

POWERED BY



TI5400GHMD GROUND POWER UNIT



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1/1/2008

WARNING



SHOCK HAZARD POTENTIAL



IMPROPER USE/FAILURE TO FOLLOW INSTRUCTIONS IN OPERATORS MANUAL CAN RESULT IN UNIT FAILURE AND/OR POSSIBLE INJURY, OR DEATH, BY ELECTRICAL SHOCK.

**THE TI5400GHMD IS A MAINTENANCE FREE, SEALED UNIT
NO REPAIRS ARE AUTHORIZED**

WARRANTY WILL BE VOIDED IF
UNIT IS TAMPERED WITH
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WARNING



SHOCK HAZARD POTENTIAL



ATTEMPTS TO OPEN OR ENTER THE INSIDE OF THIS UNIT, USING ANY TOOL OR DEVICE; i.e. PROBE, BORESCOPE, etc. CAN RESULT IN UNIT FAILURE AND/OR POSSIBLE INJURY BY ELECTRICAL SHOCK. THIS UNIT IS MAINTENANCE FREE AND SHALL NOT BE OPENED OR DISASSEMBLED FOR ANY REASON.



SHIPPING HAZARDS



NONE

“DRY” Non-spillable, POWER CELL (battery),
No free liquids to leak or toxic gases.
Always protect unit from short circuit.
Return Power Cells to Tesla for Recycling.

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CHAPTER 1

INTRODUCTION

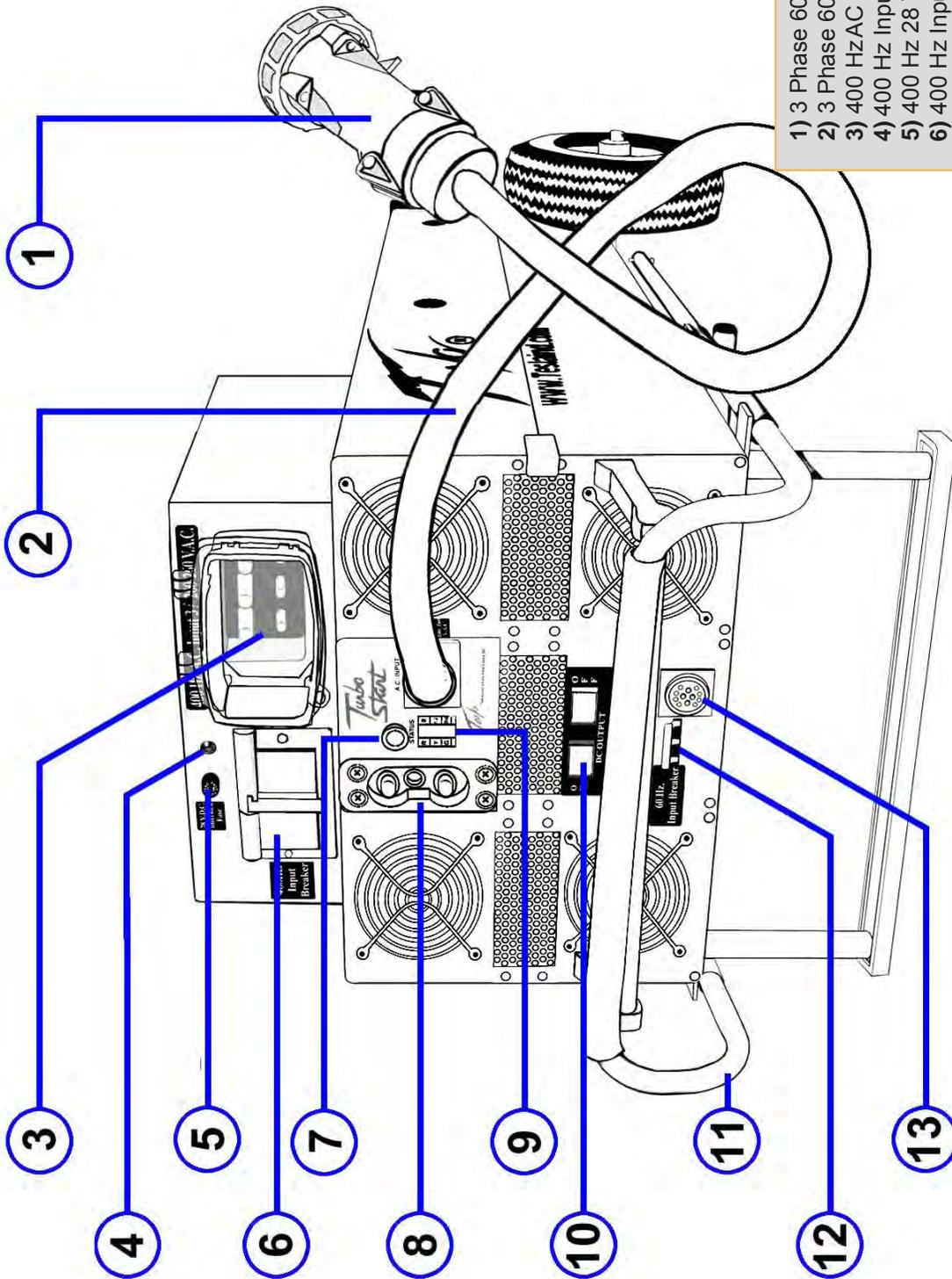
1.1 DESCRIPTION

This manual contains the complete operating instructions and procedures for the TI5400GHMD ground power unit. The Turbo Start TI5400GHMD 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 30.5 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 TI5400GHMD ground power unit.

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.

1.3 FRONT PANEL OVERVIEW



- 1) 3 Phase 60 Hz AC Input Plug
- 2) 3 Phase 60 Hz AC Input Cable
- 3) 400 Hz AC Input
- 4) 400 Hz Input Interlock Indicator Light
- 5) 400 Hz 28 Volt Interlock Fuse
- 6) 400 Hz Input Circuit Breaker
- 7) Battery State of Charge
"Push to Test" Button
- 8) 28 Volt Output DC Connector
- 9) Battery Status Bar Graph
- 10) DC Output ON/OFF Buttons
- 11) Telescopic Handle
- 12) 3 Phase 60 Hz Input Circuit Breaker
- 13) Accessory Volt / Amp Meter Plug

Figure 1-1: Front Panel Overview

CHAPTER 2

SAFETY

2.1 DEFINITIONS: DANGER, WARNING, CAUTION, AND NOTE

A warning, caution, or note is used to emphasize important and critical instructions as defined for the following conditions:

DANGER

An operating procedure, practice, etc., which, if not correctly followed, will result in personal injury or loss of life.

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

A procedure, condition, etc., which is essential to proper operation.

2.2 MOST IMPERATIVE PRECAUTIONS

WARNING



SHOCK HAZARD POTENTIAL



Severe injury, or death, from electrical shock is possible when wet electrical plugs are connected to the unit. To prevent this, make sure electrical outlets are switched to “OFF” position before connecting electrical plugs. (Please refer to page 3-4)

WARNING



FIRE/EXPLOSION HAZARD POTENTIAL



Severe injury, or death, from fire or explosion is possible if electrical sparks are produced near fuel vapors. To prevent this, make sure electrical outlets are switched to “OFF” position before connecting electrical plugs. For added safety, users should not operate this unit within 20 feet of fueling. (Please refer to page 4-3 and 4-6)

CAUTION

The 208-240 three phase VAC 50/60 Hz 50 amps max power plug can only be connected to 208-240 three phase VAC 50/60 Hz 50 amps max power. Any other type of AC power may cause damage to the unit. (Please refer to page 4-2)

CAUTION

The 200 Y 115 three phase VAC 400 Hz 50 amps max input can only be connected to 200 Y 115 three phase VAC 400 Hz 50 amps max power. Any other type of AC power may cause damage to the unit. (Please refer to page 4-6)

CAUTION

The ambient temperature may cause the unit’s protective “over-temperature” sensors to shut down the VAC functions (converter and charger) until the unit cools to normal operating temperatures. If the unit shuts down, move 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 return the unit to Tesla for recalibration for use in these environments. (Please refer to page 3-3)



CAUTION



Damage may occur if unit is operated after exposure to moisture (rain, drizzle, fog, sleet or snow) or moisture contamination is suspected. DO NOT USE until unit’s exterior and receptacles are dried. Operation shall be restricted to use without 208-240 three phase VAC 50/60 Hz 50 amps max or 200 Y 115 three phase VAC 400 Hz 50 amps max power. DO NOT CONNECT power cord until unit has been dried for a MINIMUM of one (1) hour, prior to use. (Please refer to page 3-4)



CAUTION



Unit’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 TURBO START internal charger or the AC power cord furnished with the equipment, or when connected to vehicle’s external DC power receptacle. (Please refer to page 7-2)

2.3 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
DVAM	Digital Volt Amp Meter
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
	Explosion Hazard Potential
	Shock Hazard Potential
	Guard from moisture
	Guard from incorrect power source

CHAPTER 3

SPECIFICATIONS AND DIMENSIONS

3.1 GENERAL SPECIFICATIONS

INPUT POWER AC TI5400GHMD:

208-240 Three Phase VAC 50/60 Hz 50.0 amps max
200 Y115 Three Phase VAC 400 Hz 50.0 amps max

POWER CELL

DRY, HIGH RATE DISCHARGE, RECHARGEABLE, MAINTENANCE-FREE

Specifications

Output -

30.5 Volt DC 400 amp continuous power
24 Volt DC 46 amp hour rechargeable power
3000 Peak starting amps

Power Output Rate -

One (1) hour constant power to 20.0 end V olts DC
446 amp hours (10,615 watt hours) with 208-240 VAC power, 3 phase
46 amp hours (1,024 watt hours) without 208-240 VAC power, 3 phase

Rechargeable Rate -

12 minutes (from full discharge) with 208-240VAC power, 3 phase

Size - 49" Long x 24.50" Wide x 21.25" High
1244.6mm x 645.16mm x 539.75mm

Weight - 267 lbs..

Temperature -

Operating

Without AC Power -40 degrees C to +60 degrees C

With AC Power -40 degrees C to +50 degrees C

Storage

-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%

3.1.2 Dimensions

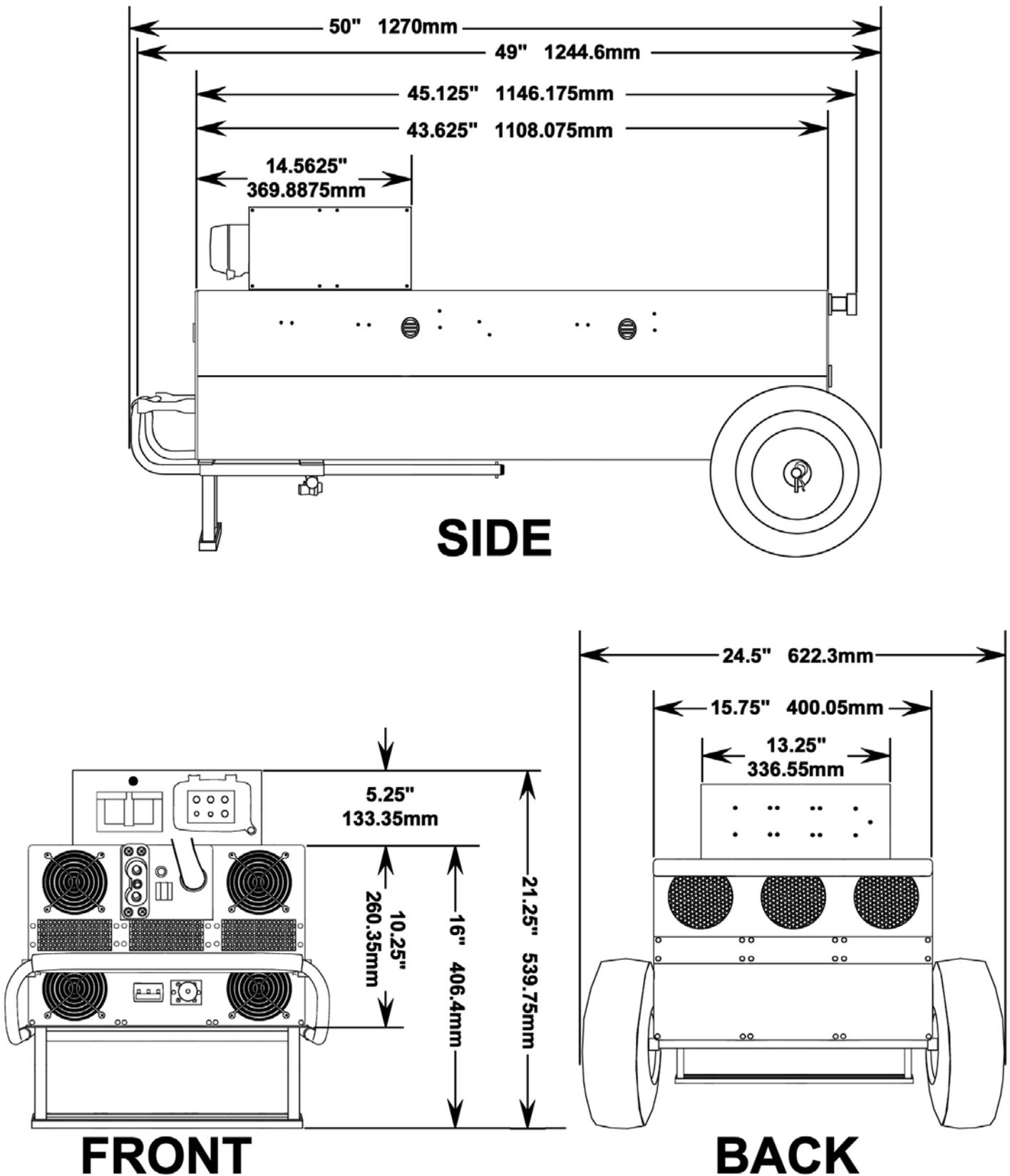


Figure 3-1: Unit Dimensions

ENGINE START PEAK CURRENT Requirements

650 - 850 peak starting amps
850 - 1000 peak starting amps
1000 - 1500 peak starting amps
1500 - 1800 peak starting amps
1800 - 2500 peak starting amps
2500 - 3000 peak starting amps

MINIMUM CHARGE

40% charged
50% charged
60% charged
70% charged
80% charged
90% charged

NOTE

If power output is greater than rated amp hour rate, power cell discharge rate will increase correspondingly.

3.2 TEMPERATURE

Temperatures refer to the unit's cold/heat soaked temperature. The ambient temperature that a unit is exposed to for one (1) hour or more shall establish a unit's cold/heat soaked temperature. If unit's cold/heat soaked temperature exceeds operating temperature range, unit shall be stabilized prior to operation as follows: COLD SOAKED, warmed for a minimum of three hours above +10C° (+41°F) or two hours above +20C° (+68°F); WARMED SOAKED, cooled for one hour below +38C° (+100°F).

Operating range:

without AC power -40C° (-40°F) TO +60C° (+140°F)

with AC Power -30C° (-22°F) TO +50C° (+124°F)

Storage range:

-60C° (-76°F) TO +60C° (+140°F)

CAUTION

The ambient temperature may cause the unit's protective "over-temperature" sensors to shut down the VAC functions (converter and charger) until the unit cools to normal operating temperatures. If the unit shuts down, move 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 return the unit to Tesla for recalibration for use in these environments.

NOTE

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

3.3 ENVIRONMENTAL

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 TI5400GHMD moisture resistant to prevent damage or failure. If the Turbo Start TI5400GHMD 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 rear outlet cooling fan vent ports

3.3.1 Rain

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

Conditions	With Raincover	Without Raincover
Heavy or steady rain:	OK	OPERATION NOT RECOMMENDED
Light rain, drizzle or sleet:	OK	NO CONVERTER OR CHARGER (NO VAC)
Fog, snow	OK	OK



Severe injury, or death, from electrical shock is possible when moist electrical plugs are connected to the unit. To prevent this, make sure electrical outlets are switched to “OFF” position before connecting electrical plugs.



Damage may occur if unit is operated after exposure to moisture (rain, drizzle, fog, sleet or snow) or moisture contamination is suspected. DO NOT USE until unit’s exterior and receptacles are dried. Operation shall be restricted to use without 208-240 three phase VAC 50/60 Hz 50 amps max or 200 Y115 three phase VAC 400 Hz 50 amps Max Power. DO NOT CONNECT power cord until unit has been dried for a MINIMUM of one (1) hour, prior to use.

3.3.2 Blowing Sand or Dust

Unit inlet and outlet vent ports shall be covered from exposure. Unit shall be kept horizontal. It is also recommended that a Protective Rain Cover is used to cover the unit to guard it from blowing sand or dust.

3.4 OPERATING POSITION AND AIRFLOW

The TI5400GHMD can be operated in both the horizontal and vertical positions shown below. Make sure the airflow is not obstructed from the air intake or outlet. At room temperature (78° Fahrenheit) the exhaust air will not exceed the temperature of the ambient air by more than 5 degrees. In more extreme temperatures (90° Fahrenheit and higher) the exhaust air will not exceed the temperature of the ambient air by more than 10 degrees. This is less than the heat generated by the exhaust of a personal computer

CAUTION

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

-  Blue Signifies Air Intake
-  Red Signifies Air Exhaust

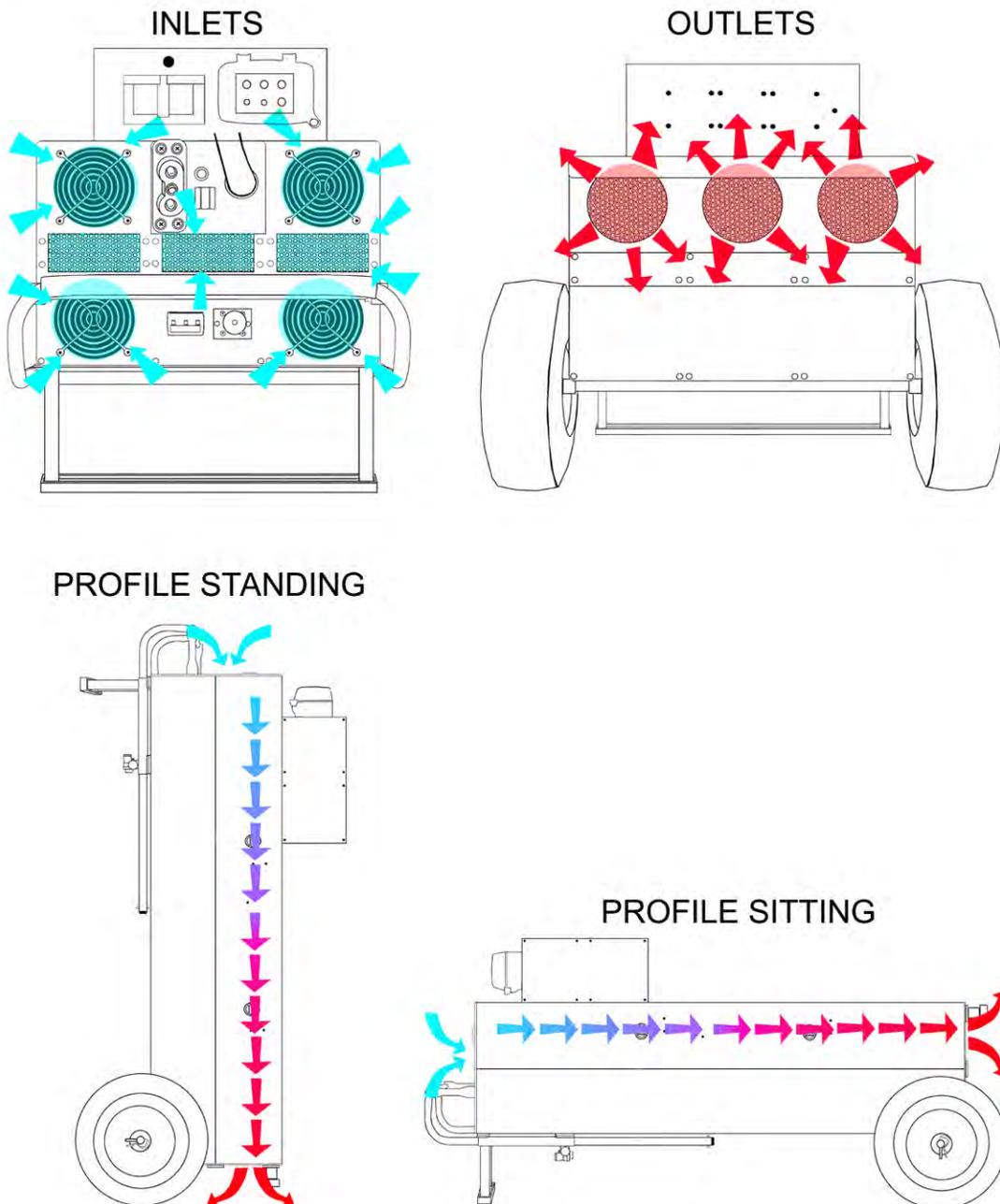


Figure 3-2: Airflow Diagram Sitting and Standing

CHAPTER 4

FEATURES

4.1 FEATURES OVERVIEW

The TI5400GHMD is designed to provide flatline 24 VDC power for sensitive avionics. The front panel features a DC output receptacle that can be switched to ON and OFF positions by using push buttons. The TI5400GHMD provides this power by converting it from one of two different VAC sources depending on the user's requirements. There is a 208-240 three phase V AC 50/60 Hz 50 amp s max cable attached to the unit. This cable has its own circuit breaker that acts as a backup "ON/OFF" switch. There is also an extra module permanently mounted to the top of the main body of the unit that houses all of the controls for 200 Y115 three phase V AC 400 Hz 50 amp s max input power . These include the 400 Hz input, acircuit breaker that acts as a backup "ON/OFF" switch, an interlock indicator light and a interlock fuse. The TI5400GHMD depends on non spillable dry cell batteries to provide DC power. The status of the cells can be monitored by the status bar graph on the front panel. Directly above the status bar graph is a "Push to Test" button that activates the status bar graph. An extra feature of the TI5400GHMD is a cylindrical connector for the Tesla Digital Volt/Amp Meter. This enables the user to monitor the amount of voltage and current the unit outputs.

