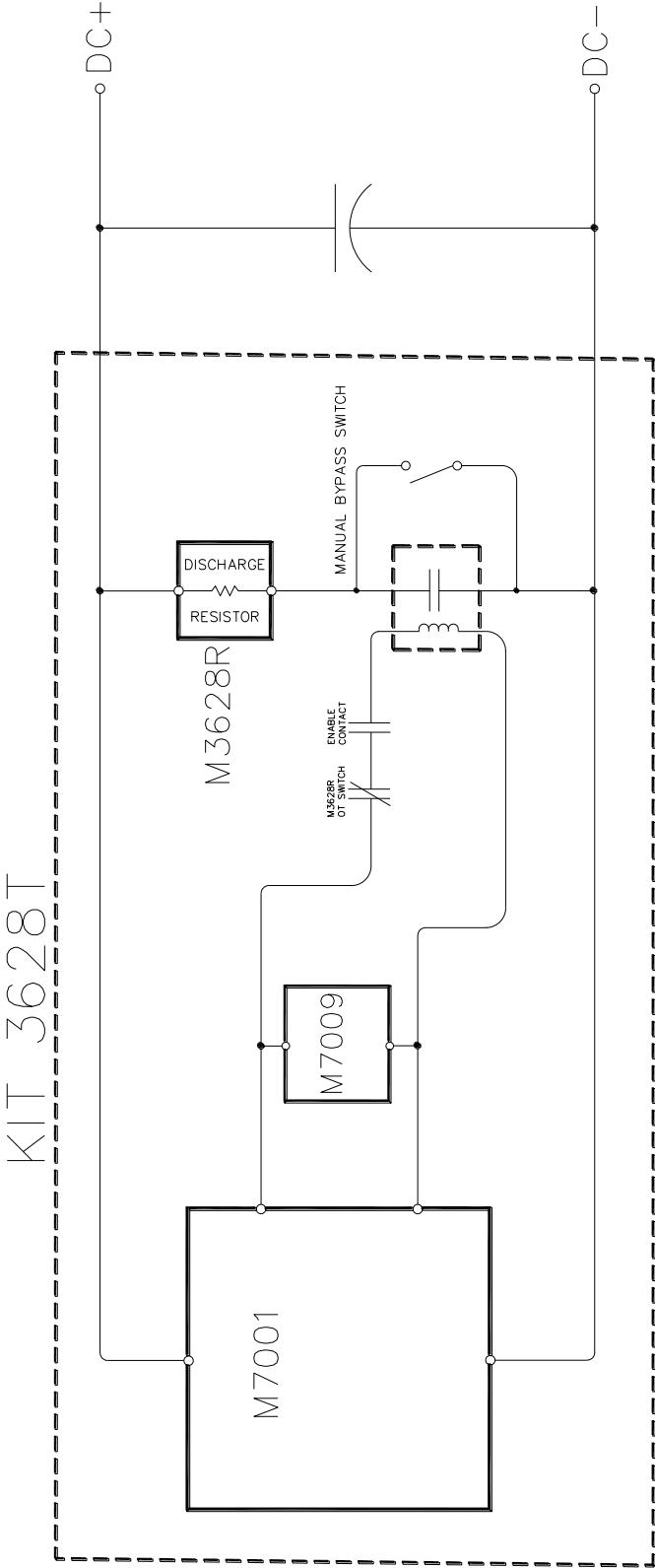


Figure 3-2: KIT 3628T-Y600-V2 (600A) Typical Wiring

