



# TI3000 GPU-24-INV-1800

Power Anytime, Anywhere



## Benefits

- Ideal for hangars, FOBs, motor pools, and deployments.
- Perfect for testing and troubleshooting (avionics, TMDE, electronics, and hydraulics).
- System back-charges from the started vehicles' engine in minutes.
- Will charge and maintain vehicle batteries when unit is left connected to vehicle (ac power required).
- Safe, easy, maintenance-free operation.
- Dual GFI outlet makes it convenient to plug in laptops, test instruments, cell phone chargers, and other electronic devices without using an alternate power source.

## Safe and Easy Operation

- One person can maneuver and operate the unit.
- Safe for flight, non-hazardous, dry-cell technology.
- "Push to Test" feature provides instant state of charge.

## Pure Power

- No spikes or surges.
- 3000 peak starting amps.
- 46 amp hours of rechargeable battery power without ac.
- 96 amp hours with ac power.
- Operates and charges from 100-260 Vac power 50/60 Hz.
- 50 amps continuous @ 28.5 Vdc - 1425 Watts (when plugged into ac power).
- 1800 Watt ac uninterruptible pure sine wave inverter (<3% THD) with 60 Hz 120V power outlet.

**INCLUDES**



**TI25000-211**  
NEMA 515P North American Line Cord

and



**TI2007-208**  
8ft. DC Aviation Cable Assembly

or



**TI2007-315**  
15ft. DC NATO Cable Assembly

Tesla™ Industries, Inc.

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**Headquarters:** (302) 324-8910

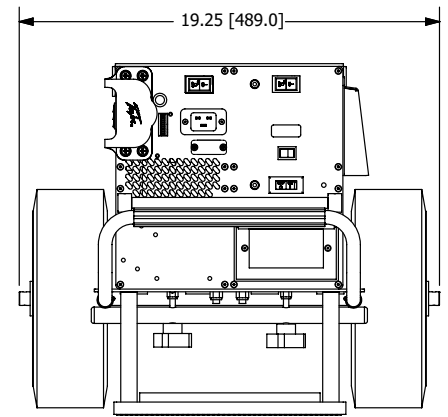
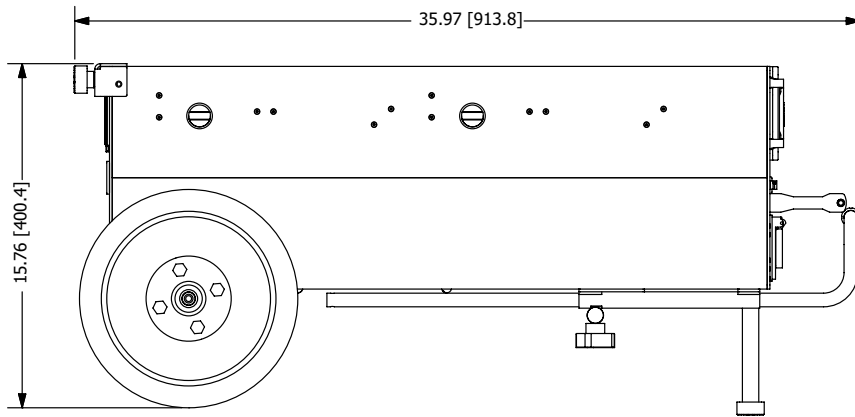
101 Centerpoint Blvd. New Castle, DE 19720 USA

**Western Regional Office:** (775) 622-8801

9475 Double R Blvd. Suite 2, Reno, NV 89521 USA



# Dimensions and Technical Specifications



\* All dimensions are in inches [millimeters]

## Technical Specifications:

|                                 |   |
|---------------------------------|---|
| DC Output                       | 3000 peak starting amps<br>50 amps continuous @ 28.5 VDC - 1425 Watts (when plugged into ac power)<br>96 amp hours (2449 watt hours) with ac power<br>46 amp hours (1024 watt hours) of rechargeable battery power without ac |
| AC Input                        | Operates and charges from Single Phase 100-260 Vac, 50/60 Hz<br>20 amps @ 120 Vac 60 Hz - 2400 Watts<br>10 amps @ 240 Vac 60 Hz - 2400 Watts  |
| AC Inverter                     | 1800 watts<br>120 Vac 60 Hz Pure Sine Wave <3% THD<br>15 amps output<br>Surge 2900 watts<br>Dual GFI receptacle   |
| Recharging Rate                 | 60 minutes (from full discharge) @ 25 °C  |
| Shock                           | 40 G per MIL-STD-810G, Method 516.6   |
| Vibration                       | Exceeds MIL-STD-810G transportation, helicopter, and CWV profiles per Method 514.6  |
| Humidity                        | 95% aggravated profile per MIL-STD-810G, Method 507.5   |
| Temperature                     | Meets or Exceeds MIL-STD-810G operational and storage temperature ranges per Method 501.5 and Method 502.5  |
| GPU Operating Temperature:      | -40 °C to 60 °C (-40 °F to 140 °F) without AC power<br>-40 °C to 55 °C (-40 °F to 131 °F) with AC power   |
| GPU Storage Temperature:        | -65 °C to 105 °C (-85 °F to 221 °F)   |
| Inverter Operating Temperature: | -40 °C to 60 °C (-40 °F to 140 °F)  |
| Inverter Storage Temperature:   | -40 °C to 70 °C (-40 °F to 158 °F)  |
| Dimensions                      | 35.97" L x 19.25" W x 15.76" H<br>913.8 mm x 489.0 mm x 400.4 mm  |
| Weight                          | 154 lbs (69.85 kg)  |
| Warranty                        | 2 Years (3 Year Optional)   |



*Power Anytime, Anywhere*

# Tesla™ TI3000 GPU-24-INV-1800

## User Manual



*Built Smart...Proven Tough*

**Tesla™ Industries, Inc.**  
101 Centerpoint Blvd.  
New Castle, DE 19720  
(302) 324-8910 Phone  
(302) 324-8912 Fax  
[www.teslaind.com](http://www.teslaind.com)

**NOTE: All users must read this entire manual prior to operating the TI3000 GPU-24-INV-1800.**

The TI3000 GPU-24-INV-1800 is a maintenance-free and sealed unit. No repairs are authorized. Warranty will be voided if unit is tampered with in any way, or if unauthorized repairs are made. For technical support please contact:

**TESLA™ INDUSTRIES INCORPORATED**

101 CENTERPOINT BLVD.

CENTERPOINT INDUSTRIAL PARK

NEW CASTLE, DELAWARE 19720

PHONE: (302) 324-8910

FAX: (302) 324-8912

WEBSITE: [www.teslaind.com](http://www.teslaind.com)

EMAIL: [tesla1@teslaind.com](mailto:tesla1@teslaind.com)



**CAUTION**

**Shock Hazard Potential**

Improper use or failure to follow instructions in this user manual can result in unit damage and/or injury or death by electrical shock.

Any attempts to open or examine the inside of the TI3000 GPU-24-INV-1800 via a tool or device (borescope, probe, etc.) can result in unit failure and/or injury by electrical shock. This GPU is maintenance free and should not be opened or disassembled for any reason.

Always protect the unit from short circuit.

Shipping Hazards: The TI3000 GPU-24-INV-1800 contains sealed, dry cell rechargeable batteries that do not pose a shipping hazard.

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## INFORMATION ONLY - PLEASE READ SECTION X

### SECTION I - PRODUCT AND MANUFACTURER IDENTITY

Product Identity:

#### Tesla<sup>®</sup>™ Turbo Start<sup>®</sup>™ Ground Power Unit (GPU) and Micro Power Unit (MPU) Containing Dry Cell (Starved Electrolyte) Batteries Used on Aviation/Military Application

Manufacturer's Name and Address:

Tesla Industries Inc.  
101 Centerpoint Blvd.  
New Castle, Delaware 19720

Emergency Telephone Number:

(302)324-8910  
Fax: (302)324-8912  
www.Teslainsd.com

### SECTION II - INGREDIENTS

| Hazardous Components      | CAS #     | OSHA PEL-TWA          | % (By weight) |
|---------------------------|-----------|-----------------------|---------------|
| Lead                      | 7439-92-1 | 50 µg/m <sup>3</sup>  | 45 - 60 %     |
| Lead Dioxide              | 1309-60-0 | 50 µg/m <sup>3</sup>  | 15 - 25%      |
| Sulfuric Acid Electrolyte | 7664-93-9 | 1.0 mg/m <sup>3</sup> | 15 - 20%      |
| Non-Hazardous Materials   | N/A       | N/A                   | 5 - 10%       |

### SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point - N/A

Specific Gravity (H<sub>2</sub>O=1) - NA

Vapor Pressure (mm Hg.) - N/A

Melting Point - N/A

Solubility in Water - N/A

Appearance & Color - N/A

### SECTION IV - FIRE & EXPLOSION HAZARD DATA

Flash Point (Method Used): N/A

Flammable Limits: N/A

LEL: N/A

UEL: N/A

Extinguishing Media: Multipurpose Dry chemical CO<sub>2</sub> or water spray.

Special Fire Fighting Procedures: Cool GPU/MPU exterior to prevent rupture. Acid mists and vapors in a fire are toxic and corrosive.

Unusual Fire and Explosion Hazards: Hydrogen gas may be produced and may explode if ignited. Remove all sources of ignition.

### SECTION V - REACTIVITY DATA AND SHIPPING/HANDLING ELECTRICAL SAFETY

Stability: Stable

Conditions to Avoid: Avoid shorting, high levels of short circuit current can be developed across the battery terminals. Do not rest tools or cables on the battery. Avoid over-charging. Use only approved charging methods. Do not charge in gas tight containers.

### SECTION VI - HEALTH HAZARD DATA

Routes of Entry: N/A

Health Hazards (Acute & Chronic): N/A

Emergency & First Aid Procedures:

Battery contains acid electrolyte, which is absorbed in the separator material. If battery case is punctured, completely flush any released material from skin or eyes with water.

Proposition 65:

Warning: Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemical known to the State of California to cause cancer. Wash hands after handling

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## SECTION VII - PRECAUTIONS FOR SAFE HANDLING & USE

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Steps to be taken in case material is released or spilled

Avoid contact with acid materials. Use soda ash or lime to neutralize. Flush with water.

Waste Disposal Method

Dispose of in accordance with Federal, State, & Local Regulations. Do not incinerate. Batteries should be shipped to a reclamation facility for recovery of the metal and plastic components as the proper method of waste management. Contact distributor for appropriate product return procedures.

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## SECTION VIII - CONTROL MEASURES - NOT APPLICABLE

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## SECTION IX - OTHER REGULATORY INFORMATION

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Tesla™ Industries GPU/MPU batteries are sealed electrolyte batteries, which means the electrolyte is absorbed in the separator material. The batteries are also sealed.

### NFPA Hazard Rating for Sulfuric Acid:

Health (Blue) = 3

Flammability (Red) = 0

Reactivity (Yellow) = 2

Sulfuric Acid is Water Reactive if concentrated.

**U.S. DOT:** Tesla™ Industries GPU/MPU batteries are classified as Nonspillable. They have been tested and meet the nonspillable criteria listed in 49 CFR § 173.159(f) and 173.159a(d)(1).

Nonspillable batteries are excepted from 49 CFR Subchapter C requirements, provided that the following criteria are met:

1. The batteries must be securely packed in strong outer packagings and meet the requirements of 49 CFR § 173.159a.
2. The batteries' terminals must be protected against short circuit.
3. Each battery and their out packaging must be plainly and durably marked "NONSPILLABLE" or "NONSPILLABLE BATTERY".

The exception from 49 CFR, Subchapter C means shipping papers need not show proper shipping name, hazard class, UN number and packing group. Hazardous labels are not required when transporting a nonspillable battery.

**IATA:** Tesla™ Industries GPU/MPU batteries have been tested and meet the nonspillable criteria listed in IATA Packing Instruction 872 and Special Provision A67. Nonspillable batteries must be packed according to IATA Packing Instructions 872. This means shipping papers need not show proper shipping name, hazard class, UN number and packing group. Hazardous labels are not required when transporting a nonspillable battery.

These batteries are excepted from all IATA regulations provided that the batteries are packed in a suitable out packaging and their terminals are protected against short circuits.

**IMDG:** Tesla™ Industries GPU/MPU batteries have been tested and meet the nonspillable criteria listed in Special Provision 238. Non-spillable batteries must be packed according to IMDG Packing Instruction P003. This means shipping papers need not show proper shipping name, hazard class, UN number and packing group. Hazardous labels are not required when transporting a nonspillable battery. These batteries are excepted from all IMDG codes provided that the batteries are packed in a suitable out packaging and their terminals are protected against short circuits per PP16.

**RCRA:** Spent lead-acid batteries are not regulated as hazardous waste by the EPA when recycled, however state and international regulations may vary.

### CERCLA (Superfund) and EPCRA:

- (a) Reportable Quantity (RQ) for spilled 100% sulfuric acid under CERCLA (Superfund) and EPCRA (Emergency Planning Community Right to Know Act) is 1,000 lbs. State and local reportable quantities for spilled sulfuric acid may vary.
- (b) Sulfuric acid is a listed "Extremely Hazardous Substance" under EPCRA, with a Threshold Planning Quantity (TPQ) of 1,000 lbs.
- (c) EPCRA Section 302 notification is required if 1,000 lbs. or more of sulfuric acid is present at one site.
- (d) EPCRA Section 312 Tier 2 reporting is required for batteries if sulfuric acid is present in quantities of 500 lbs. or more and/or if lead is present in quantities of 10,000 lbs. or more.
- (e) Supplier Notification: this product contains toxic chemicals, which may be reportable under EPCRA Section 313 Toxic Chemical Release inventory (Form R) requirements.

If you are a manufacturing facility under SIC codes 20 through 39, the following information is provided to enable you to complete the required reports:

| <u>Toxic Chemicals</u> | <u>CAS Number</u> | <u>Approximate % by Wt.</u> |
|------------------------|-------------------|-----------------------------|
| Lead                   | 7439-92-1         | 45-60                       |
| Sulfuric Acid          | 7664-93-9         | 15-20                       |

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## SECTION X - ADDITIONAL INFORMATION

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The Tesla™ Industries GPU/MPU sealed lead acid battery is determined to be an "article" according to the OSHA Hazard Communication Standard and is thereby excluded from any requirements of the standard. The Material Safety Data Sheet is therefore supplied for informational purposes only.

