

| REVISIONS |      |                                    |         |    |
|-----------|------|------------------------------------|---------|----|
| REV       | ECO  | DESCRIPTION                        | DATE    | BY |
| A         | 3355 | Product Release                    | 2/28/01 | BF |
| B         | 3574 | UPDATE UNDERVOLTAGE CHARACTERISTIC | 3/29/03 | BF |
| 003       | 3876 | MORE UNDERVOLTAGE CHANGES          |         |    |

Product Specification

522XX EQUALIZER AND 523XX  
CONVERTER FAMILY



52210 Model Shown

|                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                 |                        |                                                                                               |                                        |                                                                                                      |                                             |                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------------------|
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|                                                                                                                                                                                                                                                                   | <div>APPROVALS</div>                                                                                                                                                                                            |                        | <div>DATE</div>                                                                               |                                        | <div>TITLE</div> <div>PRODUCT SPECIFICATION<br/>522XX EQUALIZER AND 523XX<br/>CONVERTER FAMILY</div> |                                             |                               |
|                                                                                                                                                                                                                                                                   | <div>DRAWN<br/>A. VANDERZANDEN</div>                                                                                                                                                                            |                        | <div>23FEB01</div>                                                                            |                                        |                                                                                                      |                                             |                               |
|                                                                                                                                                                                                                                                                   | <div>PRJCT ENGR</div>                                                                                                                                                                                           |                        | <div></div>                                                                                   |                                        |                                                                                                      |                                             |                               |
|                                                                                                                                                                                                                                                                   | <div>ENGR MNGR</div>                                                                                                                                                                                            |                        | <div></div>                                                                                   |                                        |                                                                                                      |                                             |                               |
| <div>SALES/MRKTG</div>                                                                                                                                                                                                                                            |                                                                                                                                                                                                                 | <div></div>            |                                                                                               | <div>SIZE</div> <div>A</div>           | <div>CAGE CODE NO.</div> <div>55156</div>                                                            | <div>DWG NO.</div> <div>SPEC-52210FAM</div> | <div>REV</div> <div>003</div> |
|                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                 | <div>SCALE: NONE</div> |                                                                                               | <div>FILE: 52210FAM Rev 003-SPEC</div> |                                                                                                      | <div>SHEET</div> <div>1</div>               | <div>OF</div> <div>11</div>   |

## General Description

The Sure Power family of equalizers and converters are designed to provide 24V to 12V power conversion for heavy duty applications.

The equalizers provide equalization for dual battery systems where high 12V loads are required, enhancing battery life and ensuring maximum performance for vehicle charging systems.

Converters provide fixed outputs to power 12V loads directly where a 12V battery is not available.

## Features

- Under and Over Voltage Protection
- Reverse Voltage Protection
- Voltage Transient Protection
- Over load and Short Circuit Protection
- Thermal Overload Shutdown
- Equalization Status Indicator
- Protected from the Elements