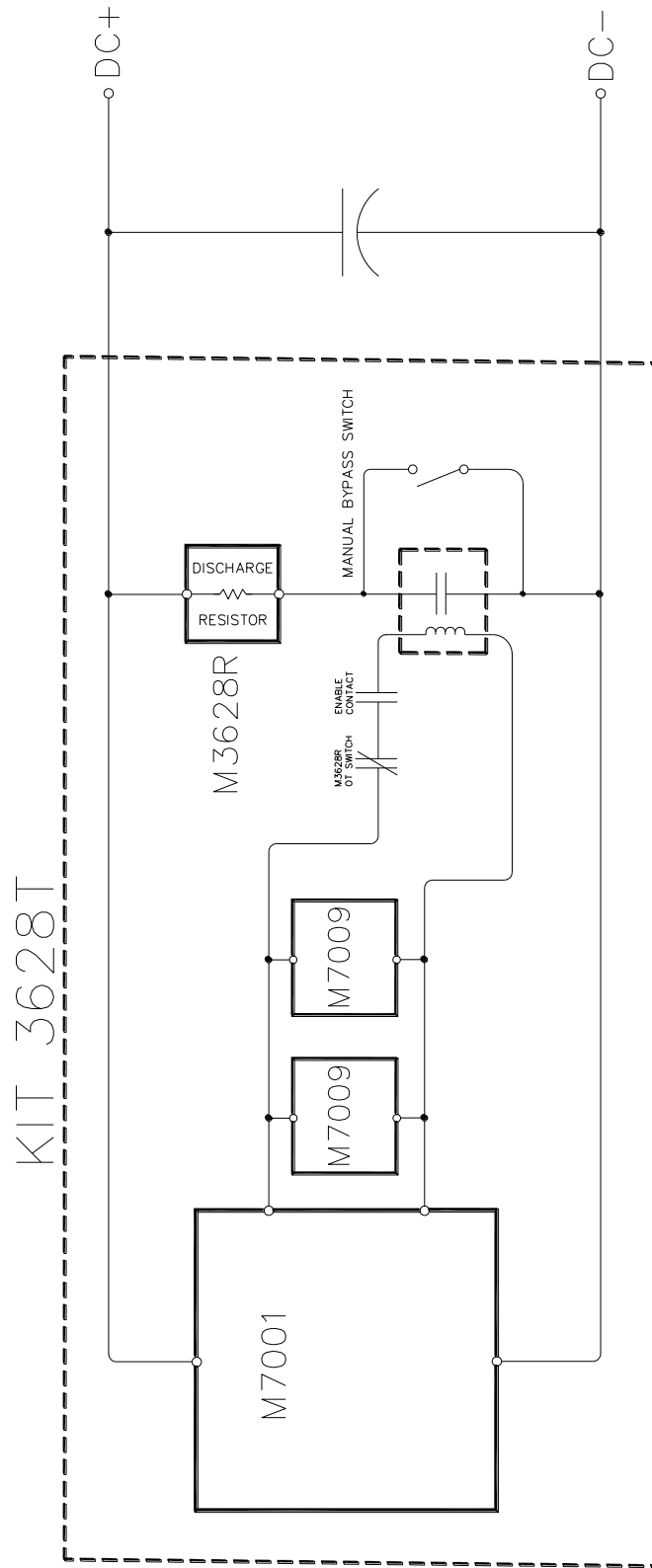
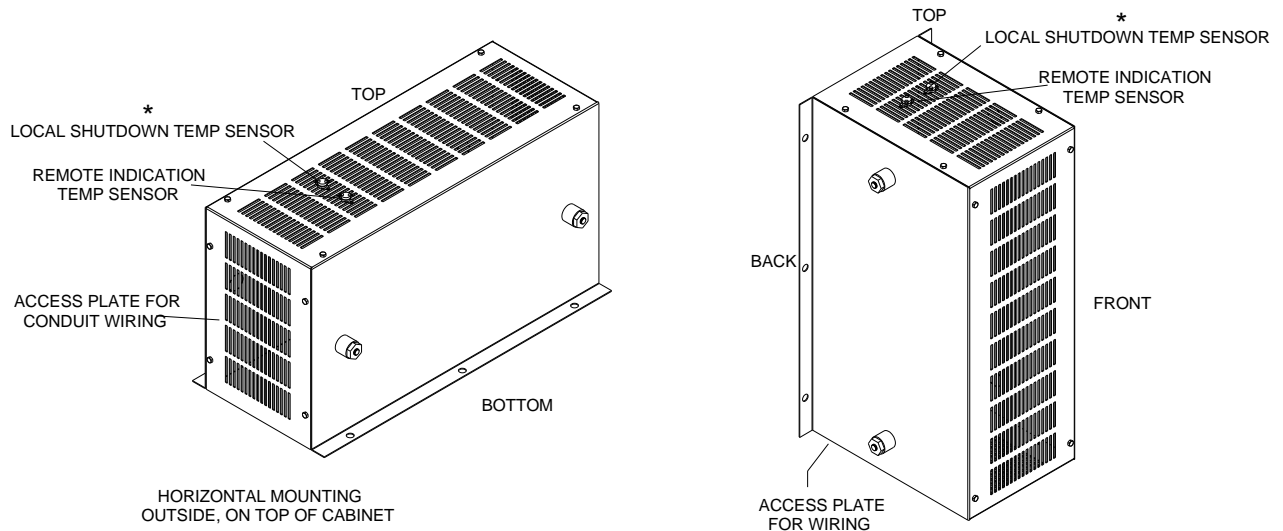


