

**NOTE: All users must read this entire manual prior
to operating the TI4676 MPU.**

The TI4676 MPU 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:

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



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 TI4676 MPU 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 TI4676 MPU 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 TI4676 micro power unit. The TI4676 MPU 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 TI4676 MPU.



Figure 1.1.1 – TI4676 MPU

1.2 – 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.

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 TI4676 MPU. 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.

2.2 - Key Words and Symbols

 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.

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 TI4676 MPU 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 TI4676 MPU 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 TI4676 MPU. 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.

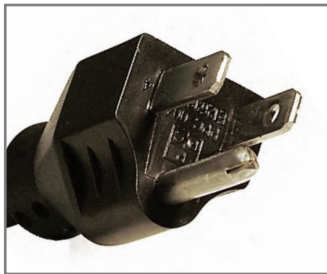


Figure 2.3.1 – Proper Ground Grounded Plug with Grounding Pin



Figure 2.3.2 – Proper Ground Adapter with Grounding Mechanism



Figure 2.3.3 – Improper Ground Plug with No Grounding Pin

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 TI4676 MPU 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
- 5.5 Amps @ 120 VAC 60 Hz
- 2.75 Amps @ 240 VAC 60 Hz

Power Cell:

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

DC Output Power:

- 1500 peak starting amps
- 10 amps of continuous power @ 28.5 VDC (when plugged into AC power)
- 33 amp hours (797 watt hours) with 95-260 VAC power
- 23 amp hours (512 watt hours) of rechargeable battery power without 95-260 VAC

Rechargeable Rate:

- 143 minutes (from full discharge) @ 25 °C

Size:

- 10.85" long x 9.68" wide x 9.43" high
275.6mm x 245.87mm x 239.52mm

Weight

- 53 lbs (24 kg)

Operating Temperature:

- -40 degrees C to +60 degrees C (without AC power)
- -40 degrees C to +50 degrees C (with AC power)

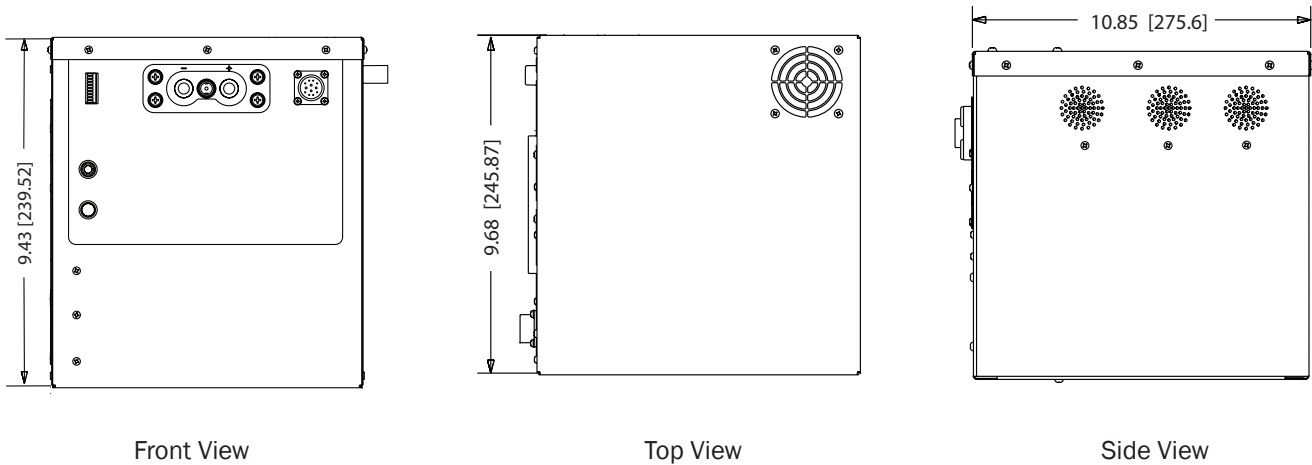
Storage Temperature:

- -65 degrees C to +60 degrees C


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



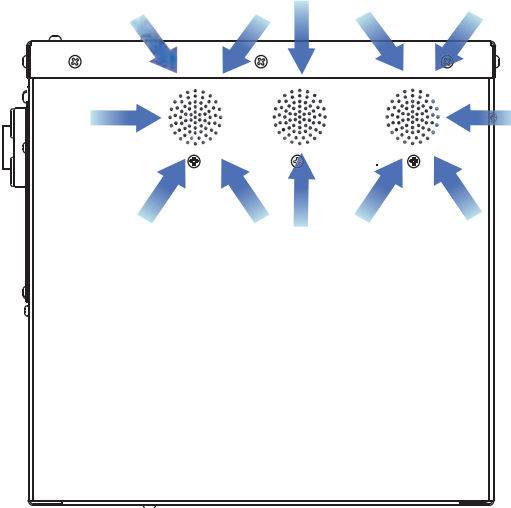
3.3 – Airflow Ports

 **CAUTION** Damage may occur if the TI4676 MPU's air intake or outlet ports are obstructed. Ensure that ports are clear at all times.

