

**NOTE: All users must read this entire manual prior
to operating the TIMV3000 GPU-24.**

The TIMV3000 GPU-24 is a limited 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:

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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 TIMV3000 GPU-24 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 TIMV3000 GPU-24 contains sealed, dry cell rechargeable batteries that do not pose a shipping hazard.

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Section 1 – Product Overview

1.1 – Introduction

This manual contains the complete operating instructions and procedures for the TIMV3000 GPU-24 (Turbo Start 3000) ground power unit. The Turbo Start 3000 is intended to provide DC electrical ground power for aircraft flight line and maintenance ground support operations. The unit is designed to provide 24 volt DC electrical power output for aircraft engine starting and 24 or 28.5 volts DC electrical support for ground maintenance, avionics/electrical trouble shooting and testing. The observance of procedures, limitations and performance criteria is essential to ensure peak operating efficiency and to maximize operational capabilities and life of the Turbo Start 3000 ground power unit.



Figure 1.1.1 – TIMV3000 GPU-24


1.2 – Use of Words 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.


Section 2 – Safety Review


2.1 - Safety Notices

Safety notices appear throughout this manual to alert the user to important information regarding proper installation, operation, maintenance and storage of the TIMV3000 GPU-24. 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.

 WARNING	Indicates a condition, operating procedure or practice, which if not adhered to could result in serious injury or death.
--	--

 CAUTION	Indicates a condition or operating procedure, which if not strictly adhered to could result in damage or destruction of equipment.
--	--

 DANGER	Indicates a condition, operating procedure or practice, which if not adhered to could result in serious injury or death.
---	--

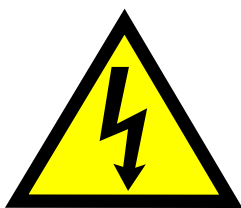
 NOTE	Indicates a condition, operating procedure or practice, which is essential to highlight.
--	--

2.2 - Symbols

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



General Warning



Electrical Hazard



Explosion Hazard



Fire Hazard



Battery Warning



Guard from Moisture

Figure 2.2.1 – Different types of hazard and caution symbols

2.3 – Hazards

⚡ WARNING SHOCK HAZARD POTENTIAL

Severe injury or death from electrical shock will occur if either the user or the TIMV3000 GPU-24 is wet while operating the unit with the 120-240 VAC power source attached. Be sure to disconnect AC power from the AC source if the TIMV3000 GPU-24 has come into contact with water. If either 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 TIMV3000 GPU-24. Make sure the electrical outlet is switched off before making any connections. Failure to use proper grounding can cause potential shock hazard! In different countries, the 240 VAC 50 Hz power cord may require the use of a plug adapter to achieve plug style compatibility for operation. Use only adapters with proper grounding mechanism.

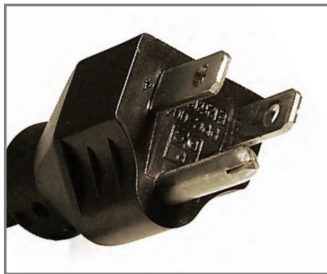


Figure 2.3.1 – Proper Ground Grounded Plug with Grounding Pin



Figure 2.3.2 – Proper Ground Adapter with Grounding Mechanism



Figure 2.3.3 – Improper Ground Ungrounded Plug

⚡ CAUTION UNIT DAMAGE POTENTIAL

The unit will be damaged if unapproved AC power is applied. Check the Input Voltage Selector Switch window to ensure the setting reads either 115V or 230V prior to connecting AC power cord to AC power source. The setting (115V/230V) must match AC power source (hangar wall, flight line AC power) prior to connecting the TIMV3000 GPU-24 for recharging.



Figure 2.3.4 – TIMV3000 GPU-24 Input Voltage Selector Switch

2.4 – 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. Power output is restricted to 24 VDC power cell output only. DO NOT CONNECT 120 or 240 VAC Power Supply. 120-240 VAC Power (charger or AC-DC converter) functions of unit shall not be operated during any aircraft fuel handling operation.

2.5 – Extreme Environments



CAUTION

UNIT DAMAGE POTENTIAL

The TIMV3000 GPU-24 is equipped with a charger temperature switch that automatically disables AC and charging functions when the internal temperature reaches 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.

Section 3 – Unit Specifications

3.1 – General Specifications

Electrical

AC Input Power:

- Operates and charges from Single Phase 95-260, VAC 50/60 Hz
- 20 Amps @ 120 VAC 60 Hz
- 10 Amps @ 240 VAC 60 Hz

DC Output Power:

- 3000 peak starting amps
- 50 amps of continuous power @ 28.5 VDC when plugged into AC power
- 96 amp hours (2,449 watt hours) with AC power
- 46 amp hours (1,024 watt hours) of rechargeable power without AC power

Rechargeable Rate:

- 60 minutes (from full discharge) with 110-220 AC power @ 25 °C

Size:

- 36.40" long x 14.25" wide x 15.64" high
924.40mm x 362.0mm x 397.20mm

Weight

- 127 lbs (57.60 kg)

Operating Temperature:

- -40° C to +60° C / -40° F to +140° F (without AC power)
- -40° C to +50° C / -40° F to +122° F (with AC power)

Storage Temperature:

- -65° C to +60° C / -65° F to +140° F

Cell Capacity:

- +40 degrees C 110% ± 05%
- +25 degrees C 100% ± 05%
- +00 degrees C 80% ± 05%
- -20 degrees C 65% ± 10%
- -40 degrees C 50% ± 10%

