# Power Storage Device

LSI P/N 7809-2

Component Maintenance Manual

with

Illustrated Parts List

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## RECORD OF REVISIONS

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LIST OF EFFECTIVE PAGES

# TABLE OF CONTENTS

## 1.0. Introduction

This manual describes the use and maintenance for the 7809-2 Power Storage Device. The manual is used to describe the operation, care, and maintenance of the device.

The instructions in this manual provide the information required to perform maintenance functions ranging from simple checks to minor repairs.

Refer to the Table of Contents for the page location of applicable sections.

All weights and measurements in the manual are in English units with metric units in parenthesis or brackets, unless otherwise stated.

This manual will be revised as necessary to reflect current information.

### 1.1. List of Abbreviations

There are no non-standard abbreviations used in this manual

### 1.2. List of Terminology

There is no non-standard terminology used in this manual.

### 1.3. Special Handling Requirements

The device contains a nickel-cadmium battery pack assembly. The unit should be stored in an environment with a temperature between 0 °C and 60 °C.

### 1.4. General Description and Operation

1. The 7809-2 Power Storage Device contains two battery packs and associated control circuitry to power an electro-explosive device and related aircraft systems for deployment of life rafts. A thorough description of the operation is provided in Section 4.

2. The electronics associated with the power storage device have no pre-determined maintenance cycle.

3. The battery pack used in the unit has definite shelf life related to self-discharge. See battery storage and maintenance information.

### 1.5. Technical Data:

Inputs:

Power Input: 28 V DC Nom ± 10 %, 320 mA max.

Control Inputs: Open Circuit
Ground. Ground must be capable of sinking 60 $\mu$A from each input.

Outputs:

Output 1: 21.6 V, nominal, 17 A Max, 10 mS max.

CAUTION: Exceeding the stated current output and/or exceeding the time limit will cause fuse failure.

Output 1A: 21.6 V, nominal, 20 mA

Output 2: 21.6 V, nominal, 200 mA, nominal.

| | | | |
|---|---|---|---|
| B1 | Voltage: | 21.6 VDC | Nominal |
| | Capacity: | 1.6 A-H | Nominal |
| | Charge Rate: | 160 mA for 14 to 16 hours | |
| | Operating Temp: | -20 to +60 °C | |

| | | | |
|---|---|---|---|
| B2 | Voltage: | 4.8 VDC | Nominal |
| | Capacity: | 650 mA-H | Nominal |
| | Charge Rate: | 65 mA for 14 to 16 hours. | |
| | Operating Temp: | -20 to +60 °C | |

1.6 Physical Data:

Approximate Dimensions are shown below.

| | |
|---|---|
| Length: | 9.6 in. (244 mm) |
| Width: | 3.2 in. (81 mm) |
| Height: | 3.3 in (83 mm) |

Weight: Approx. 3 lbs. 6 oz (1532 grams)

2.0. General

2.1. Batteries

B1 consists of 18 nickel cadmium cells packaged as a single unit.

B2 consists of 4 nickel cadmium cells packaged as a single unit.

2.2. Battery Parts

There are no serviceable parts with the battery packs.

2.3. Battery Storage

1. Battery Packs are fully charged when shipped. Each battery pack may be stored separately or in a power storage device.

2. Battery packs stored separately may be stored in a charged or uncharged state. Batteries in long term storage greater than 3 months are recommended to be stored in the discharged state.

3. Battery packs stored in a charged state will experience self-discharge. The rate of discharge increases with increasing temperature. Batteries should be stored at less than 30° C. Battery shelf life is enhanced at storage temperatures below 20 °C.

4. Battery packs stored in the power storage device will experience self-discharge.

5. Battery packs stored in the power storage device at 25 °C should be recharged at the C/10 rate for 14-16 hours at 23° C at 56 day intervals.

6. Battery packs stored in the power storage device at 0 °C should be recharged at the C/10 rate for 14-16 hours at 23° C at 149 day intervals.

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## 3.0 Battery Maintenance

The internal battery pack is kept charged during aircraft operation. The battery pack may be charged periodically outside of the device or while installed in the device.

### 3.1. Charging Battery In the Unit

3.3.1. Equipment Required:

Constant current power supply capable of generating 160 mA at 32 V DC.
Battery charge cable as illustrated below:

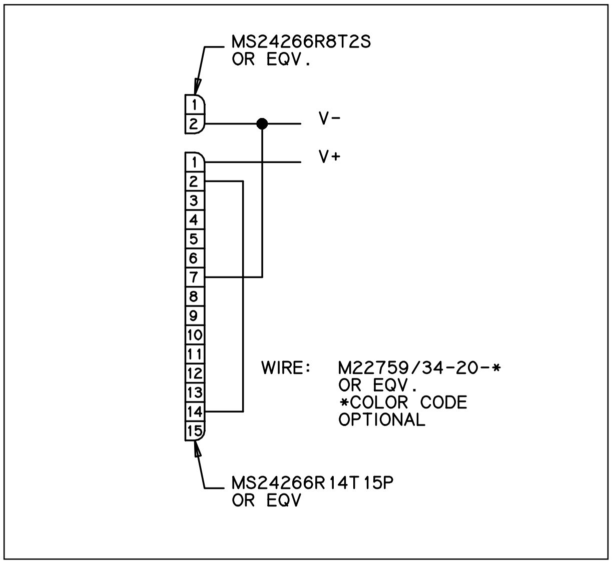



Figure 3.1: Battery charge cable. Use when charging battery in unit.

| Parts List | |
|---|---|
| Quantity | Description |
| 1 | Connector, Plug, MS24266R8T2S |
| 1 | Connector, Plug, MS24266R14T15P |
| A/R | Wire, M22759/34-20 |

Table 3.1.
Parts List for In-Unit Battery Charge Cable shown in Figure 3.1.

3.1.2. Procedure

Connect charge cable to unit. Set charge current and time as listed below:

Normal Charge: Set constant current power supply to 160 mA (32 V DC max). Charge a fully discharged battery for 14 to 16 hours.

| | |
|---|---|
| Rapid Charge | Set constant current power supply to 400 mA (32 V DC max). Charge a fully discharged battery for 4 to 5 hours. |

The charge circuit used is shown here for reference:

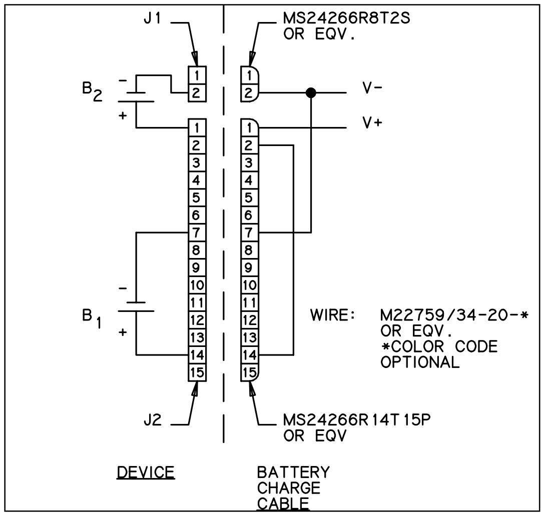



Figure 3.2: Schematic for charge circuit, in-unit

## 3.2. Charging Battery Outside of Unit

3.2.1. Equipment Required

Constant current power supply capable of generating 160 mA @ 32 V DC.
Battery Charge Cable, shown below.

