Battery Support System

for use with the LIFEPAK® 5 monitor/defibrillator

Operating and Service Manual

Manual No. 802065-01
March 1984

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SERIAL NO. ______________

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CONFIGURATION
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EQUIPMENT DASH NUMBERS COVERED IN THIS MANUAL

BATTERY SUPPORT SYSTEM	801807-10 THROUGH 801807-18

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HOW TO USE THIS MANUAL.

Section I of the manual provides introductory information with FUNCTIONAL DESCRIPTIONS and GENERAL SPECIFICATIONS.

Section II informs the authorized user how to OPERATE THE EQUIPMENT, identifies various CONTROLS AND INDICATORS, and gives simple SERVICING INSTRUCTIONS.

Section III gives detailed TECHNICAL OPERATION and circuit descriptions, accompanied by schematic drawings, helpful in understanding the high-technology electronic designs.

Section IV consists of MAINTENANCE PROCEDURES and test data which assist in TROUBLESHOOTING the equipment. DISASSEMBLY PROCEDURES are also described.

Section V contains ILLUSTRATED PARTS LISTS with EXPLODED VIEWS to help identify replaceable parts by number and location.

Section VI is a folio of useful SCHEMATIC DRAWINGS which are updated periodically, as well as useful connector pin-outs and interconnect information. We believe this compendium of information will be helpful to maintenance staff, and others.

SECTION 1
INTRODUCTION

1-1. SCOPE

This is the operating and service manual for the LIFEPAK 5 Battery Support System manufactured by Physio-Control Corporation, Redmond, Washington, U.S.A.

The six sections of this manual provide Introductory information with Functional Descriptions and Specifications, Operating Instructions, Circuit Descriptions, Maintenance Procedures, Illustrated Parts Lists, and Engineering Schematics.

1-2. GENERAL DESCRIPTION

The LIFEPAK 5 Battery Support System is a companion instrument to the LIFEPAK 5 Monitor/Defibrillator and ECG/Voice Recorder, serving as a battery charger, battery capacity evaluator and defibrillator available energy checker.

The Battery Support System can provide recharge and maintenance charge for up to three LIFEPAK 5 batteries (nickel cadmium, 12 Vdc, 1AH).

A set of indicators corresponding to each of the three charge positions shows the charge state of the batteries.

A battery discharger circuit provided in the right-hand charge position on the unit can perform a reconditioning cycle.

The digital display on the Battery Support System can show the percentage of available capacity (in the right-hand charge position), the available defibrillator energy selected or the amount of defibrillator energy delivered.

The defibrillator output energy can be checked using a test load circuit in the Battery Support System.

The System is available in 100Vac, 117Vac, or 235Vac versions. Any of the three charge positions will charge a battery. The number of batteries being charged at one time is not critical.

