

| REVISIONS |      |   |          |    |
|-----------|------|---|----------|----|
| REV       | ECO  | DESCRIPTION   | DATE     | BY |
| 001       | 4265 | PRODUCTION RELEASE  | 10/18/04 | BF |
| 002       | 5070 | REFORMAT TITLE BLOCK - REFINE LABEL DET ON LAST TWO PAGES | 3/6/08   | BF |

## Product Specification

# 120XXE00 EQUALIZER AND 120XXC00 CONVERTER, 12V TO 24V FAMILY



12040E00 Model Shown

|   |  |  |                                       |
|---|--|--|---------------------------------------|
| <p><b>UNLESS OTHERWISE SPECIFIED<br/>DIMENSIONS ARE IN INCHES [MM]</b><br/> TOLERANCES ARE: .XX ± .10 [X.X ± 2.5]<br/> .XXX ± .030 [X.XX ± 0.76]<br/> INTERPRET GEOMETRIC DIMENSIONS AND<br/> TOLERANCING PER ASME Y14.5-1994<br/> DRAWINGS IN THIS DOCUMENT ARE NOT TO SCALE</p> |  |  |                                       |
| <p><b>APPROVALS</b></p>   |  | <p><b>DATE</b></p>   |                                       |
| <p>DRAWN BY <b>DSR</b></p>  |  | <p><b>9/21/04</b></p>  |                                       |
| <p>PROJECT ENG APPROVAL</p>   |  | <p><b>TITLE</b></p>  |                                       |
| <p>ENG MANAGER APPROVAL</p>   |  | <p><b>MODEL NO: 120XXX00</b><br/> <b>12V TO 24V DC TO DC</b><br/> <b>CONVERTER / EQUALIZER</b><br/> <b>SPECIFICATION OUTLINE</b></p> |                                       |
| <p>SALES/MRKTG APPROVAL</p>   |  | <p>SIZE<br/><b>A</b></p>   | <p>CAGE CODE NO.<br/><b>55156</b></p> |
|   |  | <p>DRAWING NO.<br/><b>120XXX00</b></p>   | <p>REV<br/><b>002</b></p>             |
|   |  | <p>SCALE: <b>NONE</b></p>  | <p>FILE: 120XXX00-002</p>             |
|   |  | <p>SHEET <b>1</b> OF <b>12</b></p>   |                                       |

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## General Description

This Sure Power product is designed to provide 12V to 24V power conversion for heavy duty applications.

The equalizers provide equalization for dual battery systems where the charging system is 12V.

## Features

- Under and Over Voltage Protection
- Reverse Voltage Protection
- Voltage Transient Protection
- Over load and Short Circuit Protection
- Thermal Overload Shutdown
- Equalization Status Indicator
- Sealed from the Elements
- Ignition Turn On
- Output Voltage Shift Pin (equalizers only)

## Part Number / Ordering Information

| Sure Power Part Number | Output Current | Equalizer / Converter |
|------------------------|----------------|-----------------------|
| 12040E00               | 40 Amps        | Equalizer             |
| 12025E00               | 25 Amps        | Equalizer             |
| 12040C00               | 40 Amps        | Converter             |
| 12025C00               | 25 Amps        | Converter             |



TITLE

**MODEL NO: 120XXX00  
12V TO 24V DC TO DC  
CONVERTER / EQUALIZER  
SPECIFICATION OUTLINE**

|      |               |             |     |
|------|---------------|-------------|-----|
| SIZE | CAGE CODE NO. | DRAWING NO. | REV |
| A    | 55156         | 120XXX00    | 002 |