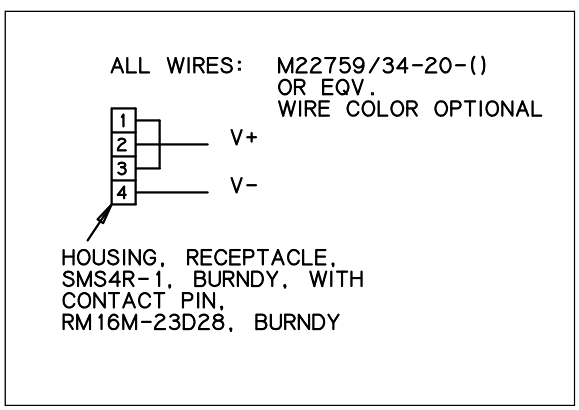



Figure 3.3: Battery charge cable. Use when charging battery outside of unit.

| Parts List | | |
|---|---|---|
| Quantity | LSI P/N | Description |
| 1 | 61977 | Connector Housing, Receptacle, SMS4R-1, Burndy |
| 1 | 61978 | Contact, Pin, RM16M-23D28, Burndy |
| A/R | - | Wire, M22759/34-20 |
| Ref | 61956 | Crimp Tool Turret Head for M22520/1-01 Crimp Tool Frame (TH-206, Daniels Manufacturing Co.) |

Table 3.2
Parts List for Battery Charge Cable shown in Figure 3.3.

3.2.2. Procedure

NOTE: While other methods of charging nickel cadmium batteries can be successfully used, maximum battery performance can be obtained using the constant current charging method.

Connect charge cable to unit. Set charge current and time as listed below:

Normal Charge: Set constant current power supply to 160 mA (32 V DC max). Charge a fully discharged battery for 14 to 16 hours.

Rapid Charge Set constant current power supply to 400 mA (32 V DC max). Charge a fully discharged battery for 4 to 5 hours.

The charge circuit used is shown here for reference:

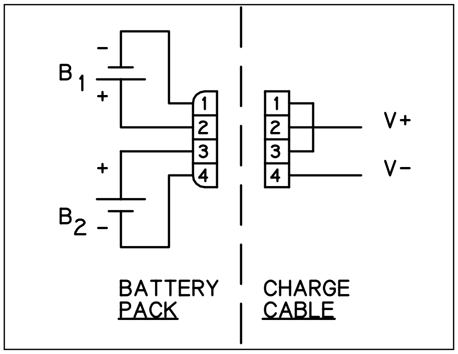



Figure 3.4: Schematic for charge circuit, out of unit charging.

3.3. Battery Maintenance Schedule

As the battery is charged during normal aircraft operation, additional attention to the pack should not be required under normal circumstances. A discharged pack must be recharged before returning to service.

3.3.1. Recommended Battery Service Schedule

NOTE: This schedule is suggested to assure full battery performance.

NOTE: Battery must be replaced when it can no longer hold a charge.

Every year: Discharge and recharge battery pack.

Every 3 years: Replace battery pack.

3.3.2. Determination of Adequate Battery capacity.

A battery is considered to have adequate capacity if a fully charged battery requires at least 45 minutes to drop to the voltage levels given in section 3.3.3. during discharge.

3.3.3. Annual Maintenance — Battery Pack Charge Cycling

This describes the procedure for annual battery maintenance.

CAUTION: Do not discharge both batteries connected together in series below 22.0 Volt DC.
Do not discharge B1 below 18.0 Volts DC.
Do not discharge B2 below 4.0 Volts DC.

Discharge below these voltage levels may result in battery cell polarity reversal and may damage the cell, resulting in reduced battery performance.

NOTE: This procedure may be performed with the battery in the unit or outside of the unit.

1. Connect battery to charge harness of choice as shown in section 3.2.

   NOTE: A 16.5 Ω, 100 W resistor may be used as a load for the 2 batteries connected in series.

   NOTE: A fully charged battery pack with both battery sets connected in series will require approximately 50-55 minutes to discharge to this level. A less than fully charged battery will discharge in less time.

2. Discharge battery pack to approximately 1.1 V DC per cell. Use the C rate, 1.6 A. With both B1 and B2 in series, discharge at 1.6 A to 24.2 ± 0.1 V.

3. Recharge battery pack according to procedure in Section 3.2.

## 4.0. Description and Operation

This topic describes the components and explains the operation of the power storage device 7809-2.

### 4.1. Introduction

7809-2 Power Storage Device is intended to provide reserve power for deployment of helicopter life rafts in the event of complete aircraft power loss and ditching of aircraft in water.

### 4.2.0. Operation

The device has 3 modes of operation:

Off
Test
Arm

#### 4.2.1. Off

In the off mode, the supply output is not active.  The battery charges from aircraft power, if available.

#### 4.2.2. Test

The unit is put in test mode through the activation of a *push-to-test* switch located in the cockpit.  In the test mode, the output of the device is active and is used to check for continuity of the circuit.

Current is limited to 20 mA on the test output line.  This is intended to light a systems OK LED in the cockpit.

#### 4.2.3. Arm

In the arm position all outputs are armed.  In this position output power becomes available to supply power to the aircraft life raft deployment system upon loss of aircraft power.

### 4.3.0. Principles of Operation

Inputs consist of aircraft power and logic control lines.  Aircraft power is industry standard 27.5 VDC.  The logic control lines are grounded or open circuited, depending on aircraft operating condition.

The two control lines with the addition of aircraft power, provide for three inputs which control device logic state.  These three inputs allow for eight discreet logic states for the power storage device.  Three of the states are accessed during normal operation.  The power storage device is not put into any of the other 5 states under normal circumstances.