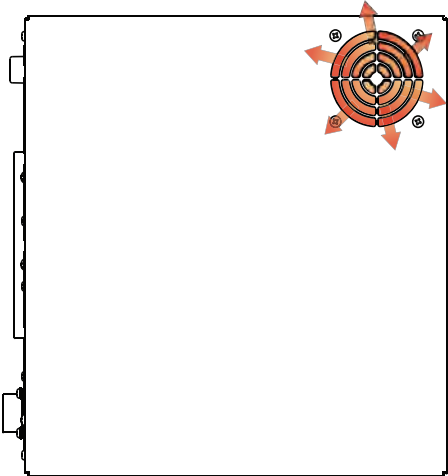
When the TI4676 MPU is plugged into 240 VAC 60 Hz AC power, the internal cooling system will efficiently regulate unit temperature regardless of load. At room temperature (+77 °F) the exhaust air will not exceed the ambient temperature by more than 5 degrees. In more extreme temperatures (greater than 90 °F) the exhaust air will not exceed the ambient temperature by more than 10 degrees.

Airflow Ports Continued

Make sure that the airflow is not obstructed from air intake and outlet.



Side Inlet



Top 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 TI4676 MPU'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 TI4676 MPU's available cell capacity as a function of temperature.

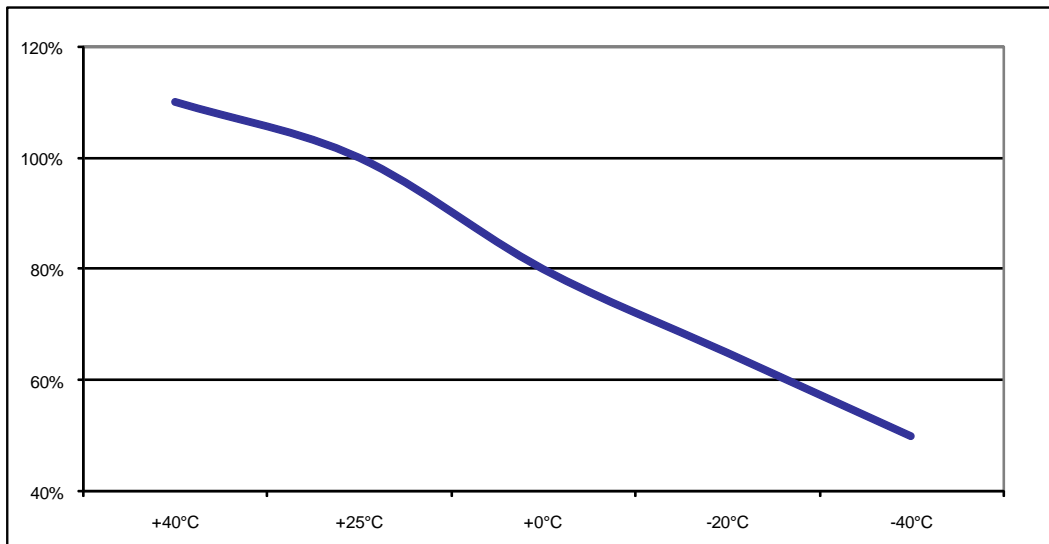


Figure 3.5.1 – Cell storage capacity versus ambient temperature

Note: The TI4676 MPU 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 TI4676 MPU moisture resistant to prevent damage or failure. If the TI4676 MPU 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. Damage may occur if the TI58D MPU is operated after exposure to moisture. If moisture is suspected, **DO NOT CONNECT** the power cord. Move the unit to a non-humid location and allow it to dry for a minimum of one (1) hour before operating again. **DO NOT USE** the unit if the exterior and/or receptacles are damp.



Section 4 - Pre-Operation

4.1 – AC Input Circuit Breaker

The AC input circuit breaker is located above the “Push to Test” button. When the circuit breaker has been tripped, 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.



