



Power Anytime, Anywhere

Tesla™ TI10C Hybrid GPU

User Manual



*shown with optional tow cart

Built Smart...Proven Tough

Tesla Industries, Inc.
101 Centerpoint Blvd.
New Castle, DE 19720
(302) 324-8910 Phone
(302) 324-8912 Fax
www.teslaind.com

NOTE: All users must read this entire manual prior to operating the TI10C Hybrid GPU.

The TI10C Hybrid GPU (also referred to as the Hybrid) is a limited maintenance unit. Only scheduled maintenance outlined in this User Manual is authorized, all other scheduled maintenance will be performed by Tesla™ Industries, Inc. Warranty will be voided if unit is tampered with in any way, or if unauthorized repairs are made. For technical support please contact:

TESLA™ INDUSTRIES INCORPORATED

101 CENTERPOINT BLVD.

CENTERPOINT INDUSTRIAL PARK

NEW CASTLE, DELAWARE 19720

PHONE: (302) 324-8910

FAX: (302) 324-8912

WEBSITE: www.teslaind.com

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 TI3950 GPU within the TI10C Hybrid GPU 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: To avoid any hazards, the TI10C Hybrid MUST be drained of all engine oil and fuel. The TI10C Hybrid GPU contains sealed, dry cell rechargeable batteries that do not pose a shipping hazard.

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without prior written permission from Tesla Industries, Inc.



CAUTION

The TI10C is a Diesel engine that has been converted to run on JP4, JP5, JP8 Fuel ONLY. Using any grade of gasoline will cause damage to the engine and void the warranty.



CAUTION

Certain procedures MUST be followed during operations. Failure to follow these procedures will void the warranty.



SAFETY DATA SHEET

Form #: 853027
 Revised: AC
 Supersedes: AB (12-16-16)
 ECO #: 1001828

I. PRODUCT IDENTIFICATION	
Chemical Trade Name (as used on label): Tesla™ Industries, Inc.	Chemical Family/Classification: Sealed Lead Battery
Synonyms: Sealed Lead Acid Battery, VRLA Battery	Telephone: For information, contact Tesla™ Industries, Inc. Customer Service Department at 302-324-8910
Manufacturer's Name/Address: Tesla™ Industries, Inc. 01 Centerpoint Blvd. New Castle, DE 19720-4180	24-Hour Emergency Response Contact: CHEMTREC DOMESTIC: 800-424-9300 CHEMTREC INTL: 703-527-3877

II GHS HAZARDS IDENTIFICATION		
HEALTH	ENVIRONMENTAL	PHYSICAL
Acute Toxicity (Oral/Dermal/Inhalation) Category 4 Skin Corrosion/Irritation Category 1A Eye Damage Category 1 Reproductive Category 1A Carcinogenicity (lead compounds) Category 1B Carcinogenicity (acid mist) Category 1A Specific Target Organ Toxicity (repeated exposure) Category 2	Aquatic Chronic 1 Aquatic Acute 1	Explosive Chemical, Division 1.3

GHS LABEL:		
HEALTH	ENVIRONMENTAL	PHYSICAL

Hazard Statements	Precautionary Statements
DANGER! Causes severe skin burns and serious eye damage. May damage fertility or the unborn child if ingested or inhaled. May cause cancer if ingested or inhaled. Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure. May form explosive air/gas mixture during charging. Extremely flammable gas (hydrogen). Explosive, fire, blast, or projection hazard. May cause harm to breast-fed children Harmful if swallowed, inhaled, or contact with skin Causes skin irritation, serious eye damage.	Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Wear protective gloves/protective clothing, eye protection/face protection. Avoid breathing dust/fume/gas/mist/vapors/spray. Use only outdoors or in a well-ventilated area. Contact with internal components may cause irritation or severe burns. Avoid contact with internal acid. Irritating to eyes, respiratory system, and skin. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood Avoid contact during pregnancy/while nursing Keep away from heat./sparks/open flames/hot surfaces. No smoking

III. COMPOSITION/INFORMATION ON INGREDIENTS		
Components	CAS Number	Approximate % by Weight
Inorganic Lead Compound:		
Lead	7439-92-1	45 - 60
Lead Dioxide	1309-60-0	15 - 25
Tin	7440-31-5	0.1 - 0.2
Sulfuric Acid Electrolyte (Sulfuric Acid/Water)	7664-93-9	15 - 20
Case Material:		5 - 10
Polypropylene	9003-07-0	
Polystyrene	9003-53-6	
Styrene Acrylonitrile	9003-54-7	
Acrylonitrile Butadiene Styrene	9003-56-9	
Styrene Butadiene	9003-55-8	
Polyvinylchloride	9002-86-2	
Polycarbonate, Hard Rubber, Polyethylene	9002-88-4	
Polyphenylene Oxide	25134-01-4	
Polycarbonate/Polyester Alloy	--	
Other:		



SAFETY DATA SHEET

Form #: 853027
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Absorbent Glass Mat	--	1 - 2				
Inorganic lead and sulfuric acid electrolyte are the primary components of every battery manufactured by EnerSys Energy Products. There are no mercury or cadmium containing products present in batteries manufactured by EnerSys Energy Products.						
IV. FIRST AID MEASURES						
Inhalation: <u>Sulfuric Acid:</u> Remove to fresh air immediately. If breathing is difficult, give oxygen. Consult a physician <u>Lead:</u> Remove from exposure, gargle, wash nose and lips; consult physician.						
Ingestion: <u>Sulfuric Acid:</u> Give large quantities of water; do not induce vomiting or aspiration into the lungs may occur and can cause permanent injury or death; consult a physician <u>Lead:</u> Consult physician immediately.						
Skin: <u>Sulfuric Acid:</u> Flush with large amounts of water for at least 15 minutes; remove contaminated clothing completely, including shoes. If symptoms persist, seek medical attention. Wash contaminated clothing before reuse. Discard contaminated shoes <u>Lead:</u> Wash immediately with soap and water.						
Eyes: <u>Sulfuric Acid and Lead:</u> Flush immediately with large amounts of water for at least 15 minutes while lifting lids Seek immediate medical attention if eyes have been exposed directly to acid.						
V. FIRE FIGHTING MEASURES						
Flash Point: N/A		Flammable Limits: LEL = 4.1% (Hydrogen Gas)		UEL = 74.2% (Hydrogen Gas)		
Extinguishing Media: Carbon dioxide; foam; dry chemical. Avoid breathing vapors. Use appropriate media for surrounding fire.						
Special Fire Fighting Procedures: If batteries are on charge, shut off power. Use positive pressure, self-contained breathing apparatus. Water applied to electrolyte generates heat and causes it to spatter. Wear acid-resistant clothing, gloves, face and eye protection. Note that strings of series connected batteries may still pose risk of electric shock even when charging equipment is shut down.						
Unusual Fire and Explosion Hazards: Highly flammable hydrogen gas is generated during charging and operation of batteries. To avoid risk of fire or explosion, keep sparks or other sources of ignition away from batteries. Do not allow metallic materials to simultaneously contact negative and positive terminals of cells and batteries. Follow manufacturer's instructions for installation and service.						
VI. ACCIDENTAL RELEASE MEASURES						
Spill or Leak Procedures: Stop flow of material, contain/absorb small spills with dry sand, earth, and vermiculite. Do not use combustible materials. If possible, carefully neutralize spilled electrolyte with soda ash, sodium bicarbonate, lime, etc. Wear acid-resistant clothing, boots, gloves, and face shield. Do not allow discharge of unneutralized acid to sewer. Acid must be managed in accordance with local, state, and federal requirements. Consult state environmental agency and/or federal EPA.						
VII. HANDLING AND STORAGE						
Handling: Unless involved in recycling operations, do not breach the casing or empty the contents of the battery. There may be increasing risk of electric shock from strings of connected batteries Keep containers tightly closed when not in use. If battery case is broken, avoid contact with internal components. Keep vent caps on and cover terminals to prevent short circuits. Place cardboard between layers of stacked automotive batteries to avoid damage and short circuits. Keep away from combustible materials, organic chemicals, reducing substances, metals, strong oxidizers and water. Use banding or stretch wrap to secure items for shipping.						
Storage: Store batteries in cool, dry, well-ventilated areas with impervious surfaces and adequate containment in the event of spills. Batteries should also be stored under roof for protection against adverse weather conditions. Separate from incompatible materials. Store and handle only in areas with adequate water supply and spill control. Avoid damage to containers. Keep away from fire, sparks and heat. Keep away from metallic objects which could bridge the terminals on a battery and create a dangerous short-circuit						
Charging: There is a possible risk of electric shock from charging equipment and from strings of series connected batteries, whether or not being charged. Shut-off power to chargers whenever not in use and before detachment of any circuit connections. Batteries being charged will generate and release flammable hydrogen gas. Charging space should be ventilated. Keep battery vent caps in position. Prohibit smoking and avoid creation of flames and sparks nearby. Wear face and eye protection when near batteries being charged.						
VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION						
Exposure Limits (mg/m3) Note: N.E.= Not Established						
INGREDIENTS (Chemical/Common Names)	OSHA PEL	ACGIH	US NIOSH	Quebec PEV	Ontario OEL	EU OEL
Lead and Lead Compounds (inorganic)	0.05	0.05	0.05	0.05	0.05	0.15 (b)
Tin	2	2	2	2	2	N.E
Sulfuric Acid Electrolyte	1	0.2	1	1	0.2	0.05 (c)
Polypropylene	N.E	N.E	N.E	N.E	N.E	N.E
Polystyrene	N.E	N.E	N.E	N.E	N.E	N.E
Styrene Acrylonitrile	N.E	N.E	N.E	N.E	N.E	N.E
Acrylonitrile Butadiene						
Styrene	N.E	N.E	N.E	N.E	N.E	N.E

For expanded detailed info, download the PDF online at...
<http://www.teslaind.com/PDF/chart/Tesla-Safety-Data-Sheet.pdf>

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Abbreviations and Symbols

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

LIST OF ABBREVIATIONS

Abbreviation **Definition**

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

Section 1 – Safety Review

1.1 - Safety Notices

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

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

1.2 - Symbols

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



Figure 1.2.1 – Different types of hazard and caution symbols

1.3 – Hazards



WARNING

Shock Hazard Potential

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



WARNING

Shock Hazard Potential

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



CAUTION

Unit Damage Potential

Damage may occur if the TI10C Hybrid GPU is operated after exposure to moisture (rain, fog, snow, etc.). If water infiltration is suspected, DO NOT CONNECT the power cable. 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. See Section 8.1 for standard procedures in wet conditions.

1.4 – Important Safety Precautions



WARNING

Fire/Explosion Hazard Potential

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

1.5 – Extreme Environments



CAUTION

Unit Damage Potential

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

Warning Summary

The following safety precautions are for personnel to understand and apply during many phases of operating and maintaining the TI10C Hybrid GPU. Disregarding these warnings and precautionary information can result in serious injury or death.

Warning statements considered essential to the protection of personnel have been strategically placed throughout this manual prior to operation or maintenance procedures. Before starting any task, be sure to review and understand all warnings in the text for that task. This manual describes physical and chemical processes that may require the use of chemicals, solvents, paints, or other commercially available material. Users of this manual should obtain the material safety data sheets (Occupational Safety and Health Act (OSHA) Form 20 or equivalent) from the manufacturer or suppliers of materials to be used. Users must be completely familiar with manufacturer/supplier information and adhere to their procedures, recommendations, warnings, and cautions for safe use, handling, storage, and disposal of these materials. Make sure personnel are familiar with the TI10C before operating.



WARNING

Shock Hazard Potential

Do not replace components or make adjustments with the voltage supply turned on. Dangerous potentials may exist under certain conditions when the power control is off. Avoid casualties by always removing power and by discharging and grounding a circuit before touching it. Failure to observe this warning could result in severe personal injury or death.



WARNING

Shock Hazard Potential

High voltage is produced when TI10C is being operated. Use care when working around an open control panel when TI10 set is on. Improper operation of TI10C or failure to follow this warning could result in severe personal injury or death by electrocution.



CAUTION

Unit Damage Potential

Liquids under pressure are generated as a result of operating this TI10C. High-pressure leaks could cause severe personal injury or death. Failure to observe this warning could result in severe personal injury or death.



WARNING

Injury Potential

The TI10C Hybrid is heavy. To prevent injury to personnel and damage to equipment, use caution when lifting or moving TI10C. Do not lift TI10C over personnel. Failure to observe this warning could result in severe personal injury or death.



WARNING

Injury Potential

Class III oil leaks should be reported IMMEDIATELY to your supervisor. Fuel leaks of any kind require immediate system shutdown. Failure to observe this warning could result in severe personal injury or death. (See Classification of Fluid Leaks on Page 6).

**WARNING****Shock Hazard Potential**

DC voltages are present at TI10C electrical components even with TI10C shut down. Avoid shorting any positive terminal with ground or negative. If no dc voltage is required, always disconnect dc power source to TI10C before working on it. Failure to observe this warning could result in severe personal injury or death by electrocution.

**WARNING****Shock Hazard Potential**

Never attempt to connect or disconnect load cables while TI10C is running. Failure to observe this warning could result in severe personal injury or death by electrocution.

**WARNING****Injury Potential**

Never service or perform maintenance on TI10C while engine is running. Always shut down TI10C before servicing. Allow engine to cool before handling components. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Injury Potential**

Never work alone when reaching into TI10C to service or adjust it. Be sure to work with someone who could provide aid in case of an emergency. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Injury Potential**

Shut down TI10C at first sign of failure. Continued operation could result in injury to personnel and will cause damage to equipment. If TI10C is shut down by activation of a safety device, do not operate again until the cause of the shut down has been determined and eliminated. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Injury Potential**

If damaged or defective components are discovered, repair must be performed before operations can begin. Perform required repairs and adjustments before proceeding. Do not operate TI10C with damaged components. Personal injury could occur if damaged parts are left unfixed. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Injury Potential**

With access cover open, noise level of TI10C when operating could cause hearing damage. Hearing protection must be worn when working near TI10C while it is running. Failure to observe this warning could result in severe personal injury.

**CAUTION****Poisoning Potential**

Exhaust discharge contains deadly gases including carbon monoxide. Do not operate TI10C in an enclosed area unless exhaust discharge is properly vented outside. Position TI10C as far away from personnel, shelters, and occupied vehicles as possible. Failure to observe this warning could result in severe personal injury or death due to carbon monoxide poisoning.

**WARNING****Injury Potential**

Fuel used in this TI10C is flammable and toxic to skin, eyes, and respiratory tract. Avoid repeated or prolonged contact. Handle only in a well-ventilated area. Keep away from sparks, open flames, or other sources of ignition. Do not splash fuel on hot components. Do not fuel TI10C while it is operating. Do not overfill tank. Ensure TI10C is properly grounded before fueling. Failure to observe this warning could result in personal injury and equipment damage due to potential fuel ignition and possible explosion. Ensure approved gloves and face shield are worn during handling. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Unit Damage Potential**

Do not use TRICHLOROTRIFLUOROETHANE, TRICHLOROETHANE, and similar chemical solvents for ordinary cleaning of equipment. These substances threaten public health and the environment by destroying ozone in the Earth's upper atmosphere. Use suitable non-hazardous cleaning materials such as a clean cloth, water, and mild detergent or an approved substitute solvent, such as isopropyl alcohol. Failure to observe this warning could result in severe personal injury or death.

Do not stand on or store heavy objects on TI10C.

**WARNING****Injury Potential**

Adhesives used in maintaining this TI10C are flammable and toxic. Vapors may ignite explosively. Avoid breathing in vapors. Provide adequate ventilation to prevent vapor concentrations in excess of permissible exposure levels. Keep away from heat, sparks, and open flame. Extinguish all flames and turn off non-explosion-proof electrical equipment during use until vapors are dissipated. Close containers tightly. Failure to observe this warning could result in severe personal injury or death.

Metal jewelry could conduct electricity. Loose, dangling articles and clothing could be caught in moving parts. Remove jewelry and loose, dangling articles and clothing before working on TI10C. Failure to observe this warning could result in severe personal injury or death.

**WARNING****Injury Potential**

If battery is not installed, battery cable ends must be isolated from each other, and positive end must be isolated from ground. Failure to isolate battery cable ends could result in severe electrical discharge. When not connected to battery, connect battery cable ends to plastic storage stud. When connecting battery cables, always connect positive cable first and negative cable last. Failure to observe this warning could result in severe personal injury or death.

Classification of Fluid Levels

It is necessary for you to know how fluid leakage affects the status of your vehicle. The following definitions of the types or classes of leaks you need to know to be able to determine the status of your vehicle. Learn, then be familiar with them and remember – when in doubt, notify your supervisor!.