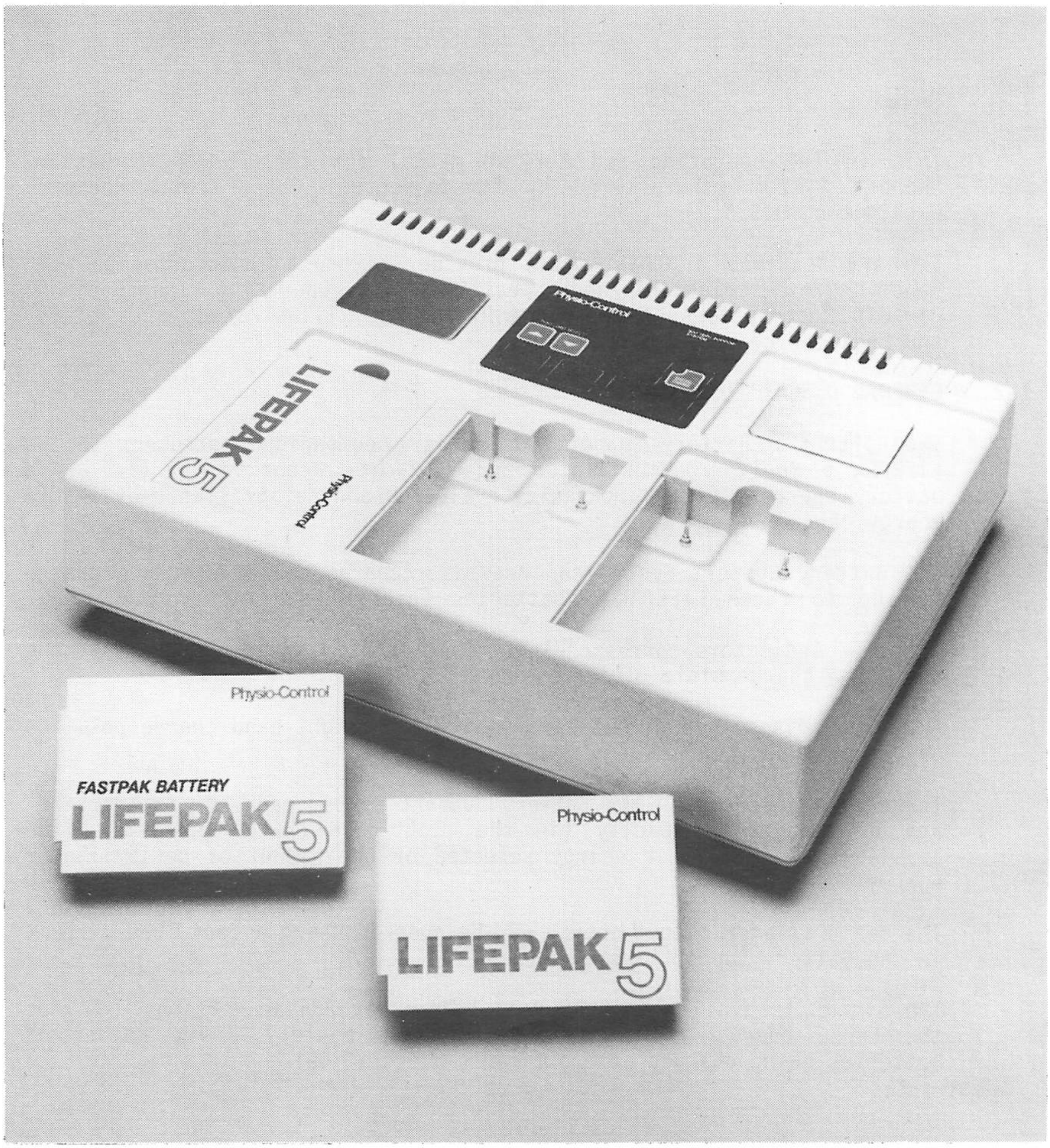


FIGURE 1-1. LIFEPAK 5 BATTERY SUPPORT SYSTEM

1-3. FUNCTIONAL DESCRIPTION

A charging cycle is initiated by placing a battery in any charge position. A display associated with each charge position indicates if the battery is charging up, ready, or faulty (at a critically low voltage).

When DISCHARGE is pressed, the percentage of battery capacity available for the battery in the righthand charge position is automatically displayed after that battery recharges. The capacity available during recharge is obtainable on the display by depressing the DISCHARGE pushbutton.

Each battery position is thermally isolated from the heat generating portion of the unit.

The Battery Support System also features an AC power indicator, a discharge indicator, defibrillator TEST LOAD SELECT pushbuttons, and test load pads for checking defibrillator output energy.

Details of control and indicator functions are given in Section 2. Table 1-1 on the following page lists general specifications for the Battery Support System.

TABLE 1-1

LIFEPAK 5 BATTERY SUPPORT SYSTEM GENERAL SPECIFICATIONS

CHARACTERISTIC	QUANTITY OR SPECIFICATIONS
GENERAL	
● SIZE	16.5 x 12.8 x 4.1 inches. (420 x 325 x 105 millimeters).
● WEIGHT	22.0 pounds (10 kg) with three batteries installed.
● AC INDICATOR	Indicator illuminates when connected to AC line.
POWER SOURCE	100Vac ± 10%, 50/60Hz. 117Vac ± 10%, 50/60Hz. 235Vac ± 10%, 50/60Hz.
CHARGE SYSTEM	
● CHARGE TIME	75 minutes for a completely discharged FASTPAK battery. 4.5 hours for a completely discharged LIFEPAK 5 battery.
● INITIATION	Charge cycle begins when a battery is inserted in any charge position.
● ISOLATION	Batteries are thermally isolated from the heat generating portion of the system.
● BATTERY TYPE	12Vdc, 1 AH, nickel cadmium.
TEST LOAD	50Ω, 50W test load.
DISPLAY	
● TEST LOAD SELECT RANGE	0-500J for displayed energy selected.
● RESOLUTION	10J for displayed energy selected. 1J for displayed energy delivered.
ENVIRONMENT	
● TEMPERATURE RANGE	10°-40°C.
● RELATIVE HUMIDITY	10-90%, non-condensing.

SECTION 2
OPERATION

2-1. GENERAL

This section of the manual provides the information and procedures necessary to properly operate and provide operator service for the Battery Support System.

2-2. CONTROLS AND INDICATORS

A. The controls and indicators on the Battery Support System are shown in Figure 2-1. Each item is keyed on the figure to a corresponding listing in Table 2-1. The table lists the nomenclature and briefly describes the function of each item.

B. Figure 2-2 provides the rear panel view of the Battery Support System. Each item on this figure is keyed to a corresponding listing in Table 2-2. The table lists the nomenclature of each item and briefly describes its function.