3.2 – Physical Dimensions

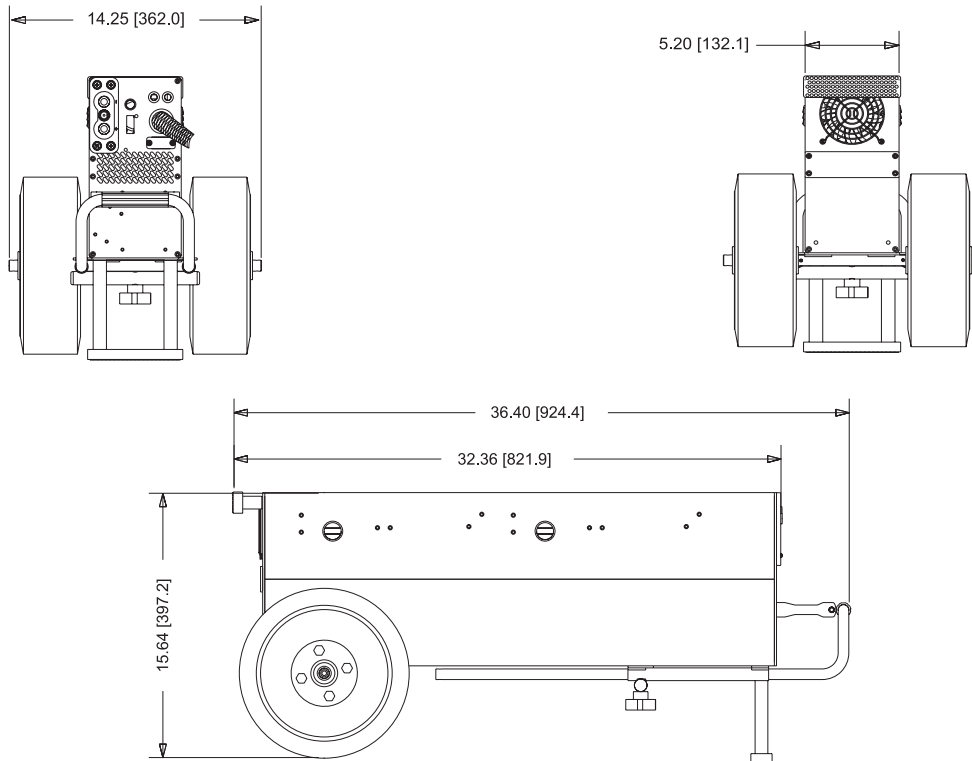



Figure 3.2.1 – TIMV3000 GPU-24 physical dimensions

3.3 – Airflow Ports

 CAUTION	Damage may occur if the TIMV3000 GPU's air intake or outlet ports are obstructed. Ensure that ports are clear at all times.
--	---

When the TIMV3000 GPU-24 is plugged into 240 VAC 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 degrees. In more extreme temperatures (greater than 90 °F) the exhaust air will not exceed the ambient temperature by more than 10 degrees.

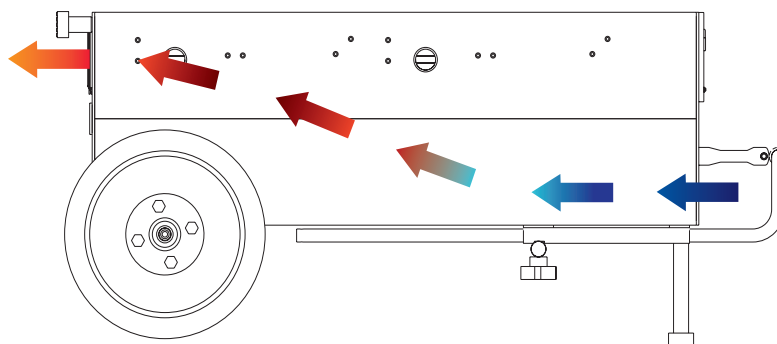
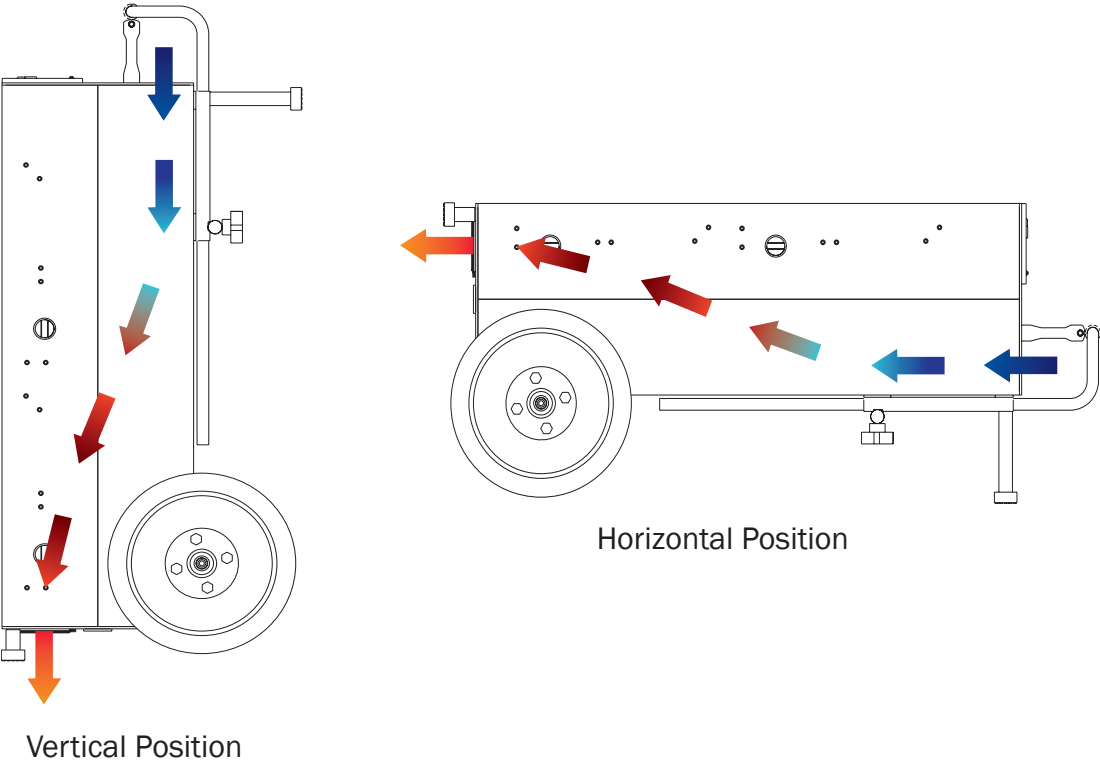
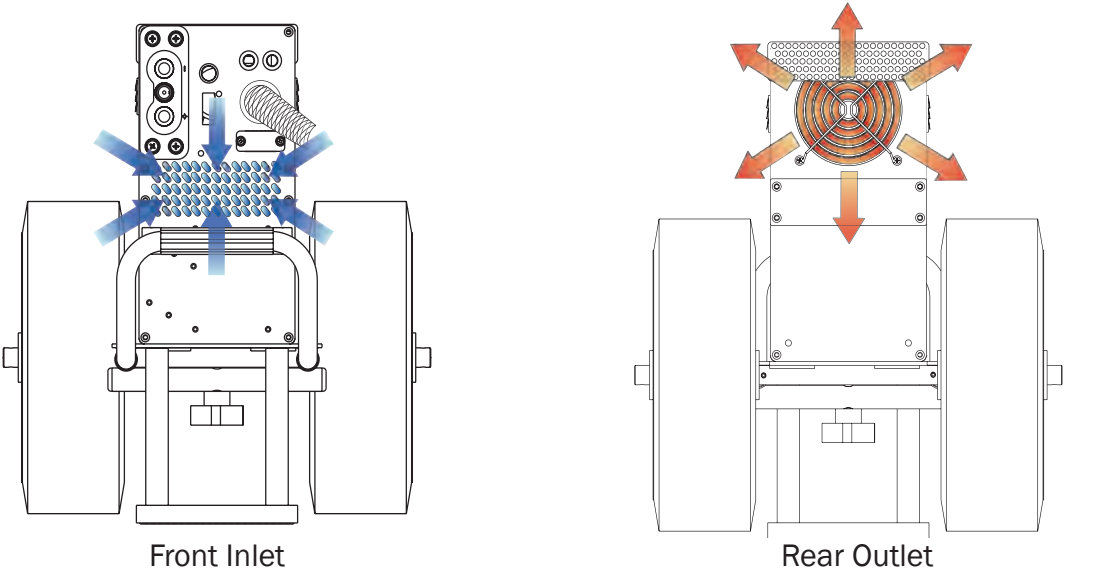


