

Installation Manual and Operating Instructions

TRUE BLUE POWER

T1250 SERIES

STATIC ELECTRICAL
POWER INVERTER

Manual Number
9018067



Revision K • January 9, 2024

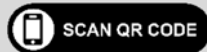
FOREWORD

This manual provides information intended for use by persons who, in accordance with current regulatory requirements, are qualified to install this equipment. If further information is required, please contact:

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We welcome your comments concerning this manual. Although every effort has been made to keep it free of errors, some may occur. When reporting a specific problem, please describe it briefly and include the manual part number, the paragraph/figure/table number and the page number. Send your comments to:

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REVISION HISTORY

Rev	Date	Detail	Approved
A	12/10/2013	Initial release	BAW
B	02/11/2014	Revised Technical Specifications	BMC
C	05/27/2014	Revised Section 3.3.1, Wire Gauge Selection	BMC
D	01/02/2015	Added TI254 and TI256 models	BMC
E	05/11/2015	Added -4 Configuration	BMC
F	06/16/2015	Updated -4 Configuration specifications	BMC
G	01/06/2017	Update connector Pinout Table to agree with the input voltage in the Specification Table.	CAS
H	07/26/2019	Updated altitude in Table 1.3 and Qualification sheet.	VAA
J	05/04/2020	Updated style and brand to meet Marketing and Engineering guidelines.	DLR
K	01/09/2024	Added TI250 60VAC 125VA model.	JRC

SECTION 1 GENERAL DESCRIPTION

1.1 INTRODUCTION

The model TI250 Series Static Electrical Power Inverter is a lightweight power inverter that translates a 20 to 36 VDC input to various output options:

Model	Part Number	Output
TI250	6430250-1	115 VAC, 60 Hertz
TI254	6430250-2	115 VAC, 400 Hertz
TI256	6430250-3	115/26 VAC, 400 Hertz
TI256	6430250-4	115/26 VAC, 400 Hertz with sync capability
TI250	6430250-5	60 VAC, 60 Hertz, 125VA

All models, except the TI250 (6430250-5), provide 250 watts (VA) of power. The TI250 (6430250-5) provides 125 watts (VA) of power. The alternating current output is defined as a pure sine wave with less than 2% of total harmonic distortion for clean, noise-free, harmonic-free power to supply loads of corresponding voltage, power and frequency. For the TI250 (6430250-1), the 115VAC, 60 Hertz (Hz) is suitable for nearly any common commercial or consumer load rated for a nominal input of 110-120VAC. The TI254 and TI256 are designed for 115VAC outputs with an AC frequency of 400 Hz for common avionics and related equipment, with the TI256 also providing an additional independent 26VAC output and optional dual-unit synchronization. The TI250 (6430250-5) is a 60VAC, 60 Hertz (Hz), 125VA option designed for powering LCD privacy windows and panels.

The TI250 Series Static Inverter is FAA certified to TSO C73 and tested to rigorous environmental standards and levels of RTCA DO-160. The small size and light weight in conjunction with its installation flexibility (inside or outside the pressure vessel) make it an ideal choice for aircraft power needs while reducing the challenges associated with other similar products.

Highlighted features include short circuit protection, overload capability, low voltage shut-down, temperature monitoring, a self-resettable over-temperature disable, a remote on/off function, and a fault indication output. The TI250 Series has the same connector of legacy designs plus ground fault interrupter protection. The rugged extrusion that houses the unit is designed to help dissipate heat and provide mechanical strength against vibration or other possibilities of damage. The TI250 Series is engineered to run cooler and requires no active cooling, featuring a fanless design, which saves energy, reduces weight and allows flexible installation locations. At only 2.5 pounds or less, it is lighter and smaller than competing inverters. Additionally, the primary stage of the TI250 Series utilizes current mode control for increased reliability and safety.

1.2 TECHNICAL SPECIFICATIONS

Electrical Attributes					
	Model TI250 (-1)	Model TI254 (-2)	Model TI256 (-3)	Model TI256 (-4)	Model TI250 (-5)
Input Voltage	28VDC nominal; 20-36VDC			18-36VDC	28VDC
Input Current (full load)	10 amps nominal; 15 amps max			20A max	5 amps nominal; 10 amps max
Input Current (no load)	150 milliamps				
Input Current (ON/OFF = OFF)	50 milliamps				
Recommended Input Circuit Breaker	15 amps				10 amps
Output Voltage	115VAC ±3% at 60 Hertz ±0.1%	115VAC ±3% at 400 Hertz ±0.1%	115/26VAC ±3% at 400 Hertz ±0.1%	115/26VAC ±3% at 400 Hertz ±0.1%	60VAC ±3% at 60 Hertz ±0.1%
Output Power	250 watts (250 VA at power factor = 1)				125 watts (125 VA at power factor = 1)
Output Waveform	Single phase, pure sine wave				
Power Factor	-0.8 to +0.8				
Efficiency	87 – 90% nominal				
Total Harmonic Distortion (THD)	Less than 2%				

Table 1.1

Physical Attributes					
	Model TI250 (-1)	Model TI254 (-2)	Model TI256 (-3)	Model TI256 (-4)	Model TI250 (-5)
Weight:	2.2 lbs (1 kg)	2.2 lbs (1 kg)	2.6 lbs (1.15 kg)	2.6 lbs (1.15 kg)	2.2 lbs (1 kg)
Dimensions: (not including connector mate)	6.7 inches long x 6.0 inches wide x 2.0 inches high (171 mm long x 152 mm wide x 51 mm high)				
Mating Connector (and cable clamp):	MS3106A-18-9S (MCI P/N 9016905-1, -2)				
Mounting:	Base mount – orientation not critical				

