

Installation Manual and Operating Instructions

# TRUE BLUE POWER

**TC120**

DC/DC POWER  
CONVERTER

Manual Number  
9018558



Revision K • June 8, 2022

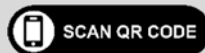
## **FOREWORD**

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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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**

<b>Rev</b>	<b>Date</b>	<b>Detail</b>	<b>Approved</b>
A	02/10/2016	Initial release	SHO
B	03/04/2016	Updated EQF in Section 5, corrected input voltage range, added note to Section 2.4.	BAW
C	03/15/2016	Add -2 version.	BAW
D	05/27/2016	Updated wiring drawings in Section 3.	VAA
E	02/10/2016	Updated Section 4.2.1.	KJW
F	05/07/2020	Updated style and brand to meet Marketing and Engineering guidelines.	DLR
G	10/21/2020	Updated weight.	MEK
H	04/13/2021	Updated Section 4 – provided additional clarification in the operation section; correct graph info; added new graph to illustrate power range. Section 5 corrected typo	DLR
J	09/03/2021	Updated Sections 1.1, 1.2 and 5.2 to include MIL-STD testing	WVC
K	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 TC120 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 TC120 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 120 watts to power avionics, instrumentation, personal charging, lighting, and many other applications. The TC120 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 TC120 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

<b>Electrical Attributes</b>	
Input Voltage	Rated 28VDC nominal, Operating 24 – 32VDC
Input Current (full load)	5 amps max at nominal input voltage
Output Voltage	5 – 24 VDC adjustable
Output Power	120 watts nominal
Efficiency	95% nominal

**Table 1.1**

<b>Physical Attributes</b>	
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	MCIA P/N 9018651
Mounting	Base mount – orientation not critical

**Table 1.2**

<b>Qualifications</b>	
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 TC120 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 TC120 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.

## 2.5 MODIFICATION

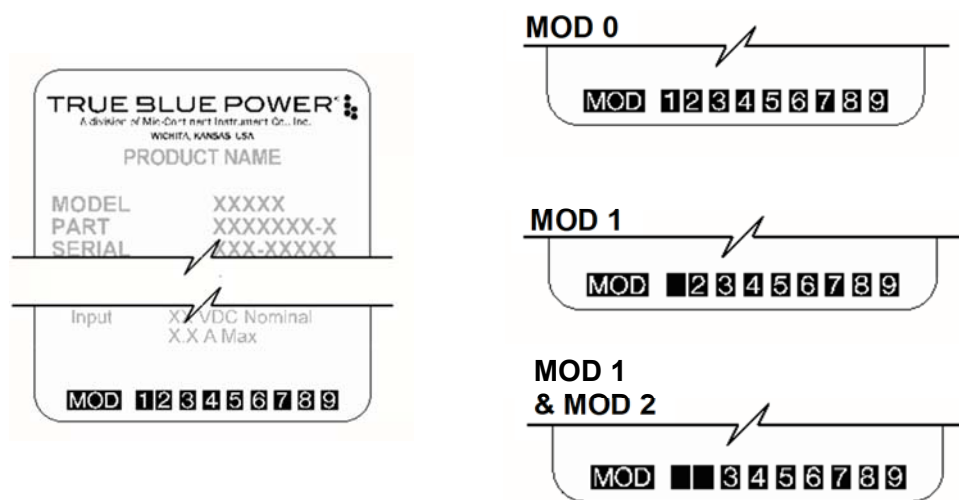
This product has a nameplate that identifies the manufacturer, part number, description, certification(s) and technical specifications of the unit. It also includes the “MOD” or modification number representing notable changes in the hardware design of the unit.

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](http://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 TC120 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
6430120-1	No (output always enabled)
6430120-2	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 incurred during shipment. The following parts should be included:

- |                        |                 |
|------------------------|-----------------|
| A. DC/DC Converter     | P/N 6430120-( ) |
| B. Connector Kit       | P/N 9018651     |
| i. Mating Connector    |                 |
| ii. Strain Relief      |                 |
| C. Installation Manual | P/N 9018558     |

Equipment not provided:

- |                       |  |
|-----------------------|--|
| A. Mounting Hardware  | four 6-32 x 1" (min) pan head screws<br>#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 Figures 3.3 – 3.5, and Wiring Diagram of Table 3.3.