Figure 3.3.1 – Air intake and exhaust ports and internal air circulation

3.4 – Operating Positions

The TIMV3000 GPU-24 can be operated in both the horizontal and vertical positions as shown. Make sure that the airflow is not obstructed from air intake and outlet.



3.5 – Temperature Specifications

Cold/Heat Soaked Temperature

The ambient temperature that a unit is exposed to for one (1) hour or more establishes the unit’s cold/heat soaked stabilization temperature. If the TIMV3000 GPU’s cold/heat 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 HEAT SOAKED temperature stabilization, the unit must be placed in an environment with a temperature below +38°C (+100°F) for 1 hour. Cell

Storage Capacity

The graph below illustrates the TIMV3000’s available cell capacity as a function of temperature.

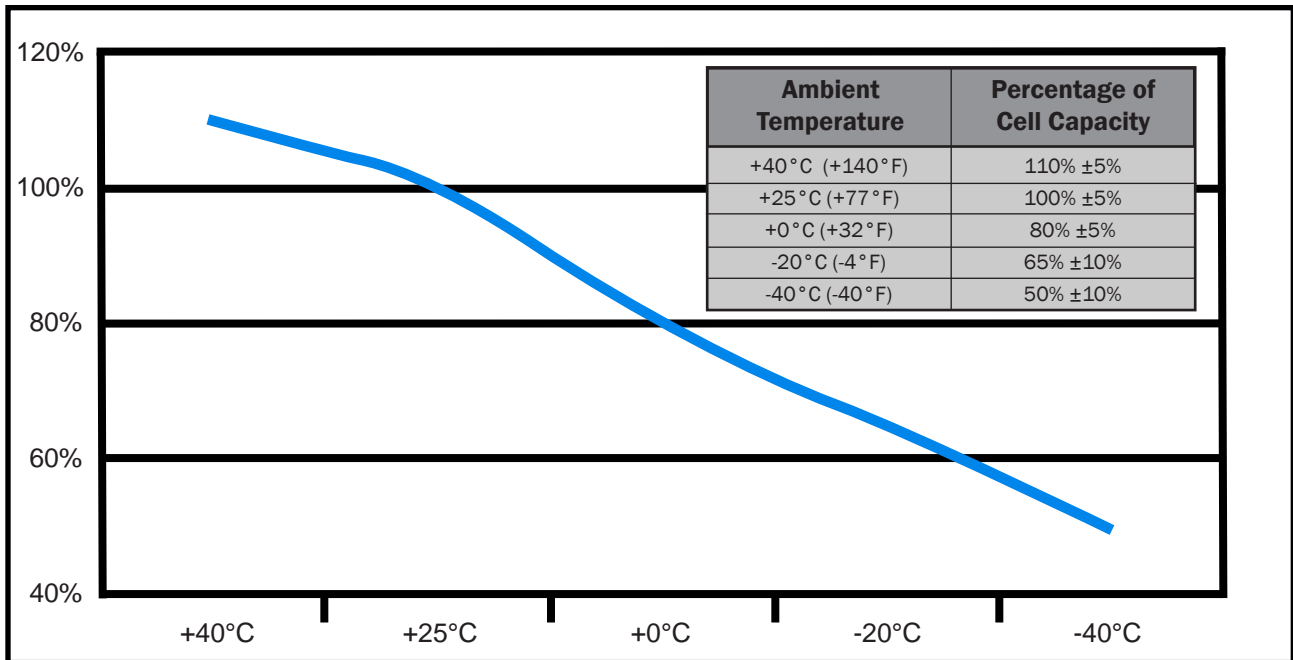


Figure 3.5.1 – Cell storage capacity versus ambient temperature

Heat soaked or cold soaked definition

Simple terms: A hunk of metal (or other thing) starts out at ambient temperature. It’s exposed to another temperature that warms or cools the surface. As time goes on, the heat (or cold) evens out throughout the metal and the object is “heat soaked” (or cold soaked). If you take away the source of heat (or cold), the part will remain hot (or cold) for quite some time as it gives off the heat (or cold) that has “soaked” in the metal.

Note: The TIMV3000 GPU is equipped with a charger temperature switch that automatically disables AC and charging functions when the internal temperature reaches 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.

3.6 – Environmental



WARNING

SHOCK HAZARD POTENTIAL

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 Turbo Start 3000 moisture resistant to prevent damage or failure. If the Turbo Start 3000 is exposed to 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 AFT outlet cooling fan vent ports

Unit inlet and outlet vent ports shall be covered from exposure. Unit shall be kept horizontal. It is recommended that the TI700-047 Protective Rain Cover be fitted onto the Unit to guard it from moisture. The limits and operational constraints listed below shall apply for the following environmental (weather) conditions:

Conditions	With Rain Cover	Without Rain Cover
Heavy or steady rain:	OK	OPERATION NOT RECOMMENDED
Light rain, drizzle or sleet:	OK	NO CONVERTER OR CHARGER 120-240 VAC
Fog, snow	OK	OK



Figure 3.6.1 – TIMV3000 GPU-24 with TI7000-047 Protective Rain Cover

Section 4 - Pre-Operation

4.1 – Pre-Operation

1. Be sure to check that all input and output cables are not damaged. (see section 7.1)
2. Check unit carefully for any evidence of damage. (see section 7.2)
3. Make sure that airflow is not obstructed from air intake and outlet. (see section 3.4)
4. Check that all connections are secure and free from water.



Figure 4.1.1 TIMV3000 GPU-24

4.2 – AC Input Circuit Breakers

The AC input circuit breakers are located above the AC Input Connector. When the circuit breaker has been tripped, the red button 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.