Figure 3-3: Recommended External Temperature Sensor Placement for M3628R



USE 0A220 (open at 220°c) *
WITH M3628T IGBT SWITCH

1. USE TEFLON HIGH TEMP WIRE
2. SECURE WIRES TO EXTERNAL MOUNT, PULLING THEM AWAY FORM CHASSIS DO NOT SECURE WIRE TO CHASSIS

4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The KIT 3628T discharger and M3628R resistor are used together to safely and quickly discharge a capacitor bank. The kit is composed of an M7001 power supply, a M7009 buffer module, and a normally-open relay. Since the M7001 runs directly off the capacitor bank, discharge can be accomplished even with no external power feed. During power-down conditions, the open relay and resistor are connected across the capacitor bank. When the capacitor bank begins charging and the voltage increases to approximately 190VDC, the M7001 power supply will begin operating, the power LED on its front panel turns on, and 24VDC is available at its output terminals. This 24VDC is fed directly to the M7009 buffer module. When the user wishes to initiate a discharge event, a user-defined contact closes the buffered 24VDC to the relay coil. This contact is typically either a PLC command or an auxiliary contact on the door handle.

During a typical discharge cycle, the KIT 3628T would be enabled and the capacitor bank voltage would begin to decrease. When the capacitor bank voltage gets down to approximately 60VDC, the M7001 will deactivate. The M7009 will support the relay coil for approximately 60 additional seconds, allowing the system to complete discharge to a safe level. The manual bypass switch should be closed during maintenance to prevent the capacitor bank from slowly charging back up. Closing the manual bypass switch during maintenance will keep the discharge resistor across the capacitor bank and maintain zero volt across the capacitors. The manual bypass switch must be OFF before powering up the system.

To prevent resistor overheating, a normally closed temperature sensor may be connected in series with the relay coil.

4.2. I/O AND FEATURES

4.2.1. INDICATORS

4.2.1.1. M7001 POWER LED

The Power light illuminates green when the internal power supply is operating.

4.3. STARTUP PROCEDURE



- ***TURNING THE DISCHARGE RELAY ON AND CHARGING THE CAPACITOR BANK SIMULTANEOUSLY CAN CAUSE EXCESSIVE HEATING IN THE RELAY AND M3628R. ENSURE THAT RELAY IS NOT CLOSED DURING CHARGING.***
- ***SYSTEMS ARE TYPICALLY DESIGNED TO DISCHARGE THE CAPACITOR BANK VOLTAGE TO LESS THAN 50VDC IN 60-120 SECONDS.***



ALWAYS MEASURE DC VOLTAGES, AND FOLLOW PROPER PRECAUTIONS TO ENSURE THEY ARE AT SAFE LEVELS BEFORE MAKING CONNECTIONS.