**CAUTION****Unit Damage Potential**

Equipment operation is allowable with minor leakages (Class I or II). Of course, consideration must be given to the fluid capacity in the item or system being checked or inspected. When in doubt notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required.

Class III leaks should be reported to your supervisor or to unit maintenance for corrective action.

- Class I Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
- Class II Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked or inspected.
- Class III Leakage of fluid great enough to form drops that fall from the item being checked or inspected.

Section 2 – Unit Specifications

2.1 – General Specifications

Electrical

Continuous AC Output Power:

- 4,950 watts

Peak AC Output Power:

- 6,000 watts

DC Voltage Output with Series Parallel Cabling

- 28.6 Vdc @ 150 A continuous (6000 A surge @ 15 sec.)
- 48.2 Vdc @ 75 A continuous (3000 A surge @ 15 sec.)
- 26 Vdc @ 250 A intermittent for 1 hr (60% duty cycle)
- 24 Vdc @ 96 A for 1 hr non-engine silent operation
- 12 Vdc regulated / isolated @ 10 A continuous

AC Voltage Output:

- 240 Vac @ 20 A
- 120 Vac @ 40 A
- 120 Vac @ 1 A

Mechanical

Engine Displacement:

- 26.5 cu. in (0.435 L)

Maximum RPM

- 3800

Engine Oil Capacity

- 2.6 qt (2.5 L)

Decibel

- 81 dBA

Recommended Oil Type

- Mobil 1 Synthetic 5W-40 Motor Oil

Shock/Vibration

- Exceeds MIL-STD-801F

Fuel Tank Capacity

- 8 Gallons (30 L)

Recharging Rate

- 38 minutes

Fuel Type

- JP-4, JP-5, JP-8

It is recommended to add ½ fl. oz. of two-stroke oil per gallon to the fuel. Adding oil will add lubricity to the fuel pump and fuel injector and extend the life of components.

Temperature Ratings

- Operating Temperature: -31°C - 60°C (-25°F - 140°F)
- Storage temperature: -40°C - 75°C (-40°F - 167°F)

Weight (with fluids)

- 702 lbs (318.42 kg)

Run Time (at 75% max. output)

- 18 hours

Weight of Optional Tow Cart

- 198 lbs (89.81 kg)

2.2 – TI3950 GPU General Specifications

AC Input Power:

- 210-250 Vac 50, 60 Hz

Type of Power Cell:

- High rate discharge/rechargeable/maintenance-free cell

Power Output Rate (24 VDC) -- per DC Outlet:

- 28.5 Vdc @ 75 amps continuous
- 24.0 Vdc @ 46 amp hours continuous
- 121 amps for 1 hour (2904 watt hours) with 208-240 Vac power source
- 46 amps for 1 hour (1104 watt hours) with 208-240 Vac power source
- 3000 peak starting amps

Recharging Rate

- 38 minutes

Temperature Ratings

Operating Temperature:

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

Storage Temperature:

- -65 °C to +105 °C (-85 °F to 221 °F)

Cell Capacity:

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

Weight

- 270 lbs (122.47 kg)



2.3 – Physical Dimensions

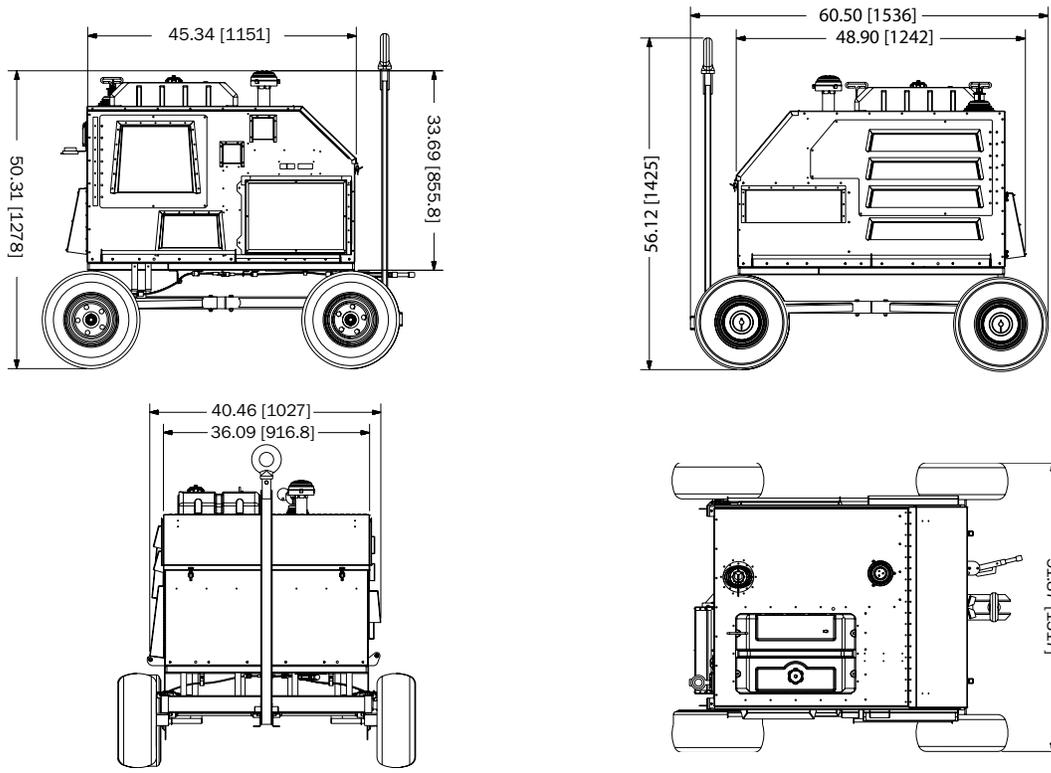


Figure 2.3.1 – Hybrid TI10C GPU physical dimensions

2.4 – Airflow Ports



CAUTION

Damage may occur if the TI10C Hybrid GPU's air intake or outlet ports are obstructed. Ensure that ports are clear at all times.

When the TI3950 GPU is plugged into ac power, the internal cooling system will efficiently regulate unit temperature regardless of load. At room temperature (+77 °F) the exhaust air will not exceed the ambient temperature by more than 5 °F. In more extreme temperatures (greater than 90 °F) the exhaust air will not exceed the ambient temperature by more than 10 °F. More info about Hybrid Air Intake and Exhausts in Section 3.9.

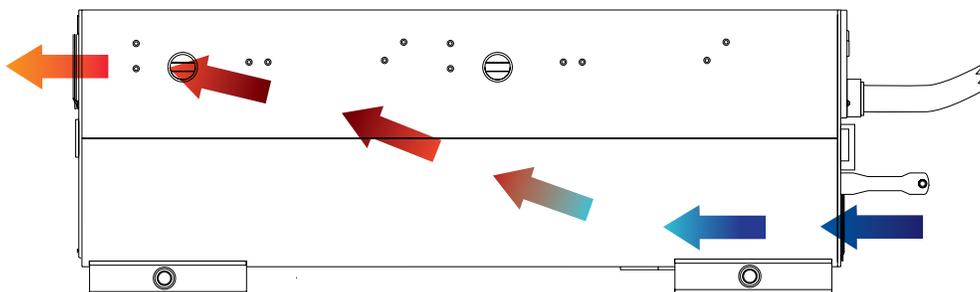


Figure 2.4.1 – Air intake and exhaust ports and internal air circulation

2.5 – Temperature Dimensions

Cold/Hot Soaked Temperature

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

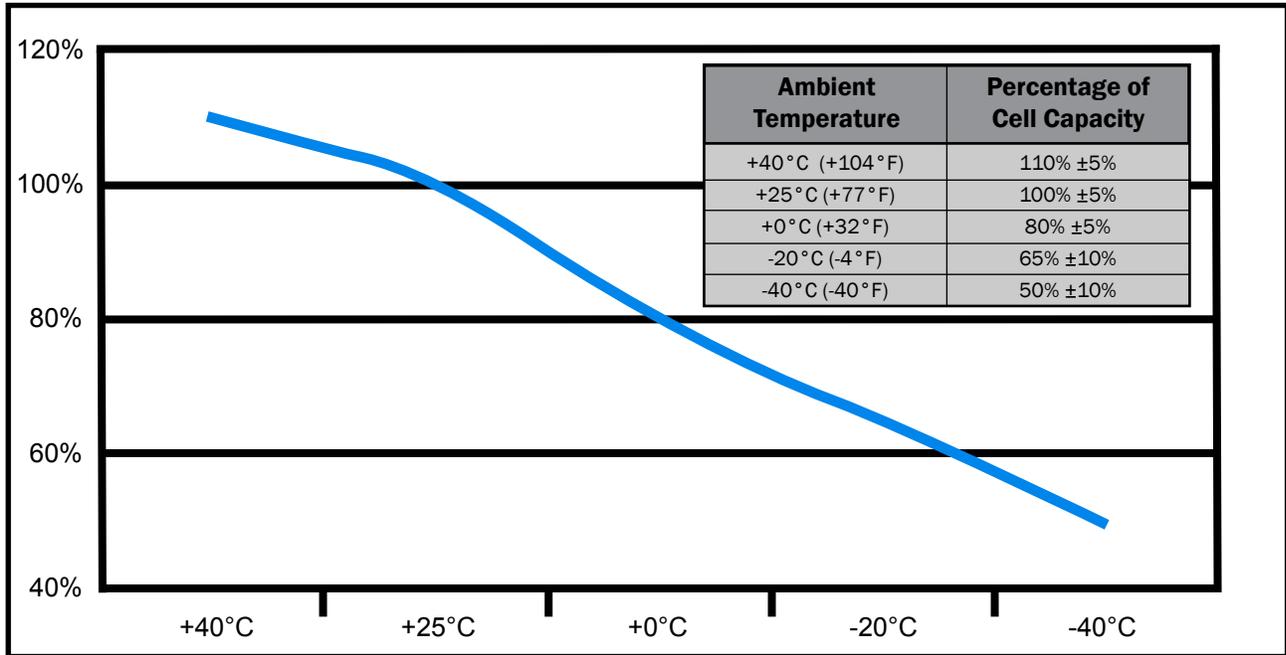


Figure 2.4.1 – Output power capability versus ambient temperature

Hot Soaked or Cold Soaked Definition

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

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



NOTE

The unit’s temperature switch automatically disables ac power functions when the internal temperature is above 150°F (65°C). This protects the unit from overheating and damage. If the unit shuts down, move the unit into a cooler climate, such as shade or air conditioning when possible. Perform a full function test prior to use after the unit has been allowed to cool.

2.6 – Engine Starting Power

The user should always ensure that the unit has been charged to at least 80% of full charge prior to ground support engine starting. However, in certain circumstances a full unit recharge may not be possible and immediate external engine starting power is required. The following chart provides minimum states of charge necessary to provide ample power for an efficient engine start under specific current load demands.

% of Full Charge	40%	50%	60%	80%	100%
Charge Time (min)	15	19	23	31	38
Peak Current (amps)	2400	3000	3600	4800	6000

Figure 2.6.1 – Engine starting power in amps versus percentage of battery charge - 2 DC Receptacles

Section 3 – Product and Feature Overview

3.1 – Introduction

This manual contains the complete operating instructions and procedures for the TI10C Hybrid Ground Power Unit. The Tesla™ TI10C Hybrid GPU has been designed to serve as single source of power for both maintenance facilities and remote locations. The Hybrid is powered by an air-cooled, 10 horsepower, diesel OHV engine with a 5000 watt generator. The TI3950 GPU built into the unit is capable of delivering 6000 peak amps and 150 continuous amps. The TI10C Hybrid GPU will handle all of your power needs including 12, 24, and 48 Vdc and 110 - 240 Vac, single phase.

The Tesla™ TI10C Hybrid GPU has state-of-the-art electronic control and monitoring circuitry that produces a perfect combination of ultra-high current output with power generation. Water-tight gaskets and extensive weatherproofing (sand separator, exhaust fans, etc.) allow the TI10C Hybrid to withstand the harshest battlefield conditions and other extreme environments.



Figure 3.1.1 – TI10C Hybrid GPU (shown with optional tow cart)

3.2 – 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.

3.3 – TI10C Hybrid GPU Front and Top View

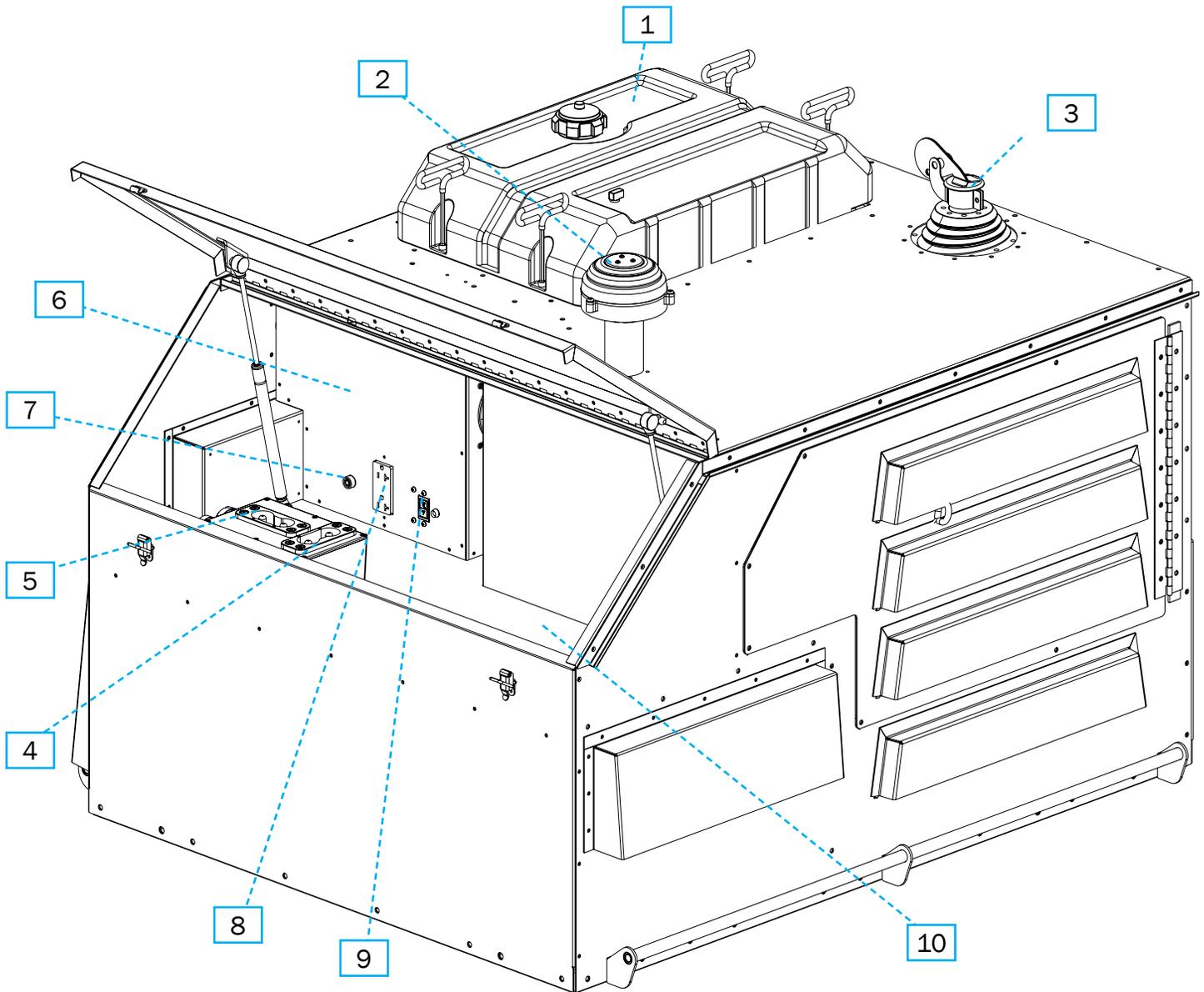


Figure 3.3 – Front Panel View of TI10C Hybrid GPU

1 – Removable Fuel Tank

 CAUTION	JP-4, JP-5, JP-8, ONLY. Using any grade of gasoline will cause damage to Engine and void warranty
--	--

The TI10C Hybrid is equipped with a removable fuel tank that holds 8 gallons of JP-4, JP-5, or JP-8 fuel (see Figure 3.3.1). The tank can be quickly removed to allow for maintenance or transport. It can also be removed to refill the tank without moving the entire unit. The TI10C Hybrid was designed to run for 5 minutes at a 75% load without the fuel tank, so that the tank may be filled and replaced, or switched out for a full tank. An optional 8-Gallon Removable Replacement Fuel Tank (see section 9.4) can also be purchased to make refilling easier and faster.