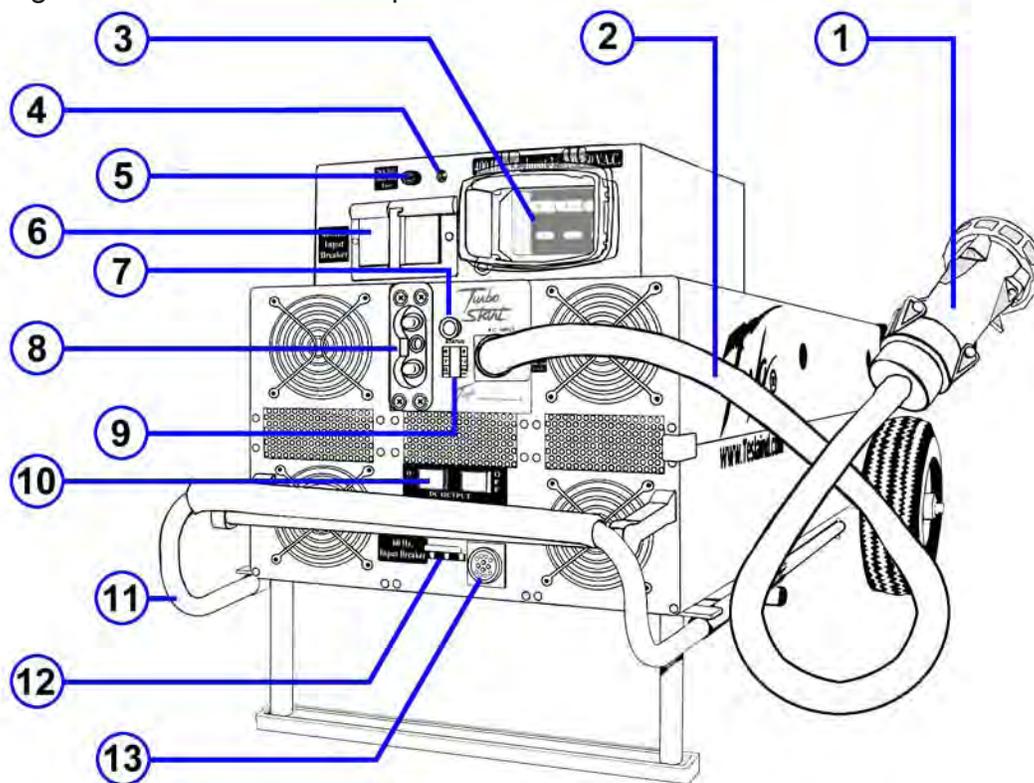


Figure 4-1: Front Panel Overview

- | | |
|--|--|
| 1) 3 Phase 60 Hz AC Input Plug | 8) 28 Volt Output DC Connector |
| 2) 3 Phase 60 Hz AC Input Cable | 9) Battery State of Charge / Power Output Status Bar Graph |
| 3) 400 Hz AC Input | 10) DC Output "ON/OFF" Buttons |
| 4) 400 Hz Input Interlock Indicator Light | 11) Telescopic Handle |
| 5) 400 Hz 28 Volt Interlock Fuse | 12) 3 Phase 60 Hz Input Circuit Breaker |
| 6) 400 Hz Input Circuit Breaker | 13) Accessory Volt / Amp Meter Plug |
| 7) Battery State of Charge "Push to Test" Button | |

4.2 60 HZ AC INPUT CABLE

The TI5400GHMD comes with a permanently attached 208-240 three phase VAC 50/60 Hz 50 amps max line cord. This cord is used to plug the TI5400GHMD into 208-240 three phase 50/60 Hz VAC 50 amp power.

CAUTION

The 208-240 three phase VAC 50/60 Hz 50 amps max power plug can only be connected to 208-240 three phase VAC 50/60 Hz 50 amps max power. Any other type of AC power may cause damage to the unit.

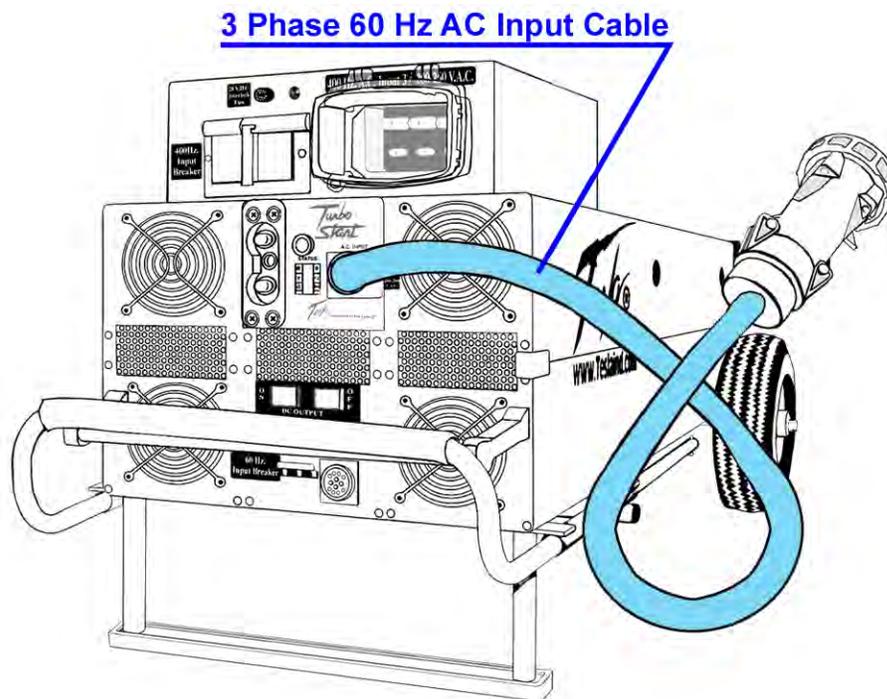


Figure 4-2: Three Phase Cable Location

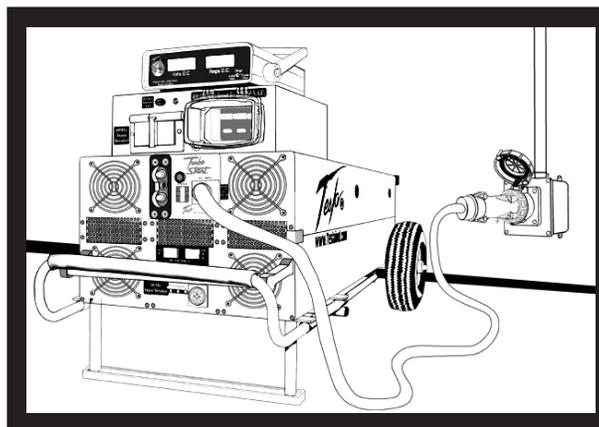


Figure 4-3: Plug in AC Power

4.3 60 HZ AC INPUT PLUG

The unit is designed with a single point AC receptacle for external power to operate both the internal charger and converter. The plug is made for 208-240 three phase VAC 50/60 Hz 50 amps max.



WARNING



FIRE/EXPLOSION HAZARD POTENTIAL

Severe injury, or death, from fire or explosion is possible if electrical sparks are produced near fuel vapors. To prevent this, make sure electrical outlets are switched to “OFF” position before connecting electrical plugs. For added safety, users should not operate this unit within 20 feet of fueling.

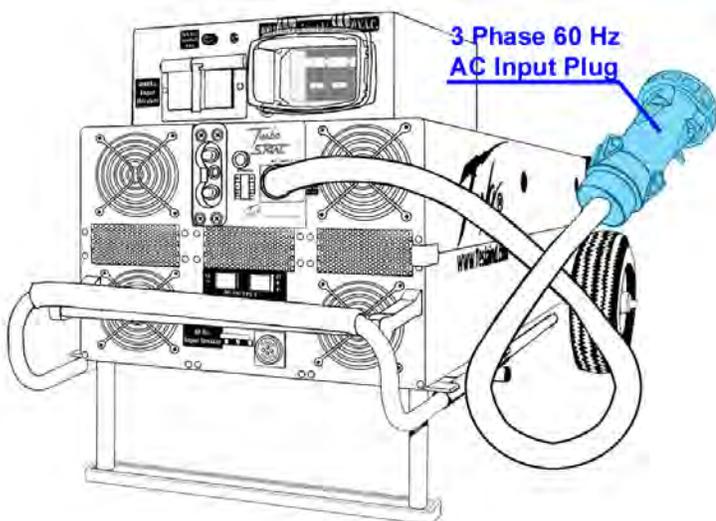


Figure 4-4: Three Phase Plug Location



Figure 4-5: 208-240 Three Phase Plug

When not in use the AC plug can be secured by a velcro strap attached to the back of the unit.

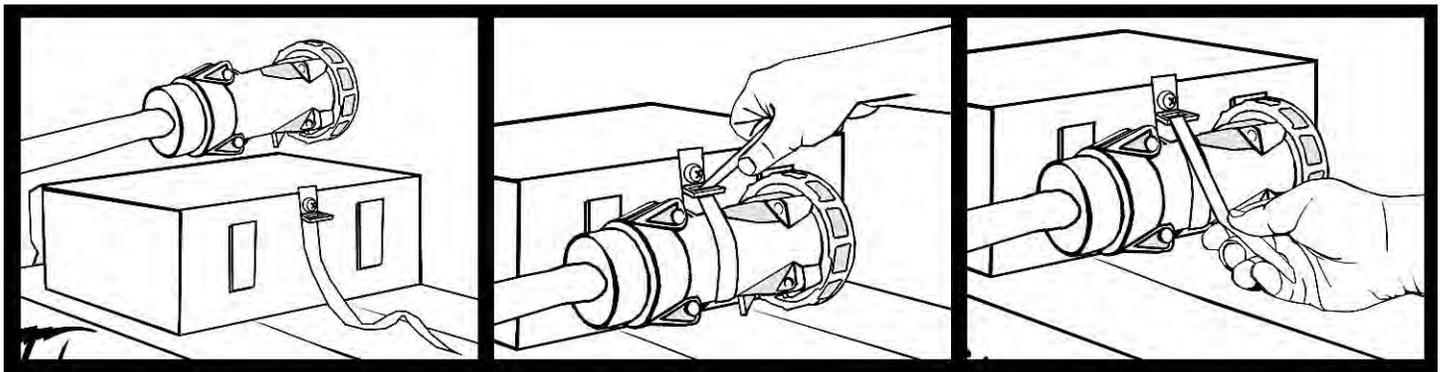


Figure 4-6: AC Plug Strap

4.4 60 HZ AC INPUT CIRCUIT BREAKER

The 208-240 three phase VAC 50/60 Hz 50 amp max input is equipped with a circuit breaker that is also used as an “ON/OFF” switch.

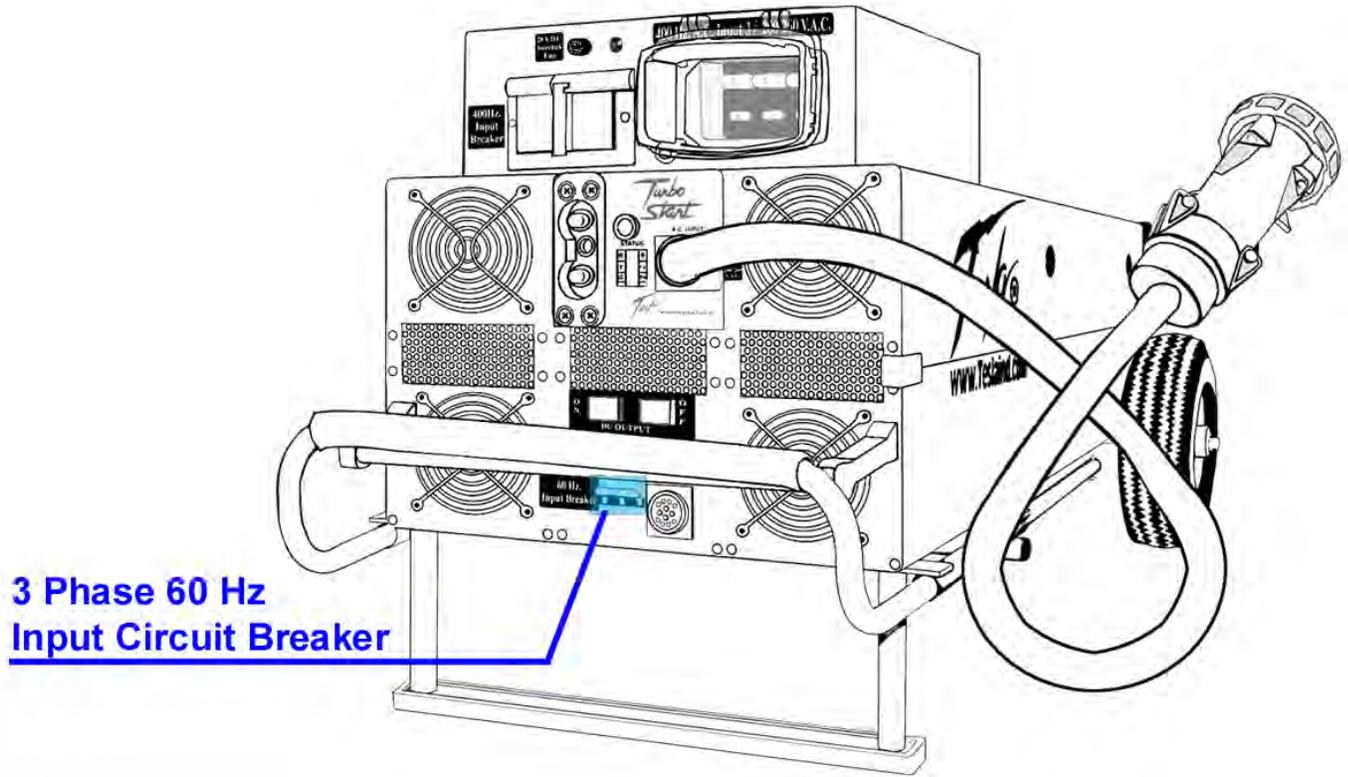
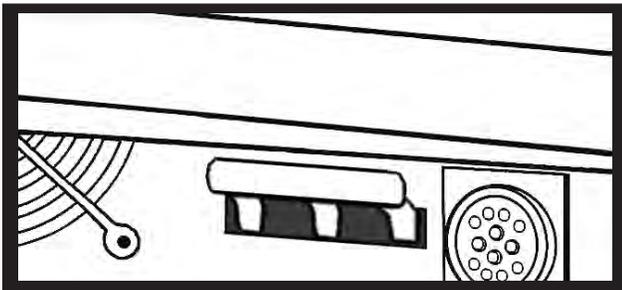


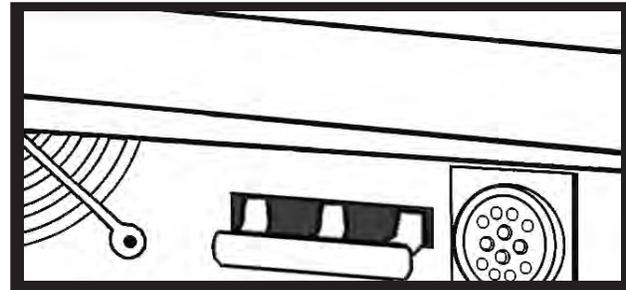
Figure 4-7: 3 Phase Circuit Breaker Location

4.4.1 Operation 208-240 three phase Circuit Breaker

1) Place the “ON/OFF” switch in the “OFF” position.



Circuit Breaker “ON”



Circuit Breaker “OFF”

Figure 4-8: Circuit Breaker Operation

2) Plug the unit into 208-240 three phase AC 50/60 Hz 50.0 amps max power

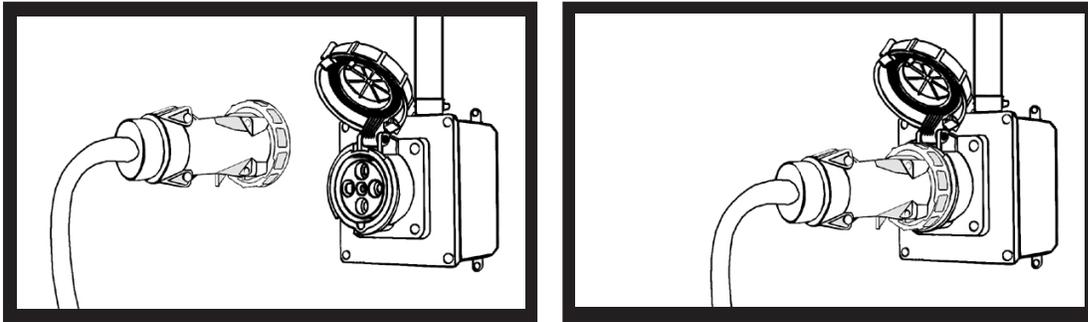
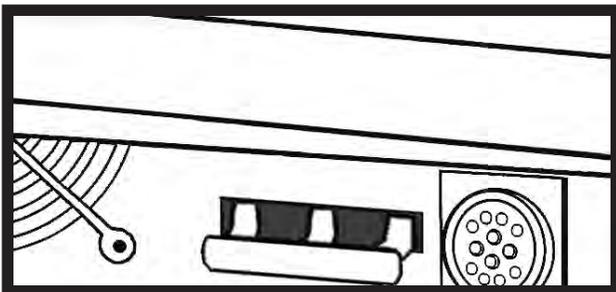
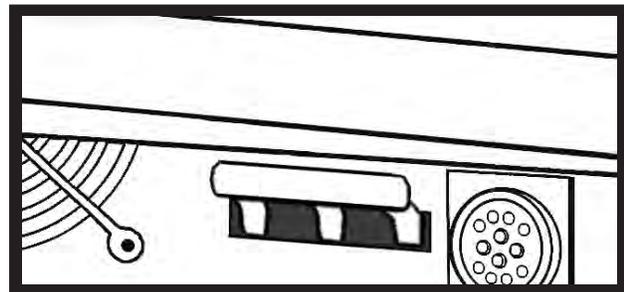


Figure 4-9: Plugging Into AC

3) Place the "ON/OFF" switch to the "ON" position After 2-3 seconds, the led bar graph should light and the fans should begin to operate.



Circuit Breaker "OFF"



Circuit Breaker "ON"

Figure 4-10: Circuit Breaker Operation

4) If the fans and led bar graph do not operate, check the AC outlet for power

NOTE

If a breaker trips:

1) Disconnect unit from AC input and DC output. Wait 60 Seconds.

2) Switch breaker to ON position.

3) Reconnect unit and it will automatically power up.

If breaker continues to trip return unit to manufacturer for repair.

4.5 400HZ AC INPUT

The TI5400GHMD comes equipped with an additional 200Y115 three phase VAC 400 Hz 50 amps max input located above the front faceplate. This input receives a 200 Y115 three phase VAC 400 Hz 50 amps max plug (See figure: 4-11) The TI5400GHMD does not come equipped with a 400 Hz plug or cable.

CAUTION

The 200 Y115 three phase VAC 400 Hz 50 amps max input can only be connected to 200 Y115 three phase VAC 400 Hz 50 amps max power. Any other type of AC power may cause damage to the unit.

WARNING



FIRE/EXPLOSION HAZARD POTENTIAL



Severe injury, or death, from fire or explosion is possible if electrical sparks are produced near fuel vapors. To prevent this, make sure electrical outlets are switched to “OFF” position before connecting electrical plugs. For added safety, users should not operate this unit within 20 feet of fueling.

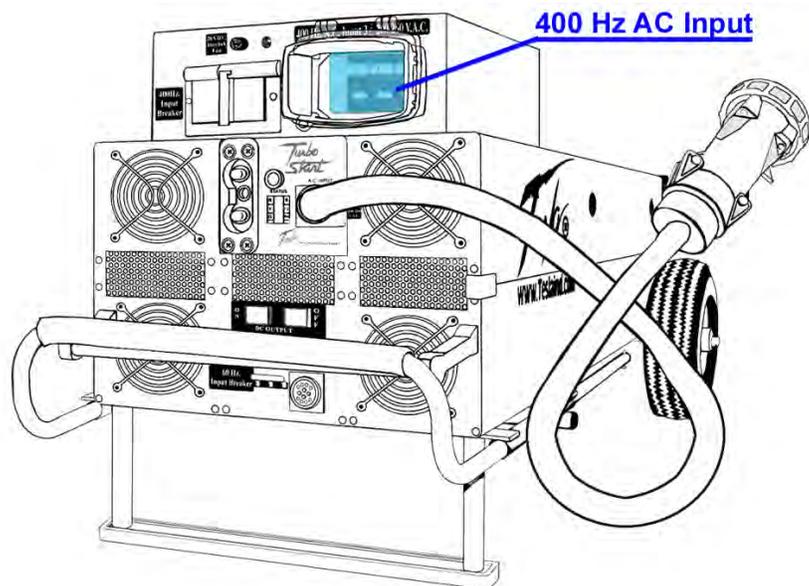


Figure 4-11: 400 Hz AC Input Location

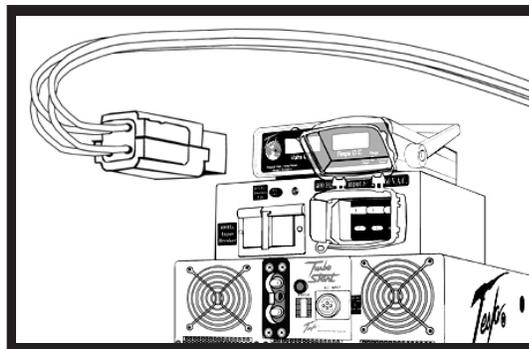


Figure 4-12: 400 Hz Plug

4.6 400HZ AC INPUT CIRCUIT BREAKER

The 200 Y115 three phase VAC 400 Hz 50 amps max input has a circuit breaker switch that is used as an “ON/OFF” switch. The circuit breaker is located to the left of the 400 Hz input.