The three system states accessed during normal system operation are those which:

1. Place the unit in the off state.
2. Place the unit in the test state.

3. Place the unit in the arm state.

4.3.2.0. Control Logic

A table summarizing the eight logic control states is shown in Table 1.

| Cockpit Switch | A/C supply voltage | Logic Control 1 | Logic Control 2 | Output 1/1A | Output 2 | Remarks |
|---|---|---|---|---|---|---|
| Auto | 0 | Ground | Ground | 21.6 V | 21.6 V | On |
| Test | 0 | Ground | Open | 21.6 V | 21.6 V | On |
| Off | 0 | Open | Ground | Open | Open | Off |
| N/A | 0 | Open | Open | Open | Open | Off |
| Auto | 28 | Ground | Ground | Open | Ground | Off |
| Test | 28 | Ground | Open | 21.6 V | 21.6 V | On |
| Off | 28 | Open | Ground | Open | Ground | Off |
| N/A | 28 | Open | Open | Open | Open | Off |

Table 4.1: System Logic

This discussion references schematic diagram shown in Figure 4.1.

4.3.2.1. Output Control

Aircraft power voltage is reduced through the voltage divider $R_4$ and $R_5$ to a level appropriate for the CMOS logic. In this case, about 4.5 V. This provides the logic indication that aircraft power is present.

Control inputs 1 and 2 are held high through resisters $R_{56}$ and $R_{57}$, unless specifically grounded by the aircraft input. These control logic inputs provide the state of the aircraft cockpit control switch position.

The three inputs — control inputs 1 and 2, and aircraft voltage — define the state of the power storage device at all times. The inputs are decoded by a triple 2-channel analog multiplexer/demultiplexer ($U_1$). This is essentially a switch which connects the input on each of three lines between two possible output lines. It performs a function similar to a single pole, double-throw switch.

$U_1$ allows the input logic to be encoded into high signals that can then be easily decoded by AND and OR gates downstream.

Control line 1 is connected to input B. Control line 2 is connected to input A.

The switched inputs to $U_1$ are all tied to $+V_{BB}$ ( $B_2$, +4.8 VDC). Input Z is tied to +4.8V through $R_6$. This signal is switched to $Z_0$ when aircraft power is off ($\overline{C}$), and switched to $Z_1$ when aircraft power is on (C).
Similarly, Input Y is tied to $+V_{BB}$ through $R_7$. This signal is switched to $Y_0$ when B is low (grounded) ($\overline{B}$) and to $Y_1$ when B is high (B)

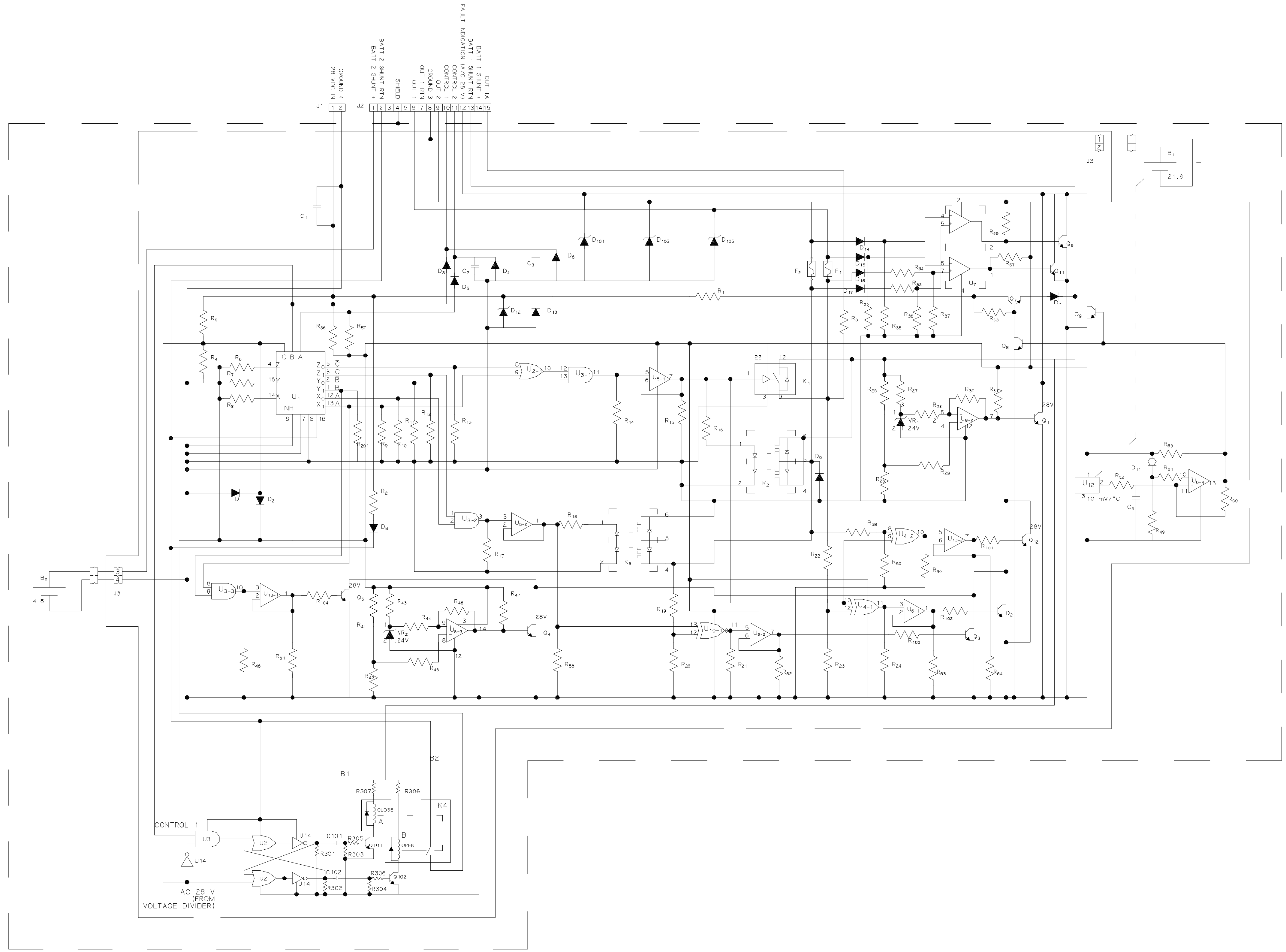


Figure 4.1: Schematic Diagram

Input X is tied to $+V_{BB}$ through $R_8$, The signal is switched to $X_0$ when A is low (grounded) ($\overline{A}$) and it is switched to $X_1$ when A is high.

The net result is a logic high where needed based on the input to control logic AND and OR gates.

$U_2$ provides the OR function for $\overline{C}$ and A. $U_3$ provides the AND function for ($\overline{C}$ + A) and $\overline{B}$.

$U_2$ is a quad OR gate. $U_3$ is a quad AND gate. There are 4 gates on each logic module.

The output of $U_3$ is used to control two solid state relays. $U_3$ is a CMOS device, so the output drive is somewhat limited. $U_5$ is a dual op amp configured as a buffer driver and is used to provide the current drive needed to operate the solid state relays.