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

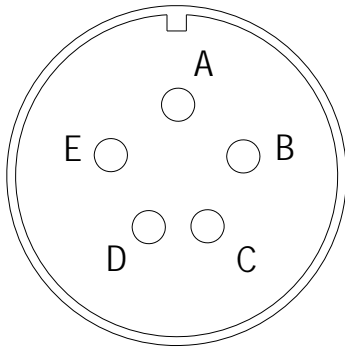
#### 3.3.1 Wire Gauge Selection

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:

- Pins A and B – 18 or 16 AWG stranded or solid
- Pins C and D – 16 AWG stranded or solid
- Pin E – 24 AWG stranded or solid

### 3.3.2 Pin Assignment Information

- DC Input – Connect pin A to the aircraft positive 28 VDC bus (24-32 VDC)  
(7.5 amp circuit breaker recommended)
- DC Return – Connect pin B to input power return or aircraft ground. Equivalent to pin D
- DC Output – Connect pin C as the positive output voltage (adjustable)
- DC Return – Connect pin D to output return or aircraft ground. Equivalent to pin B
- Enable – 6430120-1: pin E to remain open/unconnected  
6430120-2: pin E to be grounded to enable power output  
(via switch or similar. See section 4.2.1 and figure 3.3 for related details)



**Figure 3.1**  
**Pinout View of Unit Connector**

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

**Table 3.1**  
**Connector Pinout**

### 3.3.3 Harness Verification

With the TC120 DC/DC Power Converter disconnected, activate the aircraft power bus that supplies the unit and use a multi-meter to measure and verify the power, ground, and enable voltages on the appropriate pins within the mating harness.