Figure 3.3.1 – Removable Fuel Tank

2 – Engine Air Intake with Sand Separator

Fresh air enters the engine through the Engine Air Intake. To ensure that no sand or other damaging debris enters the engine, the air intake is topped with a Sand Separator (shown in Figure 3.3.2).

3 – Engine Exhaust

 WARNING	The engine gasses escaping from the exhaust are extremely hot – up to 950° F. Severe burns could occur if personnel stand too close to exhaust system.
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The Engine Exhaust System (see Figure 3.3.3), is designed so that the temperature within the engine compartment does not increase above 10 degrees of the ambient temperature. The exhaust system runs at 81 Db under a 75% load on the engine.

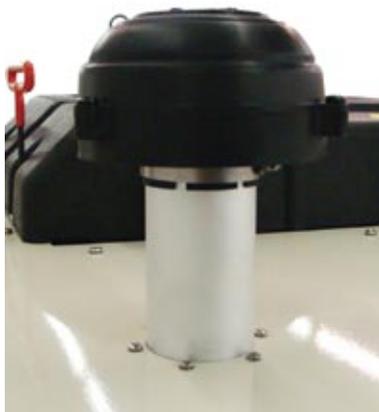


Figure 3.3.2 – Air Intake with Sand Separator.



Figure 3.3.3 – Exhaust

4 – 150 amp DC Output and DC Output for Inverter

Located in the Storage Compartment, the DC Outputs run directly from the TI3950 GPU. The DC Output Connectors are battery style receptacles. One is used as the dc output for the Inverter, the other can be connected to a dc plug. The dc plug connects to the DC Output Connector (see figure 3.3.4) and is secured via a threaded T-handle. Turning the handle one full turn clockwise securely locks the plug.

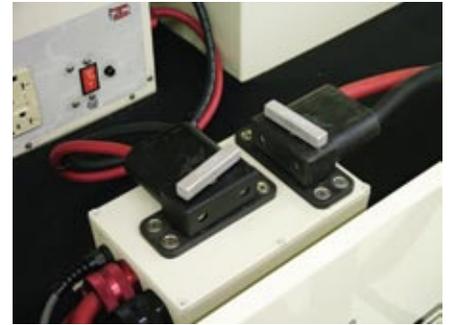


Figure 3.3.4 – DC Output Connector (located in front storage compartment)

5 – DC Output for Inverter - Provides dc power for inverter.

6 – Inverter Control Panel

The 60 Hz 120 Vac Power Outlet is located in the Storage Compartment of the TI10C (see figure 3.3.5)

7 – 20 A Circuit Breaker - Trips if load exceeds 20 amps.

8 – AC Output - 60 Hz 120 VAC 2000 W (16.666 amps) Cont. Max

The GFCI 60 Hz 120 Vac Power Outlet, powered by the inverter, is located in the storage compartment of the TI10C. When the inverter is active it will provide 120 Vac 16.66 amps max.

9 – 120 A Circuit Breaker and Indicator Light

To the right of the outlet is a 120 Amp Circuit Breaker for the dc outputs also located in the storage compartment. If the load on the dc outputs exceeds 120 amps, the breaker will trip into the “off” position.

10 – Storage Compartment - Stores cables when not in use.

Storage compartment provides storage space for Basic Issue Items (BII) that come standard with the Hybrid. Storage compartment also has quick reference pull down tabs for basic operation of unit and Preventative Maintenance Checks and Services (PMCS). Access to the dc outputs and the Inverter Front Panel, are located in the storage compartment. (see figure 3.3.6)

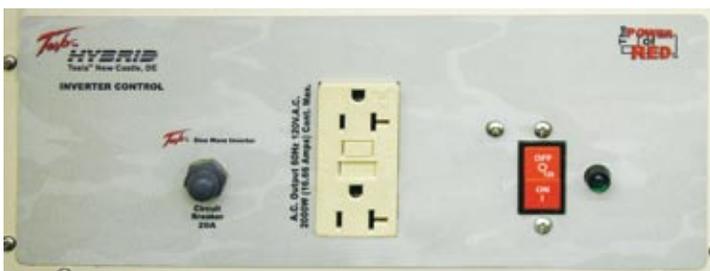


Figure 3.3.5 – Inverter Control Panel and 120 Amp Circuit Breaker.

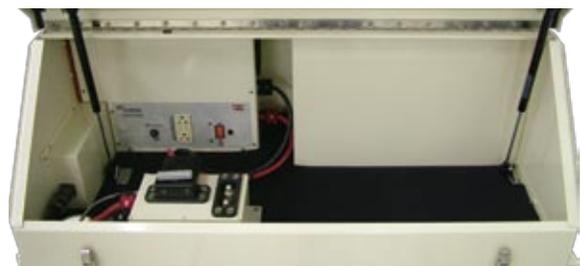


Figure 3.3.6 – 120 Vac 60 Hz Output

3.4 – TI3950 GPU Front Panel View

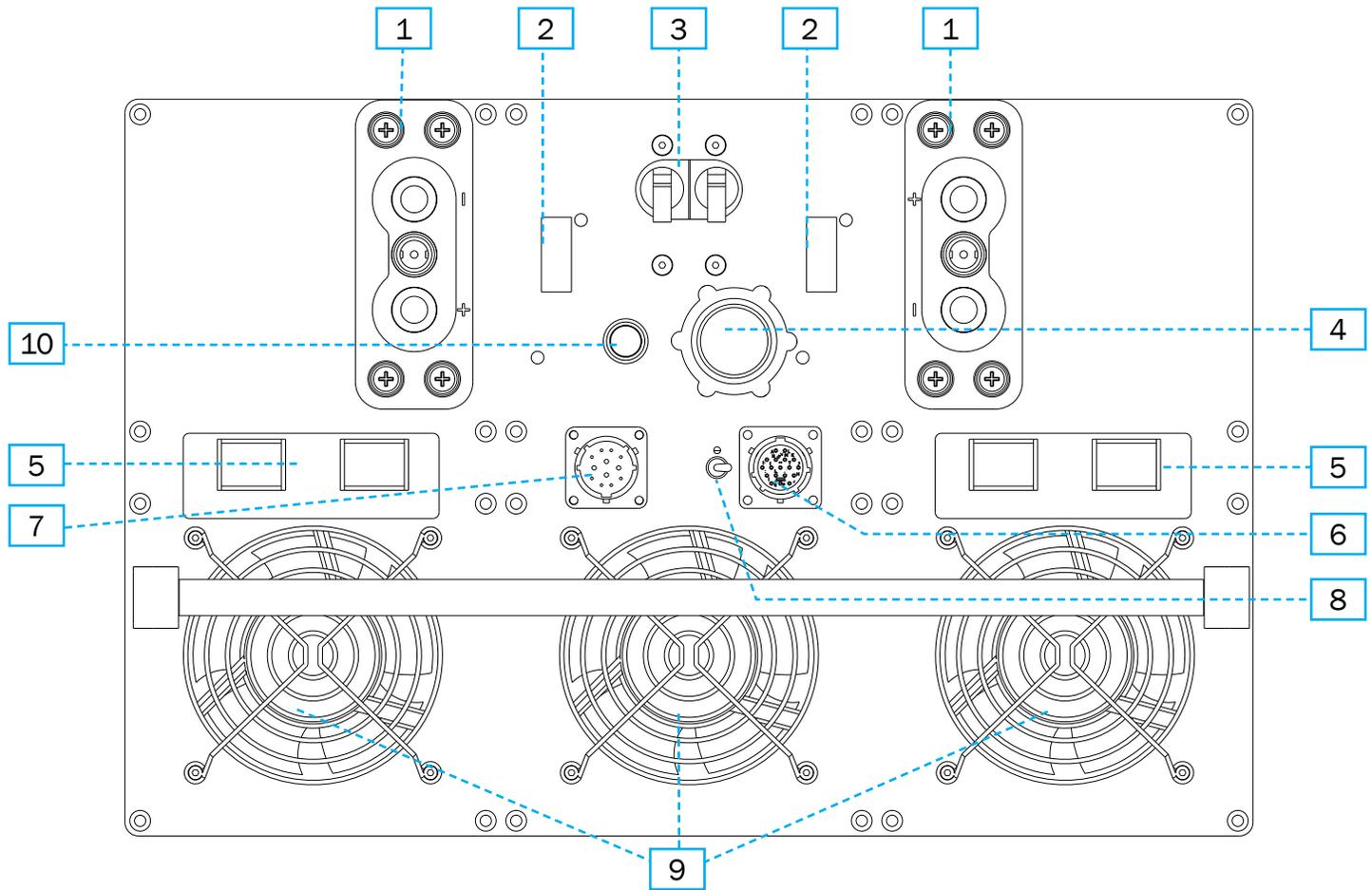


Figure 3.4.1 – View of TI3950 GPU Front Panel

TI3950 Ground Power Unit

The TI10C Hybrid GPU comes equipped a TI3950 Ground Power Unit that can be removed for service only. The unit provides 28 Vdc at 150 amps. The unit locks into place to prevent shifting while transporting the TI10C Hybrid.

1 – DC Output Receptacles – The TI3950 is equipped with two isolated DC Output Receptacles, providing 28Vdc @ 75 amps per receptacle, located just below the DVAM panel in the GPU compartment.

2 – LED Charge Status Meters – Indicates battery charge state/power output status. See (10) “Push to Test” Button.

3 – AC Input Circuit Breaker – Trips under a fault condition when amperage exceeds 30 amps.

4 – AC Input Cable – Allows the GPU to be charged via ac wall outlet

5 – DC Output OFF and ON Buttons – Turns DC Output Receptacles Off (red) and On (green).

6 – Remote –

7 – Program Interface – For factory use only.

8 – Switch – To switch from local to remote

9 – GPU Air Intake – Pulls fresh air into GPU.

10 – “Push to Test” Button

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

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



CAUTION

Never press the “Push to Test” button while the unit is plugged into ac power for recharge, or plugged into aircraft for dc power output.

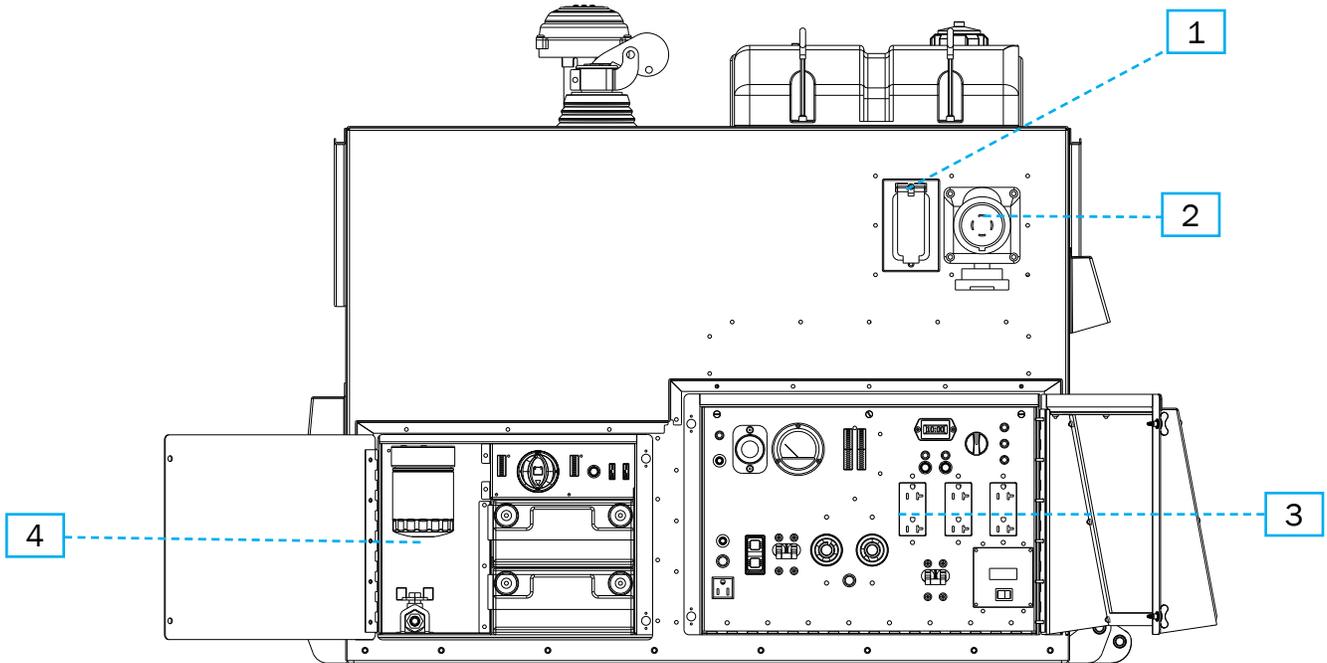


CAUTION

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



3.5 – TI10C Hybrid GPU Rear View



- 1 - 120/240 VAC Input Circuit Breaker - Trips if input exceeds 30 amps.
- 2 - 120/240 VAC Input 30 A Max - Allows TI10C Hybrid to be plugged into ac power.
- 3 - Rear Panel - See enlarged view (3.6) for breakdown of components.
- 4 - Engine Oil Filter/Battery Compartment - See enlarge view (3.7) for breakdown of components.

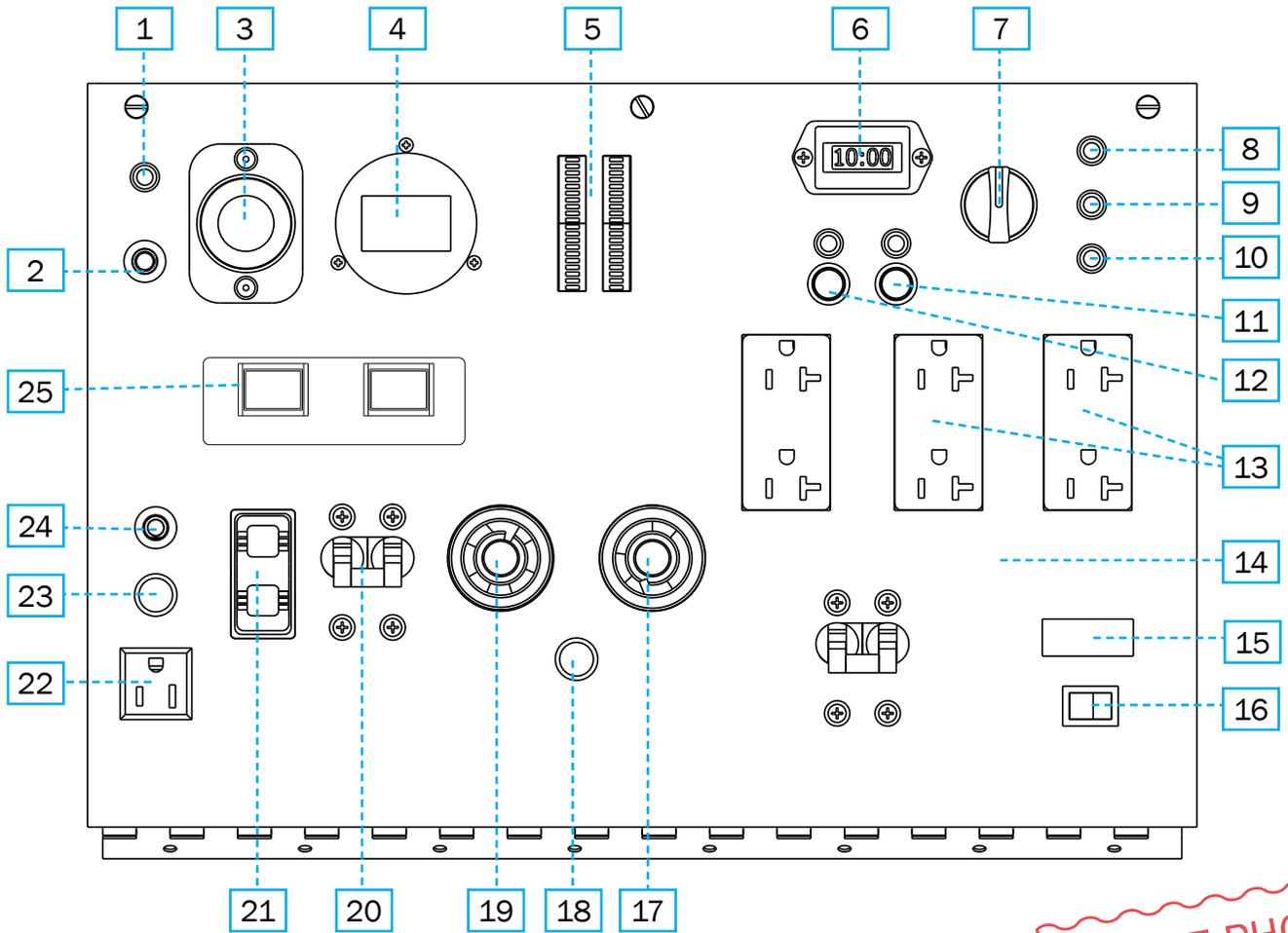


Figure 3.5.1- 120/240 Vac Plug



Figure 3.5.2- AC Power Circuit Breaker

3.6 - TI10C Hybrid GPU Rear Panel Enlarged



UPDATE PHOTO



1 – 12 VDC Output-Indicator Light – Illuminates when 12 Vdc output is in use.