|             |                    |               |
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| SCALE: NONE | FILE: 120XXX00-002 | SHEET 2 OF 12 |
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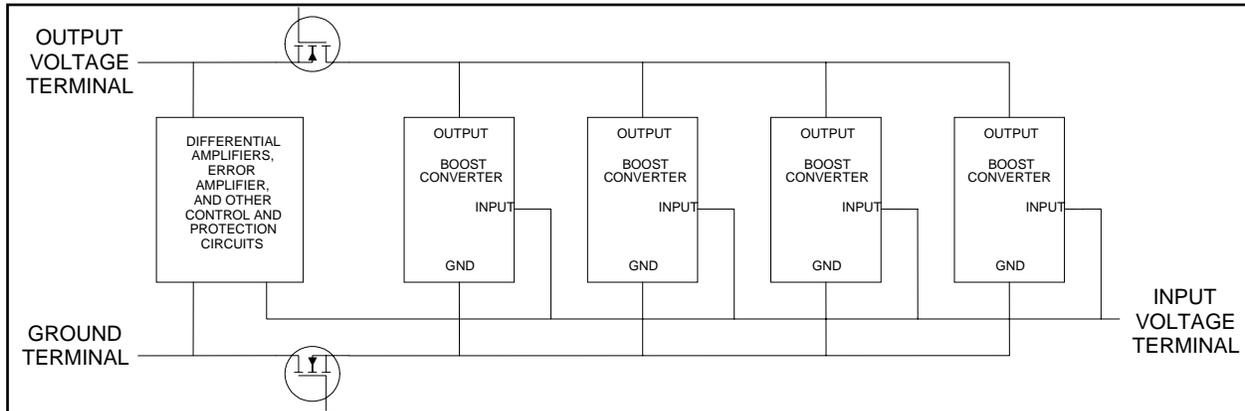
## Theory of Operation

The 120XXX Sure Power family of equalizers and converters are designed to step up the input voltage in order to achieve the appropriate output voltage. To reduce quiescent current, the converter / equalizer is enabled through an ignition terminal.

The equalizers monitor the input voltage at the terminals and provide an output that is twice the input. On equalizers, an output voltage shift terminal is available to aid in optimizing charging systems. This terminal also serves as an ignition pin. When power is applied to the voltage shift terminal, the output voltage is increased. At 13.5V input, the output will increase 0.9V above the normal  $2 \cdot V_{in}$  value. The amount of increase is input voltage dependent. Please refer to graph for other voltages.

The converters provide a fixed output to power 24V loads directly from a 12V source.

## Block Diagram



## Description of Features

Included are a number of protection and added features.

### PROTECTION FEATURES:

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

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



|                              |                    |                 |            |
|------------------------------|--------------------|-----------------|------------|
| TITLE                        |                    |                 |            |
| <b>MODEL NO: 120XXX00</b>    |                    |                 |            |
| <b>12V TO 24V DC TO DC</b>   |                    |                 |            |
| <b>CONVERTER / EQUALIZER</b> |                    |                 |            |
| <b>SPECIFICATION OUTLINE</b> |                    |                 |            |
| SIZE                         | CAGE CODE NO.      | DRAWING NO.     | REV        |
| <b>A</b>                     | <b>55156</b>       | <b>120XXX00</b> | <b>002</b> |
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**Description of Features (cont.)**

Short circuit and current limiting protection is supplied by monitoring the output current. Detection of a short circuit or overload turns the output off. The unit then cycles the output on every 1.5 seconds to determine if the short circuit has been removed. 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. When the heatsink cools approximately 15°C the unit will automatically turn back on.

Loss of ground protection ensures no damage occurs to the unit.

Unit is protected against all miswiring conditions with the exception of the condition where: Unit GND is connected to system +12V, Unit +12V is connected to system +24V, Unit +24V is connected to GND, and Unit IGN is connected to system +24V.

**STATUS INDICATOR:**

An LED status indicator is provided to denote when the unit is producing current. As the batteries become equalized the equalizer current will approach 0 amps, and the LED indicator will diminish in intensity and eventually go dark. In converters, as the output current approaches zero the LED will go dark.

|   |  |   |                                  |
|---|--|---|----------------------------------|
|                  |  |   |                                  |
| <b>MODEL NO: 120XXX00<br/>12V TO 24V DC TO DC<br/>CONVERTER / EQUALIZER<br/>SPECIFICATION OUTLINE</b> |  |   |                                  |
| <small>SIZE</small><br><b>A</b>   | <small>CAGE CODE NO.</small><br><b>55156</b> | <small>DRAWING NO.</small><br><b>120XXX00</b> | <small>REV</small><br><b>002</b> |
| <small>SCALE: NONE</small>  |  | <small>FILE: 120XXX00-002</small>             | <small>SHEET 4 OF 12</small>     |

## 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 12040X00              | 40A            |        |
| Model 12025X00              | 25A            |        |
| 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 INPUT 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.