Figure 4.2.1 - AC Input Circuit Breakers (outlined in blue)

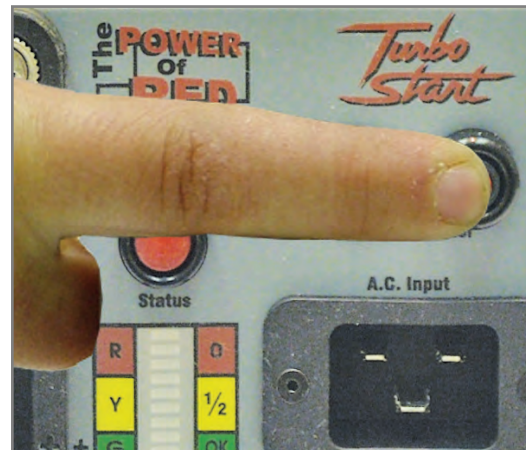


Figure 4.2.2 - Pressing Circuit Breakers

4.3 – 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 220 - 260 VAC.



Figure 4.3.1 Input Voltage Selector Switch (outlined in blue)

4.4 – 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.
2. Flip the switch to read 230V.
3. Rotate cover back into place. Replace and tighten screw.

Do not plug unit into 220 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 4.4.1 - Unscrew Protective Cover



Figure 4.4.2 - 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.

4.5 – “Push to Test” Button and LED 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 applied, 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 for recharge, or plugged into aircraft for DC power output.



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.)

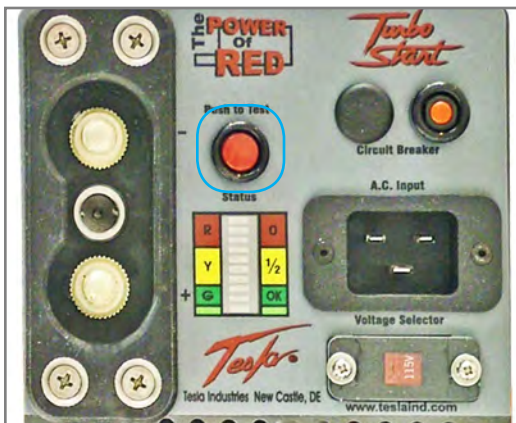
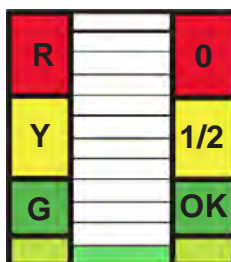


Figure 4.5.1 - “Push to Test” button location (outlined in blue)



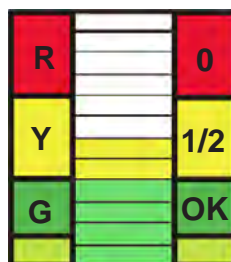
Figure 4.5.2 - Pushing to Test

STATUS



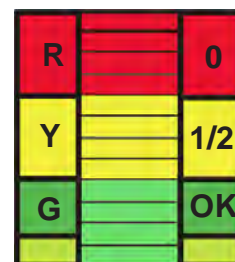
Full Charge

STATUS



Half Charge

STATUS



No Charge

4.6 – Charging Unit

Once you have the fuse set to match the power characteristics of your line cord, you can plug the unit into a wall socket to charge the batteries. Until the unit is fully charged, the LED status will read half or no charge.



Figure 4.6.1 - Connecting TIMV3000 GPU-24 to AC Power Supply

If you received this manual with a new GPU.

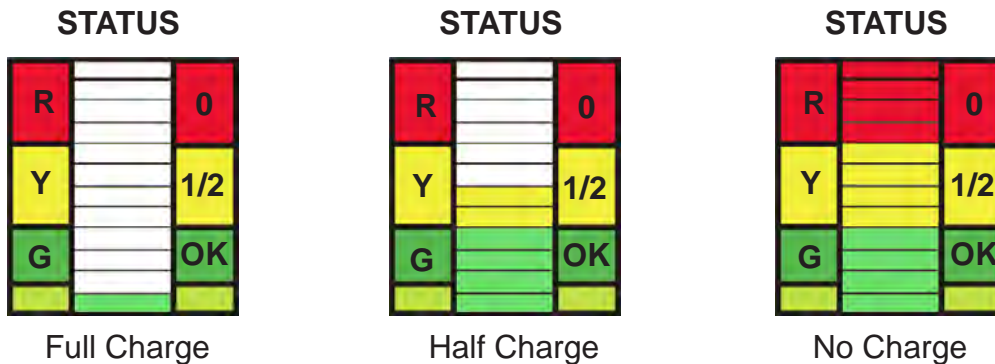
Under a full charge the LED indicator should show a single steady green bar or a single green bar blinking. The fan will also come on at reduced speed. This is normal operation indicating the unit is in standby mode and is ready for use.

If you own an older GPU and this is a replacement manual.

Under a full charge the LED indicator should show a single steady green bar or the entire LED will be blinking. The fan will also exhibit ratcheting but will not come on. 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 one and a half hours (90 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.



Section 5 – Operation Procedures

5.1 – Operating Procedures

This section deals with normal procedures, and includes all steps necessary to ensure safe and efficient operation of the TIMV3000 GPU-24 (Turbo Start 3000). As experience is gained with the Turbo Start 3000, the user will be able to maximize the unit's unique capabilities to enhance the flexibility of aircraft maintenance and support operations.

NOTE: When the TIMV3000 GPU-24 is not in use, it should always remain plugged into a suitable AC power source to insure operational readiness at all times.

NOTE: 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.

5.2 – 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.

NOTE: The ambient temperature may cause the unit's protective "over-temperature" sensors to shut down the 120-240 AC functions (converter 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 prior to continued use once the unit is allowed to cool. For continued use in extremely hot environments, it is advised to send the unit back to Tesla for recalibration for use in these environments.

NOTE: In the event that the temperature sensors do not shut the system down, extended use above specified limits may damage the unit. If the unit is operated when cold or heat soaked temperatures are exceeded, a full functional check should be accomplished prior to continued use.

ENGINE START PEAK CURRENT Requirements

MINIMUM CHARGE

650 - 850 peak starting amps	40% charged
850 - 1000 peak starting amps	50% charged
1000 - 1500 peak starting amps	60% charged
1500 - 1800 peak starting amps	70% charged
1800 - 2500 peak starting amps	80% charged
2500 - 3000 peak starting amps	90% charged

5.3 – General

Correct operation of the TIMV3000 GPU-24 (Turbo Start 3000) 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.

5.4 – 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.

5.5 – Performance

Refer to Chapter 5.2, PERFORMANCE DATA to determine the capability of the Turbo Start. Consideration must be given to changes in performance resulting from variations in ambient temperature, mode of operation, state of charge (with or without 120 or 240 VAC power), and aircraft DC bus system inefficiency (voltage drops).

