INSTALLATION MANUAL AND OPERATING INSTRUCTIONS

MD835-( ) Series
Emergency Power System

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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

ECO	Rev.	Date	Detail
	1	04/30/09	Preliminary release.
	2	12/02/09	Updated information.
	A	03/11/10	Production release.
5376	B	04/15/10	Revised Figure 3.3 Installation Diagram.
5399	C	05/18/10	Added MCI P/N 54-2007-1 to diode options in Section 3.3.2. Add Section 4.3.5 and related information regarding MD835-2 version.
5486	D	10/12/10	Update unit picture with True Blue Power label.
5535	E	01/13/11	Updated to include optional annunciator switch.
5583	F	04/14/11	Added 9017201 5V Module as an optional part.
5630	G	07/27/11	Added additional installation instructions for 9017201 5V Module.

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SECTION 1 GENERAL DESCRIPTION

1.1 PURPOSE

The MD835 Emergency Power Supply (EPS) is designed to supply DC power to the aircraft emergency bus when the main power bus has been de-energized. This emergency power can be utilized to maintain operation of required equipment in the event of a primary system power loss. During normal aircraft operation, the MD835 EPS will utilize the aircraft main power supply to recharge or maintain existing charge to full capacity.

1.2 PHYSICAL DESCRIPTION

The MD835 EPS consists of a single chassis with a 13-pin ARINC-style connector for electrical interface. The unit includes a user-replaceable fuse that limits the output current of the EPS and is accessible through a hole in the end plate above the connector. The unit is designed to be mounted in a ¼-ATR aircraft equipment rack. The rear plate of the unit provides an alignment hole that mates with the mounting rack. A handle on the front of the unit allows ease of removal and a convenient carrying method. There are no user interface controls on the product.

1.3 FUNCTIONAL DESCRIPTION

During typical operation the MD835 utilizes input power from the primary aircraft power supply to charge and/or maintain the charge on the internal battery cells. In the event of primary aircraft power loss, the MD835 will automatically supply power to the associated external loads without interruption.

1.4 TECHNICAL SPECIFICATIONS

MD835 EPS Physical Characteristics:	
Weight:	4.8 pounds (2.16 kg)
Dimensions: (see Figure 1.1)	12.3 inches long max. (+1 inch for handle) 3.10 inches high max. (excluding rear tab) 2.30 inches wide max.
Mating Connector:	ITT Cannon DPXB-13-33S-0001 or equivalent
Mounting:	1/4 ATR Rack

Table 1.1

MD835 EPS Functional Performance:	
Certification:	FAA TSO-C179
Performance Qualification:	RTCA DO-311 Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems
Environmental Qualification:	RTCA DO-160F F2S2BB[(RCC1)(UG)(U2FF1)]EXXXXXZ(ZXX)AZ(ZC)[RR]H[A3H33]XXAX With MD835 5V Module (P/N 9017201) installed: DO-160E, Section 20 (HG); DO-160F, Section 22 [A4G44]
Power Input	20 to 32 VDC, 3A max
Power Output	24.5 VDC nominal, 20A max
Battery Capacity	4.5 Ah nominal @ 1C rate
Maintenance	Perform capacity check every 2 years
Reliability	10 year expected life (80% initial capacity retained)

Table 1.2

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 is designed with internal thermal monitoring and protection circuits. See Section 4: Operation for more details.

2.2 EQUIPMENT LOCATION

The MD835 EPS is designed for mounting flexibility, allowing for installation inside or outside the pressure vessel with no requirement for temperature control. Although not required, optimum performance can be achieved by mounting the MD835 in a temperature controlled section of the aircraft. 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. Approved mounting includes the use of a standard ¼-ATR avionics mounting rack. Access to the rear connector may be needed for installation but the nature of the rack allows for convenient removal and installation of the unit from the front.

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. The interconnect cables should not run adjacent to heaters, engine exhausts, or other heat sources.

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 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.

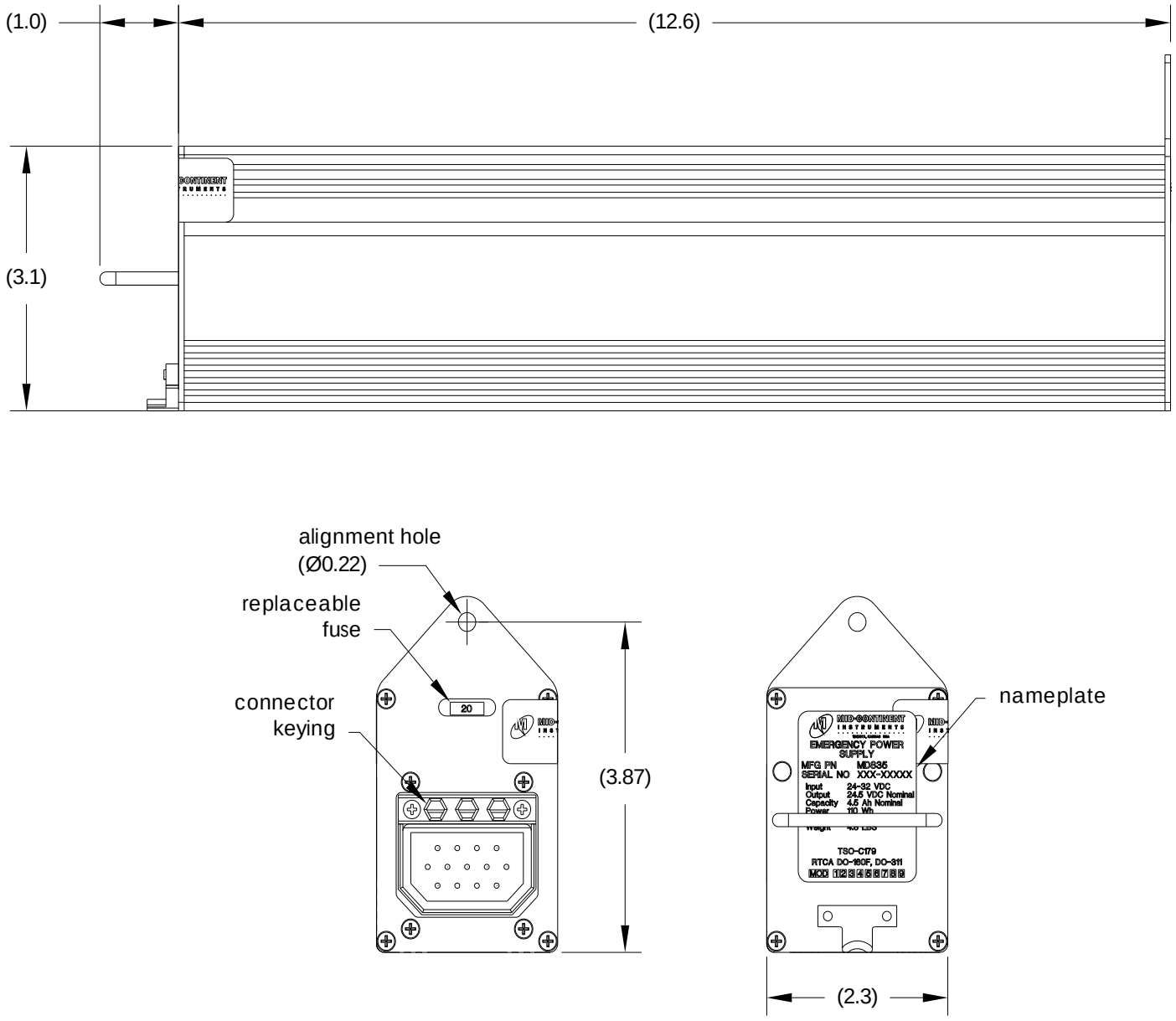
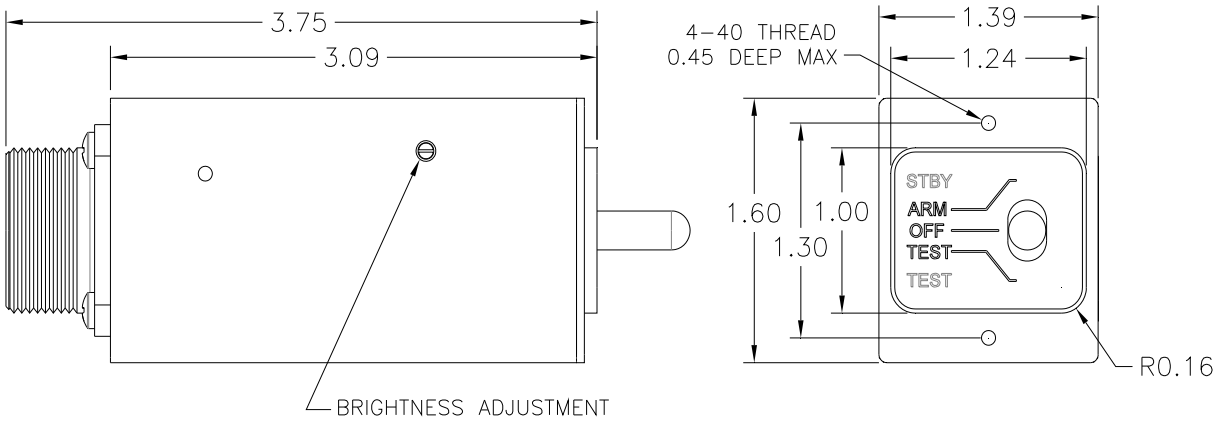
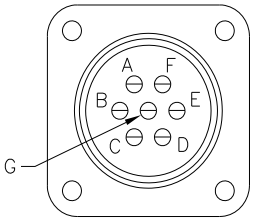


