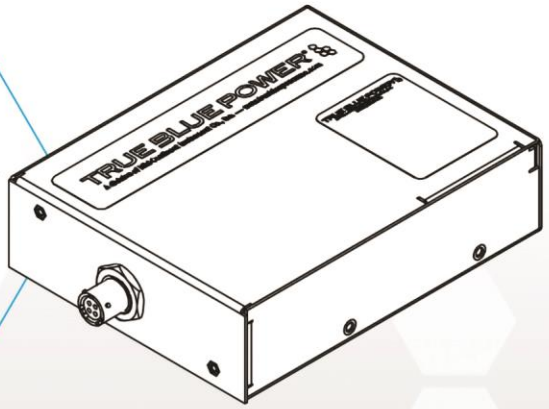
Installation Manual and Operating Instructions

TRUE BLUE POWER

TS28

EMERGENCY BATTERY POWER SUPPLY

Manual Number
9019932



Revision C • October 17, 2023

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.
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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:

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TABLE OF CONTENTS

REVISION HISTORY

Rev	Date	Detail	Approved
A	08/24/2023	Production Release	ESH
B	09/29/2023	Changed Capacity to Wh, and output current to 1.1 A	AS
C	10/17/2023	Updated figure 1.1.	MKN

SECTION 1 GENERAL DESCRIPTION

1.1 INTRODUCTION

The True Blue Power TS28 series Emergency Battery Power Supply is designed to supply DC power for aircraft loads such as lighting and other critical equipment in the event of a primary power loss. During normal aircraft operation, the TS28 Emergency Battery Power Supply (EBPS) will utilize aircraft power to recharge or maintain existing charge at full capacity. The TS28 is a sophisticated power system that utilizes state-of-the-art NiMH cell technology which provides improvements in performance, safety, and life when compared to traditional or competing backup systems. With emphasis on a robust design, the EBPS meets applicable regulatory standards and has been tested to environmental and performance qualifications that exceed industry requirements. The TS28 is a complete EBPS that provides significant value and benefit to an aircraft designer, owner and operator.

The TS28 requires professional use and maintenance to deliver maximum performance and value as designed. This manual contains information related to the specifications, installation, operation, storage, scheduled maintenance, and other related topics associated with the proper care and use of this product.

1.2 PHYSICAL ATTRIBUTES

The TS28 consists of a rugged metal chassis with a 4-pin Mil-Spec circular-style connector for electrical interface, and a rechargeable battery that is easily removed to shorten maintenance timelines and extend product life. The unit is designed to be mounted with four threaded fasteners to attach the unit to the aircraft structure.

1.3 UNIT ARCHITECTURE

The unit is comprised of four primary functional pieces:

- Main Boards
- Connector Interface Board
- Battery Pack
- Metal Chassis

The external 4-pin connector used for charging, discharging and power pass-through is connected internally to one of two main printed circuit boards (PCBs). The Main Boards provide control of all battery functions such as management, charging and discharging. The main boards also protect against short circuit, over temperature, under-voltage, over-voltage, and EMI filtering.

The Battery Pack assembly contains twenty (20) cells in series, temperature sensors for monitoring, and includes the Connector Interface Board. When installed, the connector on the interface board plugs the battery pack into the main board. The battery pack is housed in its own rugged metal chassis for easy handling and streamlined replacement as needed.

1.4 TECHNICAL SPECIFICATIONS

Electrical Attributes	
Power Input:	26.5 to 32 VDC; 0.8 A peak
Nominal Power Output	1.1 A @ 24 VDC nominal
Max Continuous Current Output:	3 A
Battery Capacity:	28 Wh
Charge Time @ 28 VDC:	2.5 hours to 95% state of charge; +1 hour to 100% state of charge
Discharge Time:	60 minutes @ 1.1 A
Maintenance:	Perform capacity check every 24 months

Table 1.1

Physical Attributes	
Weight:	1.7 pounds [0.84 kg]
Dimensions: (LxWxH) (See Figure 1.1)	5.5 x 4.4 x 1.5 inches - without connector [140 x 112 x 38 mm]
Mating Connector:	MS3116E-4P or equivalent
Mounting: (See Figure 1.1)	Chassis mounted with (4) #6 Screws