2 – 10 Amp Circuit Breaker – Trips if dc output exceeds 10 amps.

3 – 12 VDC Output-10 amps max

The TI10C Hybrid GPU offers a car cigarette lighter style 12 Vdc output to accommodate a cell phone charger or other device that runs on 12 Volt dc power. The 12 Vdc Output and Circuit Breaker are located on the top left of the TI10C Hybrid GPU’s main panel. When active, the outlet will provide 12 Vdc at 10 A max. If the load exceeds 10 A, the circuit breaker will trip. The 12 Vdc Output Indicator Light Illuminates when the 12 Vdc output is in use, and flashes when on standby.



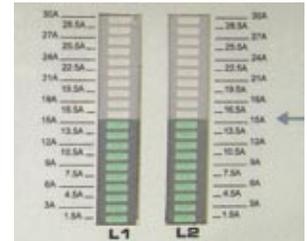
4 – AC Voltage Meter

The AC Voltage Meter, located to the right of the 12 Vdc Output on the TI10C Hybrid GPU’s main control panel, allows the user to see the amount of voltage being produced by the generator.



5 – LED AC Amp Meters

The dual current meter is located to the right of the AC Voltage Meter on the TI10C Hybrid GPU’s front panel. The dual current meters display both legs of the ac generator with multi-color bar graphs.



6 – Engine Hours Meter

The Engine Hours Meter is located at the upper right hand corner of the TI10C Hybrid GPU’s front panel. This meter allows the user to monitor the engine’s total running time in elapsed hours for scheduling routine maintenance.



7 – Engine Control Dial

The Engine Control Switch is to the right of Engine Hours Meter. The dial has three positions: “Off”, “Run”, and “Start”. In the “Run” position, power is available for the starter and other engine accessories. Turning the switch to the “Start” position will energize the starter motor and initiate the generator engine.



The TI10C Hybrid GPU comes equipped with three indicator lights located to the right of the Engine Control Switch that aid in monitoring the status of the engine. The Oil Cooler Light, the Engine Fan Light, and the Low Oil Pressure Light

8 – Oil Cooler Indicator Light

The Oil Cooler Light indicates that the engine circulation system is in operation. The engine temperature switch turns on the engine oil circulation system at 180° F and shuts it off at 160° F to maintain a constant engine oil temperature.

9 – Engine Fan Indicator Light

The Engine Fan Light Indicates that the engine compartment air circulation system is in operation. The engine compartment temperature switch will turn on the engine compartment exhaust fan to help maintain the air temperature below 130° within the engine compartment.

10 – Low Oil Pressure Indicator Light

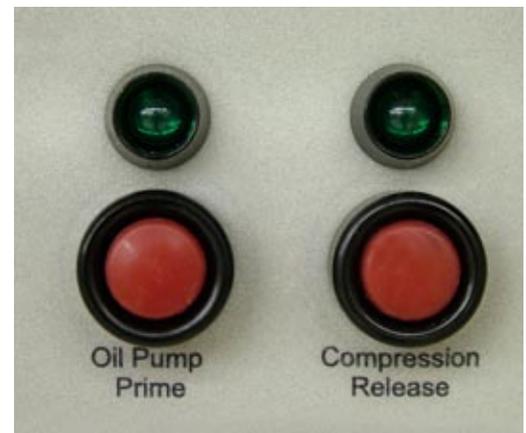
The Low Oil Pressure Light indicates that the engine oil lubrication system's pressure is below 8 PSI. The light should be illuminated during starting procedures, and should go out once the engine is started. The engine should shut down immediately if the light comes on during engine operations. If the engine fails to shut off, shut down the engine and refer to the Troubleshooting Section of this manual.

11 – Oil Pump Prime Button and Indicator Light

The Oil Pump Prime Button is used to manually circulate oil throughout the engine after oil filter replacement. It is also used for routine engine maintenance. When the button is pressed, the green light above it will illuminate to indicate that the oil pump is receiving power.

12 – Compression Release Button and Indicator Light

The Compression Release Button must be pressed before starting to release engine pressure and make it easier to start the engine. When pressed, the Compression Release releases compression in the diesel engine combustion chamber to allow for easier rotation of the engine during the initial electrical start sequence, during manual



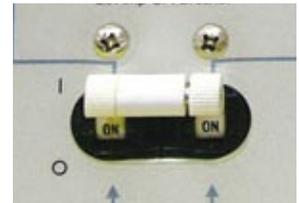
13 – Dual 120 VAC 60 Hz Output Outlets

When active (powered by the generator), the 120 Vac 60 Hz Output will provide 120 Vac at 20 amps per duplex. The GFCI outlet is a ground fault interrupter that can disconnect or open the power to a receptacle. The GFCI can tell the difference between the flow of the current from a hot wire that flows through a neutral. If the difference is significant, the circuit is tripped by the ground fault. The GFCI Outlet has a test button and a reset button. If the outlet is working correctly, you can press the test button and the outlet will be shut down until you press the reset button. The outlets are designed to protect electrical items as well as the people who handle the items.



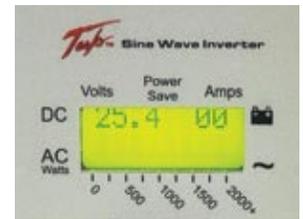
14 – 20 AMP GFCI Breaker

The 20 Amp GFCI Circuit Breaker, provides power to the two 120 Vac 60 Hz GFCI duplex outlets. It protects the internal circuits from being overloaded.



15 – Inverter Display Panel

The Inverter Display Panel provides information about the dc input voltage and current levels as well as the amount of ac power going out. If either the 60 Hz AC Inverter Power Switch or the Inverter On/Off Switch are switched “OFF” the Inverter Display Panel LCD will turn off, indicating that the inverter is “OFF.”



16 – 2 kW Pure Sine Wave Inverter On/Off Switch

Enables/disables inverter output. The AC Output, controlled by the Inverter, is located in the storage compartment



The 240 Vac 60 Hz Outlets are located on the bottom center of the rear main control panel. There are two standard NEMA outlets for 240 Vac; one 3-wire and one 4-wire receptacle. The combined max current load on both of these outlets is 20 amps.

17 – 4- Wire 240 VAC 60 Hz Output – Provides 240/120 Vac @ 20 amps for a 4-wire plug.

18 – 240 VAC 60 Hz Output Indicator Light – Indicates that the 240 Vac plugs are on.

19 – 3-Wire 240 VAC 60 Hz Output – Provides 240 Vac @ 20 amps for a 3-wire plug.



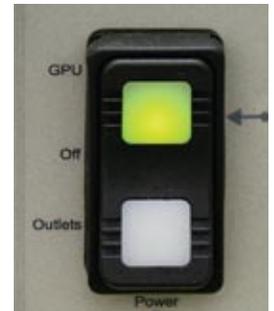
20 – 30 Amp Main Circuit Breaker

The 30 Amp Main Circuit Breaker provides power to the AC Output Selector Switch and protects the internal interlock circuitry from potential shorts within the system.



21 – Output Selector Switch

The Output Selector Switch is located to the left of the 30 Amp Main Circuit Breaker, and allows the operator to select “GPU Power” and energize the forward loaded GPU’s for up to 150 amps of continuous current at 28.5 Vdc. Or, the operator can select the “AC Outlet Power” and both 120 Vac and 240 Vac are available through four standard outlets shown in Sections 4.12 and 4.14



The 120 Vac 60 Hz Output Power Outlet and 1 amp Circuit Breaker are located on the bottom left of the GPU’s control panel next to the three way selector switch. When the generator is active, the Power Outlet will provide 120 Vac at 1 A continuous. If the load exceeds 1 A, the Output Circuit Breaker will trip. The outlet is a convenient place to plug in laptops, cell phone chargers and similar devices.

22 – 120 VAC 60 Hz AC Output Outlet – Provides 2000 W (16.66 amps) Cont. Powered by Inverter.

23 – 120 VAC/60Hz Outlet Indicator Light – Indicates power at the outlet.

24 – 1 Amp Circuit Breaker – Circuit breaker trips if output exceeds 1 amp.



25 – GPU DC Output Switch

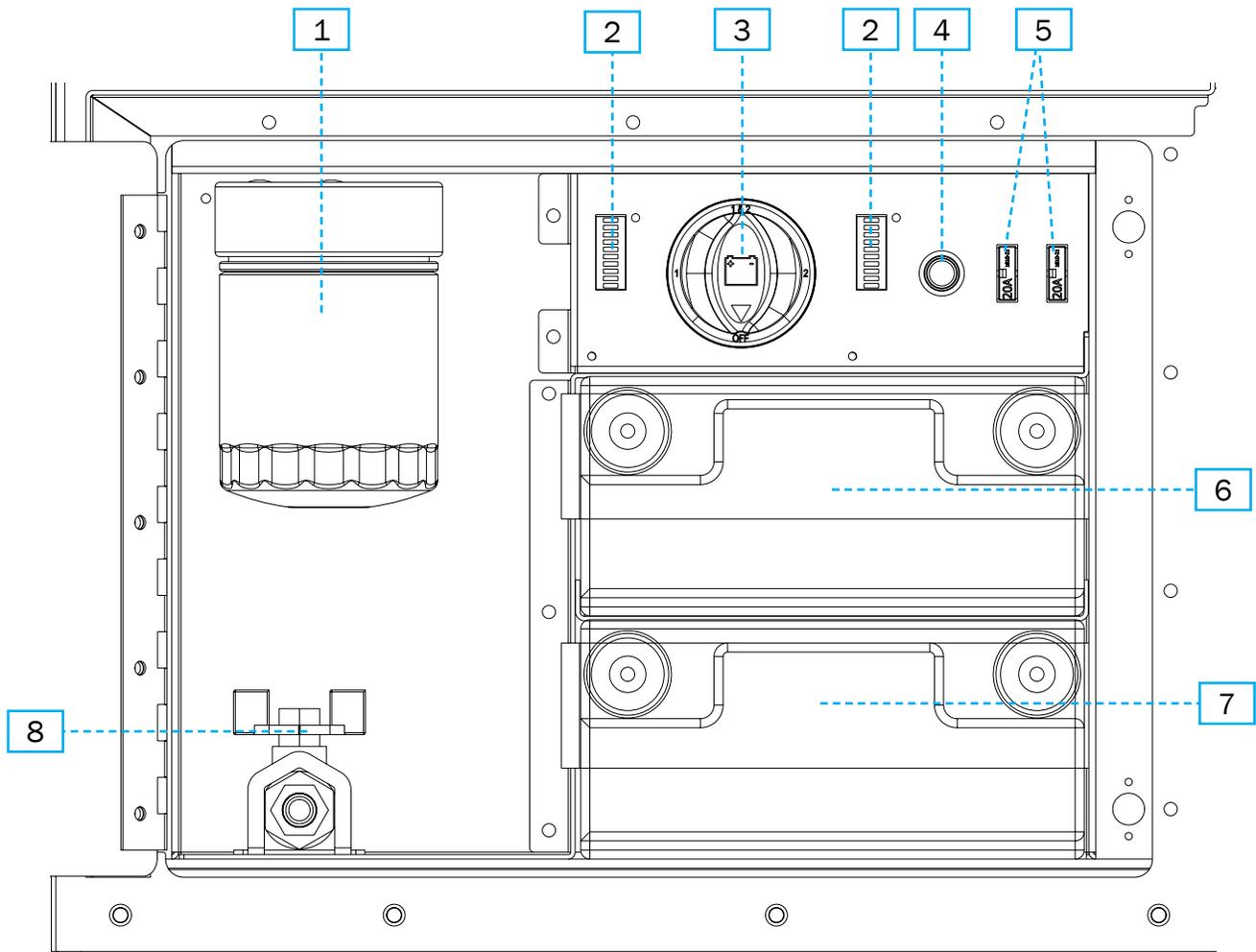
The TI3950 GPU is now ready to safely transfer up to 6000 amps. When ready, press the unit’s DC Output “ON” Button. The button should illuminate green. DC power should be on and the aircraft’s voltmeter should read between 23 and 24 Vdc.



To transfer power internally to the aircraft, the user should follow system operating procedures as specified in the aircraft’s operator manual.

When power is no longer needed, make sure to press the DC Output “OFF” Button before disconnecting any plugs. Once confirming that the DC Output is “OFF” the user can safely proceed to disconnect the cable.

3.7 – Engine Oil Filter/Battery Compartment

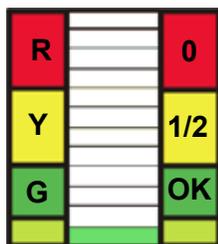


1 – Oil Filter

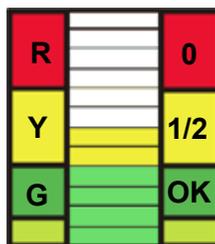
The TI10C Hybrid GPU uses a standard spin-on oil filter that can be ordered using **NSN# 2940-01-154-5127**. The filter screens out impurities in the oil that could cause damage to the engine.



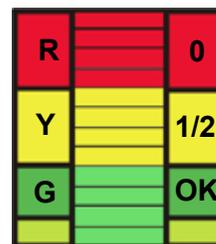
2 – Capacity % Indicators - Left Indicator Shows status of charge for Battery 1 (Top). Right Status is for Battery 2 (bottom).



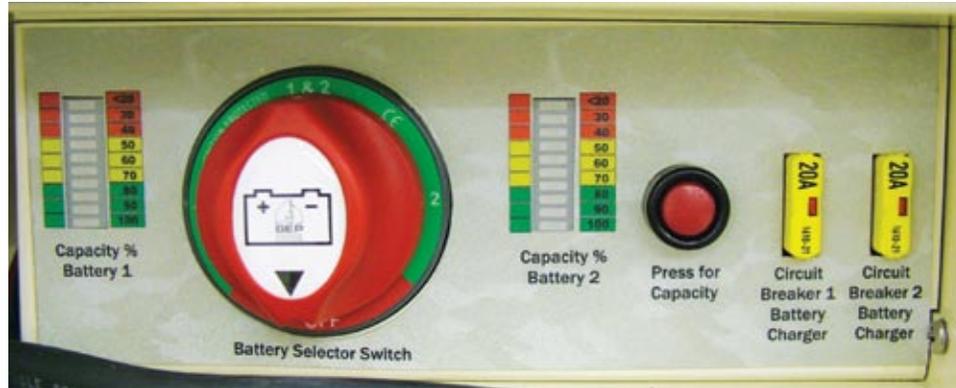
Full Charge



Half Charge



No Charge



3 – Battery Selector Switch

The TI10C Hybrid is equipped with dual 12 volt starter batteries (1 and 2) that can be selected with the Battery Selector Switch. To use both batteries, switch to “1 & 2”.



NOTE

Set the Battery Selector Switch to the “OFF” position when not in use.

4 – Press For Capacity Button

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.

5 – Charging System Circuit Breakers

The Circuit Breakers help protect the batteries and the charging system from short circuits. Charge time should take 25 minutes per battery, after 25 minutes if the bar graph indicators are in the yellow to red areas, see troubleshooting section.