The output of $U_5$ is used to turn on relays $K_1$ and $K_2$. Relay $K_1$ connects battery voltage to the squib fire circuit. $K_2$ connects battery voltage to the aircraft control relay power bus.

Battery voltage also appears on the test output contact as a result of $K_1$ switching battery power onto the squib fire circuit. Current through the test output (Out 1A) is limited to approximately 20 mA by $R_3$. Power from this line is routed through the entire squib fire circuit and is used to verify continuity through the squib. The current is used to light an LED in the aircraft cockpit.

As the load on $K_2$ is relay coils, it is inductive. $D_{12}$ is used to provide voltage suppression on the output of $K_2$ to protect $K_2$ from potentially high voltage due to the inductive loading of the relay coils.

A second gate of the quad AND gate which is $U_3$ is used to provide the AND function for C and $\overline{A}$ which is the signal used to activate $K_3$. The output of $U_3$ drives the other half of the dual op-amp which is $U_5$. $U_5$ provides the drive current for $K_3$.

$K_3$ is active most of the time. It is used to keep output 1 at near ground potential so that spurious signals that may be induced into the relay power lines do not activate aircraft relays when not intended.

4.3.2.2. Battery Charge control

Each battery is installed fully charged. Each battery maintains charge through trickle charging. The charge rate of $B_1$ is controlled by $R_1$. The charge rate of $B_2$ is controlled by $R_2$.

$B_1$ charge rate is maintained at a trickle charge rate of approximately C/20. This is intended to replenish the battery from self discharge effects and from the brief discharge of the test cycle.

The $B_2$ charge rate is intended to maintain the charge rate of the battery plus provide sufficient current to the system to provide housekeeping functions while the aircraft is operating. This is required so that $B_2$ does not discharge during normal operation.

Each battery voltage is monitored. The monitoring circuit uses analog comparator — the LM139 — and a precision voltage reference — the LM185H-1.2. The LM139 is a quad comparator, so contains four individual comparators.

One quarter of $U_8$ provides the battery monitoring function for $B_1$. The battery voltage is reduced through the voltage divider network of $R_{25}$ and $R_{26}$. This network is established so that the output of the voltage divider is 1.24 volts when the battery voltage is approximately 1 volt per cell (18 volts). The precision voltage reference provides the 1.24 volt reference signal to the comparator. $R_{27}$ limits the current to the voltage reference. 1.24 volts from the voltage reference is on the non-inverting input of the comparator at all times. As long as the voltage on the inverting input is greater than 1.24 volts, the comparator output will be low. When the voltage on the inverting input drops below 1.24 volts, the comparator output goes high. The comparator output drives a switching transistor ($Q_1$) which completes the circuit to ground for a fault indicating lamp located in the aircraft cockpit. $R_{31}$ provides the pull-up function for the open collector output of the comparator.

$R_{28}$ and $R_{30}$ are used to provide hysteresis on the comparator so that the output does not oscillate when the inputs reach the switching criteria. $R_{29}$ provides impedance matching for the non-inverting input.

One quarter of $U_8$ provides a similar function for $B_2$. Here $R_{41}$ and $R_{42}$ provide the voltage divider for the battery voltage. The network is designed to provide 1.24 V when the battery voltage is 1 volt per cell (4 volts).

$R_{43}$ is the current limiter for the 1.24 V precision voltage reference. $R_{44}$ and $R_{46}$ provide hysteresis to eliminate the potential for oscillation on the comparator output. $R_{45}$ matches the impedance of the non-inverting input with the inverting input. $R_{47}$ is the pull up resistor for the open collector output of the comparator.

The comparator output controls $Q_4$, which closes the circuit to ground for the fault indication lamp.

4.3.2.3. Logic Fault Indication

The control logic from the aircraft is set up so that both control line 1 and control line 2 will not be open at the same time. If both lines are open, then there is a problem with the aircraft wiring or with the PSD wiring.

This condition is monitored and if detected the fault indication is activated. Monitoring is done using one of the AND gates of $U_3$. The A and B outputs of $U_1$ are connected to the inputs of one of the $U_3$ AND gates. When both the A and B outputs of $U_1$ are high, then the output of the $U_3$ gate will be high. This output is used to drive one of the dual op-amps in $U_5$, which the drives $Q_5$. When $Q_5$ is active, it completes the circuit to ground for the fault indication.

4.3.2.4. Relay Fault Indication

Relay fault indication is realized by comparing the commanded input to the relay with the realized output.

For $K_1$ and $K_2$, when the input is low, the output should be low. When the input is high, the output is high. For each relay, this is monitored by an XOR gate ($U_4$). The XOR (eXclusive OR) function yields a logic high only when one or the other input is high. If both inputs are low or high, then the XOR function output is low. The output of each XOR gate ($U_4$) drives a NPN transistor through a buffer ($U_6$).

Relay K3 is monitored in a similar fashion, but with an XNOR (eXclusive NOR) gate. When the input to $K_3$ is high, the output of $K_3$ is grounded. When the input to $K_3$ is low, the output of $K_3$ should have voltage on it, supplied by $K_2$.

$U_{10}$ provides the XNOR function. It drives a transistor through a buffer when a fault is detected.

4.3.2.5. Fuse Failure

Fuse failure is monitored only when power is available on the output. This is only during test and when the outputs are active due to loss of aircraft power in the arm condition.

Voltage is monitored on both sides of the fuse by $U_7$. $U_7$ is a dual comparator with voltage reference. The voltage reference is not used in this application.

In the case of output 2, voltage from one side of the fuse is connected to the comparator non-inverting input through voltage divider $R_{32}$ and $R_{36}$. Voltage from the far side of the fuse is connected to the inverting input.

While the fuse is intact, voltage is on both sides of the fuse. The voltage divider on the non-inverting input assures that the voltage summation at the comparator will always be less than 0, and the comparator output will be low.

When the fuse fails, the far side of the fuse goes to 0V potential through $R_{33}$. The near side is at high voltage. The voltage summation is positive, and the comparator goes high, turning on $Q_6$. $Q_6$ completes the circuit to ground on the fault indication circuit.

4.3.2.6. Battery Overtemperature

$B_1$ battery temperature is monitored to guard against overtemperature operation of the main power source. Battery temperature is monitored by a precision temperature sensor ($U_{12}$). This is a semiconductor device which outputs 10 mV/°C. The output of $U_{12}$ is compared the voltage resulting from a controlled current through a precision resistor.

$D_{11}$ is a current limiting diode, which limits current passing though it to .220 mA. $R_{49}$ is a precision resistor with a low temperature coefficient, with a resistance of 2520Ω. The voltage produced by the combination of the nominal current limiting diode, $D_{11}$ and R49 is 554.4 mV. $U_{12}$, the temperature sensor, develops this voltage at a nominal temperature of 55.4 °C.