## Part Number / Ordering Information

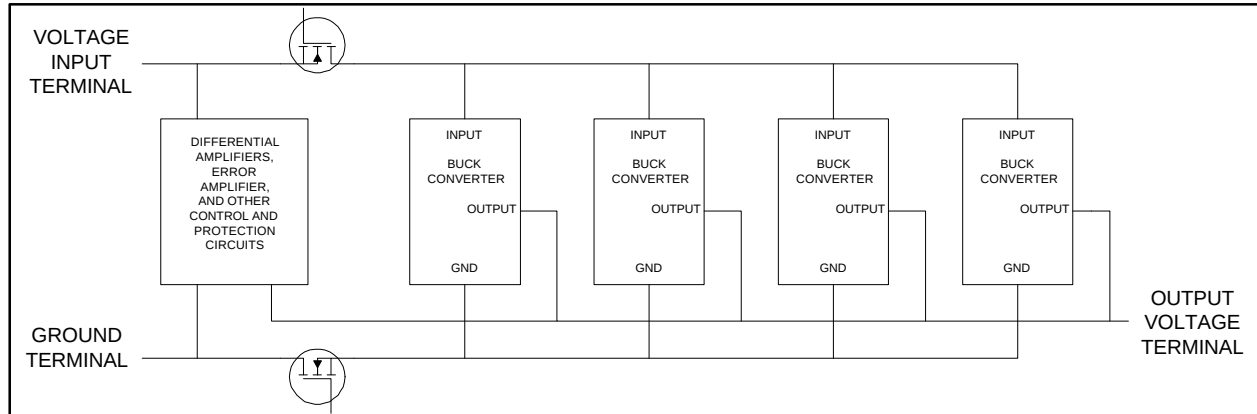
| Sure Power Part Number | Output Current | Equalizer / Converter |
|------------------------|----------------|-----------------------|
| 52210                  | 100 Amps       | Equalizer             |
| 52208                  | 80 Amps        | Equalizer             |
| 52206                  | 60 Amps        | Equalizer             |
| 52204                  | 40 Amps        | Equalizer             |
| 52308                  | 80 Amps        | Converter             |
| 52306                  | 60 Amps        | Converter             |
| 52304                  | 40 Amps        | Converter             |

## Theory of Operation

The family of equalizers and converters utilize paralleled buck converters to step down the input voltage in order to achieve the appropriate output voltage.

The equalizers monitor the input voltage at the terminals and provide an output that is one-half of the input. Converters provide a fixed output independent of the input voltage at the terminals.

Block Diagram



## Description of Features

Included are a number of protection and other features.

### PROTECTION FEATURES:

Reversal of the input polarity is protected with MOSFETs in series with the input.

Reversal of the output polarity is protected with MOSFETs in series with the ground connection.

A Metal Oxide Varistor circuit is used to protect the input from load dump and inductive transients.

Input under-voltage and over-voltage conditions cause the unit to safely turn off.

Short circuit and current limiting protection is supplied by monitoring the output current. Detection of a short circuit or overload limits the output current to 1.2 to 1.4 times the maximum steady state output rating. Upon removal of this condition the output voltage will return to its normal state.

Thermal protection is provided by monitoring the heatsink temperature. Detection of extreme temperature shuts the unit off. As the heatsink cools, the unit will automatically turn back on.

Loss of ground protection ensures no damage occurs to the unit if ground is inadvertently lost.

## Description of Features (cont.)

### STATUS INDICATOR:

An LED status indicator is provided to denote when the unit is producing current. In equalizers, As the batteries become equalized the LED indicator will diminish in intensity and eventually go dark. In converters, when the output current approaches zero, the LED will go dark.

## ELECTRICAL SPECIFICATIONS

### ABSOLUTE MAXIMUM RATINGS:

Maximum ratings establish the maximum electrical rating to which the unit may be subjected without damage.

| Parameter                   | Value         | Notes: |
|-----------------------------|---------------|--------|
| Standoff Voltage            | 36V           | Note 1 |
| Reverse Polarity            | -26V          | Note 2 |
| Output Current              |               |        |
| Model 52204, 52304          | 40A           | Note 3 |
| Model 52206,52306           | 60A           | Note 3 |
| Model 52208,52308           | 80A           | Note 3 |
| Model 52210                 | 100A          | Note 3 |
| Heat Sink Temperature       | 100°C         | Note 4 |
| Operating Temperature Range | -40°C - +85°C | Note 3 |
| Storage Temperature Range   | -55°C- 105°C  |        |

#### Notes:

1. This is maximum voltage applied between VBAT and GND that the unit will standoff without causing damage to the unit.
2. This is the maximum reverse voltage that may be applied between INPUT and GND, or between OUTPUT and GND.
3. Units can be operated up to 85°C at a reduced output current. Reference "Output Current vs Ambient Temperature Chart".
4. The unit generates a significant amount of heat (as shown in the ELECTRICAL CHARACTERISTICS section). When determining a mounting location it is important to account for this heat. Adequate ventilation must be provided.