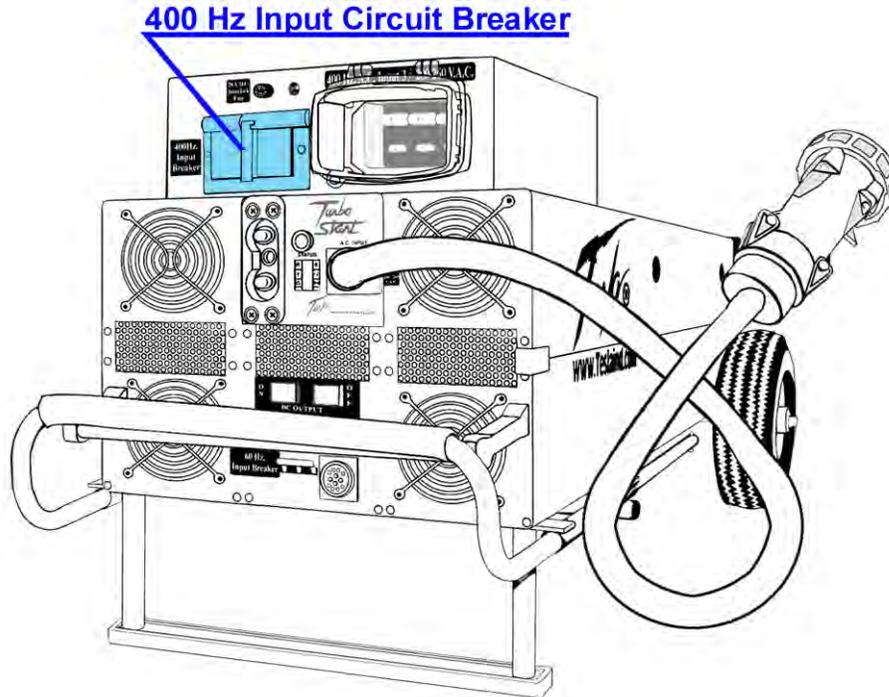
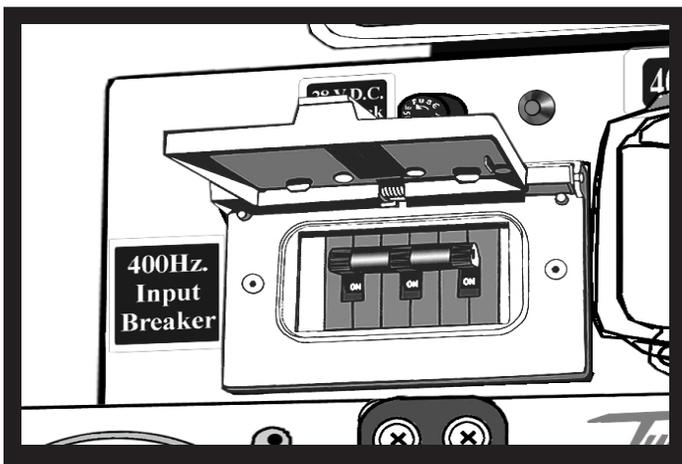


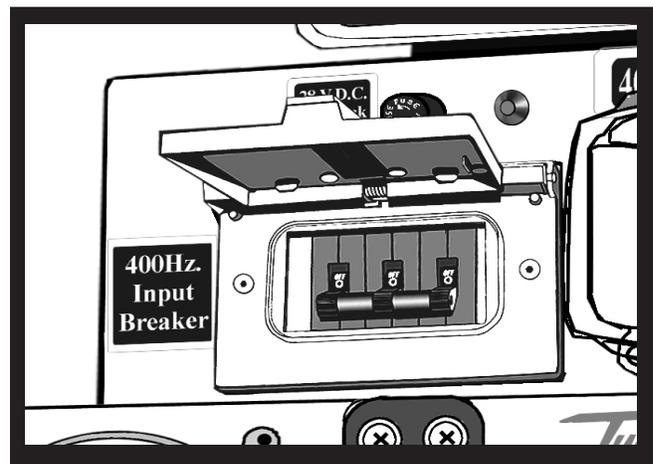
Figure 4-13: 400 Hz AC Circuit Breaker Location

4.6.1 Operation 200 Y115 VAC 400Hz Circuit Breaker

1) Place the “ON/OFF” switch in the “OFF” position.



Circuit Breaker “ON”



Circuit Breaker “OFF”

Figure 4-14: Circuit Breaker Operation

2) Plug the unit into 200Y115 three phase VAC 400 Hz 50 amps max power.

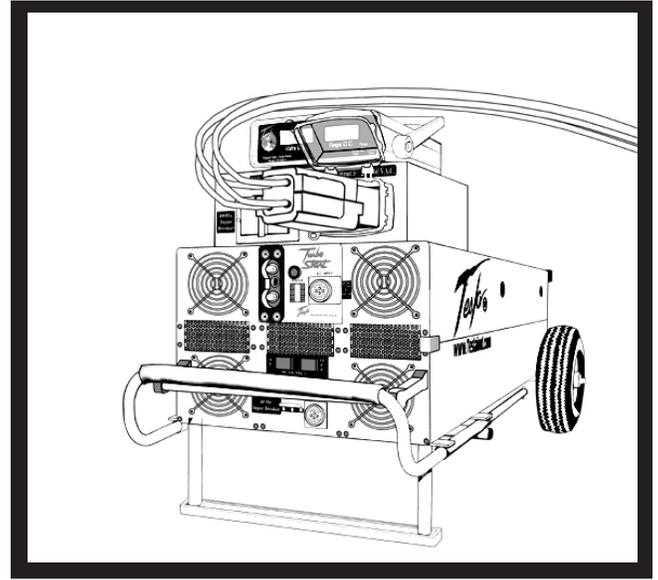
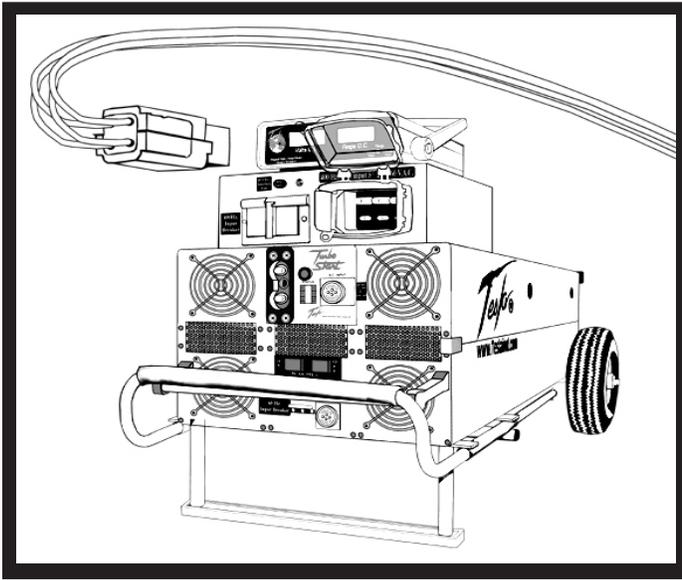
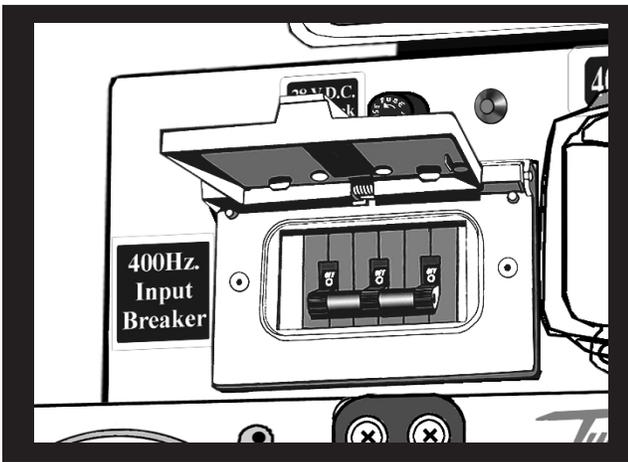
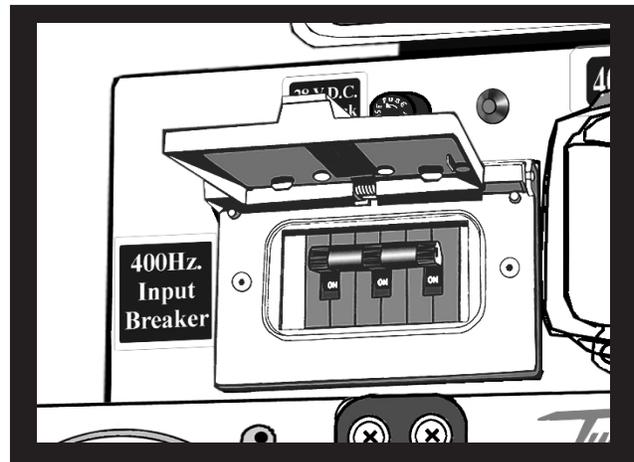


Figure 4-15: Plugging Into AC

3) Place the "ON/OFF" switch to the "ON" position. After 2-3 seconds, the led bar graph should light and the fans should begin to operate.



Circuit Breaker "OFF"



Circuit Breaker "ON"

Figure 4-16: Circuit Breaker Operation

4) If the fans and led bar graph do not operate, check the AC outlet for power

NOTE

If a breaker trips:

1) Disconnect unit from AC input and DC output. Wait 60 Seconds.

2) Switch breaker to ON position.

3) Reconnect unit and it will automatically power up.

If breaker continues to trip return unit to manufacturer for repair.

4.7 INTERLOCK FUSE AND INDICATOR LIGHT

Many 400 Hz generators have a 28 volt interlock. The TI5400HMD is equipped with an interlock fuse as a safety measure in the event of a shortage in the 400 Hz cable. It is also equipped with a red light that indicates whether or not an interlock signal is present. Both devices are located directly above the 400 Hz input circuit breaker

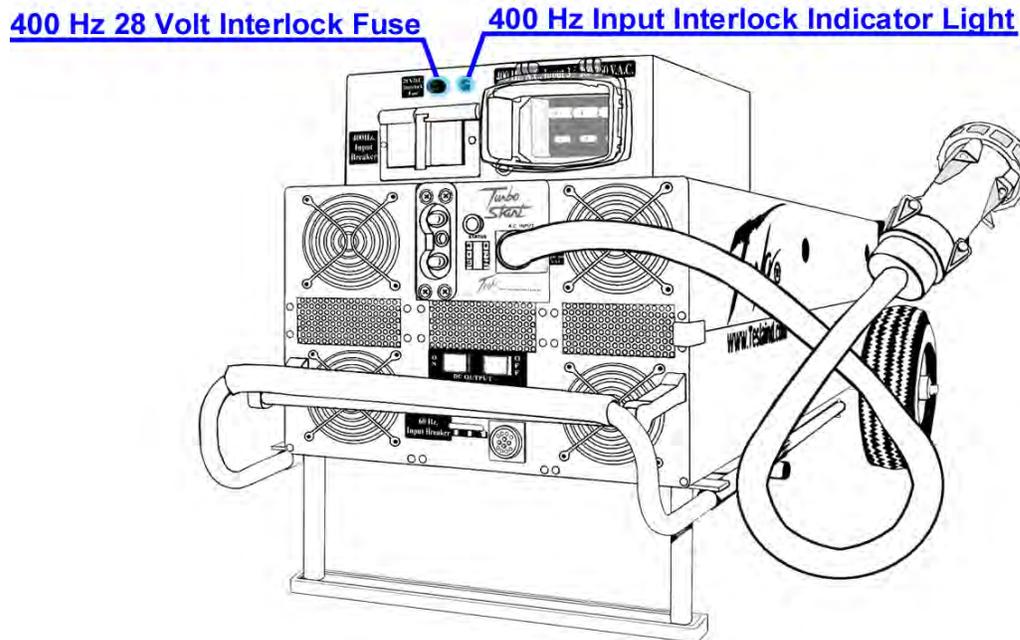


Figure 4-17: Interlock Fuse and light Locations

4.8 "PUSH TO TEST" BUTTON AND LED STATUS INDICATOR

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

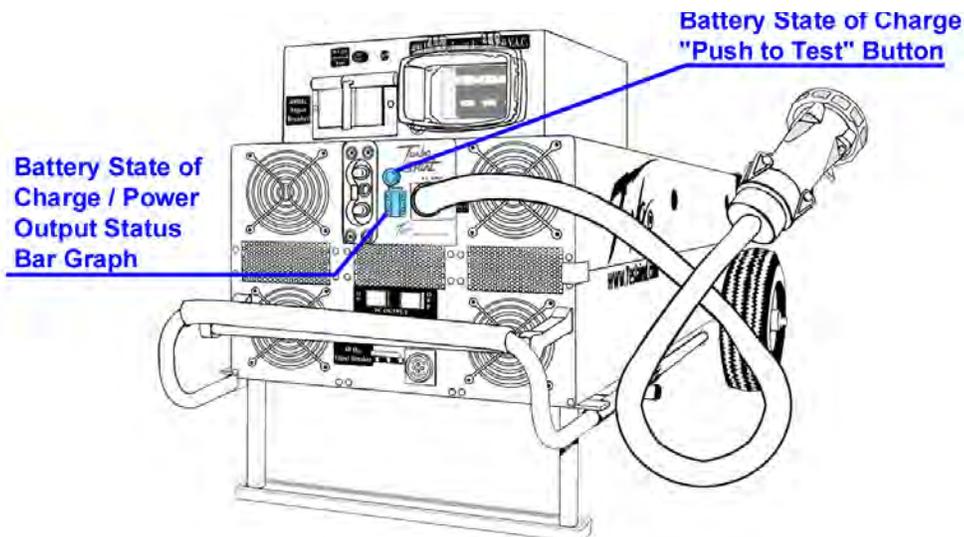


Figure 4-18: Status and "Push to test" Button Locations

4.8.1 Operation

1) Before you depress the “Push to Test” button, make sure you wait at least two minutes ~~for~~ AC power is applied, or DC power is extracted from the unit. This will ensure a correct reading. Never depress the “Push to Test” button while the unit is plugged into AC power for recharge, or plugged into aircraft for DC power output.

2) Without AC power input or DC power output, simply depress the “Push to Test” button on the face plate and hold for approximately 2 to 3 seconds. (See figure: 4-19) Never depress the “Push to Test” button for more than 5 seconds. This may cause a temperature sensor to temporarily disrupt the “Push to Test” function. (If this sensor is tripped, allow ten minutes for unit to cool before operating “Push to Test” button.)



Figure 4-19: Pressing “Push to Test” Button

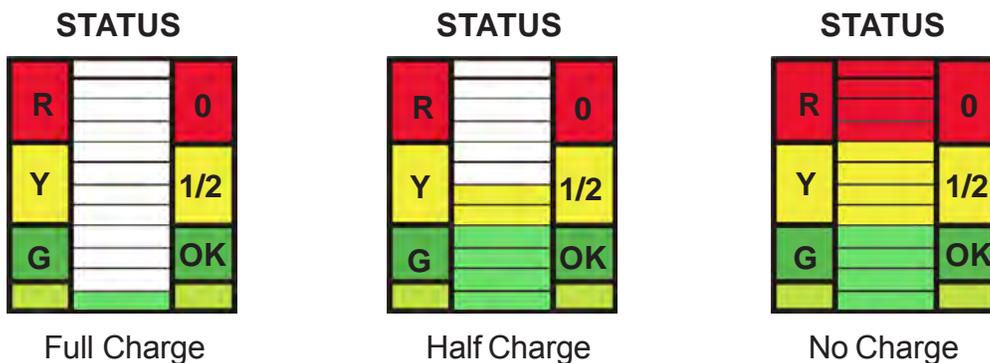


Figure 4-20: Reading Status Bar

3) 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 depressing the button and check for any obstructions to the fan.

4.9 DC OUTPUT

The DC output is an aviation battery style connection. The DC Plug (See figure: 4-22) connects to the DC receptacle with a threaded insert that is turned clockwise to connect.

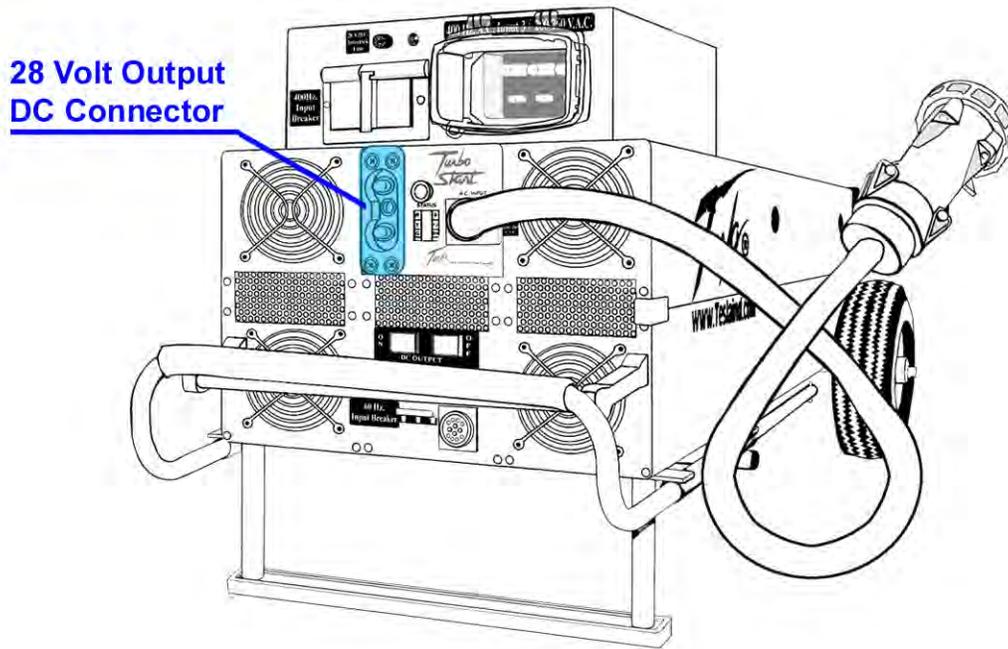


Figure 4-21: DC Output Location

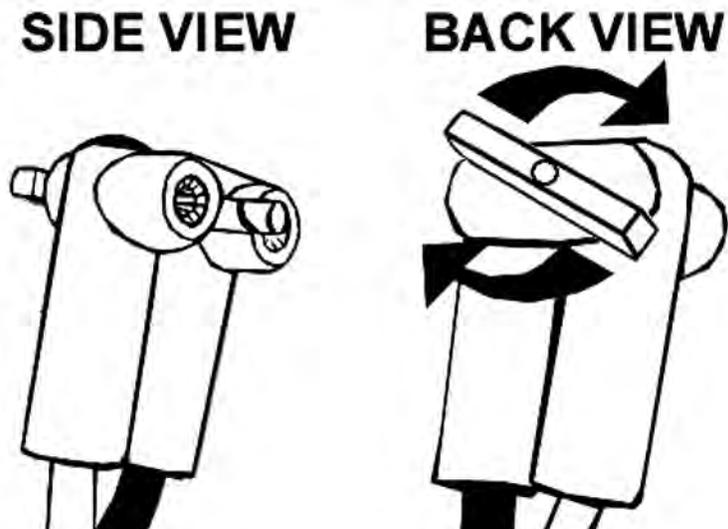


Figure 4-22: DC plug

4.10 DC CABLE

The DC cable supplied with this unit is 25 feet long. It features a DC plug on one end and Tesla DC aviation connector on the other end.



Figure 4-23: DC Cable Assembly

4.11 DC ON/OFF BUTTONS

Underneath the DC output receptacle are the DC output “ON” and “OFF” switches. To prevent arcing while connecting or disconnecting DC power plugs from aircraft, press the “OFF” button, then connect or disconnect the DC power. When you are ready to supply DC Power, press the “ON” button.

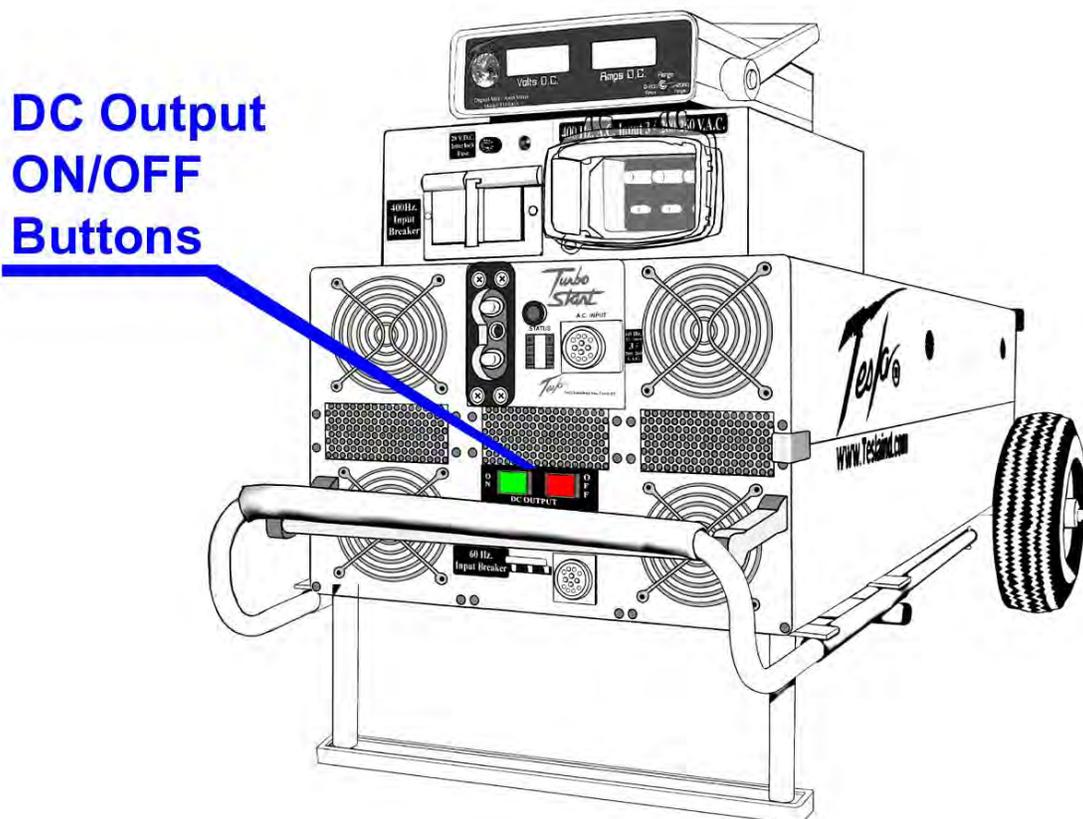


Figure 4-24: DC Output “ON/OFF” Button Location

4.12 TELESCOPIC HANDLE

The TI5400GHMD unit has a telescopic handle that makes it easy to roll or push the unit. 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. (Please refer to chapter 9 for optional accessories).