C. Figure 2-3 shows the two types of battery paks in use.

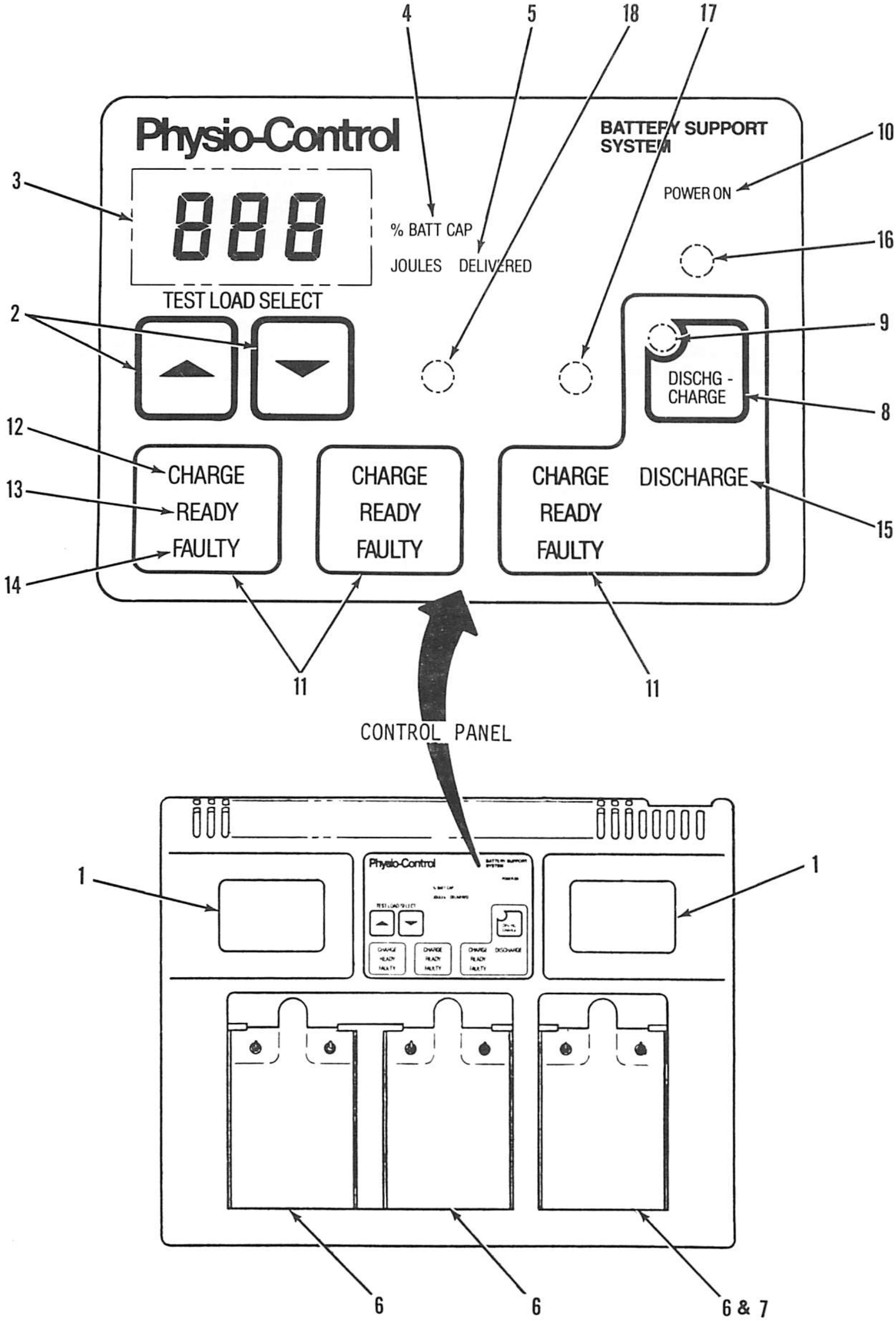


FIGURE 2-1. BATTERY SUPPORT SYSTEM CONTROLS AND INDICATORS

TABLE 2-1

BATTERY SUPPORT SYSTEM CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
1	Test Load Pads	Provide access for paddles to internal 50 ohm test load.
2	TEST LOAD SELECT	Use increase or decrease pushbutton to set the defibrillator test output energy. When these switches are used in conjunction with Test and Calibration Mode switches, they will step the instrument through its six test modes.
3	Digital Display	3-digit display shows percent of battery capacity, defibrillator energy selected or defibrillator energy delivered. Display range is 0-500J for energy selected. Display resolution is 10 joules for displayed energy selected and 1 joule for displayed energy de-ivered.
4	Display Indicators % BATT CAP	Lights up at end of reconditioning cycle Lights up during recharge if DISCHARGE pushbutton is depressed (see below).
5	JOULES DELIVERED	Lights for 5 ± 1 seconds after Defib-rillator is discharged into test load.
6	Charge Positions	Receptacles for charging one, two or three batteries simultaneously.
7	Discharge Position	Right-hand charging position also has reconditioning cycle circuits.
8	DISCHG - CHARGE	Press to initiate battery discharge for the battery in the right-hand charge position; Press to display % battery capacity during recharge.
9	DISCHG - CHARGE Indicator	Lights steady during discharge and flashes during recharge.
10	POWER ON	Lights up when unit is connected to its appropriate power source.
11	Battery Charge Indicators	Three indicators associated with each battery charge position show the state of the battery in each position.

TABLE 2-1 (Continued)

BATTERY SUPPORT SYSTEM CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
12	CHARGE	Lights up during charging cycle. Lights up during recharge cycle for the battery in the right-hand position.
13	READY	Lights up when battery is ready for use (approximately 70 minutes for a completely discharged FASTPAK. 4.5 hours for a Battery Pak).
14	FAULTY	Lights when the battery terminal voltage is less than 5 volts or is less than 12.50 volts after completion of the charge cycle.
15	DISCHARGE	Lights when the battery is being discharged.
	Test and Calibration Mode Switches	
16	Test Enable	Pressing this switch enables the test and calibration mode switch.
17	Test and Calibration	Pressing this switch simultaneously with the TEST ENABLE switch initiates the test and calibration mode.
18	Power Age Cycler	For factory use.