Table 1.2

Qualifications					
	Model TI250 (-1)	Model TI254 (-2)	Model TI256 (-3)	Model TI256 (-4)	Model TI250 (-5)
Certification:	FAA TSO-C73				
Environmental Qualification:	RTCA DO-160G Environmental Category; See Section 5.2				
Altitude:	-15,000 feet to +70,000 feet				
Temperature:	-55°C to +70°C (-67°F to +158°F)				

Table 1.3

SECTION 2 PRE-INSTALLATION CONSIDERATIONS

2.1 COOLING

The TI250 Series does not require external cooling or contain internal active cooling. Cooling of the unit occurs exclusively through passive conduction through the base or radiated cooling across the metal case. Additional cooling can be realized through convective effects of the environment (exposure to free moving air). These methods are not required to achieve rated performance but can help prevent potential overheating and extend life when the unit is operated at full power or during overload conditions. Specifically, mounting the unit to a metal surface is preferred, but not required.

2.2 EQUIPMENT LOCATION

The TI250 Series is designed for mounting flexibility, allowing for installation inside or outside the pressure vessel with no requirement for temperature control. In addition to altitude and temperature resistance, the unit is also designed to withstand high levels of condensing humidity. However, installation locations where the unit could be subject to standing or direct water exposure should be avoided. The unit can be mounted in any orientation. Clearance should be provided for the mating connector and may require as much as five inches past the unit connector to allow for back shell access to the connector.

2.3 ROUTING OF CABLES

The wires and cable bundle associated with the unit are heavy gauge wire and carry significant power. Be aware of routing cables near other electronics or with other wire bundles that may be susceptible to high energy flow.

Avoid sharp bends in cabling and routing near aircraft control cables. Also avoid proximity and contact with aircraft structures, avionics equipment, or other obstructions that could chafe wires during flight and cause undesirable effects.

2.4 LIMITATIONS

The TI250 Series of static electric power inverters is certified to FAA TSO-C73 with the following limitations identified:

- 1) Alternating current (AC) output is provided at 115 volts and 60 hertz for the 6430250-1 in lieu of 115 volts and 400 hertz as identified in the MPS of the TSO.
- 2) For the TI250 (6430250-5), alternating current (AC) output is provided at 60 volts and 60 hertz.
- 3) Equivalent environmental qualification was verified per RTCA DO-160G in lieu of those identified within the MPS of the TSO.

The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards, specification of the article, and deviations as listed above. TSO articles must have separate approval for installation in an aircraft. The article may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

2.5 MODIFICATION

This product has a nameplate that identifies the manufacturer, part number, description, certification(s) and technical specifications of the unit. It also includes the “MOD” or modification number representing notable changes in the hardware design of the unit.

Modification (MOD) 0 is the initial release of the product and is identified on the nameplate by the lack of marking on the MOD numbers 1 through 9 (i.e. 1-9 are visible). All subsequent modifications are identified on the nameplate by the marking/blacking out of that particular MOD number (i.e. for MOD 1, the number 1 is not visible and 2-9 are visible - see Figure 2.1 for examples). MODs do not have to be sequentially inclusive and may be applied independent of each other.

For additional details regarding specific changes associated with each MOD status refer to the product published Service Bulletins at www.truebluepowerusa.com.

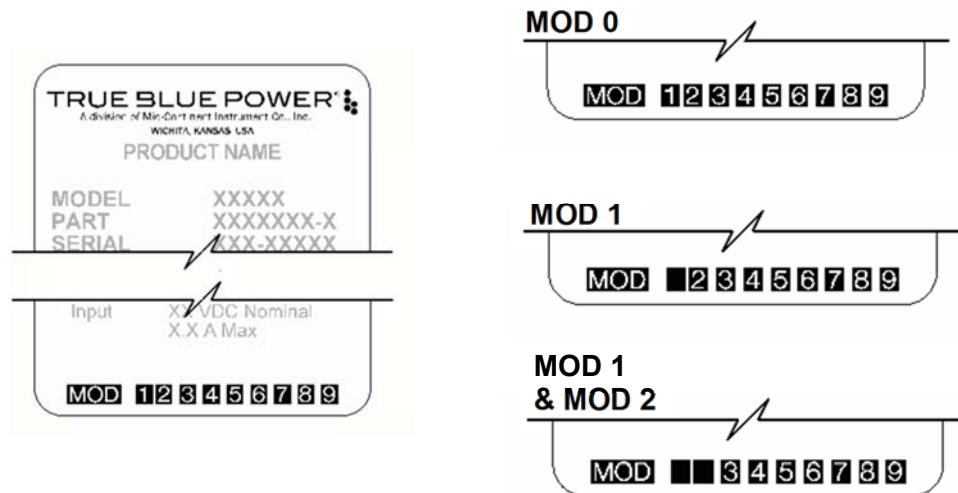


Figure 2.1
Nameplate and MOD Status Example

SECTION 3 INSTALLATION

3.1 GENERAL INFORMATION

This section contains interconnect diagrams, mounting dimensions and other information pertaining to the installation of the TI250 Series Static Inverter. After installation of cabling and before installation of the equipment, ensure that power is applied only to the pins specified in the interconnect diagram.