The information and recommendations contained herein have been compiled from sources believed to be reliable and represent current opinion on the subject. No warranty, guarantee, or representation is made by Tesla™ Industries, as to the absolute correctness or sufficiency of any representation contained herein and Tesla™ Industries assumes no responsibility in connection therewith, nor can it be assumed that all acceptable safety measures are contained herein, or that additional measures may not be required under particular or exceptional conditions or circumstances.

\*N/A or Not Applicable - Not applicable for finished product used in normal conditions.

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# Abbreviations and Symbols

Abbreviations that may be used within the text, headings and titles of this manual.

## LIST OF ABBREVIATIONS




### **Abbreviation**   **Definition**

|          |   |
|----------|---|
| ac       | Alternating Current                           |
| AFT      | Airflow Technology                            |
| AWG      | American Wire Gauge                           |
| amp or A | Ampere  |
| cont     | Continuous                                    |
| °C       | Degree Celsius                                |
| °F       | Degree Fahrenheit                             |
| dc       | Direct Current                                |
| EFF      | Efficiency                                    |
| ft       | Feet  |
| FWD      | Forward                                       |
| GPU      | Ground Power Unit                             |
| Hr       | Hour  |
| Hz       | Hertz   |
| kg       | Kilograms                                     |
| kHz      | Kilohertz                                     |
| kW       | Kilowatts                                     |
| LED      | Light Emitting Diode                          |
| max      | Maximum                                       |
| MΩ       | megaohm                                       |
| min      | Minimum                                       |
| MPU      | Micro Power Unit                              |
| NEMA     | National Electrical Manufacturers Association |
| Ω        | ohm   |
| PF       | power factor                                  |
| PFC      | power factor correction                       |
| rms      | root-mean-square                              |
| THD      | Total Harmonic Distortion                     |
| TMDE     | Test, Measurement, & Diagnostic Equipment     |
| UAV      | Unmanned aerial vehicle                       |
| Vac      | Volts, Alternating Current                    |
| Vdc      | Volts, Direct Current                         |
| W        | watts   |

# Section 1 – Safety Review

## 1.1 - Safety Notices

Safety notices appear throughout this manual to alert the user to important information regarding proper installation, operation, maintenance and storage of the unit. These notices, as illustrated below, contain a key word that indicates the level of hazard and a triangular icon that indicates the specific type of hazard.

|  |  |
|--|--|
|  <b>WARNING</b> | Indicates a condition, operating procedure or practice, which if not adhered to could result in serious injury or death.           |
|  <b>CAUTION</b> | Indicates a condition or operating procedure, which if not strictly adhered to could result in damage or destruction of equipment. |
|  <b>NOTE</b>    | Indicates a condition, operating procedure or practice, which is essential to highlight.   |

## 1.2 - Symbols

The following symbols will appear within the warning triangles to alert the user to the specific type of danger or hazard.



Figure 1.2.1 – Different types of hazard and caution symbols

### 1.3 – Hazards



**WARNING**

**Shock Hazard Potential**

Severe injury or death from electrical shock may occur if either the user or the unit is wet while the operating unit is connected to a power source. Be sure to disconnect ac power from the ac source if the unit has come into contact with water. If AC Input Circuit Breaker has tripped due to water infiltration, DO NOT try to reset it with the ac line voltage attached.



**WARNING**

**Shock Hazard Potential**

Severe injury or death from electrical shock can occur when damp electrical plugs are connected to the unit. Make sure the unit is turned off before making any connections. Failure to use proper grounding can cause potential shock hazard! In different countries, the power cord may require the use of a plug adapter to achieve plug style compatibility for operation. Use only adapters with proper grounding mechanism.

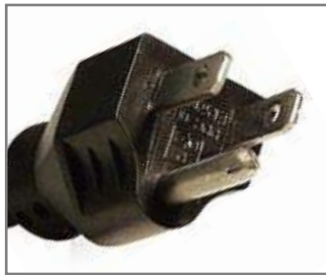


Figure 1.3.1 – Proper Ground Grounded Plug with Grounding Pin



Figure 1.3.2 – Proper Ground Adapter with Grounding Mechanism (Secured to Outlet)



Figure 1.3.3 – Improper Ground Plug with No Grounding Pin



**CAUTION**

**Unit Damage Potential**

The unit will be damaged if unapproved ac power is applied. Check the Input Voltage Selector Switch window (outlined in blue) to ensure the switch setting (115V or 230V) matches the ac power source (hangar wall, flight line ac power) prior to connecting the unit for recharging.



Figure 1.3.4 – TI3000 GPU-24-INV-1800 Input Voltage Selector Switch

## 1.4 – Important Safety Precautions



### WARNING

#### Fire/Explosion Hazard Potential

Severe injury or death from fire or explosion can occur if electrical sparks are produced near fuel vapors. DO NOT CONNECT ac power supply WHILE FUELING. AC power functions of unit shall not be operated during any fuel handling operation. Power output is restricted to dc power only.

## 1.5 – Extreme Environments



### CAUTION

#### Unit Damage Potential

The unit is equipped with a charger temperature switch that automatically disables the unit when the internal temperature exceeds 150 °F (65 °C). This protects the unit from overheating and damage. If the unit shuts down, move the unit into a cooler environment such as shade or air conditioning when possible. Perform a full function test after the unit has been allowed to cool prior to use.

## Section 2 – Product Overview

### 2.1 – Introduction

Thank you and congratulations on the purchase of your new TI3000 GPU-24-INV-1800 Ground Power Unit.

The TI3000 GPU-24-INV-1800 is intended to provide dc ground power for aircraft flight line, maintenance, and ground support operations. The unit is designed to provide 50 amps continuous at 24 volt dc output for aircraft engine starting and 24 or 28.5 volts dc output for ground maintenance, avionics/electrical troubleshooting and testing. Another feature is the 1,800 Watt ac uninterruptible pure sine wave inverter with up to 15 amps continuous @ 60 Hz 120V power outlet. This outlet makes it convenient to plug in laptops, test instruments, cell phone chargers, and other electronic devices without using an alternate power source.

The observance of procedures, limitations and performance criteria is essential to ensure peak operating efficiency and to maximize operational capabilities and life of the TI3000 GPU-24-INV-1800.

This manual contains the complete operating instructions and procedures for the TI3000 GPU-24-INV-1800 that the end user will need to safely and efficiently operate this GPU.



Figure 2.1.1 – TI3000 GPU-24-INV-1800

### 2.2 – Indication of Terms: Shall, Should and May

Within this technical manual the word “shall” is used to indicate a mandatory requirement for proper operation and warranty purposes. The word “should” is used to indicate a non-mandatory but preferred method of accomplishment. The word “may” is used to indicate an acceptable method of accomplishment.

## 2.3 – Front Panel Overview



1. **AC Input Circuit Breaker**– Trips if over-current fault condition occurs.
2. **“Push to Test” Button** – Displays current battery charge state when pressed.
3. **24 Vdc Output Connector** – Provides 24 Vdc to 28.5 Vdc @ 50 A.
4. **24 Vdc Capacity Meter** – Indicates the 24V battery charge state/power output status.
5. **Input Voltage Selector Switch** – Allows unit to operate within voltage range of either 100-130 Vac or 200-260 Vac.
6. **Telescopic Handle** – Allows for easy transport of unit.
7. **DC Input Circuit Breaker**– Trips if over-current fault condition occurs.
8. **AC Input Connector** – Connects to Single Phase 100-260 Vac line voltage.
9. **Inverter Display Panel** – Indicates input voltage and current, and output power.
10. **Inverter On/Off Switch** – Enables/disables Inverter Output.
11. **AC Output Circuit Breaker**– Trips if over-current fault condition occurs.
12. **60 Hz 120 Vac Power Outlet** – Provides output of 120 Vac @ 15 A when active.

## 2.4 – General Specifications

### Electrical

#### DC Output:

- 3000 peak starting amps
- 50 amps continuous @ 28.5 Vdc - 1425 Watts (when plugged into ac power)
- 96 amp hours (2449 watt hours) with ac power
- 46 amp hours (1024 watt hours) of rechargeable battery power without ac

#### Recharge Rate From Full Discharge:

- 60 minutes @ 25 °C

#### AC Input:

- Operates and charges from Single Phase 100-260 Vac, 50/60 Hz
- 20 Amps @ 120 Vac 60 Hz - 2400 Watts
- 10 Amps @ 240 Vac 60 Hz - 2400 Watts

#### 2 kW AC Inverter:

- 1800 watts
- 120 Vac 60 Hz Pure Sine Wave <3% THD
- 15 amps output
- Surge 2900 watts
- Dual GFI receptacle

#### Power Cell:

- Dry, High Rate Discharge, Rechargeable , Maintenance-free

#### Physical Properties:

- Size: 35.97" L x 19.25" W x 15.76" H  
913.8 mm x 489.0 mm x 400.4 mm
- Weight: 154 lbs (69.85 kg)

#### GPU Operating Temperature:

- -40 °C to 60 °C (-40 °F to 140 °F) without ac power
- -40 °C to 55 °C (-40 °F to 131 °F) with ac power

#### GPU Storage Temperature:

- -65 °C to 105 °C (-85 °F to 221 °F)

#### Shock

- 40 G per MIL-STD-810G, Method 516.6

#### Inverter Operating Temperature:

- -40 °C to 60 °C (-40 °F to 140 °F)

#### Vibration

- Exceeds MIL-STD-810G transportation, helicopter, and CWV profiles per Method 514.6

#### Inverter Storage Temperature:

- -40 °C to 70 °C (-40 °F to 158 °F)

#### Humidity

- 95% aggravated profile per MIL-STD-810G, Method 507.5

#### Cell Capacity:

- +40 °C 110% ± 05%
- +25 °C 100% ± 05%
- 0 °C 80% ± 05%
- -20 °C 65% ± 10%
- -40 °C 50% ± 10%

#### Temperature

- Meets or Exceeds MIL-STD-810G operational and storage temperature ranges per Method 501.5 and Method 502.5



### 2.5 – Physical Dimensions

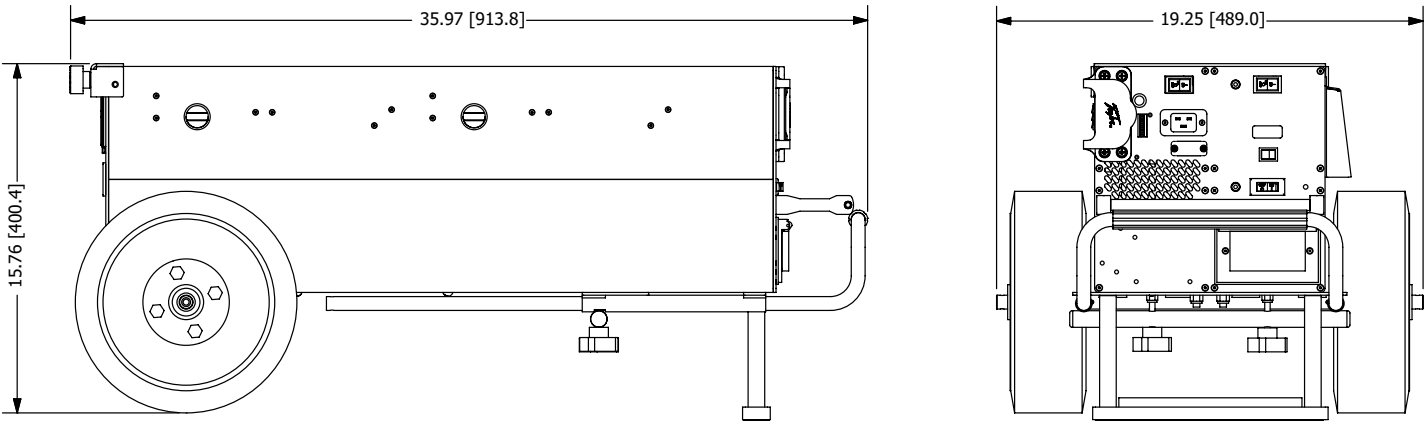



Figure 2.5.1 – TI3000 GPU-24-INV-1800 physical dimensions

### 2.6 – Airflow Ports

 **CAUTION** Damage may occur if the TI3000 GPU-24-INV-1800's air intake or outlet ports are obstructed. Ensure that ports are clear at all times.

When the TI3000 GPU-24-INV-1800 is plugged into Single Phase 100-260, Vac 50/60 Hz ac power, the internal cooling system will efficiently regulate unit temperature regardless of load. At room temperature (+77 °F) the exhaust air will not exceed the ambient temperature by more than 5 °F. In more extreme temperatures (greater than 90 °F) the exhaust air will not exceed the ambient temperature by more than 10 °F.