|                              |                           |                      |            |
|------------------------------|---------------------------|----------------------|------------|
| <b>TITLE</b>                 |                           |                      |            |
| <b>MODEL NO: 120XXX00</b>    |                           |                      |            |
| <b>12V TO 24V DC TO DC</b>   |                           |                      |            |
| <b>CONVERTER / EQUALIZER</b> |                           |                      |            |
| <b>SPECIFICATION OUTLINE</b> |                           |                      |            |
| <b>SIZE</b>                  | <b>CAGE CODE NO.</b>      | <b>DRAWING NO.</b>   | <b>REV</b> |
| <b>A</b>                     | <b>55156</b>              | <b>120XXX00</b>      | <b>002</b> |
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**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              | 8                  | 9.5          | 10                 | V    |   |
| Input Under Voltage Hysteresis           |                    | 0.5          |                    | V    |   |
| Input Over Voltage Turn OFF (Equalizers) | 16                 | 16.5         | 17                 | V    | Voltage on INPUT that causes the equalizer to turn off                      |
| Input Over Voltage Turn OFF (Converters) | 15                 | 15.5         | 16                 | V    | Voltage on INPUT that causes the converter to turn off                      |
| Input Over Voltage Hysteresis            |                    | 0.4          |                    | V    |   |
| Quiescent Current IGN off                |                    |              | 1                  | mA   | Current draw from the INPUT with IGN off. $V_{IN} = 12V$                    |
| Quiescent Current IGN on                 |                    | 55           |                    | mA   | Current draw from the INPUT with no load attached to OUTPUT. $V_{IN} = 14V$ |
| Output Voltage (Equalizers)              | $V_{IN} * 2 - 1\%$ | $V_{IN} * 2$ | $V_{IN} * 2 + 1\%$ | V    |   |
| Output Voltage (Converters)              | 23.5               | 24.0         | 24.5               | V    |   |
| Output Offset Voltage                    |                    | 0.9          |                    | V    | Equalizers only. With $V_{in} = 13.5V$ ; refer to graph for other voltages  |
| Current Limit                            | 40                 | 42           |                    | A    |   |
| Over-Temp Limit                          |                    | 105          |                    | °C   | The trip point for over-temp shutdown                                       |
| Over-Temp Hysteresis                     |                    | 15           |                    | °C   |   |

**ELECTROMAGNETIC COMPATIBILITY:**

| Transient Immunity Tests | Level                        | Notes:  |
|--------------------------|------------------------------|---|
| Load Dump                | $14 + 86e^{t/(0.4)}$         | IAW with SAE J1455 Rev 8/94 Section 4.11.2.2, Table 4a. |
| Inductive Switching Kick | $14 \pm 600e^{t/(0.001)}$    | IAW with SAE J1455 Rev 8/94 Section 4.11.2.2, Table 4a. |
| Mutual Inductance        | $14 \pm 300e^{t/(0.000015)}$ | IAW with SAE J1455 Rev 8/94 Section 4.11.2.2, Table 4a. |

| Electrostatic Discharge Immunity | Level                                | Notes:   |
|----------------------------------|--------------------------------------|--|
| In Vehicle ESD                   | $\pm 8$ kV direct<br>$\pm 15$ kV air | Ref. SAE J1113/13 Rev 2/95, Class C utilizing a 330pF / 2000ohm discharge network.                                 |
| Package and Handling ESD         | $\pm 8$ kV direct<br>$\pm 15$ kV air | IAW with SAE J1455 Rev 8/94 Section 4.11.2.2.5.1 / SAE J551/15 Rev 5/95 utilizing a 150pF/150ohm discharge network |

| Emissions Testing       | Level    | Notes:   |
|-------------------------|----------|--|
| Radiated; 30MFz – 1 GHz | Per spec | Certified to UN Regulation ECE R 10.02<br>Also reference ISO 13766, EN 13309 |



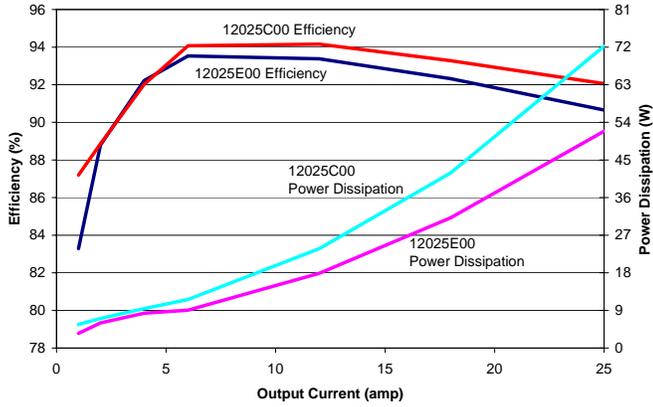
**TITLE**  
**MODEL NO: 120XXX00**  
**12V TO 24V DC TO DC**  
**CONVERTER / EQUALIZER**  
**SPECIFICATION OUTLINE**

|             |                      |                    |            |
|-------------|----------------------|--------------------|------------|
| <b>SIZE</b> | <b>CAGE CODE NO.</b> | <b>DRAWING NO.</b> | <b>REV</b> |
| <b>A</b>    | <b>55156</b>         | <b>120XXX00</b>    | <b>002</b> |