3.2 UNPACKING AND INSPECTING EQUIPMENT

When unpacking this equipment, make a visual inspection for evidence of any damage that may have incurred during shipment. The following parts should be included:

- | | |
|-------------------------------------|---------------------------------|
| A. Static Inverter | MCI P/N 6430250-() |
| B. Mating Connector (& cable clamp) | MCI P/N 9016905-1 and 9016905-2 |
| C. Installation Manual | MCI P/N 9018067 |

Equipment not provided:

- | | |
|-----------------------|--|
| A. Mounting Hardware | four (4) 10-24 pan head screws
¼" lock washers (optional) |
| B. Cable Harness Wire | See Section 3.3 for specifications |

3.3 CABLE HARNESS

Construct the cable harness with regards to the instructions below, and using the Connector Pinout of Figure 3.3, Figure 3.4, and Wiring Diagram of Table 3.3.

Refer to Section 2: Pre-Installation Considerations in regards to routing precautions.

3.3.1 Wire Gauge Selection

Use of PTFE, ETFE, TFE, Teflon, or tefzel insulated wire is recommended for aircraft use. Use the following wire gauges for each of the pins in the connector:

- Pin A and D – 12-14 AWG stranded or solid
- Pin B and C – 18-20 AWG stranded or solid
- Pin E and F – 18-24 AWG stranded or solid

Suggestion: If the TI250 is installed in an application where the pin-compatible 500 Watt MD50 inverter may be later used; the larger wire gauge sizes of the MD50 can be used.

3.3.2 Pin Assignment Information

INVERTER INPUT POWER:

Positive DC input – +24 to 32 VDC. Connect to the aircraft 28 VDC bus using a 15 Amp circuit breaker unless the unit is the TI250 (6430250-5). Use a 10 Amp circuit breaker for the TI250 (6430250-5).

Negative DC input – Connect to aircraft ground.

Note: Two common practices for the connecting the -28V of power devices in aircraft are: The negative lead connects from the device to the negative power bus.

The negative lead connects from the device to the negative power bus, and a second lead connects to the aircraft structure close to the power device.

The TI250 Series passes DO160G Section 21 Table 1.2.3 conducted emissions testing using both methods.

INVERTER AC OUTPUT:

AC Return – Used for powering devices where terrestrial/utility power designations are used, pin C can be connected as “Neutral”.

AC Output – Used for powering devices where terrestrial/utility power designations are used, pin B can be connected as “Line” or “Hot”.

Note: Use of a circuit breaker on the AC output is optional. For the full output of 250VA (125VA for the TI250 6430250-5), a 2.5 Amp circuit breaker is sufficient. For convenience at each AC outlet, individual circuit breakers of 1 to 3 amps each can be used. If a single pole breaker is used, install the breaker on the wire from pin B. If a double pole breaker is installed, route both pins B and C through the circuit breaker.

INVERTER REMOTE ON/OFF CONTROL: (see section 4.2.1)

Remote ON/OFF Control – Connecting this pin to either DC Negative or to aircraft ground will enable the AC output of the inverter. By utilizing a switch between this pin and ground or negative, it will allow remote on/off control of the unit. When unconnected (output is OFF) this pin will have approximately 16 VDC present, internally limited to less than 3 mA. If the inverter is to be enabled at all times, pin E can be connected to pin G.

Remote ON/OFF Return – This pin is internally connected to pin D. Pin G may be used as the return from an ON/OFF switch or left unconnected. It is recommended that pin G not be connected directly to ground or 28V negative.

INVERTER FAULT INDICATION OUTPUT:

Fault Indication Output (-1/2/3 and 5 only) – This pin can be connected to an external LED or status monitoring device to indicate the operating status of the inverter. The inverter will provide Fault indication when: Power Output capability has been exceeded, the output has been short-circuited, the output is ground-faulted (GFI protection activated), or the inverter has shut-down in over-temperature protection. The output is an open-collector transistor with a weak pull-up to 28V (21K ohm) capable of sinking 100 mA.

Phase Sync (-4 only) – Two TI256 units may be synchronized by connecting these pins together on each unit. This configuration will ensure the 115 VAC (and 26 VAC) outputs on each unit are phase locked within 5°.

Note: The AC outputs are not designed to be connected in parallel with other units regardless of the optional phase sync function.

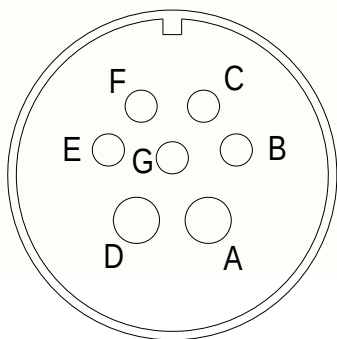


Figure 3.3
Pinout View of Unit Connector

Connector Pinout			
	-1	-2	-3
A	20-36VDC Input	20-36VDC Input	20-36VDC Input
B	115VAC Output	115VAC Output	115VAC Output
C	AC Return	AC Return	AC Return
D	DC Return	DC Return	DC Return
E	Remote On/Off	Fault Indication	Fault Indication
F	Fault Indication	Remote On/Off	Remote On/Off
G	Remote Return	Remote Return	26VAC Output
	-4	-5	
A	DC Return	20-36VDC Input	
B	AC Return	60VAC Output	
C	Remote On/Off	AC Return	
D	18-36VDC Input	DC Return	
E	26VAC Output	Remote On/Off	
F	Phase Sync	Fault Indication	
G	115VAC Output	Remote Return	