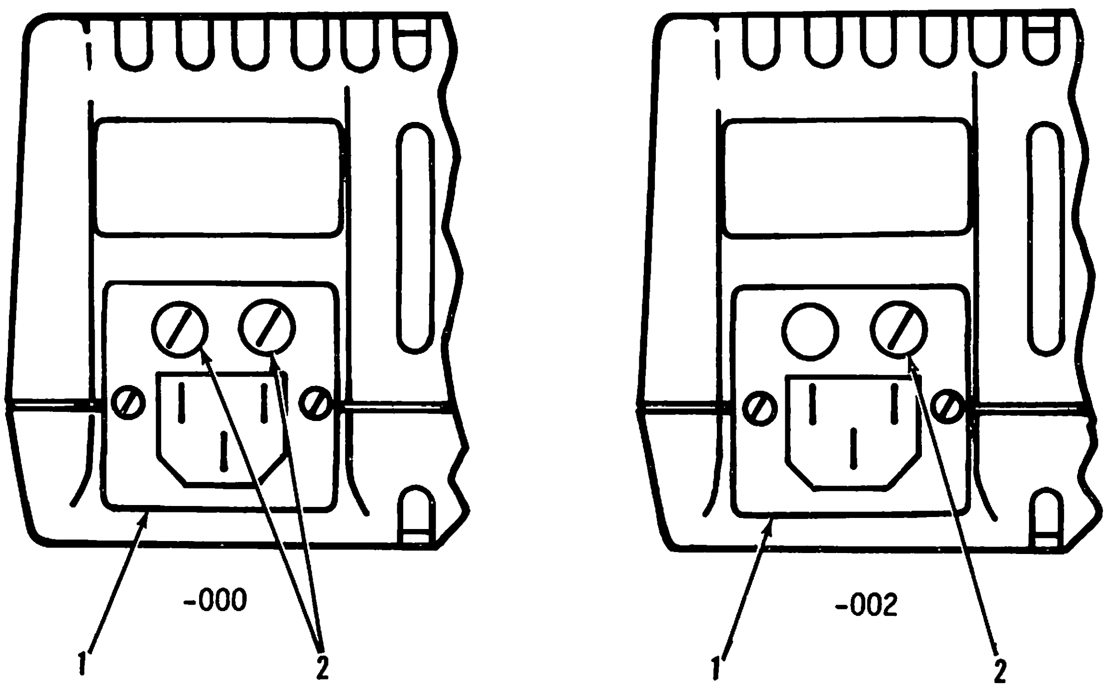


FIGURE 2-2. REAR PANEL

TABLE 2-2

REAR PANEL ITEMS

FIGURE KEY NO.	ITEM	FUNCTION OR DESCRIPTION
1	Appliance Connector	UL, CSA units (single fuse): P/N 200602-002. International Units (dual fuse): P/N 200602-000
2	Fuse (Slo-Blo)	100 and 117Vac units: P/N 200619-015, 250V, 2A. 235Vac units: P/N 200619-012, 250V, 1A.