Figure 4.1.1 AC Input Circuit Breaker location (outlined in blue)



Figure 4.1.2 Pushing AC Input Circuit Breaker

4.2 – Universal AC Input Line Cord

Units equipped with universal AC inputs are outfitted with a cylindrical connector and a circuit breaker. Custom AC line cords are used to plug the unit into standard 110 VAC or 240 VAC wall outlets.



Figure 4.2.1 AC Input (outlined in blue)



Figure 4.2.2 AC Input Line Cord Attached

4.3 – “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.

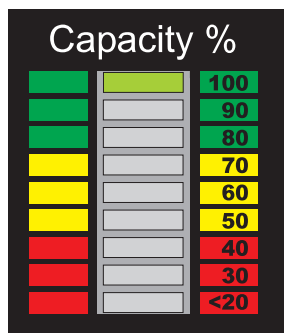
- 1) Make sure that you wait at least 2 minutes after AC power is applied, or DC power is extracted from the unit, before you press the “Push to Test” button. This will ensure a correct reading.
- 2) Without AC power input or DC power output, simply press the “Push to Test” button on the faceplate and 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.
- 5) 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.
- 6) 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.)



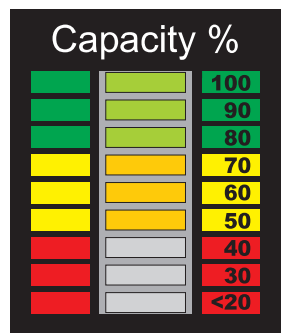
Figure 4.3.1 “Push to Test” button location (outlined in blue)



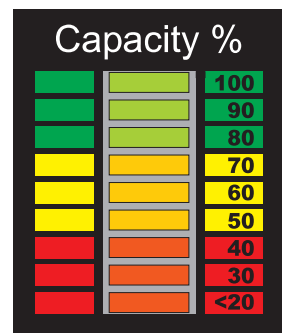
Figure 4.3.2 Pushing to Test



Full Charge



Half Charge



No Charge

4.4 – Charging the 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 4.4.1 Connecting TI4676 MPU 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 three hours (180 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.

4.5 – Installation Procedures

Removing Original Battery

Follow the aircraft's user manual for removal of original battery and proper disposal.

Check Charge

Ensure the TI4676 MPU is fully charged before installation.

Place TI4676 MPU into aircraft.

Remove AC cord and place the TI4676 MPU in the same position as the original battery.

Secure unit in aircraft.

Secure the TI4676 MPU in the same position as the original battery.

Attach DC Connector

Attach the aircraft DC connector into the TI4676 MPU DC receptacle and be sure that it is fully seated.



WARNING

Fire / Explosion Hazard Potential

Note: *Severe injury, or death, from fire or explosion is possible if electrical sparks are produced near fuel vapors. To prevent this, users should not connect this unit's AC or DC receptacles within 20 feet of fueling.*



Figure 4.5.1 Attaching DC Power Cable to TI4676 MPU

Steps not required

The TI4676 MPU uses monolithic dry-cell batteries. There is no need to attach ventilation tubes to the TI4676 MPU. There are no hazardous materials or liquids in the cells; no risk of thermal runaway; and no need to hook up temperature sensors.

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 TI4676 MPU.

NOTE: *When the TI4676 MPU 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 10 AMPS, converter output voltage will drop below 28.5 VDC and three 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	peak starting amps	40% charged
650 - 850	peak starting amps	50% charged
850 - 1000	peak starting amps	60% charged
1000 - 1200	peak starting amps	70% charged
1200 - 1500	peak starting amps	80% charged
1500<	peak starting amps	90% charged

5.3 – General

Correct operation of the TI4676 MPU 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 Section 9, PERFORMANCE DATA to determine the capability of the MPU. 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 – Operating with AC Power Connected

When the TI4676 MPU is plugged into AC power, the output is 28.5 volts. This voltage allows the system to recondition and recharge the vehicles battery(ies). It is also an optimum voltage for powering avionics and lighting on most aircraft. The unit's AC to DC converter produces continuous amps of DC power depending on the size of the system.

Connect to AC Power



Figure 5.6.1 Connecting TI4676 MPU to AC Power Supply

5.7 – Power to Aircraft

Low Power Demand

Low power demand is defined by a requirement of 10 amps or less. DC bus power should come on and the aircraft voltmeter should indicate 28.5 VDC. If aircraft power demand is less than 10 amps, converter output will remain at 28.5 VDC, only one (green) LED status indicator bar will illuminate. If aircraft power demand exceeds 10 mps, 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 11 amps or more. DC bus power should come on and aircraft's voltmeter should indicate between 24 VDC minimum and 27.6 VDC maximum. If current demand is above 11 amps, converter output voltage will drop below 27.6 VDC and two or more LED status indicator bars will illuminate. At approximately 11 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 11 amps.