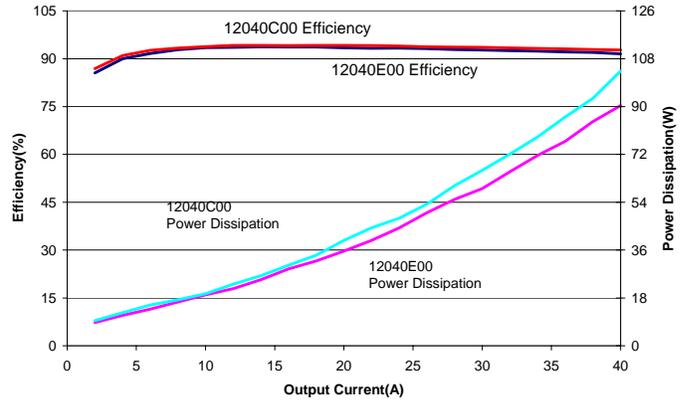
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| <b>SCALE: NONE</b> | <b>FILE: 120XXX00-002</b> | <b>SHEET 6 OF 12</b> |
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ELECTRICAL CHARACTERISTICS (cont.)

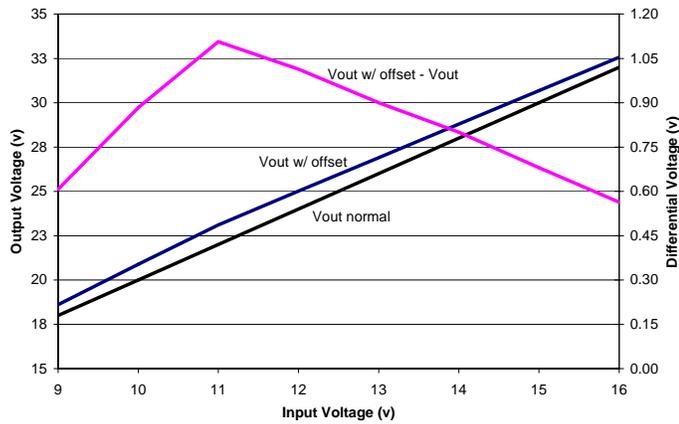
12025X00 Typical Efficiency and Power Dissipation vs. Output Current with Vin at 14V



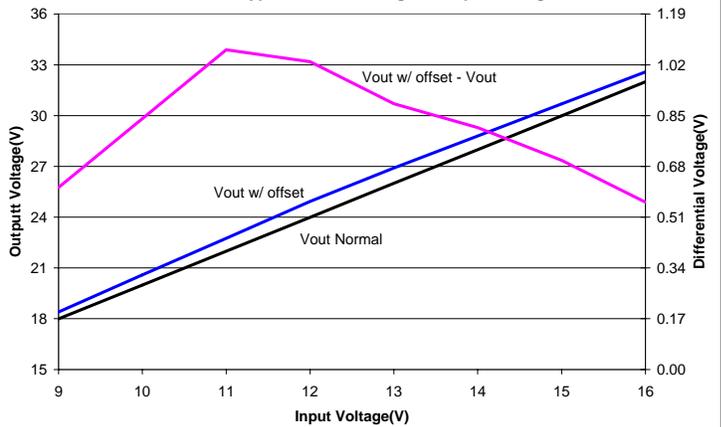
12040X00 Typical Efficiency and Power Dissipation vs Output Current with Vin at 14V



12025E00 Typical Offset Voltage vs. Input Voltage



12040E00 Typical Offset Voltage vs. Input Voltage



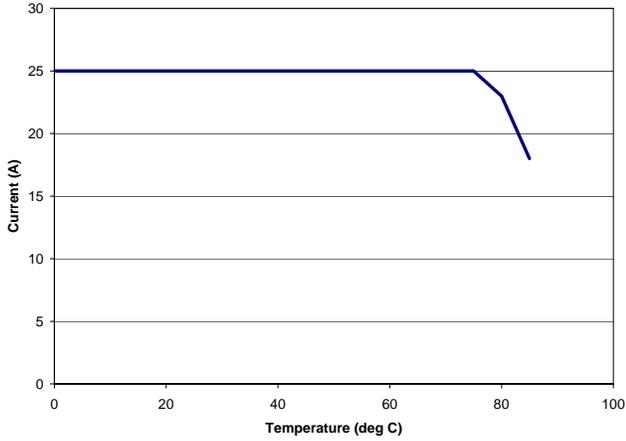
TITLE  
**MODEL NO: 120XXX00**  
**12V TO 24V DC TO DC**  
**CONVERTER / EQUALIZER**  
**SPECIFICATION OUTLINE**