5.6 – Transporting Unit

The TIMV3000 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 5.6.1 Releasing Telescopic Handle

5.7 – Regulated 28.5 VDC Output Ground Power

Connecting DC Power Cable To Unit

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



Figure 5.7.1 Attaching DC Power Cable to TIMV3000 GPU-24

Connecting DC Power Cable To Vehicle

Ensure DC power cable plug is fully seated into the vehicle's DC Receptacle. Attaching a DC plug is quick and easy. DC bus power should come on and aircraft voltmeter should indicate 24 VDC to 23.5 VDC (23 VDC minimum).



Figure 5.7.2 Attaching DC Power Cable to vehicle

Engine Starting

Check DC power cable for secure and correct installation prior to engine starting. Follow ground power engine starting procedure as specified in vehicle operator's manual.



Figure 5.7.3 Starting vehicle with TIMV3000 GPU-24

Removing DC Power Supply From Vehicle

1. Remove DC power cable GPU connector from vehicle.
2. Remove DC power cable connector from TIMV3000 GPU-24 (if necessary).

5.8 – Regulated AC Power

Plugging in with AC Power

When the TIMV3000 GPU-24 is plugged into AC power, the output is 28.5 volts. This voltage allows the system to recondition and recharge the vehicle's battery(s). 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.

CHECK FUSE WINDOW FOR PROPER SETTING. 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 5.8.1 Connecting TIMV3000 GPU-24 to AC Power Supply

Connect DC Power Cable To Unit

Ensure DC power cable connector is fully seated into unit's receptacle (if necessary).

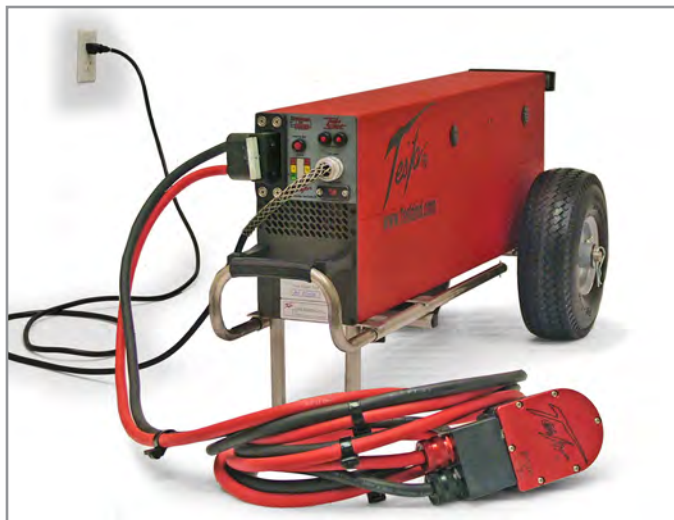


Figure 5.8.2 Connecting TIMV3000 GPU-24 to AC Power Supply with DC Power Cable Attached

Connect DC Power To Aircraft (Low Power Demand)

Low power demand is defined by a requirement of 50 AMPS or less. Connect DC power to aircraft ground power receptacle. DC bus power should come on and aircraft voltmeter should indicate 28.5 VDC to 27 VDC (26.5 VDC minimum). If 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 aircraft power demand exceeds 50 amps converter voltage output will decrease and two or more LED status indicator bars will illuminate.



Figure 5.8.4 Starting UH-1 Huey Helicopter with TI3000 GPU-24

Connect DC Power To Aircraft (High Power Demand)

High power demand is defined by a requirement of 51 AMPS or more. Connect to aircraft ground power receptacle. DC bus power should come on and aircraft voltmeter should indicate 27.5 VDC to 23.5 VDC (23 VDC minimum). If current demand is above 51 amps, converter output voltage will drop below 28.5 VDC and two or more LED status indicator bars will illuminate. At approximately 51 amps of current demand, converter output voltage will be regulated at 24 VDC output and the last (RED) LED status indicator bar will illuminate.

NOTE: When all LED status indicator bars illuminate, both the converter and power cells are supplying 24 VDC power output for current demands above 51 amps.

Engine Starting

UNPLUG AC POWER CORD BEFORE STARTING ENGINE WITH TIMV3000 GPU-24

Prior to engine start, ensure power cell charge is sufficient to provide an efficient engine start.

Removing DC Power Supply From Aircraft

1. Remove DC power cable GPU connector from aircraft.
2. Remove DC power cable connector from TIMV3000 GPU-24 (if necessary).

Section 6 – Post Operation

6.1 – General

Although the TIMV3000 GPU-24 (Turbo Start 3000) 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.

6.2 – 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.

6.3 – Power Cell Recharge

NOTE: The TIMV3000 GPU-24 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 an infinite number of vehicles if the GPU is allowed to backcharge for approximately 30 seconds.

NOTE: Plug the TIMV3000-GPU24 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

Check fuse window for proper setting. 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.

Connect AC Power Cord to Unit

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 6.3.1 Connecting TIMV3000 GPU-24 to AC Power Supply


CAUTION Guard From Incorrect Power Source


The TIMV3000 GPU's power cells may be damaged if recharged by NiCad or Lead Acid-type battery chargers. Power cells should only be charged by either the TIMV3000 GPU's internal charger and the AC power cord furnished with the equipment, or when connected to aircraft's external DC power receptacle.



Figure 6.3.3 Proper and Improper Charging Methods

Section 7 – Unit Care and Maintenance

 DANGER	Severe injury or death from electrical shock will occur if either the user or the TIMV3000 GPU is wet while operating the unit with an AC power source attached.
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 CAUTION	Damage may occur if an unapproved or modified AC line cable or input plug is attached to the GPU. Do not use any type of AC voltage converter.
--	--

7.1 - Unit Care

Avoid Prolonged Exposure to Extremely Damp Environments

Be sure to disconnect AC power from the AC source if the TIMV3000 GPU-24 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 infiltration. 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 TIMV3000 GPU-24. 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 TIMV3000 GPU-24.



Figure 7.1.1 – Damaged cable

Check Unit Internal Resistance (Test for Shorts)

This section deals with “normal function” test procedures, and includes all steps necessary to ensure that the TIMV3000 GPU is operating within specified parameters prior to use. A digital multimeter (an example is shown in Figure 7.2.1) 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.



1. Place the negative probe on the AC ground probe and the positive probe on the case.



2. Move the negative probe to the DC negative post.



3. Move the negative probe to the DC positive post.

Better than 10 Megohms, ensure no short exists.
Negative(-) DC receptacle terminal and unit case.
Positive (+) DC receptacle terminal and unit case.

Check DC Voltage Reading at DC Receptacle Terminals

26.5 to 28 VDC depending on state of charge.



Figure 7.2.3 – Testing DC Receptacle

7.3 – Unit Servicing

The TIMV3000 GPU 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 7.3.1 below). If the unit requires maintenance, please contact Tesla's™ Customer Service Department at (302) 324-8910. A Repair Request Form can be found in the back of this manual.