Table 3.3
Connector Pinout

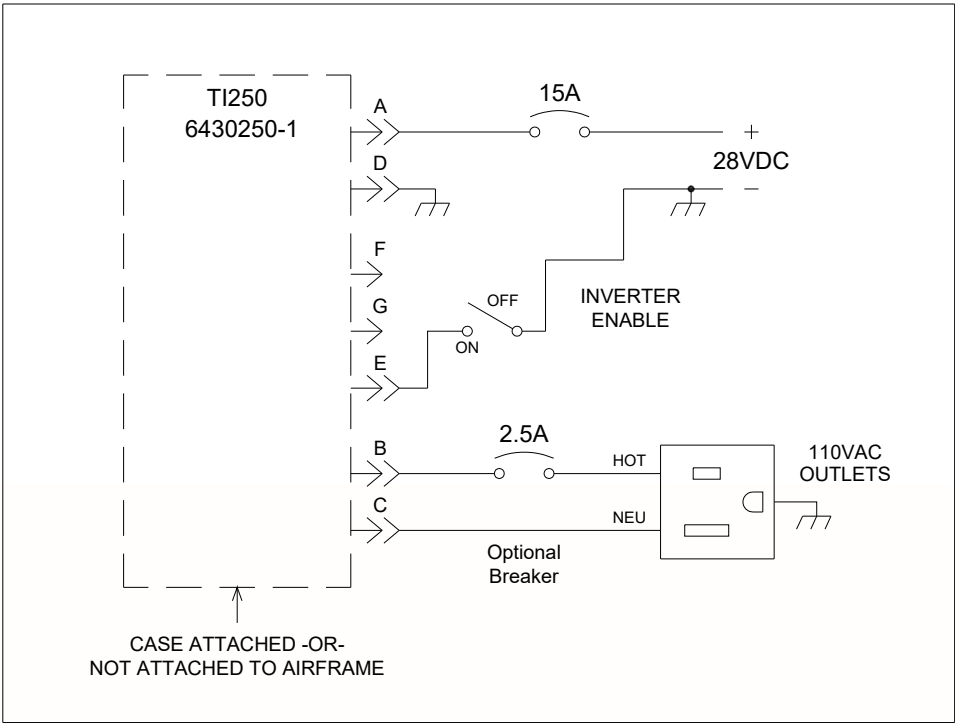


Figure 3.4A: Typical TI250 115VAC Small Aircraft Minimum Wiring Installation

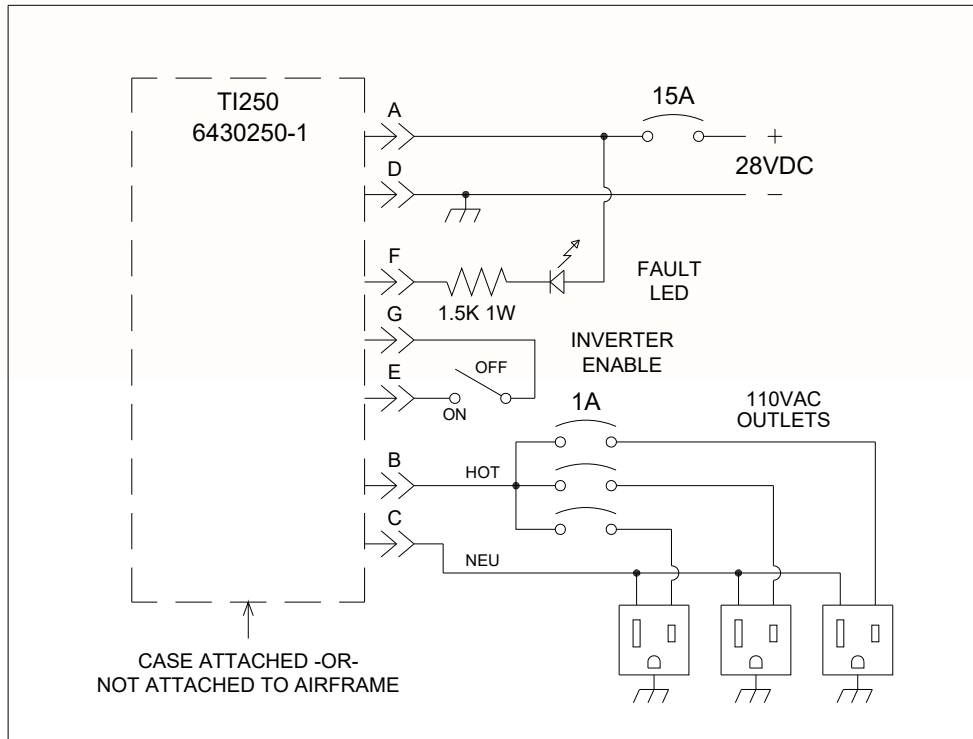


Figure 3.4B: Typical TI250 115VAC Aircraft Wiring Installation

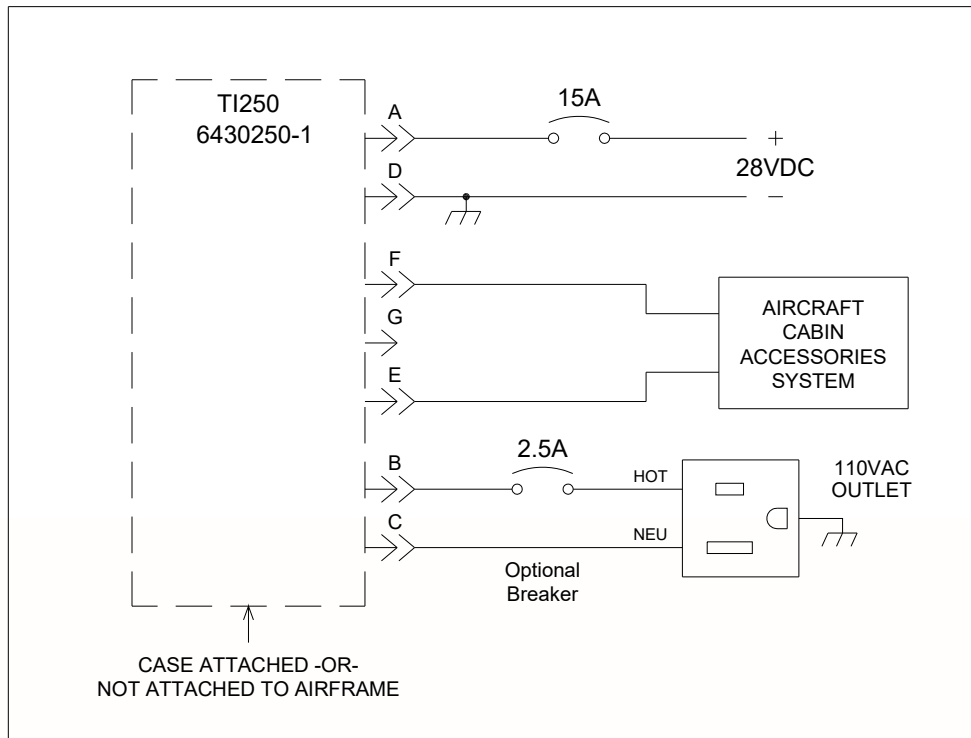