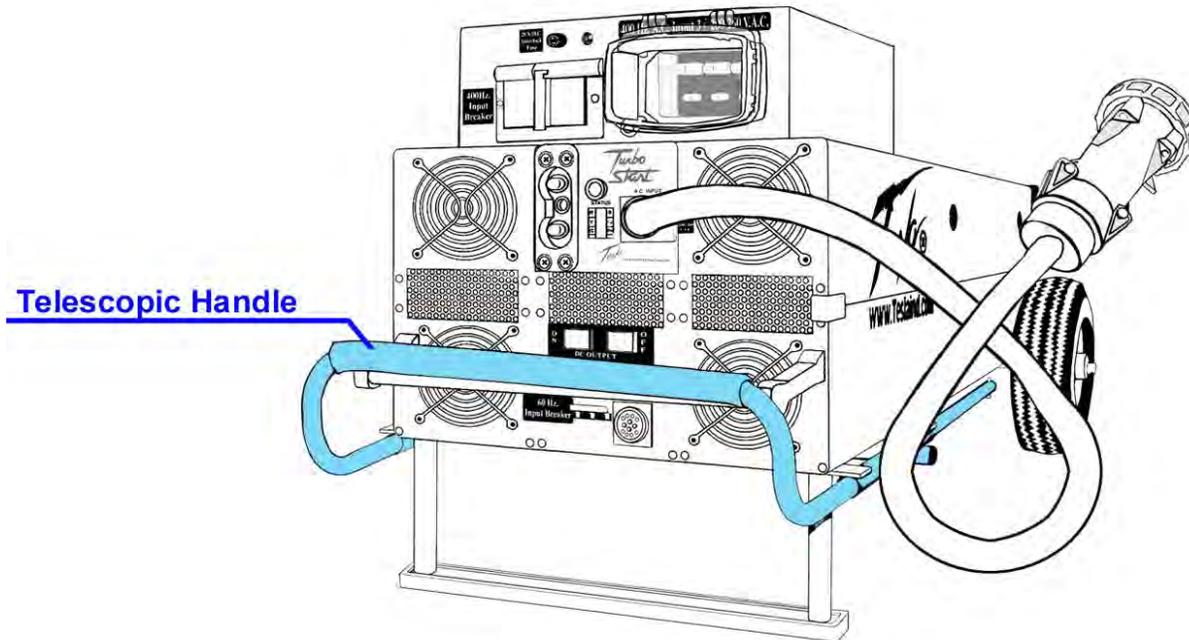


Figure 4-25: Telescopic Handle Location

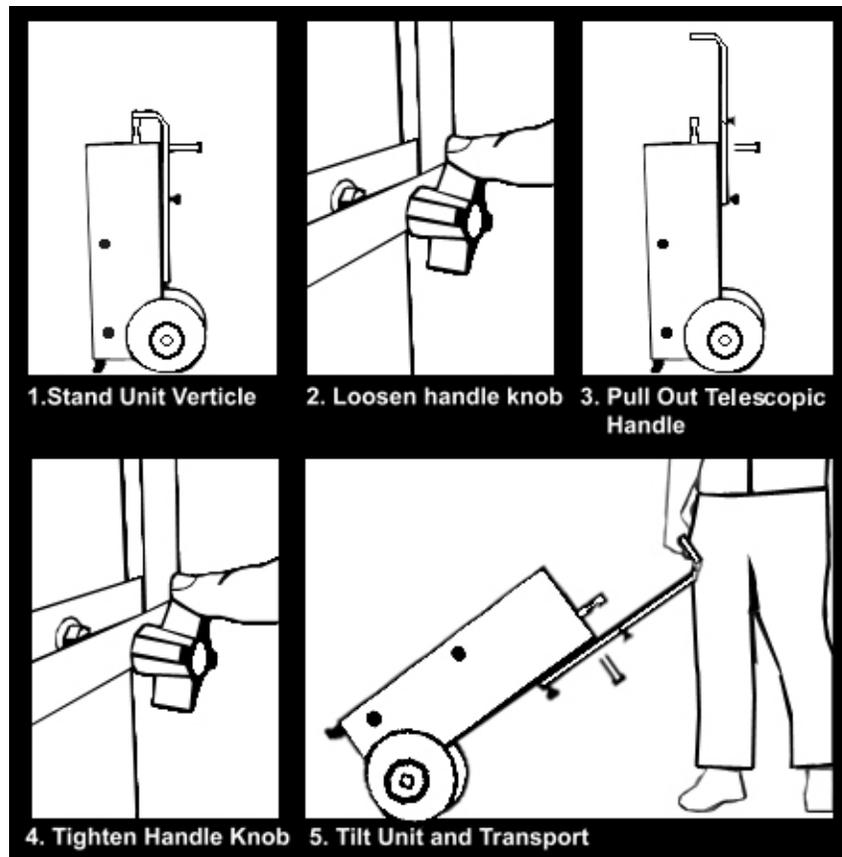


Figure 4-26: Operating Telescopic Handle

4.13 DIGITAL VOLT AMP METER PLUG (DVAM)

The Tesla Digital Volt Amp Meter plug is located on the front panel to the right of the 50/60 Hz three phase circuit breaker. It is used for attaching a Tesla Digital Volt Amp meter to the TI5400GHMD.

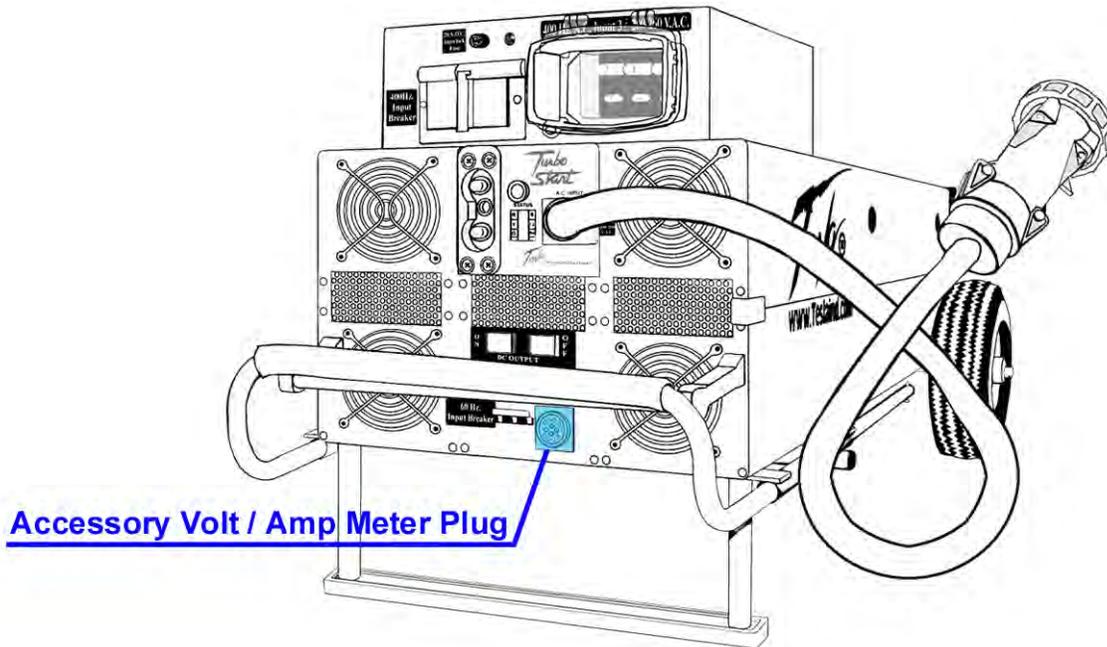


Figure 4-27: DVAM Plug Location

4.14 DIGITAL VOLT AMP METER

The Tesla Digital Volt Amp Meter is a high DC Power Measuring Solution. The DVAM 3100A provides measurements for all voltage ranges and amperage draws between zero and 2,000. The DVAM 3100A indicates the aircraft or vehicle's current demand. Integrated with the Tesla Turbo Start GPU power supply, the DVAM is a valuable tool for troubleshooting and conducting systems checks. (For operating instructions see paragraph: 6.9)

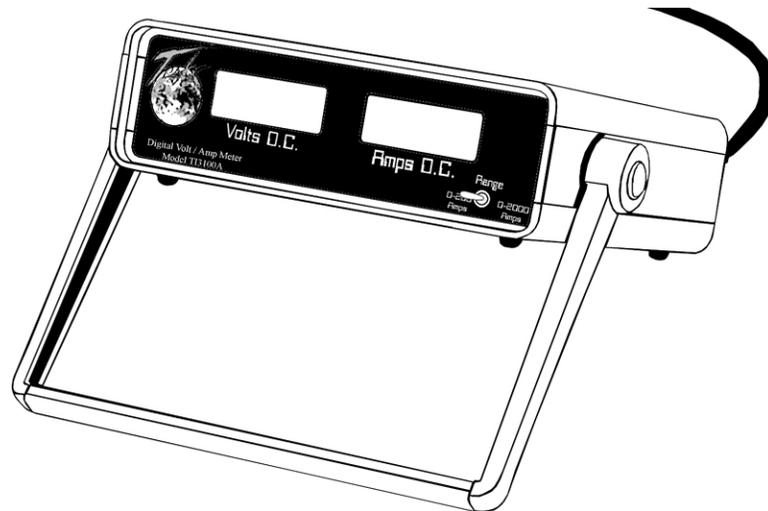


Figure 4-28: Digital Volt Amp Meter
4-14

CHAPTER 5 PRE-OPERATION

5.1. INTRODUCTION TO PRE-OPERATING PROCEDURES

This section includes all steps necessary to ensure safe and efficient pre-operation of the 5400GHMD.

NOTE

When the TURBO START 5400GHMD is not in use, it should *always* remain plugged into a suitable AC power source to ensure operational readiness at all times.

5.2 CHARGING UNIT

Before operating the TI5400GHMD the unit must be fully charged. The TI5400GHMD must be plugged into **208 to 240 three phase VAC at 50/60 Hz 50 amps max or 200 Y115 three phase VAC 400 Hz 50 amps max, for a minimum of 15 minutes, in order to charge.** The LED status will read half or no charge until the unit is fully charged. 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.

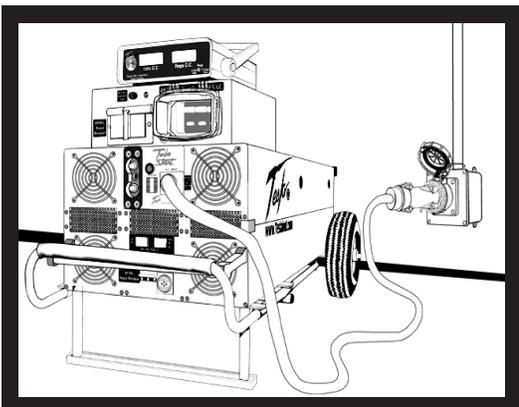
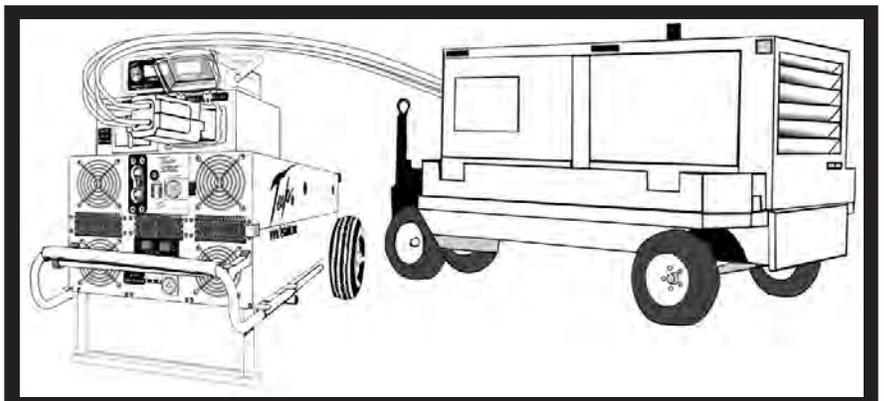


Figure 5-1: Plug in AC Power



5.2.3 If The GPU's Cells Need To Be Replaced

After 15 minutes of AC power input, the unit should be fully charged. Press the “Push Test” button. If the status bar indicates the unit is not fully charged, the cells should be replaced. In the event the cells need to be replaced return the unit to Tesla Industries for maintenance.

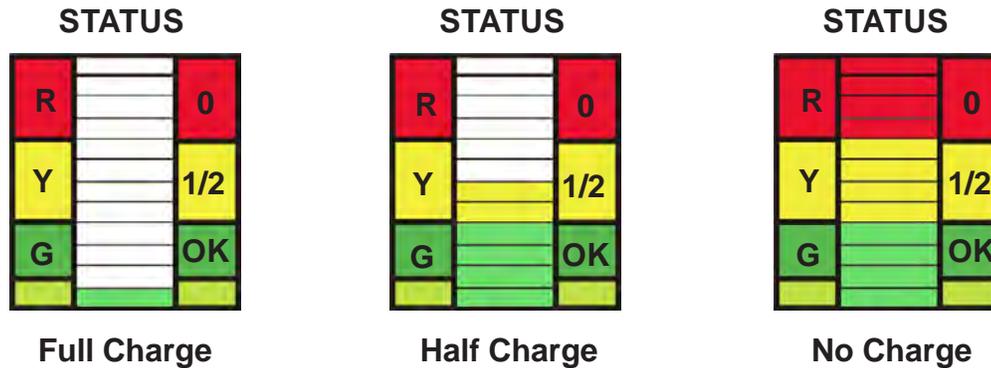


Figure 5-2: Reading Status Bar

5.3 MAINTENANCE CHECK

Before operating the TI5400GHMD check for any signs of damage or wear to the unit, tires, cables and plugs.

5.3.1 Check Unit

Check the unit for dents, punctures, case distortion or misalignment, cracked or loose connectors. If no external damage is evident user may proceed. If damage is evident contact Tesla Industries.



Figure 5-3: Misalignment Case with Bent Face Plate

5.3.2 Check Tires

The TI5400GHMD comes equipped with solid Run-Flat tires. No air is required. However if the tires are damaged they can be easily replaced.

5.3.3 Check DC Power Cable And AC Power Cord For Damage.

Crushed or torn cables will need to be replaced.



Figure 5-4: Damaged Cable

5.3.4 Check DC Power Cable/Connections For Damage.

Check connectors for cracks, cuts, distortions, excessive wear, broken/loose fasteners and cable attachment. Replace contacts or entire plug if necessary



Figure 5-5: Damaged NATO Plug

5.4 TRANSPORT

The TI5400GHMD has a telescopic handle that makes it easy to roll or push. 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.

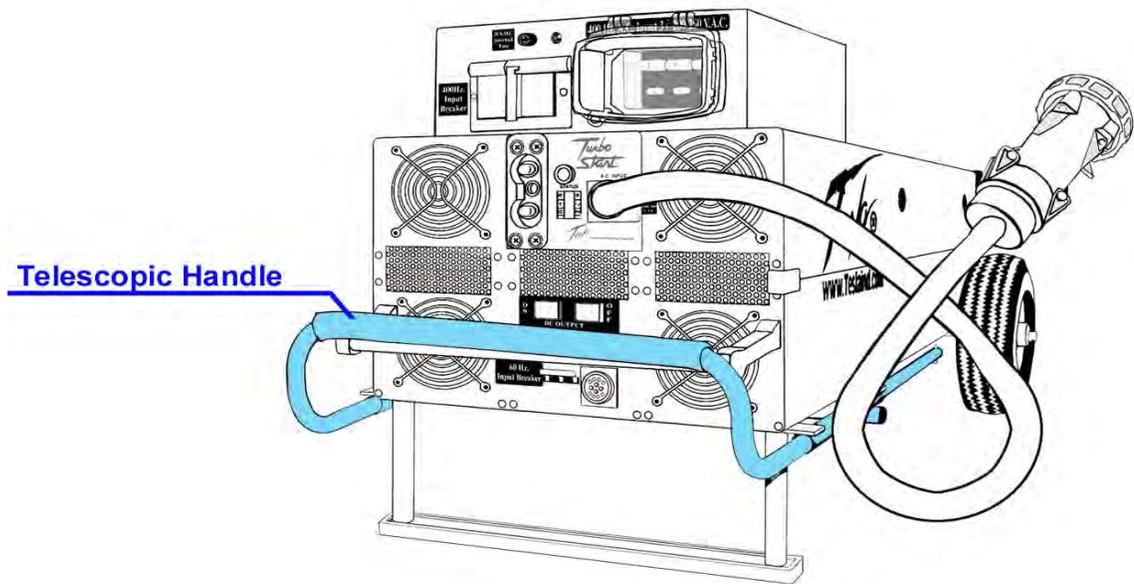


Figure 5-6: Telescopic handle Location

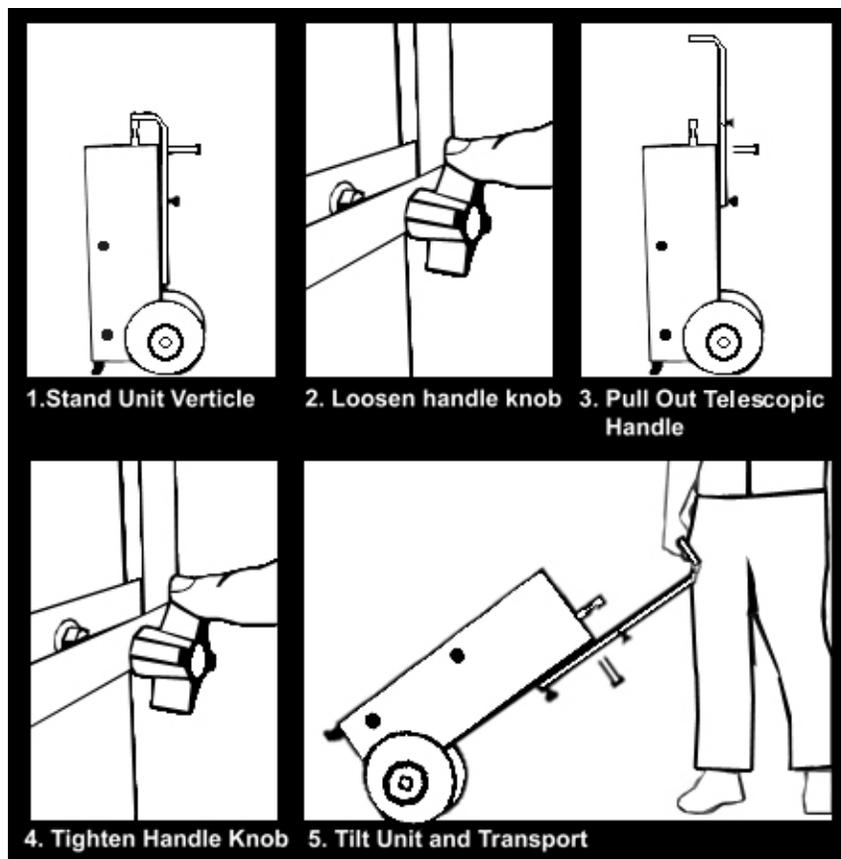


Figure 5-7: Transporting Unit

CHAPTER 6 OPERATION

6.1. INTRODUCTION TO OPERATING PROCEDURES

This section defines the operating procedures, which includes all steps necessary to ensure safe and efficient operation of the TI5400GHMD. As users gain experience with the Turbo Start TI5400GHMD, users will be able to maximize the unit's unique capabilities to enhance the flexibility of aircraft maintenance and support operations.

NOTE

When the TURBO START 5400GHMD is not in use, it should *always* remain plugged into a suitable AC power source to ensure operational readiness at all times.

NOTE

If current demand exceeds 400 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

6.2. ENGINE STARTING POWER

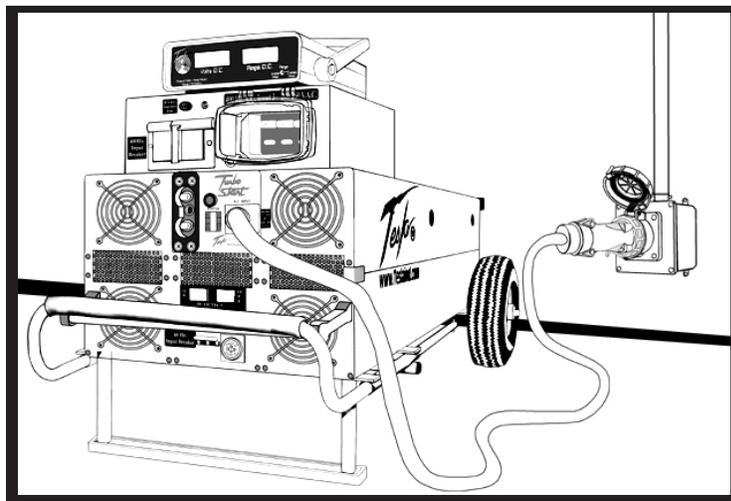


Figure 6-1: Plug in AC Power

Users 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 chart provides minimum starts of charge necessary to provide ample power for an efficient engine start under specific current load demands.

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

NOTE

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

The ambient temperature may cause the unit's protective "over-temperature" sensors to shut down the VAC functions (converter and charger) until the unit cools to normal operating temperatures. If the unit shuts down, move 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 return the unit to Tesla for recalibration for use in these environments.

6.3 GENERAL

Maintenance checks, as defined in Chapter 5, must be performed each time prior to using the unit. Knowledge of the operating limits, restrictions, performance, unit capabilities and functions is fundamental to a correct and safe operation. The user shall ensure compliance with the instructions in this manual that affect operational safety and the warranty of the unit.

6.4 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. All of these limitations are mentioned in chapters three, five and six.

6.5 PERFORMANCE

Refer to Chapter 11 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 VAC power), and aircraft DC bus system inefficiency (voltage drops).

6.6 OPERATING WITHOUT AC POWER CONNECTED

When the system is standing alone without AC power, the output is 24 volts.

6.6.2. Connect DC Power Cable To Unit

The chances of accidental arcing are low, but for added safety, press the DC Output “OFF” button. Ensure power cable connector is fully seated into unit’s DC output receptacle.