This level was selected to allow for variations in diode current. The $D_{11}$ diode has a minimum device current of .198 mV. The selection of the nominal temperature allows for the use of a diode at the minimum specification while still allowing for battery charge up to 50 °C

These two voltage inputs are fed into one quarter of the $U_8$ comparator. The output of this comparator is high, as long as the non-inverting input stays below the voltage developed by the $D_{11}$-$R_{49}$ combination. When the voltage of the temperature sensor exceeds the $D_{11}$-$R_{49}$ voltage, the comparator switches the output low.

The comparator output is used to bias the base of $Q_8$. $Q_8$ is a PNP transistor that is used to drive $Q_7$. With $U_8$ output high, (battery temperature below maximum), $Q_8$ is off, and $Q_7$ is biased on by $R_{53}$.

When battery temperature exceeds the maximum temperature, $U_{11}$ output goes low, turning on $Q_8$. This drops the voltage at the base of $Q_7$, turning it off. This also turns on $Q_9$, which closes the circuit to the fault indicator.

4.3.2.7. System On-Off Control

Due to the high power consumption of the circuits, a provisions made to shut down all but the on-off function when the system is in the manually commanded off state. This function is provided by $K_4$. $K_4$ is latching single pole double throw latching relay. A SET-RESET (S-R) flip-flop arrangement formed by gates from $U_2$ and $U_{14}$ control the relay.

One of the U3 gates is used to AND the control line 1 input and the inverse of the aircraft power signal. The output of this AND function is fed to the SET input of a SET-RESET flip flop. The aircraft power signal is fed to the RESET input of the flip flop. When the control 1 input is open, a high voltage appears at the input of the S-R AND gate. When aircraft power is on, the aircraft power signal is high, and the inverse of this signal is low. The output of the AND gate is low. The SET input is low. The RESET input is the aircraft power signal, and is high. The relay is commanded to the power on position.

With control 1 input open (signal high) and aircraft power off, the output of inverter $U_{14}$ goes high, forcing the SET input to the S-R flip flop high and the reset input low. This puts the relay into the power off position.

The relay coils are driven by transistors $Q_{101}$ and $Q_{102}$. Capacitors $C_{101}$ and $C_{102}$ transmit the only the leading edge of the relay command signal, so the relay coils only energize for the brief period of time required for them to latch, so current flows through the relay coils only when a relay state switch is commanded.

Note that this feature requires that the unit be turned on and off in a specific sequence:

<u>Turn on Sequence</u>:

1. Place aircraft cockpit switch in OFF position. This places the control 1 input in the open state, which results in a logic high on the control 1 inputs internal to the PSD.

2. Turn on aircraft power. This in combination with the OFF switch position places the $K_4$ relay in the on position.

<u>Turn Off Sequence</u>

Sequence A

1. Place aircraft cockpit switch in OFF position.

2. Turn off aircraft power. This in combination with the OFF switch position places the $K_4$ relay in the off position.

Sequence B (Alternate Sequence)

1. Turn off aircraft power.

2. Place aircraft cockpit switch in OFF position.

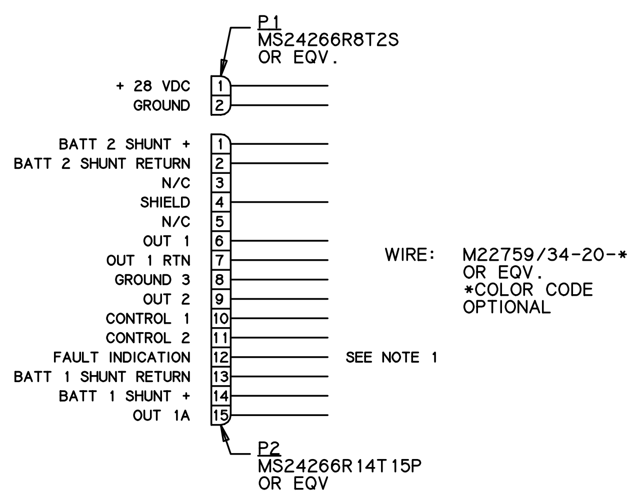
## 5.0 Testing and Fault Isolation

This section describes the procedures to use when determining the status of a unit, and to troubleshoot a unit removed from an aircraft with a fault complaint.

Test Equipment and Materials.

Equivalent substitutes may be used for all test equipment listed.

Voltage Meter
Current Meter
Switch Arrangement
Test harnesses (See Fig 5.1)




Notes:

1. 28 V DC through incandescent bulb connects to pin 12 fault indication.

Figure 5.1: Test Harnesses

Connect unit under test to test harnesses. Connect cable marked P1 to J1, connect cable marked P2 to J2.

1. Measure battery voltage at J2.

   Correct battery voltage is as follows:

| J2 Terminals | Min Value (Volts) | Nominal Value (V) | Max Value (V) |
|---|---|---|---|
| 1-2 (B2) | 4.0 | 4.8 | 5.8 |
| 13-14 (B1) | 18.0 | 21.6 | 26.1 |

Table 5.1
Acceptable Battery Voltages

If battery voltage is below nominal value, charge batteries. See section 3 for details

If battery can not be charged or can not hold charge, replace. See section 6.4 for details.

2. Put unit through logic sequences as shown in table 5.2 in the order shown in table 5.2.

Caution: Do not apply ground to Control line 1 with 28 Volt supply off unless intended. With 28 Volts removed and ground applied to control line 1, the unit is in the off state. To put the unit back in the on state requires 28 Volts to be reapplied to J1 pin 1 and Control line 1 being open circuited. Reference Description and Operation Section 3.7.

| Test Step | A/C supply voltage | Logic Control 1 | Logic Control 2 | Output 1/1A | Output 2 | Remarks |
|---|---|---|---|---|---|---|
| 1 | 0 | Open | Ground | Open | Open | Off |
| 2 | 28 | Open | Ground | Open | Ground | Off |
| 3 | 28 | Ground | Ground | Open | Ground | Off |
| 4 | 28 | Ground | Open | Voltage | Voltage | On |
| 5 | 28 | Open | Open | Open | Open | Off/Fault |
| 6 | 28 | Open | Ground | Open | Ground | Off |
| 7 | 0 | Ground | Ground | Voltage | Voltage | On |
| 8 | 0 | Ground | Open | Voltage | Voltage | On |
| 9 | 0 | Ground | Ground | Voltage | Voltage | On |
| 10 | 0 | Open | Ground | Open | Open | Off |
| 11 | 0 | Open | Open | Open | Open | Off |
| 12 | 0 | Open | Ground | Open | Open | Off |
| 13 | 28 | Open | Ground | Open | Ground | Off |
| 14 | 0 | Open | Ground | Open | Open | Off |

Table 5.2: Test Sequence

Any unit that does not test is faulty. There are no field repairs for a unit that fails the logic test sequence.

