Installation Manual and Operating Instructions

TRUE BLUE POWER

TC240

DC/DC POWER CONVERTER

Manual Number
9018640

Revision J • June 8, 2022

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:

True Blue Power
c/o Mid-Continent Instrument Co., Inc.
Attn: Customer Service Dept.
9400 E. 34th St. N.
Wichita, KS 67226 USA
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www.mcico.com

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:

True Blue Power
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REVISION HISTORY

Rev	Date	Detail	Approved
A	05/23/2016	Initial release	SHO
B	06/22/2016	Corrected typo, page 12, 4.2.3, 'maximum.' 5.2 Environmental Qualification Statement: Section 4, changed from F2 to F1; Section 4.5.1 Operating Low Temp changed from -55C to -40C Section 4.5.3 Operating High Temp changed from +70C to +55C.	KJW
C	12/02/2016	Corrected description, Figure 3.3. Revised the Environmental Qualification Statement table for Temperature and Altitude, Section 4.	KJW
D	10/24/2017	Changed Environmental Qualification Statement to add helicopter vibe levels.	KJW
E	05/07/2020	Updated style and brand to meet Marketing and Engineering guidelines.	DLR
F	10/21/2020	Updated weight.	MEK
G	04/13/2021	Updated Section 3.3 wire choices; updated Section 4 providing additional clarification in the operation section; correct graph info; added new graph to illustrate power range.	DLR
H	09/09/2021	Updated Sections 1.1, 1.2 and 5.2 to include MIL-STD testing	WVC
J	06/08/2022	Updated adjustable output range from 5-18VDC to 5-24VDC for MOD 1 units. Updated Figures 4.1 and 4.2 accordingly.	BAW

SECTION 1 GENERAL DESCRIPTION

1.1 INTRODUCTION

The model TC240 DC/DC Power Converter is a lightweight power converter that translates a direct current (DC) input of 28 volts to an adjustable 5 to 24 volt direct current (DC) output.

The input operating voltage (24–32VDC) makes the TC240 suitable for nearly any common general, business, or commercial aviation application and provides an adjustable DC output voltage of 5 to 24 VDC. The unit is rated for a nominal output of 240 watts to power avionics, instrumentation, personal charging, lighting, and many other applications. The TC240 DC/DC Converter is FAA certified to TSO-C71 and tested to rigorous environmental standards and levels of RTCA DO-160G, MIL-STD-810, MIL-STD-704 and MIL-STD-461. 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 input voltage shut-down, temperature monitoring, reverse polarity protection, a self-resettable over-temperature disable and an optional remote enable (on/off) feature.

The TC240 DC/DC converter has a robust Military-rated circular connector and a rugged aluminum case which dissipates heat and provides excellent mechanical strength. It is engineered to require no external cooling and contains no internal fans or cooling methods, which saves energy, reduces weight and allows more flexible installation locations. At only 11 ounces (312 g), it is lighter and smaller than any other certified solution in the aviation market today.

1.2 TECHNICAL SPECIFICATIONS

Electrical Attributes	
Input Voltage	Rated 28VDC nominal, Operating 24 – 32VDC
Input Current (full load)	10 amps max at nominal input voltage
Output Voltage	5 – 24 VDC adjustable
Output Power	240 watts nominal
Efficiency	95% nominal

Table 1.1

Physical Attributes		
Weight	11.0 oz (312g)	
Dimensions (not including connector mate)	2.75 long x 3.75 wide x 1.29 high [inches] 69.9 long x 95.3 wide x 32.8 high [mm]	
Mating Connector Kit	6430240-1	MCIA P/N 9018654
	6430240-2	MCIA P/N 9018655
Mounting	Base mount – orientation not critical	

Table 1.2

Qualifications	
Certification	FAA TSO-C71
Environmental Qualification	RTCA DO-160G MIL-STD-461F, MIL-STD-704F & MIL-STD-810F; See Section 5.2
Altitude	-15,000 feet to +55,000 feet (65,000 feet non-operating)
Temperature	-55°C to +70°C (-67°F to +158°F)

Table 1.3

SECTION 2 PRE-INSTALLATION CONSIDERATIONS

2.1 COOLING

The TC240 product 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 convection (exposure to free moving air) or conduction (mounting to a thermally conductive metal surface). 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 TC240 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 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. TSO articles must receive additional installation approval prior to being operated on each aircraft. The article may be installed only according to 14 CFR Part 43 or the applicable airworthiness requirements.