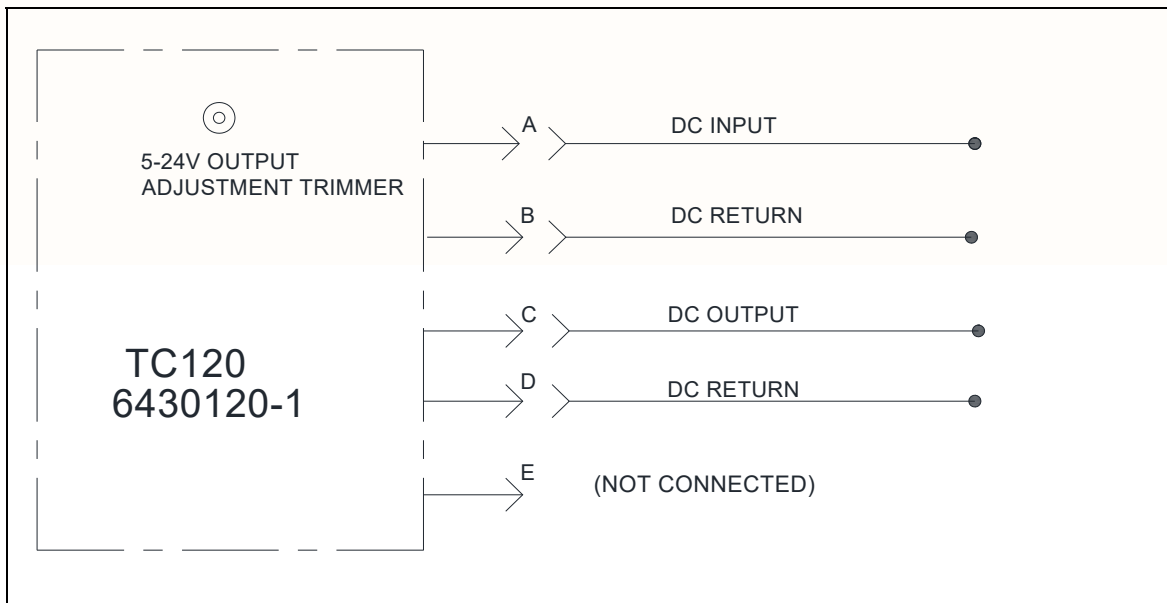
### 3.3.4 Output Voltage Adjustment

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

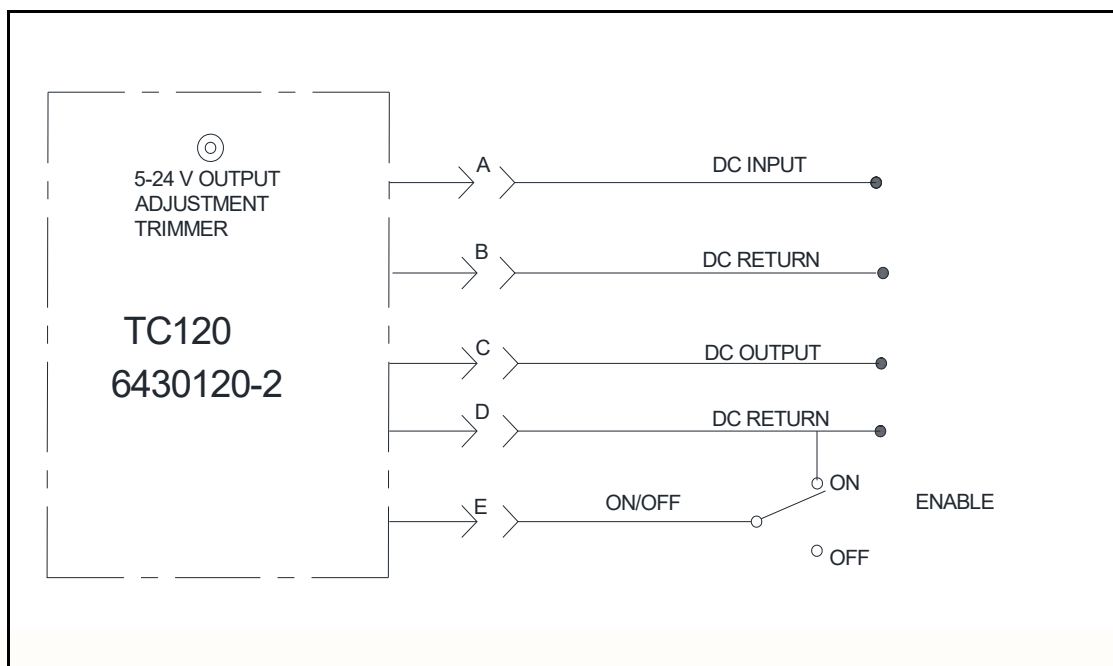
**NOTE:** The default output voltage is initially set to approximately 13.8V at the factory.

The output voltage may be adjusted while the TC120 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 3.4. 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 3.2: Typical 6430120-1 Aircraft Wiring Installation – Constant On**