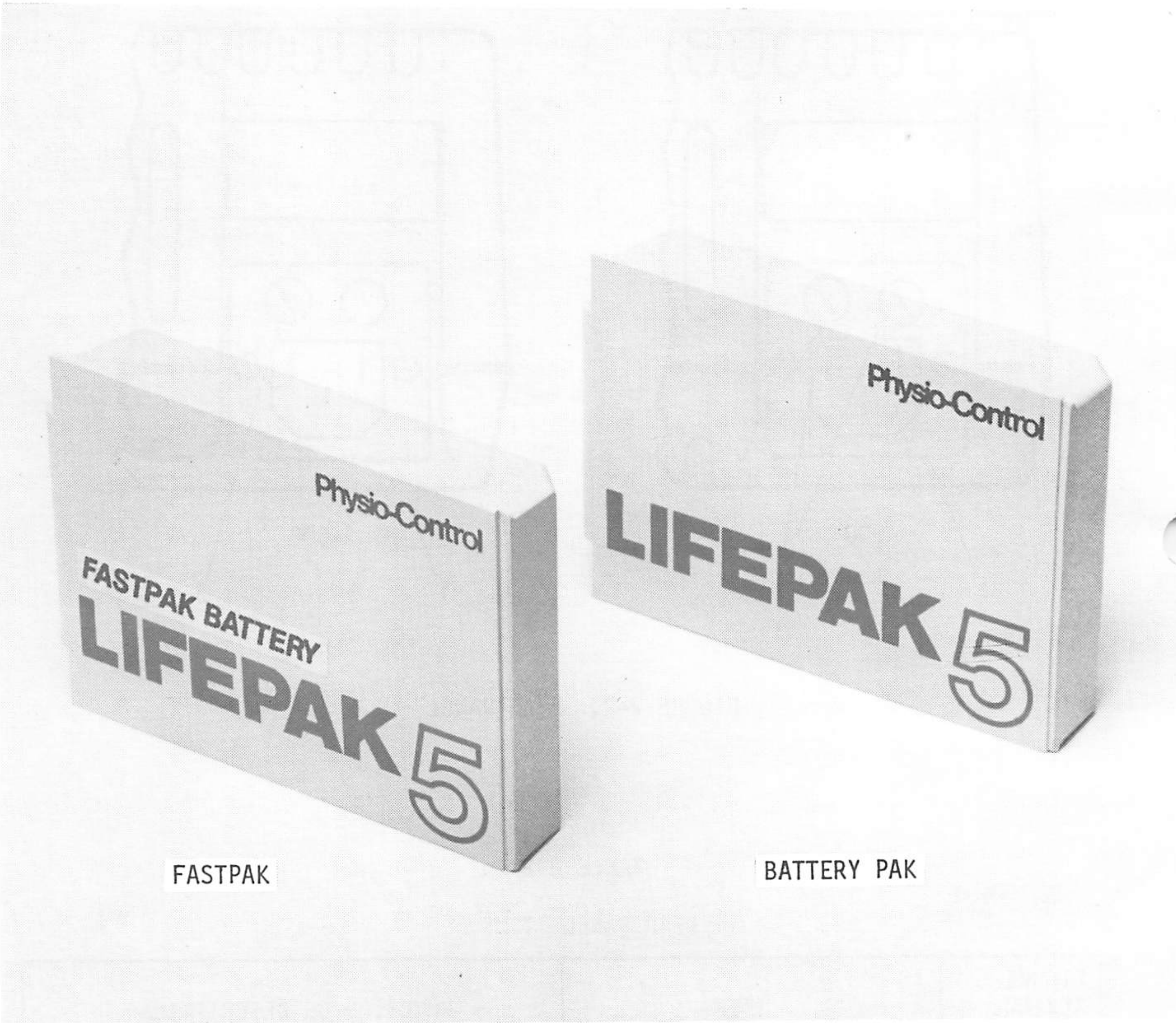


FIGURE 2-3. LIFEPAK 5 BATTERIES

2-3. OPERATING INSTRUCTIONS

The following procedures provide brief operating instructions for the Battery Support System.

A. Battery Charging.

A discharged FASTPAK battery requires approximately 70 minutes to insure a complete recharge. A discharged LIFEPAK 5 Battery Pak requires approximately 4.5 hours for complete recharge. Each battery in the charger charges independently, so either one, two or three batteries may be inserted. To charge a battery, proceed as follows:

1. Connect the Battery Support System to a power source (100Vac, 117Vac, 235Vac). A power cord is provided for AC input.

2. Align the battery with the recessed mounting area so that the battery clip is towards the rear.

3. Lower the front end of the battery into the recessed mounting area.

4. Lower the rear end of the battery into the recessed mounting area (until a click is heard).

5. Verify that the CHARGE indicator lights (Figure 2-1).

6. When a detectable point is reached in the charge curve, the READY indicator illuminates, which indicates that the battery has been charged to a minimum of 90%. (Maximum battery capacity will vary depending upon its physical differences and the ambient temperature at which it is charged).

NOTE: A battery may be left in the charger indefinitely without damaging it; however, longest battery life will be obtained when it is exercised regularly per paragraph 2-3 B. To maximize battery life and capacity, the battery should be charged at ambient room temperature (approximately 22°C, 70°F).

7. The FAULTY indicator lights when a battery is at a very low voltage. If the FAULTY indicator lights up, the battery is probably defective and should be replaced. A battery that has been drained (as with a unit left on for an extended period of time) may be restored by leaving it in the charger, with the faulty light on, for several hours and then removing and reinserting it. The battery may be permanently damaged so a shelf life test is recommended.

B. Battery Exercising.

Both nickel cadmium batteries used in the LIFEPAK 5 last longest if they undergo an exercising cycle every three or four months. The following paragraphs provide brief operating instructions for exercising a battery on the Battery Support System.

A battery exercise cycle consists of charging the battery until it is fully charged, discharging it down to a preset level, and then recharging it again to a fully charged state. The right-hand charge position in the Battery Support System contains the discharge circuits necessary to perform a battery exercise cycle.

To exercise a battery, place it in the right-hand charge position and charge it according to the procedures of paragraph 2-3 A., then proceed as follows:

1. The discharge switch may be pressed at any point in the Charge or Ready sequence, unless it is already performing some part of the Discharge/Charge cycle. A second discharge cycle may be initiated only after a cycle reset is accomplished by removing the battery and reinserting it.

C. Defibrillator Test Load.

The defibrillator Test Load is intended to measure the output energy of the LIFEPAK 5 Defibrillator. Using this Test Load to measure the output energies of other defibrillators may yield incorrect data.

NOTE: Verify that the Test Load contact plates and the defibrillator paddles are not pitted and are clean and dry. If paddles or contact plates are pitted, they must be replaced prior to use (see Section 4 for contact plate replacement).

NOTE: Do not discharge the paddles into the unit without first scrolling in the selected Test Load.

1. Connect the Battery Support System to a power source.

2. Select the defibrillator output energy.

3. Press increase ▲ or descrease ▼ of the TEST LOAD SELECT until the displayed energy matches that selected on the defibrillator.

4. Place and hold the paddles firmly on the Test Load contact plates; insure a good metal to metal contact.

5. Turn on the Defibrillator power. Press the CHARGE pushbutton and immediately afterwards press and hold both DISCHARGE pushbuttons.

6. When the defibrillator reaches the selected energy level it will immediately discharge into the Test Load; JOULES DELIVERED lights.