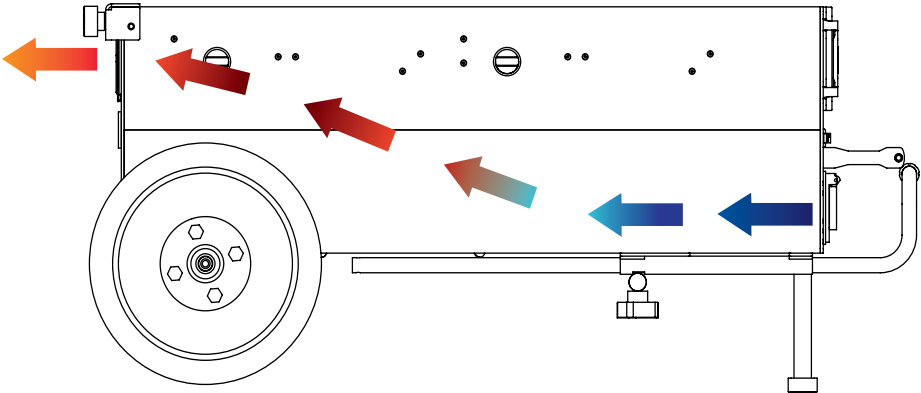
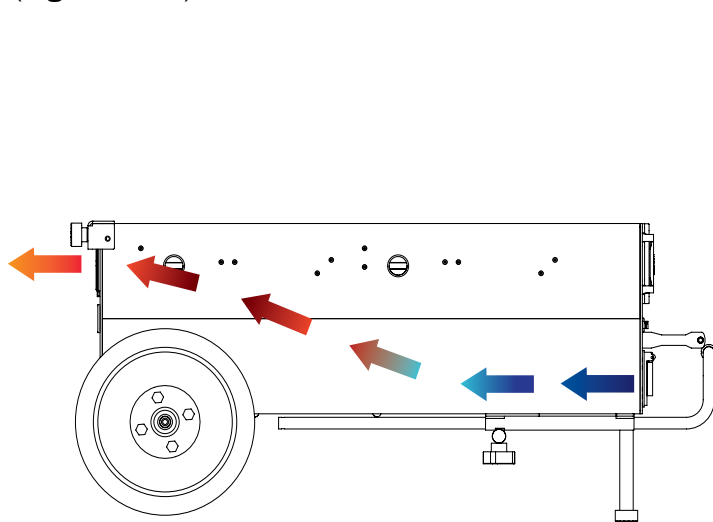


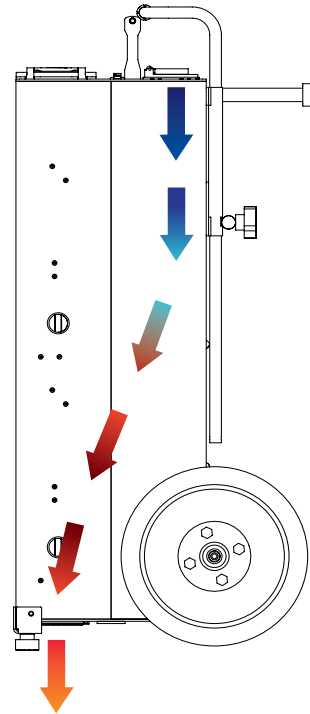
Figure 2.6.1 – Air intake, exhaust ports and internal air circulation

## 2.7 – Operating Positions

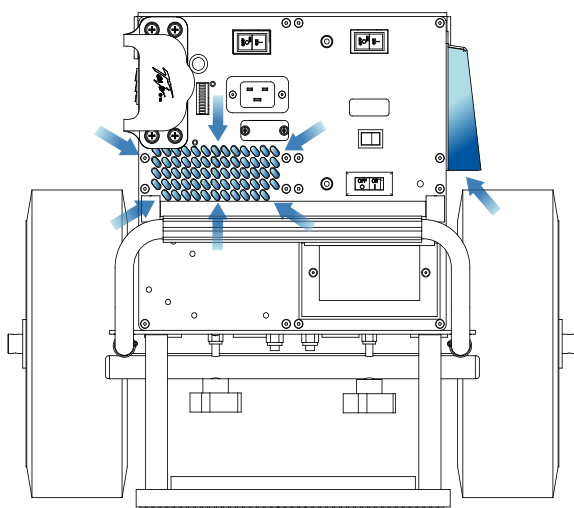
The TI3000 GPU-24-INV-1800 can be operated in both the horizontal (Figure 2.7.1) and vertical (Figure 2.7.2) positions as shown. Make sure that the airflow is not obstructed from air intake (Figure 2.7.3) and outlet (Figure 2.7.4).



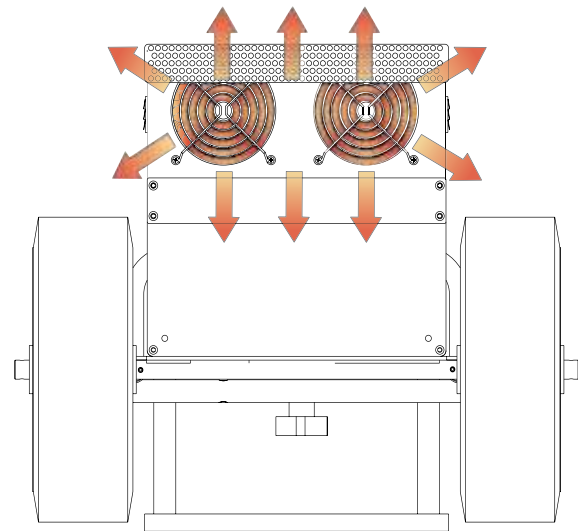
2.7.1 Horizontal Position



2.7.2 Vertical Position



2.7.3 Front Inlet



2.7.4 Rear Outlets

## 2.8 – AC Input Circuit Breaker

The AC input circuit breaker is located above the AC Input Connector. When the circuit breaker has been tripped, the switch will pop out. In the event that the breaker trips:

1. Disconnect the ac and dc connectors. (Unplug ac line cord on military unit.)
2. Wait for a minimum of 60 seconds.
3. Reset breaker by pressing rocker switch.
4. Reconnect ac and dc connections to the unit.

The unit should power up automatically. If the breaker continues to trip, return the unit to Tesla™ Industries for repair.



Figure 2.8.1 - AC Input Circuit Breaker (outlined in blue)

## 2.9 – 24 Vdc Output Connector

The 24 Vdc Output Connector will provide 50 amps continuous @ 28.5 Vdc (when plugged into ac power). When the Output Connector is not in use, cover the receptacle with the protective cover (see figure 2.9.1). This will protect the Output Connector from dust and foreign matter.



Figure 2.9.1 - 24 Vdc Output Connector Protective Cover

## 2.10 – Input Voltage Selector Switch

The Input Voltage Selector Switch allows the unit to operate safely within the expected voltage range of either 100 - 130 Vac or 200 - 260 Vac.



Figure 2.10.1 Input Voltage Selector Switch (outlined in blue)

### Changing Input Voltage Selector Switch

To change the input voltage from 115 Vac to 230 Vac, simply follow these steps:

1. With cross tip screwdriver, remove one screw and rotate the clear protective cover to one side. (see figure 2.10.2)
2. Flip the switch to read 230V. (see figure 2.10.3)
3. Rotate cover back into place. Replace and tighten screw.



#### CAUTION

Do not plug unit into 230 Vac when Input Voltage Selector Switch is set on 115 Vac.



#### NOTE

The 115 Vac setting accommodates the voltage range of 100-130 Vac. The 230 Vac setting accommodates the voltage range of 200-260 Vac.



Figure 2.10.2 - Unscrew Protective Cover



Figure 2.10.3 - Select Voltage



#### NOTE

Do not overtighten Selector Shield screws. Be sure star locks are on screws and snug the screw. Overtightening will damage the Selector Shield.

### 2.11 – “Push to Test” Button and LED Status Indicator

The “Push to Test” button is used to indicate the capacity of the power cells without applying ac input power. It allows the end user to check the status of the power cells. This lets the operator know if there is enough power to perform another engine start, or if the unit has to be connected to ac power to allow it to recharge.

1. Make sure that you wait at least 2 minutes after ac power is disconnected, or dc power is extracted from the unit, before you press the “Push to Test” button. This will ensure a correct reading.
2. Without ac power input or dc power output, simply press the “Push to Test” button on the faceplate and hold for approximately 2 to 3 seconds.
3. At this time the LED bar graph should light up indicating the status of the power cells.
4. The fan should also operate at this time. If you do not hear the fan running, stop pressing the button and check for any obstructions to the fan.

**CAUTION** Never press the “Push to Test” button while the unit is plugged into ac power or connected to an aircraft or vehicle.

**CAUTION** Never press the “Push to Test” button for more than 5 seconds. This may cause a temperature sensor to temporarily disrupt “Push to Test” function. (If this sensor is tripped, allow ten minutes for unit to cool before operating “Push to Test” button.)



Figure 2.11.1 - “Push to Test” button location (outlined in blue)



Figure 2.11.2 - Pushing to Test

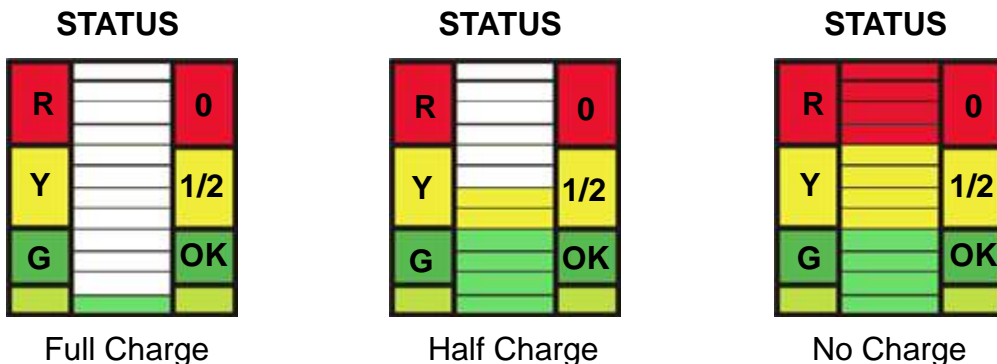


Figure 2.11.2 - Unit Charge Status

## 2.12 – Inverter Display Panel

The Inverter Display Panel (see figure 2.12.1), provides information about the dc input voltage and current levels as well as the amount of ac power output. If the Inverter On/Off Switch is switched “OFF” the Inverter Display Panel LCD will turn off, indicating that the inverter is “OFF.”



Figure 2.12.1 Inverter Display Panel

## 2.13 – 60 Hz 120 Vac Power Outlet and AC Output Circuit Breaker

When the Inverter is active and the AC Output Circuit Breaker is switched to the “ON” position, the Power Outlet will provide 120 Vac at 15 amps continuous and up to 20 amps peak. (see figure 2.13.1) If the load exceeds 20 amps, the Inverter Output Circuit Breaker will trip. The outlet makes it convenient to plug in laptops, test instruments, cell phone chargers, and other electronic devices without using an alternate power source. (see figure 2.13.2)

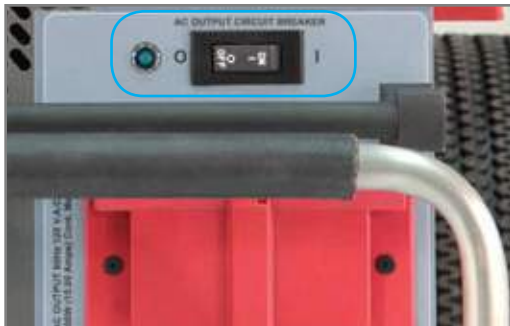


Figure 2.13.1 - 60Hz 120 Vac Output and AC Output Circuit Breaker (outlined in blue)




Figure 2.13.2 - 60Hz 120 Vac Output




# Section 3 – Operating Procedures

## 3.1 – Operating Procedures

This section deals with normal procedures, and includes all steps necessary to ensure safe and efficient operation of the unit.

|   |  |
|---|--|
|  <b>NOTE</b> | When the unit is not in use, it should always remain plugged into a suitable ac power source to ensure operational readiness at all times. |
|---|--|

|   |  |
|---|--|
|  <b>NOTE</b> | If current demand exceeds 50 amps, converter output voltage will drop below 28.5 Vdc and two or more LED status indicator bars will illuminate. If all LED status indicator bars illuminate, both the converter and power cells are supplying 24 Vdc power output. |
|---|--|

## 3.2 – General

Correct operation of the unit includes both pre-use and operational checks of the unit. Knowledge of the operating limits, restrictions, performance, unit capabilities and functions is fundamental to correct and safe operation. The operator shall ensure compliance with the instructions in this manual that affect operational safety and the warranty of the unit.

## 3.3 – Operating Limits and Restrictions

The minimum, maximum and normal operating ranges result from careful engineering and evaluation of test data. These limitations must be adhered to during all phases of operation.

## 3.4 – Performance

Refer to Section 7, PERFORMANCE DATA to determine the capability of the unit. Consideration must be given to changes in performance resulting from variations in ambient temperature, mode of operation, state of charge (with or without ac power), and aircraft dc bus system inefficiency (voltage drops).

## 3.5 – Engine Starting Power

Operators should always ensure the unit is charged above 80% prior to ground support engine starting. However, circumstances may exist during use where unit recharge is not readily available and immediate external engine starting power is required. The following provides minimum states of charge necessary to provide ample power for an efficient engine start under specific current load demands.

### ENGINE START PEAK CURRENT Requirements

Under 1200 peak starting amps  
1200 - 1500 peak starting amps  
1500 - 1800 peak starting amps  
1800 - 2100 peak starting amps  
2100 - 2400 peak starting amps  
2400 - 3000 peak starting amps

### MINIMUM CHARGE

0-40% charged  
40-50% charged  
50-60% charged  
60-70% charged  
70-80% charged  
80-100% charged



### 3.6 – Temperature Specifications

#### Cold/Hot Soaked Temperature

The ambient temperature that a unit is exposed to for one (1) hour or more establishes the unit’s cold/hot soaked stabilization temperature. If the unit’s cold/hot soaked temperature is outside the normal operating temperature range, the unit must be stabilized prior to operation. For COLD SOAKED temperature stabilization, the unit must be placed in an environment with a temperature above +10°C (+41°F) for 3 hours or a temperature above +20°C (+68°F) for 2 hours. For HOT SOAKED temperature stabilization, the unit must be placed in an environment with a temperature below +38°C (+100°F) for 1 hour.

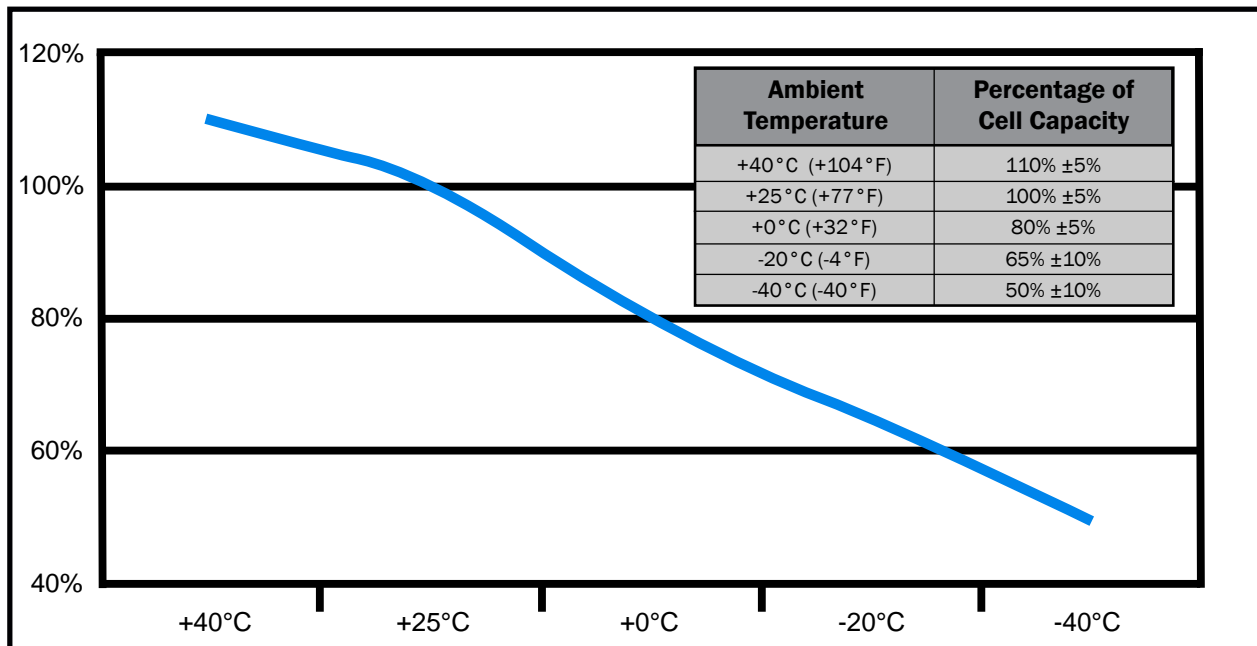



Figure 3.6.1 – Output power capability versus ambient temperature

#### Hot Soaked or Cold Soaked Definition

Simple terms: When a material is exposed to a change in temperature, its temperature will also change. Some material changes temperature quickly, others slowly. If the ambient temperature changes and is then held constant, the materials temperature will also change until its temperature stabilizes. Once the material temperature has stabilized, it is considered “soaked”.