Figure 3.4C: TI250 115VAC Fully-Integrated Multi-Inverter Aircraft Cabin System

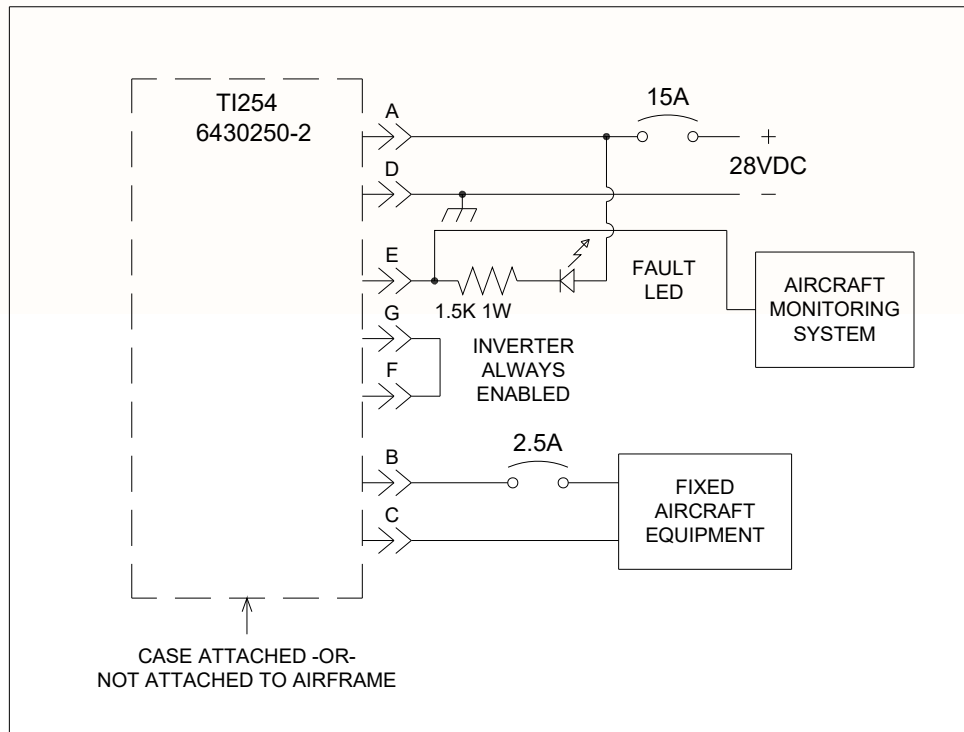


Figure 3.4D: Typical Installation (400 Hz; Fixed Equipment)

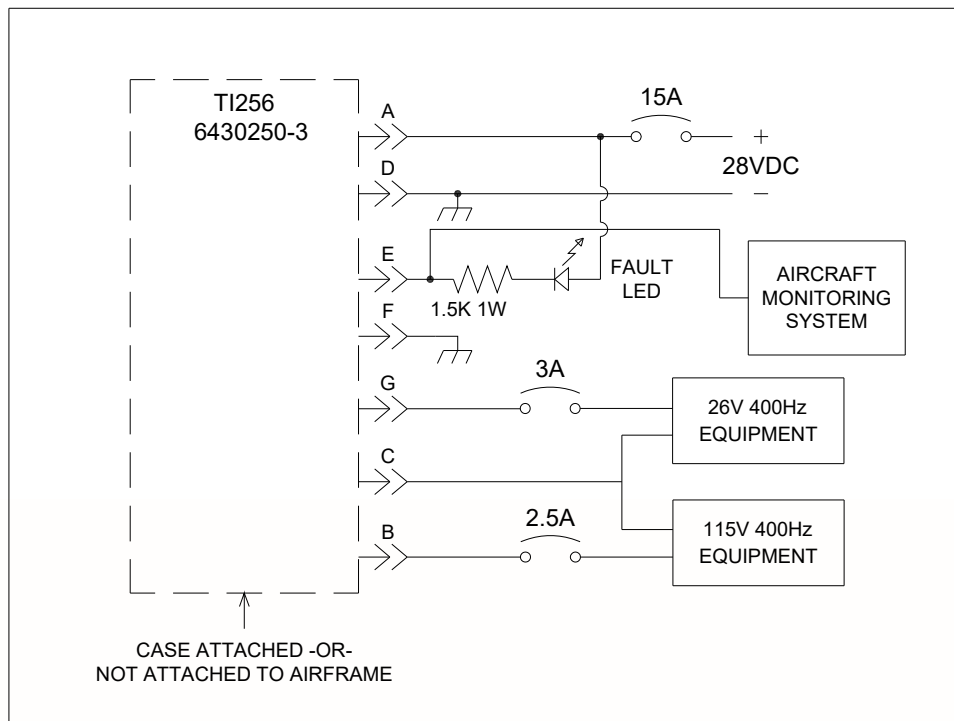


Figure 3.4E: Typical Installation (115VAC and 26VAC; Fixed Equipment)