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|------|---------------|-------------|-----|
| SIZE | CAGE CODE NO. | DRAWING NO. | REV |
| A    | 55156         | 120XXX00    | 002 |

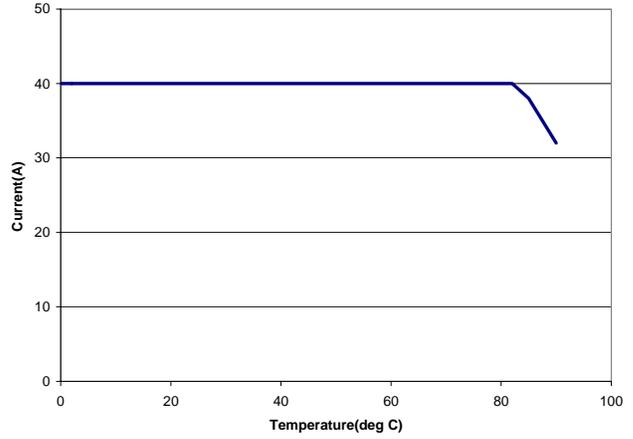
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| SCALE: NONE | FILE: 120XXX00-002 | SHEET 7 OF 12 |
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ELECTRICAL CHARACTERISTICS (cont.)

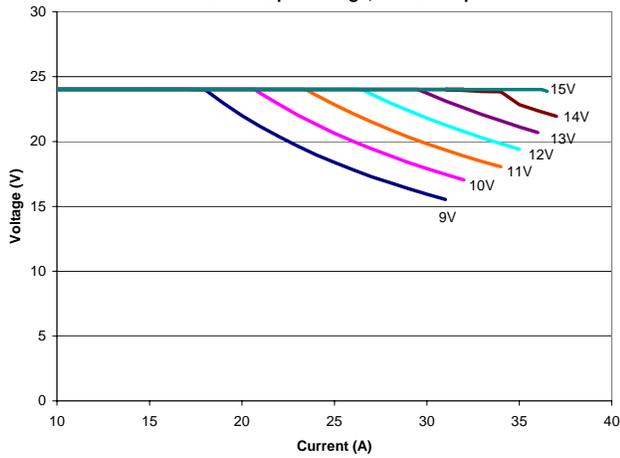
12025X00 Output Current vs. Ambient Temperature,  
Vin = 14.0V



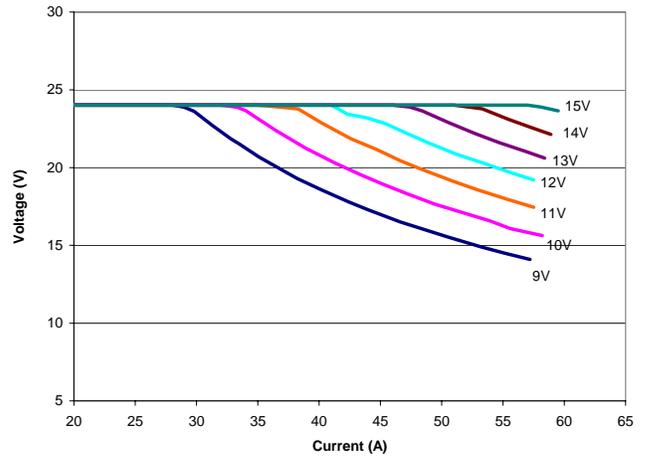
12040X00 Output Current vs. Ambient Temperature,  
Vin = 14V



12025C00 Output Voltage vs. Output Current  
as a Function of Input Voltage, Room Temp



12040C00 Output Voltage vs. Output Current  
as a Function of Input Voltage, Room Temp



TITLE  
**MODEL NO: 120XXX00**  
**12V TO 24V DC TO DC**  
**CONVERTER / EQUALIZER**  
**SPECIFICATION OUTLINE**

|                  |                               |                                |                   |
|------------------|-------------------------------|--------------------------------|-------------------|
| SIZE<br><b>A</b> | CAGE CODE NO.<br><b>55156</b> | DRAWING NO.<br><b>120XXX00</b> | REV<br><b>002</b> |
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|--------------------|---------------------------|-----------------------------|