The TC240 is designed to operate at full rated load (per Figure 4.1) throughout the specified environmental temperature range (per section 5.2). Note that when operating at full power, the unit case can be hot to the touch. Reference the following examples of selected conditions when operating at *maximum* rated load of 240 watts (stabilized after 20 minutes):

- At an ambient test temperature of +23°C when not mounted to a metal surface, the maximum case temperature can reach +62°C. (+42°C when mounted to a metal surface)
- At an ambient test temperature of +70°C when not mounted to a metal surface, the maximum case temperature can reach +87°C. (+68°C when mounted to a metal surface)

Caution and consideration should be taken with respect to aircraft installation and operation.

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.

MOD 1: Update adjustable output voltage range to 5 – 24 VDC.
NOTE: Units prior to MOD 1 have an adjustable output voltage range of 5 – 18 VDC.

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

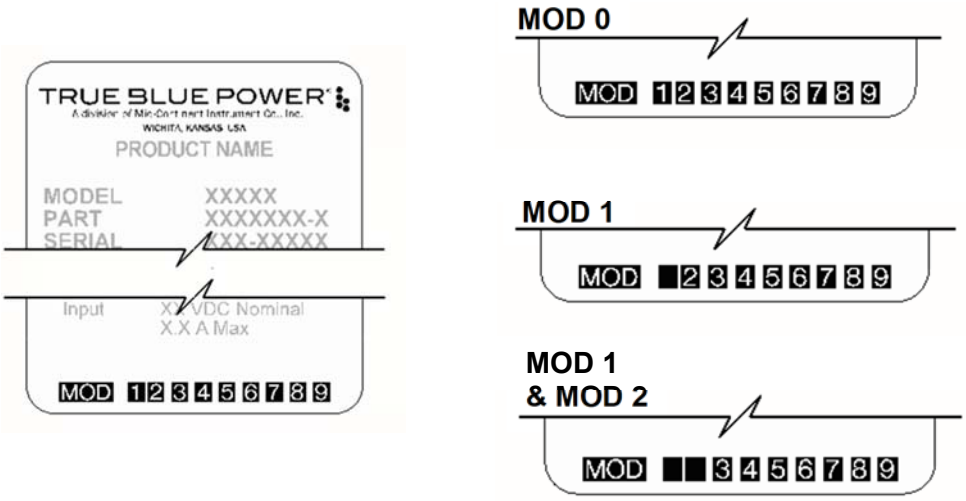

Figure 2.1

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 TC240 DC/DC Converter. After installation of cabling and before installation of the equipment, ensure that power is applied only to the pins specified in the interconnect diagram.

The following two versions of the unit are available. See Section 4.2.1 for additional details of the remote enable (on/off) feature and installation details within Section 3.

Part Number	Remote On/Off
6430240-1	No (output always enabled)
6430240-2	Yes (enable signal required)

3.2 UNPACKING AND INSPECTING EQUIPMENT

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

A. DC/DC Converter	MCIA P/N 6430240-( )
B. Connector Kit	
i. 6430240-1	MCIA P/N 9018654
ii. 6430240-2	MCIA P/N 9018655
C. Installation Manual	MCIA P/N 9018640

Equipment not provided:

A. Mounting Hardware	Four 6-32 x 1” (min) pan head screws #6 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 Connector Pinout of Table 3.1 or 3.2 and referencing Typical Wiring Diagrams of Figures 3.3 or 3.4, as applicable.

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. Recommended wire size depends upon the model of TC240 being installed and the maximum continuous current required from the output of the TC240 in your aircraft installation. Use Figure 4.1 as a reference.

For the TC240 p/n 6430240-1 equipped with a 3-pin MS3102A-10P connector:

- For pin A use 12 AWG stranded or solid wire. Pin A carries return currents from both input and output. If the output voltage setting is less than 10 VDC, 12 AWG wire is recommended to minimize voltage drop in the wire.

- For pins B and C use 12 or 14 AWG stranded or solid wire. Note maximum TC240 continuous current on Figure 4.1 depends upon wire size.

For the TC240 p/n 6430240-2 equipped with a 4-pin MS3102A-9P use Figure 4.2 curves for a 14 Ga Wire limit.