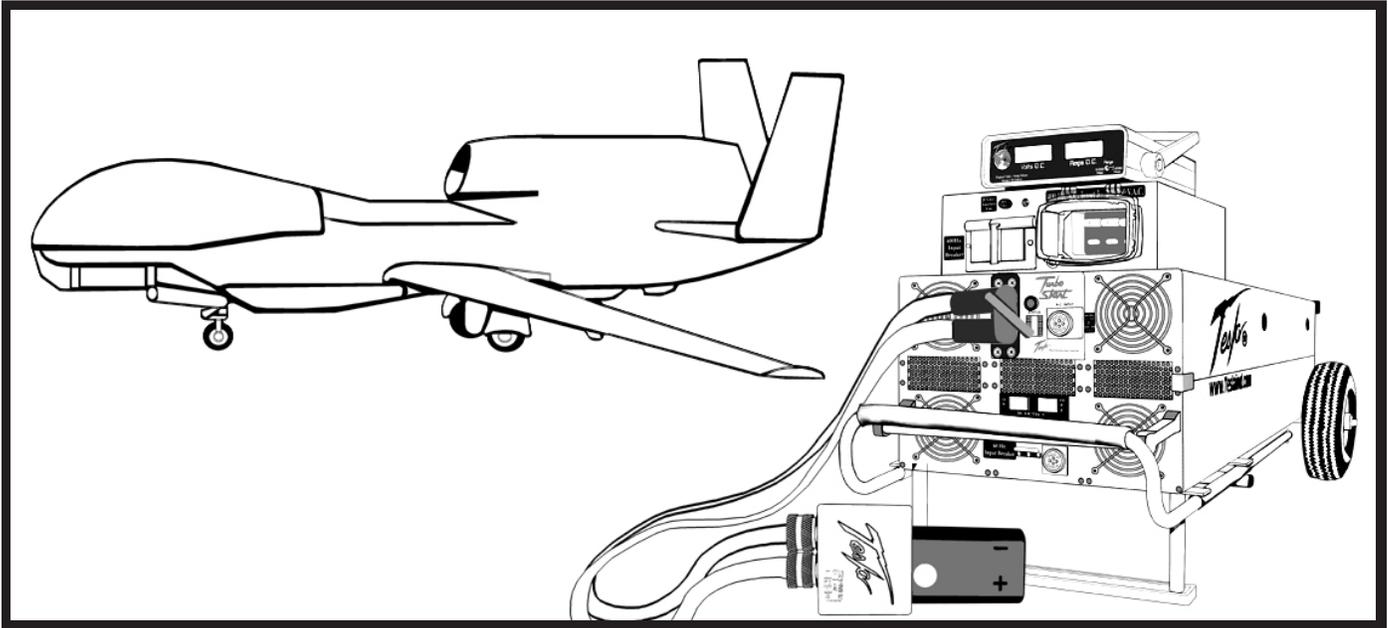


Figure 6-2: Connect DC Cable to Unit

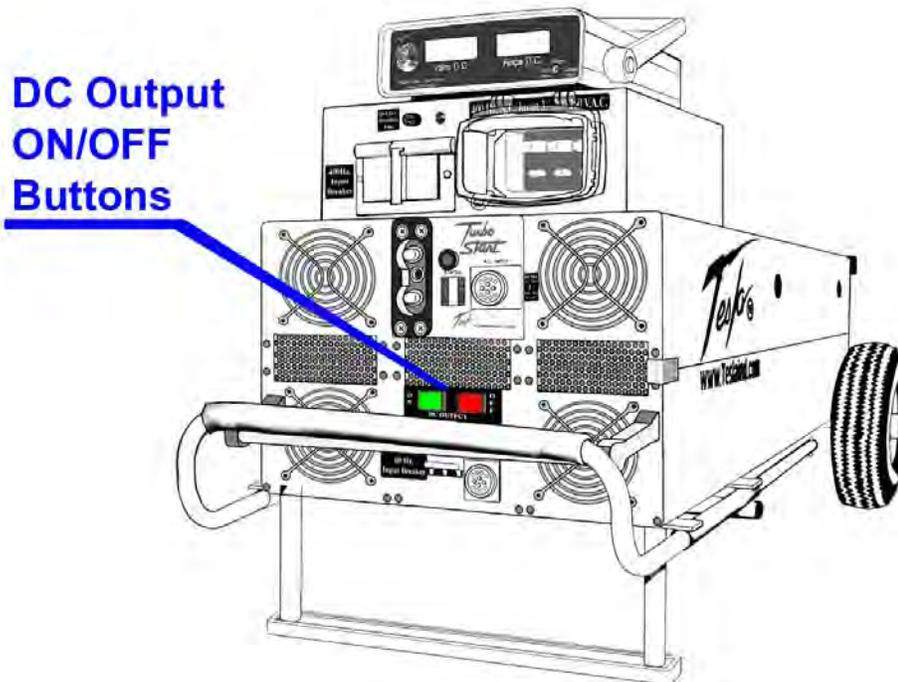


Figure 6-3: DC Output “ON/OFF” Button Location

6.6.3. Connect DC Power To Vehicle

To prevent arcing while connecting DC power to the aircraft press the DC Output “OFF” button, then connect DC power to the vehicle. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When you are ready to supply DC Power press the DC Output “ON” button, the “ON” button will illuminate. DC bus power should come on and the vehicle’s voltmeter should indicate 24 VDC to 23.5 VDC (23 VDC minimum).

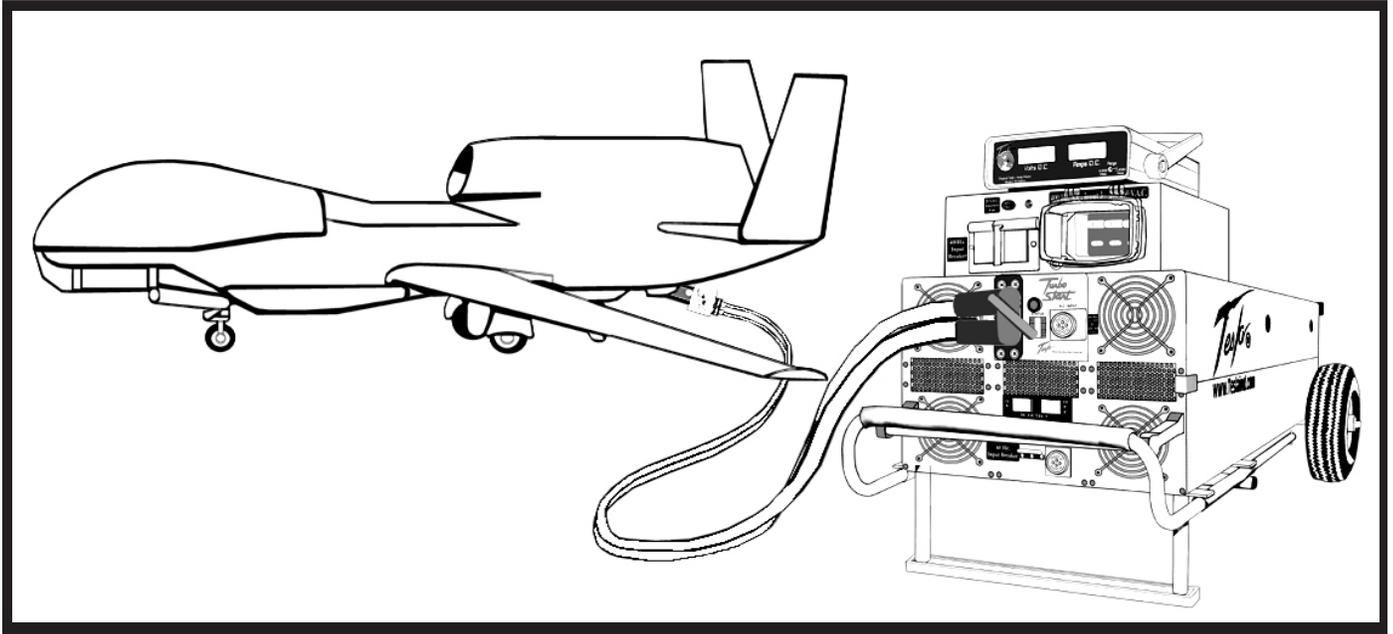


Figure 6-4: Connect DC Cable to Vehicle

6.6.4. Engine Starting

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

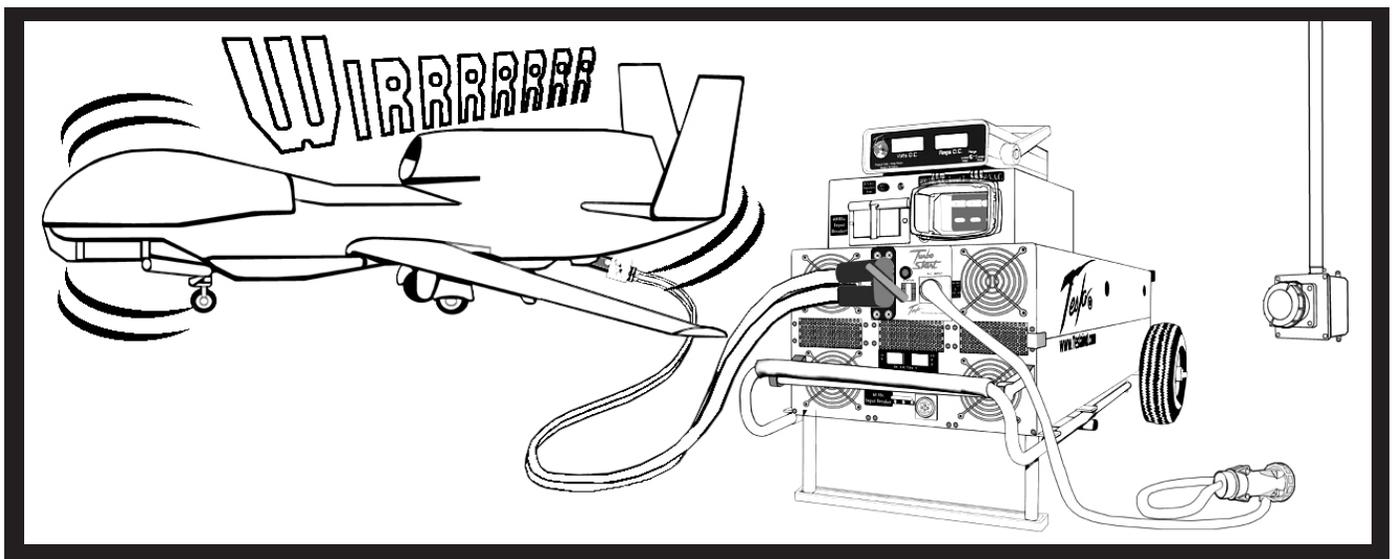


Figure 6-5: Engine Starting

6.6.5. Removing DC Power Supply From Vehicle

To prevent arcing while disconnecting DC power to the aircraft, press the DC Output “OFF” button, then disconnect DC power.

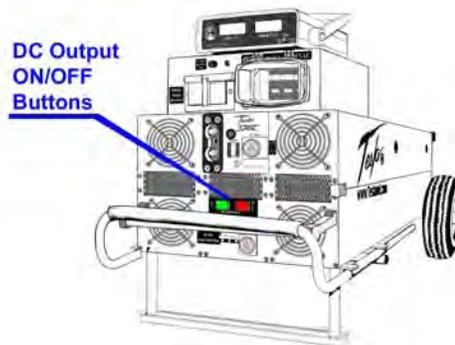


Figure 6-6: DC Output ON/OFF Button Location

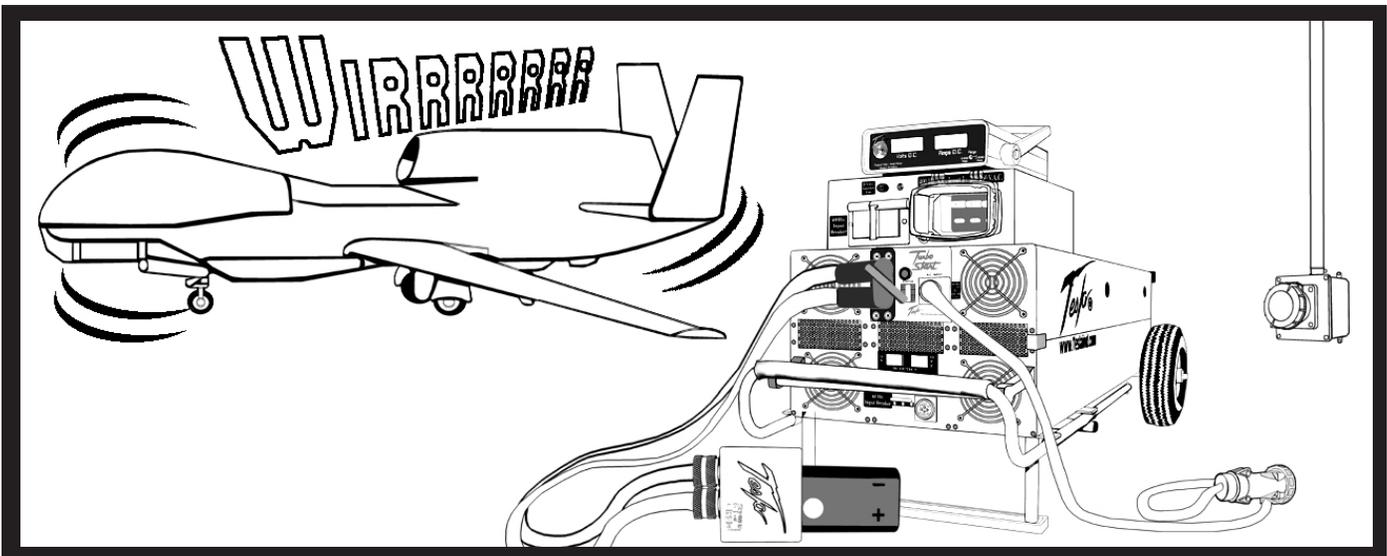


Figure 6-7: Remove DC Cable from Vehicle

6.7. OPERATING PLUGGED IN WITH 60 HZ 3Ø VAC

When the system is plugged into AC power, the output is 30.5 volts. This voltage allows the system to recondition and recharge the vehicle's battery(ies). It is also an optimum voltage for powering avionics and lighting on most aircraft. The system's AC to DC converter produces continuous amps of DC power depending on the size of the system.

6.7.2. Connect AC Power Cord To Power Supply

Place the 208 to 240 three phase VAC at 50/60 Hz 50 amps max circuit breaker in the “OFF” position (See paragraph: 4.4). Plug the unit into 208 to 240 three phase VAC at 50/60 Hz 50 amps max power. Ensure the power cord is properly connected to an approved AC power supply. Place the “ON/OFF” switch to the “ON” position. After 2-3 seconds, the led bar graph should light and the fans should begin to operate. If the fans and led bar graph do not operate, check the AC outlet for power

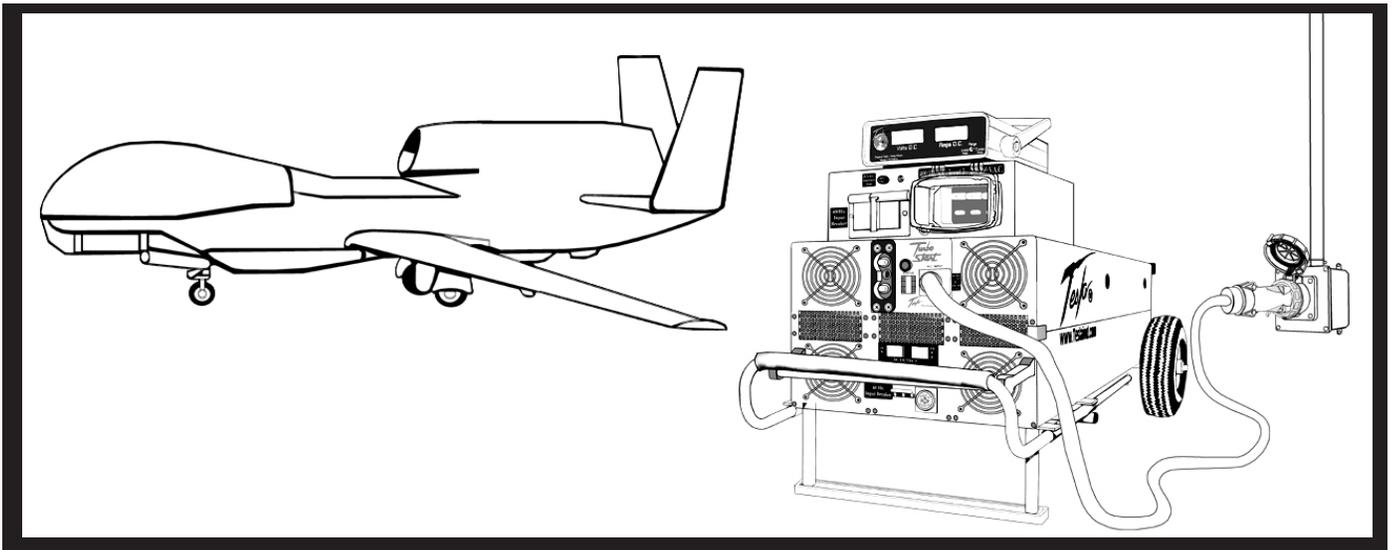


Figure 6-8: Connect AC Cable to Power

6.7.3. Connect DC Power Cable To Unit

The chances of accidental arcing are low, but for added safety press the DC Output “OFF” button. Ensure power cable connector is fully seated into unit’s DC output receptacle.

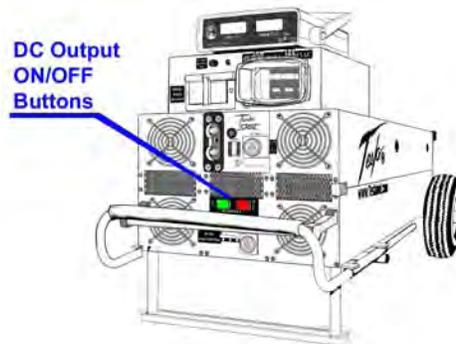


Figure 6-9: DC Output ON/OFF Button Location

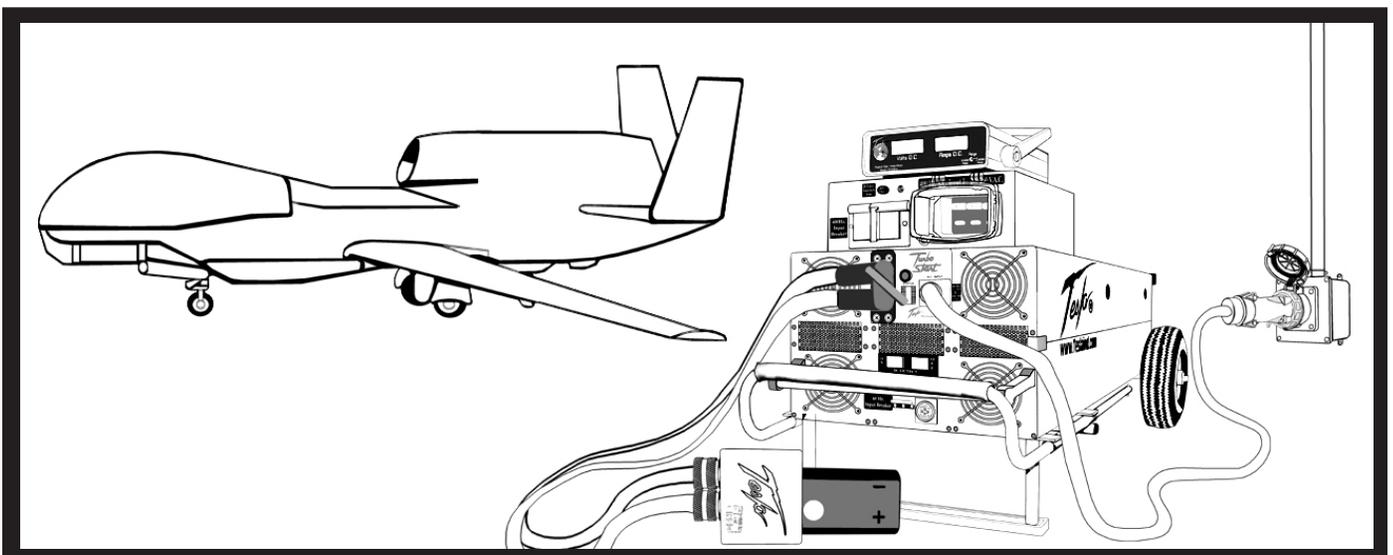


Figure 6-10: Connect DC Cable to Unit

6.7.4. Connect DC Power To Vehicle (Low Power Demand)

Low power demand is defined by a requirement of 400 amps or less. To prevent arcing while connecting DC power to the aircraft, press the DC Output “OFF” button, then connect DC power. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When user’s are ready to supply DC power, press the DC Output “ON” Button. DC bus power should come on and the vehicle’s voltmeter should indicate 28.5 VDC to 27 VDC (26.5 VDC minimum). If vehicle power demand is less than 400 amps, converter output will remain at 30.5 VDC (only one GREEN LED status indicator bar will illuminate). If vehicle power demand exceeds 200 amps, converter voltage output will decrease and two or more LED status indicator bars will illuminate.

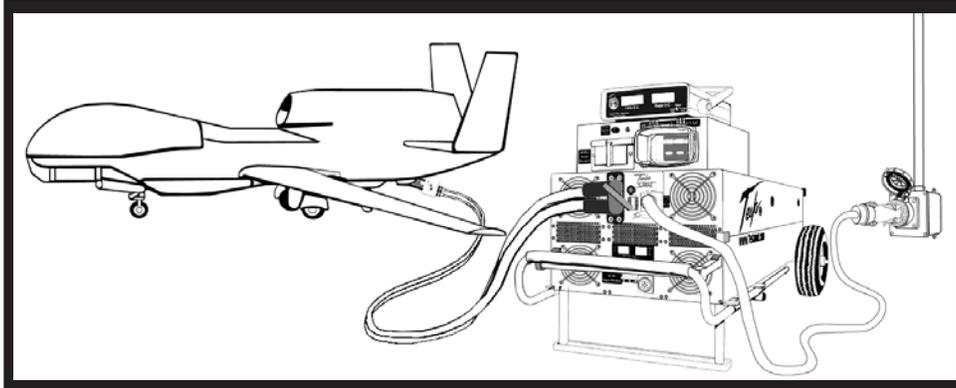


Figure 6-11: Connect DC Cable to Vehicle

6.7.5 Connect DC Power To Vehicle (High Power Demand)

High power demand is defined by a requirement of 401 amps or more. To prevent arcing while connecting DC power to the aircraft, press the DC Output “OFF” button, then connect DC power. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When you are ready to supply DC power, press the DC Output “ON” Button. DC bus power should come on and vehicle voltmeter should indicate 27.5 VDC to 23.5 VDC (23 VDC minimum). If current demand is above 401 amps, converter output voltage will drop below 30.5 VDC and two or more LED status indicator bars will illuminate. If unit output exceeds 401 amps, 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, the converter and power cells are supplying 24 VDC power output for current demands above 401 amps.

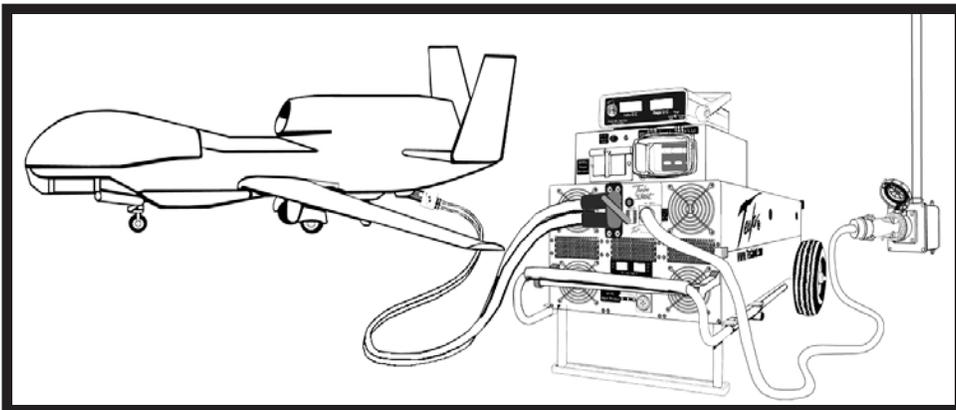


Figure 6-12: Connect DC Cable to Vehicle

6.7.6 Engine Starting

UNPLUG AC POWER CORD BEFORE STARTING ENGINE WITH TURBO START.