Example: The unit is moved from the cool shade into the hot sun. The unit’s temperature will increase until it stabilizes. Once stabilized, the unit would be considered “hot soaked”.

|   |                    |   |
|---|--------------------|---|
|  | <p><b>NOTE</b></p> | <p>The unit is equipped with a temperature switch that automatically disables AC power functions when the internal temperature is above 150°F (65°C). This protects the unit from overheating and damage. If the unit shuts down, move the unit into a cooler climate such as shade or air conditioning when possible. Perform a full function test prior to use after the unit has been allowed to cool.</p> |
|---|--------------------|---|

### 3.7 – Environmental



#### WARNING

Operating any electrical equipment in the presence of moisture creates possible safety hazards and/or potential for equipment damage. Every effort has been made, within the scope of existing technology to prevent foreseeable safety hazards and make the unit moisture resistant to prevent damage or failure.

If the TI3000 GPU-24-INV-1800 is exposed to significant moisture, preventive measures and precautions shall be taken to:

- A. Prevent accumulation of moisture on ac and dc connectors/receptacles
- B. Minimize moisture entering forward inlet and outlet cooling fan vent ports

When not in use, unit inlet and outlet vent ports shall be covered from exposure. Unit shall be kept horizontal.



#### NOTE

The ambient temperature may cause the unit's protective "over-temperature" sensors to shut down the 120-240 ac functions (inverter and charger) until the unit cools to normal operating temperatures. If the unit shuts itself down, get the unit into a cooler environment such as shade or air conditioning (if possible). Perform a full function check once the unit is allowed to cool prior to continued use.

### 3.8 – Normal Function Test Procedures

This section deals with “normal function” test procedures, and includes all steps necessary to ensure that the TI3000 GPU-24-INV-1800 is operating within specified parameters prior to use. A digital multimeter (an example is shown in Figure 3.8.1) capable of measuring dc and ac voltage and resistance will be required to perform some of the tests. These functional test procedures should become routine.



Figure 3.8.1 – Digital Multimeter

#### Check Unit for Evidence of Damage

Check for dents, punctures, case distortion or misalignment, and cracked or loose connectors. If no damage is evident, proceed to the next step. If damage is evident, contact Tesla™ Industries, Inc.

#### Check DC Voltage Reading at DC Receptacle Terminals

To verify that the power cells are fully charged, set the digital multimeter to measure dc voltage. As shown in Figure 3.8.2., place the positive probe (red) on the positive post of the DC Output Connector and the negative probe on the negative post. The multimeter display should read approximately 28.5 Vdc ( $\pm 0.5$  Vdc) when power cells are fully charged and the unit is plugged into an appropriate ac power source. When the unit is not plugged into an ac power source, the multimeter display should read approximately 25.5 Vdc.

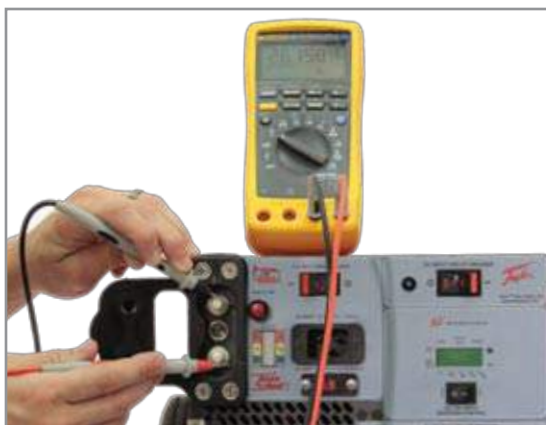


Figure 3.8.2 – Testing DC Receptacle

## Check Unit Internal Resistance (Test for Shorts)



### NOTE

Unit should be disconnected from any ac power sources prior to testing for shorts.



1. Set multimeter to Ohms.



2. Place the negative probe on the ac ground post and the positive probe to the dc positive post. Multimeter should read greater than 10 MΩ.



3. Move the positive probe to the dc negative post. Multimeter should read about 2 MΩ.



4. Move the positive probe to the fastener screw on the DC Receptacle. Multimeter should read less than 1 Ω.

## Testing the DC Outlet



1. Set multimeter to Volts.



2. Place the positive probe to the fastener screw on the DC Receptacle. Move the negative probe to the dc negative post. Multimeter should read 0 Volts.



3. Place the negative probe to the fastener screw on the DC Receptacle. Move the positive probe to the dc positive post. Multimeter should read about 21-23 Volts.

### 3.9 – Pre-Operation

1. Be sure to check that all input and output cables are not damaged. (See Section 5.1)
2. Check unit carefully for any evidence of damage. (See Section 3.8)
3. Make sure that airflow is not obstructed from air intake and outlet. (See Section 2.6)
4. Check that all connections are secure and free from water.



Figure 3.9.1 - TI3000 GPU-24-INV-1800

### 3.10 – Transporting Unit

The TI3000 GPU-24-INV-1800 has a telescoping handle that makes rolling the unit easy. For transporting on uneven ground, axle extensions should be added to the unit. For use on sand, balloon tires should be installed on the unit (see Optional Accessories).

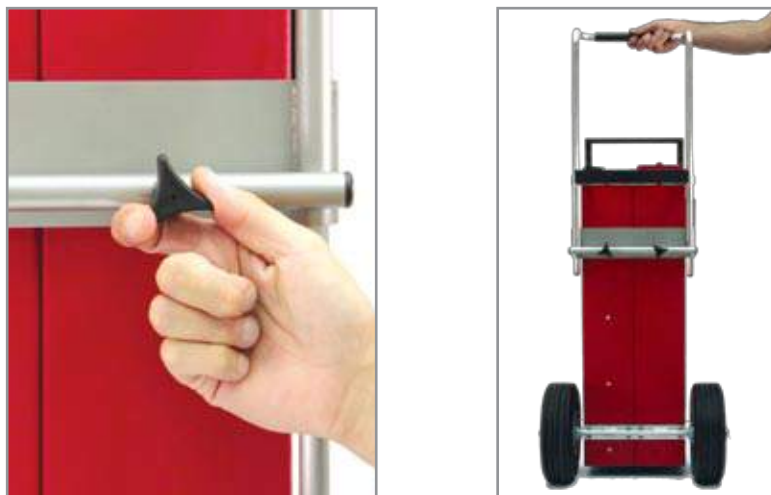


Figure 3.10.1 Releasing Telescopic Handle



### 3.11 – Regulated 28.5 Vdc Ground Power

#### Connecting DC Power Cable To Unit

Line up the dc plug with the receptacle. Push forward while rotating the T-handle one full turn clockwise. Ensure dc power cable plug is fully seated into the GPU's DC Battery Receptacle. The unit is now ready to safely transfer power.



Figure 3.11.1 Attaching DC Power Cable to TI3000 GPU-24-INV-1800

#### Connecting DC Power Cable To Vehicle or Aircraft

Line up the NATO plug or aviation dc plug pins and push it in. DC bus power should come on and aircraft voltmeter should indicate 24 Vdc to 23.5 Vdc (23 Vdc minimum). Ensure dc power cable plug is fully seated into the vehicle or aircraft's dc receptacle.



Figure 3.11.2 Attaching a NATO DC Power Cable to vehicle



Figure 3.11.3 Attaching an Aviation DC Power Cable to aircraft

#### Low Power Demand

Low power demand is defined by a requirement of 50 amps or less. Connect dc power to vehicle or aircraft ground power receptacle. DC bus power should come on and vehicle or aircraft voltmeter should indicate 28.5 Vdc to 27 Vdc (26.5 Vdc minimum). If vehicle or aircraft power demand is less than 50 amps converter output will remain at 28.5 Vdc (only one GREEN LED status indicator bar will illuminate). If vehicle or aircraft power demand exceeds 50 amps converter voltage output will decrease and two or more LED status indicator bars will illuminate.

## High Power Demand

High power demand is defined by a requirement of greater than 50 amps. Connect to aircraft ground power receptacle. DC bus power should come on and aircraft voltmeter should indicate 28.5 Vdc to 23.5 Vdc (23 Vdc minimum). If current demand is greater than 50 amps, converter output voltage will drop below 28.0 Vdc and LED status indicator lights will illuminate indicating current is being drawn from the power cells. The greater the current draw, the quicker the LED status indicator will approach red. Note the LED status indicator shows the status of the power cells.



### NOTE

When all LED status indicator bars illuminate, both the converter and power cells are supplying 24 Vdc power output for current demands above 50 amps.

For long term power requirements the TI3000 GPU-24-INV-1800 can be slaved to a vehicle charging system. To avoid damage to the vehicle or the inverter unit, several precautions must be taken.

The vehicle must have a sufficient charging system: 24Vdc @ 100 A. The alternator of the slaved vehicle must be operating in it's excited state. The slave vehicle engine must be operating at 1800RPM.



### WARNING

Never connect or disconnect the inverter to a vehicle while the inverter is running. Always turn off the ac circuit breaker, inverter power switch, and dc circuit breaker before connecting or disconnecting to a vehicle.

1. To slave to a vehicle the NATO to dc cable must be attached to the inverter
2. The NATO connector must be attached to the vehicle
3. The ac load must be connected to the inverter GFI outlet and the GFI reset if it has tripped
4. The slave vehicle engine must be brought up to 1800 RPM
5. The dc circuit breaker of the inverter must be set to on
6. The inverter power switch must be set to on
7. The ac circuit breaker must be set to on

## Engine Starting



### CAUTION

Unplug ac power cord before starting engine with TI3000 GPU-24-INV-1800

Prior to engine start, ensure power cell charge is sufficient to provide an efficient engine start. Check dc power cable for secure and correct installation prior to engine starting. Follow ground power engine starting procedure as specified in the aircraft or vehicle's operator manual.



### CAUTION

Please ensure that the Inverter is turned off prior to performing an engine start.

## Removing DC Power Supply From Vehicle

1. Remove dc power cable GPU connector from vehicle.
2. Remove dc power cable connector from TI3000 GPU-24-INV-1800 (if necessary).
3. Reinstall dc receptacle's protective cover.



### 3.12 – Regulated AC Power

#### Plugging in with AC Power

When the TI3000 GPU-24-INV-1800 is plugged into ac power, the output is 28.5 volts. This voltage allows the system to recondition and recharge the vehicle's battery(ies). It is also an optimum voltage for powering avionics and lighting on most aircraft. The GPU's ac to dc converter produces continuous amps of dc power depending on the size of the system.



#### CAUTION

Check Input Voltage Selector Switch for proper setting. Do not plug unit into 220 Vac when Input Voltage Selector Switch is set on 115 Vac.

#### Connect AC Power Cord To Unit

Ensure 120 or 240 Vac power cord is properly connected to an approved ac power supply. After approximately 5-8 seconds, unit's LED status indicator will illuminate indicating power cell state of charge. Cooling fan will operate. Ensure LED status indicator and cooling fan is operational prior to continuing.



Figure 3.12.1 Connecting TI3000 GPU-24-INV-1800 to AC Power Supply



Figure 3.12.2 AC North American Line Cord

### 3.13 – Charging Unit

Once you have the voltage selector switch set to match the power characteristics of your line cord, you can plug the unit into a wall socket to charge the batteries. When the LED status reads full charge (see figure 2.11.2) plug the TI3000 GPU-24-INV-1800 into ac power to keep the cells charged whenever it is not in use, even if it is at Full Charge. The unit will not overcharge or overheat.

When the Unit is fully charged the LED indicator should show a single steady green bar. The fan will run at reduced speed. This is normal operation indicating the unit is in standby mode and is ready for use.

If the GPU's cells need to be replaced.

After 60 minutes of ac power input the unit should be fully charged. If the "Push to Test" button is pressed and the unit still indicates it is not fully charged then the cells should be replaced.

### 3.14 - Activating the Pure Sine Wave Inverter

To activate the 1800 Watt Pure Sine Wave Inverter first press the DC Input Circuit Breaker to the “ON” position. (see figure 3.14.1) Next press the AC/DC Input Inverter Control switch to the “ON” position. Then press the AC Output Circuit Breaker switch to the “ON” position. This will activate the 60 Hz 120 Vac Power Outlet.

When the Pure Sine Wave Inverter is fully activated, the Inverter display screen will be lit as well as the LED Indicators located to the left of the DC Input Circuit Breaker and the AC Output Circuit Breaker. (see figure 3.14.2)



Figure 3.14.1 TI3000 GPU-24-INV-1800 DC Input circuit breaker in “on” position (outlined in blue)

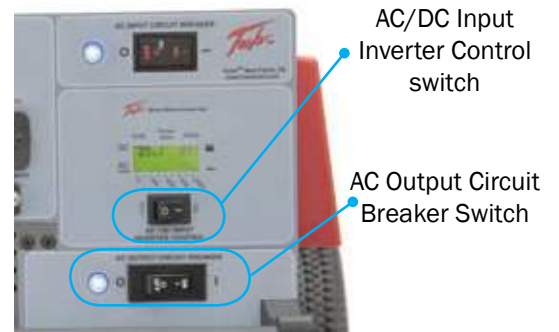


Figure 3.14.2 TI3000 GPU-24-INV-1800 with Inverter Activated

### 3.15 - Operating the Pure Sine Wave Inverter

Once the standard display screen is shown, any type of 120 Vac load can be attached to the 60Hz 120 Volt AC Outlet, including cell phone chargers, lap tops and any other electronic devices. When equipment is plugged in, the output power is displayed in watts on an analog bar graph at the bottom of the LCD display.