6 – Battery 1

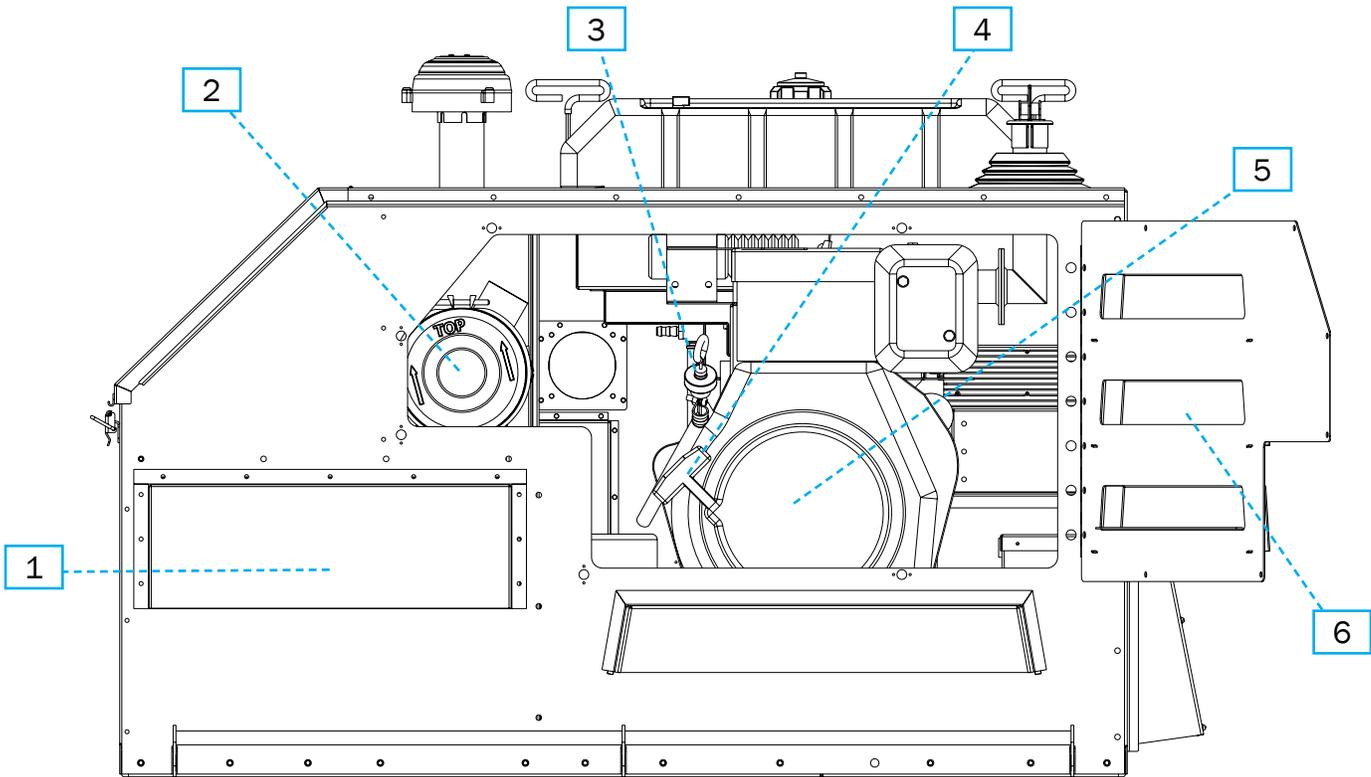
7 – Battery 2

8 – Oil Drain Valve

The Oil Drain Valve is located in the bottom left of the battery compartment. Turning the T-Handle releases the engine oil.



3.8 – TI10C Hybrid GPU Left Side View



1 – GPU Exhaust Louver - Vents hot air from GPU. (see next page)

2 – Air Filter

The TI10C Hybrid Air Filter prevents abrasive particles from entering the engine’s cylinders, reducing mechanical wear and oil contamination. Replacement air filters can be reordered using **NSN# 2940-01-235-3676**.



3 – Oil Dipstick and Oil Fill Tube

A specially designed oil dipstick has been positioned for easy access. When the dipstick is removed, engine oil can be added through the tube. The oil should be changed every 300 engine hours.



4 – Engine Pull Start

A 10 horsepower, 26.5 cubic inch, Overhead Valve (OHV) Engine comes with an electric starter. In the unlikely event that the TI10C’s starting batteries become discharged, a manual pull cord can be used to start the unit. Refer to Section 6.4 for Manual Pull Start procedures.

5 – Engine - 10 horsepower, air-cooled, OHV engine.

6 – Engine Compartment Air Intake - Introduces fresh air into the engine compartment. (see next page)



3.9 – Air Intake and Exhausts



CAUTION

Damage may occur if the TI10C Hybrid GPU's air intake or outlet ports are obstructed. Ensure that all ports are clear at all times.

The TI3950 GPU is equipped with its own internal cooling fans on the front and an exhaust port on the back. When GPU is mounted in the Hybrid, the cooling air is drawn in through the right side and exhausted through the GPU exhaust port on the left side of the Hybrid. (See Figure 3.9.1)

The Engine Lubrication System has its own cooling fan and radiator located on the lower right side of the engine compartment. It draws cooling air from the right side GPU compartment and discharges it through the radiator and out the right side oil cooler louver.

The Engine Compartment Cooling System is comprised of louvers on the both right and left engine compartment doors. The louvers on the left engine compartment door draw in air to be brought across all components within the engine compartment. The heated air is then discharged by the engine compartment cooling fan out the right side engine compartment door. There is a temperature switch on top of the generator housing that turns the engine compartment cooling fan on when the external temperature of the generator reaches 130°F. (See Figure 3.9.2)

Engine Cooling Air is drawn into the engine housing via the flywheel through the left side engine compartment door. It is then circulated around the engine and then ducted to the right side engine cooling air port. (See Figure 3.9.2)

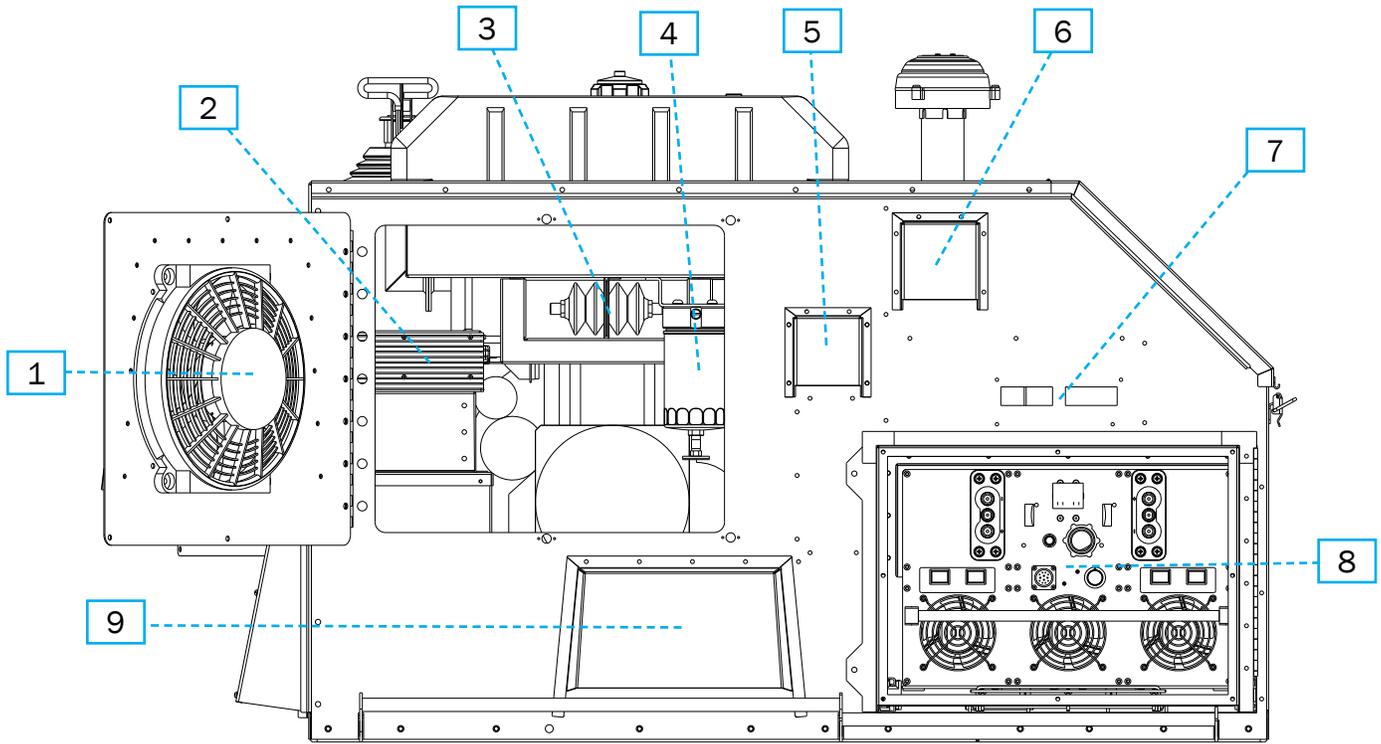


Figure 3.9.1 – GPU Exhaust Louver (outlined in red)



Figure 3.9.2 – Engine Compartment Air Intake

3.10 – TI10C Hybrid GPU Right Side View



1 – Engine Compartment Cooling Fan – Allows heated air to exit engine compartment.

2 – Dual Internal Battery Chargers

The TI10C Hybrid is equipped with Dual Internal Battery Chargers. Located on the right side engine compartment, these units recharge dead batteries faster than any other product of comparable size. Additionally, all models incorporate an intelligent recharging circuit that prevents overcharging and provides pure dc output for efficient battery conditioning.



3 – Fuel Bladder – Holds fuel to allow engine to run for up to 5 minutes at 75% load when fuel tank is removed.

4 – Fuel Filter

The main function of the fuel filter is to filter out, or trap, debris particles and/or contaminants from flowing fuel. It ensures that the fuel entering the TI10C Hybrid’s engine is as clean and pure as possible. The filter can be reordered using **NSN# 2910-01-376-5666**. The Fuel Filter should be replaced every 300 running hours. Water should be drained from the fuel filter after 10 hours of constant use.



5 – Engine Heat Shroud Exhaust - Vents hot air out of engine compartment.

6 – Inverter Air Exhaust Louver - Vents heated air from the inverter.

7 – Digital Volt/Amp Meter(DVAM)

The T110C Hybrid is equipped with power monitoring for the dc outputs known as Digital Volt/Amp Meter (DVAM) located on the right panel of the Hybrid. Two backlit LCD displays register the output dc voltage and current up to 2000 amps. The built-in DVAM indicates the aircraft or vehicle's current demand. The left meter indicates dc voltage output and the right meter indicates amperage draw. The DVAM continually monitors the dc output of the GPU through the built-in junction interface box. The DVAM is a valuable troubleshooting tool, as it enables the user to easily isolate faults.



8 – TI3950 GPU Front Panel - Details of front panel on Section 3.4.

9 – Oil Cooler Exhaust Louver – Allows hot air from oil cooler to vent.

Section 5 – Pre-Operation Procedures

5.1 – Checking Fluids and Filter

Before operating the T110C Hybrid, it is recommended that all Pre-Operation Procedures be completed.

Check Fuel

Begin by removing the cap of the fuel tank and looking into the tank (see Figure 5.1.1.) If the tank is full of fuel, proceed to next step. If the tank needs to be filled, use only JP4, JP5, or JP8 fuel. It is recommended to add ½ fl. oz. of two-stroke oil per gallon to the fuel. Adding oil will add lubricity to the fuel pump and fuel injector and extend the life of components. **JP4, JP5, JP8, ONLY. Using any grade of gasoline will cause damage to Engine and void warranty.** If tank is completely empty refer to section 6.2.



Figure 5.1.1 – Fuel Cap

Check Oil

Begin by removing the oil dipstick and wiping it clean with a cloth. Then, replace the clean dipstick, making sure to push it all the way in, then pull it back out and hold it horizontally in front of you. If the oil on the stick is at the “Low” line, add 10 to 12 oz. of oil and recheck to ensure that the oil has reached the “Full” line. Add oil by unscrewing the dipstick cap, pouring in the oil and replacing the cap.

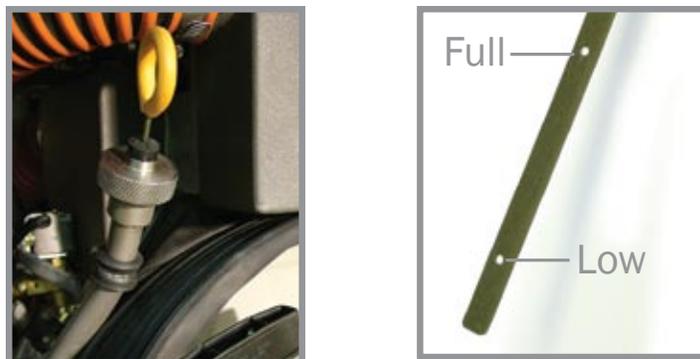


Figure 5.1.2 – Oil Dipstick and Fill Line

Check Air Filter

Check the Air Filter by first unscrewing wing screw at the top of the filter cover (see Figure 5.1.3). After pulling off the cover, remove and inspect the air filter. Replace filter if necessary, then replace cover and tighten wing screw. (See Figure 5.1.4). Order replacement air filter with **NSN# 2940-01-235-3676**.



Figure 5.1.3 – Unscrewing Filter Cover



Figure 5.1.4 – Inspecting Air Filter

5.2 – Maintenance Check

Check the unit for dents, punctures, case distortion or misalignment, and cracked or loose connectors. Check cables for cuts, chafing or evidence of crushing. Check connectors for cracks, cuts, distortion, excessive wear, broken/loose fasteners, and cables or strain reliefs. Also be sure to check the tires. If no external damage is evident, proceed to the next step. Otherwise, contact Tesla™ for further instructions.

Section 6 – Operating Procedures

6.1 – Operating Overview

In this section you will become familiar with electric and manual starting procedures, shut down procedures, switching from wall power to generator power, cable configuration, as well as GPU operations.

6.2 – Bleeding the Fuel Line

NOTE: This procedure will only have to be done the very first time you start the TI10C Hybrid, or if you need to start the TI10C Hybrid after completely running out of fuel. You will need a rag and a flat head screwdriver for this procedure.

1. Fill the tank completely with fuel, Ensure that all Quick-Disconnects are connected (See Figures 6.2.1 and 6.2.2) 1. and Fuel Drain Cock (See Figure 6.2.3) is unscrewed all the way. It is recommended to add ½ fl. oz. of two-stroke oil per gallon to the fuel. Adding oil will add lubricity to the fuel pump and fuel injector and extend the life of components. **JP4, JP5, JP8, ONLY.**
Using any grade of gasoline will cause damage to Engine and void warranty.



Figure 6.2.1– Supply Quick-Disconnect



Figure 6.2.2– Return Quick-Disconnect



Figure 6.2.3– Fuel Drain Cock

2. Hold rag beneath Fuel Filter Bleeder Screw (See Figure 6.2.4) Loosen screw, do not unscrew completely.
3. In approximately 30 to 60 seconds fuel should begin to flow, tighten screw.
4. Turn Manual Bypass “ON” (See Figure 6.2.5).
5. Hold rag beneath Bleeder Screw (See Figure 6.2.6). Loosen screw until an even flow of fuel begins to run, do not unscrew completely.



Figure 6.2.4– Fuel Filter Bleeder Screw

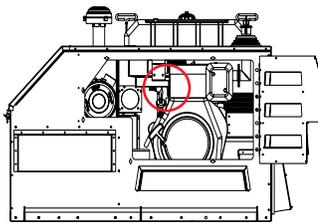


Figure 6.2.5– Manual Bypass



Figure 6.2.6– Bleeder Screw

6. Tighten Bleeder Screw and turn Manual Bypass “OFF”. **Failure to turn Manual Bypass “OFF” will cause damage to Engine and void Warranty (refer to Figure 6.2.7.)**
7. Loosen the High Pressure Fuel Line Bleeder Valve (Figure 6.2.8) by unscrewing the T-handle counter-clockwise one full turn. If T-handle becomes tight, stop unscrewing. Attempting to unscrew valve all the way will damage the seals and cause a fuel leak.



Figure 6.2.7– Manual Bypass “OFF” Position

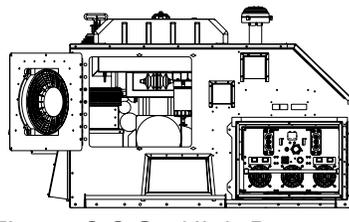


Figure 6.2.8– High Pressure Fuel Line Bleeder T-handle



8. Be sure that all circuit breakers are in the “Off” position (See Figure 6.2.9).
9. Be sure that the Output Selector Rocker Switch is in the middle, or “Off” position (See Figure 6.2.10).



Figure 6.2.9– Location of Circuit Breakers

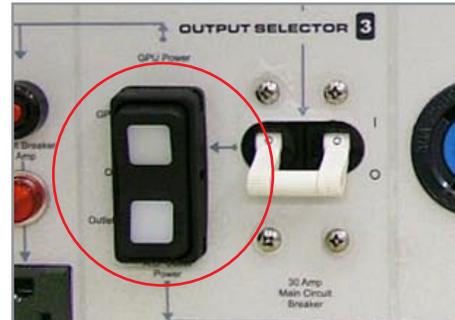


Figure 6.2.10– Output Selector Rocker Switch

10. Push “Press for Capacity” button (located in battery compartment) to check status of battery. (See Figure 6.2.11).
11. Rotate Battery Selector Switch (See Figure 6.2.11) to select Starter Battery 1 or 2 (depending on state of charge.)