## ELECTRICAL CHARACTERISTICS

Unless otherwise stated, conditions apply to full temperature range and full input voltage range.

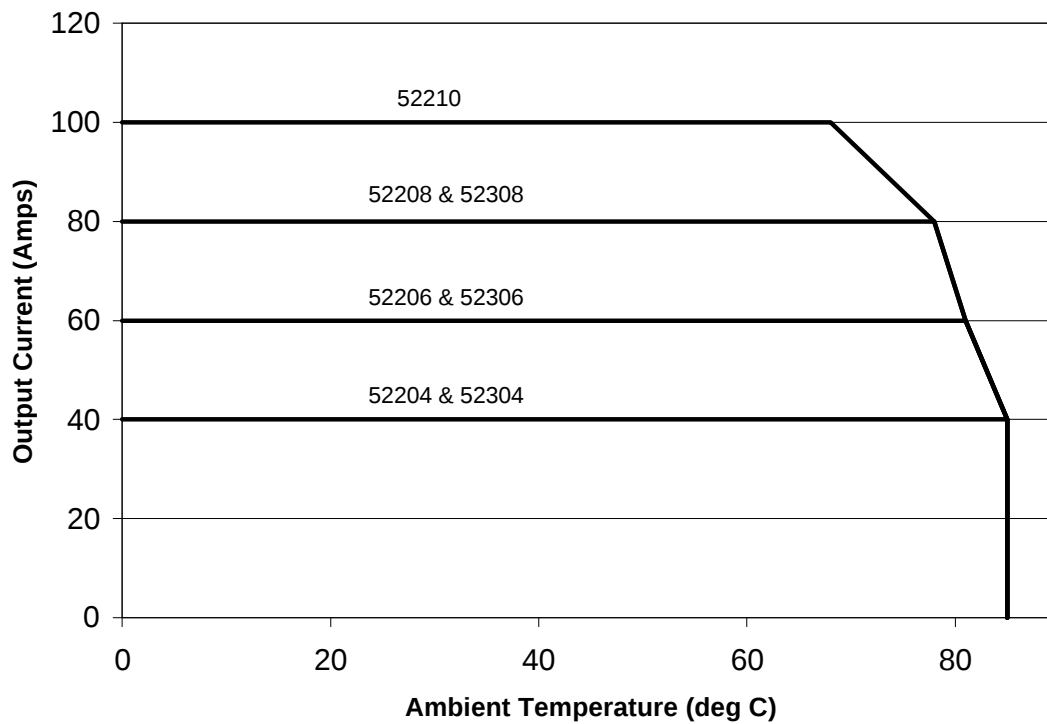
| Characteristic                 | MIN              | TYP        | MAX              | Unit | Notes:                                                                                                                                                      |
|--------------------------------|------------------|------------|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Under Voltage Turn ON    | 10               | 11.5       | 14               | V    |                                                                                                                                                             |
| Input Under Voltage Hysteresis |                  | 0.5        |                  | V    |                                                                                                                                                             |
| Input Over Voltage Turn OFF    | 32               | 33         | 34               | V    | Voltage on INPUT that causes the equalizer to turn off.                                                                                                     |
| Input Over Voltage Hysteresis  |                  | 0.4        |                  | V    |                                                                                                                                                             |
| Quiescent Current              |                  | 20         | 25               | mA   | Current draw from the INPUT with no load attached to OUTPUT. $V_{IN} = 24V$                                                                                 |
| Output Voltage (Equalizers)    | $V_{IN}/2 - 1\%$ | $V_{IN}/2$ | $V_{IN}/2 + 1\%$ | V    | 52210, 52208, 52206, 52204                                                                                                                                  |
| Output Voltage (Converters)    | 13               | 13.5       | 14               | V    | For Models 52308, 52306, 52304 When Input Voltage is greater than 22V. (For Input Voltage less than 22V, Output Voltage Equals $\frac{1}{2}$ Input Voltage) |
| Current Limit                  |                  |            |                  |      |                                                                                                                                                             |
| Model 52204, 52304             | 40               | 42         |                  | A    |                                                                                                                                                             |
| Model 52206, 52306             | 60               | 62         |                  | A    |                                                                                                                                                             |
| Model 52208, 52308             | 80               | 84         |                  | A    |                                                                                                                                                             |
| Model 52210                    | 100              | 108        |                  | A    |                                                                                                                                                             |
| Over-Temp Limit                |                  | 105        |                  | °C   | The trip point for over-temp shutdown                                                                                                                       |
| Over-Temp Hysteresis           |                  | 15         |                  | °C   |                                                                                                                                                             |
| Load Dump                      |                  | 150V       |                  |      | Ref. SAE J1455, Table 4b. As tested with EM Test LD200                                                                                                      |
| Inductive Load Switching       |                  | $\pm 300V$ |                  |      | Ref. SAE J1455, Table 4b.                                                                                                                                   |
| Mutual Coupling                |                  | $\pm 600V$ |                  |      |                                                                                                                                                             |