Figure 2.1 MD835 Outline Drawing





Connector Pinout	
Pin #	
A	Power input from aircraft
B	Power output to emergency bus
C	Power input from MD835 Pin 11
D	Test (out) to MD835 Pin 2
E	Test (in) to MD835 Pin 6
F	Power output to MD835 pin 10
G	Aircraft ground

Figure 2.2
MD835 Control Switch Annunciator Outline Drawing and Pinout

Specifications	
Power Input	28 VDC 15 amps max
Lighting	LEDs
Weight	0.33 lbs
Temperature	-55°C to 70 °C
Altitude	0 to +55,000 Ft.
Connector	MS3102E16S-1P
Mating Connector	MS3106F16S-1S
Color	Bezel and Case: Black
	Arm, Off, Test Labels: Opaque and Backlit White
	STBY Annunciator: Backlit Amber on discharge
	TEST Annunciator: Backlit Green (pass); no light (fail)

Table 2.2 Optional MD835 Annunciator Specifications

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

A. Unpacking: Carefully remove the MD835 EPS from the shipping container. The shipping container and packing are designed specifically for the transit of lithium batteries and approved by international transportation agencies. These materials should be retained for use should these units require future shipment.

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

C. NOTE: The unit is shipped with approximately a 50% state-of-charge to extend storage life and prevent loss of capacity. Perform a complete external charge on the MD835 using the procedures listed in this manual prior to installation and/or use.

3.3 PARTS

3.3.1. Included Parts

A. MD835-( ) Emergency Power Supply
B. 20A mini blade fuse, installed (MCI p/n 9016763 or equivalent)
C. Installation Manual (MCI p/n 9016798)
D. CR1 diode kit (MCI p/n 9017207)

3.3.2. Installer Supplied Parts

A. Rack: ¼ ATR (MCI p/n 5120-107-C01 or equivalent)
B. Mating Connector: 13-pin ARINC (MCI p/n 9016600-2, -4, or equivalent)
C. Emergency Fuse Bypass Switch (-2 version only):
Two position (off-on, capable of appropriate current for applied load)

(Panel Controls)

D. MCI Control Switch Annunciator (MCI p/n 9017176)
E. Annunciator Mating Connector: 7-pin circular (MCI p/n 9017119 or equivalent)

-OR-

D. Panel Switch: Three position (off-on-momentary, capable of 20A minimum)
E. Test Annunciator: 327 lamp or equivalent

3.3.3. Optional Parts

(for Emergency Power “On” Annunciation)
(This feature is included in the MCI Control Switch Annunciator p/n 9017176)

A. Diodes: 1N5614 (qty of 2), or equivalent
B. Annunciator: 327 lamp or equivalent

(for Aircraft 5VDC Power)
(This feature includes CR1 diode and Mating Connector)

C. MD835 5V Module (MCI p/n 9017201)

3.4 INSTALLATION

Install the EPS in the aircraft in accordance with the aircraft manufacturer's instructions and the following steps:

A. Refer to the Unit Connector Figure 3.1 and Mating Connector Figure 3.2 to ensure that the three half-hex alignment pins are installed correctly to mate with the alignment holes in the unit connector. Note: there are two possible configurations as shown in the figures referring to the MD835-1 and the MD835-2 alignment pins.

B. If used, install the MD835 5V Module in the ¼ ATR rack according to MCI P/N 9017201 drawing. See Figure 3.7.

C. Prepare mating harness and interconnects in accordance with the appropriate installation configuration:

   A. Unit harness:
      i. with MD835 5V Module (MCI p/n 9017201)
         Prepare harness in accordance with Installation Wiring Diagram Figure 3.4.
         5V module includes the Mating Connector per Figure 3.1.
      ii. without MD835 5V Module
         Prepare harness in accordance with MD835 connector pinout in Figure 3.1 and Installation Wiring Diagram Figure 3.3.
   B. Panel Harness:
      i. with MD835 Control Switch Annunciator (MCI p/n 9017176)
         Prepare mating harness and interconnects per Figure 2.2.
         Note: contains portions of required installation components as well as optional ones.
      ii. without MD835 Control Switch Annunciator
         If the MCI Control Switch Annunciator is not used, allow for location of parts external to the unit. This includes a panel switch (S1), a power diode (CR1), and an annunciator (DS2) per Section 3.3 and Figure 3.3.
   C. CR1 Diode Installation:
      i. The CR1 Diode is included with the MD835 Control Switch Annunciator
      ii. The CR1 Diode is included with the MD835 5V Module
      iii. If neither the Control Switch Annunciator nor 5V Module is used, the CR1 diode must be installed per Figure 3.3. Firmly mount diode to a thermally conductive surface/heatsink. An electrical insulator which is thermally conductive must be placed between the diode and heatsink (included with unit in CR1 diode kit). Mounting the diode to the side of the ATR rack is an acceptable location. See figure 3.6 for an example.

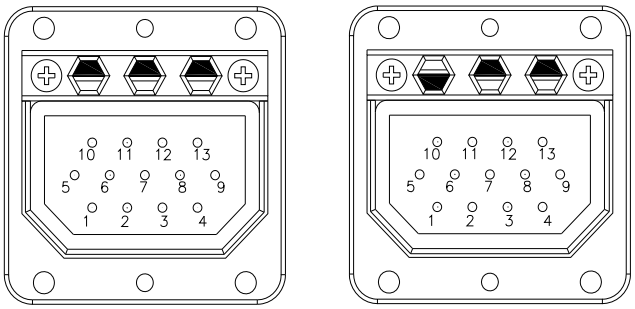
D. Install the MD835 Control Switch Annunciator, or other 3-way switch and test annunciation lamp, in the instrument panel. If using the MD835 Control Switch Annunciator, set the brightness of the ARM/OFF/TEST backlight for night time viewing using the adjustment on the side of the unit. For the MD835-2 unit, install the user supplied Emergency Fuse Bypass switch in the instrument panel. Installation of the Emergency Power On annunciation lamp is optional (included with MD835 Control Switch Annunciator). See Figure 3.3.

E. Select location in accordance with Section 2 and mount the ¼ ATR rack according to the aircraft manufacturer's recommended specification. (See sample of ¼ ATR rack in Figure 3.5. Other racks may vary.)

F. Install the mating harness into the ¼ ATR rack. If MD835 5V Module is installed, adjust trimpot on Module for desired aircraft lighting voltage output (2.7-5.5V).

G. Slide the MD835 into the ¼ ATR rack ensuring that the large, spring-loaded alignment pin mates with the Index Hole on the rear flange of the unit. Hand-tighten the spring nut of the rack onto the locking tab of the unit to secure. If the MD835 5V Module is installed, the mating connector may need to be aligned to the MD835. Loosen MD835 5V Module screws, install MD835 into ¼ ATR rack, tighten top two screws, remove MD835, and then tighten remaining screws to secure MD835 5V Module.