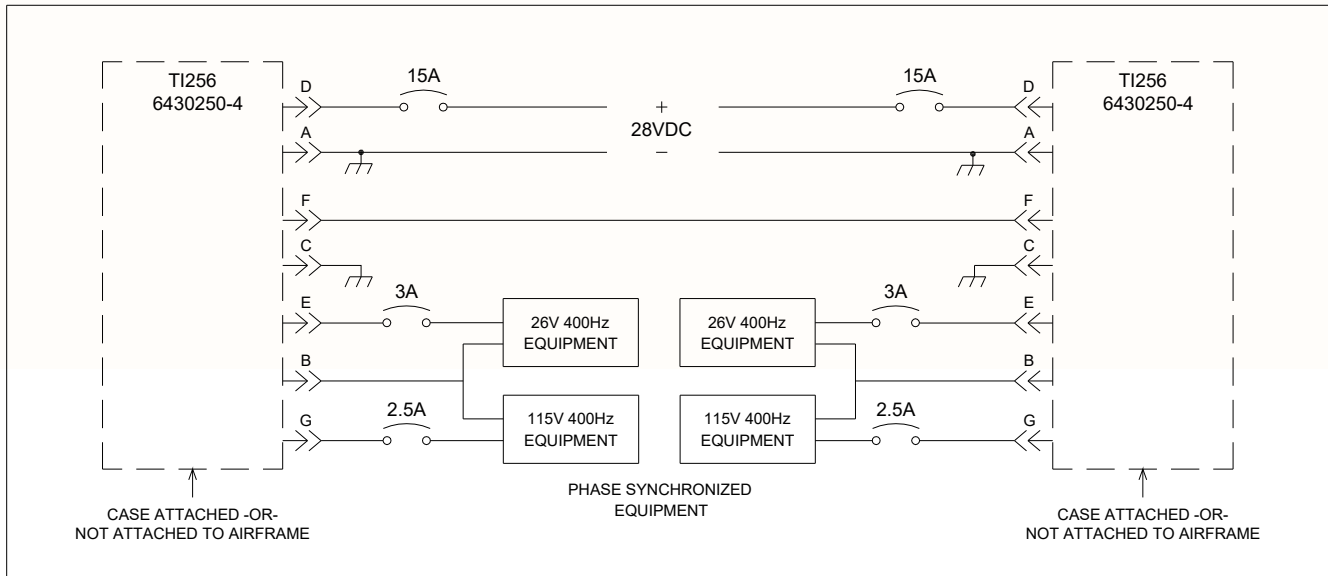


Figure 3.4F: Dual 400 Hz Sync'd Installation

Note: The AC outputs are not designed to be connected in parallel with other units regardless of the optional phase sync function.

3.3.3 Example Wiring Diagrams

The inverter is flexible in the wiring installation allowing for it to be integrated into the aircraft according to the application needs. Several examples are shown in the diagrams.

3.3.4 Harness Verification

With the TI250 Series Static Inverter disconnected, activate the aircraft power bus that supplies the unit and use a multi-meter to verify that aircraft power and ground with appropriate voltage is on the pins within the mating harness.

3.4 MOUNTING

Refer to Section 2: Pre-Installation Considerations in regards to equipment location.

The TI250 Series Static Inverter is designed for base mounting only. Four #10 mounting holes should be provided in the aircraft in accordance with Figure 3.5. Secure the unit with four #10 pan head Phillips screws, or equivalent. A lock washer under the head of each screw is recommended.

3.5 INSTALLATION COMPLETION

Prior to operating the unit in the aircraft, it is recommended to verify the output and functionality of the unit. In order to prevent accidental damage to other systems, it is best not to attach the output to other equipment or power busses prior to verification. Verify the output of the unit at the terminating end of the cable with a multi-meter to ensure proper voltage and polarity. Once verified, installation can be completed and functionality of the remote on/off feature (if used) should be checked.

3.6 INSTALLATION CAUTION

Do not connect the output of the TI250 Series Static Inverter to the output of any other inverter or damage will result. Under no circumstance allow the output of the inverter to be connected to ground utility AC power or damage will result. If more than 250 watts of power is required for an installation, a higher power inverter model such as the 500 watt Mid-Continent MD50 should be selected.