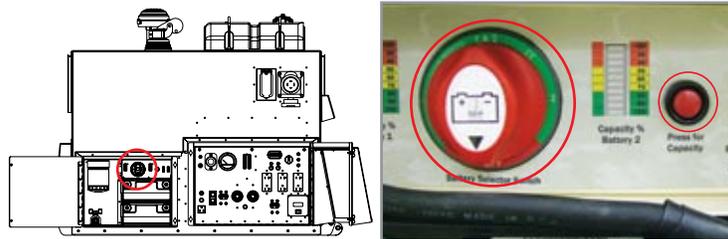


Figure 6.2.11 – Starter Battery 1 or 2 Selector Switch and “Press for Capacity” button

12. This step requires a second person to perform the operation. Hold in Compression Release Button while simultaneously turning Engine Control Switch to “Start” position and crank engine until second person has observed that air bubbles have cleared PVC tube (See Figure 6.2.13). If clear tube has no flow of fluid or air bubbles after cranking engine for 15 seconds, then repeat Steps 4-6.

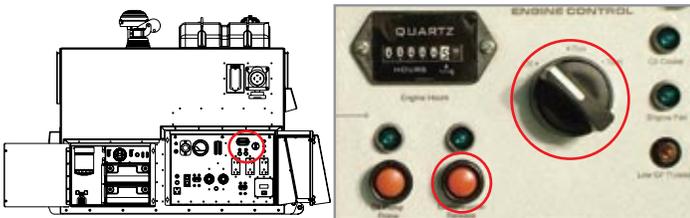


Figure 6.2.12– Compression Release Button and Engine Control Switch

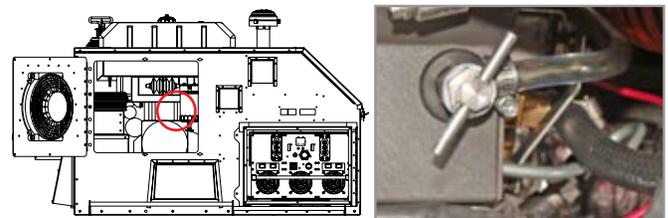


Figure 6.2.13– Fuel Line Clear PVC Tube

13. Tighten the High Pressure Fuel Line Bleeder Valve by rotating clockwise (See Figure 6.2.13).
14. Attempt to start Engine (See Section 6.3 and 6.4). It is normal for Engine to shut off during initial start. If Engine is shutting off, press and hold the Compression Release Button to prevent the Engine from rocking violently. Steps 7-13 may have to be repeated until Engine is running and all the air has cleared the fuel system.
15. If Engine stays running, Safely dispose of rag.
16. Refer to Engine shutdown procedure (Section 6.5) to turn off engine.

6.3 – Starting Procedures using Electric Starter

1. Push “Press for Capacity” button to check status of battery.
2. Be sure that all circuit breakers are in the “Off” position.
3. Select Starter Battery 1 or 2 (depending on state of charge.)
4. Rotate the engine control switch to the “Run” position.
5. Push and release the Compression Release Button. Rotate the Engine Control Switch clockwise to the “start” position.
6. Once the engine is started, release the engine control switch, ensuring that it returns to the “Run” position.
7. Allow engine to run for two minutes before selecting power output.
8. Flip Main Breaker to “On” position.
9. Position Output Selector Switch to “Outlets.” The 240 Vac 60 Hz Output Indicator Light Lamp should illuminate.
10. Flip the 20 Amp circuit breaker to “On” and the two 120 Vac Outlets will come on (illuminate.)
11. It is now safe to plug in electronic devices into the appropriate outlets.

6.4– Starting Engine using Manual Pull Start

1. Be sure that the Main Breaker is in the “Off” position.
2. Switch to “Battery 1.”
3. Rotate the engine control switch to the “Run” position.
4. Open left engine cover.
5. Bypass electric fuel solenoid by rotating Manual Bypass Lever to “On” position. (See Figure 6.4.1.)
6. Pull cord until you feel resistance (compression stroke).
7. Engage compression release by rotating red lever on the top of engine. (See Figure 6.4.2.)
8. Pull start cord vigorously. (If engine does not start repeat steps 6 and 7.)
9. Rotate the manual bypass lever to the “Off” position.
Failure to turn Manual Bypass “OFF” will cause damage to Engine and void Warranty (refer to Figure 6.2.7.)



Figure 6.4.1– Manual Bypass Lever



Figure 6.4.2– Compression Release Lever

6.5 – Engine Shutdown

1. Turn off all output selectors: Main Power, AC Outlet Power, and GPU outputs.
2. Unplug any equipment from the TI10C Hybrid’s 28.5 Vdc and ac outputs.
3. Return all cables to storage compartment.
4. Allow engine to run for 2 minutes while not under external load.
5. Rotate the engine control switch to the “Off” position.
6. If Engine does not turn off, rotate the control switch back to the “Run” position. Make sure the manual bypass is in the “Off” position (See Figure 6.2.7). Repeat Step 5.
7. Push and hold the Compression Release Button until engine completely shuts down.
8. Rotate Battery Selector Switch to the “Off Position”.

6.6 – Wall Power Procedure - Single Phase 120/240 VAC

1. Be sure that the Main Breaker is in the “Off” position.
2. Plug 120/240 Vac Twist Lock into the wall socket.
3. Plug 120/240 Vac Twist Lock into the Hybrid. (See Figure 6.6.1)
4. Switch on AC Power Circuit Breaker, located next to plug. (See Figure 6.6.2)
5. Switch Main Breaker to “On” position.
6. To disconnect power from the wall, first turn off main breaker, then breaker next to ac cord, then unplug cord from the wall.



Figure 6.6.1- 120/240 Vac Plug



Figure 6.6.2- AC Power Circuit Breaker

6.7 – Switching From Generator Power to AC Wall Power

1. Plug AC Line Cable into the Single Phase 120/240 Vac 30 amp input located above the main control panel on the T110C Hybrid.
2. Plug the AC Line Cable into a Single Phase 120/240 Vac power outlet.
3. Flip breaker next to ac line cable to “On” position.
4. Flip Main Breaker to “On” position.
5. Rotate Battery Selector to “Battery 2”
6. Shut generator off by turning switch to “Off” then pushing Compression Release Button until engine is completely off.
7. Any time power is switched from generator power to wall power, or vice versa, power from the T110C will be lost for 3 seconds unless equipment is plugged into inverter outlets. The dc outputs of the GPU must be on.

NOTE: Battery Selector Switch must be on “Battery 2” when running in the ac wall power mode. This will charge battery 2.??????????

6.8 – Switching From AC Wall Power to Generator Power

1. Press the Compression Release button on the main control panel.
2. Start engine.
3. Flip Main Breaker for external ac power source to “Off” position.
4. Remove 120/240 Twist lock from the Hybrid.
5. Rotate Battery Selector switch to “Battery 1.”
6. Any time power is switched from generator power to wall power, or vice versa, power from the T110C will be lost for 3 seconds unless equipment is plugged into inverter outlets.

6.9 – Regulated 28.5 VDC Output Ground Power

**CAUTION**

Make sure that the unit is at least 20 feet (6 meters) away from the nearest fueling source before connecting the DC plug.

Selecting 28.5 VDC Power Output from GPU

Set Main Circuit Breaker to “On” position (see Figure 6.9.1). Set the Output Selector to “GPU Power” (see Figure 6.9.2), and the green light will illuminate.

Attaching DC Plug Cable Assembly – Main Aircraft Engine Startup

NOTE: Ensure that the DC outputs are switched off before attempting to connect DC cables to the unit.

Attach the DC Output Connector to the DC Output Receptacle by pushing the DC Plug into place and turning the T-handle on the plug one full rotation clockwise until it locks (shown in Figure 6.9.3).

Make sure that both DC Connectors are attached to DC outputs on the TI3950 GPU to get 150 amps DC (See Figure 6.9.3).

Attach Aviation Cable DC Connector to DC Output Junction Box (See Figure 6.9.4).

Next, attach the DC Aviation Plug to the aircraft, making sure that it is properly seated in the aviation receptacle. Consult the aircraft’s operator manual for receptacle location.



Figure 6.9.1 – Circuit Breaker to “On” position

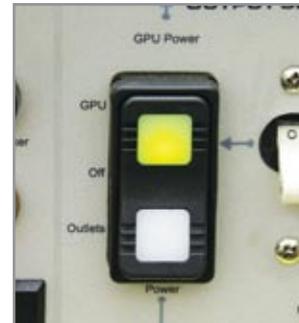


Figure 6.9.2 – Output Selector to “GPU Power”



Figure 6.9.3 – Both DC Cables connected to GPU



Figure 6.9.4 – Attach Aviation Cable DC connector to DC Junction Box

Activating/Deactivating the DC Output

The TI3950 GPU is now ready to safely transfer up to 6000 amps. When ready, press the unit's DC Output "ON" Button. The button should illuminate green (see Figure 6.9.5). DC power should be on and the Aircraft's voltmeter should read between 23 and 24 Vdc.

To transfer power internally to the aircraft, the user should follow system operating procedures as specified in the aircraft's operator manual.

When power is no longer needed, make sure to press the DC Output "OFF" Button before disconnecting any plugs. Once confirming that the DC Output is "OFF" the user can safely proceed to disconnect the cable.

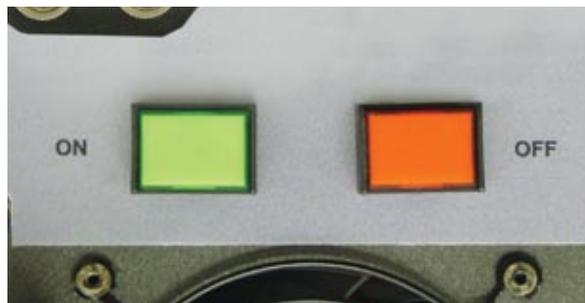


Figure 6.9.5 – DC Output Power Buttons

Monitoring DC Output with DVAM

Both dc volt and amp outputs can be monitored continuously and simultaneously for the GPU when using dc power cables. The DVAM can monitor and display up to 2000 amps. (See Figure 6.9.6)



Figure 6.9.6 – DVAM

AC Power to Outlet and GPU

When the Output Selector Switch is set to GPU Power, the 120 Vac 60 Hz Output Outlet and the TI3950 GPU are active. The 1 amp outlet can be used to plug in cell phone chargers, laptops and other devices that draw less than one amp.

6.10 – Selectable AC Power

Select AC Power Output

In order to select the ac power, complete the following steps with the TI10C Hybrid GPU's engine running or with the Hybrid plugged into ac power.

1. Set Main Circuit Breaker to “ON” position (up).
2. Set the Output Selector to AC Outlet Power.
3. Plug in equipment to proper AC Outlet. See below for more information on each type of outlet.

240 VAC 60 Hz Output

To activate the 240 Vac 60 Hz Outlets, switch the output selector to AC Outlet Power (see Figure 6.10.1). The red lamp will illuminate (see Figure 6.10.2) when the receptacle is live. In the event that the outlet does not work after resetting the Output Circuit Breaker (see Figure 6.10.1) contact Tesla™ for further instructions. The 240 outlet on the left accommodates a 3-wire plug, the other, a 4-wire plug. Once a plug is inserted into the receptacle it must be turned clockwise to lock it into place. To remove, turn the plug counter clockwise.

NOTE: Only 240 Vac devices should be plugged into these outlets. 120 Vac devices will be damaged.



Figure 6.10.1 – Switch to AC Outlet Power

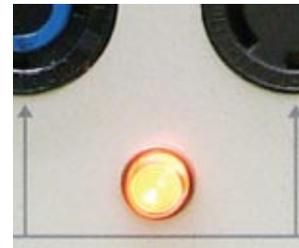


Figure 6.10.2 – Red Lamp illuminated

GFCI Outlet Test and Reset Buttons

The AC output is equipped with a GFCI outlet that will protect the user from potentially dangerous shocks from ground faults (see Figure 6.10.3). Pressing the “Test” button will trip the outlet and break the circuit. Pressing “Reset” will restore the circuit assuming no ground fault is present. The green LED will illuminate (see Figure 6.10.3) when the receptacle is live. In the event that the outlet does not work after resetting both the Output Circuit Breaker (see Figure 6.10.4) and the GFCI receptacle, contact Tesla™ for further instructions.

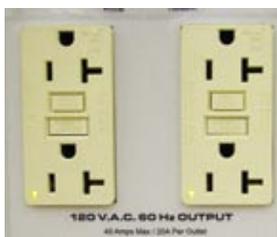


Figure 6.10.3 – 60 Hz 120 Volt AC Outlet with active GFCI receptacle (LED On)



Figure 6.10.4 – Circuit Breaker for 60Hz 120 Vac Output Receptacle

120 VAC 60 Hz Output (40 amps max. 20 amps per outlet)

Enabling the 60 Hz 120 VAC Power Outlets

To activate the 60 Hz 120 Vac Power Outlet, first set the 20 amp GFCI Breaker switch to the “ON” position (see Figure 6.9.4). This provides power directly from the generator to the outlet. You can now use the outlets to plug in electronic devices like cell phone chargers, laptops, and lighting.

Disabling the 60 Hz 120 VAC Power Outlet

When power is no longer needed, make sure to turn off the 120 Vac 60 Hz Output Circuit Breaker and switch the Output selector to “GPU Power.” This will charge TI3950 GPU. If needed, you can use the 120 Vac 60 Hz 1 amp outlet while charging the GPU.

TI10C Inverter Operations

1. Connect Inverter DC connector to DC Junction Box. (See Figure 6.10.5)
2. Make sure that the DC Connectors are attached to DC outputs on the TI3950 GPU to get 150 amps DC (See Figure 6.9.3).
3. Turn on the TI3950’s DC Outputs. The “On” button should illuminate. (See Figure 6.10.6)
4. Set the Inverter Control ON/OFF Switch to the ON Position, the LED display should illuminate. (See Figure 6.10.9).
5. The 120 Vac Outlet (Figure 6.10.7) for the INVERTER OUTPUT, the INVERTER CONTROL digital display should be active, and the 120 Vac outlet in the front compartment should be active (See Figure 6.10.8.)
6. Utilize outlets as needed.



Figure 6.10.5 – DC Junction Box



Figure 6.10.6 – TI3950 DC Output “On” Button Illuminated



Figure 6.10.7 – Inverter Outlet on Rear Panel



Figure 6.10.8 – Inverter GFCI Outlet.



Figure 6.10.9 – Inverter Control

6.11 – Inverter Power in Use



Figure 6.10.7 – Inverter Outlet on Rear Panel



Figure 6.10.8 – Inverter GFCI Outlet.

Section 7 – Post-Operation

7.1 – After Operation

When not in use, the TI10C Hybrid GPU should be stored indoors in a dry, temperature controlled area. To extend cell life, the Hybrid should be started, and the Output Selector should be set to GPU power, so that the GPU power cells are fully charged. Although the GPU is rugged and weather resistant, good general care should be taken to maximize the GPU's life. Therefore, protect the unit from the elements and man-made hazards whenever possible.

7.2 – Power Cell Recharging

The GPU has an intelligent recharging system that will enable it to rapidly recharge when the Hybrid is running. If the unit's power cells become fully discharged, the unit should be recharged within 24 hours to ensure maximum life and performance. A minimum of 38 minutes will be required to fully recharge the unit when plugging the TI10C Hybrid into 120/240 Vac wall power. Make sure that the power selector switch is set to "GPU Power."