H. NO INTERNAL OR EXTERNAL COOLING OF THE UNIT IS REQUIRED.



MD835-1 MD835-2

Connector Pinout	
Pin 1	(empty)
Pin 2	Test Switch
Pin 3	(empty)
Pin 4	External Charge Enable
Pin 5	(empty)
Pin 6	Test Indicator
Pin 7	Power Ground (optional)
Pin 8	(empty)
Pin 9	Fuse Bypass (-2 only)
Pin 10	+28 VDC In
Pin 11	20-26 VDC Out
Pin 12	Power Ground
Pin 13	(empty)

Figure 3.1 Pinout and Unit Connector

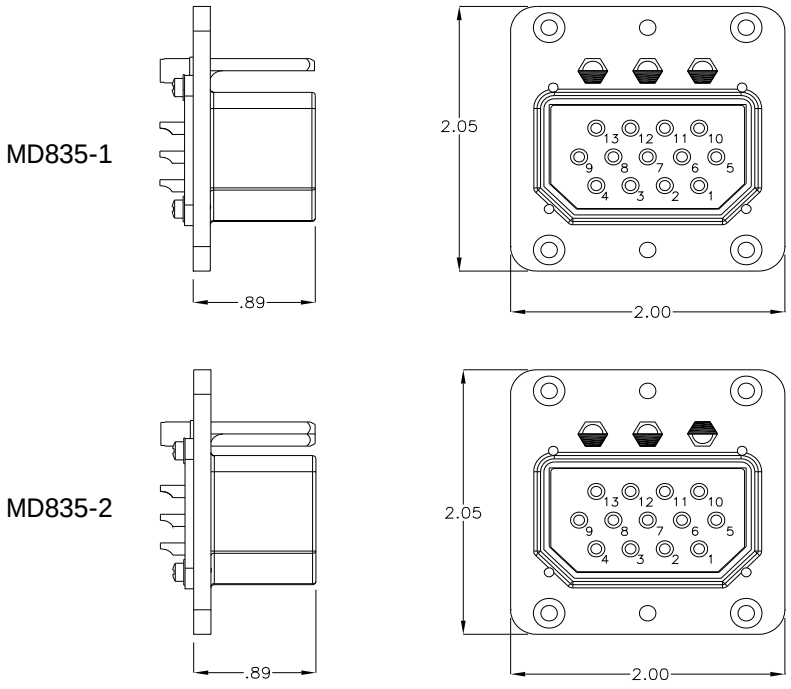
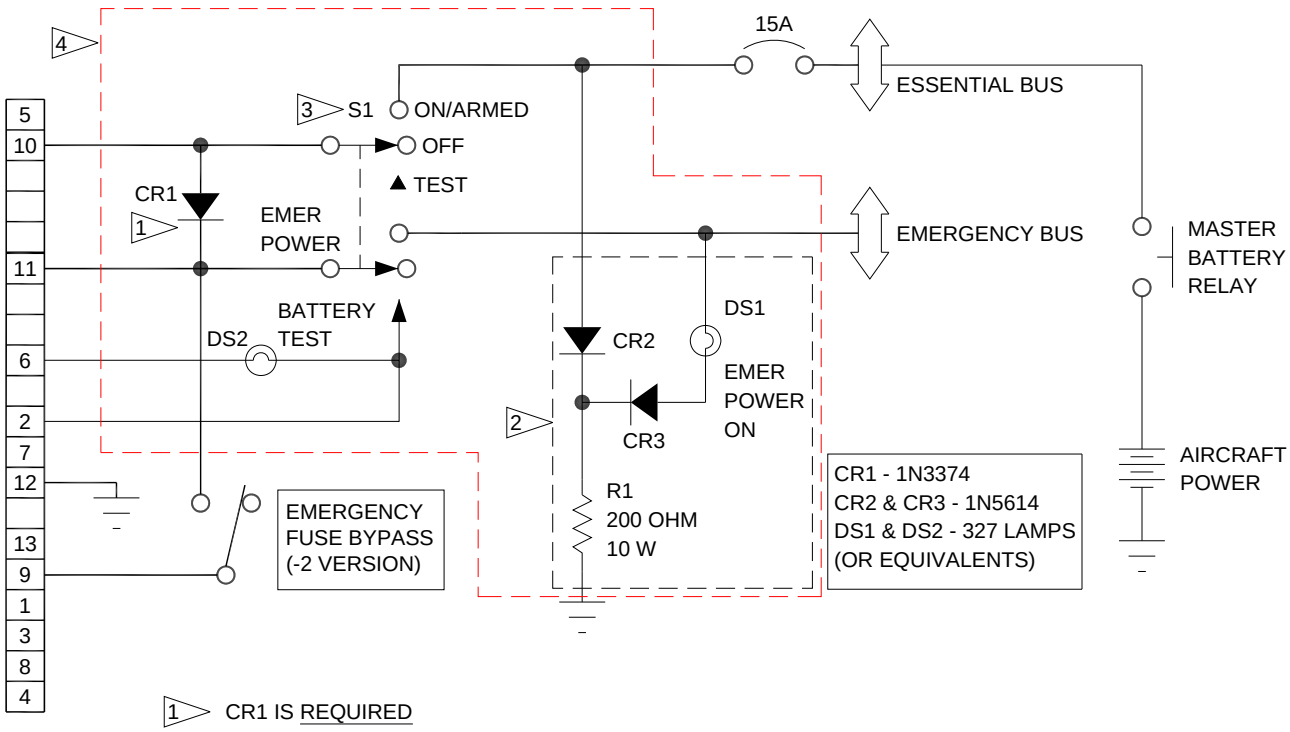


Figure 3.2 Mating Connector for the MD835-1 and MD835-2



1. CR1 IS REQUIRED
(SEE SECTION 3.3.1 AND NOTE 4)

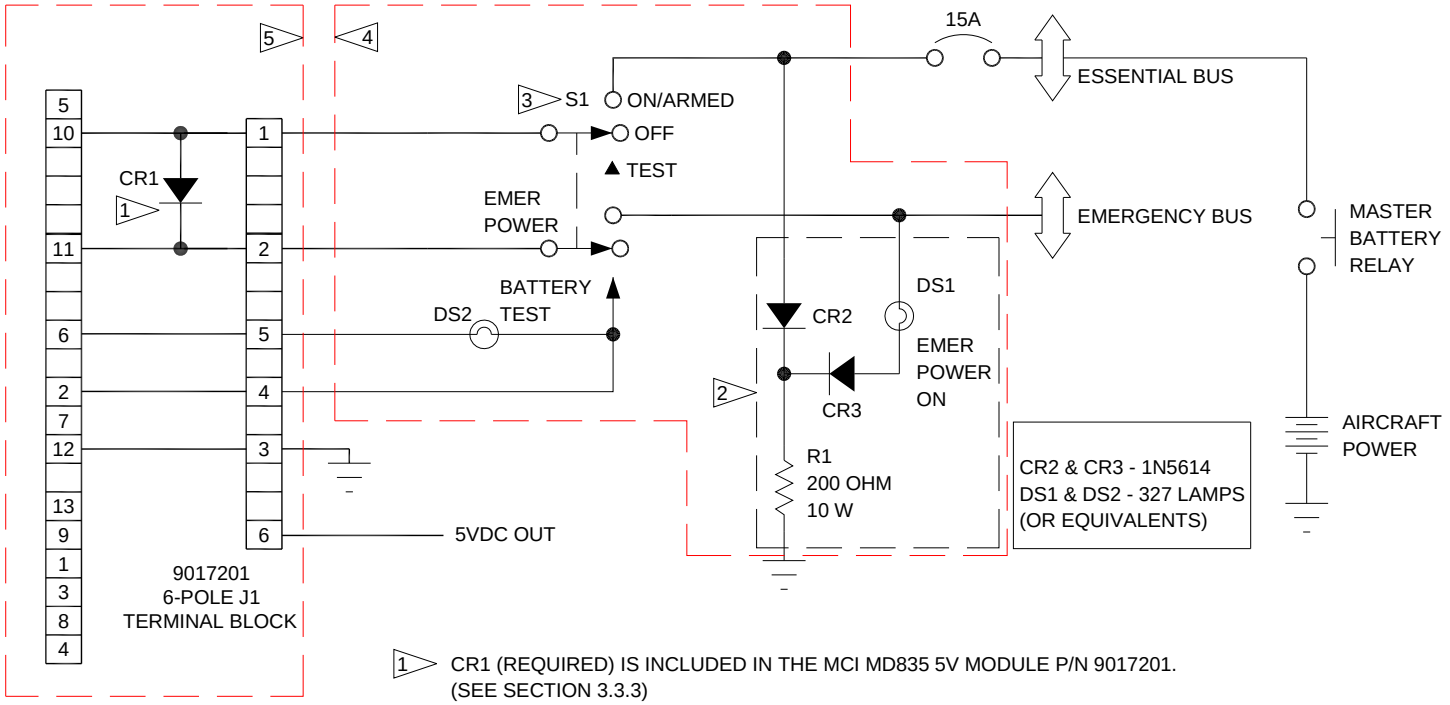
2. INSTALL CR2, CR3, DS1, AND R1 IF ANNUNCIATION OF EMERGENCY POWER ON IS REQUIRED.
(SEE SECTION 3.3.3 AND NOTE 4)