7. If the actual delivered energy is within ±10% of the displayed energy, the display will not change. If the actual delivered energy exceeds ±10% of the displayed energy, the display will change showing the actual delivered energy.

NOTE: The Test Load will not measure energy in excess of 500 joules.

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION

This Section provides a detailed description of the circuits contained in the LIFEPAK 5 BATTERY SUPPORT SYSTEM. The Power Supply description is the first circuit to be described since it supports all of the other circuits. The remaining circuits are all referenced from the Block Diagram on page 3-3. Some blocks have a reference to a paragraph number that describes that circuit in detail.

3-2. Power Supply. (See Power Supply Block Diagram, Figure 3-1 and Figure 6-1 for Schematic Diagram.)

A. The line power transformer has dual tapped primaries. Each of the primary windings is rated at 117.5 volts with a tap at 100 volts. In parallel, the primary will support the system from a 50 or 60 hertz line with nominal voltages of 117.5 or 100 volts. Series connections of the primary windings provide 235 volt, 50 or 60Hz capability. A terminal block mounted on the heat sink provides convenient connection and jumper capability.

1. The first of two secondary windings provides power to the full wave rectifier CR3 and 4 for the +24 Vdc supply. It also provides power to the full wave bridge rectifier, CR1, for the +12 and -12 Vdc supplies.

2. The other secondary provides power to diode bridge, CR2, for the +5Vdc supply.

B. The plus and minus 12 volt supplies are regulated by standard three terminal regulators of appropriate voltage and polarity.

C. The 5 volt supply is regulated by VR3 and Q1. As load is applied to the five volt supply, current is drawn through the three terminal regulator and the resistor in series with its input. When the load current exceeds approximately 65 milliamperes, the voltage drop

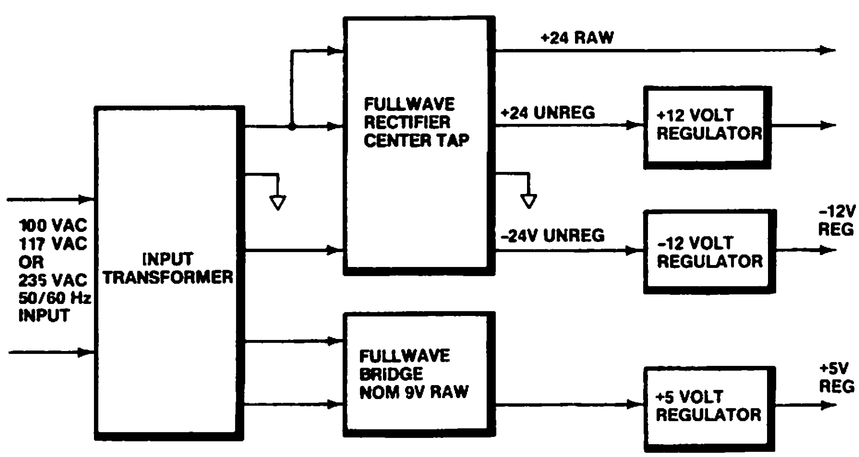


FIGURE 3-1. POWER SUPPLY BLOCK DIAGRAM

across the series resistor, which also appears across the transistor's base to emitter junction, starts to turn the transistor on, thus providing a portion of the required current through the transistor. The resistor in series with the transistor assures circuit stability at elevated temperatures and light loads. With typical loads and transistor current gain one-tenth of the current flows through the three terminal regulator and the remainder through the power transistor.

3-3. Microcomputer. (See Functional Block Diagram, Figure 3-2 and Figure 6-2 for Schematic Diagram.)

A. The processor timing is derived from a four megahertz parallel resonant crystal. Internally the processor divides this frequency by four and provides the processor output with two one megahertz signals in *quadrature labeled E-clock and Q-clock. These two clocks or subharmonics are buffered and provide all on board timing signals.

B. The Reset line to the processor is active only at power up or in response to the power up "watch dog" timer (see paragraph 3-4, A, 2). A resistor to the five-volt supply and capacitor to ground form a reset circuit that maintains the reset in the low state (less than 800 millivolts) until the clock oscillator is fully operational. The diode, CR17, normally reverse biased and in parallel with the timing resistor, R17, is used to rapidly discharge the reset capacitor during short duration power drop-out conditions.

C. Three interrupt request lines are used by the microprocessor. Each is described below.

1. The standard interrupt request (IRQ) responds to each low assertive signal by stacking the entire machine state. This interrupt may be inhibited under software control or by the occurence of any hardware interrupt.

2. The fast interrupt request (FIRQ) responds to each low input by stacking only the condition code register and the program counter. FIRQ may be inhibited by software or by the occurence of FIRQ or a non-maskable interrupt.

3. The non-maskable interrupt (NMI) stacks the entire machine state. Nothing may inhibit this interrupt except an NMI in progress.

D. Five control lines are buffered from the processor and distributed on the system bus. These are the read/not write (R/$\overline{W}$), enable clock (E CLK), *quadrature clock (Q CLK), bus available (BA), and bus status (BS) signals. From the first three of these, two more signals are generated and added to the bus. These negative assertive signals are write ($\overline{W}$) and output enable ($\overline{OE}$).

*Quadrature: The relation between two periodic functions when the phase difference between them is one-fourth of a period.