## ELECTRICAL CHARACTERISTICS (cont.)

|                            |  |                            |     |     |                                                              |
|----------------------------|--|----------------------------|-----|-----|--------------------------------------------------------------|
| ESD – Handling             |  | ±15kV                      |     |     | Ref. SAE J1455, Section 4.11.2.2.5.1                         |
| ESD – In Vehicle           |  | ±8kV, Direct<br>±15kV, Air |     |     | Ref. SAE J1113-13, Class C                                   |
| EMI Immunity               |  | 55                         | 100 | V/m | @10kHz – 1GHz (See Note 1)<br>SAE J1113/21 Class B Region II |
| EMI Emissions<br>Conducted |  | TBD                        |     |     | SAE J1113/41 See Note 1:                                     |
| EMI Emissions<br>Radiated  |  | TBD                        |     |     |                                                              |

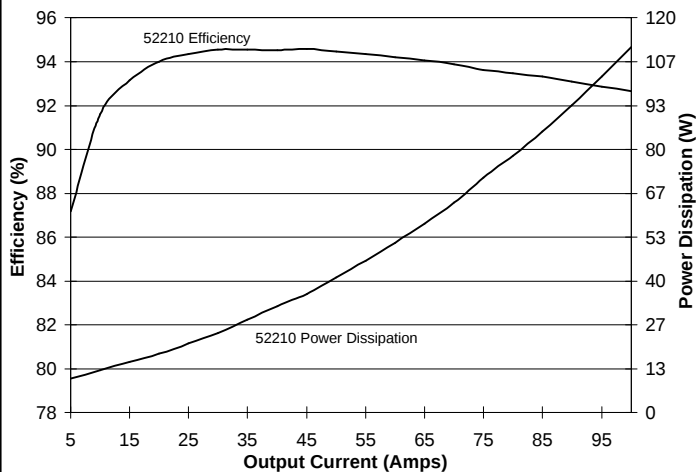
Note 1: EMI Specifications not validated at this revision, SAE J1113/41 represents design intent.