3. S1 IS ON-OFF-MOMENTARY SWITCH.

4. THIS PART OF THE CIRCUIT IS INCLUDED IN THE MCI MD835 SWITCH ANNUNCIATOR P/N 9017176

5. USE AWG 16 WIRE FOR POWER AND GROUND.
ALL OTHER LINES CAN BE AWG 22 WIRE.

Figure 3.3 Installation Wiring Diagram



1. CR1 (REQUIRED) IS INCLUDED IN THE MCI MD835 5V MODULE P/N 9017201. (SEE SECTION 3.3.3)
2. INSTALL CR2, CR3, DS1, AND R1 IF ANNUNCIATION OF EMERGENCY POWER ON IS REQUIRED. (SEE SECTION 3.3.3 AND NOTE 4)
3. S1 IS ON-OFF-MOMENTARY SWITCH.
4. THIS PART OF THE CIRCUIT IS INCLUDED IN THE MCI MD835 SWITCH ANNUNCIATOR P/N 9017176
5. THIS PART OF THE CIRCUIT IS INCLUDED IN THE MCI MD835 5V MODULE P/N 9017201 (PORTIONS OF INTERNAL CIRCUITRY NOT SHOWN)
6. USE AWG 16 WIRE FOR POWER AND GROUND. ALL OTHER LINES CAN BE AWG 22 WIRE.

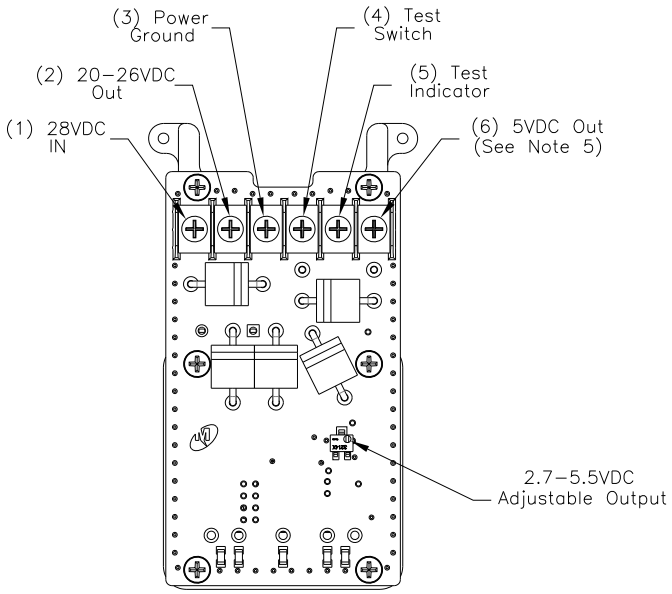


Figure 3.4 Installation Wiring Diagram With MD835 5V Module

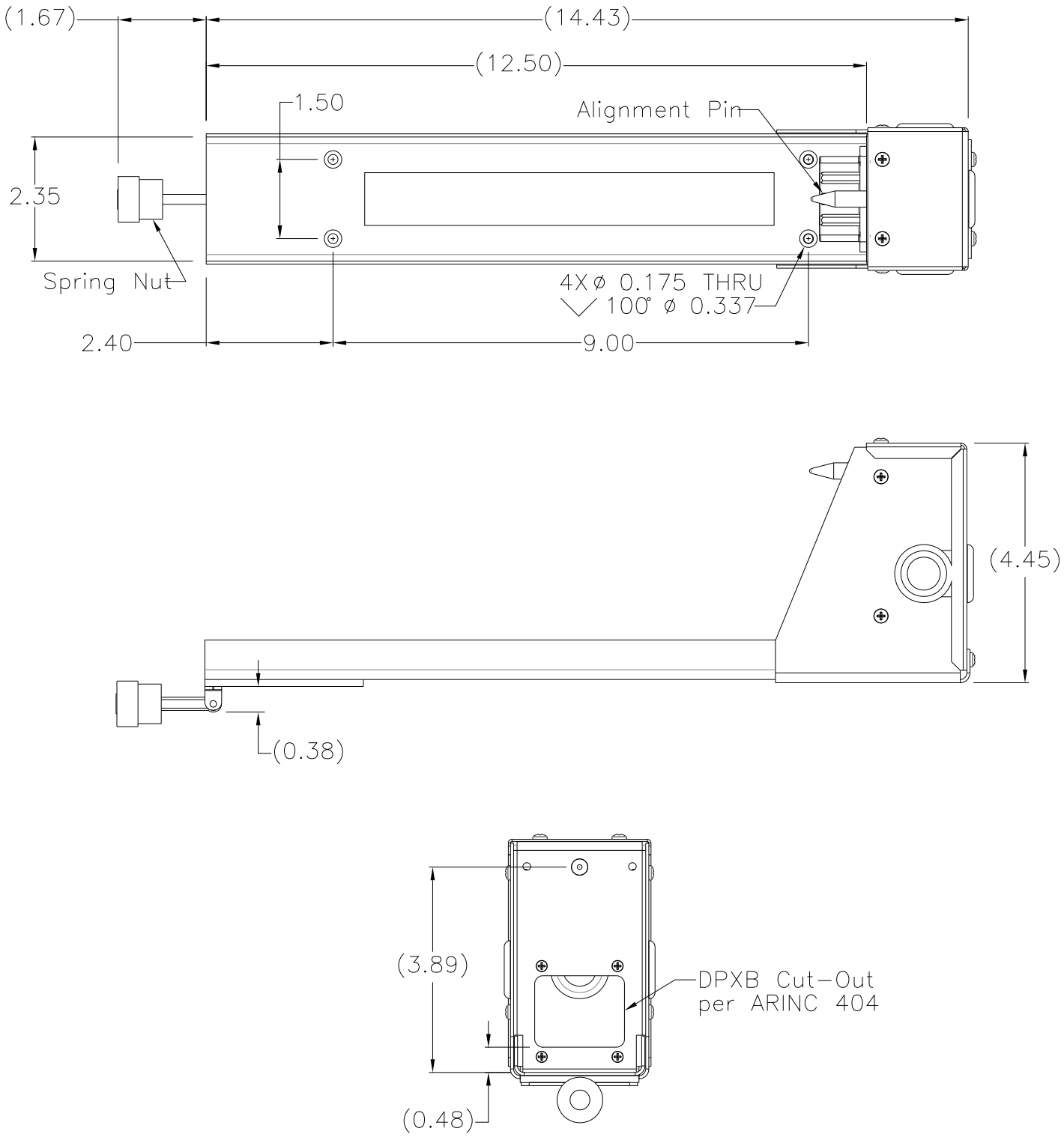


Figure 3.5 Installation Rack Drawing
Per P/N 5120-107-C01

Item	Qty	Description
1	1	Screw 4-40x7/16 Pan Phil Blk Patch
2	1	Washer Lock #4 Split SS
3	1	Washer Flat #4x0.315 OD, 0.025 thk
4	1	Diode, 400V, 60A, TO-247
5	1	Pad, Insulating, SilPad 900S
6	1	Nut 4-40 Hex