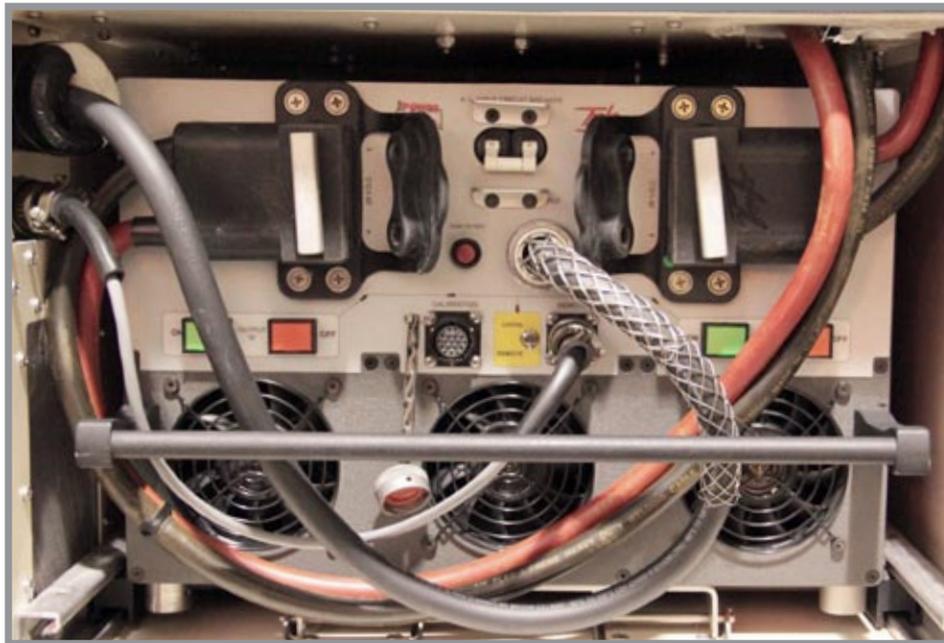


Figure 7.2.1 – TI3950 GPU

Section 8 – Unit Care and Maintenance



DANGER

Severe injury or death from electrical shock will occur if either the user or the TI10C Hybrid GPU is wet while operating the unit with an ac power source attached.



CAUTION

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

8.1 - Unit Care

Avoid Prolonged Exposure to Extremely Damp Environments

Be sure to disconnect ac power from the ac source if the TI10C Hybrid GPU 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 TI10C Hybrid GPU. 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 TI10C Hybrid GPU.



Figure 8.1.1 – Damaged cable

8.2 – Normal Function Test Procedures

This section deals with “normal function” test procedures, and includes all steps necessary to ensure that the TI10C Hybrid GPU is operating within specified parameters prior to use. A digital multimeter (an example is shown in Figure 8.2.1) 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 3.8.1 – Digital Multimeter

Check Unit for Evidence of Damage

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

Checking AC Voltage at the 120VAC and 240VAC output connectors.

1. NOTE: Before making an ac voltage check, the Hybrid needs to be running (see Section 6.3 for starting procedures) and the ac power needs to be turned on using the AC Power Output procedures.
2. Place Output Selector on “GPU Power.” Check the 120 Vac 1 amp receptacle on the Main Control Panel by placing the Black probe in the larger of the two “T” shaped (Neutral) sockets and the Red probe in the left socket (see Figure 8.2.2.) The meter should read approximately 120 Vac. Then place the Black probe in the “D” shaped socket (Ground), the meter should also read approximately 120 Vac (see Figure 8.2.3.)



Figure 8.2.2



Figure 8.2.3

3. While the Output Selector is on GPU Power, check the outlet that provides power to the TI3950 GPU, which is located on the top left hand side of the GPU slot. Place the Red probe on the left socket and the Black probe on the right socket. The multimeter should read approximately 240 Vac (see Figure 8.2.4). Then, move the Black probe to the “L” shape socket (Ground) and it should read approximately 120 Vac (see Figure 8.2.5). The reading should be the same if you keep the Black probe in the ground and place the Red probe in the right socket.



Figure 8.2.4



Figure 8.2.5

- While the Output Selector is on AC Outlet Power, check the 3-wire 240 Vac outlet located on the rear panel of the Hybrid. Place the Red probe on the left socket and the Black probe on the right socket. The multimeter should read approximately 240 Vac (see Figure 8.2.6). Then, move the Black probe to the “L” shaped socket (Ground) and it should read approximately 120 Vac (see Figure 8.2.7). The reading should be the same if you keep the Black probe in the ground and place the Red probe in the right socket.



Figure 8.2.6



Figure 8.2.7

- To check the 4-wire 240 Vac Outlet on the Rear Control Panel, first make sure that the output selector switch is on “AC Outlet Power.” Place the Red probe on left socket and the Black probe in the right socket (see Figure 8.2.8). The meter should read approximately 240 Vac. Then, move the Red probe to the “L” shaped socket and Black probe to the right socket – the multimeter should read approximately 120 Vac (see Figure 8.2.9). Then, move the Black probe to the left socket and the multimeter should read approximately 120 Vac. Lastly, move the Black probe to the bottom socket and the multimeter should read approximately 120 Vac.



Figure 8.2.8



Figure 8.2.9

- To check the 4 - 120 Vac receptacles you first have to turn on the 20 Amp GFCI Breaker. Then place the Black probe in the “T” shaped (Neutral) socket and the Red probe in the left socket, should read approximately 120 Vac (see Figure 8.2.10). Then place the Black probe in the “D” shaped socket (Ground), should read approximately 120 Vac. Do this for all for receptacles (see Figure 8.2.11). To test the GFCI Circuit press the “TEST” button until it clicks and the repeat the steps above for each receptacle. The multimeter should read 0 Vac with the GFCI tripped. Ensure that you reset the GFCI circuit by pressing the “RESET” button all the way in.



Figure 8.2.10



Figure 8.2.11

8.3 - Testing between the Chassis and the DC Output Receptacle

Checking Unit Internal Resistance (Testing for Shorts)

It is essential to test for shorts to detect any problems with the unit. To do so, you will need to set your multimeter to measure Ω or “resistance.” You can test to see if both DC Output terminals are isolated from the chassis ground and the line ground in the following steps. Place the red lead of the multimeter on one of DC Output Receptacle screws as shown in Figures 8.3.1 and 8.3.2. Next, touch the black lead of the multimeter to the negative pin of the DC Output Receptacle (see Figure 8.3.1). Do the same for the positive pin (see Figure 8.3.2). In both cases the meter should read open circuit (shown in Figure 8.3.3). If this is not the case, please contact Tesla™.



Figure 8.3.1 - DC Output Receptacle Negative pin



Figure 8.3.2 - DC Output Receptacle Positive pin

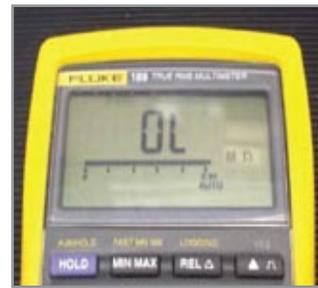


Figure 8.3.3 - Multimeter reading open circuit.

Function Test Complete

Once the TI10C Hybrid GPU has fully passed function test procedures, the GPU should be plugged into ac power and remain plugged in until required for use.

8.4 – Unit Servicing

The TI3950 GPU (The ground power unit within the Hybrid) 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 8.4.1 below). If the unit requires maintenance, please contact Tesla™ Customer Service at (302) 324-8910. A Repair Request Form can be found in the back of this manual.



Figure 8.4.1 – Warranty Void stickers Front and Back on the TI3950 GPU

8.5 – Packaging and Shipping

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

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



Figure 8.5.1 – Tesla Industries Shipping Container for the 10C Hybrid GPU

8.6 – Remove and Inspect Fuel Tank

1. Remove Fuel Tank

Note: Quick Disconnects have shut offs on both sides.

- a. Shut down generator set.
- b. Disconnect fuel return line quick disconnect. (Figure 8.6.1)
- c. Remove four T-handle fuel tank mounting screws. (Figure 8.6.2)
- d. Raise fuel tank to gain access to primary fuel line under tank. (Figure 8.6.3)
- e. Disconnect primary fuel line quick disconnect coupling from fuel tank. (Figure 8.6.4)
- f. Remove and set aside fuel tank.

2. Inspection

- a. Shut down generator set.
- b. Remove fuel tank
- c. Inspect fuel tank for leaks and cracks.
- d. Inspect fuel lines, quick disconnects, and fittings for leaks, cracks, dry rot, and any other damage.

3. Install Fuel Tank

- a. Use a clean rag and wipe off all fuel line quick disconnects and fuel tank mounting tray.
- b. Set fuel tank on top of unit.
- c. Connect primary fuel line from tank to bulk head.
- d. Place fuel tank into mounting tray, make sure that holes align with thread inserts.
- e. Install (4) T-handle fuel tank mounting screws. Hand tight only.
- f. Connect fuel return hose quick disconnect.
- g. Service fuel tank with JP-4, JP-5, or JP-8 fuel. Bleed fuel lines if necessary. Refer to Section 6.2.
- h. Start generator set and check for leaks and proper operation.
- i. Shut down generator set.



Figure 8.6.1 – Fuel return line quick disconnect



Figure 8.6.2 - T-handle fuel tank mounting screws



Figure 8.6.3 – Removing Fuel Tank



Figure 8.6.4 -Primary fuel line quick disconnect

8.7 – Changing Air Filter -- Replace with NSN #2940-01-235-3676

1. Removal

- a. Shut down generator set.
- b. Open left side engine compartment access door.
- c. Loosen clamp (Item 1) and remove cap (item 2).
- d. Remove wing nut (item 3) and air filter element (item 4).

2. Cleaning and Inspecting

- a. Remove air filter element (item 2).
- b. Wipe inside of air cleaner housing (item 5) and cap (item 2) with clean rag.
- c. Inspect filter (item 4) for clogs and damage, and replace as necessary.
- d. Install air filter element (item 4).

3. Installation

- a. Install air filter element (item 4) and wing nut (item 3). Hand tight only.
- b. Install cap (item 2) and tighten clamp (item 1) hand tight only.
- c. Close left side engine access door.

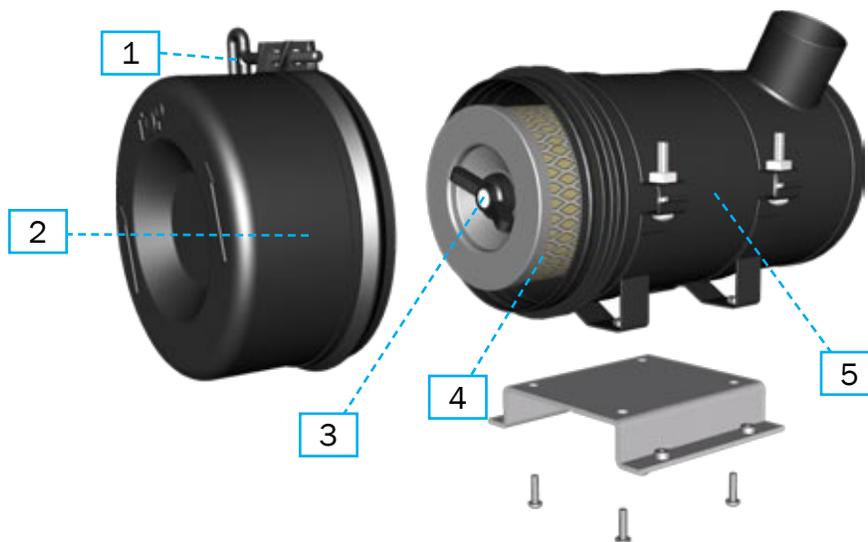
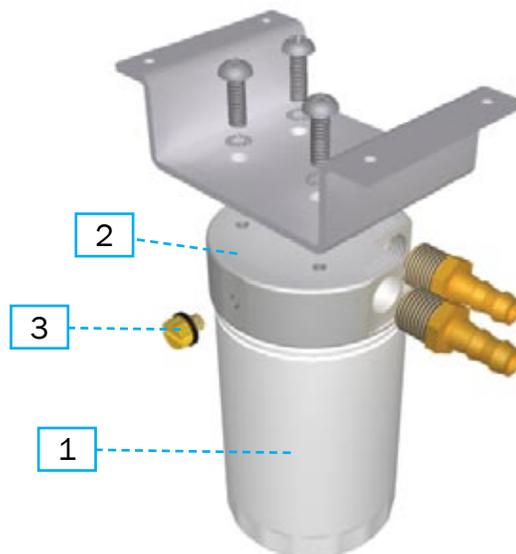


Figure 8.7.1 – Air Filter

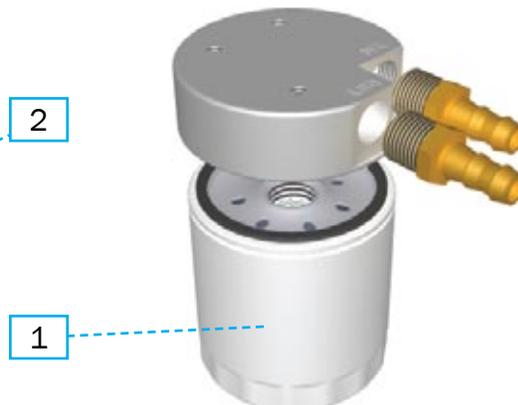
8.8 – Changing Fuel Filter – Replace with NSN# 2910-01-376-5666

- 1.** Removal
 - a.** Shut down generator set.
 - b.** Remove Fuel Tank (see Section 8.6).
 - c.** Open oil filter/battery compartment door, disconnect negative battery cable.
 - d.** Open right side engine compartment access door.
 - e.** Drain water and fuel from filter by unscrewing valve at bottom of the filter.
 - f.** Unscrew and remove fuel filter/water separator (item 1) from base (item 2).
- 2.** Inspect
 - a.** Remove fuel filter/water separator element (item 1).
 - b.** Inspect element for clogging, tears and other damage.
 - c.** Inspect fuel filter/water separator for damaged threads, cracks, or other damage.
 - d.** Replace fuel filter/water separator element (item 1) using Installation instructions below.
- 3.** Installation
 - a.** Open petcock valve on fuel filter/separator.
 - b.** Apply a thin film of fuel to the sealing surface of the fuel filter/water separator.
 - c.** Install fuel filter/water separator element (item 1) on base (item 2). Hand tight only.
 - d.** Tighten petcock valve (item 3) on fuel filter/separator.
 - e.** Install Fuel Tank. See Section 8.6.
 - f.** Refer to Section 6.2 - Bleeding Fuel Lines to remove air from fuel lines.
 - g.** Start up TI10C Hybrid to ensure that fuel system is properly functioning.



8.9 – Changing Engine Oil – Use Fully Synthetic Motor Oil (Mobil 1) 5W-40

1. Removal
 - a. Shut down generator set.
 - b. Open rear oil filter/battery compartment access door.
 - c. Place engine oil drain hose in oil drain pan and drain oil (item 2) by turning drain valve counter clockwise (See Figure 2).
 - d. Loosen oil filter (item 1) by turning filter counterclockwise with filter wrench.
 - e. Discard used filter.
 - f. Wipe down oil filter manifold to remove all used oil residue with clean rag.
2. Repair Replace old oil filter using NSN# 2490-01-154-5127.
3. Installation
 - a. Replace engine oil drain line and close drain valve.
 - b. Apply light coat of engine lubricating oil to new filter gasket.
 - c. Fill oil filter about 2/3 full of new engine oil - Use fully synthetic motor oil 5W-40.
 - d. Place oil filter on filter manifold and turn clockwise until oil filter is hand tight.
 - e. Using oil filter wrench, turn oil filter an additional $\frac{1}{2}$ to $\frac{3}{4}$ turn.
 - f. Fill engine oil until the oil level reaches the upper line on the dipstick (10 to 12 oz).
 - g. Start engine and run it for 2 minutes and check for leaks.
 - h. Press Oil Pump Prime Button for approximately 1 minute.
 - i. Shut down engine and let it set for 10 minutes.
 - j. Recheck the engine oil level by fully inserting the dipstick.
 - k. Add new engine oil as needed until the level is between the upper and lower lines on the oil dipstick.
 - l. Replace the dipstick and tighten by hand, by inserting dipstick into filler neck, align dipstick screw cap and turn clockwise until hand tight. Over-tightening may damage the dipstick screw cap.
 - m. Clean up any spillage.



Section 9 – Optional Accessories

9.1 – Tow Cart

The optional Tow Cart is the safest way to transport the TI10C Hybrid GPU. This custom steel cart weighs 198 lbs and comes equipped with rear brakes and rugged all-terrain tires.



Figure 9.1.1 – Optional Tow Cart

9.2 – Customized 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. Contact Tesla's™ customer service department to find out more about our selection of cables.



Figure 9.2.1 – Cobra Aviation Plug

9.3 – Cobra™ DC Replacement Contacts and Tools

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

TI2005-238

Cobra™ Aviation Plug



TI2005-078

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



TI2005-251

DC Aviation Plug
Positive/Negative
Contact



TI2005-654

DC 400Hz Aviation Plug
Positive/Negative
Contact



TI2004-444

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



TI2005-250

DC Aviation Plug
3-slotted Connector



TI2005-239

Aviation Insertion/
Extraction Tool



TI2005-121

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



TI2005-117

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



TI2004-341

Replacement Nose for
Aviation Plug



TI2004-340

Replacement Nose for
400Hz Aviation Plug



TI2005-126

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



TI27000-082

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



9.4 – Removable Fuel Tank

The optional 8-Gallon Removable Replacement Fuel Tank (see Figure 9.4.1) makes refueling the TI10C Hybrid easier and faster by switching tanks instead of moving the Hybrid to be refilled. The tank holds 8 gallons of JP-4, JP-5, or JP-8 fuel. To order, contact Tesla™ Customer Service at (302) 324-8910.