Table 1.2

Qualifications	
Certification:	FAA TSO-C173a
Performance Qualification:	RTCA DO-293A Minimum Operational Performance Standards for Rechargeable Nickel-Metal Hydride (NiMH) Batteries and Battery Systems
Environmental Qualification:	RTCA DO-160G (see Section 5.7 for tests and categories)

Table 1.3

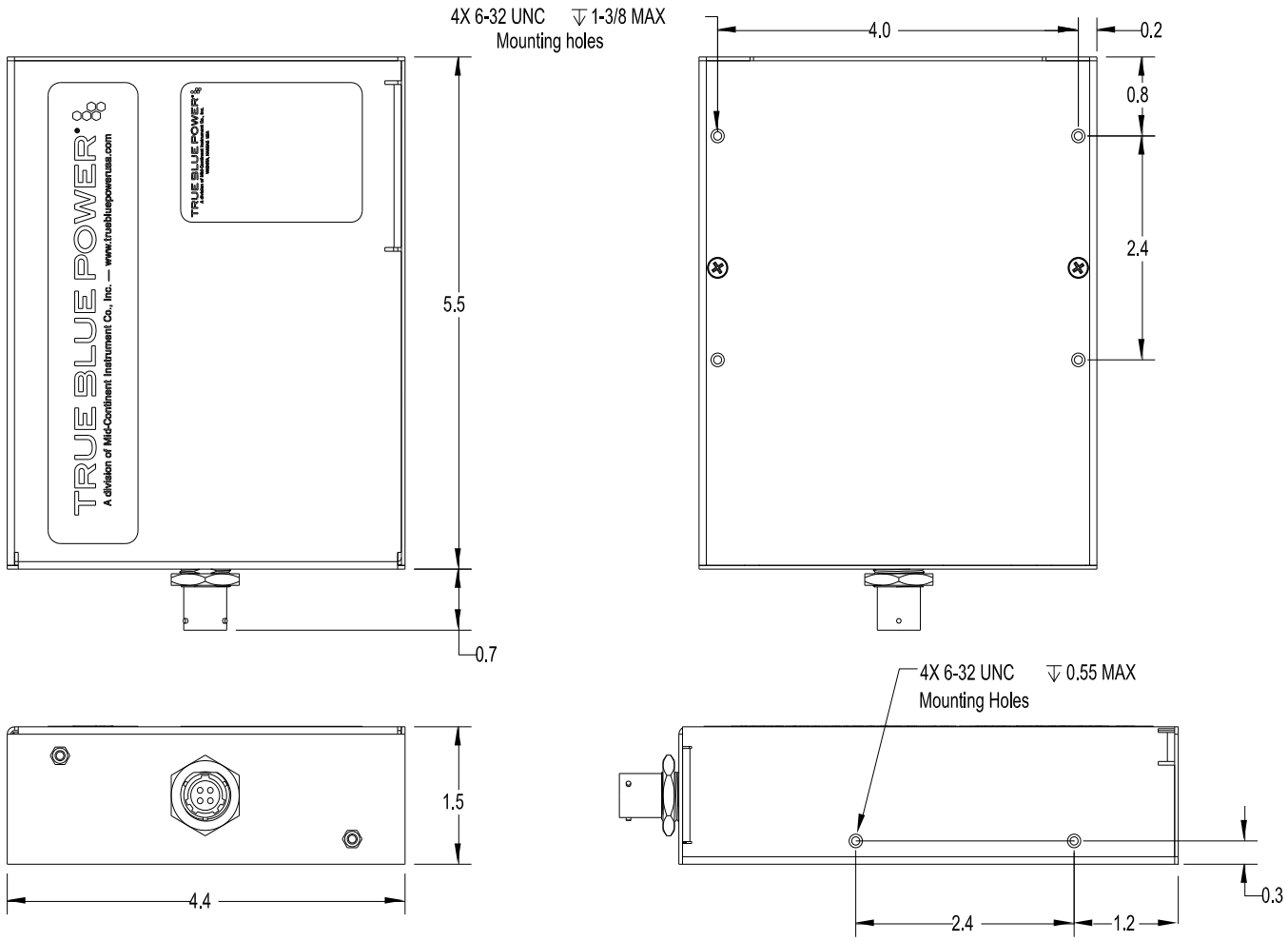


Figure 1.1
Outline Drawing

1.5 IMPORTANT SAFETY INFORMATION

1.5.1 Symbol Definition

Read this safety information BEFORE maintaining or servicing the battery.