1. Ensure all system components are wired properly.
2. Enable the charger, and allow capacitor bank voltage to increase.

KIT 3628T & M3628R

- Charge time is dependent on capacitor bank value and charge current level.
 - M7001 "POWER" light should illuminate as DC bus increases past 190VDC.
3. After the capacitor bank has fully charged, remove power from charger and close 24V to the discharge relay. This will turn the relay on and begin discharging the capacitor bank.
 - Capacitor bank voltage should decrease.
 - M3628R will begin to emit heat.
 4. M7001 will turn off when the capacitor bank voltage drops below approximately 60VDC. M7009 will hold the relay closed for approximately 60 seconds past this point.

5. MAINTENANCE, AND TROUBLESHOOTING

5.1. MAINTENANCE

The KIT 3628T and M3628R require no maintenance.

5.2. TROUBLESHOOTING

Below are suggestions on how to check some common issues.

If you continue to have problems after going over this list, please contact Bonitron.

Table 5-1: Troubleshooting Guide

SYMPTOM	ACTION
KIT 3628T will not discharge storage bank	<ul style="list-style-type: none"> ▪ Ensure proper wiring ▪ Verify 24VDC is reaching relay coil
KIT 3628T will not allow storage bank to charge	<ul style="list-style-type: none"> ▪ Ensure proper wiring ▪ Verify 24VDC is not reaching relay coil
M7001 POWER light will not come on	<ul style="list-style-type: none"> ▪ Confirm voltage to M7001 input is over 190 VDC ▪ Confirm polarity of wiring to M7009



REPAIRS OR MODIFICATIONS TO THIS EQUIPMENT ARE TO BE PERFORMED BY BONITRON APPROVED PERSONNEL ONLY. ANY REPAIR OR MODIFICATION TO THIS EQUIPMENT BY PERSONNEL NOT APPROVED BY BONITRON WILL VOID ANY WARRANTY REMAINING.

5.3. TECHNICAL HELP – BEFORE YOU CALL

If possible, please have the following information when calling for technical help:

- Exact model number of affected units
- Serial number of unit
- Name and model number of attached drives
- Name of original equipment supplier
- Brief description of the application
- The AC line to line voltage on all 3 phases
- The DC bus voltage
- KVA rating of power source
- Source configuration Wye/Delta and grounding

This information will help us support you much more quickly. Please contact us at (615) 244-2825 or through www.bonitron.com

6. ENGINEERING DATA

6.1. RATINGS

Table 6-1: KIT 3628T Ratings

MODEL	PEAK CURRENT RATING	RMS CURRENT RATING	PEAK WATT LOSS ⁽¹⁾
KIT 3628T-Y200-V2	200 A	50 A	3 W
KIT 3628T-Y600-V2	600 A	200 A	3 W

- ⁽¹⁾ M3628R resistor modules are designed to dissipate power. The watts dissipated must be calculated from the capacitor bank energy being discharged.

6.2. DIMENSIONS AND MECHANICAL DRAWINGS

Table 6-2: M3628R Chassis Dimensions

CHASSIS CODE	DIM. A	DIM. B	DIM. C	DIM. D	DIM. E
6T	10.00	13.50	7.50	12.50	N/A
6H	25.50	12.00	14.00	10.50	10.00
10H	25.50	16.00	14.00	14.50	10.00
14H	25.50	20.00	14.00	18.50	10.00