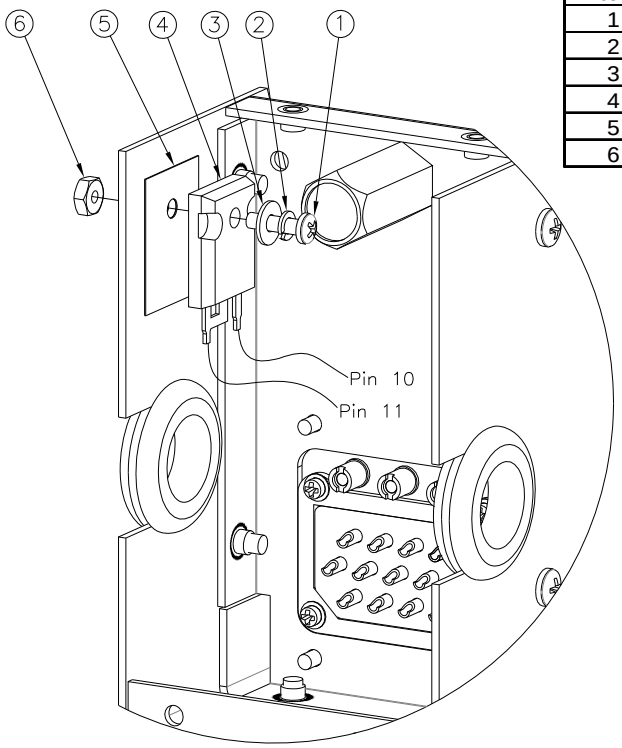


Figure 3.6
Example Installation of CR1 Diode (p/n 54-2007-1) into Rack

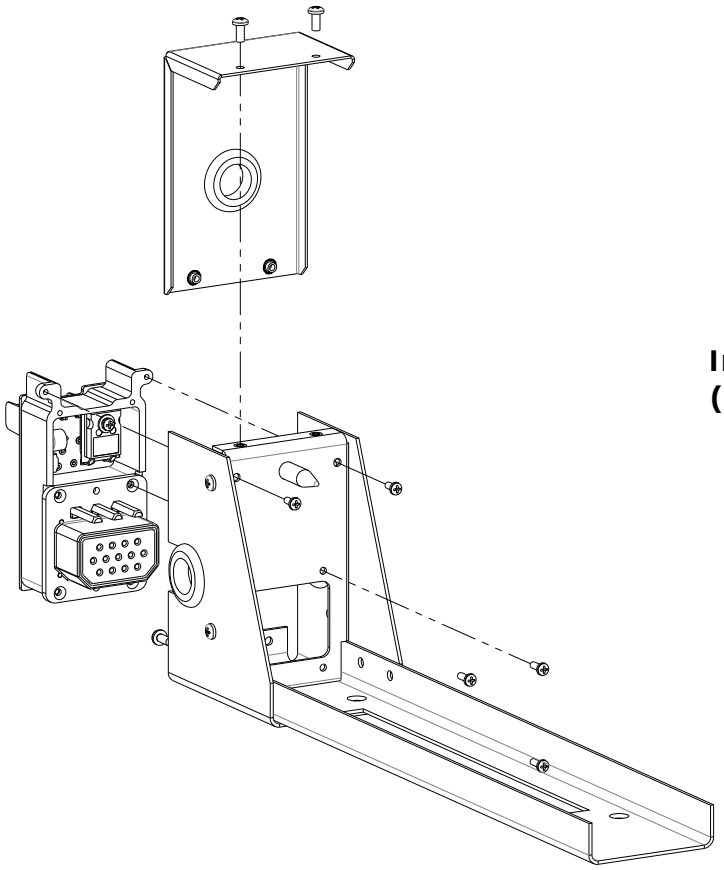


Figure 3.7
Installation of 5V Module (p/n 9017201) into Rack

SECTION 4 OPERATION

4.1 DESCRIPTION

The Mid-Continent Instruments and Avionics MD835 Emergency Power Supply is designed to supply backup power to any load desired in the case of primary power loss in an aircraft. It utilizes rechargeable lithium iron nanophosphate chemistry to provide 20.0-28.0VDC and 4.5 Ampere-hours of capacity at the 1C rate (see "Performance" below). It utilizes a 13-pin ARINC-style connector and is designed to be installed in a standard ¼ ATR equipment rack.

4.2 THEORY OF OPERATION

The MD835 Emergency Power Supply system provides a nominal voltage of 24.5VDC and a fuse-limited maximum power output of 20 amps. The unit is designed to receive a 20-32VDC input from the aircraft.

4.2.1. Maintaining Charge

In normal operation, the unit does not provide power and continuously monitors the input voltage from the aircraft's primary electrical system. The unit uses the aircraft power to maintain a full charge on the battery cells. This is not a constant load on the aircraft. The charging circuit only activates when the voltage on the cells drops below a set value. When in this recharging mode, the load on the aircraft system is less than 0.3A. When the aircraft voltage drops below 24.0V, the battery will stop charging in order to minimize the load on the main power system.

4.2.2. Discharge

When the input voltage to the unit drops below 21.5V, the unit will begin supplying power to the associated load. The output voltage can range from 28.0 to 20.0VDC during a discharge cycle. However, the output voltage is typically between 24-25V during the majority of the discharge time (after the first 5% is discharged and then until about 15% of the battery's capacity is remaining). The unit will shut itself off when the voltage provided by the batteries reaches approximately 19.5V. This is to prevent permanent damage to the unit or individual cells. At the end point voltage of 19.5V, the battery has approximately 1% of remaining power available. Therefore this precautionary shut off does not significantly detract from the amount of available power that might be supplied to the load in an emergency.

If the aircraft power should return to normal levels, the battery will cease to provide an output when the aircraft voltage exceeds the battery voltage. The unit will begin recharging the cells (if needed) when the aircraft power returns to 24V or higher.

4.2.3. Automatic Shut-off

This feature allows the unit to prevent accidental or excessive self discharge when the aircraft is not in use. When the input voltage drops below 21.5V and the load is below 100mA for a period of 5 minutes (or no load exists), then the unit will turn itself off. The unit can be reactivated either with an input voltage greater than 22V or by activating the test feature. This safety and functional feature prevents downtime of the aircraft by ensuring that the unit is charged and ready for operation.

4.2.4. Remote Test

The unit has a self-test feature that can be accessed through a pair of pins on the connector. When activated via a switch from the panel, the circuit will close and light an annunciator if the unit passes the built-in self-test routine. This indicates a minimum of 80% of the unit's capacity is available.

4.2.5. Battery Technology

The MD835 utilizes state-of-the-art lithium nanophosphate battery cells. Lithium nanophosphate batteries implement a technologically advanced chemistry and manufacturing process to enhance the performance of the cell and address challenges with the use of traditional lithium chemistries in aviation applications. The application of nanotechnology manufacturing processes allows the cells to obtain one of the highest power densities possible (power-to-weight ratio) in the field of battery development. Additionally, the use of lithium iron phosphate chemistry enhances the inherent safety of the cells significantly.

The nanophosphate cathodes (positive electrode) in combination with the liquid electrolyte produce an extremely high tolerance to abuse, including the exclusion of oxygen generation. This equates to an inherent stability against the potential for thermal runaway, flammable destruction, or venting of toxic or flammable gas. When combined with the circuitry of the unit which monitors cell temperature and balances the charging of the cells, the potential for a catastrophic event is essentially eliminated.

4.2.6. Battery Performance and Capacity

Based on new nanoscale materials initially developed at MIT, low impedance nanophosphate electrode technology provides significant performance advantages over alternative high power technologies. A standard measure of rechargeable battery capacity involves both the current-to-time performance (i.e. amp-hours) and also the "C" rate.

Many typical lead acid batteries, and some lithium systems as well, are defined at a $1/20^{th}$ (0.05) or $1/10^{th}$ (0.1) C-rate. This is defined as the load that can be applied over 20 or 10 hours respectively. For example, a battery rated at 5 Ah at a 0.1 C-rate can deliver 0.5A for 10 hours (0.5A x 10 hours = 5Ah). However, that same system typically does not perform linearly at the 1C rate. As an example, a 5Ah lead acid battery rated at 0.1C will typically provide approximately 3.6A for 1 hour (equal to a 1C rate of 3.6Ah). The capacity is defined by a logarithmic function of load versus time. Therefore, loads applied to this type of battery which exceed the capacity rating increasingly decrease the time available. Applying a 5A load to a 5Ah battery rated at 0.1C would last approximately 36 minutes. Doubling the load to 10A for the same system would last less than half the time, or approximately 15 minutes.