It is recommended to add ½ fl. oz. of two-stroke oil per gallon to the fuel. Adding oil will add lubricity to the fuel pump and fuel injector and extend the life of components. **JP4, JP5, JP8, ONLY. Using any grade of gasoline will cause damage to Engine and void warranty.**



Figure 9.4.1 – Optional Removable Fuel Tank

Section 10 – Frequently Asked Questions

1. What are the advantages of owning a Tesla™ Hybrid TI10C?

Tesla™ Hybrids are multi-functional systems that are ideal for support of 24 Vdc vehicles and aircraft and their electronics/avionics. This unit is remarkably smaller and lighter than comparable generators on the market today. The TI3950 GPU within the Hybrid is maintenance free and provide pure, flat-line dc power in a completely safe package. Tesla™ Hybrids are perfect for maintenance support at a main facility or in remote locations.

2. How does a TI10C Hybrid work?

The Hybrid is powered by an air-cooled, 10 horsepower, diesel OHV engine with a 5000 watt generator, or can be plugged into 120/240 Vac outlet. The TI3950 GPU built in to the unit is capable of delivering 6000 peak amps and 150 continuous amps @28 Vdc. The TI10C Hybrid GPU will handle all of your power needs including 12, 24, and 48 Vdc and 110 - 240 Vac, single phase.

3. Do the cells have memory?

No. The user can start the TI10C Hybrid GPU or plug the GPUs into 60 Hz ac power source for charging regardless of the unit's state of charge. The intelligent charging system will rapidly recharge the cells and then switch to trickle mode to maintain a full charge.

4. How can the TI10C Hybrid be used in aviation support?

A Tesla™ Hybrid can be used to start any aircraft that uses a 24 volt system and can provide reliable ground power. It can also be used to power up testing equipment, laptops, power tools, and other essential items needed in the hangar or in the field.

5. How much DC power will the TI10C Hybrid GPU provide?

The TI10C Hybrid GPU will provide up to 150 continuous amps @ 28 Vdc with an ac power source and 6000 peak starting amps directly from the internal cells.

6. How many engine starts will the TI3950 GPU provide until depleted?

If the GPU is not allowed time to recharge after an engine start, it should provide approximately 12 starts before it needs to be plugged in to an ac power source for recharging.

7. How long does this unit stay charged?

When not plugged into an AC power source, the TI10C's internal TI3950 GPU will retain 80% of its capacity after one year of storage. However, the TI3950 should never be allowed to fully discharge.

8. How do I check the status of the charge?

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

9. Why does the cooling fan run continuously when the TI3950 GPU is connected to AC power? Why does the cooling fan slow down?

The internal cooling system of the TI3950 GPU has been designed to efficiently regulate unit temperature regardless of load. The cooling fan speed varies to regulate the temperature of the internal circuitry when plugged into an ac power source.

10. How do you prolong the life of the TI3950 GPU's power cells?

When not in use, try to plug the TI10C Hybrid into AC power to charge the TI3950's internal cells. Users who periodically plug the unit into AC power can expect to get approximately 5 to 7 years from their cells before replacement.

11. Is the TI10C Hybrid GPU waterproof?

The TI3950 GPU is water-resistant, but not waterproof. The TI10C is water resistant with all doors securely shut, but not waterproof.

Section 11 – Troubleshooting

1. When I set the Output Selector to GPU Power, the GPU Air Exhaust Fans do not turn on.

The internal cooling system of the TI3950 GPU has been designed to efficiently regulate unit temperature regardless of load. The cooling fan speed varies to regulate the temperature of the internal circuitry when plugged into an AC power source. If the fans are not on, but the Capacity Meter displays a charge, this may indicate that the Air Exhaust Fans has failed. Disconnect power immediately and contact Tesla™ for further instructions.

2. The TI3950 GPU has power, but the cells are not charging.

Under normal circumstances, the unit requires a minimum of 38 minutes to fully recharge after a complete discharge. If the unit is not fully charged after 1 hour, the power cells may need to be replaced. Return the unit to Tesla™ for evaluation and maintenance.

3. The TI3950 GPU is charged, but the “Push to Test” button does not seem to work.

If the unit is fully charged, the internal temperature sensor may have tripped. This happens any time the “Push to Test” button has been pressed for more than 30 seconds. Allow 5 minutes for cooling before pushing the button again. If the “Push to Test” button still fails to activate the Capacity Meter contact Tesla™ for evaluation and maintenance.

4. The unit is charged, but I’m not getting any voltage from the DC Output Receptacle.

The power cells on the TI3950 GPU require a minimum charge level to function properly. If one or more red LEDs are illuminated on the Capacity Meter, the GPU may need recharging. If this is not the case, verify that the green DC Output “ON” button is illuminated.

Is the DC Output ON Button active (button illuminated)?

No: Press the DC Output ON Button. **Yes:** Contact Tesla™ Industries.

The DC Output Receptacle should read between 24.0 Vdc and 27.6 Vdc when the TI3950 is off, and 28.5 Vdc with the TI3950 on. If the unit is still not putting out any voltage, contact Tesla™ Industries for further instructions.

5. What steps do I take if the TI10C Hybrid runs out of fuel?

You must refill the tank with fuel and bleed the fuel lines before restarting. See Section 6.2 for complete instructions.

6. The TI10C Hybrid’s engine is running, but the engine compartment cooling fan won’t come on. What should I do?

The Engine Compartment Fan should come on when the engine compartment reaches more than 140°F. In the event that the fan does not come on, turn off the TI10C. Go the Rear Control Panel and unscrew the three screws at the top of the Control Panel. Pull down the panel and locate the three breakers on the left side of the panel. If any of the breakers have been tripped, reset them by setting the switch to the up or “On” position (see Figure 11.1.1). If the fan still does not come on after restarting the engine, please contact Tesla™ Customer Service at (302) 324-8910.

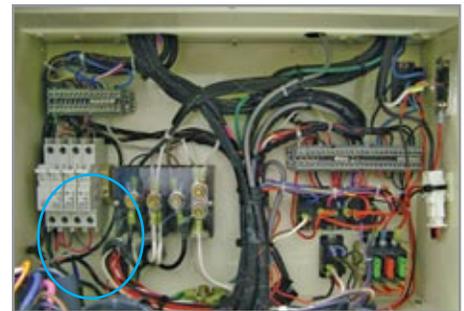


Figure 11.1.1 – Control Panel Breaker location

7. The engine is not cranking/won’t start.

First, ensure that you have selected a battery with enough capacity for normal startup. Go to the Rear Control Panel and unscrew the three screws at the top. Pull down the panel and on the bottom right you will see three resettable fuses. The first fuse on the left (See figure 11.1.2) is for the starter. Check to see if it has been tripped. If so, reset it by pressing in the red tab. Make sure that the other two fuses have not been tripped (this may also contribute to the starting problem.) If starting problems persist, contact Tesla™ Customer Service at (302) 324-8910.

8. When I press the compression release button, it doesn't engage the compression release lever. What should I do?

Ensure that you have selected a battery with enough capacity for normal startup. If, after selecting a battery, the problem still persists, unscrew the three screws on top of the rear control panel. Pull down the panel and on the bottom right is a 30 amp resettable fuse (see figure 11.1.2). If the red tab is sticking out, it can be easily reset by pushing the tab back into place. Continue with the normal startup procedure. If the problem persists, contact Tesla Industries.

9. When the TI10C Hybrid's engine runs at operating temperature, the oil cooler fan and oil pump don't come on. What should I do?

In the event that the fan and oil pump do not come on, turn off the TI10C. Go the Rear Control Panel and unscrew the three screws at the top of the Control Panel. Pull down the panel and locate the three breakers on the left



Figure 11.1.2 – Control Panel Fuse location



Figure 11.1.3 – Example of Control Panel Fuse

side of the panel. If any of the breakers have been tripped, reset them by setting the switch to the up or “On” position (see Figure 11.1.4). If the fan and oil pump still do not engage after restarting the engine, please contact Tesla™ Customer Service at (302) 324-8910.

10. Can I make repairs to the unit?

No. Only scheduled maintenance outlined in this manual can be performed. 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 of the TI3950 GPU that is incorporated into the TI10C Hybrid.

11. How do I get my TI10C Hybrid GPU repaired?

If the unit needs to be returned for repairs, please contact Tesla’s Customer Service Department by phone at 302-324-8910, or by email at tesla1@teslaind.com and a representative will explain the return process. For your convenience, a Repair Request Form can be found in the back of this manual. The form can also be found online at www.teslaind.com.



Figure 11.1.4 – Control Panel Breaker

Section 12 – Performance Data

12.1 – Purpose

This chapter provides performance data for the TI10C Hybrid GPU. This information will allow the user to obtain maximum performance and life from the unit. Regular referral to this chapter is recommended to:

- a.** Gain knowledge of the unit's performance characteristics to anticipate unexpected conditions or extreme operational requirements.
- b.** Readily identify situations requiring maximum performance.

Note: The information provided in this chapter is most useful when anticipating operations under unknown conditions or environmental extremes. The data can also be used to establish local operating procedures and to maximize the unit's life.

12.2 – Explanation of Data

The data presented covers the full range of operating conditions and expected performance. In each area of performance, temperature effects and dc electrical load demands in relation to ground power support requirements are presented. In some cases, data is presented conservatively. In all cases, performance data presented is within the applicable limits of the TI10C Hybrid GPU. Any attempt to exceed maximum recommended limits will cause the unit to malfunction and may cause permanent damage.

12.3 – General Conditions

In addition to the specific conditions, the following general condition is applicable to the performance data. Variations 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 accounted for individually.

12.4 – Definition of Abbreviations

Unless otherwise indicated, the abbreviations defined in the beginning of this manual will be applicable to all charts and graphs in this chapter.

12.5 – Performance Graphs

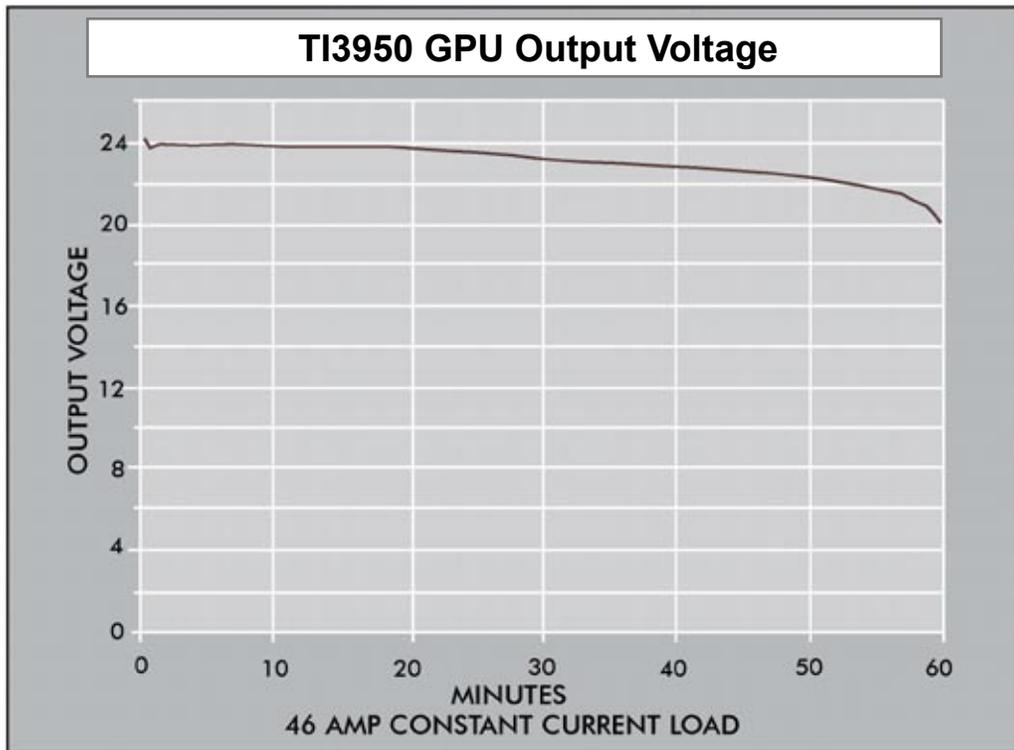


Figure 12.5.1 – Output voltage versus discharge time per DC Receptacle

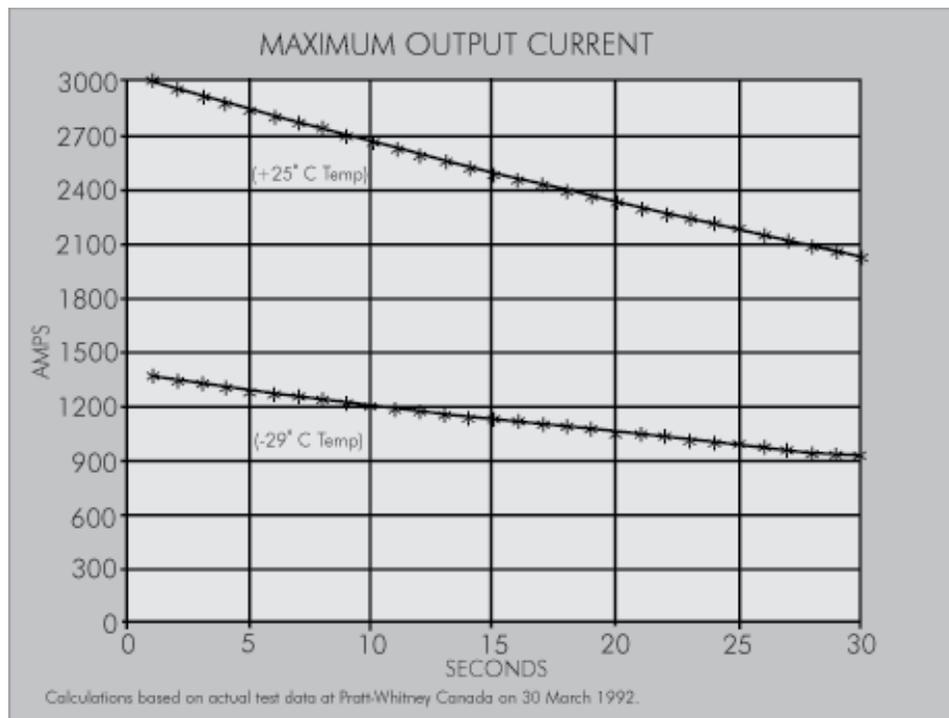


Figure 12.5.2 – Maximum output current versus time per DC Receptacle

12.6 – Temperature Conversion Chart

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

Figure 12.7.1 – Temperature conversion from °Celsius to °Fahrenheit.

Glossary

Avionics	A combination of the words “aviation” and “electronics,” avionics comprises electronic systems for use on aircraft such as communications, navigation, and the display and management of multiple systems.
Digital Multimeter	A digital multimeter, also known as a volt/ohm meter or VOM, is an electronic measurement device that combines several functions into one unit. A standard multimeter may include features such as the ability to measure voltage, current and resistance.
Ground Fault	A condition in which an imbalance in electrical current occurs due to a faulty connection path such as a current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit.
Intelligent Recharging	A system which continuously monitors the cell’s charge state and automatically adjusts the recharge rate to maximum performance and minimize cell degradation.
Memory Effect	If a NiCd battery is only partially discharged then recharged many times, it will begin to “remember” the level it was discharged to and will no longer fully recharge. The TI3950 Hybrid GPU’s internal cells do not have a memory effect.
Monolithic Dry-Cell	A one-piece battery that is hermetically sealed and designed for maintenance-free operation.
Single Phase Power	In electrical engineering, single-phase electric power refers to the distribution of electric power using a system in which all the voltages of the supply vary in unison. Single-phase distribution is used when loads are mostly lighting and heating.

Repair Request Form

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

Date of return: _____

Company name & _____

Billing address: _____

Contact person: _____

Phone #: _____ Fax #: _____

Email: _____

Purchase Order #: _____

Model #: _____ Serial #: _____

Model #: _____ Serial #: _____

Shipping method to Tesla™: _____

Description of shipping package: _____

Description of problem: _____

Return to Tesla™

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



WE GET THE MILITARY STARTED!

Tesla™

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

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

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