- For pin A use 12 or 14 AWG stranded or solid wire. If the output voltage setting is less than 10 VDC, 12 AWG wire is recommended to minimize voltage drop in the wire. Note maximum TC240 continuous current on Figure 4.1 depends upon wire size.

- For pin B use 16 AWG stranded or solid wire. This is the largest gauge wire that pin B will handle.

- For pin C use 12 or 14 AWG stranded or solid wire. If the output voltage setting is less than 10 VDC, 12 AWG wire is recommended to minimize voltage drop in the wire. Note maximum TC240 continuous current on Figure 4.1 depends upon wire size.

- For pin D use 22 or 24 AWG stranded or solid wire.

3.3.2 Pin Assignment Information

DC input	–	Connect pin B to the aircraft positive 28 VDC bus (24-32 VDC) (15 Amp circuit breaker recommended)
DC Output	–	Connect pin C as the positive output voltage (adjustable)
DC Return	–	Connect pin A to input power return or aircraft ground
Enable	–	6430240-1: Not available 6430240-2: Pin D to be grounded to enable power output (via switch or similar. See section 4.2.1 and figure 3.4 for related details)

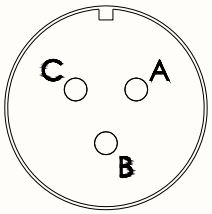

Figure 3.1
Pinout View of 6430240-1 Unit Connector

Connector Pinout	
A	DC Power Return
B	DC Power Input
C	DC Power Output

Table 3.1
6430240-1 Connector Pinout

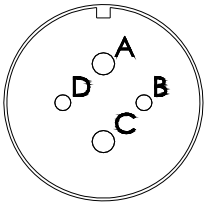

Figure 3.2
Pinout View of 6430240-2 Unit Connector

Connector Pinout	
A	DC Power Return
B	DC Power Input
C	DC Power Output
D	Enable

Table 3.2
6430240-2 Connector Pinout

3.3.3 Harness Verification

With the TC 240 Static Converter 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.

3.3.4 Output Voltage Adjustment

The output voltage can be set to any value between 5 and 24 VDC.

NOTE: The default output voltage is initially set to approximately 13.8VDC at the factory.

The output voltage can be adjusted while the TC240 DC/DC Power Converter is connected to the mating harness and aircraft power, but disconnected from the output load. Use a multi-meter at the load end of the harness to measure output voltage.

The adjustment trimmer can be accessed by removing the flat-head screw near the label as shown in Figure 3.5. After removing the screw, a flat blade screwdriver (2mm) will fit into the hole and the trimmer screw slot. Turn the trimmer carefully either clockwise to increase voltage or counter-clockwise to decrease voltage. Replace the flat-head screw after adjustment is complete.