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 5.7.1 Aircraft with T4676 MPU

Section 6 – Post Operation

6.1 – General

When not in use, the TI4676 MPU should be stored indoors guarded from moisture and extreme temperatures. To extend cell life, the TI4676 MPU should be plugged into AC power source. Although the unit has been made weather resistant within the scope of the unit's intended use, it is essential that good general care is taken to maintain that the unit is in good operating condition and to maximize the 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

If your aircraft does not have a voltage lockout feature at the auxiliary power receptacle, the TI4676 MPU will back-charge from the aircraft's VDC. The TI4676 MPU has an internal, independent, intelligent recharger that will enable the unit to rapidly recharge from either the aircraft's generator or any 120-240 VAC 50/60Hz power source.

NOTE: Plug the TI4676 MPU 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

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.

Power Cell Recharge Limits

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 TI4676 MPU to AC Power Supply



Figure 6.3.2 AC Line Cord



CAUTION

Guard From Incorrect Power Source

The T14676 MPU'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 T14676 MPU's internal charger and the AC power cord furnished with the equipment, or when connected to aircraft's external DC power receptacle.

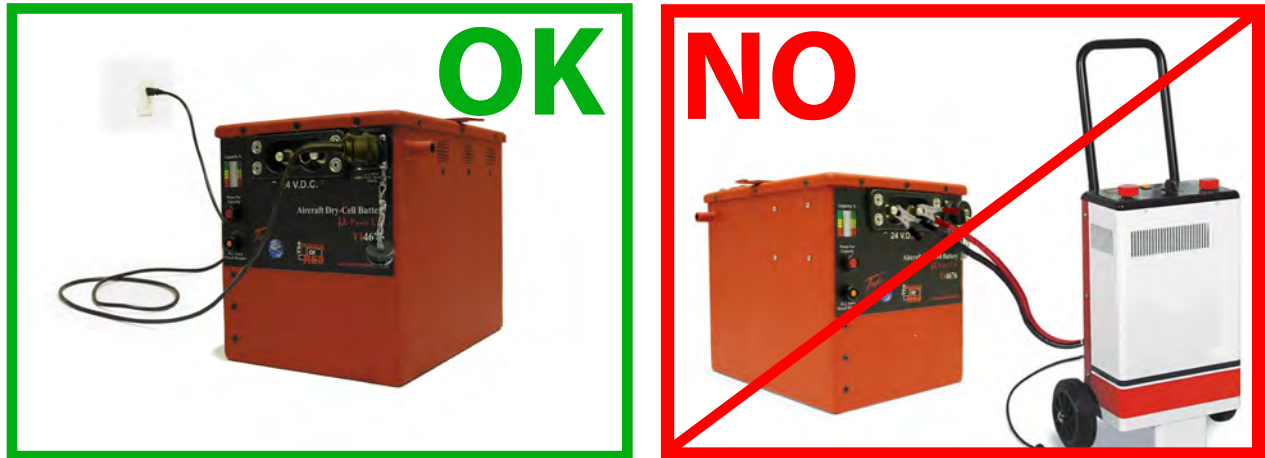




Figure 6.3.3 Proper and Improper Charging Methods

Section 7 – Unit Care and Maintenance

 DANGER	Severe injury or death from electrical shock will occur if either the user or the TI4676 MPU 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.
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7.1 - Unit Care

Avoid Prolonged Exposure to Extremely Damp Environments

Be sure to disconnect AC power from the AC source if the TI4676 MPU 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 TI4676 MPU. 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 TI4676 MPU.



Figure 7.1.1 – Damaged cable

7.2 – Normal Function Test Procedures

This section deals with “normal function” test procedures, and includes all steps necessary to ensure that the TI4676 MPU 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.