One of the significant advantages to the lithium nanophosphate technology is its constant capacity versus load (see Figure 4.2). The MD835 is rated for 4.5Ah at the 1C rate. This produces 1 hour of operation with a 4.5A load. However, its constant capacity versus load capability means that at double the rated capacity load, or 9.0A, the battery still maintains the linear (instead of logarithmic) relationship of load versus time, producing 30 minutes (or 0.5 hours) of power (9.0A x 0.5 hours = 4.5Ah at 2C rate). Similar results can be found at the maximum power rating of the MD835. For a 20A load (or approximately a 4.5C rate), the battery will last approximately 13.5 minutes (4.5Ah / 20A = 0.225 hours = 13.5 minutes). Ultimately, this allows a much longer lasting battery at all load levels.

The battery cells are stable and perform well over temperature. While comparable technologies suffer significantly from the effects of high temperature, the lithium cells used in the MD835 can retain more than 90% of their capacity after 200+ full discharge cycles at 60°C.

Mid-Continent's use of lithium nanophosphate cells translates to less long term maintenance costs. At the 1C rated load of 4.5A, data from the cell manufacturer demonstrates that 80% of the original capacity is retained after 7000+ complete discharge and recharge cycles. While the emergency use of the MD835 system in an aviation application may only see a few complete discharges in its lifetime, its cycle life also translates to calendar life. The cell manufacturer asserts a projection of more than 10 years of usable life in the field.

4.2.7. System Safety

In addition to the safety associated with the chemistry of the cells themselves, the unit provides a number of methods to enhance the overall safety of the product. Although the lithium nanophosphate cells are designed to operate at lower temperatures than nearly any other battery type, the unit also incorporates a heater to provide additional performance at even lower temperatures. A temperature monitoring circuit is incorporated in the cell pack that is used to activate the heater when ambient temperature drops below approximately -8°C. (The heater draws about 1.7A when in use.) This prevents the cell electrolyte from freezing during discharge or charging at extremely low temperatures.

A temperature monitor in the circuit also checks for any over-temperature condition that could arise from either the cells or the heater. A fault would result in the unit shutting down to prevent damage to the pack. This also prevents the possibility of any dangerous failure mode of the cells as a redundant backup to the inherent safety of the cell's chemistry.

The replaceable fuse in the unit prevents damage to equipment in the event of a short circuit at the load. *No software or complex hardware is incorporated in the design of this product.*

4.3 INSTALLED OPERATION

The following are operating instructions for using the MD835 Emergency Power System when installed in an aircraft.

4.3.1. Remote Test

The activation switch installed in the panel (MCI p/n 9017176 or installer provided) has three positional settings: OFF (latched), ARM (latched), and TEST (momentary). On the MD835 Control Switch Annunciator, the ARM/OFF/TEST display is opaque white for daytime viewing and backlit (dimmable) for night time viewing. This can be set on the side of the annunciator during installation.

To test the unit (typically required by the aircraft operation manual prior to dispatch), depress the three-way switch into the Test position. When installed correctly (per Figure 3.3) the test annunciation light will illuminate. This indicates that the battery has a minimum of 80% capacity available and is qualified for use. On the MD835 Control Switch Annunciator, the green "TEST" annunciation light will appear.

For most accurate results; test the MD835 prior to activating the system (see Section 4.3.2) before dispatch for each flight operation.

4.3.2. Activation

To activate or "arm" the system prior to flight, place the three-way activation switch in the ARM or ON position. This will apply power to the unit, allowing it to maintain its maximum charge capability and to provide uninterrupted power to the loads on the emergency bus should primary aircraft power fail. If installed, the optional "Emergency Power On" feature provides annunciation of when the battery is in use/discharging. This feature is included in the MD835 Control Switch Annunciator and is indicated by an amber "STBY" annunciation.

4.3.3. Disarm

By placing the three-way activation switch in the OFF position, the input voltage to the unit will be disconnected, disabling both the ability of the battery to charge or discharge. The activation switch should always be kept in the OFF position when not in use to prevent accidentally discharging the battery.

4.3.4. Resetting the Automatic Shut-off

The unit is designed to shut down within 5 minutes to prevent unwanted discharge in the event that input power is lost and the load is below 100mA. In order to reactivate the unit for charging or discharge, restore an input voltage of 22-32V or briefly activate the test feature and then return the switch to the ARM position. Either action will reset the automatic timer and allow the unit to function properly.

4.3.5. Emergency Fuse Bypass (MD835-2 ONLY)

The MD835-2 has a fuse bypass feature available. When installed, a panel mounted switch allows the pilot or crew to route battery power around the internal fuse of the MD835. This would allow the emergency bus to remain powered in the event that primary aircraft power fails and the internal fuse of the MD835 was open.

4.3.6. 5V Module Operation (MCI p/n 9017201)

The MD835 5V module allows for the unit to simultaneously provide the primary 24.5V nominal output and a separate adjustable 2.7-5.5V lighting output. This output is available during normal operation (aircraft power available) and emergency operation. However, it is recommended that an external relay be provided on the 5V output so that it only provides power to the emergency lighting bus load when aircraft power has failed.

4.4 MAINTENANCE

Because the cells are designed to maintain their charge-holding capability over time, Mid-Continent Instruments and Avionics is recommending a two-year maintenance cycle. The two-year check includes a full charge, discharge, and recharge while evaluating the discharge time against minimum requirements. Additionally, at any time when the capacity of the unit is in question or after being utilized in an in-flight emergency situation, Mid-Continent recommends the application of this procedure.

4.4.1. Standard Charging

A. If 28V power is applied to the primary input pin (power on pin 10, return on pin 12), a standard charge will take approximately 12 hours for a fully discharged unit. The current draw should be between 0.8A and 0.06A throughout the charge cycle.

B. When the current draw of the unit reaches 0.1A or below, the unit is fully charged.

4.4.2. Fast Charging

By grounding an additional pin on the connector during charging (pin 4), the unit can be put into 'fast charge' mode. This allows the unit to draw up to 3A and fully charge the battery cells in approximately 2 hours. The unit must be removed from the airplane to utilize the fast charge procedure.

A. To manually fast charge a unit, apply a ground to pin 4 to enable the fast charge mode.

B. Apply 28.9 ±0.1VDC of power to the input pin (pin 10) and connect the return line to pin 12. **THE POWER SUPPLY MUST BE SET TO A CONSTANT CURRENT OF 3.0A.** The unit will draw 3.0A of power until the batteries have been charged to the voltage set limit. At that time, the current draw will begin to decrease and the voltage of the cells will remain constant. (CCCV method – constant current, constant voltage)

C. When the current draw of the power supply reaches approximately 1.0A or below, complete the charge cycle by removing the ground to pin 4 and follow step 4.4.1.B. above. (Do not allow the unit to remain in fast charge mode for extended periods of time once the current draw reaches this low level.)

4.4.3. Capacity Verification

To test the unit for capacity verification, apply the following procedure @ 15°-40°C:

A. Charge the unit using either the Standard Charge or Fast Charge method described in Section 4.4.1 and 4.4.2, respectively.
B. Apply 28.0V to the input pin.
C. Remove the input power.
D. Provide constant current load to the output (pin 11) of 4.5A. (Tek Power TP3711 A or equiv.)
E. Monitor the time required from removal of input power until the unit stops providing output power to the load.
F. To be approved for service, the unit must provide 48 minutes of output power per the required procedure listed above.
G. Recharge the unit per Section 4.4.1 or 4.4.2.

4.5 PERFORMANCE

Two of the many advantages of lithium battery technology are the relatively constant output voltage over time and the linear performance of capacity at multiple load levels. The performance of the MD835 in these regards is demonstrated in Figures 4.1 and 4.2, respectively.

Actual capacity of the MD835 Emergency Power Supply may vary considerably depending on temperature, charge status, and battery condition. Low temperatures can temporarily degrade battery capacity. If the unit is stored at a low temperature for 3 hours or more prior to dispatch, refer to Figure 4.3 for required warm-up time and available capacity. The warm-up procedure requires input power to be applied and the activation switch to be in the On/Arm position.