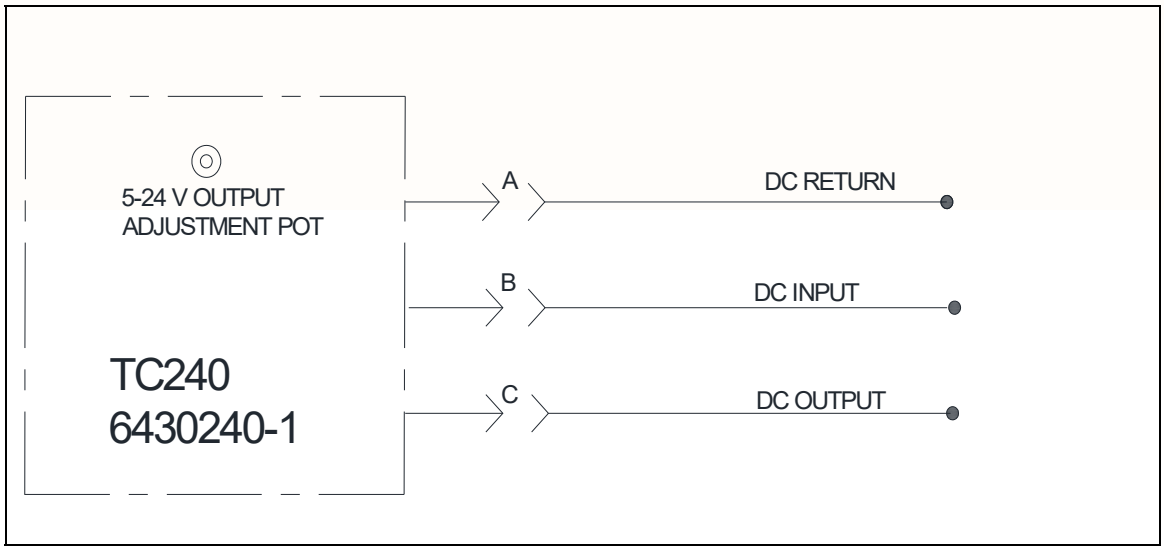

Figure 3.3: Typical 6430240-1 Aircraft Wiring Installation – Constant On

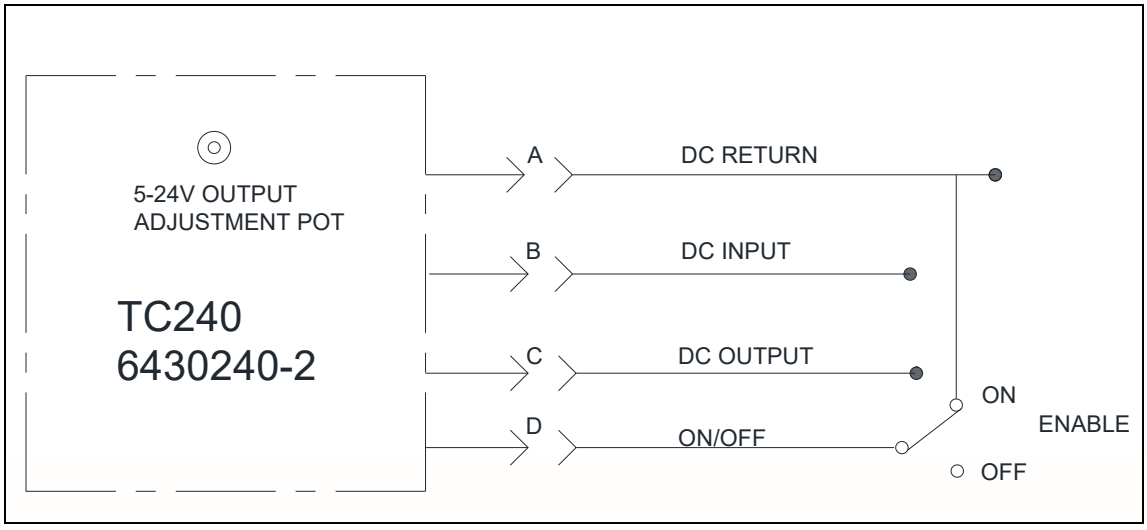

Figure 3.4: Typical 6430240-2 Aircraft Wiring Installation – Remote On/Off

3.4 MOUNTING

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

The TC240 DC/DC Converter is designed for base mounting only. Four 6-32 mounting holes should be provided in the aircraft in accordance with Figure 3.5. Secure the unit with four 6-32 pan head screws, or equivalent. A lock washer under the head of each screw is recommended.