Figure 7.2.1 – Digital Multimeter

AC Input Connector

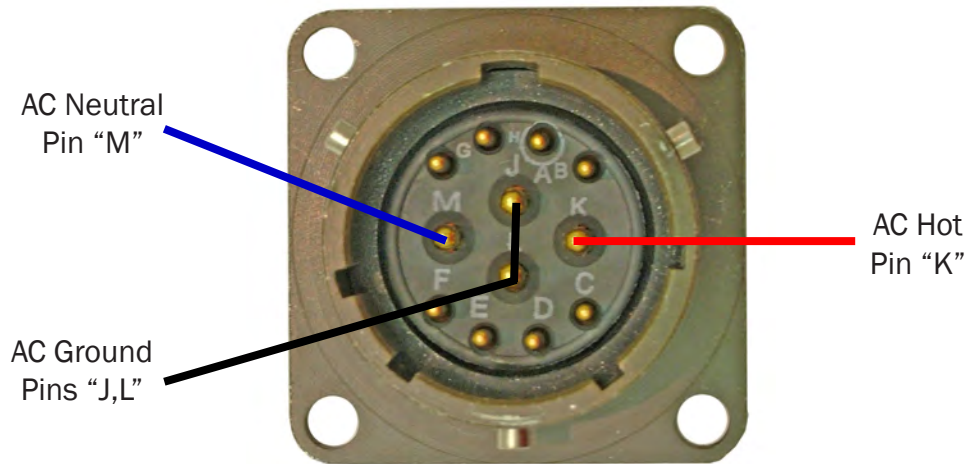


Figure 7.2.2 – AC Input Connector wiring diagram

Check Unit Internal Resistance (Test for Shorts)

This section deals with “normal function” test procedures, and includes all steps necessary to ensure that the TI4676 MPU 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 positive probe to the DC positive post.



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



4. Move the positive probe to the fastener



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



6. Move the positive 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

To verify that the power cells are fully charged, set the digital multimeter to measure DC voltage. Place the positive probe (red) on the positive post of the DC Output Connector, as shown in Figure 7.2.3. Next, place the negative probe on the negative post. The multimeter display should read approximately 28.5 VDC (± 0.5 VDC) when power cells are fully charged and the unit is plugged into an AC power source. When the unit is not plugged into an AC power source, the multimeter display should read 25.5 VDC.

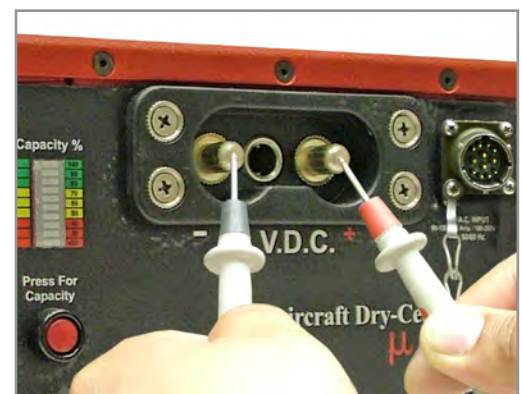


Figure 7.2.3 – Testing DC Receptacle

7.3 – Unit Servicing

The TI4676 MPU 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 sticker on the TI4676 MPU

7.4 – Packaging and Shipping

When returning the MPU, 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

1. Why should I buy a Tesla TI4676 MPU?

A Tesla MPU has dramatic advantages over standard aircraft batteries. The advantages include power, durability, and longevity. A Tesla MPU will provide more power for testing avionics and starting than comparable competitors. The dry cells are more resistant to heat and vibration. A Tesla MPU does not experience thermal runaway. A Tesla MPU is equipped with a built in intelligent charger. To keep a Tesla MPU in perfect condition, plug it into a standard wall socket.

2. Do the cells have memory?

The cells have no memory. The user can plug the TI4676 MPU into AC for charging regardless of the unit's current state of charge. The intelligent charger will keep a fully charged battery by trickle charging. Keeping a fully charged TI4676 MPU plugged into AC when not in use will prolong the life of the batteries.

3. How are Micro Power Units used in Aviation Support?

There are many ways a MPU 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 MPU as well. In the hangar, when connected to AC power, the MPU will provide 28.5 VDC for avionics testing and will also recondition and recharge the aircraft's battery.

4. How much power will my TI4676 MPU provide?

Depending on the system, the MPU will provide up to 10 continuous amps with AC line voltage and 1500 peak starting amps directly from the internal cells.

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 MPU provide until it is depleted?

The MPU back-charges, almost instantly, once the aircraft is started and the generator is on line. This "power flywheel" feature enables the Turbo Start to recharge itself right from the aircraft it started in less than 30 seconds.

7. How do you prolong the life of the TI4676 MPU'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 Page 25 Section 7.1 for further information.

9. Why does the cooling fan run continuously when the MPU is plugged into AC power? Why does the cooling fan slow down?

The cooling fan speed varies to regulate the temperature of the internal circuitry when plugged into an AC power source.