### 3.16 - Inverter Fan

When the Inverter is initially powered on, it is normal for the fan to be off. Once an ac load is applied to the Inverter, the fan will turn on. The fan will continue to run until the ac load is disconnected. Once the ac load is disconnected the fan will decrease in RPM and may eventually turn off to conserve power.



Figure 3.15.1 Inverter Display Panel with Switch set to “1” (ON) position.



Figure 3.16.1 Inverter Fan

### 3.17 - Inverter Output Circuit Breaker

The AC Output Circuit Breaker is located directly below the AC Inverter Display. (see figure 3.19.2) When the circuit breaker has been tripped, the LED will go out. In the event the breaker trips:

1. Disconnect any ac plugs.
2. Wait for a minimum of 60 seconds.
3. Reset breaker by switching off then on.
4. Reconnect the ac plugs.

The Inverter Output should power up. If the breaker continues to trip, turn off the 60Hz AC Inverter Power switch and contact Tesla™ for further instructions.

### 3.18 - Disabling the 60Hz 120 Vac Power Outlet

When power is no longer needed, make sure to turn off ac output circuit breaker, the Inverter On/Off switch and the DC Input Circuit Breaker. This will ensure that the power cells are not drained unnecessarily.

### 3.19 - GFCI Outlet Test and Reset Buttons

The inverter output is equipped with a GFCI outlet that will protect the user from potentially dangerous shocks due to faulty grounding (see figure 3.19.1). Pressing the “Test” button will trip the outlet and break the circuit. Pressing “Reset” will restore the circuit assuming no ground fault is present. The green LED (outlined in blue) will illuminate when the receptacle is live. In the event that the outlet does not work after resetting both the Inverter Output Circuit Breaker (see figure 3.19.2) and the GFCI receptacle, contact Tesla™ for further instructions.

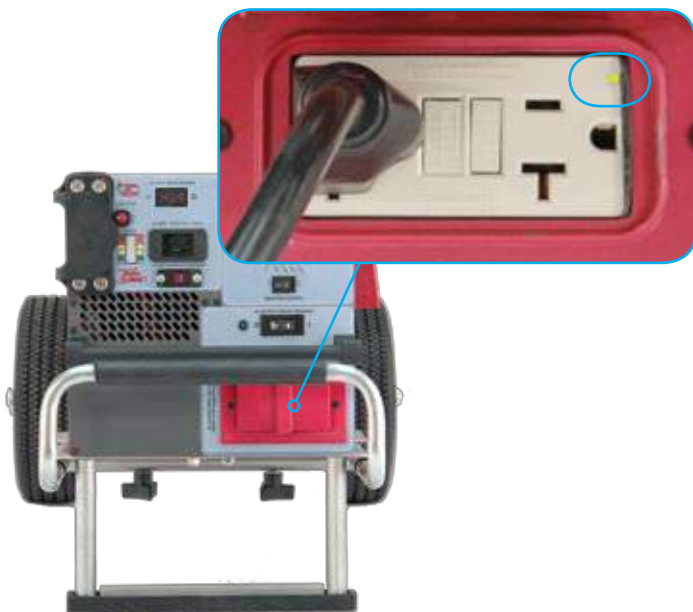


Figure 3.19.1 60Hz 120 Vac Outlet with GFCI receptacle.



Figure 3.19.2 Inverter Output Circuit Breaker for 60Hz 120 Vac Output.

### 3.20 - Pure Sine Wave Inverter Operating Limits

At a full 15 amp load the ac output will be operational for approximately 32 minutes without ac power applied to the TI3000 GPU-24-INV-1800. When the unit’s batteries drop to approximately 21 Volts the LCD display screen will begin to flash with the “LOW BATT SHUTDOWN” fault condition and an audible alarm will sound (See Section 6.3). At this point the TI3000 GPU-24-INV-1800’s batteries will need to be recharged.

### 3.21 – 60Hz 120 Vac Power Outlet Enabling the 60Hz 120 Vac Power Outlet

To activate the 60Hz 120 Vac Power Outlet, first set the DC Input Circuit Breaker switch to the “ON” position. (see figure 3.21.1) This provides power directly from the power cells to the Pure Sine Wave Inverter.

Next, set the AC/DC Input Inverter Control switch to the “I” position. Initially, the screen on the LCD Display will indicate the input voltage, output voltage and frequency configuration. Then the screen will display input voltage, input current and output power.

(see figure 3.21.2) Finally switch the AC Output Circuit Breaker to the “ON” position. (see figure 3.21.3) The 60Hz 120 Vac Power Outlet is now active.



Figure 3.20.1 TI3000 GPU-24-INV-1800 with Inverter Activated



Figure 3.21.1 60Hz AC Inverter Power Switch set to “ON” position.



Figure 3.21.2 Inverter Display Panel with Switch set to “I” (ON) position.

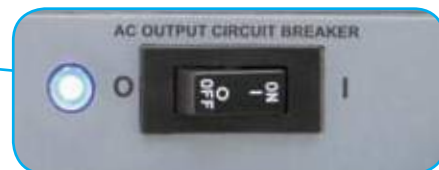


Figure 3.21.3 AC Output Circuit Breaker with Power Switch set to “ON” position.

### 3.22 - Control Panel and LCD Display

The Pure Sine Wave Inverter is equipped with a Control Panel that displays operational information so you can monitor the status of the inverter and the GPU's power cells. A backlit LCD display shows both input voltage and current from the power cells. Actual output power (in watts) from the inverter will be displayed when equipment is plugged into the power outlet. In figure 3.22.1 the inverter has an input voltage of 25.0V with a current draw of 71A. The resulting output power is displayed on an analog bar and reads 1500W.



Figure 3.22.1



#### NOTE

When activated, the power outlet will operate with or without ac power attached.

### 3.23 - Sine Wave Powersave Mode

The Sine Wave Inverter has a built-in “Powersave” mode to reduce the drain on the power cells when no load is present. This mode (when enabled) checks the output for a load every 2.5 seconds and will automatically power up with a load of at least 10 watts. To enable/disable this feature, set the Inverter Power Switch to “O” and then “I”. When the “PWR SAVE” screen comes up, quickly set the power switch to “O”, wait three seconds, and set the switch to “I”. This will toggle the “Powersave” function on and off.



# Section 4 – Post Operation

## 4.1 – General

Although the TI3000 GPU-24-INV-1800 has been ruggedized and made weather resistant within the scope of unit's intended use, it is essential that good general care be taken to maintain unit in good operating condition and to maximize unit's operational life.

## 4.2 – After Use

Unit should be protected from environmental elements and man made hazards. Ideally, unit should be secured in a building or shed. Most importantly, unit shall be fully covered if stored while exposed to environmental elements.

## 4.3 – Power Cell Recharge

**NOTE** The TI3000 GPU-24-INV-1800 incorporates a backcharge feature that enables the unit to be recharged from the vehicle once the engine is started and the starter/generator is running. This feature will enable you to start multiple vehicles without reconnecting to ac power if the GPU is allowed to backcharge for approximately 30 seconds.

**NOTE** Plug the TI3000 GPU-24-INV-1800 into ac power to keep the cells charged whenever it is not in use, even if it is at Full Charge. The unit will not overcharge or overheat.

### Connect AC Power Cord to Unit

**CAUTION** Check Input Voltage Selector Switch for proper setting. Do not plug unit into 230 Vac when Input Voltage Selector Switch is set on 115 Vac.

Ensure 120 or 240 Vac power cord is properly connected to an approved ac power supply. After approximately 5-8 seconds, ensure unit's LED status indicator illuminates indicating power cell state of charge and cooling fan is operating. Any time the unit's power cells are fully discharged the unit shall be recharged within 24 hours to prevent performance degradation and ensure maximum life.



Figure 4.3.1 Connecting TI3000 GPU-24-INV-1800 to AC Power Supply



Figure 4.3.2 AC North American Line Cord

**CAUTION****Guard From Incorrect Power Source**

The TI3000 GPU-24-INV-1800's power cells may be damaged if recharged by NiCad or Lithium Ion battery chargers. Power cells should only be charged by either the TI3000 GPU-24-INV-1800's internal charger and the ac power cord furnished with the equipment, or when connected to vehicle or aircraft's external dc power receptacle.



Figure 4.3.3 - Proper and Improper Charging Methods

**NOTE**

TI3000 GPU-24-INV-1800 Inverter cannot be plugged into itself to charge it's own batteries.





## Section 5 – Unit Care and Maintenance



### WARNING

Severe injury or death from electrical shock may occur if either the user or the unit is wet while operating the unit with an ac power source attached.



### CAUTION

Damage may occur if an unapproved or modified ac line cable or input plug is attached to the unit. Do not use any type of ac voltage converter.

### 5.1 - Unit Care

#### Avoid Prolonged Exposure to Extremely Damp Environments

Be sure to disconnect ac power from the ac source if the unit has come into contact with water. If the AC Input Circuit Breaker has tripped due to water infiltration, allow the unit to dry out before attempting to reset circuit breaker. Cover the unit to prevent water seepage. If the unit is operated in extremely damp conditions, it should be stored in an environmentally controlled building when not in use. Wipe unit clean periodically with a soft cloth to remove dust, dirt, etc.



#### Protect Cables from Damage

Do not cut, crush, or drag the input or output power cables when handling the unit. Always inspect cables prior to use. If no damage is evident, proceed to the next step. If damage is evident, contact Tesla™ Customer Service. Do not attempt to use any other type of power cables other than the Tesla™ cables included with the unit.



## 5.2– Unit Servicing

This unit is a maintenance-free, sealed unit. No repairs outside of Tesla™ are authorized. Warranty will be voided if unit is tampered with in any way including any damage to the WARRANTY VOID stickers located on the case (see Figure 5.2.1 below). If the unit requires maintenance, please contact Tesla™ Customer Service at (302) 324-8910. A Repair Request Form can be found in the back of this manual.



Figure 5.2.1 – Warranty Void stickers Front and Back on the unit

## 5.3 – Packaging and Shipping

When returning the GPU, please ensure that it is properly packaged. The only method for transport is in a sturdy shipping crate or Tesla™ Shipping Case (be sure to enclose the Repair Request Form). Seal the crate on all sides and return it to Tesla™ at the address listed below. Please contact Tesla™ Customer Service at (302) 324-8910 with any questions or concerns.

TESLA™ INDUSTRIES, INCORPORATED  
101 CENTERPOINT BLVD.  
CENTERPOINT INDUSTRIAL PARK  
NEW CASTLE, DELAWARE 19720  
PHONE: (302) 324-8910 FAX: (302) 324-8912  
Website: [www.teslaind.com](http://www.teslaind.com)  
Email: [Tesla1@teslaind.com](mailto:Tesla1@teslaind.com)



Figure 5.3.1 – Tesla™ Industries Shipping Case

## 5.4 – Storage

If unit can not be connected to ac power while in storage, we recommend to charge the unit once a year. The shelf-life of 12 months is due to the battery /cells inside the unit. We guarantee the unit will hold 80% of its charge for a period of 12 months without being recharged. When the GPU's leave the facility, they are fully charged and if they are to go into storage (without being used), they will maintain 80% of their charge after 12 months. The life expectancy of the units, if maintained properly, is 5 to 7 years.

# Section 6 – Troubleshooting and FAQ

## 6.1 – Frequently Asked Questions

### 1. Why should I buy a Tesla™ Turbo Start™ System?

Tesla™ Turbo Start™ is a multi-functional system that are ideal for support of 24 Vdc vehicles and aircraft and their electronics/avionics on the bench. Tesla™ manufactures various systems of different sizes and capacities that are man-portable, maintenance free and provide pure, dc power in a completely safe package. Designed for Military applications, these systems are equally valuable in maintenance support at the main facility or in remote locations. They are easily transported and air-portable. They will also provide 28.5 Vdc when the system is connected to the appropriate ac source.

### 2. How does a Turbo Start™ work?

The Turbo Start™ combines state of the art power conversion electronics with our proprietary “dry cell” batteries. The system’s electronics incorporate an intelligent charging system for the cells. The cells are ideal for this application as they are non-spillable, absorbed electrolyte dry cells that are sealed, maintenance free and safe for air transport.

### 3. How is Turbo Start™ used in Aviation Support?

There are many ways a Turbo Start™ will benefit your operation. By using it for pre-flight testing, you will avoid depleting the aircraft’s battery. You can start the aircraft’s engine with the Turbo Start™ as well. In the hangar, when connected to ac power, the Turbo Start™ will provide 28.5 Vdc for avionics testing and will also recondition and recharge the aircraft’s battery. Another benefit is the ability to fly with the Turbo Start™ aboard your aircraft. You may take the Turbo Start™ anywhere you travel, ensuring that you will always have power.

### 4. How much power will my Turbo Start™ provide?

Depending on the system, the Turbo Start™ will provide anywhere from 1500 to 3500 peak starting amps, 25 to 400 continuous amps dc and 23 to 96 hours of rechargeable power. See our website ([www.teslaind.com](http://www.teslaind.com)) to determine the proper Turbo Start™ for your needs.

### 5. Will a Tesla™ Turbo Start™ spool up a turbine engine?

Nothing will start a turbine engine faster or safer than the right Tesla™ Turbo Start™. Not only will it eliminate hot starts, but it will extend the life of your starter, your engine and your battery while reducing maintenance. The Turbo Start™ senses the impedance from the starter/generator. It then provides the exact power required throughout the start-up curve.

### 6. How many engine starts will my Turbo Start™ provide until it is depleted?

The Turbo Start™ back-charges, almost instantly, once the vehicle / aircraft is started and the generator is on line. This “power flywheel” feature enables the Turbo Start™ to recharge itself right from the vehicle it started in less than 30 seconds. You can go down the line in your motor pool and start every 24V vehicle, without limit!

### 7. How do you prolong the life of the Turbo Start’s cells?

All you need to do is plug the unit in to the appropriate ac power outlet the system requires. AC power will recharge the system and keep the cells healthy. Users who regularly plug the system in can expect to get 5-7 years from their cells before they need to be replaced. Tesla™ cells do not have a memory like cell phone batteries. There is no need to fully discharge them. The recharging system will not overcharge the unit or produce excess heat.