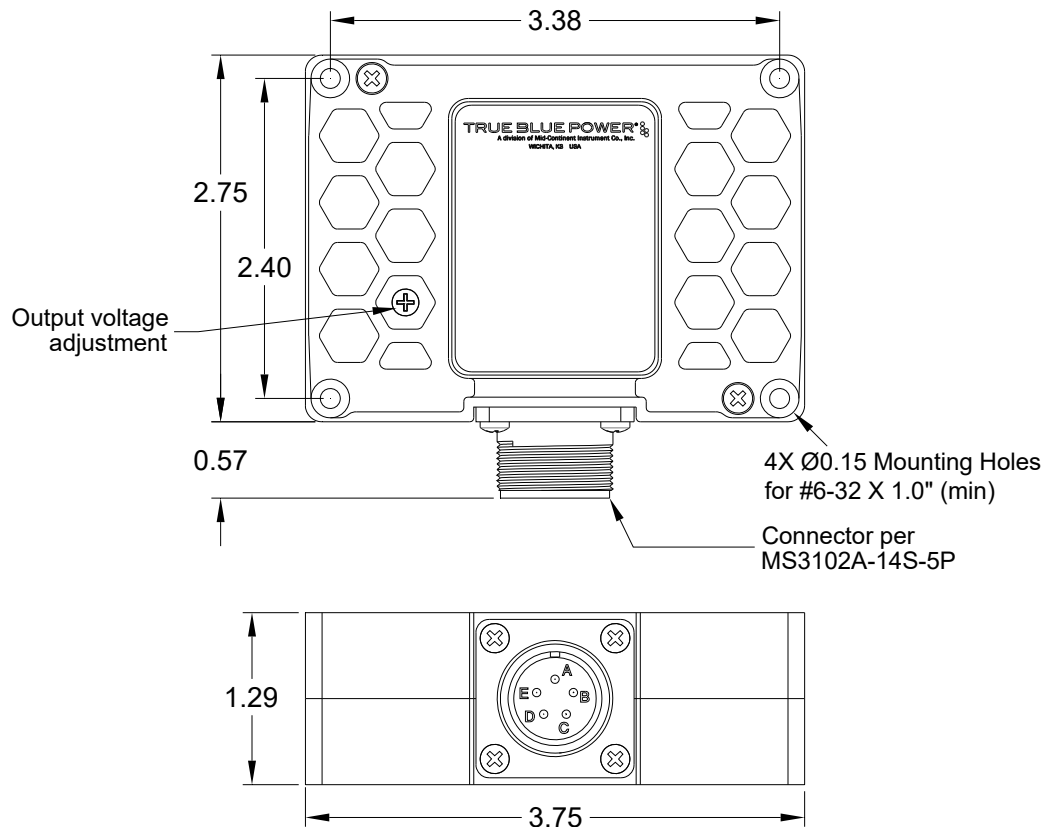


**Figure 3.3: Typical 6430120-2 Aircraft Wiring Installation – Remote On/Off**

### 3.4 MOUNTING

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

The TC120 DC/DC Converter is designed for base mounting only. Four 6-32 mounting holes should be provided in the aircraft in accordance with Figure 3.6. Secure the unit with four 6-32 pan head screws, or equivalent. A lock washer under the head of each screw is recommended.



**Figure 3.4**  
**TC120 DC/DC Converter Outline Drawing**

### 3.5 INSTALLATION CAUTION

Under no circumstances should the output of the Converter to 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

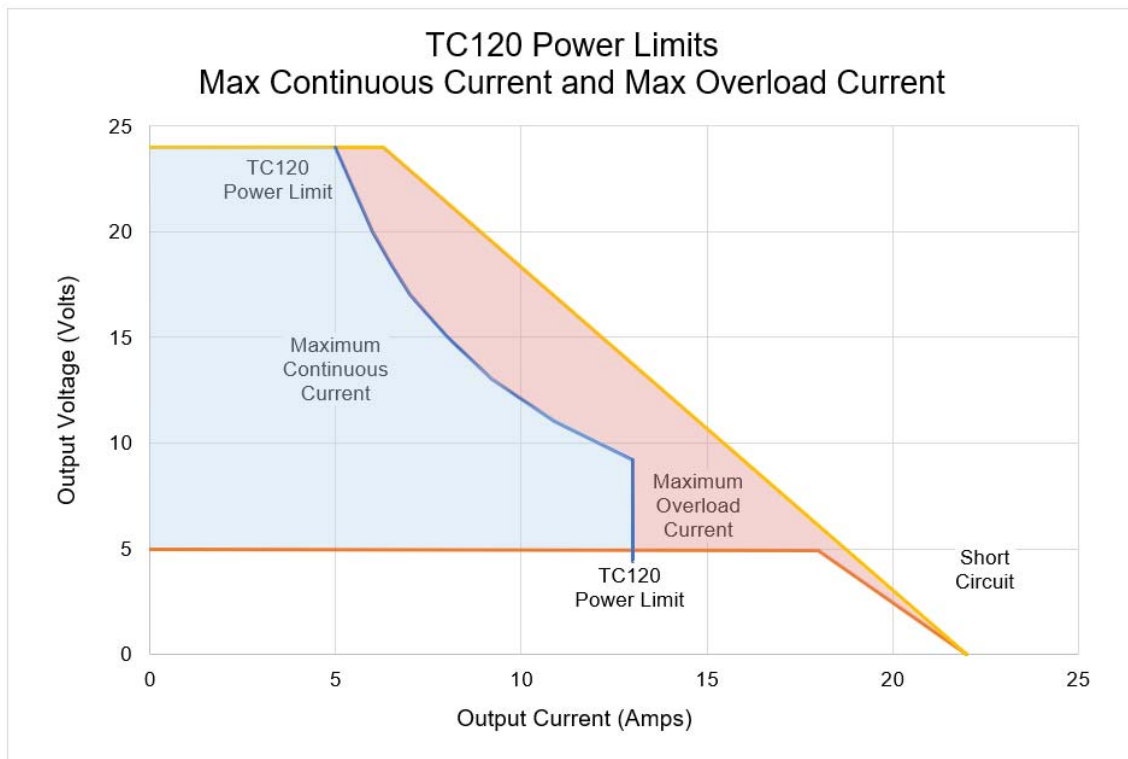
The TC120 DC/DC Converter is designed as a high-efficiency non-isolated, buck topology, solid-state switch-mode power supply. The unit converts a DC voltage input to a user-selected regulated 5 to 24 VDC output. The Pulse-Width-Modulation (PWM) circuits utilize current-mode control technology. The current-mode control operates at high frequency and pulse-by-pulse protects the internal power devices from excessive current.