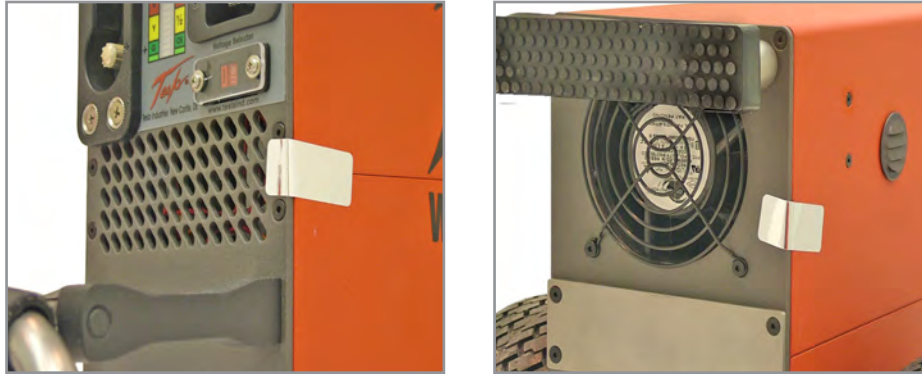


Figure 7.3.1 – Warranty Void stickers Front and Back on the TI3000 GPU

7.4 – 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's Customer Service Department at (302) 324-8910 with any questions or concerns.

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



Figure 7.4.1 – Tesla Industries Shipping Case

Section 8 – Troubleshooting and FAQ

8.1 – Frequently Asked Questions

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

Tesla Turbo Starts are multi-functional systems that are ideal for support of 24VDC 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, flat-line 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 as well as an AC to DC converter. 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 are Turbo Starts 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) 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. Systems can be protected even greater with Tesla Rain covers. (see “Environmental” page 11)

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 flat line 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 Starts are designed to be handled by one person. The TI500 GPU is our smallest system to date and weighs 35 lbs. The TI1000 weighs 56 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 NSN (National Stock Number) 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. 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).

16. What is included with my Turbo Start?

Aviation customers will receive an eight (8') foot DC cable with an aviation plug. Ground vehicle customers will receive a fifteen (15') foot DC cable with terminal ends. This cable requires a NATO plug, alligator clips or another connector prior to its use. Tesla can provide these connectors at an additional charge. Both customers receive an AC line cord for their home country and a full two year warranty. Axle extensions are included for wheeled single case units (TI2000 and TI3000).

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.

8.2 - 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. (See Page: 4-4)

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 breakers are 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(s) by pressing red button(s).
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.

8.3 - Basic Unit Troubleshooting

Fault	Possible Cause	Remedy
1. Output Capacity LED does not come on when button is pushed.	A. Units cells completely dead.	A. Plug the unit in to the appropriate AC power outlet and recharge. B. If LEDs still do not illuminate, Please contact Tesla's Customer Service Department at (302) 324-8910
2. Unit has no Output AC or DC or both.	A. Units cells completely dead. B. AC line cord is damaged or bad. C. DC line cord is damaged or bad. D. AC circuit breaker has been tripped. E. Cables loose or corroded.	A. Do a function check with digital meter, see section 7.4. B. Do continuity test. C. No continuity, check cables for cuts and replace if needed. D. Clean contacts of debris and make sure connections are tight.
3. Unit will not charge from AC Outlet.	A. AC line cord is damaged or bad. B. Is AC line cord fully plugged into unit and wall outlet. C. AC circuit breaker has been tripped. D. No AC power at outlet.	A. Do a continuity test on the AC line cord B. Check if line cord is properly secured. C. Check to make sure AC circuit breaker is placed in the "ON" position.
4. Unit failed function test.	A. Internal failure.	A. Please contact Tesla's Customer Service Department at (302) 324-8910
5. Unit emits sparks when plugged into power source.	A. Water or moisture has seeped in unit B. Internal failure.	A. Move unit to dry warm air and allow to dry for over 48 hours. B. Do Not Use Unit. Please contact Tesla's Customer Service Department at (302) 324-8910
6. Unit works then shuts down.	A. Unit is overheating. B. Cooling fans and vents are obstructed or inoperable.	A. Move the unit to an area 10° -20° less ambient temperature. B. Clean and clear cooling vents, turn on unit and inspect if air is flowing through unit. If no airflow please contact Tesla.

Fault	Possible Cause	Remedy
7. Circuit breaker continuously trips	A. Unit is overheating.	A. Disconnect unit from AC input and DC output. B. Switch breaker to ON position. C. Reconnect unit to cables and run. D. If LEDs still do not illuminate, Please contact Tesla's Customer Service Department at (302) 324-8910
8. Unit does not put out 28.5 volts DC power.	A. Unit is not plugged in.	A. Plug unit into AC power source to maintain 28.5. B. Stand alone VDC is 24 Volts (unplugged)
9. Unit stand alone voltage is less then 23 volts.	A. Cells discharged	A. Plug unit into AC power source. B. Recheck capacity after 25 minutes. C. Failure to hold above 23 VDC, Please contact Tesla's Customer Service Department at (302) 324-8910
10. Unit weakens after first start.	A. Fast killing cells.	A. Allow between 30 to 60 seconds back-charge between uses.

Section 9 – Performance Data

9.1 – Purpose

This chapter provides performance data for the TIMV3000 GPU-24 (Turbo Start 3000). Continual reference to this information will enable the user to obtain maximum performance, utilization and service life from the Turbo Start. Although maximum performance is not always required, regular referral to this chapter 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 an aircraft system malfunction exists by comparing actual performance with expected performance.

NOTE: The information provided in this chapter 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.

9.2 – 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 Turbo Start.

9.3 – 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.

9.4 – 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.

9.5 – 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.