## ENVIRONMENTAL SPECIFICATIONS

| Parameter            | Value                 | Notes:  |
|----------------------|-----------------------|---|
| Thermal Shock        |                       | per SAE J1455 Section 4.1, Rev 8/94                                       |
| Thermal Cycle        |                       |   |
| Humidity             | 0 – 100 %RH           | per SAE J1455 Section 4.2.3, Rev 8/94                                     |
| Splash               |                       | per SAE J1455 Section 4.4, Rev 8/94 Splash only See Note 1                |
| Pressure Wash        |                       | per SAE J1455 Section 4.5, Rev 8/94 See Note 1                            |
| Dust Bombardment     | 0.88 g/m <sup>3</sup> | per SAE J1455 Section 4.7, Rev 8/94 See Note 1                            |
| Salt Spray           | 96 Hrs                | per SAE J1455 Section 4.3, Rev 8/94 See Note 1                            |
| Altitude             | 12000 ft              | per SAE J1455 Section 4.8, Rev 8/94 See Note 1                            |
| Mechanical Vibration |                       | per SAE J1455 Section 4.9 and Appendix A, Category 2, Rev 8/94 See Note 1 |
| Handling Shock       | Will Show Damage      | per SAE J1455 Section 4.10, Rev 8/94                                      |

Note 1: Specifications not validated at this revision, SAE J1455 represents design intent.

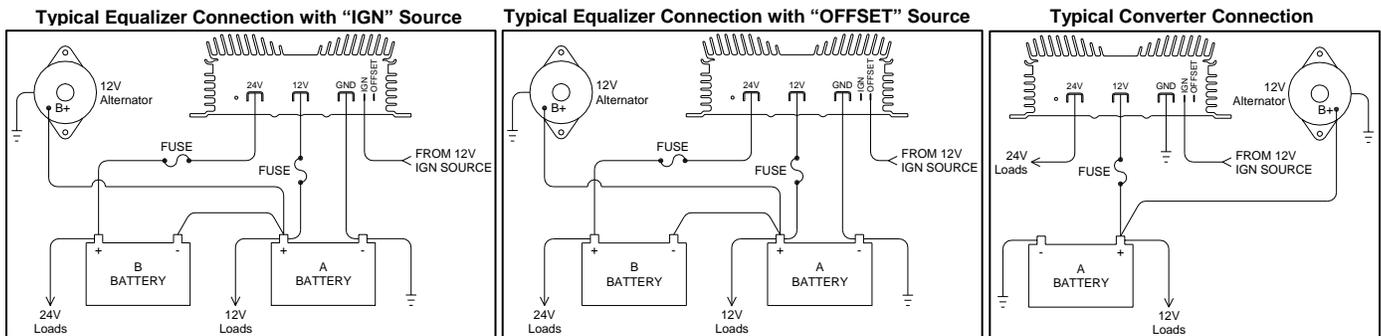
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| TITLE<br><b>MODEL NO: 120XXX00<br/>12V TO 24V DC TO DC<br/>CONVERTER / EQUALIZER<br/>SPECIFICATION OUTLINE</b> |                    |                             |            |
| SIZE   | CAGE CODE NO.      | DRAWING NO.                 | REV        |
| <b>A</b>   | <b>55156</b>       | <b>120XXX00</b>             | <b>002</b> |
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## CONNECTION DIAGRAMS

The unit has three connections and a choice of one or two signal 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 for equalizers. In converter applications, the 24V OUTPUT is connected directly to 24V loads.
- 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.
- IGN:** This connection enables and disables the unit. When voltage is applied to the ignition terminal, the unit turns on.
- OFFSET (Equalizers ONLY):** This connection also enables and disables the unit. Applying the unit power to this connection increases the output voltage between 0.6 to 1.4V – input voltage dependent, refer to graph.



|  |                               |                                |                   |
|--|-------------------------------|--------------------------------|-------------------|
| <b>SURE POWER</b><br>INDUSTRIES, INC.  |                               |                                |                   |
| TITLE<br><b>MODEL NO: 120XXX00</b><br><b>12V TO 24V DC TO DC</b><br><b>CONVERTER / EQUALIZER</b><br><b>SPECIFICATION OUTLINE</b> |                               |                                |                   |
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## MECHANICAL SPECIFICATIONS

The unit utilizes three channel shaped bus bars for making power connections. Each bus bar is equipped with an M8 hex head bolt. The bolt head is captured within the channel and the channel prevents rotation of the head when tightening the nut. The control connections are made via ¼" male tabs.