### 8. Is it waterproof?

Water-resistant but not waterproof (See Environmental Section).

## 9. Are Tesla™ GPUs used in shop maintenance and testing?

Tesla™ systems are gaining popularity throughout maintenance facilities, instructional facilities, laboratories, manufacturing plants, aircraft hangars and many other locations. The reason is due to the precise dc power, the small, portable and quiet nature of our systems and the maintenance free aspect of our GPU's. We can custom tailor ground power systems to fit your individual requirements.

## 10. Can one person transport it?

Turbo Start™ is designed to be handled by one person. The TI500 is our smallest GPU system to date and weighs 36 lbs. The TI1000 weighs 57 Lbs and can be carried or wheeled on a dolly. Larger units have wheels incorporated directly on the system with an extendable handle.

## 11. Is the Turbo Start™ in the government purchasing system?

Yes. Tesla™ Industries is an approved vendor/supplier – our cage code is OVWE2. Most Tesla™ products are class IX, have a National Stock Number (NSN) designation and can be acquired through the DLA (Defense Logistics Agency).

## 12. How long does this unit stay charged?

Unit should never be allowed to discharge fully. In-field use, it receives a dc back charge directly from a running engine. When not in use, unit should be plugged into ac power (outlet) all the time. Tesla™ systems will retain 80% of their capacity after one year of storage.

## 13. How do I get my Turbo Start™ serviced?

Contact Tesla™. We can be reached at (302) 324-8910. Ask for customer service. You can also email us at [tesla1@teslaind.com](mailto:tesla1@teslaind.com). Once we receive the unit at our facility, we will examine it. Systems that are protected under warranty will be repaired at no charge. If the warranty has expired, you will receive a quote for necessary repairs prior to work being done. Our turnaround time is 48 hours once repairs are authorized.

## 14. Can I make my own repairs to unit?

During the warranty period, the unit can only be repaired by Tesla™ Industries for the warranty to remain in effect. Regardless, we strongly recommend allowing Tesla™ to repair any unit as we will analyze the complete system and re-calibrate it.

## 15. What type of maintenance does the Turbo Start™ require?

Although the systems are maintenance free, please keep units plugged in while not in use. This will greatly extend the life of the cells. Also, keep the vent areas clean and free of debris. Keep units in a well ventilated area while charging. Keep the unit in a protected environment when not in use (maintenance facility, shed, etc.).

## 16. What is included with my Turbo Start™?

Aviation customers will receive an eight (8') foot DC Aviation Cable Assembly (TI2007-208). Ground vehicle customers will receive a fifteen (15') foot DC NATO Cable Assembly (TI2007-315). All customers receive an ac line cord for their home country and a full two year warranty.

## 17. Are there any HAZMAT issues or disposability problems?

There are none. Tesla™ will reclaim all battery cells for disposability purposes. Contact Tesla™ if you have questions.

## 6.2 - Basic Usage/Operation Questions

### 1. What's the best position to place the unit for use vertical or horizontal?

Preferred position is horizontal for stability and airflow considerations. When charging, the preferred position is horizontal. The Turbo Start™ can be put in any position while it is being used as there is nothing to spill inside the system.

### 2. Does the unit have to be plugged in all the time?

No, but for maximum performance and cell longevity, keep the unit plugged in while not in use.

### 3. What happens if I don't keep it plugged in?

Unit will eventually lose its charge and cell life is shortened.

### 4. How do I check the status of the charge?

Press the "Push to Test" LED bar indicator on the unit's faceplate. A fully charged unit will have one green LED light showing.

### 5. Why is the cooling fan always running when I am plugged into ac power?

Constant cooling fan operation ensures proper and consistent ventilation of the unit.

### 6. Why does the cooling fan slow down?

Cooling fan rpm varies for better temperature regulation.

### 7. Why does my LED flicker when the unit is plugged in?

Older Turbo Starts™ indicated a full charge with a flickering LED readout. Newer models feature the illumination of one green bar on the LED readout when the unit is fully charged.

### 8. What do I do if a circuit breaker trips?

The AC Input Circuit Breaker is located above the AC Input Connector. When the circuit breaker has been tripped, either of the red buttons will pop out. In the event that the breaker trips:

1. Disconnect the ac and dc connectors. (Unplug ac line cord on military unit.)
2. Wait for a minimum of 60 seconds.
3. Reset breaker by pressing red button.
4. Reconnect ac and dc connections to the unit. (Plug in ac line cord on military unit.)

The unit should power up automatically. If the breaker continues to trip, return the unit to Tesla™ Industries for repair.

### 6.3 - Basic Unit Troubleshooting

**When I plug my device into the 60Hz 120 Vac Power Outlet, I don't get any power.**

The 60Hz 120 Vac Power Outlet produces voltage directly from the power cells. Therefore, the 120Vac Outlet should function regardless of whether the GPU is plugged in. Before proceeding, make sure the batteries have a sufficient charge. If the Power Outlet is not on, verify that the 60Hz AC Inverter Power Switch is in the "ON" position. The LED next to the Inverter Power Switch should be on (see figure 6.3.1).

**Is the 60Hz AC Inverter Power Switch On (LED illuminated)?**

No: Turn on the 60Hz AC Inverter Power Switch.

Yes: Proceed to the next step.



6.3.1 60Hz AC Inverter Power set to "ON" position (LED illuminated)



6.3.2 Inverter Display Panel and On/Off Switch turned on and active.

**Is the Inverter On/Off Switch in the "I" position (see figure 6.3.2)?**

No: Turn on the Inverter On/Off Switch.

Yes: Proceed to the next step.

**Is the Inverter Display Panel LCD on (see figure 6.3.2)?**

No: Contact Tesla™ Industries, Inc.

Yes: Proceed to the next step.

**Is the AC Output Circuit Breaker tripped (see figure 6.3.3)?**

No: Proceed to the next step.

Yes: Push the breaker in to reset.

**Is the 60Hz AC Power Outlet LED illuminated (see figure 6.3.4)?**

No: Press the "Reset" button on the Outlet.

Yes: Proceed to the next step.

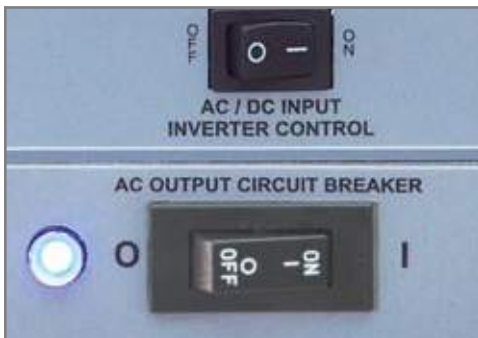


Figure 6.3.3 – 60Hz AC Output Circuit Breaker (push to reset)



Figure 6.3.4 – 60Hz AC Power Outlet "ON" (green LED illuminated (outlined in blue))

If the green LED on the front of the 60Hz AC Power Outlet is illuminated the Outlet should be live. If the LED does not light after pressing the "Reset" button, contact Tesla™ Industries for further instructions.



| Fault  | Possible Cause  | Remedy  |
|--|---|---|
| 1. Output Capacity LED does not come on when button is pushed. | <b>A.</b> Units cells completely dead.  | <b>A.</b> Plug the unit in to the appropriate ac power outlet and recharge.<br><b>B.</b> If LEDs still do not illuminate, Please contact Tesla™ Customer Service at (302) 324-8910.   |
| 2. Unit has no output dc or ac input or both.                  | <b>A.</b> Units cells completely dead.<br><b>B.</b> AC line cord is damaged or bad.<br><b>C.</b> DC line cord is damaged or bad.<br><b>D.</b> AC circuit breaker has been tripped.<br><b>E.</b> Cables loose or corroded. | <b>A.</b> Do a function check with digital meter, see section 3.8.<br><b>B.</b> Do continuity test.<br><b>C.</b> No continuity, check cables for cuts and replace if needed.<br><b>D.</b> Clean contacts of debris and make sure connections are tight. |
| 3. Unit will not charge from ac outlet.                        | <b>A.</b> AC line cord is damaged or bad.<br><b>B.</b> Is ac line cord fully plugged into unit and wall outlet.<br><b>C.</b> AC circuit breaker has been tripped.<br><b>D.</b> No ac power at outlet.                     | <b>A.</b> Do a continuity test on the ac line cord<br><b>B.</b> Check if line cord is properly secured.<br><b>C.</b> Check to make sure ac circuit breaker is placed in the “ON” position.  |
| 4. Unit failed function test.                                  | <b>A.</b> Internal failure.   | <b>A.</b> Please contact Tesla™ Customer Service at (302) 324-8910.   |
| 5. Unit emits sparks when plugged into power source.           | <b>A.</b> Water or moisture has seeped in unit<br><b>B.</b> Internal failure.   | <b>A.</b> Move unit to dry warm air and allow to dry for over 48 hours.<br><b>B.</b> Do Not Use Unit. Please contact Tesla™ Customer Service at (302) 324-8910.   |
| 6. Unit works then shuts down.                                 | <b>A.</b> Unit is overheating.<br><b>B.</b> Cooling fans and vents are obstructed or inoperable.  | <b>A.</b> Move the unit to an area 10° -20° less ambient temperature.<br><b>B.</b> Clean and clear cooling vents, turn on unit and inspect if air is flowing through unit. If no airflow please contact Tesla™ Customer Service at (302) 324-8910.      |

| Fault  | Possible Cause                    | Remedy  |
|--|-----------------------------------|---|
| 7. Circuit breaker continuously trips              | <b>A.</b> Unit is overheating.    | <b>A.</b> Disconnect unit from ac input and dc output.<br><b>B.</b> Switch breaker to ON position.<br><b>C.</b> Reconnect unit to cables and run.<br><b>D.</b> If LEDs still do not illuminate, Please contact Tesla™ Customer Service at (302) 324-8910. |
| 8. Unit does not put out 28.5 volts dc power.      | <b>A.</b> Unit is not plugged in. | <b>A.</b> Plug unit into ac power source to maintain 28.5.<br><b>B.</b> Stand alone Vdc is 24 Volts (unplugged).  |
| 9. Unit stand alone voltage is less than 23 volts. | <b>A.</b> Cells discharged.       | <b>A.</b> Plug unit into ac power source.<br><b>B.</b> Recheck capacity after 25 minutes.<br><b>C.</b> Failure to hold above 23 Vdc, Please contact Tesla™ Customer Service at (302) 324-8910.  |
| 10. Unit weakens after first start.                | <b>A.</b> Weak cells.             | <b>A.</b> Allow between 30 to 60 seconds backcharge between uses.   |

Troubleshooting for the Pure Sine-Wave Inverter is continued on the next page.

The following fault conditions may be displayed on the Inverter Display Screen along with an audible alarm sound and a blinking LCD back-light.

| Inverter Display Indication                            | Fault Condition  | Remedy  |
|--|--|---|
| HIGH BATT SHUTDOWN                                     | <b>A.</b> Battery Voltage too high                                   | <b>A.</b> Check for fault with battery charging system.<br><b>B.</b> Manually reset Inverter by turning Off then On again.  |
| LOW BATT SHUTDOWN                                      | <b>A.</b> Battery Voltage too low (21 Volts approximately)           | <b>A.</b> Charge Batteries.<br><b>B.</b> Manually reset Inverter by turning Off then On again.  |
| OVERLOAD SHUTDOWN                                      | <b>A.</b> Battery current too high<br><b>B.</b> Probable ac overload | <b>A.</b> Reduce Load on Inverter.  |
| OVERTEMP SHUTDOWN                                      | <b>A.</b> System is over-temperature                                 | <b>A.</b> Improve ventilation and cooling.<br><b>B.</b> Reduce Load on Inverter.  |
| SYSTEM SHUTDOWN<br>PS_FAULT SHUTDOWN<br>DC-DC SHUTDOWN | <b>A.</b> Overload or system hardware fault                          | <b>A.</b> Disconnect all loads.<br><b>B.</b> Manually reset Inverter by turning Off then On again.<br><b>C.</b> If Unit still does not operate, Please contact Tesla™ Customer Service at (302) 324-8910. |

# Section 7 – Performance Data

## 7.1 – Purpose

This section provides performance data for the unit. Continual reference to this information will enable the user to obtain maximum performance, utilization and service life from the unit. Although maximum performance is not always required, regular referral to this section is recommended for the following reasons:

- A.** To generate knowledge of unit's performance margins to enable the operator to make sound judgment when unexpected conditions or alternate operational requirements are encountered.
- B.** To enable the user to readily recognize situations requiring maximum performance.
- C.** To gain experience in accurately estimating the effects of variables for which data is not presented.
- D.** To help the operator determine if a vehicle or an aircraft system malfunction exists by comparing actual performance with expected performance.



### NOTE

The information provided in this section is primarily intended for operational planning and is most useful when planning operations under unfamiliar conditions or environmental extremes. The data may also be used to establish local operating procedures and to ensure unit's operational life is maximized.

## 7.2 – General

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of temperature and dc electrical load demand relating to the ground power support requirements are presented. Wherever practical, data is presented conservatively. However, **NO GENERAL CONSERVATISM HAS BEEN APPLIED.** All performance data presented is within the applicable limits of the unit

## 7.3 – Data Basis

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally are based on one of three categories:

- A.** Derived From Actual Controlled Testing: Controlled test data obtained on a similar unit type.
- B.** Calculated Data: Data based on tests, but not on a similar unit type placed under a controlled test.
- C.** Estimated Data: Data based on estimates using rules of physics, mathematics, and electrical engineering principles and concepts, but not verified by tests.

## 7.4 – Specific Conditions

The data presented are accurate only for specific conditions listed under the title of each chart or graph. Variables for which data are not presented, but which may affect that phase of performance, are discussed in associated text. Where data is available or reasonable estimates can be made the amount that each variable affect performance will be given.