Figure 6-1: M3628R Chassis Dimensional Outline

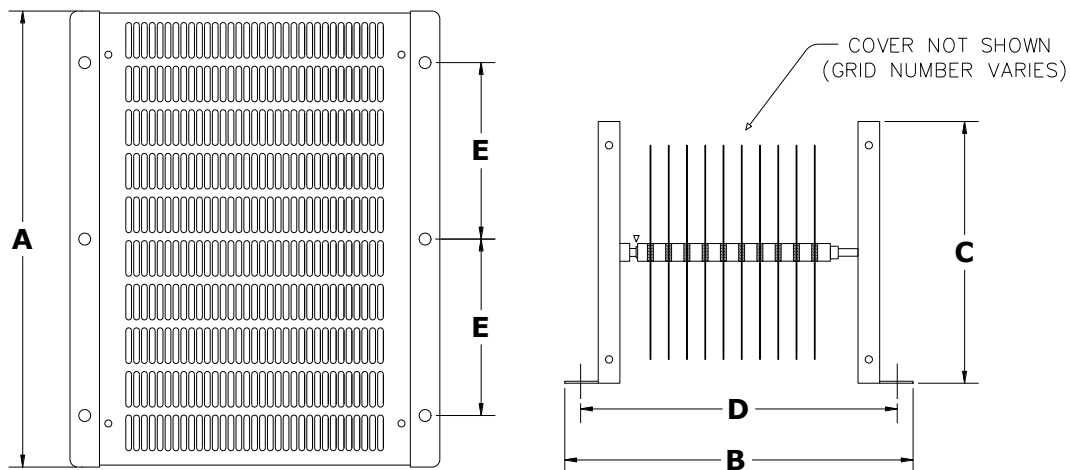


Figure 6-2: M7009 24VDC Buffer Module Dimensional Outline