This section describes the precautions necessary for safe operations. The following safety symbols have been placed throughout the guide.

WARNING

Warnings identify conditions or practices that could result in personal injury.

CAUTION

Cautions identify conditions or practices that could result in damage to the equipment.

1.5.2 Handling Precautions

WARNING

Though the TS28 has short circuit protection, caution should always be used when working with battery powered products. It is recommended to wear safety glasses and use insulated tools when servicing the EBPS.

- Mishandling the battery could generate a short circuit, cause its insulation to melt, or cause damage to its safety valve or safety mechanism, which may in turn cause the battery to generate heat or leak. Be sure to follow the instructions listed below when using the battery:
  - Do not disassemble or modify the battery pack.
  - The battery pack is keyed to fit one way into the main chassis. When installing a pack, if it cannot readily be fitted, do not insert the battery by force. Check orientation and try again or verify that the pack or chassis are not damaged.
  - When servicing the EPBS or battery, use the specified battery charger and/or instructions as provided in this manual.
  - Do not place the battery in a fire or heat the battery.
  - If connecting to the battery externally, never reverse the positive/negative pins.
  - Do not connect the battery to a power outlet.
  - Do not connect the positive terminal and the negative terminal of the battery to each other with any metal object such as a wire.
  - Do not carry or store batteries together with jewelry or other metal objects.

- The battery contains an alkaline electrolyte. This electrolyte may result in the loss of eyesight if it comes into contact with an eye. In such cases, do not rub the eye, but immediately wash the eye with clean water and then consult a doctor.

- Remove metal items such as rings, bracelets, and watches when working with batteries. A battery could produce a short circuit current that could harm a person.

- All connections for battery pack testing must include appropriate short-circuit protection as these are not present once the pack is removed from the product. Shorting the battery pack can result in venting cells and personal injury.
- Ensure that the TS28 service area is properly ventilated and egress paths are unobstructed.
- Specialized breathing filters are not required for normal use.
- Always use insulated tools.
- Never smoke or allow a spark or flame near the TS28.
- Use caution to reduce the risk of dropping a metal tool on the unit. Dropping a tool could spark or short circuit the TS28.

1.5.3 Additional Precautions

The following design and operation factors are required for safe use.

- It is not acceptable to combine or use any battery cells or modules other than those approved by True Blue Power.
- Always use appropriate Electrostatic Discharge (ESD) protection while working with the TS28.
- There are no limitations in storing or using this TS28 in the vicinity of other battery chemistries. The TS28 does not emit or absorb any gas during storage, transportation or during normal operating conditions.
- It is recommended to cover terminals and connectors with non-conductive protective devices to avoid any possibility of shorting during handling, shipping or storage.

1.5.4 Shipping

Shipping complies with domestic and international shipping regulations.

This product is NOT, nor are any of its components, restricted for the purposes of transportation by the U.S. Department of Transportation, see 49 CFR 172.102. Any method of shipping is considered acceptable, without restrictions.

SECTION 2 PRE-INSTALLATION CONSIDERATIONS

2.1 COOLING

No internal or external cooling of the unit is required. The unit is designed to operate over a wide temperature range and includes internal thermal monitoring and protection circuits.

2.2 EQUIPMENT LOCATION

The TS28 EBPS is designed to mount in a temperature-controlled environment. Although not required, optimum performance and life can be achieved by mounting the unit in a temperature-controlled section of the aircraft that does not fall below -8°C or rise above +70°C. The unit is designed to withstand elevated levels of condensing humidity. However, installation locations where the unit could be subject to standing or direct water exposure should be avoided. The unit has no limitations regarding mounting orientation.