**Finish:** Black Anodized Aluminum

**Terminals:** 0.050 thick C11000 ETP Copper, Bright Tin Plate

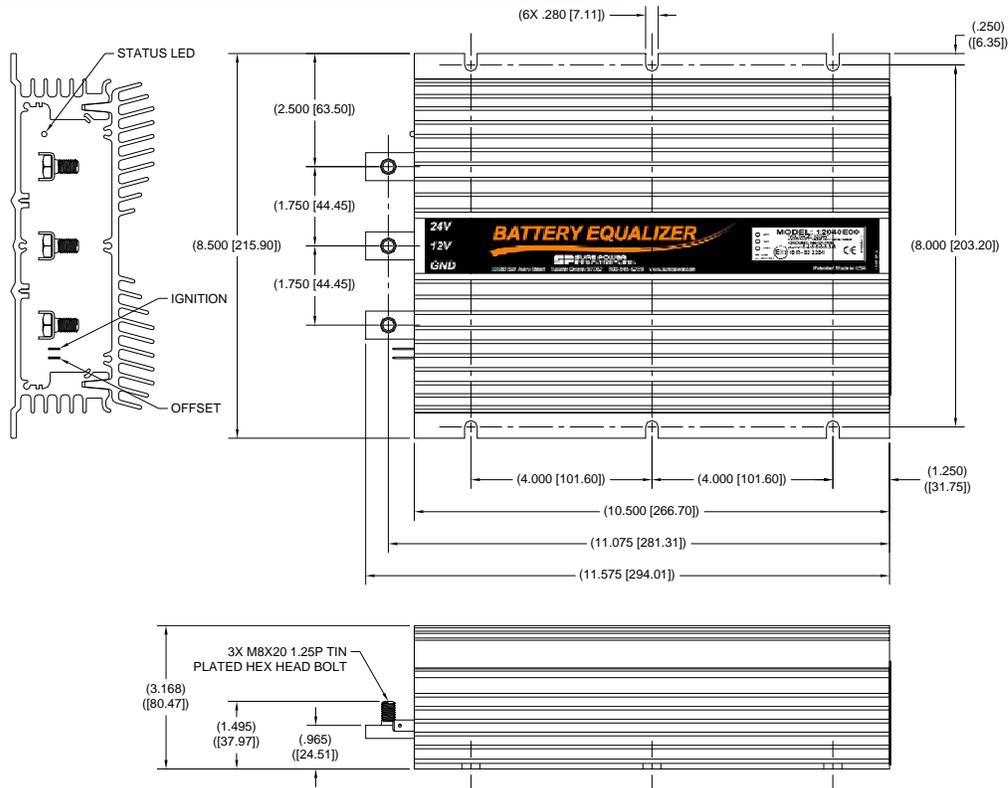
**Hardware Included:** Bolts – 3X, M8x20mm Hex Head, Tin Plated Steel  
Nuts – 3X, M8 Hex, Tin Plated Steel  
Lock Washers – 3X, M8, Tin Plated Steel