10. Can one person transport it?

Micro Power Units are designed to be handled by one person. The TI4676 MPU provides a rugged nylon strap attached to the top of the unit that helps easily transport and place into aircrafts. See Section 5.6 for more information.

11. Is the TI4676 MPU 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 TI4676 MPU 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 TI4676 MPU 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 TI4676 MPU?

Aviation customers will receive a DC cable with an aviation plug. Customers also 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.

Basic Usage/Operation Questions

1. 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.

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

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

3. 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)

4. 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.

5. Why does the cooling fan slow down?

Cooling fan rpm varies for better temperature regulation.

6. 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.

Section 9 – Performance Data

9.1 – Purpose

This section provides performance data for the TI4676 MPU. Continual reference to this information will enable the user to obtain maximum performance, utilization and service life from the MPU. 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 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.

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

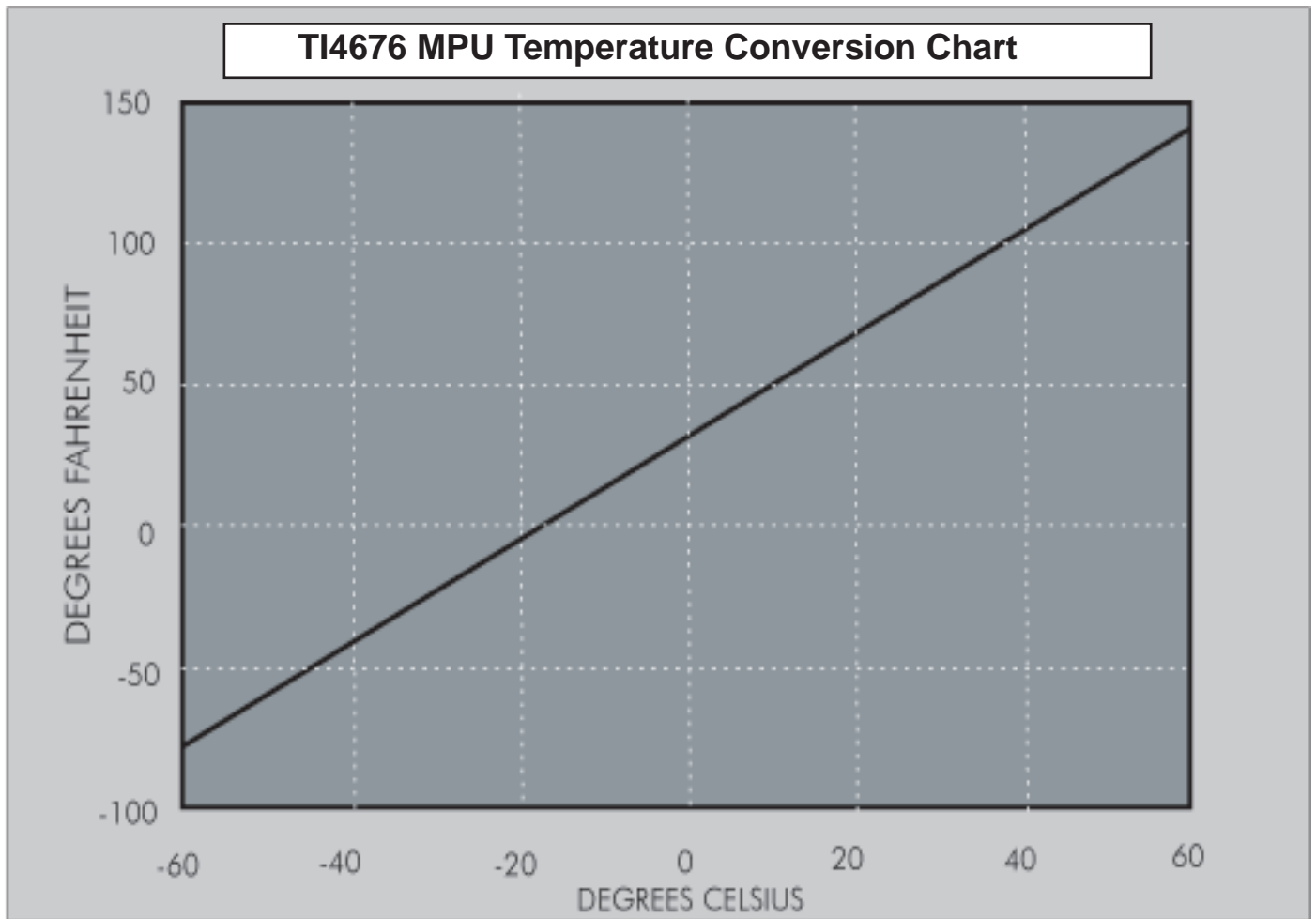
The data presented are accurate only for specific conditions listed under the title of each chart or graph. Variables for which data are not presented, but which may affect that phase of performance, are discussed in associated text. Where data is available or reasonable estimates can be made the amount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