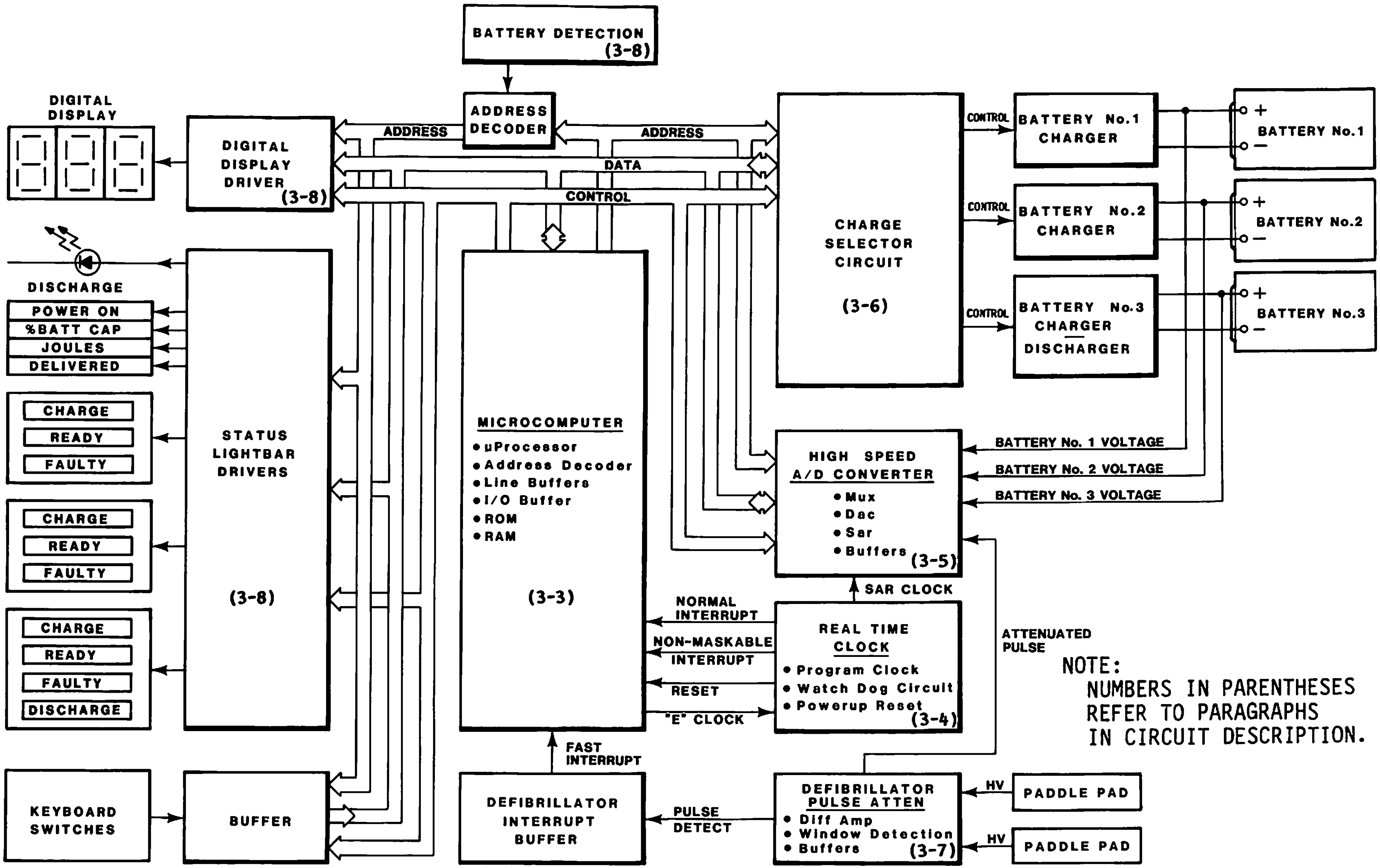


FIGURE 3-2. FUNCTIONAL BLOCK DIAGRAM

1. The R/$\overline{W}$ line from the processor is an indicator of the directional status of the processor data bus and when high indicates a data bus acting as an input and ready to read data from an external source. A low defines the bus condition as being sourced from the processor ignoring all other sources.

2. The E CLK is one-fourth of the processor crystal frequency and is unique in that the falling edge of this signal corresponds to the time at which data presented to the microprocessor is latched by internal registers.

3. The Q CLK leads the E clock by 90° and the falling edge corresponds to a point in processor output data that is a minimum of one-quarter clock cycle after it becomes valid and one half a clock cycles before data termination.

4. The BA signal is an indicator of the state of the address and data bus from the processor. A high on this line signifies these buses are in the high impedance state at the processor and may be used by some other device.

5. The BS signal when present without a BA signal is an indication of an interrupt or reset in progress. When BA and BS are both high, a halt or bus grant status is present.

   The bus status is used as an alternate source for the control of the exclusive-or gate buffering address, A11, for the EPROM.

6. The W signal is asserted low during any time that the R/$\overline{W}$ line is low and the Q CLK is high. Because of the relationship of the trailing edge of Q CLK to valid processor output data, the trailing edge of W may be used to latch data to memory or a peripheral assuring at least 250 nanoseconds setup and hold times.