A unit that has a continuous fault indication and/or fails logic test may have a blown fuse. To testing fuses requires access to circuit board.

Disassemble unit (Reference Disassembly, Section 6) to point where circuit board face is visible. Do not remove connectors at this stage.

Place meter across each fuse (F1) and (F2) and measure continuity. If continuity is measured, then fuse is good. If open, fuse is bad. Proceed with fuse replacement in repair section.

## 6.0. Disassembly, Repair, and Reassembly

6.1. List of required materials:

Battery Replacement

Phillips head screw driver
Battery Pack (IPL fig. 1 item 30)
Needle nose pliers
Soldering Iron

Fuse Replacement

Phillips head screw driver
Allen wrench, 1/16
Allen wrench, 3/32
Connector Contact Removal Tool M81969/19-07
Connector Contact Insertion Tool M81969/17-03
Fuse (IPL fig. 2 items F1 and F2)
Silicone Conformal Coat, MIL-I-46058C or eqv.
Soldering Iron

Equivalent substitutes may be used for listed items.

### 6.2. Battery Replacement

The unit must be partially disassembled to change the battery pack. All instructions in this section reference the Illustrated Parts List (IPL) Figure 1.

6.2.1. To remove battery pack:

1. Remove 4 cover screws (12).
2. Remove cover (11).
3. Remove 3 battery cover screws (21).
4. Remove battery cover (20).
5. Note arrangement of battery pack wires. Lift battery pack (30) from battery tray (40).
6. Grasp battery connector and squeeze connector retaining arms to release. Needle nose pliers may be used to compress connector retaining arms. Disconnect battery connector plug.

6.2.2. To install battery pack, reverse the disassembly process.

1. Connect battery assembly connector to receptacle next to battery tray.
2. Place battery assembly (30) in battery tray (40). Route battery wires in fashion similar to that noted in step 5 in the removal process.
3. Place battery cover (20) over battery assembly (30) in battery tray (40).
4. Secure 3 battery cover screws (21). Torque to 13-15 lb-in. (1.5-1.7 N-m) (Reference Fits and Clearances Section).

CAUTION: EMI gasket fingers are Beryllium Copper. Do not perform any functions that will create dust from them.

5. Carefully attach cover (11) to enclosure base (10). Do not damage EMI gasket fingers (31).

6. Secure enclosure cover (11) to base (12). Torque in alternate order, first to 3 in-lbs (0.3 N-m) each, then torque to 16-18 in-lbs (1.8-2.0 N-m).

## 6.3. Fuse Replacement

6.3.1. Fuse replacement requires complete disassembly of the unit.

Proceed as follows:

1. Remove 4 cover screws (12).
2. Remove cover (11).
3. Remove 3 battery cover screws (21).
4. Remove battery cover (20).
5. Note arrangement of battery pack wires. Lift battery pack (30) from battery tray (40).
6. Grasp battery connector and squeeze connector retaining arms to release. Needle nose pliers may be used to compress connector retaining arms. Disconnect battery connector plug.
7. Remove battery tray screws (41).
8. Remove battery tray (40)
9. Remove connector screws (73) from both connectors.

   CAUTION: Damaged connector gaskets must be replaced to assure proper sealing against water ingestion.

10. Remove connector nut rings (74) and (84). Carefully separate connector shell (72) and (73) from enclosure housing (10). Do not damage connector gaskets (71) and (81).

    NOTE: Connectors use front release contacts.

11. Remove connector contacts from connectors (72) and (82).
12. Remove circuit board screws (51).

    CAUTION: Do not flex wires any more than necessary.

13. Note routing of circuit board wires. Carefully remove circuit board from assembly.

6.3.2. To change fuse:

1. Unsolder suspect fuse. Conformal coat in area to be unsoldered can be burned through using a soldering iron. Remove suspect fuse from board.
2. Solder replacement fuse into board.
3. Touch up conformal coat at area of fuse. Allow conformal coat to cure.

6.3.3. Reassembly:

Reassembly is accomplished in the reverse order to disassembly:

1. Note correct orientation of circuit board. Battery connector and board tongue are towards mounting hole for J1. Carefully insert wires though holes in side of enclosure.

2. Secure board (50) to mounting plate (60) with screws (51). Use threadlocking compound on screws.

   CAUTION: Damaged connector gaskets must be replaced to assure proper sealing against water ingestion.

3. Place connector gaskets (71) and (81) over connector wires. Small gasket (71) goes over the 2 wires for J1. The large gasket (81) goes over the wire bundle for J2.

   CAUTION: To assure that all wires are correcting installed, checking of continuity is strongly recommended at this step.

4. Insert connector contacts into connector. Connector contact number is marked on board for each wire. Connector contact numbers are summarized on table below. Insert all wires into correct connector position

| J1 Connector Position Number | Identification |
|---|---|
| 1 | + 28 V DC Aircraft Power |
| 2 | Ground |

Table 6.1: J1 Connector Contact Identification

| J2 Connector Position Number | Identification |
|---|---|
| 1 | Batt 2 Shunt + |
| 2 | Batt 2 Shunt return |
| 3 | N/C |
| 4 | Shield — connect to chassis |
| 5 | N/C |
| 6 | Out 1 |
| 7 | Out 1 Return |
| 8 | Ground 3 |
| 9 | Out 2 |
| 10 | Control 1 |
| 11 | Control 2 |
| 12 | Fault Indication |
| 13 | Batt 1 Shunt Return |
| 14 | Batt 1 Shunt + |
| 15 | Out 1A |

Table 6.2: J2 Connector Contact Identification

CAUTION: Do not over torque screws. Do not over compress connector gaskets. Connector gasket edge should be clean and straight. If wrinkled, then connector screws are over torqued.

5. Install connectors. Install small nut ring (74) behind J1 and large nut ring (84) behind J2. Insert screws (73) from enclosure exterior. Note that screws are self sealing, and contain a gasket under their heads. Do not damage gasket. Progressively turn screws in order, until connector gasket (71) and (81) are seated. Torque screw to 7-8 lb-in.

6. Install battery tray (40). Note correct orientation of tray. The single battery tray cover support installs toward the small connector, J1.

7. Install battery tray screws (41). Use thread locking compound. Torque screws to 7-8 lb-in (0.8-0.9 N-m).

8. Connect battery assembly connector to receptacle next to battery tray.

9. Place battery assembly (30) in battery tray (40). Route battery wires in fashion similar to that noted in step 5 in the removal process.