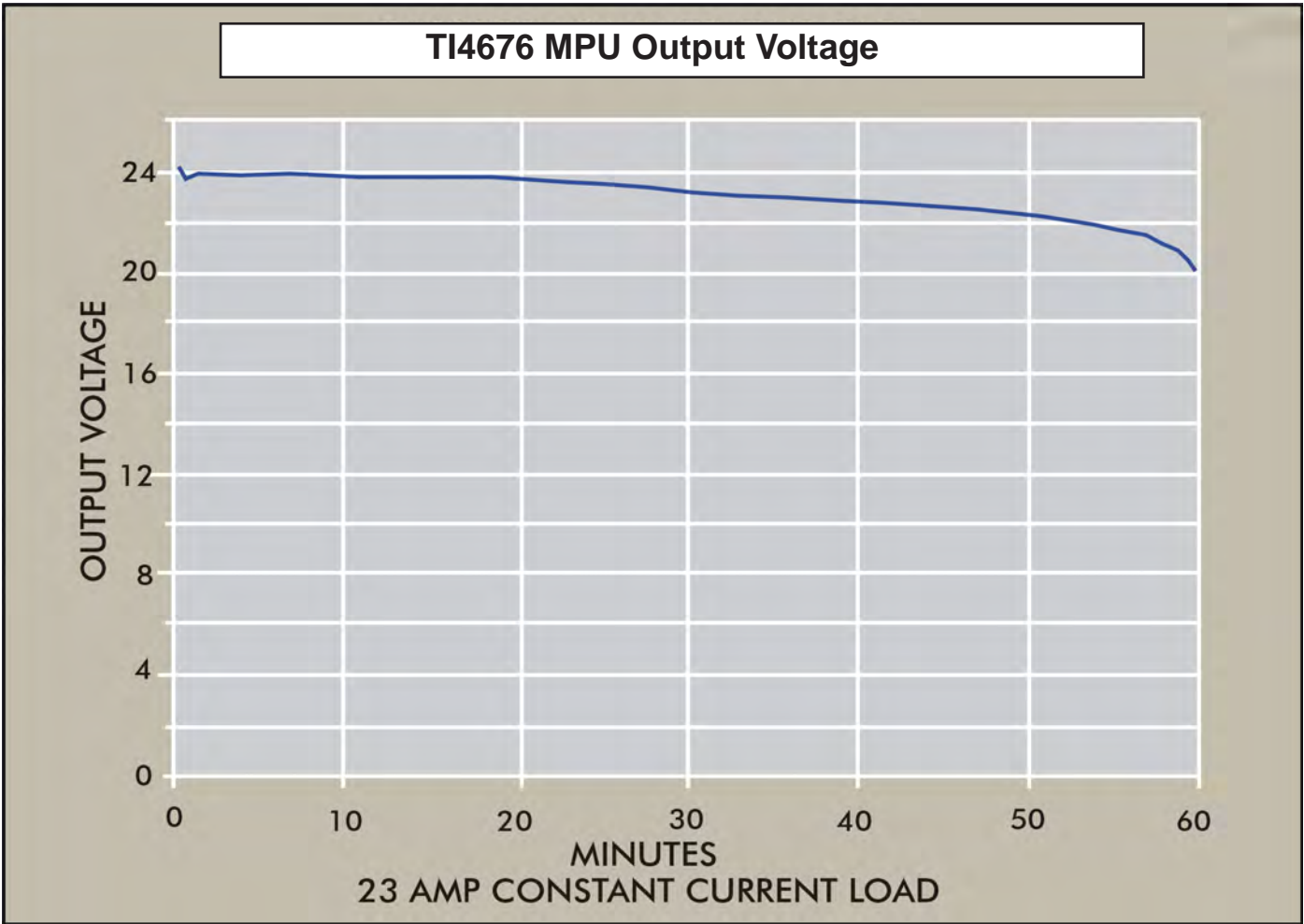
9.5 – General Conditions

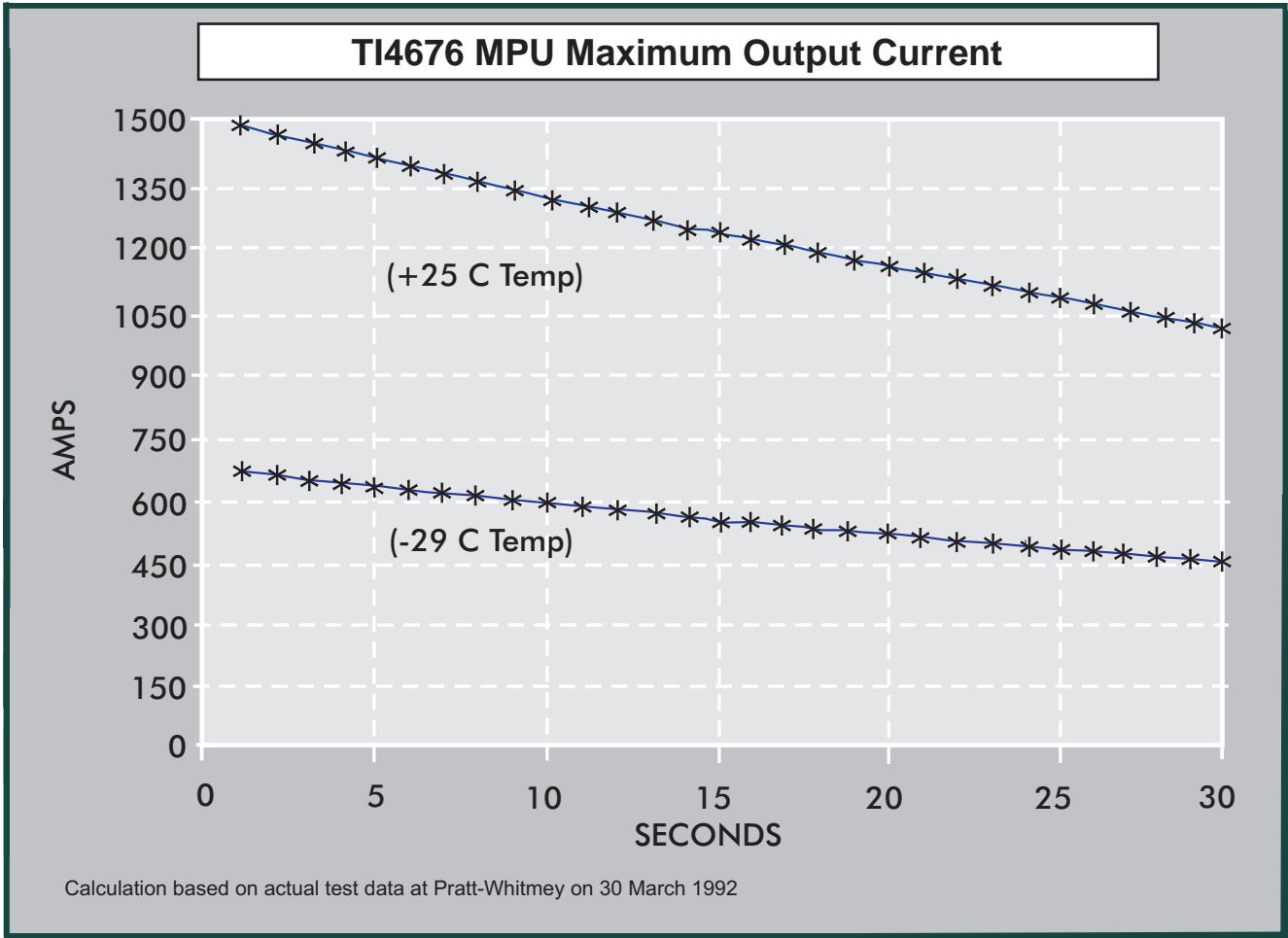
In addition to the specific conditions, the following general conditions are applicable to the performance data.

- 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.







Section 10 – Optional Accessories

10.1 – Shipping Case

The optional Shipping Case is the safest way to transport the TI58D MPU. This custom case weighs 13.5 lbs and comes equipped with side handles and locking latches.

TI7000-023

- Length: 15.25" (387.35 mm)
- Width: 14.56" (369.82 mm)
- Height: 12.56" (319.02 mm)
- Weight: 14.5 lbs (6.57 kg)



10.2 – 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
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 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
Saudia 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 Set
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 #: _____

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