### 4.2 TC120 AVILABLE CURRENT OVER THE OUTPUT VOLTAGE RANGE

The TC120 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 TC120 (in blue). The area to the right of the Power Limit line shows the temporary current capability of the TC120 (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 TC120 the capability to trip slow-acting thermal circuit breakers under fault and short-circuit conditions without degradation.

For minimum voltage drop at the load and for best thermal conduction, use of the largest wire size possible is recommended (i.e. 16 AWG).



**Figure 4.1**

**TC120 Continuous and Temporary Output Current Limits and Output Voltage**

### 4.3 PROTECTIVE FEATURES

#### 4.3.1 Input Voltage Range

The specified operating range of the input voltage for the TC120 is 22 to 34 VDC. However, the TC120 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.

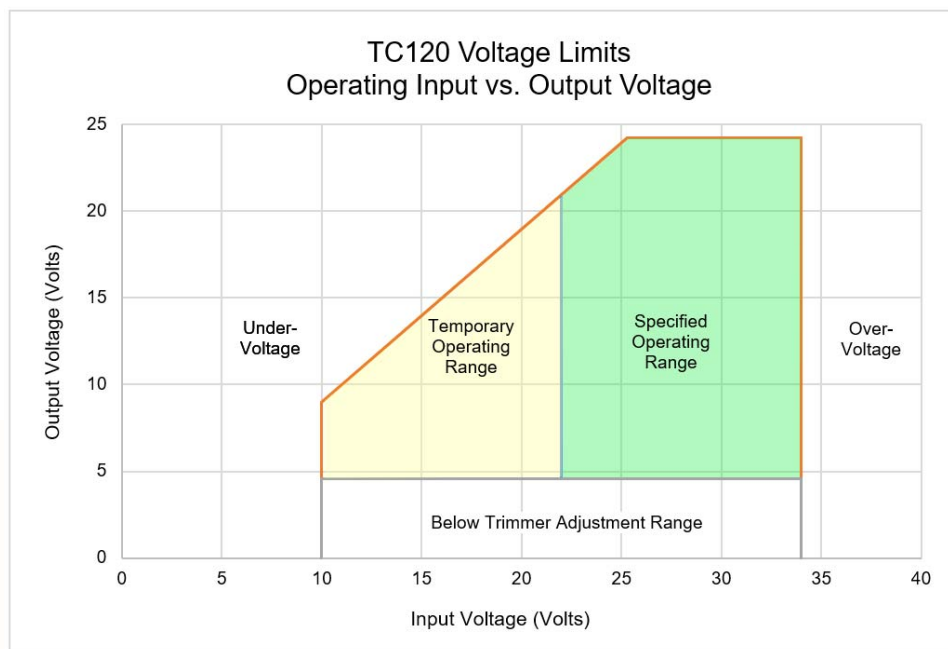
#### 4.3.2 Maximum Input Voltage

If the input voltage to the TC120 exceeds 34VDC, the unit senses an over-voltage at the input and disables the output. The TC120 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**  
**TC120 Input Voltage vs Output Voltage Range**

#### **4.3.4 Remote On/Off**

A version of the TC120 DC/DC Converter (6430120-2) 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 TC120 DC/DC converter uses a high-efficiency conversion process. The TC120 at maximum continuous power will have a case temperature typically 20C over ambient. For additional protection the TC120 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 TC120 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 22.5 Amps (See Figure 4.1). The TC120 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 TC120 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 TC120 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:** TC120 **PART NUMBER:** 6430120-( )  
**DESCRIPTION:** DC/DC Converter **CERTIFICATION:** FAA TSO-C71  
**MANUFACTURER:** True Blue Power, a division of Mid-Continent Instrument Co., Inc.  
**ADDRESS:** 9400 E. 34<sup>th</sup> St. North, Wichita, KS 67226, USA.  
**SPECIFICATION:** Test Specification (TS) 627 Test Data Sheet (TDS) 627  
**STANDARDS:** 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

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