10. Place battery cover (20) over battery assembly (30) in battery tray (40).

11. Secure 3 battery cover screws (21). Torque to 13-15 lb-in. (Reference Fits and Clearances Section).

    CAUTION: EMI gasket fingers are Beryllium Copper. Do not perform any functions that will create dust from them.

12. Carefully attach cover (11) to enclosure base (10). Do not damage EMI gasket fingers (31).

13. Secure enclosure cover (11) to base (12). Torque in alternate order, first to 3 in-lbs (0.3 N-m) each, then torque to 16-18 in-lbs (1.8-2.0 N-m).

## 7.0 Cleaning

7.1 List of Materials

Isopropyl Alcohol
De-ionized water
Mild soap

Equivalent Substitutes may be used for listed items.

7.2. Procedure

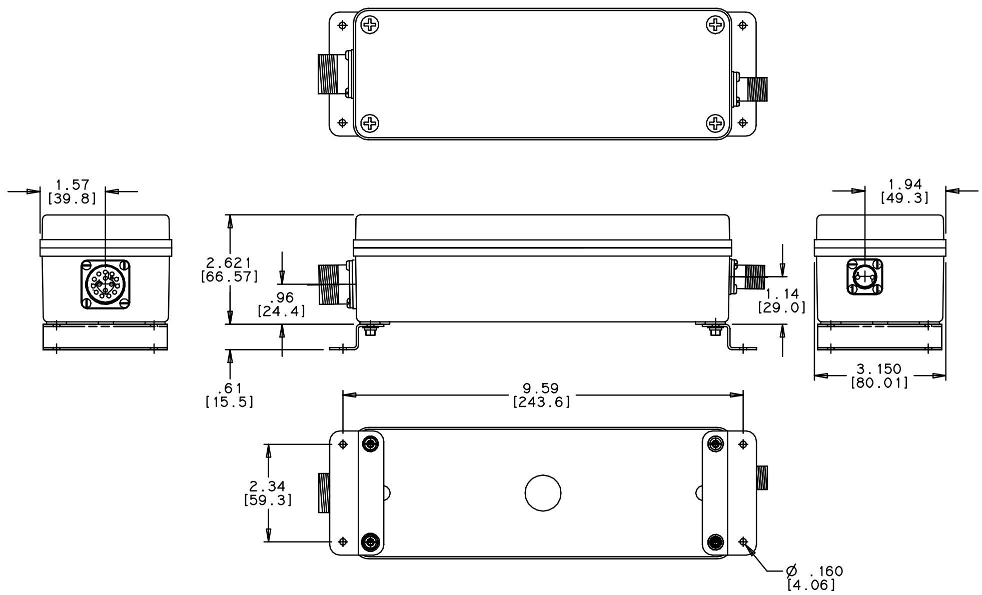
Only the exterior of the Power Storage Device enclosure can be cleaned. There are no interior parts which require cleaning.

CAUTION: Polycarbonates are attacked by alkaline solutions, esters, keytones and most aromatic and chlorinated solvents. Avoid cleaning the enclosure with substances that contain these materials.

The PSD enclosure is polycarbonate. Polycarbonates are generally resistant to acids, salts solutions, alcohols and ethers. Cleaning agents from these families can be used, if necessary.

Use soft cloth with cleaning agent and wipe exterior surface of enclosure to clean as necessary.

## 8.0 Fits and Clearances




Tolerances: .XX = ± 0.010 [0.25]
.XXX = ±.03 [0.8]

Figure 8.1: Fits and Clearances

| Item Number IPL Fig 1 | Nomenclature | Torque Pound-Inches | Torque Newton-meters | Note |
|---|---|---|---|---|
| 12 | Enclosure Fastener | | | 1 |
| 21 | Screw, 6-32 | 13-15 | 1.47-1.69 | |
| 41 | Screw, 4-40 | 7-8 | 0.79-0.90 | |
| 51 | Screw 4,40 | 7-8 | 0.79-0.90 | |
| 73 | Screw, 4-40, self-sealing | 7-8 | 0.79-0.90 | |
| 91 | Screw 8-32 | | | 2 |

Table 8.1
Torque Table

Notes:

1. Torque as follows:

   Install 4 screws, torque to 3 lb-in (0.34 N-m).
   Torque 4 screws to 16-18 lb-in (1.81-2.03 N-m).

2. Torque as follows:

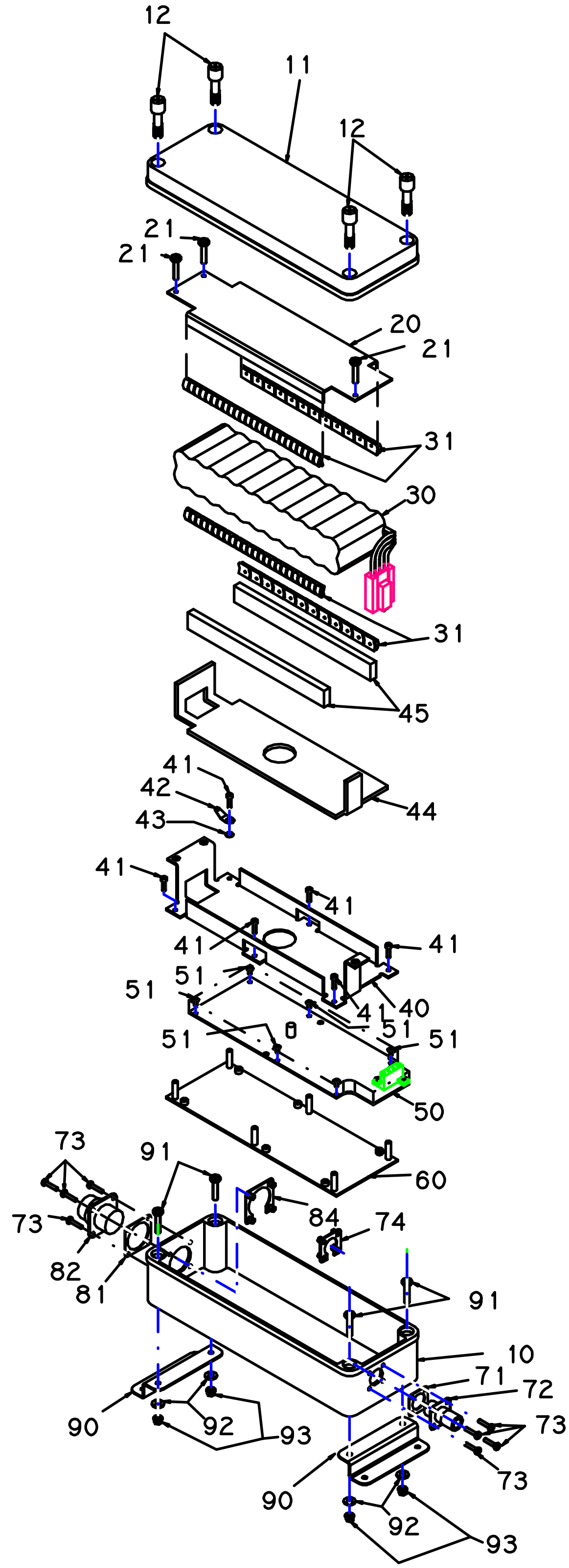
Install 4 screws and nuts. Tighten to finger tight.
Toque 4 screws to 20 lb-in (2.26 N-m).
Toque 4 screws to 23-25 lb-in (2.60-2.82).