Prior to engine start, ensure power cell charge is sufficient to provide an efficient engine start. Switch the 208 to 240 three phase VAC at 50/60 Hz 50 amps max circuit breaker to the “Off” Position, then disconnect AC power.

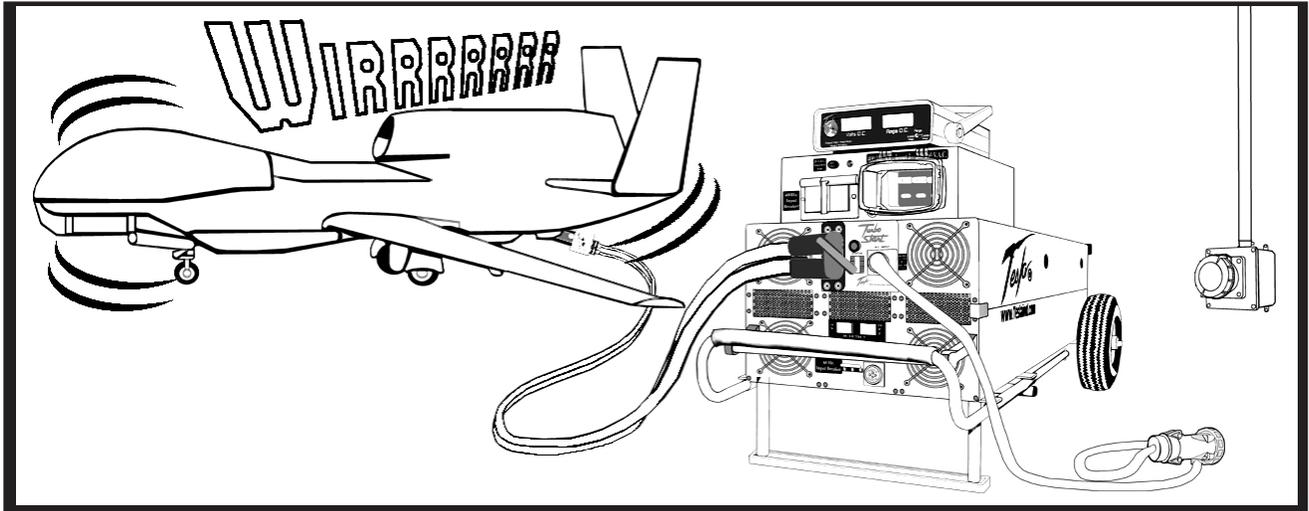


Figure 6-13: Starting Without AC Power

6.7.7 Removing DC Power Supply From Vehicle

To prevent arcing while disconnecting DC power to the aircraft, press the DC Output “OFF” button, then disconnect DC power

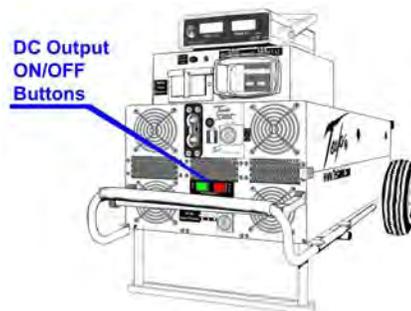


Figure 6-14: DC Output “ON/OFF” Button Location

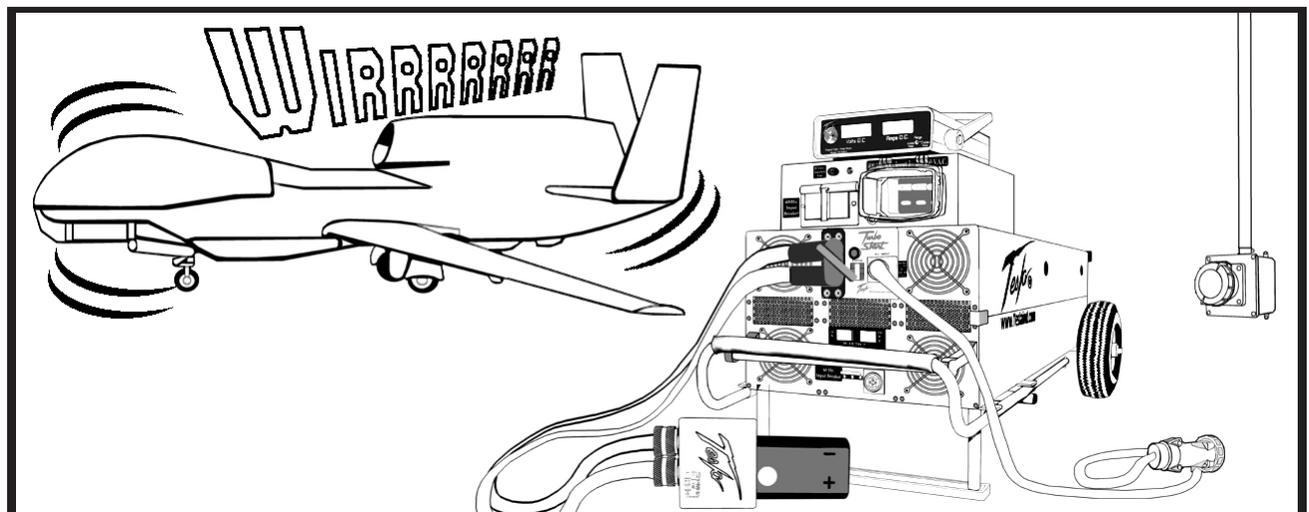


Figure 6-15: Remove DC Cable from Vehicle

6.8 OPERATING WITH 200 Y115 3Ø VAC 400 HZ AC

When the system is plugged into AC power, the output is 30.5 volts. This voltage allows the system to recondition and recharge the vehicle's battery(ies). It is also an optimum voltage for powering avionics and lighting on most aircraft. The system's AC to DC converter produces continuous amps of DC power depending on the size of the system.

6.8.1 Connect AC Power Cord To Power Supply

Place the 200 Y115 three phase VAC 400 Hz 50 amps max circuit breaker in the "OFF" position (see paragraph 4.6). Plug the unit into 200Y 115 three phase VAC 400 Hz 50 amps max power. Ensure the power cord is properly connected to an approved AC power supply. Place the "ON/OFF" switch to the "ON" position. After 2-3 seconds, the led bar graph should light and the fans should begin to operate. If the fans and led bar graph do not operate, check the AC outlet for power.

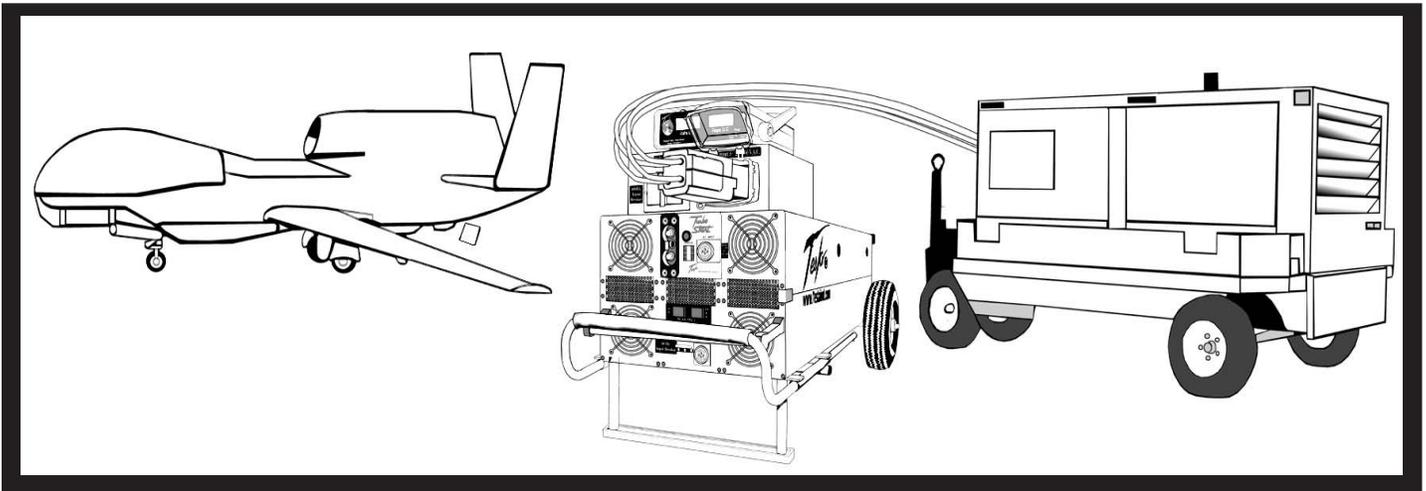


Figure 6-16: Connect AC Power

6.8.3 Connect DC Power Cable To Unit

The chances of accidental arcing are low, but for added safety press the DC Output "OFF" button. Ensure power cable connector is fully seated into unit's DC output receptacle.

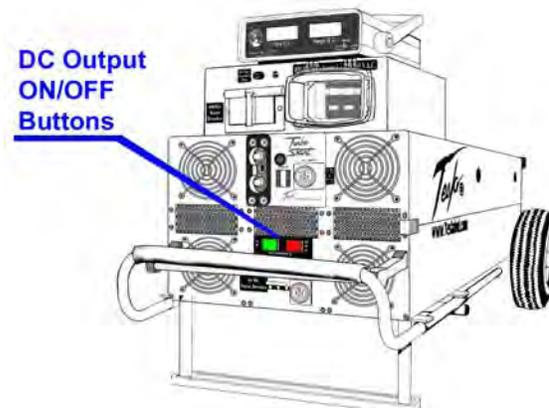


Figure 6-17: DC Output ON/OFF Button Location

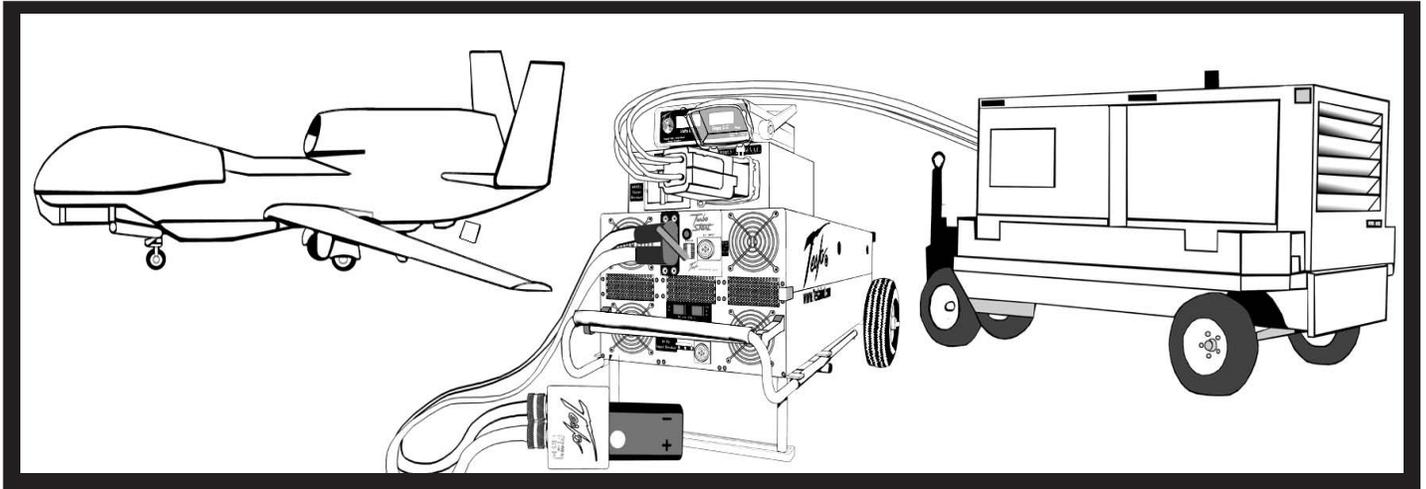


Figure 6-18: Connect DC Cable to Unit

6.8.4 Connect DC Power To Vehicle (Low Power Demand)

Low power demand is defined by a requirement of 400 amps or less. To prevent arcing while connecting DC power to the aircraft, press the DC Output “OFF” button, then connect DC power. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When you are ready to supply DC Power, press the DC Output “ON” Button. DC bus power should come on and the vehicle’s voltmeter should indicate 28.5 VDC to 27 VDC (26.5 VDC minimum). If vehicle power demand is less than 400 amps, converter output will remain at 30.5 VDC (only one GREEN LED status indicator bar will illuminate). If unit output exceeds 401 amps, converter voltage output will decrease and two or more LED status indicator bars will illuminate.

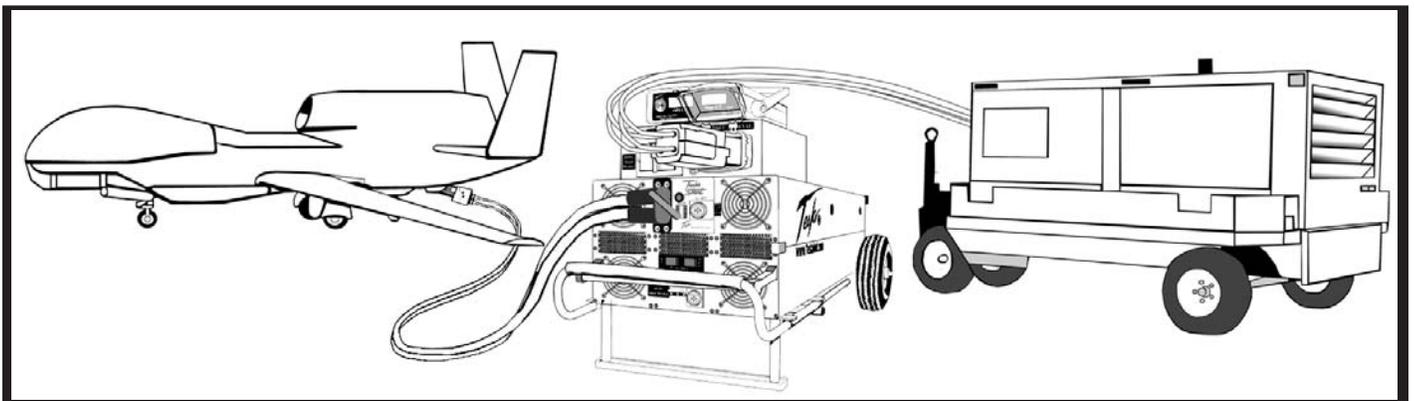


Figure 6-19: Connect DC Cable to Vehicle

6.8.5 Connect DC Power To Vehicle (High Power Demand)

High power demand is defined by a requirement of 401 amps or more. To prevent arcing while connecting DC power to the aircraft, press the DC Output “OFF” button, then connect DC power. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When you are ready to supply DC power, press the DC Output “ON” Button. DC bus power should come on and vehicle voltmeter should indicate 27.5 VDC to 23.5 VDC (23 VDC minimum). If current demand is above 401 amps, converter output voltage will drop below 30.

NOTE

When all LED status indicator bars illuminate, the converter and power cells are supplying 24 VDC power output for current demands above 401 amps.

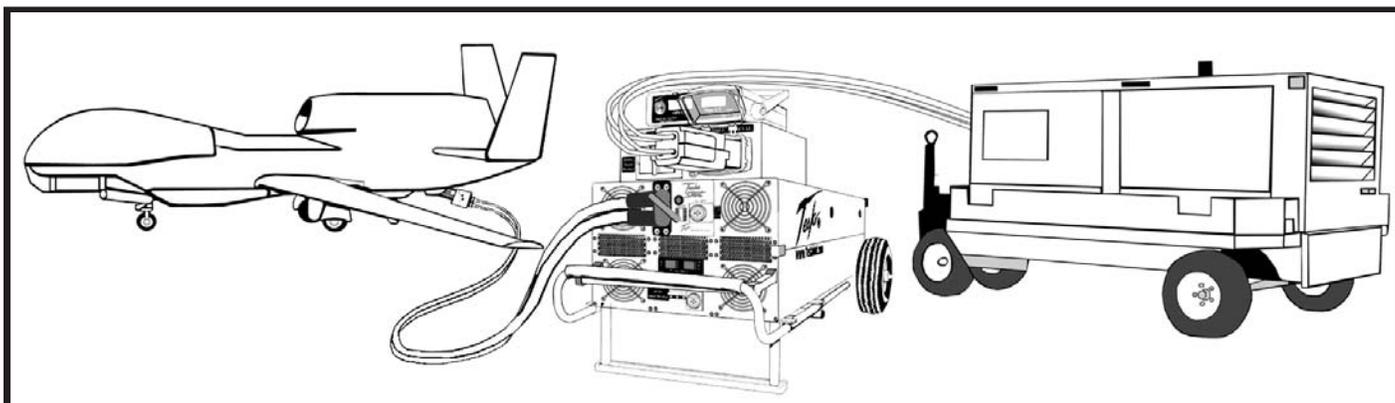


Figure 6-20: Connect DC Cable to Vehicle

6.8.6 Engine Starting

UNPLUG AC POWER CORD BEFORE STARTING ENGINE WITH TURBO START.

Prior to engine start, ensure power cell charge is sufficient to provide an efficient engine start. Switch the 200 Y115 three phase VAC 400 Hz 50 amps max circuit breaker to the “OFF” position, then disconnect AC power.

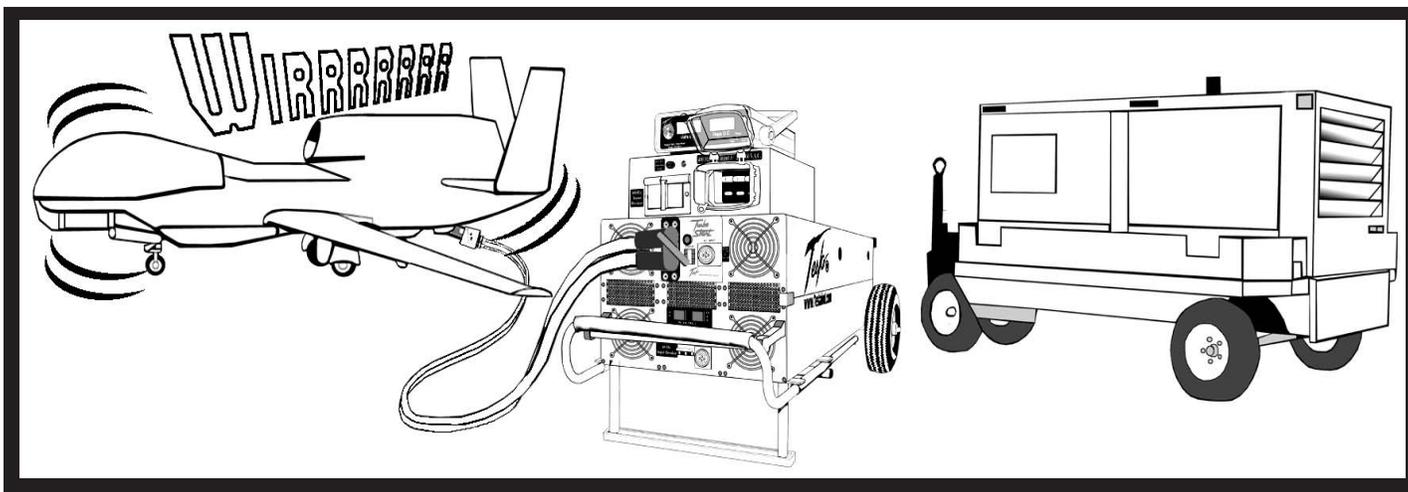


Figure 6-21: Engine Starting Without AC Power

6.8.7 Removing DC Power Supply From Vehicle

To prevent arcing while disconnecting DC power to the aircraft, first press the DC Output “OFF” button, then disconnect DC power

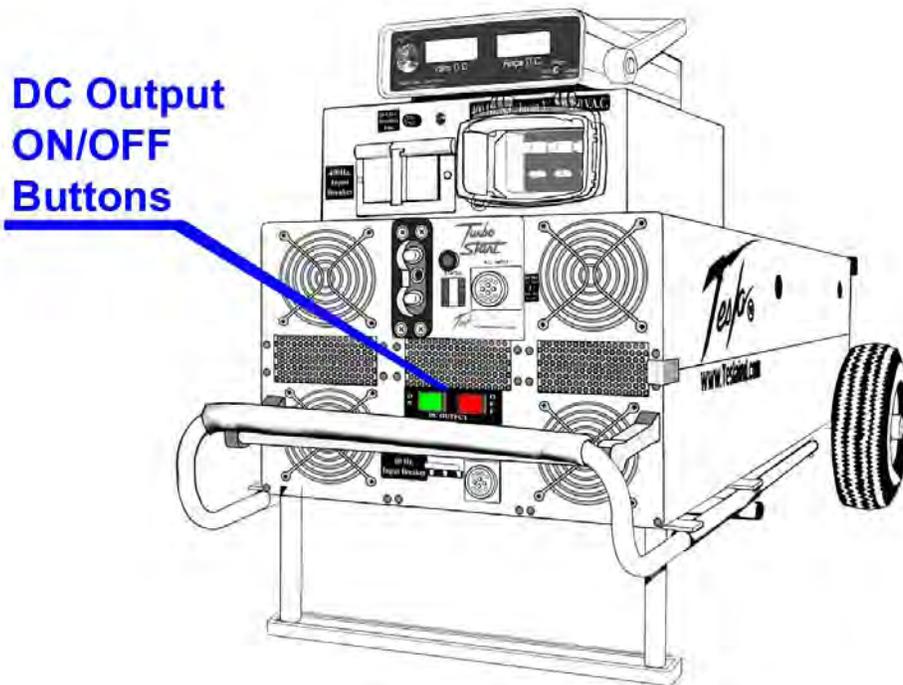


Figure 4-22: DC Output “ON/OFF” Button Location

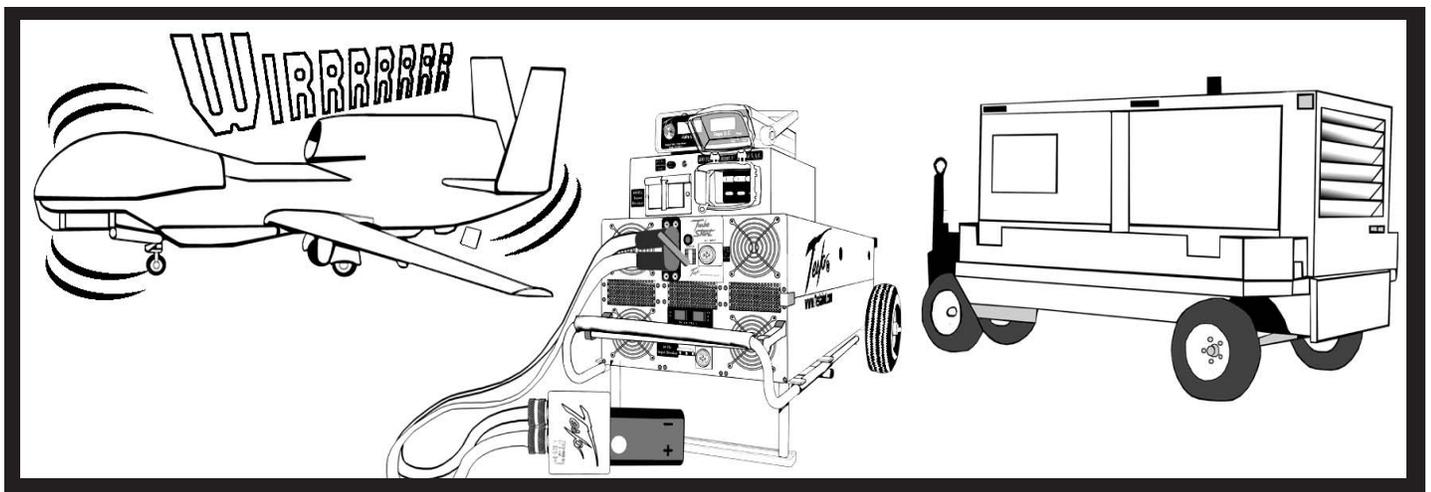


Figure 6-23: Remove DC Cable from Vehicle

6.9 USING A TURBO START WITH A DIGITAL VOLT / AMP METER

The High DC Power Measuring Solution. The DVAM 3100A provides measurements for all voltage ranges and amperage draws between zero and 2,000. The DVAM 3100A indicates the aircraft or vehicle's current demand. Integrated with the Tesla Turbo Start GPU power supply, the DVAM is a valuable tool for troubleshooting and systems checks.