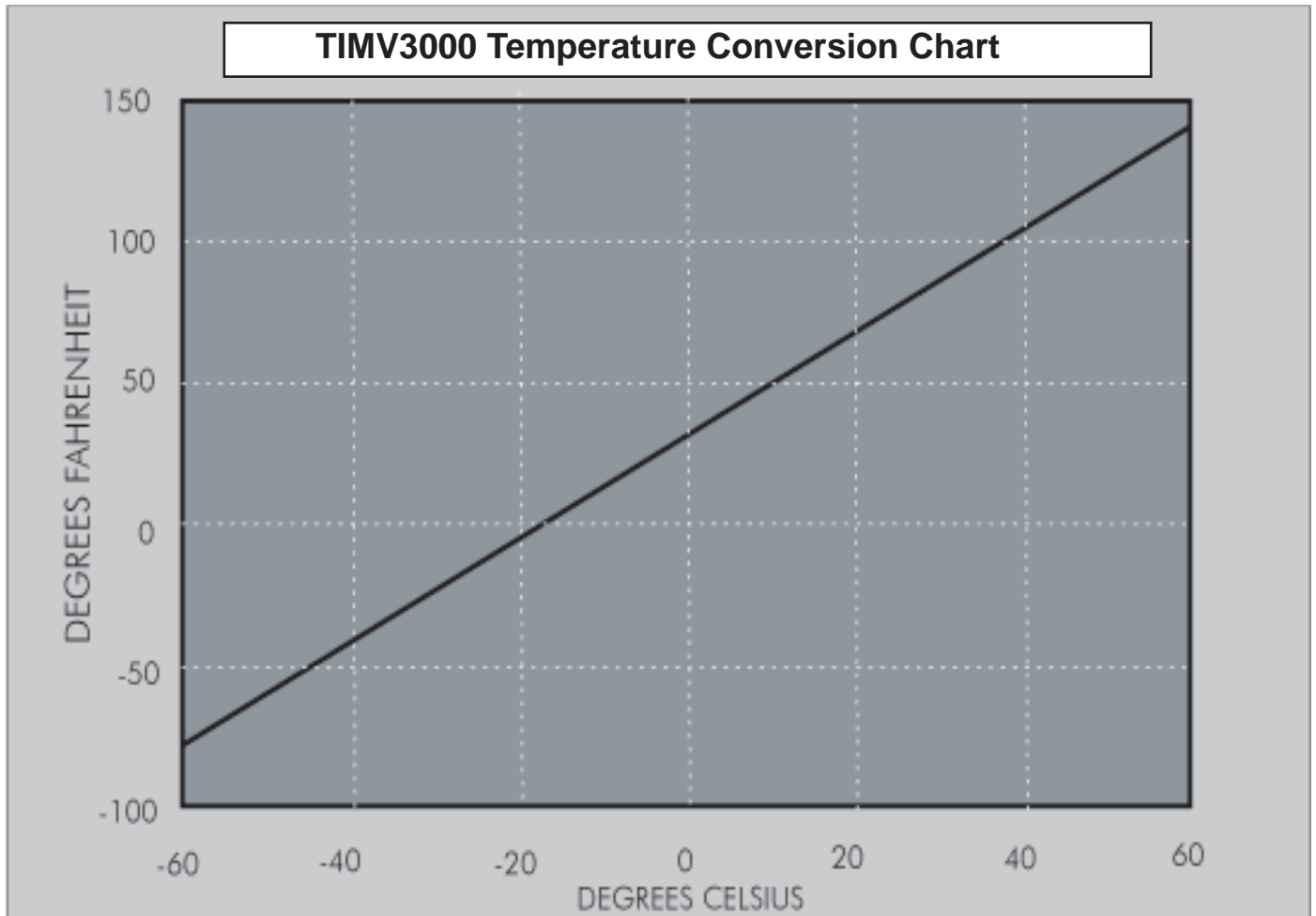


Figure 9.1.1 – Temperature Conversion Chart

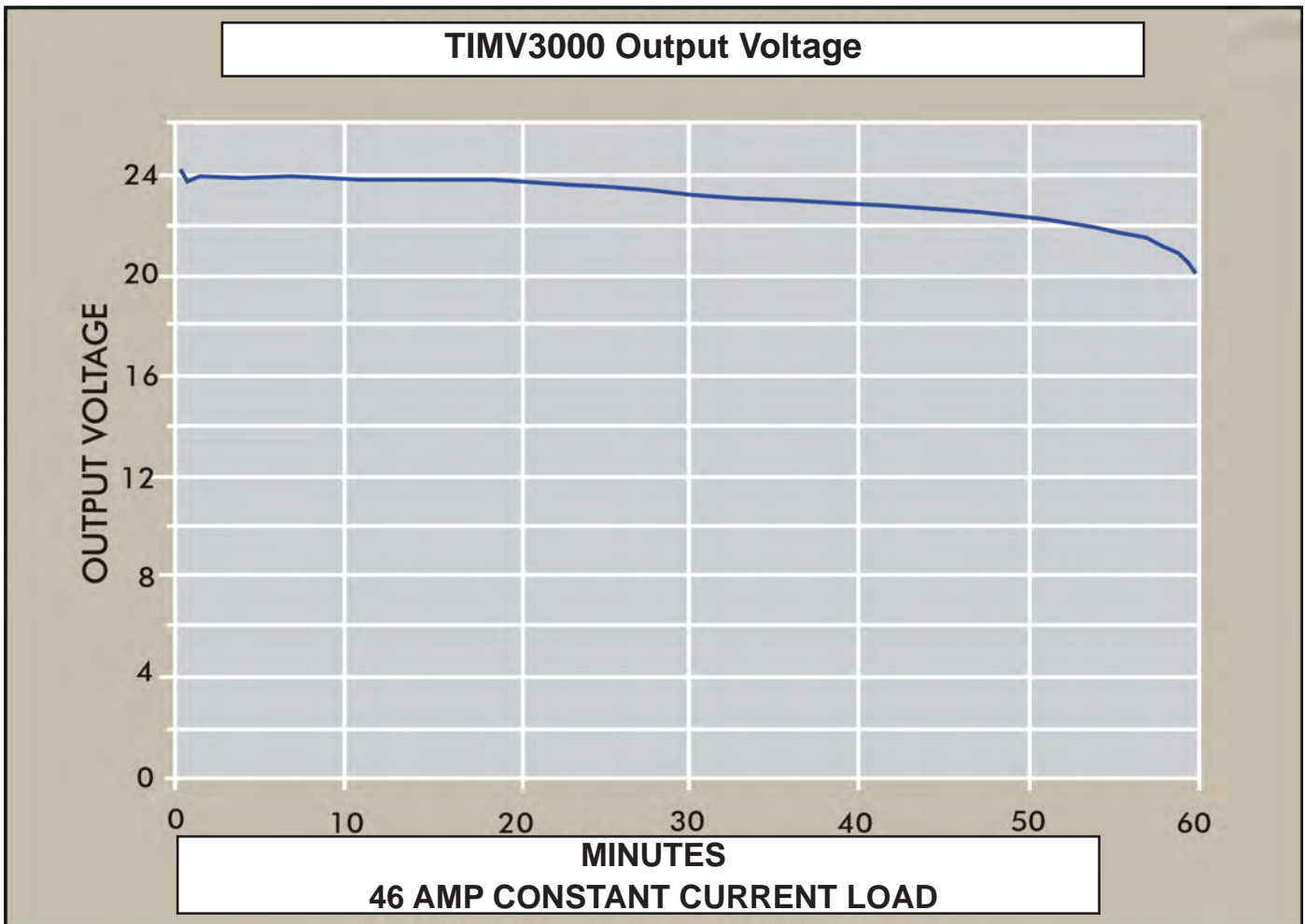


Figure 9.1.2 - Output Voltage

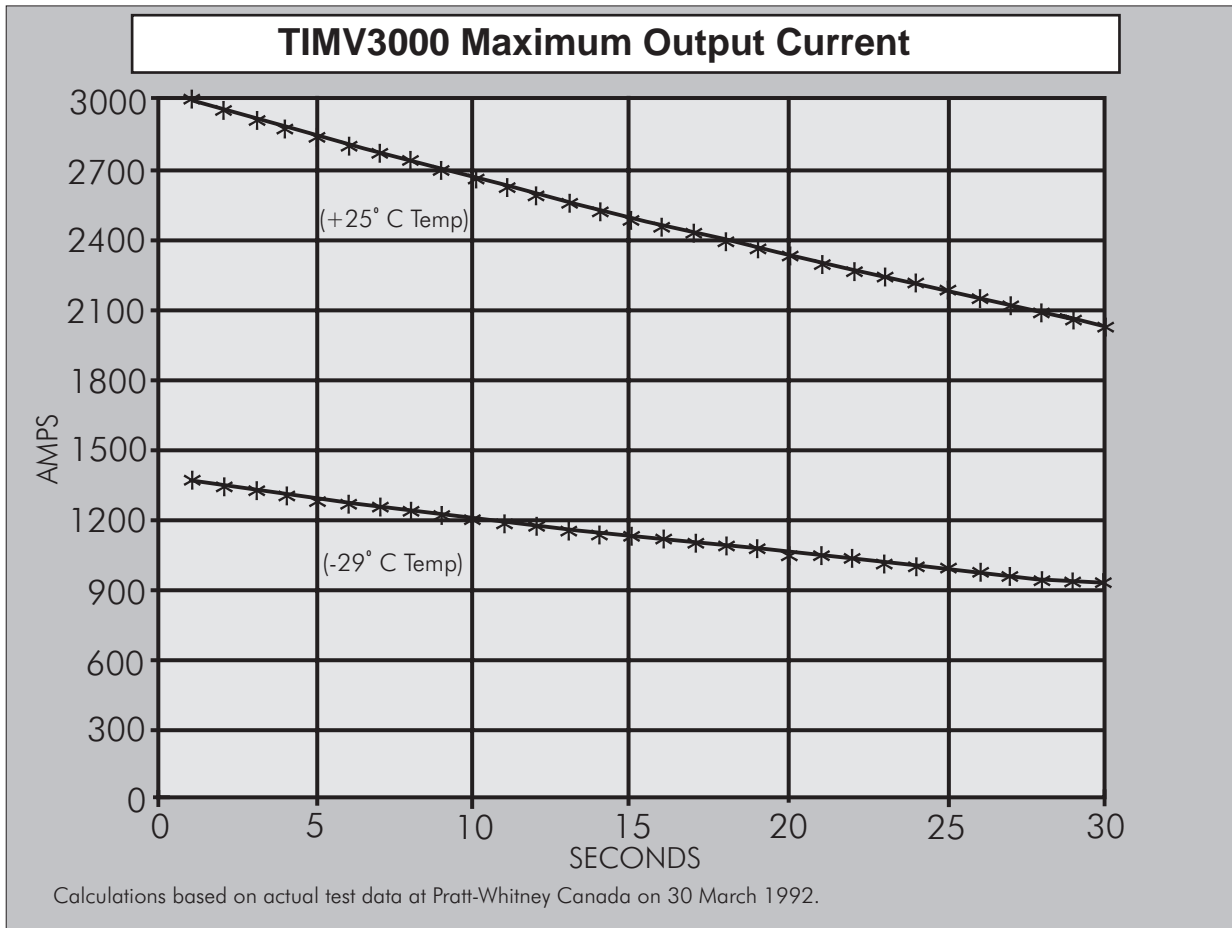


Figure 9.1.3 - Maximum Output Current

Section 10 – Optional Accessories

10.1 – Shipping Case

The optional Shipping Case is the safest way to transport the TIMV3000 GPU-24. This custom case weighs 54 lbs and comes equipped with side handles and locking latches.

TI7000-025

NSN: 8145-01-445-3667

Length: 46.18" (1173 mm)
Width: 18.37" (466.60 mm)
Height: 19.62" (498.35 mm)
Weight: 54 lbs (24.49 kg)



10.2 – GPU Protective Covers

Protective unit from moisture, sand and other damaging elements. Custom fit for the TIMV3000 GPU-24.

TI7000-047



10.3 – COBRA DC Aviation Plug Replacement Contacts and Tools

Cobra DC Plugs (patent pending) 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 space-age composite materials and corrosion-resistant alloys to maximize durability and connectivity. To extend the life of the Cobra 24 VDC Aviation Plug included with your GPU, replacement contacts and tools can be ordered through the Tesla™ Customer Service Department.



Figure 10.3.1 – Cobra Aviation Plug



Figure 10.3.2 – Cobra Aviation Plug Contact Replacement and Tools

10.4 – Tesla AC Line Cords