### Output Current vs Ambient Temperature Chart

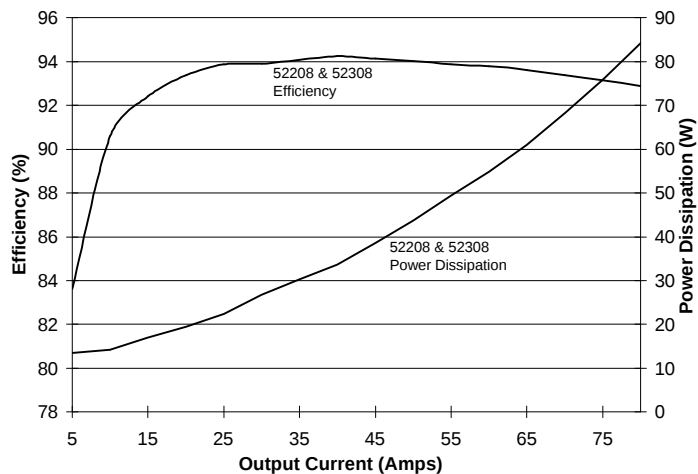


# ELECTRICAL CHARACTERISTICS (cont.)

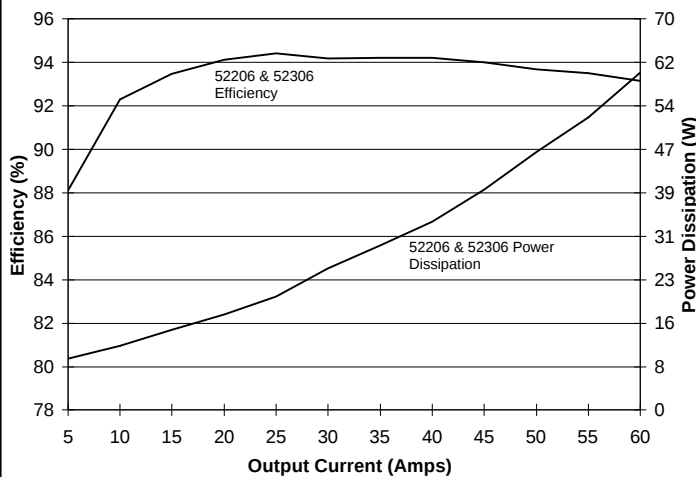
**52210 Typical Efficiency and Power Dissipation vs Output Current**



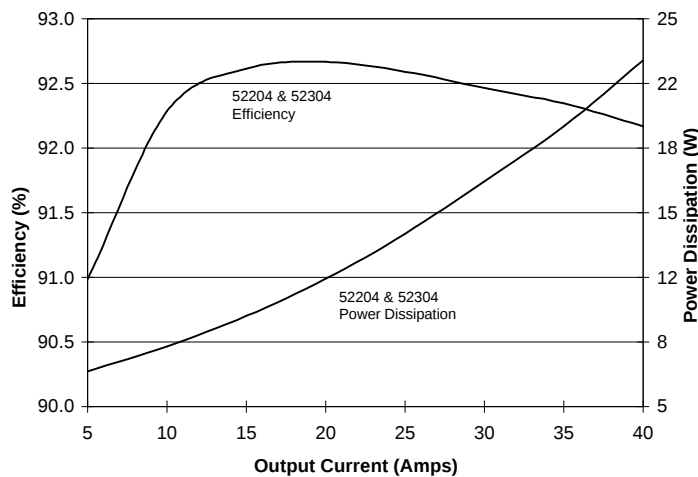
**52X08 Typical Efficiency and Power Dissipation vs Output Current**