## 9.0 Special Tools Fixtures and Equipment

No special tools or fixtures are required to service the Power Storage Device other than those already discussed in previous sections. Those items are summarized here.

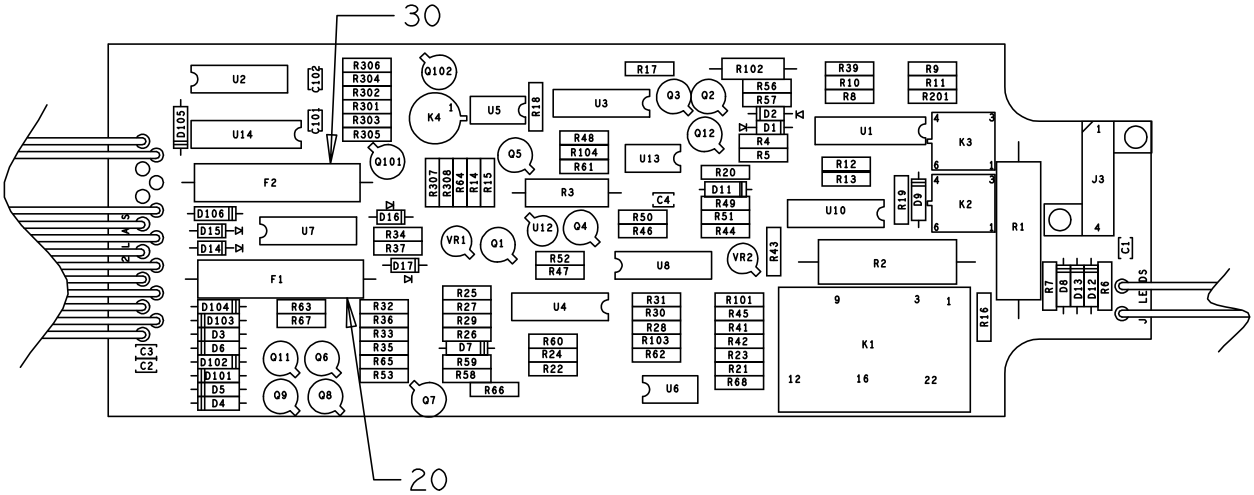
| Item | Ref Figure Number |
|---|---|
| Battery Charge Cable — In unit charging | 3.1 |
| Battery Charge Cable — Out of unit charging | 3.3 |
| Test Cables | 5.1 |

Table 8.1
Summary of Special Equipment




Power Storage Device
IPL Figure 1

| Item # | Part Number (LSI) | Operator Part Number | Nomenclature | Eff. Code | Units per Assy |
|---|---|---|---|---|---|
| 1-1 | 7809-2 | | Power Storage Device | | Ref |
| 10 | 35027-1 | | Enclosure, Base, Modified | | 1 |
| 11 | 35027-2 | | Enclosure, Cover, Modified | | 1 |
| 12 | 35027-3 | | Enclosure, Fasteners | | 4 |
| | | | | | |
| 20 | 35013-1 | | Battery Cover | | 1 |
| 21 | 61968 | | Screw, 6-32 x 3/8, pan hd phill 316 ss | | 3 |
| | | | | | |
| 30 | 7841-1 | | Battery Pack Assembly | | 1 |
| 31 | 61964 | | EMI gasket, Clip on | | 8 in |
| | | | | | |
| 40 | 35012-1 | | Battery Tray | | 1 |
| 41 | 61914 | | Screw, soc. hd cap, 4-40x3/8, 316 ss | | 6 |
| 42 | 61969 | | Terminal, Lockwasher, #4, MS 77066-1 | | 1 |
| 43 | 61905 | | Washer, MS 15795-803 | | |
| 44 | 62022 | | Foam, polyurethane, open cell, 2 w x .125 thk. | | 12 in. |
| 45 | 62023 | | Foam, Silicone, closed cell, .5 w x .186 thk. | | 10 in. |
| | | | | | |
| 50 | 34978-2 | | Circuit Board Assembly | | 1 |
| 51 | 61915 | | Screw, socket cap, button hd, 4-40 x 3/8, 18-8 ss | | 6 |
| | | | | | |
| 60 | 35014-1 | | Mounting Plate | | 1 |
| | | | | | |
| 71 | 61950 | | Gasket for receptacle, 229401S01, (ESC), or eqv. | | 1 |
| 72 | 61895 | | Connector, R071114A15SN-200, (R. M. S.) | | 1 |
| 73 | 61974 | | Screw, sealing, 4-40 x7/16 | | 8 |
| 74 | 61948 | | Nut Ring, FSU-8, (Fastener Specialty), or eqv. | | 1 |
| | | | | | |
| 81 | 61951 | | Gasket for receptacle, 229401S06 (ESC), or eqv. | | 1 |
| 82 | 61896 | | Connector, R071108A02PN-200, (R. M. S.) | | 1 |
| 84 | 61949 | | Nut Ring, FSU-14 (Fastener Specialty), or eqv. | | 1 |
| 85 | 61969 | | Terminal, Lockwasher, #4, MS77066-1, or eqv. | | 1 |
| | | | | | |
| 90 | 35028-1 | | Bracket | | 2 |
| 91 | 62005 | | Screw, MS35206-247 | | 4 |
| 92 | 62006 | | Washer, AN 960-8 (NAS1149FN832P) | | 4 |
| 93 | 62007 | | Nut, MS 21042-08 | | 4 |




IPL Figure 2:
Control Circuit Board

Replaceable Items Shown

| Item # | Part Number (LSI) | Operator Part Number | Nomenclature | Eff. Code | Units per Assy |
|---|---|---|---|---|---|
| 2-1 | 34978-2 | | Circuit Board Assembly | | Ref |
| 20 | 301035 | | Fuse, Slo-Blo, 6.25 A, 250 V, 325 6.25,(Littlefuse) | | 1 |
| 30 | 301120 | | Fuse, Fast-Blo, 2A, 250 V, 324 002, (Littlefuse) | | 1 |