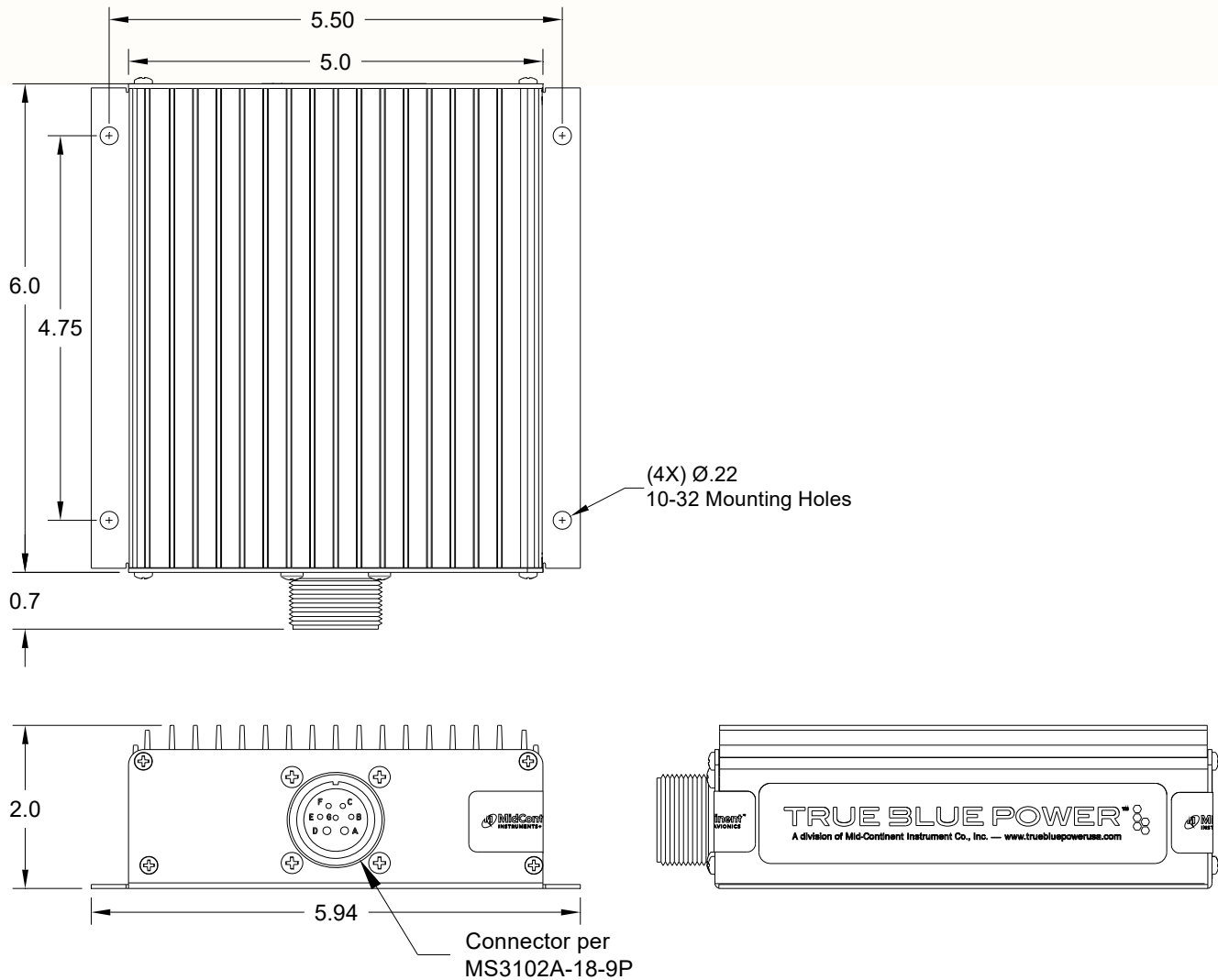


Figure 3.5
TI250 Series Static Inverter Outline Drawing

SECTION 4 OPERATION

4.1 ELECTRICAL PERFORMANCE

The TI250 Series Static Inverter converts a direct current (DC) voltage input to a regulated VAC output; the output is controlled to an established frequency and represents a pure sine wave with minimal distortion. See Table 4.1 specific output and frequency.

Model	Part Number	Input	Output	Frequency
TI250	6430250-1	20-36 VDC	115 VAC	60 Hz
TI254	6430250-2	20-36 VDC	115 VAC	400 Hz
TI256	6430250-3	20-36 VDC	115/26 VAC	400 Hz
TI256	6430250-4	18-36 VDC	115/26 VAC	400 Hz
TI250	6430250-5	20-36 VDC	60 VAC	60 Hz

Table 4.1

TI250 Series Electrical Performance

The TI250 Series is capable of providing power to a variety of aircraft accessories including laptops, personal electronics, and onboard aircraft systems. (See Technical Specification tables under Section 1.2).

The unit is designed as a two-stage, solid-state switch-mode power supply. The power transformation utilizes a first-stage push-pull methodology followed by an H-bridge AC forming second stage. The primary stage utilizes 'current-mode' control providing instantaneous load protection as an advantage over legacy designs that incorporate 'voltage-mode' controllers. Additionally, the AC output stage controls both the current and voltage of the output AC waveform providing a low-distortion sine wave output even over varying power factor requirements of the load. The AC output is frequency controlled using a crystal oscillator reference.

4.2 PROTECTIVE FEATURES

4.2.1 Remote On/Off

The TI250 Series Static Inverter incorporates a remote on/off feature that allows the user to enable or disable the output of the unit. By providing a ground on the appropriate pin (See Table 3.3) the user, via a remote mounted switch, can enable the output of the unit. The unit can be similarly disabled by removing the ground signal (open circuit) to the same pin. The remote on/off control of the inverter is also used to reset the inverter should an over-current or GFI fault condition occur.

4.2.2 Over-Voltage

When the input voltage exceeds the operating range of the unit (See Technical Specifications Section 1.2; absolute maximum input of 36VDC) the unit senses an over-voltage condition and disables the output. The unit will dynamically monitor the input voltage such that if the input returns to within the normal operating range, the output will be enabled and allow the unit to operate normally. Over-voltage will not activate the fault status output.