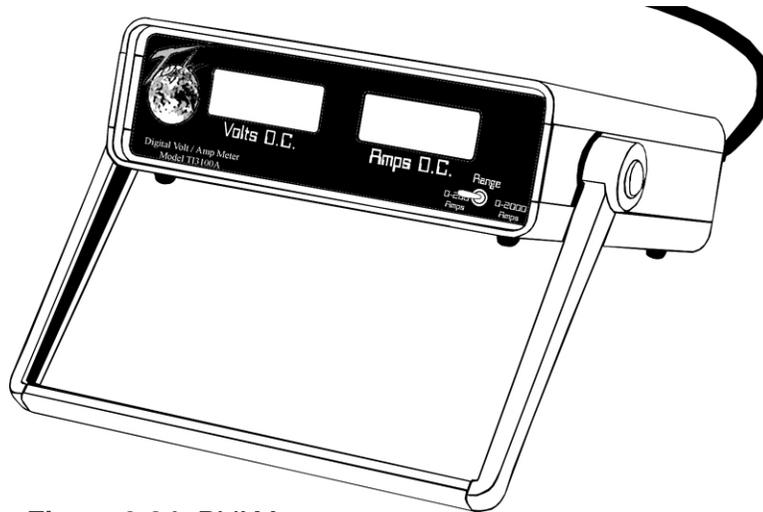


Figure 6-24: DVAM

6.9.1 Features and specifications

The left meter indicates DC voltage output and the right meter indicates amperage draw. The meter's range changes from 0-200 AMPS to 0-2,000 AMPS with the flip of a switch. The 200 amp setting provides a more detailed reading extending to two decimal places. The 2,000 amp setting reads higher currents such as engine starts and inrush currents.

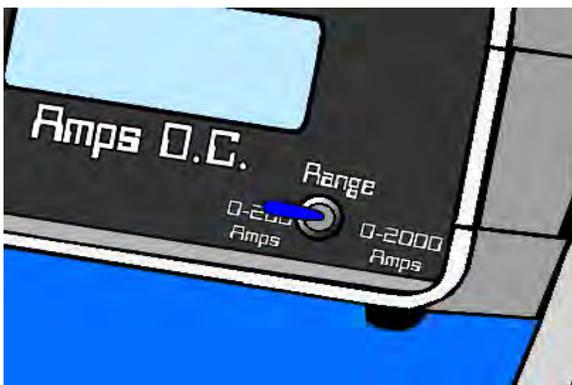


Figure 6-25: DVAM Switched to 0-200 Amps

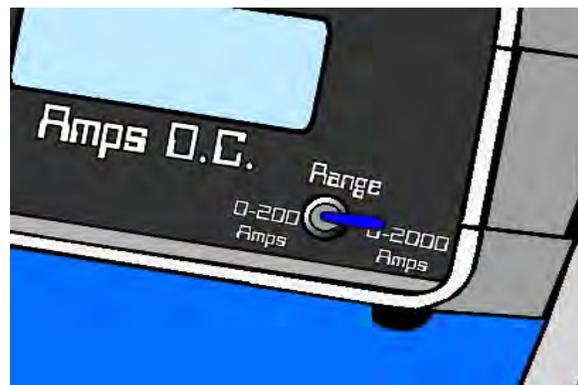


Figure 6-26: DVAM Switched to 0-2000 Amps

6.9.2 Pre-Operation

TI5400GHMD Turbo Start Ground Power Units are equipped with an integrated connector for the DVAM to plug directly into. (See figure: 6-27)

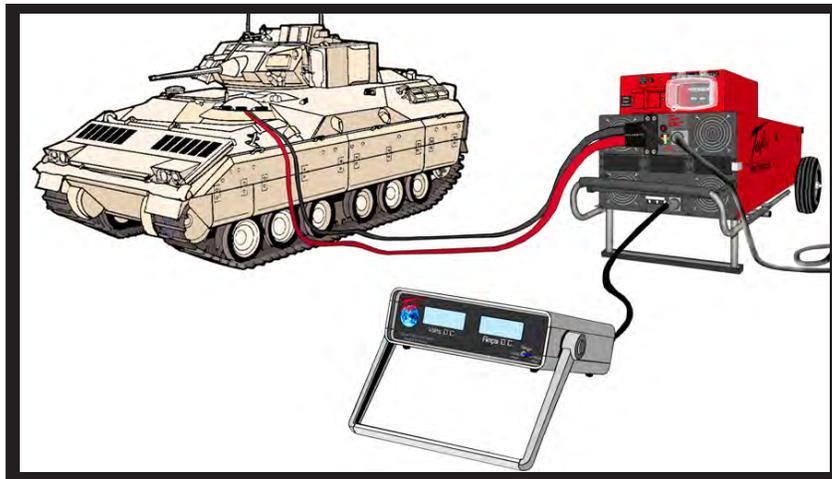


Figure 6-27: DVAM Plugging Into TI5400GHMD

The DVAM can also plug into the junction box of a specially modified Tesla DC cable. (See figure: 6-28)

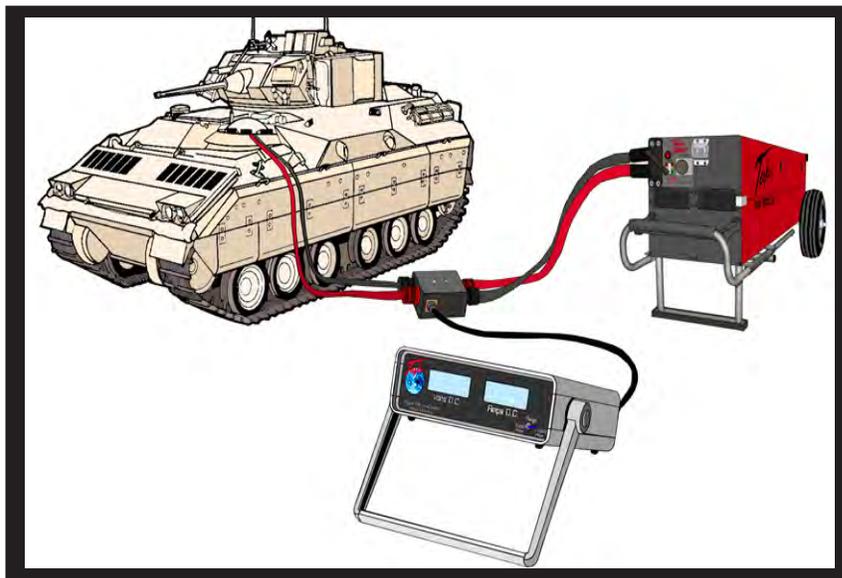


Figure 6-28: DVAM Plugged Into DC Cable Box

Connect the DC cable to Turbo Start system. Connect the DC cable to the vehicle.

6.9.3 Operation

1) Measuring a Vehicle's Start-up Draw

When starting a vehicle with a Tesla Turbo Start, the DVAM can be connected to measure the amount of current needed to start the vehicle. As a result of the Turbo Start's advanced electronics, the amount of current a vehicle requires is matched by our system. When starting a vehicle the amperage will peak and then level off depending on the vehicle's current consumption curve.

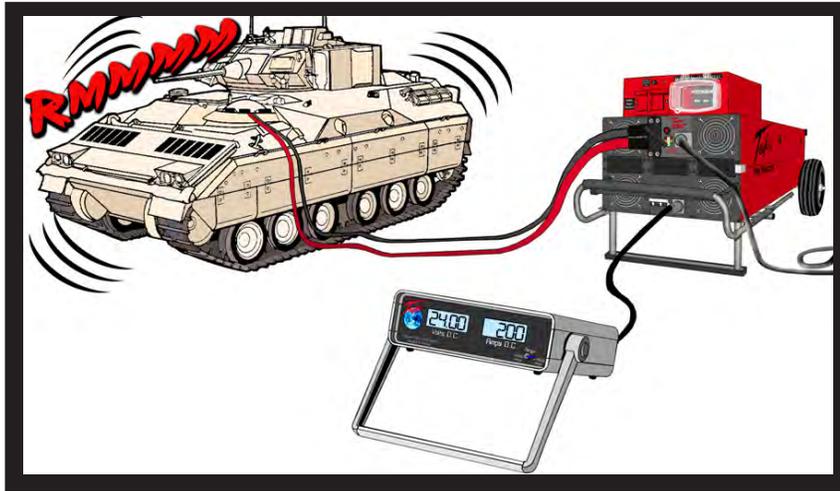


Figure 6-29: DVAM Displaying Start-up Draw

2) System Testing

The DVAM and Turbo Start can be used to check vehicle's systems when individual systems can be isolated.

First turn off all non-related systems.

Turn on individual system to be measured. Check current draw displayed on DVAM. Utilizing the proper military maintenance manual, compare the meter reading with the factory specifications for that system.

6.9.4 Post Operation

Disconnect DVAM and store in case.

6.9.5 Unit Care

Always keep DVAM in case when not in use. Keep system clean and guard from moisture.

CHAPTER 7

POST OPERATION

7.1. GENERAL

When not in use the TI5400 GHMD should be stored indoors guarded from moisture and extreme temperatures. The unit can, for short periods, be stored in the vertical position. To extend cell life the TI5400GHMD should be stored horizontally and plugged into AC power. Although the TI5400GHMD has been ruggedized and made weather resistant within the scope of unit's intended use, it is essential that good general care is taken to maintain unit in good operating condition and to maximize unit's operational life.

7.2. AFTER USE

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

7.3 POWER CELL RECHARGE

NOTE: The TI5400GHMD incorporates a back-charge 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 back-charge for approximately 30 seconds.

NOTE

Plug the TI5400GHMD into AC power to keep the cells charged whenever it is not in use, even if it is fully charged. The unit will not over-charge or over-heat.

7.3.1. Connect AC Power Cord To Unit

Ensure 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.

7.3.2 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.

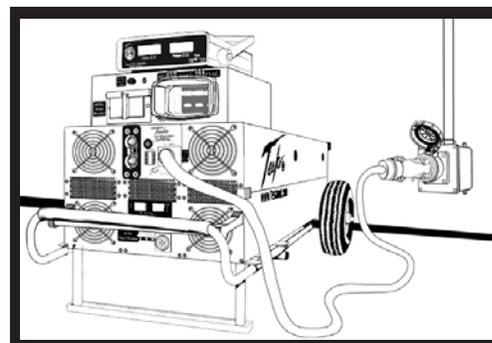


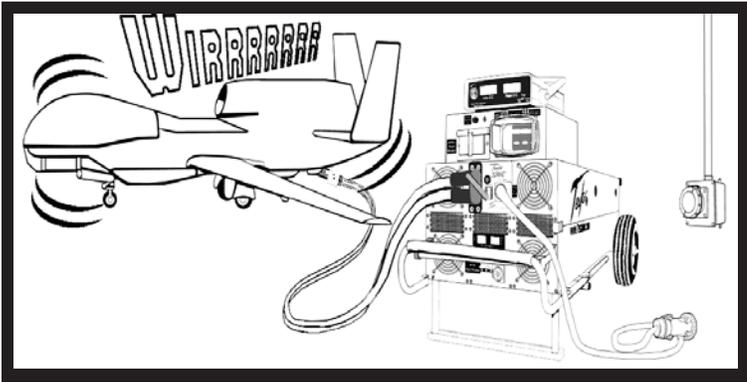
Figure 7-1: Plugged into AC Power



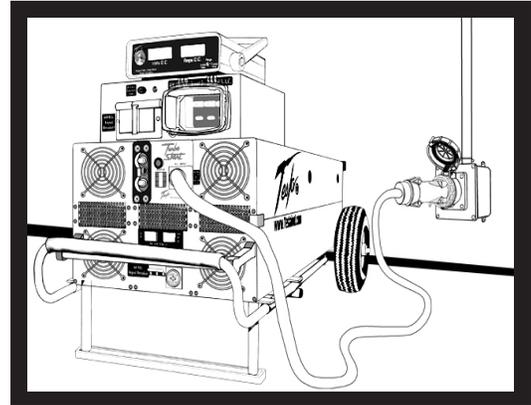
CAUTION



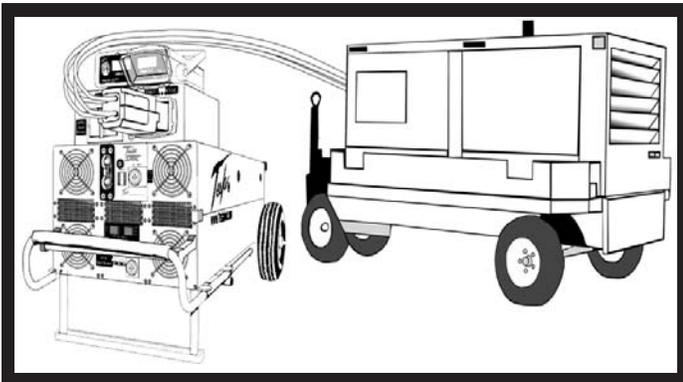
Unit's power cells may be damaged if recharged by Ni-Cad or Lead Acid-type battery chargers. Power cells should only be charged by either the TURBO START internal charger or the AC power cord furnished with the equipment, or when connected to vehicle's external DC power receptacle.



OK



OK



OK



NO

Figure 7-2: Proper and Improper Charging Methods

7.3.3 Check For Full Charge Indication

After 25 minutes, LED charge indicator should show a single steady or blinking LED bar when fully charged. AC power should be connected to unit when power cells are fully charged. The intelligent charger will keep the cells fully charged.

CHAPTER 8

UNIT CARE AND MAINTENANCE

8.1 UNIT CARE

8.1.1. Keep Unit Receptacles and Outer Case Clean

Wipe with dry cloth.

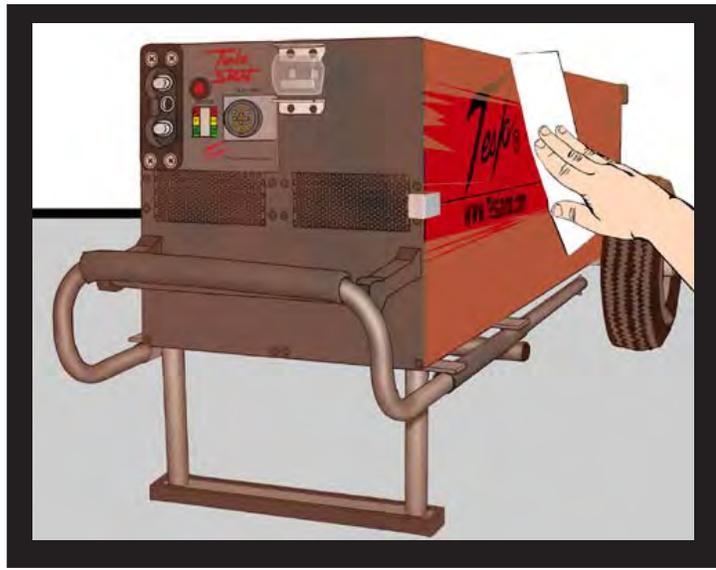


Figure 8-1: Wipe With Dry Cloth

8.1.2 Keep Foreign Objects Out of Unit

Although the unit is built to withstand foreign intrusions, try to prevent this from happening. It is recommended that the Rain/Dust cover is used in sandy environments. (See paragraph: 9.1)



Figure 8-2: Sand Filled Unit

8.1.3 Keep Unit From Prolonged Exposure To Extremely Damp Environments

Cover unit to prevent migration of moisture. If unit is operated in extremely damp environment unit should be kept in an environmentally controlled building.

8.1.4. Keep Unit Plugged Into AC Power Supply When Not In Use

To maximize life of power cells and to ensure unit is always ready for use, unit should remain plugged in to AC power when not in use. Unit will not overcharge or overheat. **Never allow a discharged unit to remain idle for more than 24 hours without fully recharging power cells.**

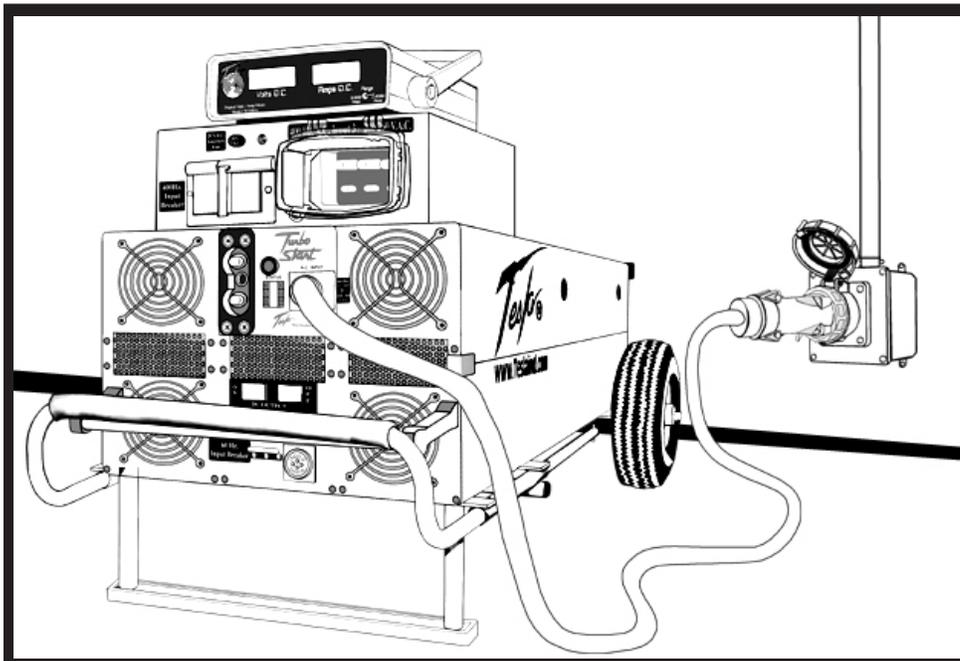


Figure 8-3: Keep Unit Charging at All Times

8.1.5. Protect DC Power Cable And AC Power Cord From Damage

Prevent from being cut, gouged, crushed, dragged or otherwise abused.



Figure 8-4: Damaged Cable

8.1.6 Check DC Power Cable/Connections For Damage

Check connectors for cracks, cuts, distortions, excessive wear, broken/loose fasteners or loose cable attachment. Replace contacts or entire plug if necessary



Figure 8-5: Damaged NATO Plug

8.2. FUNCTIONAL CHECK PROCEDURES

This section deals with normal functional check procedures, and includes all steps necessary to ensure the Turbo Start TI5400GHMD is functioning within specific operational parameters prior to operational use. As users gain experience with the Turbo Start TI5400GHMD, they will incorporate these functional checks as a routine practice.

8.3 REQUIRED EQUIPMENT FOR FUNCTIONAL CHECK

A digital multimeter capable of reading zero to forty volts.



Figure 8-6: Digital Multimeter

8.4 FUNCTIONAL CHECK

8.4.1 Check Unit For Evidence Of Damage

Check for dents, punctures, case distortion or misalignment, cracked or loose connectors. If no damage is evident proceed to step two. If damage is evident contact distributor or:

Tesla Industries, Inc.
Customer Service
(302) 324-8910
tesla1@teslainsd.com



Figure 8-7: Misaligned Case with Bent Face Plate

8.4.2 Ensure Unit is Not Plugged Into A VDC Source

Switch the VAC circuit breaker to the “OFF” Position, then disconnect AC power.

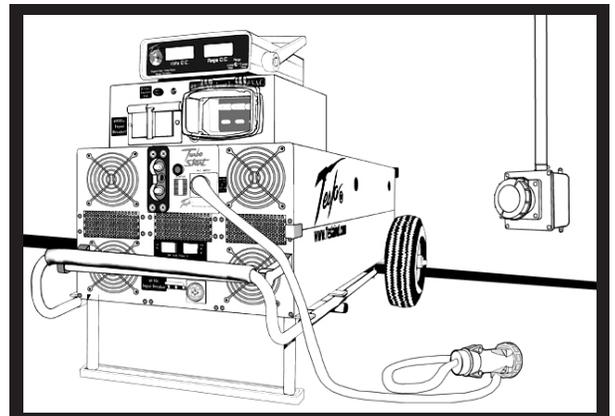
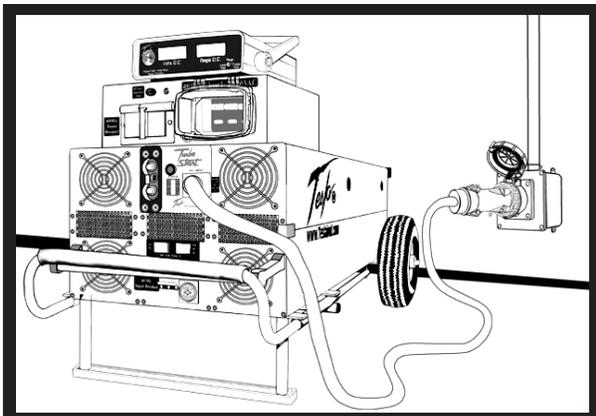


Figure 8-8: Unplug Unit

8.4.4 Check DC Voltage Reading at DC Receptacle Terminals

26.5 to 28 VDC depending on state of charge.