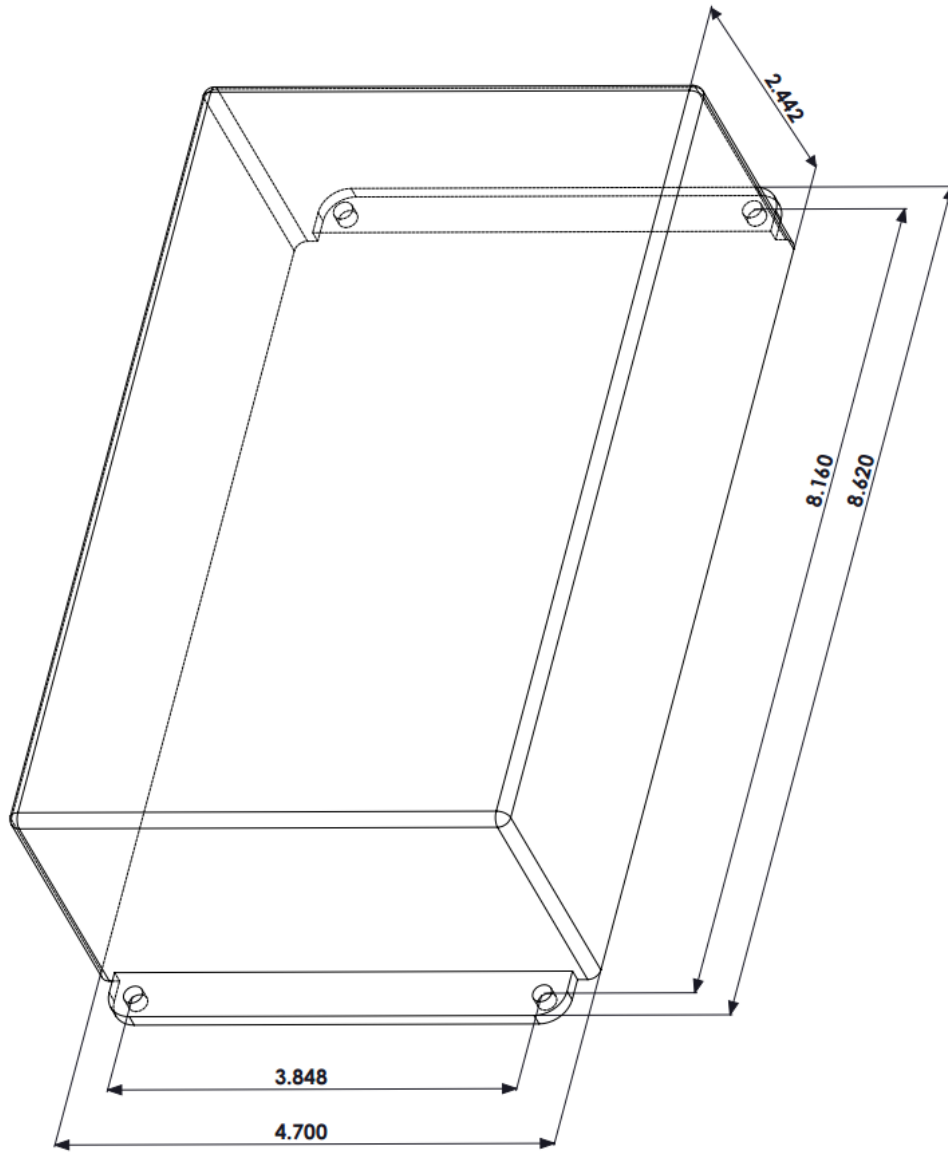


Figure 6-3: M7001 24VDC Power Supply Dimensional Outline

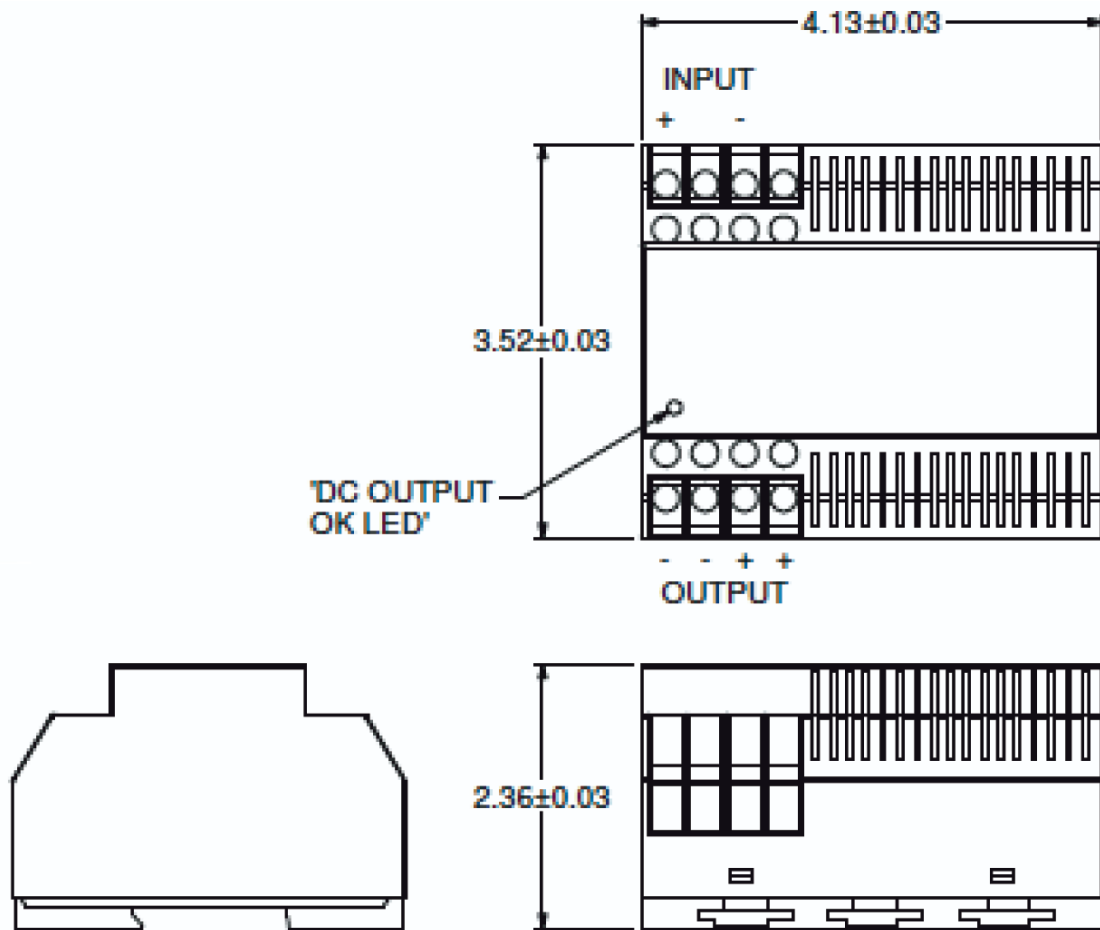