## 7.5 – General Conditions

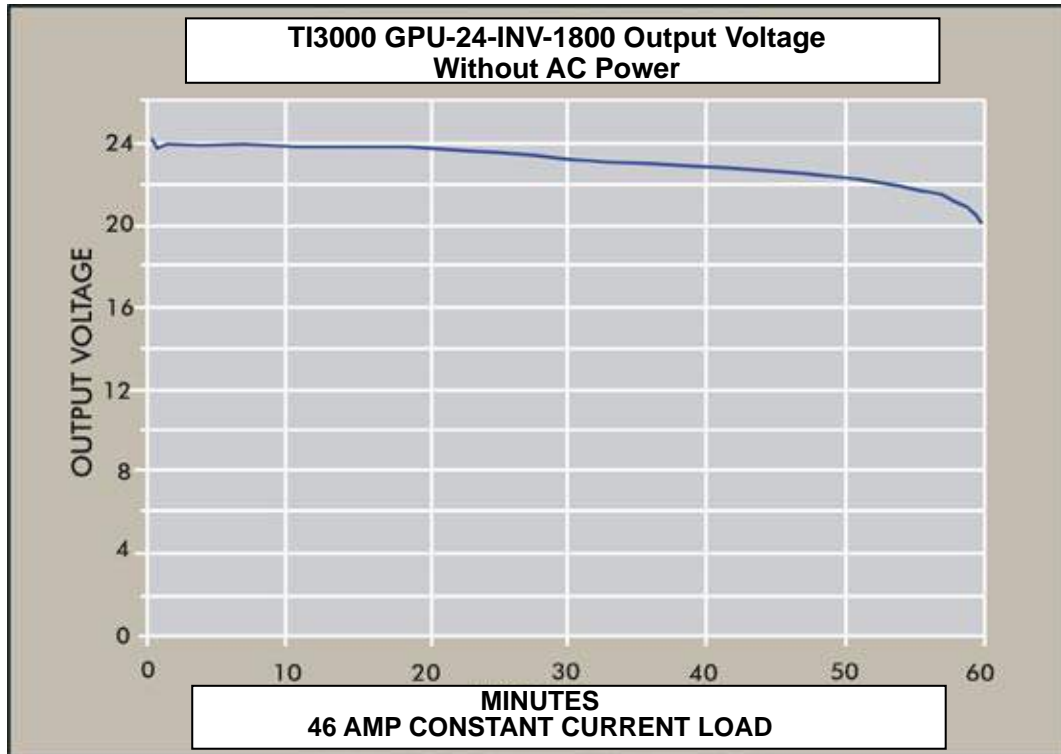
In addition to the specific conditions, the following general conditions are applicable to the performance data.

- A.** Variation in Aircraft: Power demand differences between individual aircraft of the same make and model are known to exist due to variations in dc electrical system efficiency. These differences, however, are considered insignificant and are not individually accounted for.
- B.** Ground Support and Aircraft Instrument Variations: The data shown in the performance charts do not account for instrument tolerance differences or inaccuracies.

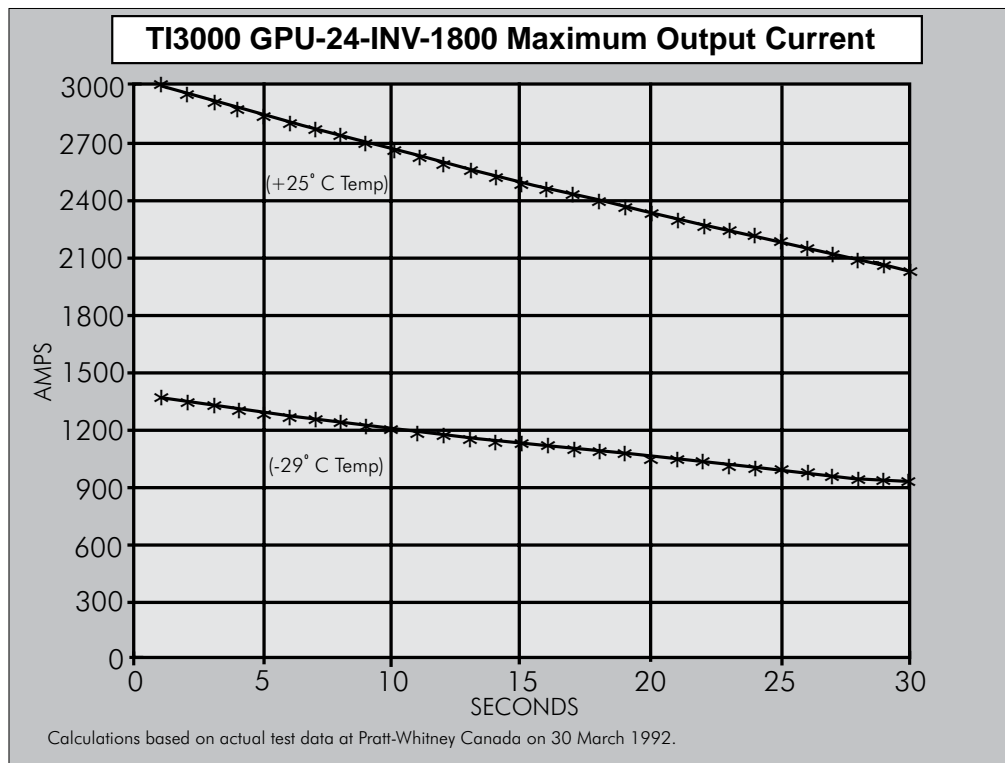
## 7.6 – Temperature Conversion Chart

| °C    | °F    | °C    | °F    | °C   | °F    | °C   | °F    |
|-------|-------|-------|-------|------|-------|------|-------|
| -60.0 | -76.0 | -27.0 | -16.6 | 6.0  | 42.8  | 39.0 | 102.2 |
| -59.0 | -74.2 | -26.0 | -14.8 | 7.0  | 44.6  | 40.0 | 104.0 |
| -58.0 | -72.4 | -25.0 | -13.0 | 8.0  | 46.4  | 41.0 | 105.8 |
| -57.0 | -70.6 | -24.0 | -11.2 | 9.0  | 48.2  | 42.0 | 107.6 |
| -56.0 | -68.8 | -23.0 | -9.4  | 10.0 | 50.0  | 43.0 | 109.4 |
| -55.0 | -67.0 | -22.0 | -7.6  | 11.0 | 51.8  | 44.0 | 111.2 |
| -54.0 | -65.2 | -21.0 | -5.8  | 12.0 | 53.6  | 45.0 | 113.0 |
| -53.0 | -63.4 | -20.0 | -4.0  | 13.0 | 55.4  | 46.0 | 114.8 |
| -52.0 | -61.6 | -19.0 | -2.2  | 14.0 | 57.2  | 47.0 | 116.6 |
| -51.0 | -59.8 | -18.0 | -0.4  | 15.0 | 59.0  | 48.0 | 118.4 |
| -50.0 | -58.0 | -17.0 | 1.4   | 16.0 | 60.8  | 49.0 | 120.2 |
| -49.0 | -56.2 | -16.0 | 3.2   | 17.0 | 62.6  | 50.0 | 122.0 |
| -48.0 | -54.4 | -15.0 | 5.0   | 18.0 | 64.4  | 51.0 | 123.8 |
| -47.0 | -52.6 | -14.0 | 6.8   | 19.0 | 66.2  | 52.0 | 125.6 |
| -46.0 | -50.8 | -13.0 | 8.6   | 20.0 | 68.0  | 53.0 | 127.4 |
| -45.0 | -49.0 | -12.0 | 10.4  | 21.0 | 69.8  | 54.0 | 129.2 |
| -44.0 | -47.2 | -11.0 | 12.2  | 22.0 | 71.6  | 55.0 | 131.0 |
| -43.0 | -45.4 | -10.0 | 14.0  | 23.0 | 73.4  | 56.0 | 132.8 |
| -42.0 | -43.6 | -9.0  | 15.8  | 24.0 | 75.2  | 57.0 | 134.6 |
| -41.0 | -41.8 | -8.0  | 17.6  | 25.0 | 77.0  | 58.0 | 136.4 |
| -40.0 | -40.0 | -7.0  | 19.4  | 26.0 | 78.8  | 59.0 | 138.2 |
| -39.0 | -38.2 | -6.0  | 21.2  | 27.0 | 80.6  | 60.0 | 140.0 |
| -38.0 | -36.4 | -5.0  | 23.0  | 28.0 | 82.4  | 61.0 | 141.8 |
| -37.0 | -34.6 | -4.0  | 24.8  | 29.0 | 84.2  | 62.0 | 143.6 |
| -36.0 | -32.8 | -3.0  | 26.6  | 30.0 | 86.0  | 63.0 | 145.4 |
| -35.0 | -31.0 | -2.0  | 28.4  | 31.0 | 87.8  | 64.0 | 147.2 |
| -34.0 | -29.2 | -1.0  | 30.2  | 32.0 | 89.6  | 65.0 | 149.0 |
| -33.0 | -27.4 | 0.0   | 32.0  | 33.0 | 91.4  | 66.0 | 150.8 |
| -32.0 | -25.6 | 1.0   | 33.8  | 34.0 | 93.2  | 67.0 | 152.6 |
| -31.0 | -23.8 | 2.0   | 35.6  | 35.0 | 95.0  | 68.0 | 154.4 |
| -30.0 | -22.0 | 3.0   | 37.4  | 36.0 | 96.8  | 69.0 | 156.2 |
| -29.0 | -20.2 | 4.0   | 39.2  | 37.0 | 98.6  | 70.0 | 158.0 |
| -28.0 | -18.4 | 5.0   | 41.0  | 38.0 | 100.4 | 71.0 | 159.8 |

7.7 – Output Voltage



7.8 – Maximum Output Current





# Section 8 – Optional Accessories

## 8.1 – Tesla™ Shipping Case

The optional Shipping Case is the safest way to transport the TI3000 GPU-24-INV-1800. This custom case weighs 73 lbs and comes equipped with side handles and locking latches.

### TI7000-026

Length: 40.66" (1032.76 mm)  
 Width: 23.66" (600.96 mm)  
 Height: 19.66" (499.36 mm)  
 Weight: 73 lbs (33.11 kg)



## 8.2 – Tesla™ AC Line Cords

These power cables come in several lengths or can be custom-ordered to fit your needs. Tesla™ specializes in outfitting cables with a variety of connectors and junction boxes. Contact Tesla™ Customer Service to find out more about our selection of cables.

### Regular Line Cords

For units with a fuse and old-style receptacle.

- TI25000-001 North American Line Cord
- TI25000-002 Italian Line Cord
- TI25000-003 Continental European Line Cord
- TI25000-004 Old British Line Cord
- TI25000-005 England / UK Line Cord
- TI25000-006 Swiss Line Cord
- TI25000-011 Australian Line Cord
- TI25000-200 Israel Line Cord
- TI25000-300 Denmark Line Cord

### Line Cords

For units with a circuit breaker and new-style receptacle.

- TI25000-211 North American Line Cord
- TI25000-212 Italian Line Cord
- TI25000-213 Continental European Line Cord
- TI25000-214 Old British Line Cord
- TI25000-215 England / UK Line Cord
- TI25000-216 Swiss Line Cord
- TI25000-201 Australian Line Cord
- TI25000-203 Israel Line Cord
- TI25000-304 Denmark Line Cord
- TI25000-032 North American Commercial Line Cord

\*To be used for TI3000 Commercial Unit only.



NEMA 515P



Italian



Continental European



Old British



England/UK



Swiss



Australian



Israel



Denmark



NEMA 520P

### 8.3 – Cobra™ Replacement Contacts and Tools

Cobra™ DC Plugs are designed to provide reliable high-power connections up to 3000 amps – even in the harshest conditions. Each plug is constructed from a rugged combination of advanced composite materials and corrosion-resistant alloys to maximize durability and connectivity. To extend the life of the Cobra™ Connector included with your unit, replacement contacts, posts, noses and tools can be ordered through the Tesla™ Customer Service.

TI2005-238

Cobra™ Aviation Plug



TI2005-078

Cobra™ NATO Connector  
NSN: 6130-01-523-1270 (CL IX)



TI2005-251

DC Aviation Plug  
Positive/Negative  
Contact



TI2005-654

DC 400Hz Aviation Plug  
Positive/Negative  
Contact



TI2004-444

NATO Replacement Post  
For newer NATO plugs with new style post, indicated by the black tip. Replacement plug uses standard 3/4" deep well socket for installation.



TI2005-250

DC Aviation Plug  
3-slotted Connector



TI2005-239

Aviation Insertion/  
Extraction Tool



TI2005-121

NATO Negative Contact  
NSN: 5999-01-525-0582 (CL IX)



TI2005-117

NATO Positive Post  
NSN: 5935-01-523-8914 (CL IX)



TI2004-341

Replacement Nose for  
Aviation Plug



TI2004-340

Replacement Nose for  
400Hz Aviation Plug



TI2005-126

NATO Negative Contact  
Insertion/Extraction Tool  
NSN: 5120-01-523-8761 (CL II)



TI27000-082

NATO Positive Contact  
Insertion/Extraction Tool  
NSN: 5120-01-527-7729 (CL II)



### 8.4 – GPU Tires

Tesla™ offers several tires in order to meet various customer mobility needs.



**TI21000-203**

Run-Flat Tire  
A solid foam rubber tire. The standard tire for ground power units.



**TI21000-192**

Balloon Tire  
For use on soft sand.