4.2.3 Under-Voltage

When the input voltage drops below the operating range of the unit (See Technical Specifications Section 1.2; absolute minimum input of 18VDC for TI256 6430250-4, 20VDC for all others) the unit senses an under-voltage condition and disables the output. The unit will dynamically monitor the input voltage such that if the input returns to within the normal operating range, the output will be enabled and allow the unit to operate normally. Under-voltage will not activate the fault status output.

4.2.4 Over-Temperature

The TI250 Series Static Inverter incorporates an internal temperature sensing device that continually provides monitoring and feedback to the control circuits. When the unit senses an internal condition that exceeds maximum temperature ratings, the output is disabled and the FAULT output will indicate. The inverter will continue to remain shut-down in a fault condition until the temperature returns to within acceptable limits. This over-temperature reset occurs automatically without external intervention required.

4.2.5 Short Circuit And Over-Current

The TI250 Series Static Inverter is capable of surviving a short circuit or over-current event without permanent damage or effect to long-term reliability. The unit can provide over its rated power output up to 150% of rated power for over 30 minutes. This is 375 Watts for most of the TI250 Series and 180 Watts for the 6430250-5. This high-power output level will continue until over-temperature shutdown occurs.

When an overcurrent event occurs, the TI250 models (6430250-1 and -5) will shut-down after 2 to 4 seconds. The FAULT indication will be activated. The inverter will wait about 5 seconds and attempt to power the load again. Unless the overcurrent event has fallen to less than 50% of rated output the inverter will again shut-down and attempt power after 5 seconds. This will continue until the load has fallen below 50% of rated load, or input power or ENABLE is toggled OFF and ON resetting the inverter. This feature is intended to remove power from cabin passenger electronics (typically powered-ON by a momentary pushbutton) by making these passenger electronics turn-OFF from power loss. This feature avoids the need for cabin crew to intervene if passengers overload the inverter. Should the overcurrent event fall below 50% of rated output, the resume normal operation but the FAULT output will remain to indicate an overcurrent event did occur.

When an overcurrent event occurs on the TI254 or TI256 inverters, they will power into the load for 2 to 6 seconds. If the overload has not cleared before this time, then the FAULT output will be set and the inverter will remain OFF. The inverter can be reset by toggling power or ENABLE.

For all models of inverters, once the FAULT has been set, either power to the inverter or the ENABLE must be toggled to reset the FAULT output. (See Section 4.2.7)

4.2.6 Ground Fault Protection (-1 and -5 only)

The TI250 Series Static Inverter monitors the AC output for indications of current imbalance between the two AC output lines. Should a ground fault be detected, the AC output will be disabled and the fault output will indicate. Remove all inverter loads before re-enabling the inverter.

4.2.7 Fault Shutdown and Indication

The TI250 Series Static Inverter monitors the AC output load, its internal temperature, and operation status. Should the load be excessive or the inverter become too hot, the inverter will disable the AC output and indicate a fault status on the FAULT output. If the inverter is in a FAULT state, a LED connected as shown in the wiring diagrams will be lit.

To reset the inverter and clear the FAULT: 1) Remove all inverter loads before re-enabling the inverter, 2) Re-enable the inverter by switching the inverter OFF for four seconds, and then back to ON. NOTE: If the inverter is over-temperature it will not re-enable until it has cooled. FAULT can also be cleared by cycling power to the inverter.

SECTION 5 CONFORMANCE

5.1 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

No periodic scheduled maintenance or calibration is necessary for continued airworthiness of the TI250 Series Static Inverter. If the unit fails to perform to specifications, the unit must be removed and serviced by Mid-Continent Instruments and Avionics or their authorized designee.

5.2 ENVIRONMENTAL QUALIFICATION STATEMENT

MODEL NUMBER: TI250, TI254, TI256 **PART NUMBER:** 6430250-() Series
DESCRIPTION: Static Electrical Power Inverter **CERTIFICATION:** FAA TSO-73
MANUFACTURER: True Blue Power, a division of Mid-Continent Instrument Co., Inc.
ADDRESS: 9400 E. 34th St. North, Wichita, KS 67226, USA.
SPECIFICATION: Test Specification (TS) 512 Test Data Sheet (TDS) 512
STANDARD: RTCA DO-160, Rev G, dated 12/08/10

CONDITIONS	SECTION	DESCRIPTION OF TEST
Temperature and Altitude	4	Category F2(Y)
Temperature Variation	5	Category S2
Humidity	6	Category B
Operational Shock and Crash Safety	7	Category B
Vibration	8	Fixed Wing: Category R; Curve C, C1 Rotorcraft: Category U; Curve G
Explosion	9	Category X
Waterproofness	10	Category X
Fluids	11	Category X
Sand and Dust	12	Category X
Fungus	13	Category F
Salt Spray	14	Category X
Magnetic Effect	15	Category Z
Power Input	16	Category Z
Voltage Spike	17	Category A
Audio Frequency Conducted Susceptibility	18	Category R
Induced Signal Susceptibility	19	Category (ZC)
Radio Frequency Susceptibility	20	Category (WF)
Emission of Radio Frequency Energy	21	Category M
Lightning Induced Transient Susceptibility	22	Category A3G3L3
Lightning Direct Effects	23	Category X
Icing	24	Category X
ESD	25	Category A
Fire, Flammability	26	Category X

REMARKS:

Section 4: Category F3 with excursions as declared by the manufacturer:

- 4.5.5 Loss of Cooling: 300 minutes; +40°C, 75%
- 4.6.2 Decompression: +8,000 feet
- 4.6.3 Overpressure: -15,000 feet