DC 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’s™ customer service department 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.



Abbreviations and Symbols

Abbreviations and symbols are used within text, headings and titles. Unless otherwise indicated, the following list of abbreviations and symbols are used in this manual:

LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	Definition
Amp	Ampere
AC	Alternating Current
C	Celsius
cont	Continuous
DC	Direct Current
F	Fahrenheit
Ft	Feet
FWD	Forward
GPU	Ground Power Unit
Hr	Hour
Hz	Hertz
Kg	Kilograms
KW	Kilowatts
°	Degree
LED	Light Emitting Diode
MAX	Maximum
MIN	Minimum
VAC	Volts, Alternating Current
VDC	Volts, Direct Current

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 FOUR PART NUMBERS:

TI25000-U01	NORTH AMERICAN LINE CORD
TI25000-U04	OLD BRITISH LINE CORD
TI25000-U03	EUROPEAN 10A/250V
TI25000-U05	ENGLAND 10A/250V

TESLA REPLACEMENT 8 FOOT DC POWER CORD, P/N: TI2006-501, IS AVAILABLE UPON REQUEST. (CUSTOM LENGTHS ARE ALSO AVAILABLE TO SUIT THE CUSTOMERS OPERATIONAL REQUIREMENTS.)

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 #: _____

Purchase Order #: _____ EMail _____

Model #: _____ Serial #: _____

Model #: _____ Serial #: _____

Shipping method to Tesla: _____

Description of shipping package: _____

Description of problem: _____

Return to Tesla™ Industries, Inc.

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