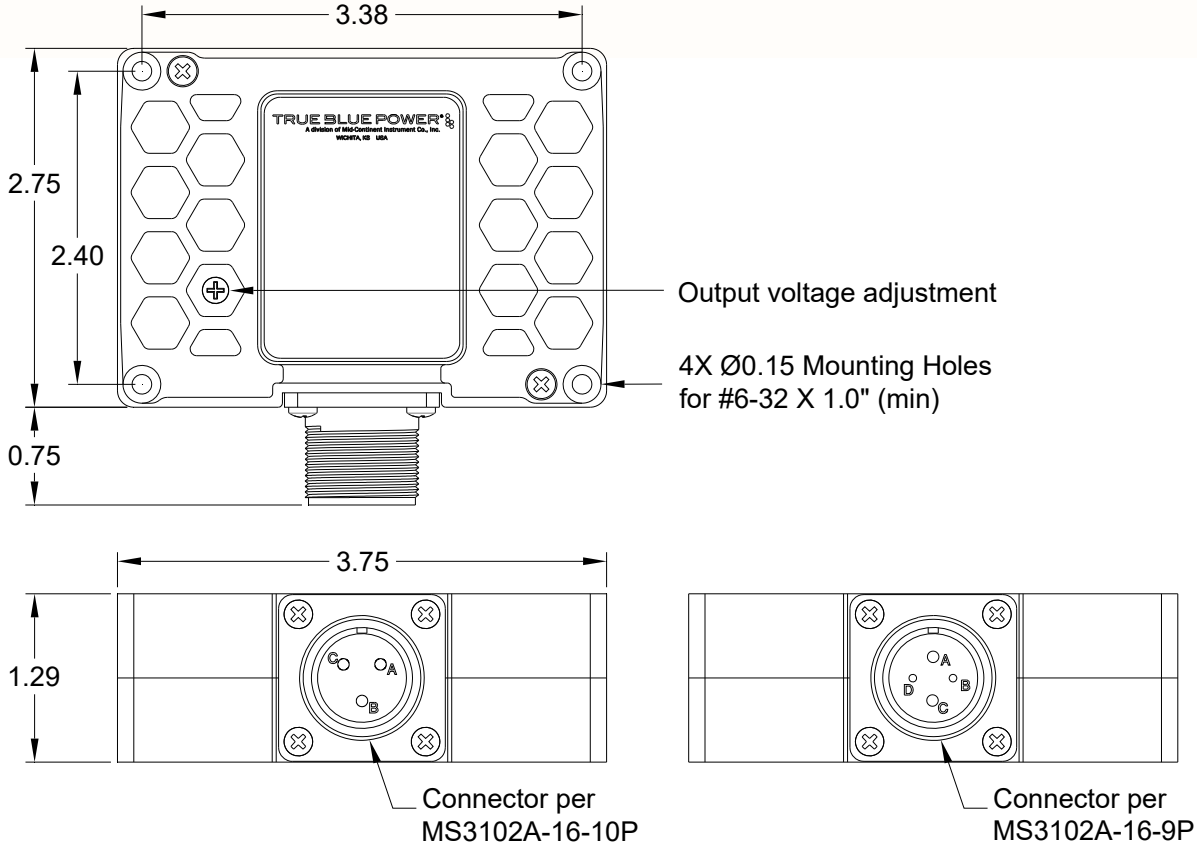

Figure 3.5

TC240 DC/DC Converter Outline Drawing

3.5 INSTALLATION CAUTION

Under no circumstances should the output of the Converter be connected to another power output source or damage will occur to the unit or the connected power source.

3.6 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.

SECTION 4 OPERATION

4.1 ELECTRICAL PERFORMANCE

The TC240 DC/DC Converter is designed as a high-efficiency, non-isolated, buck topology, solid-state switch-mode power supply. The unit converts a DC voltage input to a user-selected regulated 5 to 24 VDC output. The Pulse-Width-Modulation (PWM) circuits utilize current-mode control technology. The current-mode control operates at high frequency and pulse-by-pulse protects the internal power devices from excessive current.

4.2 TC240 AVAILABLE CURRENT OVER THE OUTPUT VOLTAGE RANGE

The TC240 continuous rated output current, and thus power, is a function of the user-selected output voltage. If the selected output voltage is lower than 9 VDC, total power output is limited by individual component ratings, including the connector pins. See Figure 4.1 for maximum continuous and temporary output current for a given output voltage.

The left side of Figure 4.1 shows the continuous current region of the TC240 (in blue). The area to the right of the Power Limit line shows the temporary current capability of the TC240 (in red). The continuous rated current can be exceeded for short periods of time in this region to accommodate surge conditions and fault conditions. This also allows the TC240 the capability to trip slow-acting thermal circuit breakers under fault and short-circuit conditions without degradation.

The dark blue area extends the maximum continuous current for applications requiring 5-14V output if 12 AWG wire is used. For minimum voltage drop at the load and for best thermal conduction in all applications, use of 12 AWG wire recommended.