2.3 ROUTING OF CABLES

Avoid sharp bends in cabling and be cautious of 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. Cables should not run adjacent to heaters, engine exhausts, or other heat sources. Individual wires are recommended to be no smaller than 20 gauge.

2.4 LIMITATIONS

The conditions and tests for TSO approval of the TS28 are minimum performance standards. Those installing the TS28, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO compliant products must receive additional installation approval prior to being operated on each aircraft. This article meets the minimum performance and quality control standards required by a technical standard order (TSO).

Installation of this article requires separate approval. The TS28 may be installed only according to 14 CFR Part 43 or the applicable airworthiness requirements.

Also see Section 2.2 for limitations associated with equipment installation location.

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 published Service Bulletins for this product at www.truebluepowerusa.com.

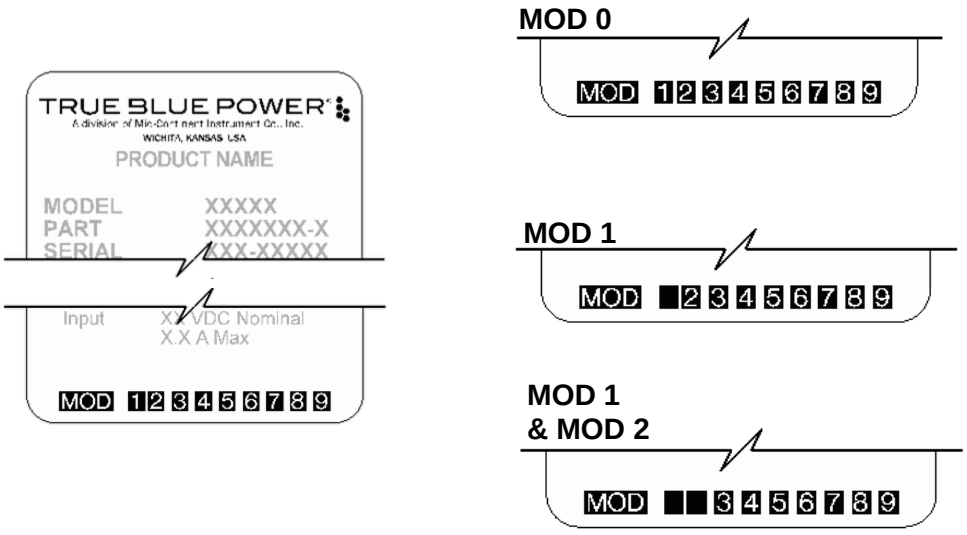


Figure 2.1
Nameplate and MOD Status Example

SECTION 3 INSTALLATION

3.1 GENERAL

This section contains mounting, electrical connections and other information required for installation. These instructions represent a typical installation and are not specific to any aircraft.

3.2 PRE-INSTALLATION INSPECTION

Unpacking: Carefully remove the TS28 battery from the shipping container

Inspect for Damage: Inspect the shipping container and unit for any signs of damage sustained in transit. If necessary, return the unit to the factory using the original shipping container and packing materials. File any claim for damages with the carrier.

3.3 PARTS

3.3.1 Included Parts

A. TS28 Emergency Battery Power Supply	MCIA P/N 6430028-( )
B. Installation and Operation Manual	MCIA P/N 9019932
i. (Available online)	

3.3.2 Available Parts

A. Connector Kit	MCIA P/N 9015514-1
B. Replacement Battery Pack	MCIA P/N 9019931

3.3.3 Installer Supplied Parts

A. Wires
B. Appropriate mounting hardware

3.4 INSTALLATION

⚠ WARNING ⚠

The connector pins of the TS28 are always active and energized.
DO NOT SHORT CONNECTOR PINS AT ANY TIME!

Always use extreme care and caution when handling and connecting to the unit, equipment damage can occur if not handled properly.

See Section 1.5 for additional handling precautions.

3.4.1 Harness Preparation

Prepare aircraft wiring with mating connectors in accordance with the proper Wire Size and Type (
Table 3.1), Unit Locations (Figure 3.1), Pin Identification Diagram (Figure 3.2), and Pin Functions (Table 3.2). Recommended external connections to the aircraft can be seen in Figure 3.4.