Figure 6-4 HX241 Relay Dimensional Outline

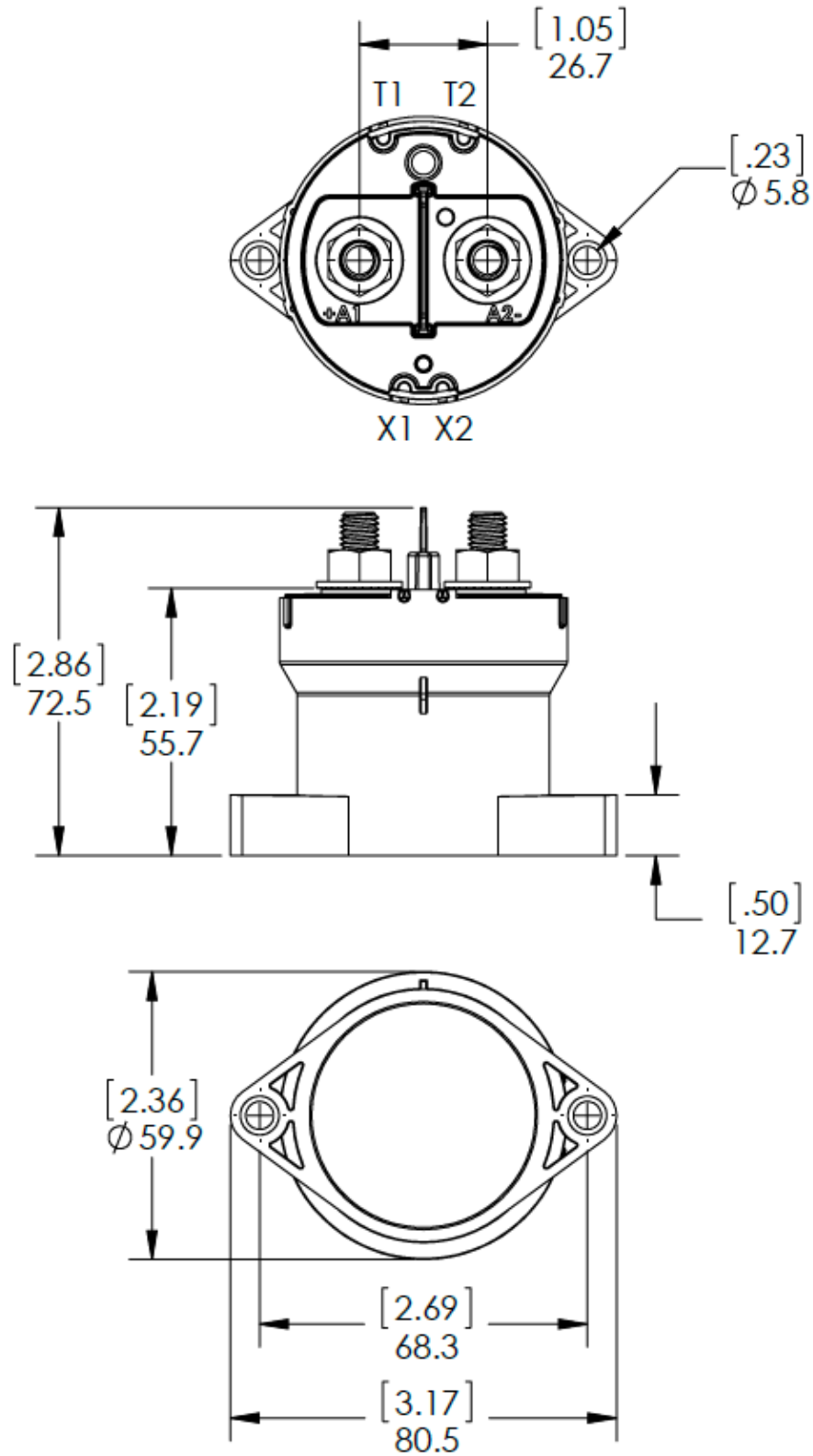


Figure 6-5: HX460 Relay Dimensional Outline