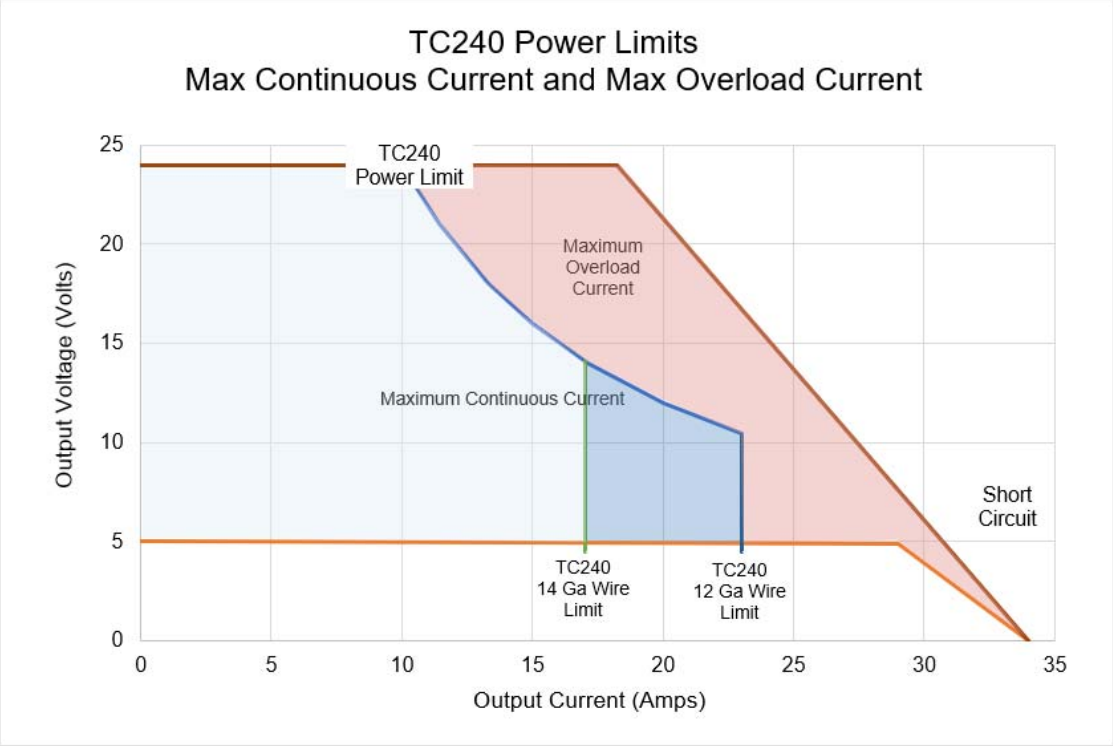

Figure 4.1
TC240 Continuous and Temporary Output Current Limits

4.3 PROTECTIVE FEATURES

4.3.1 Input Voltage Limit

The nameplate rating of the TC240 and qualification testing is 22 to 34 VDC. However the TC240 can temporarily operate at much lower voltages for start-up and emergency conditions. See Figure 4.2

The Temporary Operating Range (in yellow) represents a voltage range where extensive performance and qualification measurements have not been made other than for DO-160 Section 16 for low voltage input down to 18VDC. To request more detailed characterization for operation and behavior below input voltage of 22 VDC, contact True Blue Power.

4.3.2 Maximum Input Voltage

If the input voltage to the TC240 exceeds 34VDC, the unit senses an over-voltage at the input and disables the output. The TC240 resumes normal operation when the input voltage drops below 34VDC.

4.3.3 Output Voltage Range

The specified operating range of the output voltage for the TC120 is adjustable between 5 and 24 VDC. Each individual TC120 is tested to this range. The output can be adjusted per the procedure in section 3.3.4 above. If you require an adjustment range other than the specified 5 to 24 VDC range, contact True Blue Power.

As shown in Figure 4.2, within the specified output voltage range, the unit can only supply a maximum of approximately one volt (1 VDC) *below* the input voltage. As an example, if the output voltage is set for 18 Volts and the input voltage falls below 19 Volts, the output voltage will begin to fall as well at approximately 1 Volt less than the input voltage.