Use of PTFE, ETFE, TFE, Teflon or Tefzel insulated wire is recommended for aircraft use. Recommended wire sizes and types are identified in
Table 3.1 below.

Wire Size and Type			
Wire Gauge	Wire Type	Connector	Pins
18-20 AWG	Stranded Copper	4-pin	1-4

Table 3.1
Wire Size and Type

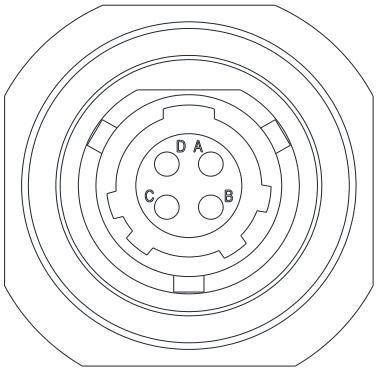
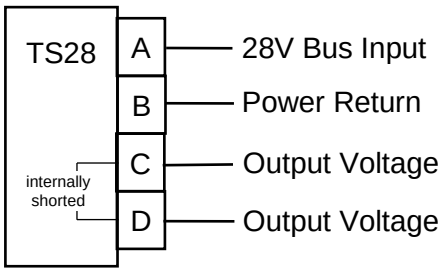


Figure 3.1
EBPS Connector

Emergency Battery Power Supply Connector (4-pin)	
Pin	Pin Function
A	Vin
B	GND
C	Vout
D	

Table 3.2
Connector Pinout

3.4.2 Installation and Wiring



3.4.3 Securing the Unit

The TS28 is designed to be secured in the aircraft using four (4) #6 screws (or equivalent) located 2.4 inches apart on each side of the unit in accordance with Figure 1.1.

SECTION 4 OPERATION

4.1 DESCRIPTION

The True Blue Power TS28 series Emergency Battery Power Supply (EBPS) is designed to supply DC power for aircraft loads such as lighting and other critical equipment in the event of a primary power loss. It utilizes rechargeable nickel metal hydride (NiMH) chemistry to provide output power. During normal aircraft operation, the TS28 EBPS will utilize the aircraft's primary power bus to recharge or maintain existing charge at full capacity. When the TS28 detects a loss of the input power, it provides output power from the battery.

4.2 THEORY OF OPERATION

The TS28 Emergency Battery Power Supply system provides a nominal voltage output of 24 VDC and a maximum power output of 3.0 amps. The units are designed to receive an input between 26.5-32 VDC and to seamlessly switch to backup battery in the event that the input bus is not present. Refer to Section 3.4 for external connection to aircraft controls.

4.2.1 Input bus present

If the input bus is present, it will pass through to the output of the TS28 and maintain or charge the backup batteries. When charging, the load on the aircraft system is approximately 0.7 A during fast charge and 0.2 A during trickle charge, falling to zero when the cells are fully charged. The unit constantly monitors a variety of conditions such as voltage, current and temperature. The TS28 will continue to pass the bus power through for all charging protections. Only the output current limiting/short circuit shut down will affect the bus pass through. In the case of a short circuit or extended over current event, the unit will enter protection mode by automatically disconnecting the TS28 from the charging source.

4.2.2 Input bus dropout

If the input bus drops out or is below 18.8 V, the unit will switch over to the battery output. The transfer from the loss of input until backup power is available is approximately 30 milliseconds.

4.2.3 Discharge

In order for the battery to provide power, the TS28 must first sense primary input power, then detect loss of power. Once activated, the battery voltage will decay from approximately 28 VDC at full charge to approximately 15.2 VDC at the end of discharge (see Section 4.3). This voltage is referred to as End Point Voltage (EPV). Once the unit has reached EPV, the output will be shut off. Short circuit protection is based on a 6-amp current limit. If the current exceeds this, the unit will shutoff for 25 ±10 seconds and then try again. While 6 amps is the upper limit and will initiate an immediate shutoff sequence, the unit does allow for up to 3 amps continuously with short-term over-current operation between 3 A to 6 A.