**Maximum Torque:** 110 in-lbs

**Mounting Slots:** 6X - (12040X00) 4X - (12025X00), Accepts M6 or ¼" Hardware (not included)

**Weight:** 13.5lbs / 6.12kg – 12040X00, 9lbs / 4.1kg – 12025X00

### Unit Dimensions – 12040X00 (12040E00 pictured)

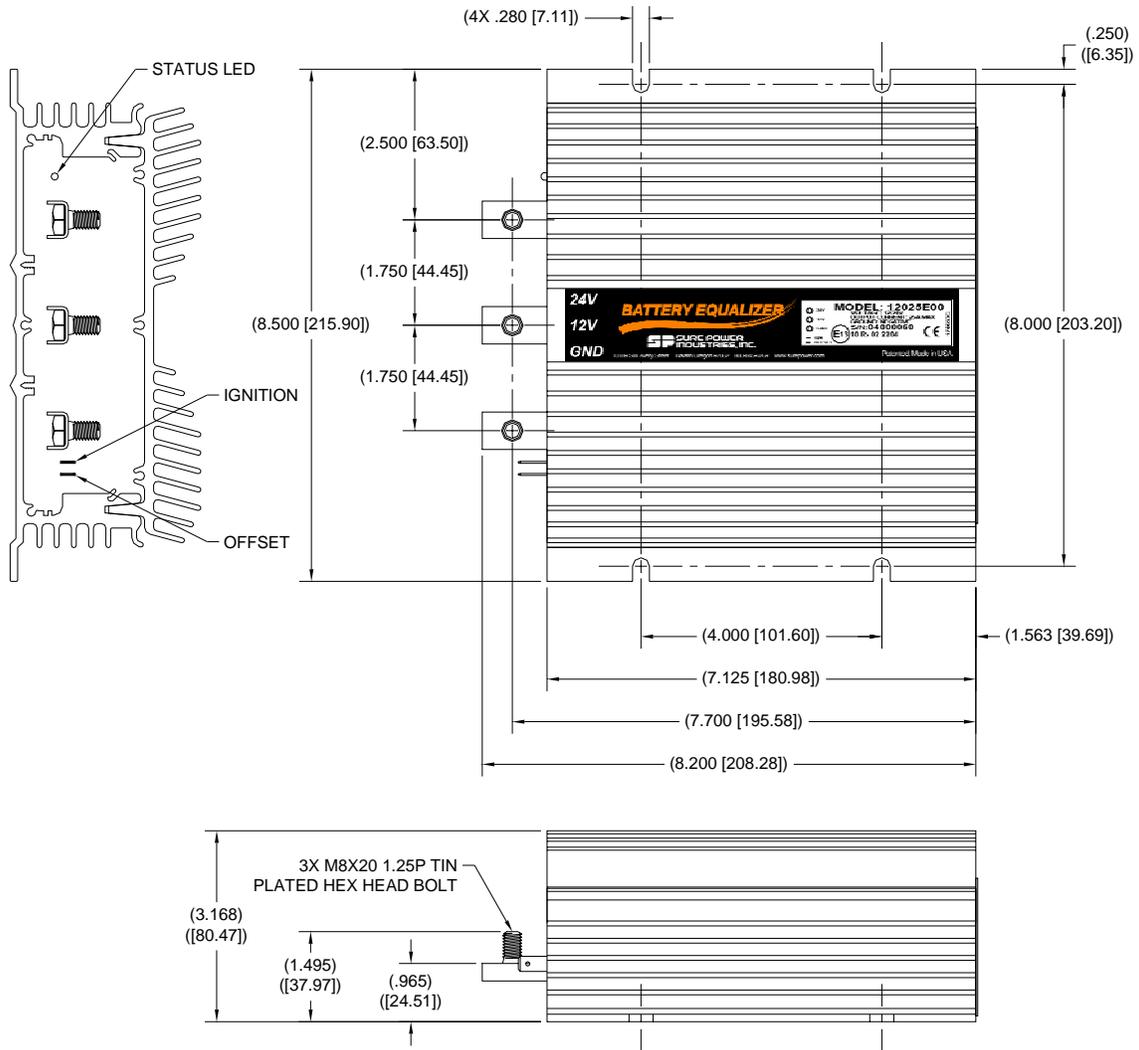


Note: Offset terminal only visible on equalizers. Product labels will dictate converter or equalizer and will coincide with the model number.

|  |                               |                                |                   |
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| <b>SURE POWER</b><br>INDUSTRIES, INC.  |                               |                                |                   |
| TITLE<br><b>MODEL NO: 120XXX00</b><br><b>12V TO 24V DC TO DC</b><br><b>CONVERTER / EQUALIZER</b><br><b>SPECIFICATION OUTLINE</b> |                               |                                |                   |
| SIZE<br><b>A</b>   | CAGE CODE NO.<br><b>55156</b> | DRAWING NO.<br><b>120XXX00</b> | REV<br><b>002</b> |
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**MECHANICAL SPECIFICATIONS (cont.)**

**Unit Dimensions – 12025X00 (12025E00 pictured)**



Note: Offset terminal only visible on equalizers. Product labels will dictate converter or equalizer and will coincide with the model number.

**SURE POWER INDUSTRIES, INC.**

TITLE  
**MODEL NO: 120XXX00  
12V TO 24V DC TO DC  
CONVERTER / EQUALIZER  
SPECIFICATION OUTLINE**

|          |               |                 |            |
|----------|---------------|-----------------|------------|
| SIZE     | CAGE CODE NO. | DRAWING NO.     | REV        |
| <b>A</b> | <b>55156</b>  | <b>120XXX00</b> | <b>002</b> |

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