The MD835 is designed for high cycle life and long calendar life. However, all batteries degrade in performance over time, even when correctly maintained. Figure 4.4 demonstrates cycle life at various temperatures. A poorly maintained battery will suffer accelerated degradation in excess of the guidelines given in this document. Extended storage in a highly discharged state or at high ambient temperatures (above +35°C) may permanently damage a battery or reduce its performance. Complete charging is required to bring the battery up to full capacity if it has been stored for more than six months or if it has been partially discharged.

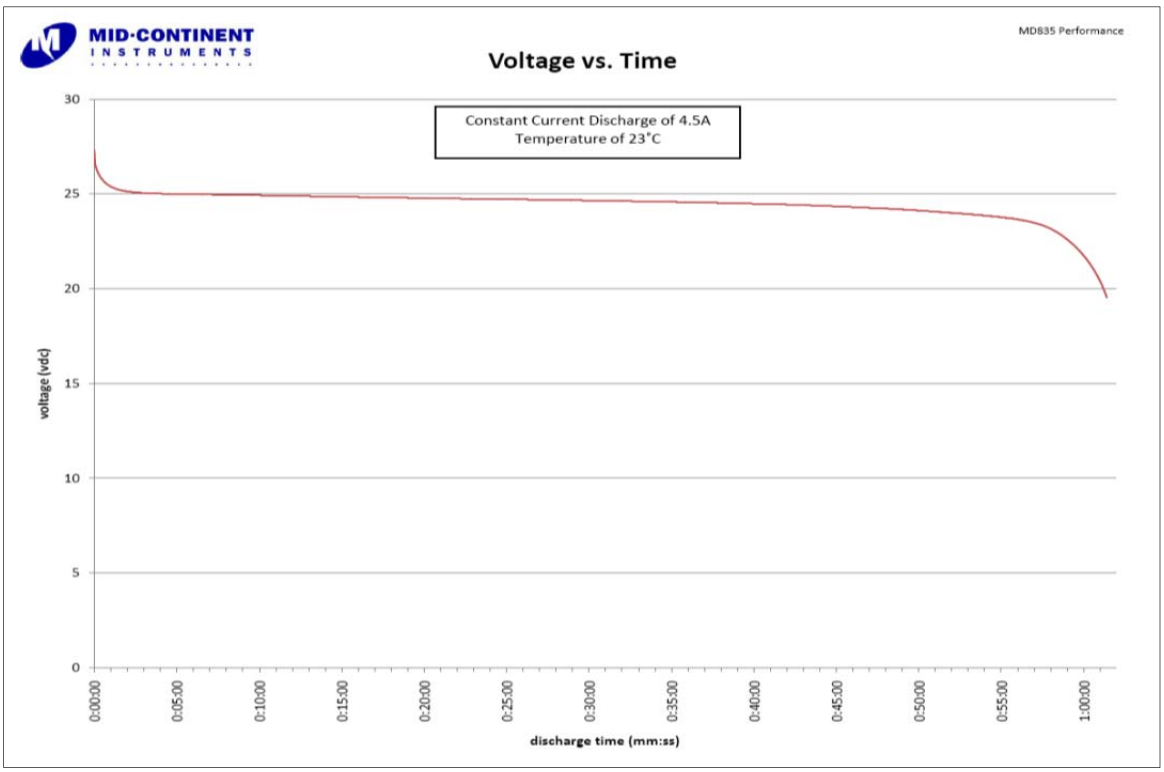


Figure 4.1 Nominal Battery Capacity and Voltage Output

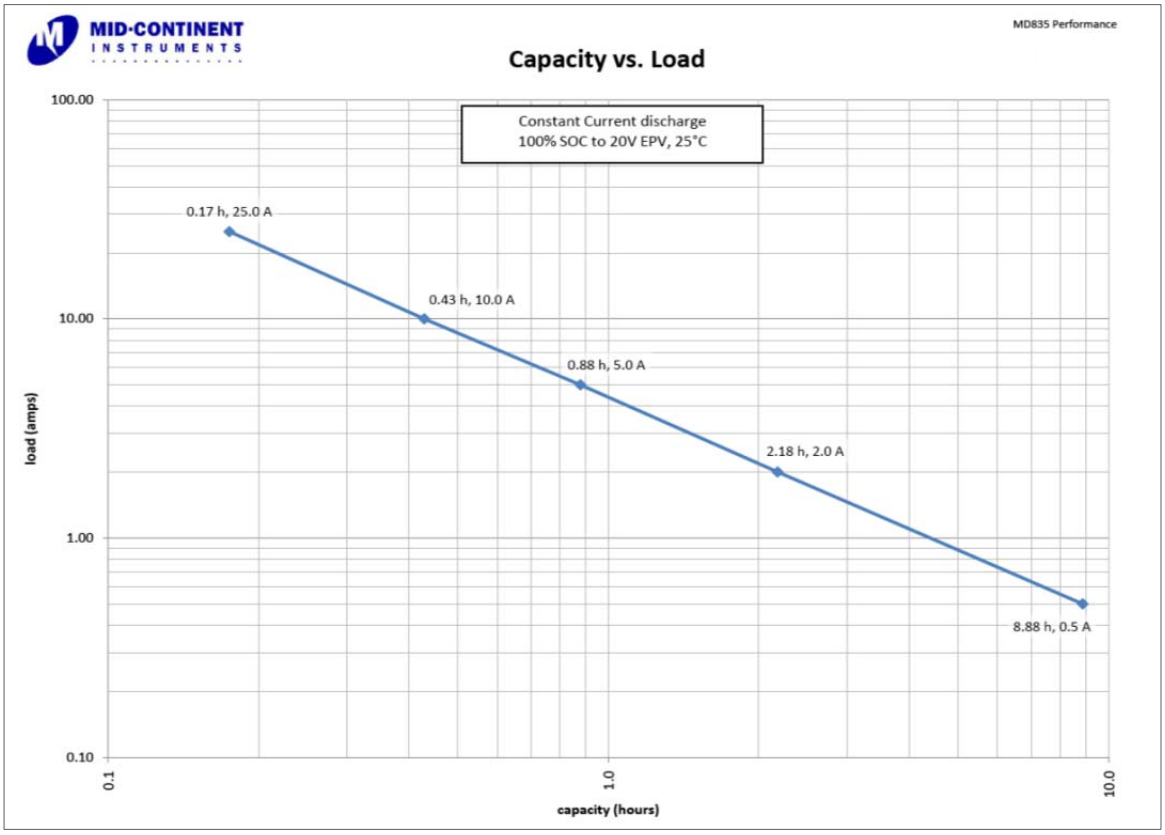


Figure 4.2 Nominal Battery Capacity versus Load

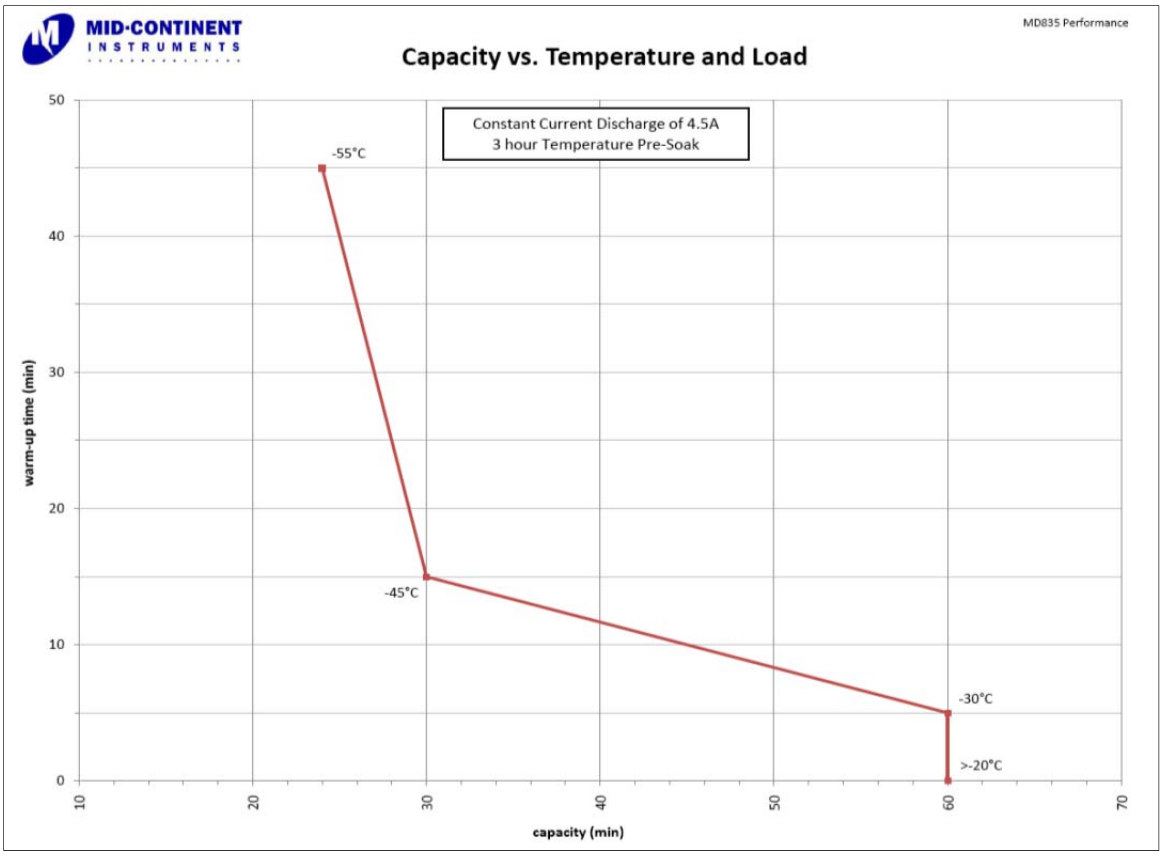


Figure 4.3 Nominal Battery Capacity versus Warm-up Time

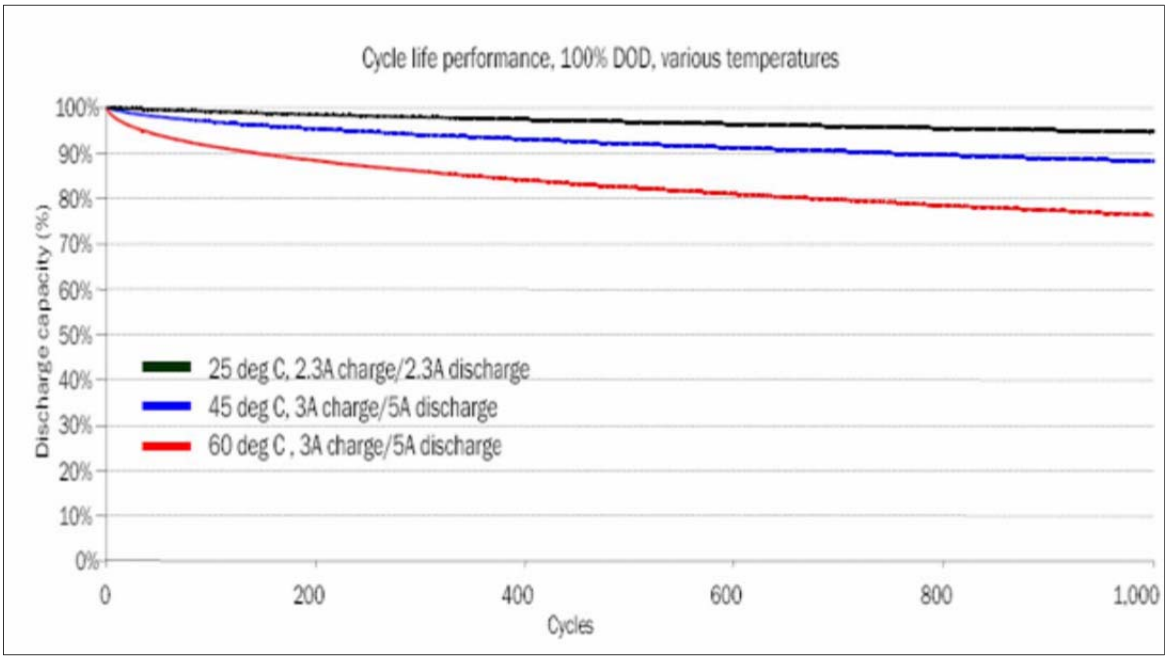


Figure 4.4 Cycle Life versus Temperature

SECTION 5 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

5.1 TEST AND VERIFICATION INTERVALS

A. A remote (in-panel) test (see Section 4.3.1) should be performed prior to flight to verify the capacity of the battery. Should the test not indicate a valid check for capacity, the unit should be remove and either recharged or capacity checked (per Section 4.4.3). If the unit continues to fail the remote test, it should be returned to the manufacturer for maintenance.

B. Routine testing and capacity verification should be performed on a bi-annual schedule (every 24 months). See Section 4.4 for test and capacity verification procedures.

C. For short uses of the unit in the aircraft, the aircraft system will recharge the unit on its own. An in-panel test can help determine whether the unit requires removal and recharge.

D. A full capacity check (Section 4.4) should be performed any time there is concern regarding the capacity of the unit. Mid-Continent recommends removal of the unit and performance of a full capacity test any time after having incurred an in-flight loss of power or subsequent activation and use of the MD835 Emergency Power System.

5.2 COMPONENT MAINTENANCE MANUAL

A. The battery, electronics, and other components that comprise the MD835 EPS, excluding the externally accessible fuse, are not user replaceable items. Therefore, data is not available from the manufacturer to conduct field repairs in the case of a faulty or expired product.