4.2.4 Software and Complex Hardware

No software or complex hardware is incorporated in the design of this product.

4.3 BATTERY PERFORMANCE AND CAPACITY

The TS28 utilizes nickel metal hydride (NiMH) cell technology and modern battery management techniques to provide significant benefits over traditional battery chemistries and products.

NiMH provides more energy in less space and weight than either sealed lead acid (SLA) or nickel cadmium (NiCad) batteries. This equates to smaller, lighter, and/or longer lasting products. Additionally, the TS28 significantly reduces maintenance cost by eliminating the memory effect common to NiCad batteries which reduces their useful capacity over time. This allows more flexible charging and discharging cycles, along with higher cycle life, without an impact on capacity.

Further, the use of modern NiMH technology in the TS28 provides for extremely low self-discharge, producing a long shelf life and on-demand state of charge after periods of non-use. This means they can retain their stored energy for longer periods without requiring frequent recharging. NiMH batteries are better suited for applications that demand extended periods of standby or intermittent use.

Unlike lead acid or NiCad batteries, NiMH batteries do not contain toxic lead or cadmium, making them more environmentally friendly and safer for disposal. NiMH batteries are considered a more sustainable choice due to their reduced environmental impact.

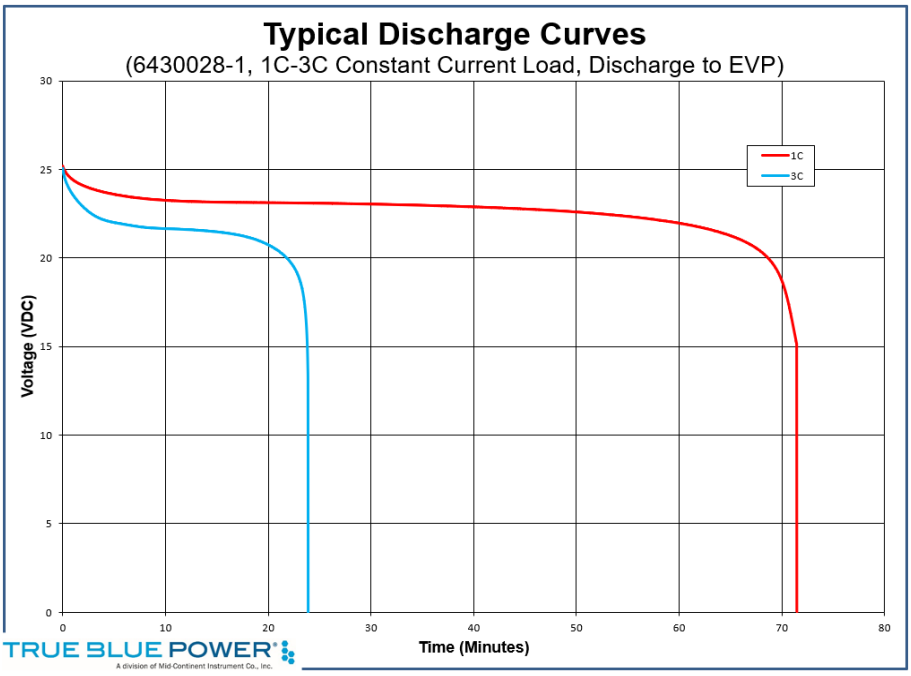


Figure 4.1

4.4 MAINTENANCE

Because the cells are designed to maintain their charge-holding capability over time, True Blue Power recommends a 24-month maintenance cycle. The 24-month check includes a full charge, discharge, and recharge while evaluating the discharge time against minimum requirements. Additionally, True Blue Power recommends conducting this procedure at any time when the capacity of the unit is in question or after being utilized in an in-flight emergency situation. For more details on the charging and capacity check, see Section 5.2.

SECTION 5 CONFORMANCE

5.1 DISPATCH VERIFICATION AND IN-FLIGHT MONITORING

The TS28 typically serves to provide aircraft exit lighting upon loss of aircraft power. There is no dispatch signal. It is recommended to test functionality prior to flight by exercising the emergency lighting system.