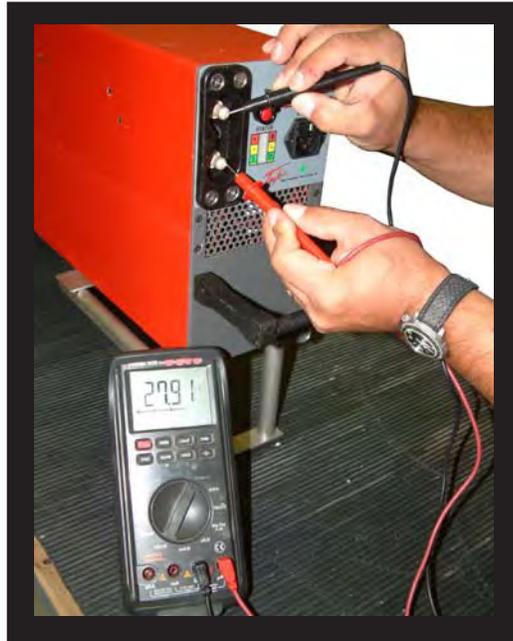


Figure 8-9: Test DC Receptacle

8.4.5 Plug in Power Cord

To prevent arcing while connecting VAC power press the VAC breaker “OFF” button, then connect VAC power. Ensure ground power cable connector is fully seated into vehicle ground power receptacle. When you are ready to supply VAC power, press the VAC breaker “ON” Button.

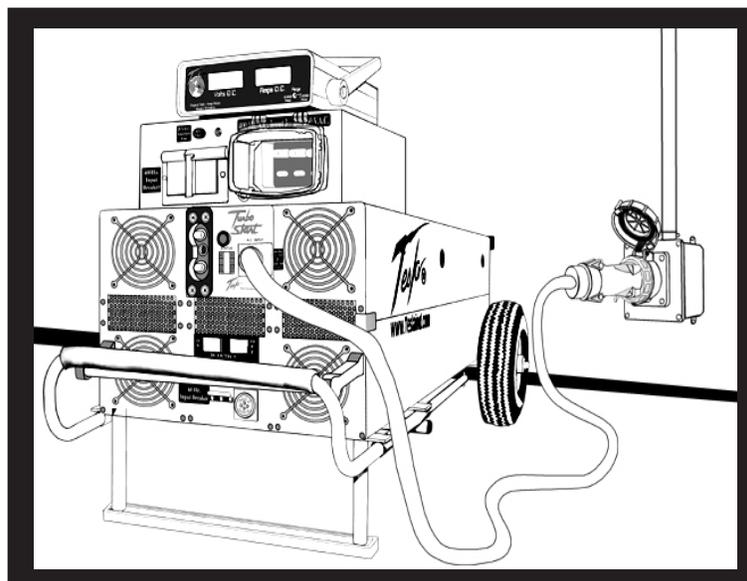


Figure 8-10: Plug in Unit

8.4.6 Check Unit for State of Charge

Unit shall be in horizontal position to ensure unit's vent ports are free from blockage. Press "Push to Test" button, for no more than 5 seconds, to determine the power cells state of charge. Ensure LED status indicator and cooling fan is operational. The LED status indicator should show a single green bar (last LED bar) or a blinking LED status bar to indicate the unit's power cells are fully charged.



Figure 8-11: Press "Push to Test" Button

8.4.7 Check DC Voltage Reading at DC Receptacle Terminals

Ensure power cells are fully charged.

30.5 (± 0.57 VDC) with power cells at full state of charge.



Figure 8-12: Test DC Receptacles
8-7

8.4.8 Functional Check Complete

Unit should remain plugged into VAC power until required for use.

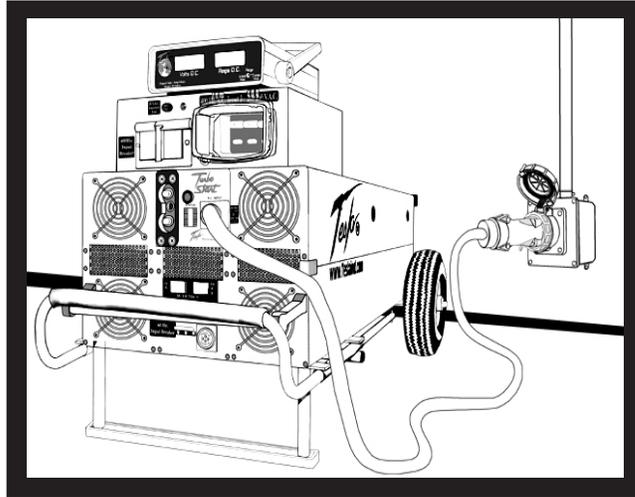


Figure 8-13: Plug in Unit

8.5 MAINTENANCE OF UNIT

Any repairs made by the customer as a result of opening the case are unauthorized and will void the warranty. Evidence of any tampering of the unit will be made evident to Tesla Industries by the Warranty void stickers located on the case (See figure: 8-14) Any repairs requiring the case to be opened must be returned to the manufacturer. In the event the unit needs to be returned to the manufacturer for maintenance contact Tesla's Customer Service Department.

Tesla Industries, Inc.
109 Centerpoint Blvd.
New Castle, DE 19720
(302) 324-8910
tesla1@teslaind.com

8.5.1 Warranty Claim

(see unit warranty).

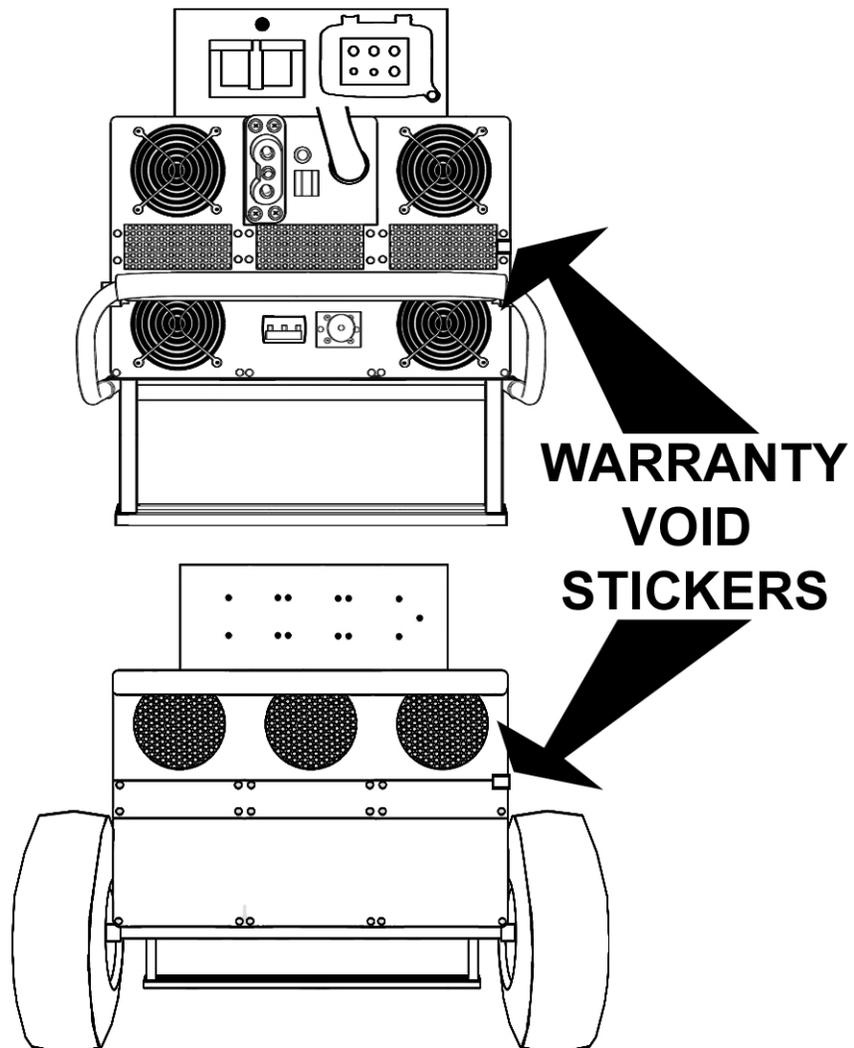


Figure 8-14: Warranty Void Stickers

CHAPTER 9

OPTIONAL ACCESSORIES

9.1 RAIN/DUST COVER

The Turbo Start TI5400GHMD has an optional Rain and Dust cover to enable operation of the unit in rain and in sandy environments. (Product number TI7002-055GHMD)



Figure 9-1: Rain/Dust Cover

9.2 STORAGE CASE

The Turbo Start TI5400GHMD has an optional case for shipping and storage. (Product number TI7000-065GHMD)



Figure 9-2: SHIPPING CASE

9.3 BALLOON TIRE KIT

Replacement balloon tires are for transporting ground power units through sand.



Figure 9-3: BALLOON TIRE KIT

9.4 CABLES

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.

9.5 COBRA PLUGS

Cobra connectors are designed to provide premium quality connections. They are made from superior materials to maximize durability and connectivity. Tesla currently provides a 24 Volt DC Aviation plug for the TI5400GHMD DC cable assembly. Replacement contacts can be ordered for this plug. In the event the TI5400GHMD is needed to start a ground vehicle equipped with a 24 Volt DC NATO receptacle, Tesla also manufactures a highly durable NATO plug.



Figure 9-4: DC Aviation Plug
3 PIN RECEPTACLE (MS25488)



Figure 9-5: NATO Plug
NSN: 6130-01-523-1270

CHAPTER 10

TROUBLESHOOTING AND FAQ

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

Tesla Turbo Starts are multifunctional systems that are ideal for support of 24 VDC vehicles and aircraft and their electronics/avionics on the bench. Tesla manufactures various systems, of different sizes and capacities, that are man-portable, maintenance free and provide pure, 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. Using it for preflight testing, users will avoid depleting the aircraft’s battery. Users 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 Please visit 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 24 volt vehicle, without limit!

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

Plugging the unit into the appropriate AC power outlet is all 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 replacing them. 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. Are Tesla GPUs used in shop maintenance and testing?

Tesla systems are gaining popularity throughout maintenance and instructional facilities, laboratories, manufacturing plants, aircraft hangars and many other locations. The reason is due to the precise flat line DC power, 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.

9. Can one person transport it?

Turbo Starts are designed to be handled by one person. The TI500 is our smallest system to date and weighs 35 lbs. The TI1000 weighs 56 pounds and can be carried or wheeled on a dolly. Larger units have wheels incorporated directly on the system with an extendable handle.

10. 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).

11. 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.

12. 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 e-mail 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.

13. 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.

14. 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).

15. 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 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).

16. 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.

17. Is it waterproof?

Water-resistant but not water proof. Systems can be protected even greater with Tesla Rain covers. (See paragraph: 9.1)

Basic Usage/Operation Questions (see manual for explanation)

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

Preferred position is horizontal for stability and air flow 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 paragraph: 4.8)

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.

CHAPTER 11

PERFORMANCE DATA

11.1 PURPOSE

This chapter provides performance data for the TI540GHMD. 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 gain knowledge of unit's performance margins which enables 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 exist 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 can also be used to establish local operating procedures and to ensure unit's operational life is maximized.

11.2 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.

11.3 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 is 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.

11.4 SPECIFIC CONDITIONS

The data presented is accurate only for specific conditions listed under the title of each chart or graph. Variables for which data is not presented, but 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 affects performance will be given.

11.5 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.

11.6 DEFINITION OF ABBREVIATIONS

Unless otherwise indicated, the abbreviations defined in Chapter two will be applicable to all charts and graphs in this chapter.

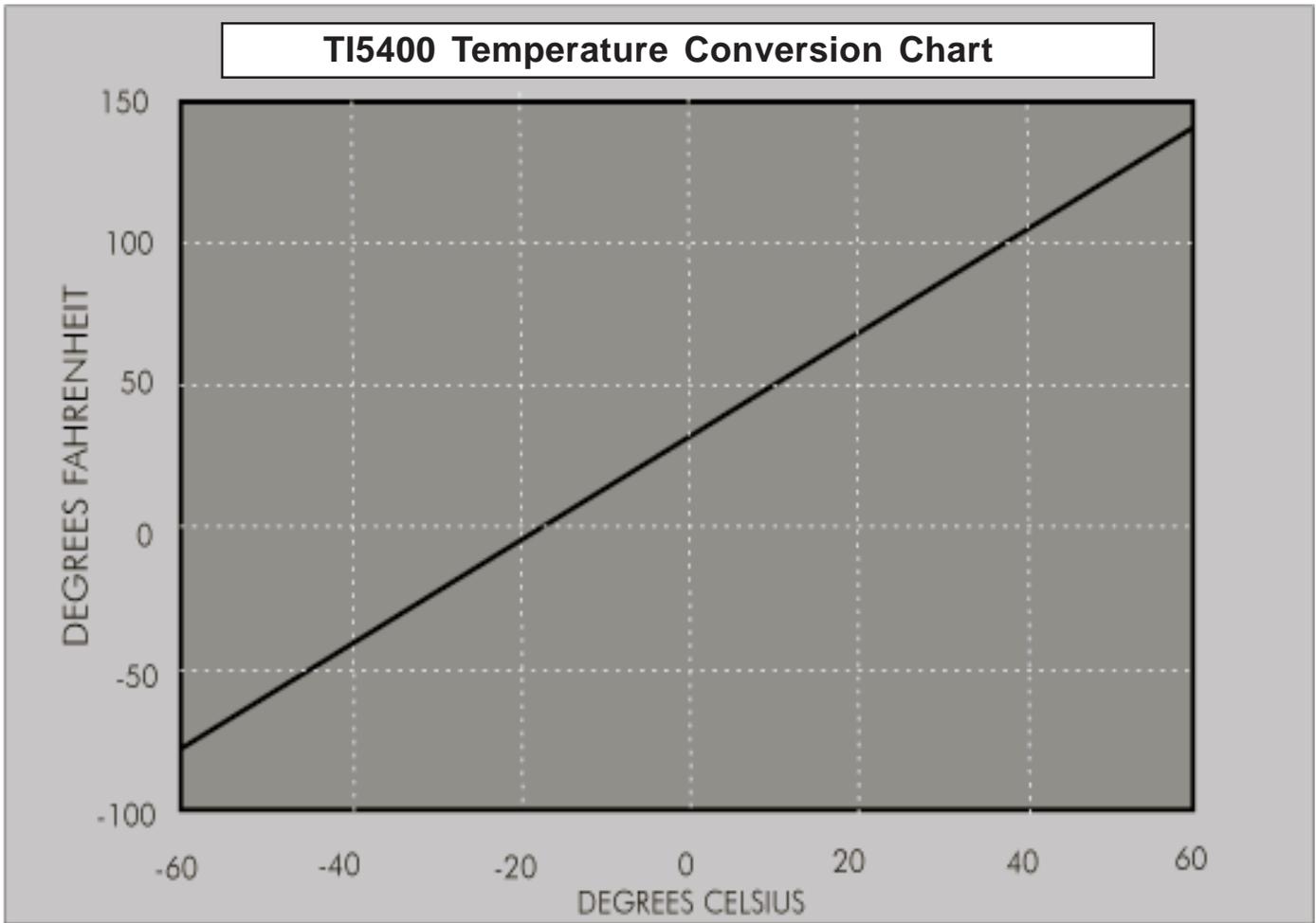


FIGURE 11-1: Temperature Conversion Chart

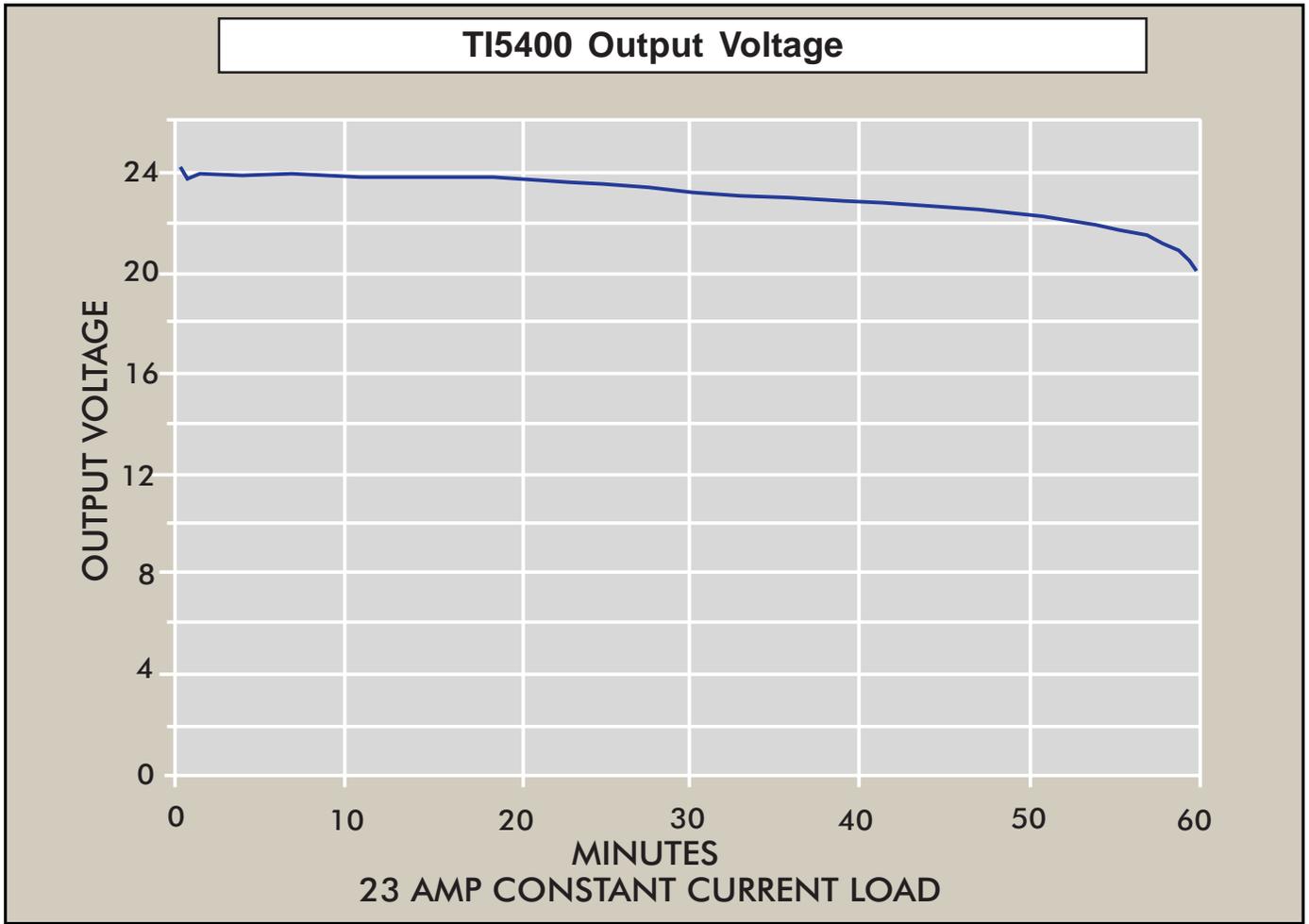


FIGURE 11-2: Output Voltage

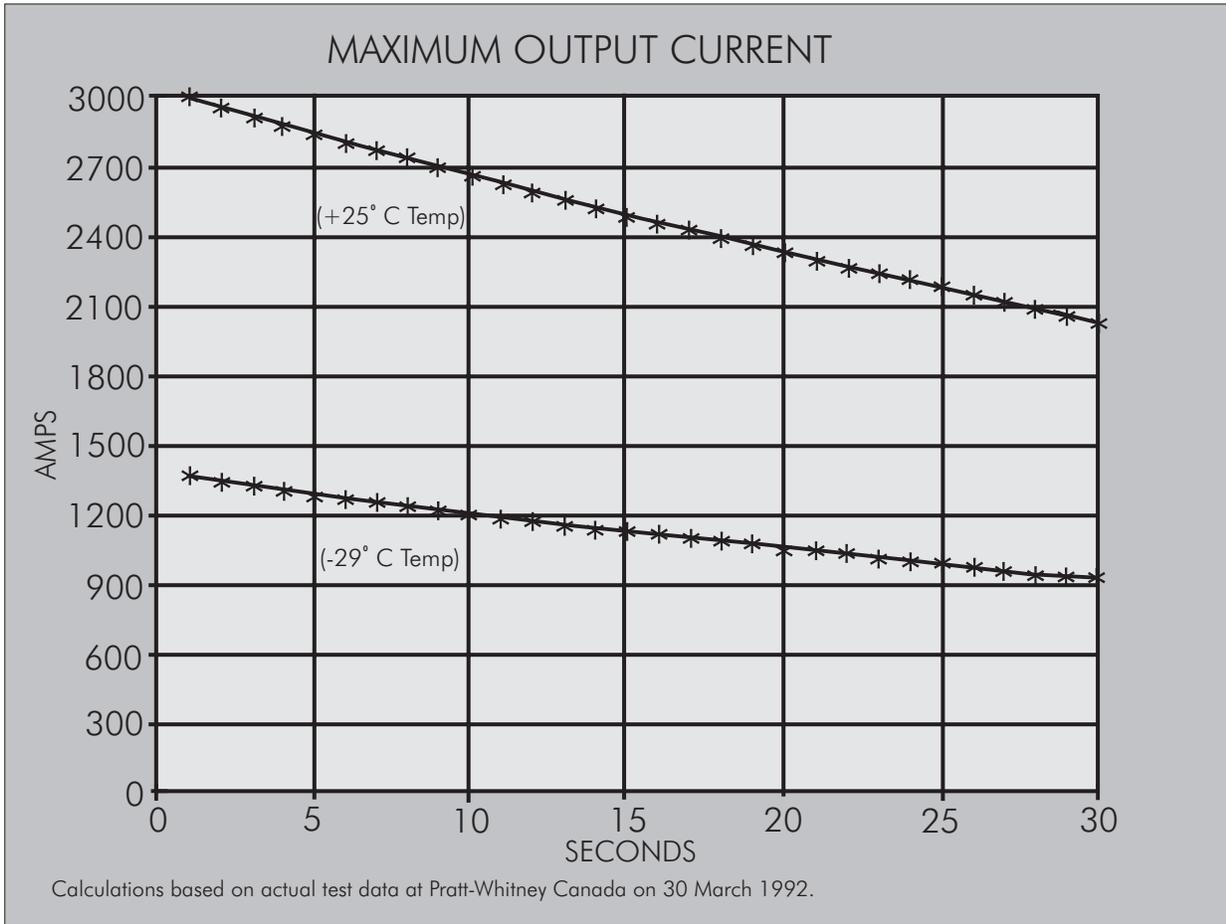


FIGURE 11-3: Maximum Output Current

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A

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