B. Estimated life and recommended replacement interval for the internal battery cells is approximately 10 years based on diminished capacity. In the event that the unit exhibits failure, insufficient capacity, or expired life, contact Mid-Continent Instruments and Avionics for overhaul, exchange, or replacement.

5.3 STORAGE INFORMATION

A. In normal use, the MD835 EPS utilizes the input power supplied to maintain the proper charge voltage and sustain the battery cells at peak capacity. Although the chemistry of the cells used in the MD835 maintain an extremely low relative self-discharge rate, all batteries will slowly self-discharge if left unused for long periods. In addition, self-discharge rates are directly related to the storage temperature. Higher storage temperatures will result in faster self-discharge rates. Recommended maximum storage temperature is 35°C (97°F). Exposure to higher storage temperatures for sustained periods of time are possible, but may increase the self-discharge rate or result in some loss of capacity.

B. If left unused for more than 6 months, the battery should be recharged prior to use following the procedure set forth in Section 4.4.

5.4 DISPOSAL

NOTE: All lithium ion batteries are classified by the federal 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. Do not incinerate.

APPENDIX 1

ENVIRONMENTAL QUALIFICATION STATEMENT

NOMENCLATURE: Emergency Power System
MODEL NUMBER: MD835-( ) **TSO NUMBER:** C179
MANUFACTURERS SPECIFICATIONS: Minimum Performance Specifications:
Test Specification (TS) 445, Test Data Sheet (TDS) 445
QUALIFICATION STANDARD: RTCA DO-160F, dated Dec 6, 2007

CONDITIONS	SECTION	DESCRIPTION OF TEST
Temperature and Altitude	4	Category F2
Low Temperature	4.5.1	Operating Low Temp = -55C
High Temperature	4.5.2	Operating High Temp = +70C
Decompression	4.6.2	Altitude = +55,000 ft
Overpressure	4.6.3	-15,000 ft
Temperature Variation	5	Category S2
Humidity	6	Category B
Operational Shock and Crash Safety	7	Category B
Vibration	8	Category R, Curve C, C1 Category U, Curve G Category U2, Curve F, F1 [(RCC1)(UG)(U2FF1)]
Explosion	9	Category E
Waterproofness	10	Category X
Fluids	11	Category X
Sand and Dust	12	Category X
Fungus	13	Category X
Salt Spray	14	Category X
Magnetic Effect	15	Category Z
Power Input	16	Category Z(XX)
Voltage Spike	17	Category A
Audio Frequency Conducted Susceptibility	18	Category Z
Induced Signal Susceptibility	19	Category ZC
Radio Frequency Susceptibility	20	Category RR
Emission of Radio Freq Energy	21	Category H
Lightning Induced Transient Susceptibility	22	Category A3H33
Lightning Direct Effects	23	Category X
Icing	24	Category X
ESD	25	Category A
Flammability	26	Category X