**52X06 Typical Efficiency and Power Dissipation vs Output Current**



**52X04 Typical Efficiency and Power Dissipation vs Output Current**

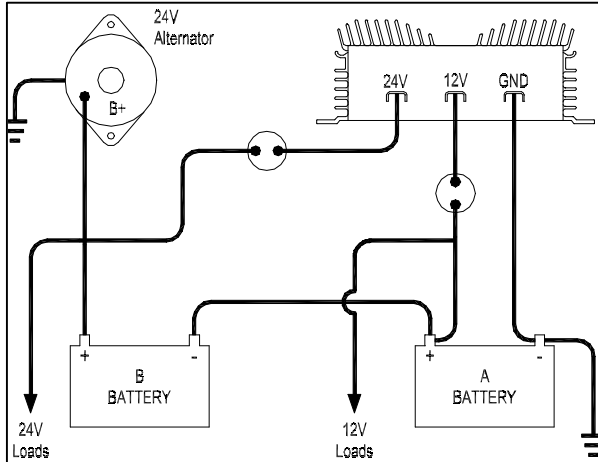


## ENVIRONMENTAL SPECIFICATIONS

| Parameter            | Level                 | Conditions / Notes                                   |
|----------------------|-----------------------|------------------------------------------------------|
| Thermal Shock        |                       | per SAE J1455 Section 4.1                            |
| Thermal Cycle        |                       |                                                      |
| Humidity             | 0 – 100 %RH           | per SAE J1455, Section 4.2.3                         |
| Splash               |                       | per SAE J1455 Section 4.4, Splash only               |
| Pressure Wash        |                       | per SAE J1455 Section 4.5                            |
| Dust Bombardment     | 0.88 g/m <sup>3</sup> | per SAE J1455 Section 4.7                            |
| Salt Spray           | 96 Hrs                | per SAE J1455 Section 4.3                            |
| Altitude             | 12000 ft              | per SAE J1455 Section 4.8                            |
| Mechanical Vibration |                       | per SAE J1455 Section 4.9 and Appendix A, Category 2 |
| Handling Shock       | Will Show Damage      | per SAE J1455 Section 4.10                           |

## CONNECTION DIAGRAMS:

### Typical Equalizer Connection



The unit has three connections. The aluminum chassis is isolated and can be grounded or ungrounded.

#### UNIT CONNECTIONS:

##### +24V:

This terminal is connected to the +24V side of the battery stack.

##### GND:

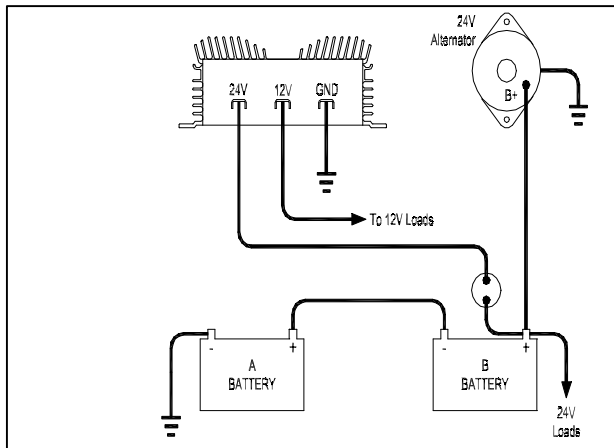
This is the terminal for grounding the unit. All internal operating currents are returned to this terminal.

##### +12V:

This terminal is connected to the +12V terminal of the battery stack for equalizers.

In converter applications the OUTPUT terminal is connected to the 12V loads.

### Typical Converter Connection



Note: If using disconnect switches, reference latest revision of Sure Powers installation instruction p/n 180098.

| SIZE        | CAGE CODE NO.              | DWG NO.       | SPEC | REV |
|-------------|----------------------------|---------------|------|-----|
| A           | 55156                      | SPEC-52210FAM | 003  |     |
| SCALE: NONE | FILE: 52210FAM Rev003-SPEC | SHEET 9 OF 11 |      |     |