APPENDIX A

OPTIONAL LINE CORDS FOR WORLDWIDE OPERATIONS

| <u>COUNTRY</u>               | <u>VOLTS</u> | <u>HZ</u> | <u>TESLA™ PART #</u>                       |
|------------------------------|--------------|-----------|--|
| Afghanistan                  | 220          | 50        | TI25000-004 Old British Line Cord          |
| Algeria                      | 220          | 50        | TI25000-004 Old British Line Cord          |
| American Samoa               | 240          | 60        | TI25000-011 Australian Line Cord           |
| Angola                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Anguilla (U.K.)              | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Antigua                      | 230          | 60        | TI25000-005 United Kingdom Line Cord       |
| Argentina                    | 220          | 50        | TI25000-011 Australian Line Cord           |
| Aruba                        | 115          | 60        | TI25000-001 North American Line Cord       |
| Australia                    | 240          | 50        | TI25000-011 Australian Line Cord           |
| Austria                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Azores (Portugal)            | 220          | 50        | TI25000-004 Old British Line Cord          |
| Bahamas                      | 120          | 60        | TI25000-001 North American Line Cord       |
| Bahrain                      | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Bangladesh                   | 220          | 50        | TI25000-004 Old British Line Cord          |
| Barbados                     | 115          | 50        | TI25000-001 North American Line Cord       |
| Belgium                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Belize (Br. Hond.)           | 110          | 60        | TI25000-001 North American Line Cord       |
| Benin                        | 220          | 50        | TI25000-004 Old British Line Cord          |
| Bermuda                      | 120          | 60        | TI25000-005 United Kingdom Line Cord       |
| Bolivia                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Botswana                     | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Brazil                       | 110          | 60        | TI25000-001 North American Line Cord       |
| Bulgaria                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Burkina Faso                 | 220          | 50        | TI25000-003 Continental European Line Cord |
| Burma (Now Myanmar)          | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Burundi                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Cambodia                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Cameroon                     | 230          | 50        | TI25000-003 Continental European Line Cord |
| Canada                       | 120          | 60        | TI25000-001 North American Line Cord       |
| Canary Islands (Spain)       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Cape Verde, Rep. of          | 220          | 50        | TI25000-003 Continental European Line Cord |
| Cayman Islands               | 120          | 60        | TI25000-001 North American Line Cord       |
| Central African Republic     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Chad                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Channel Islands              | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Chile                        | 220          | 50        | TI25000-002 Italian Line Cord              |
| China, Peoples Republic of   | 220          | 50        | TI25000-011 Australian Line Cord           |
| Christmas Island (Australia) | 240          | 50        | TI25000-011 Australian Line Cord           |
| Cocos Islands (Australia)    | 240          | 50        | TI25000-011 Australian Line Cord           |
| Columbia                     | 220          | 60        | TI25000-003 Continental European Line Cord |
| Congo, Republic of           | 220          | 50        | TI25000-003 Continental European Line Cord |
| Cook Island (New Zealand)    | 240          | 50        | TI25000-011 Australian Line Cord           |
| Costa Rica                   | 120          | 60        | TI25000-001 North American Line Cord       |
| Curacao Islands              | 110          | 60        | TI25000-001 North American Line Cord       |
| Cyprus                       | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Czech, Republic of           | 220          | 50        | TI25000-003 Continental European Line Cord |
| Denmark                      | 220          | 50        | TI25000-300 Denmark Line Cord              |
| Djibouti, Republic of        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Dominica                     | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Dominican Republic           | 110          | 60        | TI25000-001 North American Line Cord       |

## APPENDIX A (Cont.)

## OPTIONAL LINE CORDS FOR WORLDWIDE OPERATIONS

| <u>COUNTRY</u>       | <u>VOLTS</u> | <u>HZ</u> | <u>TESLA™ PART #</u>                           |
|----------------------|--------------|-----------|--|
| Ecuador              | 120          | 60        | TI25000-001 North American Line Cord           |
| Egypt                | 220          | 50        | TI25000-003 Continental European Line Cord     |
| El Salvador          | 115          | 60        | TI25000-001 North American Line Cord           |
| England              | 240          | 50        | TI25000-005 United Kingdom Line Cord           |
| Equatorial Guinea    | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Estonia              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Ethiopia             | 220          | 50        | TI25000-003 003 Continental European Line Cord |
| Fiji                 | 240          | 50        | TI25000-011 Australian Line Cord               |
| Finland              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| France               | 220          | 50        | TI25000-003 Continental European Line Cord     |
| French Guiana        | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Gabon                | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Gambia               | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Georgia              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Germany              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Ghana                | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Gibraltar            | 240          | 50        | TI25000-005 United Kingdom Line Cord           |
| Greece               | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Greenland (Denmark)  | 220          | 50        | TI25000-300 Denmark Line Cord                  |
| Grenada              | 230          | 50        | TI25000-005 United Kingdom Line Cord           |
| Guadeloupe           | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Guam                 | 110-120      | 60        | TI25000-001 North American Line Cord           |
| Guatemala            | 120          | 60        | TI25000-001 North American Line Cord           |
| Guinea               | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Guinea-Bissau        | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Guyana               | 110          | 50/60     | TI25000-001 North American Line Cord           |
| Haiti                | 110-120      | 50-60     | TI25000-001 North American Line Cord           |
| Honduras             | 110          | 60        | TI25000-001 North American Line Cord           |
| Hong Kong            | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Hungary              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Iceland              | 220          | 50        | TI25000-003 Continental European Line Cord     |
| India                | 220-250      | 50        | TI25000-004 Old British Line Cord              |
| Indonesia            | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Iran                 | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Iraq                 | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Ireland, Republic of | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Isle of Man          | 240          | 50        | TI25000-005 United Kingdom Line Cord           |
| Israel               | 230          | 50        | TI25000-200 Israel Line Cord                   |
| Italy                | 220          | 50        | TI25000-002 Italian Line Cord                  |
| Ivory Coast          | 220          | 50        | TI25000-003 Continental European Line Cord     |
| Jamaica              | 110          | 50        | TI25000-001 North American Line Cord           |
| Japan                | 110          | 50/60     | TI25000-001 North American Line Cord           |
| Jordan               | 220          | 50        | TI25000-005 United Kingdom Line Cord           |
| Kenya                | 240          | 50        | TI25000-005 United Kingdom Line Cord           |
| Korea, South         | 220          | 60        | TI25000-003 Continental European Line Cord     |
| Kuwait               | 240          | 50        | TI25000-005 United Kingdom Line Cord           |

## APPENDIX A (Cont.)

## OPTIONAL LINE CORDS FOR WORLDWIDE OPERATIONS

| <u>COUNTRY</u>               | <u>VOLTS</u> | <u>HZ</u> | <u>TESLA™ PART #</u>                       |
|------------------------------|--------------|-----------|--|
| Laos                         | 220          | 50        | TI25000-001 North American Line Cord       |
| Latvia                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Lebanon                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Lesotho                      | 240          | 50        | TI25000-004 Old British Line Cord          |
| Liberia                      | 120          | 60        | TI25000-005 United Kingdom Line Cord       |
| Liechtenstein                | 220          | 50        | TI25000-006 Switzerland Line Cord          |
| Lithuania                    | 220          | 50        | TI25000-003 Continental European Line Cord |
| Luxembourg                   | 220          | 50        | TI25000-003 Continental European Line Cord |
| Libya                        | 230          | 50        | TI25000-002 Italian Line Cord              |
| Macao                        | 220          | 50        | TI25000-004 Old British Line Cord          |
| Madagascar                   | 220          | 50        | TI25000-003 Continental European Line Cord |
| Maderia (Portugal)           | 220          | 50        | TI25000-004 Old British Line Cord          |
| Majorca                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Malawi                       | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Malaysia                     | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Maldives                     | 230          | 50        | TI25000-004 Old British Line Cord          |
| Mali, Republic of            | 220          | 50        | TI25000-003 Continental European Line Cord |
| Malta                        | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Martinique                   | 220          | 50        | TI25000-003 Continental European Line Cord |
| Mauritania                   | 220          | 50        | TI25000-003 Continental European Line Cord |
| Mauritius                    | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Mexico                       | 127          | 60        | TI25000-001 North American Line Cord       |
| Monaco                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Mongolia                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Montseurrat                  | 230          | 60        | TI25000-005 United Kingdom Line Cord       |
| Morocco                      | 220          | 50        | TI25000-003 Continental European Line Cord |
| Mozambique                   | 220          | 50        | TI25000-003 Continental European Line Cord |
| Namibia (W.S. Africa)        | 220-250      | 50        | TI25000-004 Old British Line Cord          |
| Nepal                        | 220          | 50        | TI25000-004 Old British Line Cord          |
| Neth. Antilles               | 220          | 50/60     | TI25000-003 Continental European Line Cord |
| Netherlands                  | 220          | 50        | TI25000-003 Continental European Line Cord |
| New Caledonia                | 220          | 50        | TI25000-003 Continental European Line Cord |
| New Zealand                  | 230          | 50        | TI25000-011 Australian Line Cord           |
| Nicaragua                    | 120          | 60        | TI25000-001 North American Line Cord       |
| Niger                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Nigeria                      | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Norfolk Islands (Australia)  | 240          | 50        | TI25000-011 Australian Line Cord           |
| North Ireland                | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| North Mariana Islands (U.S.) | 115          | 60        | TI25000-001 North American Line Cord       |
| Norway                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Okinawa                      | 100-120      | 60        | TI25000-001 North American Line Cord       |
| Oman                         | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Pakistan                     | 230          | 50        | TI25000-004 Old British Line Cord          |
| Panama                       | 110          | 60        | TI25000-001 North American Line Cord       |
| Papua New Guinea             | 240          | 50        | TI25000-011 Australian Line Cord           |
| Paraguay                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Peru                         | 110          | 50/60     | TI25000-001 North American Line Cord       |
| Philippines                  | 115          | 60        | TI25000-001 North American Line Cord       |
| Piccairn Islands (U.K.)      | 240          | 50        | TI25000-004 Old British Line Cord          |
| Poland                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Portugal                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Puerto Rico                  | 120          | 60        | TI25000-001 North American Line Cord       |

## APPENDIX A (Cont.)

## OPTIONAL LINE CORDS FOR WORLDWIDE OPERATIONS

| <u>COUNTRY</u>                 | <u>VOLTS</u> | <u>HZ</u> | <u>TESLA™ PART #</u>                       |
|--------------------------------|--------------|-----------|--|
| Romania                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Russia                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Rwanda                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Saudi Arabia                   | 220          | 50/60     | TI25000-003 Continental European Line Cord |
| Scotland                       | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Senegal                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Seychelles                     | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Sierra Leone                   | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Singapore                      | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Slovakia                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Somalia                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| South Africa                   | 220-250      | 50        | TI25000-004 Old British Line Cord          |
| Spain                          | 220          | 50        | TI25000-003 Continental European Line Cord |
| Sri Lanka                      | 230          | 50        | TI25000-004 Old British Line Cord          |
| St. Pierre & Miquelon (France) | 115          | 60        | TI25000-001 North American Line Cord       |
| St. Kitts & Nevis              | 230          | 60        | TI25000-005 United Kingdom Line Cord       |
| St. Lucia                      | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| St. Vincent                    | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Sudan                          | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| Surinam                        | 115          | 60        | TI25000-003 Continental European Line Cord |
| Svalbard (Norway)              | 220          | 50        | TI25000-003 Continental European Line Cord |
| Swaziland                      | 230          | 50        | TI25000-004 Old British Line Cord          |
| Sweden                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Switzerland                    | 220          | 50        | TI25000-006 Switzerland Line Cord          |
| Syria                          | 220          | 50        | TI25000-003 Continental European Line Cord |
| Tahiti                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Taiwan                         | 110          | 60        | TI25000-001 North American Line Cord       |
| Tanzania                       | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Thailand                       | 220          | 50        | TI25000-003 Continental European Line Cord |
| Togo                           | 220          | 50        | TI25000-003 Continental European Line Cord |
| Tonga                          | 115          | 60        | TI25000-004 Old British Line Cord          |
| Trinidad & Tobago              | 230          | 60        | TI25000-005 United Kingdom Line Cord       |
| Tunisia                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Turkey                         | 220          | 50        | TI25000-003 Continental European Line Cord |
| Uganda                         | 220          | 50        | TI25000-004 Old British Line Cord          |
| United Arab Emir.              | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| United Kingdom & Ireland       | 240          | 50        | TI25000-005 United Kingdom Line Cord       |
| United States                  | 120          | 60        | TI25000-001 North American Line Cord       |
| Uruguay                        | 220          | 50        | TI25000-011 Australian Line Cord           |
| Venezuela                      | 120          | 60        | TI25000-001 North American Line Cord       |
| Vietnam                        | 220          | 50        | TI25000-003 Continental European Line Cord |
| Virgin Islands                 | 120          | 60        | TI25000-001 North American Line Cord       |
| Wales                          | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Western Samoa                  | 230          | 50        | TI25000-005 United Kingdom Line Cord       |
| Yemen                          | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Yugoslavia                     | 220          | 50        | TI25000-003 Continental European Line Cord |
| Zaire, Republic of             | 220          | 50        | TI25000-003 Continental European Line Cord |
| Zambia                         | 220          | 50        | TI25000-005 United Kingdom Line Cord       |
| Zimbabwe                       | 220          | 50        | TI25000-005 United Kingdom Line Cord       |



APPENDIX A (Cont.)

UNIVERSAL LINE CORD KIT FOR WORLDWIDE OPERATIONS

NOTE: TESLA™ UNIVERSAL AC LINE CORD KIT, P/N: **TI25000-U00**, IS FOR UNITS ORIGINALLY BUILT WITH THE UNIVERSAL AC LINE CORD OPTION ONLY.  
THE AC ADAPTER OPTION IS TESLA™ P/N **TI16000-19** AND MUST BE ORDERED WITH THE ORIGINAL PROCUREMENT OF UNIT(S). UNIT(S) MAY BE RETURNED TO TESLA™ INDUSTRIES, FOR A NOMINAL COST, AND MODIFIED TO ALLOW OPERATION WITH THE UNIVERSAL AC LINE CORD KIT.

TESLA™ UNIVERSAL AC LINE CORD KIT, P/N: **TI25000-U00**, IS COMPRISED OF THE FOLLOWING FIVE PART NUMBERS:

|             |                          |
|-------------|--------------------------|
| TI25000-111 | NORTH AMERICAN LINE CORD |
| TI25000-113 | EUROPEAN 10A/250V        |
| TI25000-114 | OLD BRITISH LINE CORD    |
| TI25000-115 | ENGLAND 10A/250V         |
| TI7000-131  | LINE CORD POUCH          |

# Repair Request Form

Please complete the information below to ensure prompt and accurate service. Include this form with the unit you are returning. Thank you.

Date of return: \_\_\_\_\_

Company name & \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Billing address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Contact person: \_\_\_\_\_

Phone #: \_\_\_\_\_ Fax #: \_\_\_\_\_

Email: \_\_\_\_\_

Purchase Order #: \_\_\_\_\_

Model #: \_\_\_\_\_ Serial #: \_\_\_\_\_

Model #: \_\_\_\_\_ Serial #: \_\_\_\_\_

Shipping method to Tesla™: \_\_\_\_\_

Description of shipping package: \_\_\_\_\_

Description of problem: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Return to Tesla™ Industries, Inc.**

101 Centerpoint Boulevard, New Castle, DE 19720 Attention: Repair Department



**WE GET THE MILITARY STARTED!**

**Tesla™ Industries, Inc.**

101 Centerpoint Blvd.  
New Castle, DE 19720 USA  
Tel: 302-324-8910  
Fax: 302-324-8912

9475 Double R Blvd., Suite 2  
Reno, NV 89521  
Tel: 775-622-8801  
Fax: 775-622-8810

[www.teslaind.com](http://www.teslaind.com)