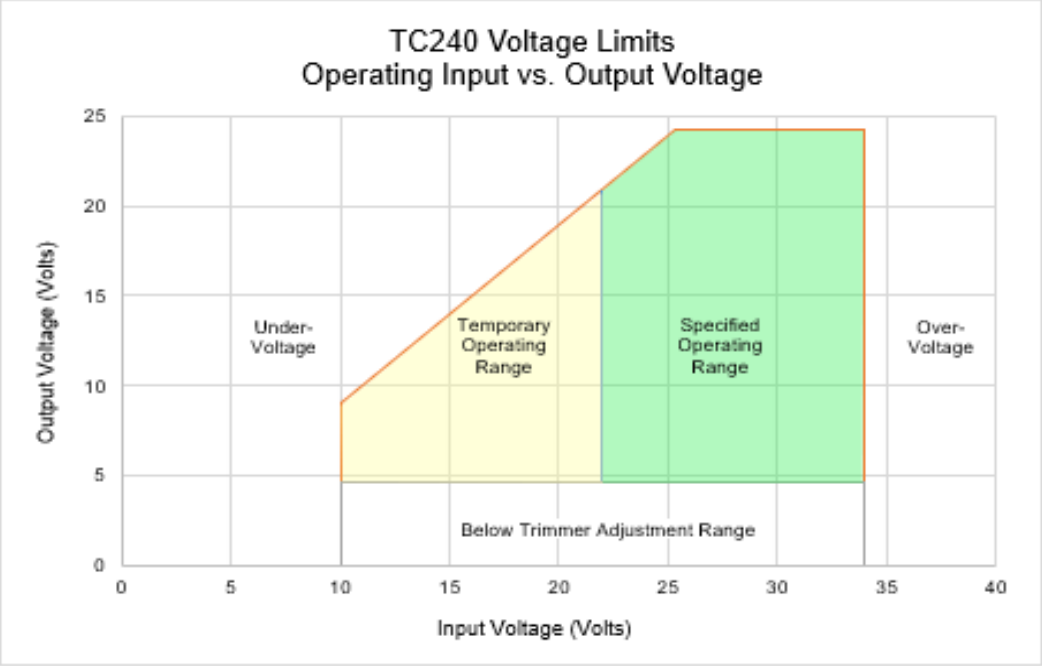

Figure 4.2
TC240 Input Voltage vs Output Voltage Range

4.3.4 Remote On/Off

A version of the TC240 DC/DC Converter (6430240-2) incorporates a remote ON/OFF feature that allows the user to enable or disable the output of the unit remotely. By providing a ground to the appropriate pin, the user can enable the output of the unit via a remote mounted switch. (See Figure 3.3)

4.3.5 Over-Temperature

The TC240 DC/DC converter uses a high-efficiency conversion process. The TC240 at maximum continuous power will have a case temperature typically 30C over ambient. For additional protection the TC240 has an internal temperature sense 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. The converter will continue to remain shut-down until the temperature returns to within acceptable limits. This over temperature reset occurs automatically without external intervention required.

4.3.6 Short Circuit

The TC240 DC/DC converter has a maximum output current. As the load current increases beyond the maximum continuous rating, a point will be reached where the TC120 output voltage begins to drop. At a full short-circuit the input current to the TC120 is low but the output current is approximately 34 Amps (See Figure 4.1). The TC240 can withstand continuous short-circuit operation without damage.

If it is undesirable in your installation for the wiring to be subjected to high currents in a short-circuit fault condition a circuit breaker on the TC240 output should be used.

SECTION 5 CONFORMANCE

5.1 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

No periodic scheduled maintenance or calibration is necessary for continued airworthiness of the TC240 DC/DC Converter. 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: TC240 **PART NUMBER:** 6430240-( ) Series
DESCRIPTION: DC/DC Converter **CERTIFICATION:** FAA TSO-C71
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) 688-P Test Data Sheet (TDS) 688-P
STANDARD: RTCA DO-160, Rev G, dated 12/08/10; MIL-STD-461F, dated 12/10/07
MIL-STD-704F, dated 03/12/04, MIL-STD-810F, dated 01/01/00

CONDITIONS	SECTION	DESCRIPTION OF TEST
Temperature and Altitude	4	Category F2[1]
Temperature Variation	5	Category S2
Humidity	6	Category B
Operational Shock and Crash Safety	7	Category B[1]
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 F[2]
Sand and Dust	12	Category D
Fungus	13	Category F
Salt Spray	14	Category S
Magnetic Effect	15	Category Z
Power Input	16	Category B(XX)[3]
Voltage Spike	17	Category A
Audio Frequency Conducted Susceptibility	18	Category R[4]
Induced Signal Susceptibility	19	Category X[4]
Radio Frequency Susceptibility	20	Category X[4]
Emission of Radio Freq Energy	21	Category M[4]
Lightning Induced Transient Susceptibility	22	Category XXH2L2
Lightning Direct Effects	23	Category X
Icing	24	Category X
ESD	25	Category A
Flammability	26	Category X

REMARKS:
1 - Qualified to MIL-STD-810F (500.4, 501.4, 502.4, 516.5)
2 - Fluids: Deicing Fluid, Solvent (IPA), Cleaning Fluid
3 - Qualified to MIL-STD-704F/MIL-HDBK-704-8 (LDC101 – LDC602)
4 - Qualified to MIL-STD-461F (CE102, RE102, CS101, CS114, CS115, CS116, RS103)