5.2 ROUTINE MAINTENANCE AND RETURN TO SERVICE

The TS28 requires scheduled maintenance based on calendar life of the EBPS. Maintenance as described in this section shall be conducted every 24 months from date of original aircraft delivery or subsequent new battery installation. The TS28 battery shall be recharged every 6 months or kept constantly connected to 28V if maintaining a full or nearly full charge during storage is desirable. Though it is not recommended, allowing the batteries to discharge completely in storage is unlikely to cause damage to the cells. Optionally, the battery may be stored out of the unit to maintain its charge. A charge and capacity check are still required prior to installation and return to service.

5.2.1 Visual Inspection

Remove the unit from the aircraft. Visually inspect the exterior of the TS28 casing for signs of damage or wear. Verify that the battery tray is secure, and not loose. Verify that no damage has occurred which would prevent the TS28 from functioning. If any wear is apparent which has not compromised the case, inspect the TS28 area of the aircraft for any signs of improper installation.

Visually inspect the connector. Verify that it is not loose and there are no signs of damage, wear, or corrosion.

If any of the above conditions are present, the unit must be evaluated and tested for repair or replacement by an authorized repair facility.

5.2.2 Charging and Capacity Check

To charge the TS28, apply 28V to pin A and ground to pin B. To discharge the TS28, apply a load on pin C or D referenced to pin B. The TS28 charge current is between 0.80 A to 0.60 A at the start of charge and the current will rise. This rise will have 1 or 2 sharp step downs in current, but the charge is not complete until the unit reaches less than 0.02 A. Charge should take approximately 2 to 3 hours with about 90% of the energy coming from the first 2 hours.

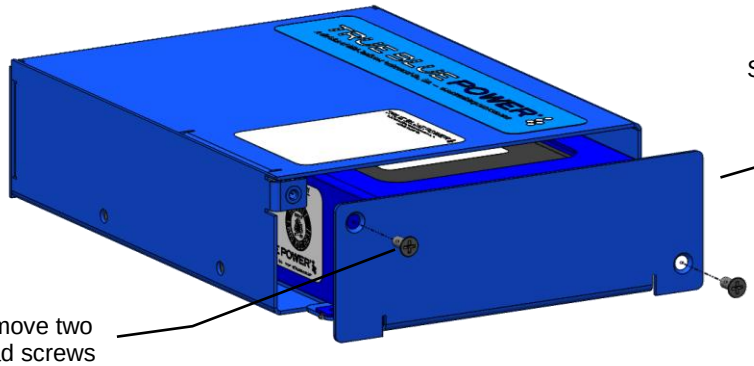
To perform a capacity check, you must first fully charge the unit and then discharge the unit at 1 A. Start a timer when discharge begins. Once the unit stops discharging, stop the timer. The capacity of the unit in Ah is $\frac{1\text{ A} * \text{time (minutes)}}{60}$.
In summary:

1. Charge:
    a. Pin A (Vin) to B (ground) should be at 28 V nominal.
    b. Charge current should start between 0.80 A to 0.60 A, and end below 0.02 A.
2. Discharge:
    a. Pin C or D to B, 1 A load.
        i. Pin C and D are shorted internally.
    b. Start timer when load is applied, end timer when load goes to 0 A.
    c. Calculate capacity using this formula $Capacity = \frac{1\text{ A} * \text{time (minutes)}}{60}$.

5.3 COMPONENT MAINTENANCE

The individual components such as the cells, electronics, or hardware that comprise the TS28 EBPS are not user serviceable.

However, the battery pack assembly (MCIA p/n 9019931) is field replaceable. See Figure 5.1 below for instructions on removal and replacement.
After installation, refer to Section 5.2 for procedures to return the unit to service.



Replacement:
Repeat steps above in reverse order. Do not apply excess force when installing the battery pack. Verify proper alignment (rivet tabs are down) and the pack should engage with minimal effort. Apply 5.0 to 5.5 in-lbs of torque to tighten the screws.