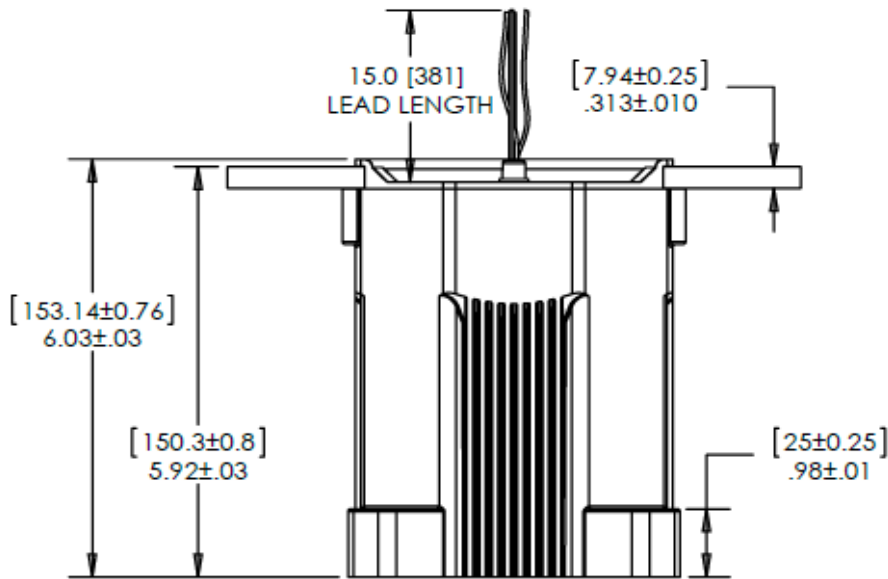
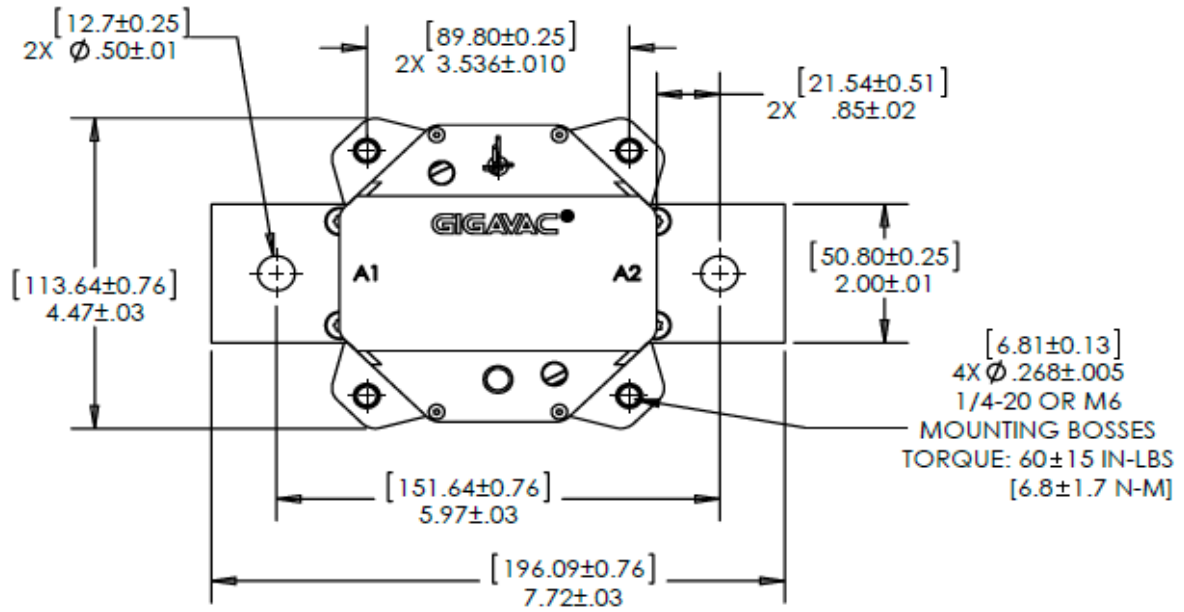


Figure 6-6: Bypass Switch Dimensional Outline