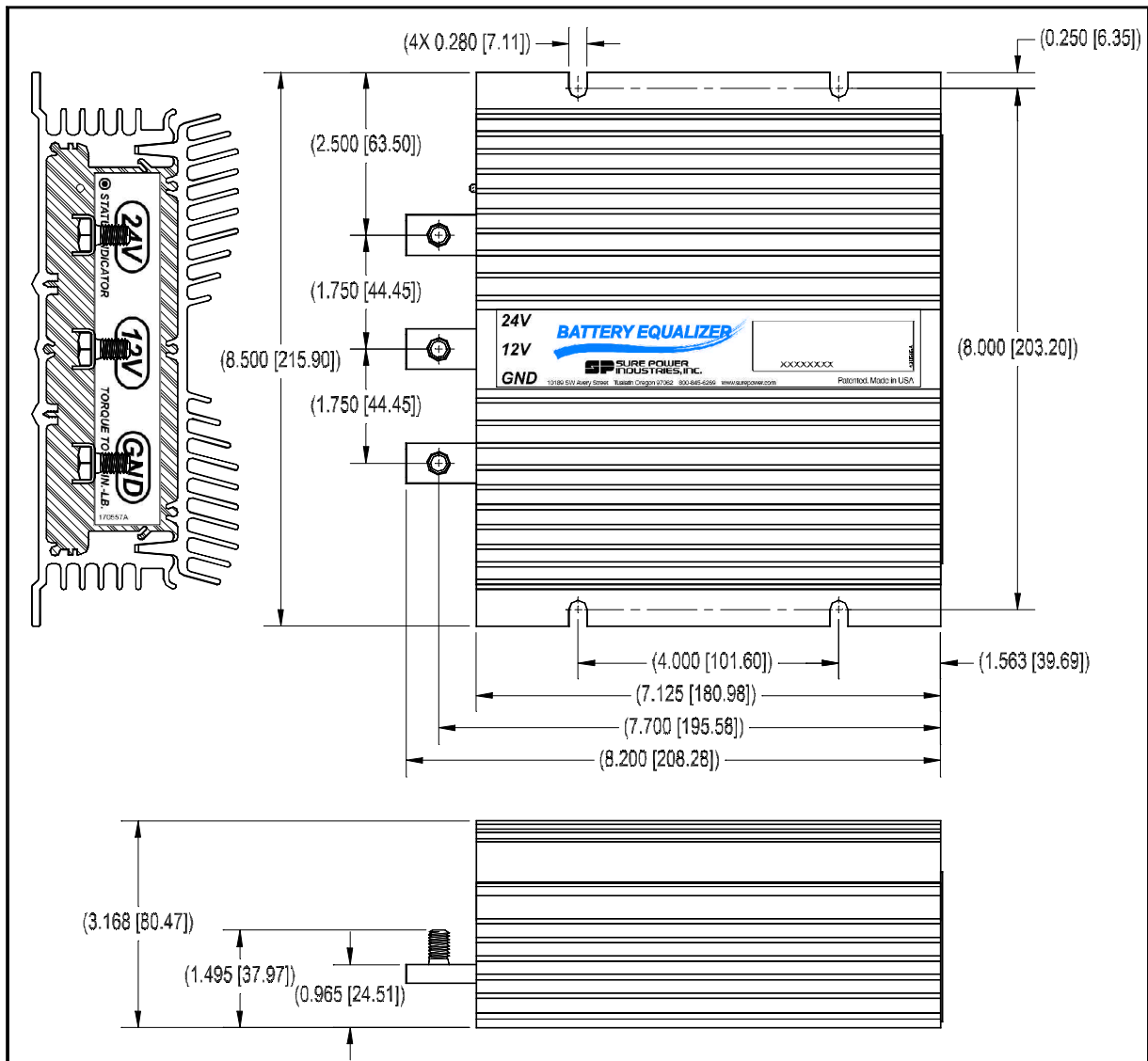
## MECHANICAL SPECIFICATIONS (cont.)

52204 and 52304

**Mounting Slots:** 4X, Accepts M6 or ¼" Hardware (not included)

**Weight:** 9 pounds

Unit Dimentions – 52204, and 52304



| SIZE        | CAGE CODE NO.              | DWG NO.        | SPEC | REV |
|-------------|----------------------------|----------------|------|-----|
| A           | 55156                      | 52210FAM       | 003  | 003 |
| SCALE: NONE | FILE: 52210FAM Rev003-SPEC | SHEET 11 OF 11 |      |     |