Figure 5.1
Replacing the Battery Pack

5.4 STORAGE INFORMATION

In normal use, the TS28 utilizes the aircraft power to maintain the proper charge voltage and sustain the battery cells at peak capacity. When not installed on an aircraft the TS28 will remain in a powered state and will self-discharge with time. Although the chemistry of the cells used in the TS28 maintain an extremely low relative self-discharge rate, all batteries will slowly self-discharge if left uncharged for prolonged periods. In addition, self-discharge rates are directly related to the storage temperature. Higher storage temperatures will result in faster self-discharge rates.

Rechargeable NiMH batteries should be stored in a dry, well-ventilated area. The unit can be stored in the same area as other battery chemistries. The TS28 does not emit or absorb any gas during storage, transportation, or during normal operating conditions.

CAUTION

SHELF LIFE: Units that are stored shall follow instructions under 5.2 for storage conditions and maintenance.

STORAGE TEMPERATURE: Exposure to temperatures above 30°C (86°F) for sustained periods of time is possible but may increase the self-discharge rate or result in some permanent loss of capacity. Storage temperatures above 45ºC (113°F) are to be avoided.

5.5 END OF LIFE

The following conditions will help maintain or extend the life and performance of your product:

- Avoid significant exposure to elevated temperatures (above 30°C (86°F)) during operation or storage.
- Store NiMH batteries in a dry location with low humidity, no corrosive gases, and at a temperature range of -20°C (-4°F) to 45ºC (113°F).
- Store NiMH batteries at around 40% state of charge (SoC) to curtail age-related capacity loss while keeping the battery operational and allowing some self-discharge.
- Avoid over-discharging NiMH batteries, as it can shorten their lifespan.
- Do not attempt to charge battery pack (9019931) outside of the TS28 EBPS or damage can occur to the cells.

End of life is represented by the inability of the unit to meet the minimum capacity requirement of the aircraft as tested during capacity verification per Section 5.2. In the event that the unit exhibits failure, insufficient capacity or expired life, contact True Blue Power for repair, exchange or replacement. Visit www.truebluepowerusa.com for more information.

5.6 DISPOSAL

NOTE: All NiMH batteries are classified by the United States government as non-hazardous waste and are safe for disposal as normal municipal waste. However, these batteries do contain recyclable materials and recycling options available in your local area should be considered when disposing of this product. Dispose of in accordance with local and federal laws and regulations. Do not incinerate.

5.7 ENVIRONMENTAL QUALIFICATION STATEMENT

MODEL NUMBER: TS28 **PART NUMBER:** 6430028-( )
DESCRIPTION: Emergency Battery Power Supply **CERTIFICATION:** FAA TSO-C173a
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) 828, Test Data Sheet (TDS) 828
STANDARD: RTCA/DO-160, Rev G, dated 12/08/10 & RTCA/DO-293, Rev A, dated 12/02/09

CONDITIONS	SECTION	DESCRIPTION OF TEST
Temperature and Altitude	4	Category F1
Temperature Variation	5	Category S2
Humidity	6	Category A
Operational Shock and Crash Safety	7	Category B (5R)
Vibration	8	Category R, Curves C & C1
Explosion	9	Category H
Waterproofness	10	Category Y
Fluids	11	Category F
Sand and Dust	12	Category X
Fungus	13	Category F
Salt Fog	14	Category X
Magnetic Effect	15	Category Z
Power Input	16	Category B(XX)
Voltage Spike	17	Category A
Audio Frequency Conducted Susceptibility	18	Category B
Induced Signal Susceptibility	19	Category AC(E)
Radio Frequency Susceptibility	20	Category RR
Emission of Radio Freq Energy	21	Category M
Lightning Induced Transient Susceptibility	22	Category X
Lightning Direct Effects	23	Category X
Icing	24	Category X
ESD	25	Category A
Fire, Flammability	26	Category C

REMARKS:
Section 4: Category F1 temperatures declared by manufacturer:

- 4.5.1: Ground Survival Low Temp -55°C
- 4.5.2: Short-Time & Operating Low Temp -20°C
- 4.6.1: Altitude +55,000 feet
- 4.5.3: Ground Survival High Temp +85°C
- 4.5.4: Short-Time & Operating High Temp +70°C
- 4.6.2: Decompression +8,000 feet

Section 13: Category F met by analysis.