7. The OE signal is not assertive when both R/$\overline{W}$ and E CLK are high. This provides a 500 nanosecond window in which memory or a peripheral may respond to a processor request for data. The hold time required by the processor is supplied by circuit propagation delay times.

E. The five high order address lines (A11-A15) divide the upper half of U45 addressable space into 16 "chapters" of 2048 addresses each.

   The lower half is not used, so enable signals are not developed for it. The high order bit is inverted and applied to the chip enable of a 4-line to 16-line demultiplexer, U5 pin 1, which decodes the binary number on the next four address lines (A11-A14) to a unique line driven to the low state. Thus, a set of enable lines are developed for application to memory or memory mapped peripherals. The output U5 is open collector with pull up resistors that provide a disable mode for external access of the computer bus.

   1. The lowest of these five lines (A11) is routed through a buffer prior to connection to the demultiplexer to facilitate its usage with the EPROM as described in paragraph 3-3, D, 5.

F. The eleven low order address lines, A0-A10, are buffered by line drivers with three state outputs.

G. The four high order chapters of address have been assigned to memory. The upper two chapters are located in a single memory device, U11. The remaining chapters are located in U12 and U13.

1. The firm-ware is located in one random access read only memory (ROM) U11. This device is electrically programmable, and capable of storing 4096 bytes of information.

2. The single soft-ware device is random access memory (RAM), U12, with a storage capacity of 2048 bytes.

H. The data bus buffer, U18, provides a controlled bi-directional data flow between the computer and system peripherals. The two device control lines are interfaced via a pair of exclusive OR gates, U17B and U17C, used as programmable inverters. In the system operating mode the control lines function as follows:

1. When the chip select (CS) line is high data flow through the buffer in either direction is inhibited. The NAND gate plus the inversion imposed by the exclusive OR applies this level when address lines A13 and A14 are high. Thus for addresses within the four top chapters of memory, only the computer memory is applied to the processor data bus. Outside this address range the buffer is enabled and peripheral devices may be accessed.

2. The direction control (DIR) line is connected, with required invertions, to the R/$\overline{W}$ line. So when the buffer is enabled, the gate direction is defined by the processor requirements with a read presenting a high to the buffer.

3-4. Real Time Clock.

A. Real time clock is derived from the processor E CLK. The count down string is formed from a pair of flip-flops, U8A & U8B, and a 14 bit binary counter, U10. Bit 13 of the binary counter is used to generate a real time interrupt on each positive edge. Real time clock period is 32.786 milliseconds.

1. The first of a pair of latches, U3B, clocked on the leading edge of bit 13 generates an interrupt on $\overline{IRQ}$. Since this latch is associated only with the leading edge of the clock signal it may be reset at the completion of interrupt routines of varying duration without effecting the clock rate.

2. The second latch, U3A, is also clocked by the leading edge of bit 13 but is only SET low (assertive) if a low still exists on $\overline{IRQ}$ indicating that a second real time clock interval has passed without the successful completion of an interrupt service routine. This output is applied to the non maskable interrupt to vector operation to an error recovery routine (watch dog timer).

3. Interrupt reset for both of these time related interrupt latches are accomplished with a negative-assertive output write and enable 7 (E7). The results of this negative NAND, U9D, function is routed to the reset input of the $\overline{IRQ}$ latch, U3B, and the set input of the $\overline{NMI}$ latch, U3A, through a NOR gate with one input leg jumperable to either the NAND gate output or a five volt pull up. When the two inputs are tied together the NOR gate functions as an inverter. If the jumper is installed in the pull up position the output maintains both of the interrupt latches in the inactive state to allow circuit test without interrupts.

4. The output from the latch described in paragraph 3-4, A, 1 and 2 shall be logically ANDed with the real time clock output. This provides a signal when the error recovery interrupt ($\overline{NMI}$) is present and one half of the next real time clock period has passed. This signal by an OR function with the power up signal (paragraph 3-3, B) and applied to the processor reset for the restoration of system operation after program disruption (power up watch dog).

3-5. A/D Converter. (See A/D Converter Schematic, Figure 3-3 and A/D Converter Timing Diagram, Figure 3-4.)

The analog to digital converter is located on the computational/power supply assembly. The conversion is accomplished by successive approximation and is sourced from an eight channel analog multiplexer.

A. A twelve bit digital-to-analog converter is the heart of the analog-to-digital (ADC) function. The conditioned input signal is applied to the R FDBK input so the DAC outputs a current proportional to the difference between the input signal and the value applied at the digital terminals.

1. This error signal is amplified by a current to voltage translator, U24B, (impedance amplifier) which has high gain near zero but limited output excursion due to a pair of Schottky diodes (CR18 and CR19) paralleled in the feedback path.

B. The successive approximation register (SAR) is a clock-driven sequencer that tests each bit location in a twelve bit binary word and sets it according to the condition presented at the "D" input. At the application of a start command the SAR sets all output bits high except for the most significant bit which is set low. On the rising edge of the next clock, D input is evaluated and if it is low the bit is left low but if D is high the bit is returned to a high. In either case the next most significant bit is set low and the test repeated. This sequence is repeated until all twleve bits have been tested. The resulting digital output is held until the next start pulse.

1. The comparator, U27, compares the output of the current to voltage translator with OV, causing its output to swing high if the error voltage is positive and low if the error voltage is negative. The output of U27 is connected to the "D" input of U29.

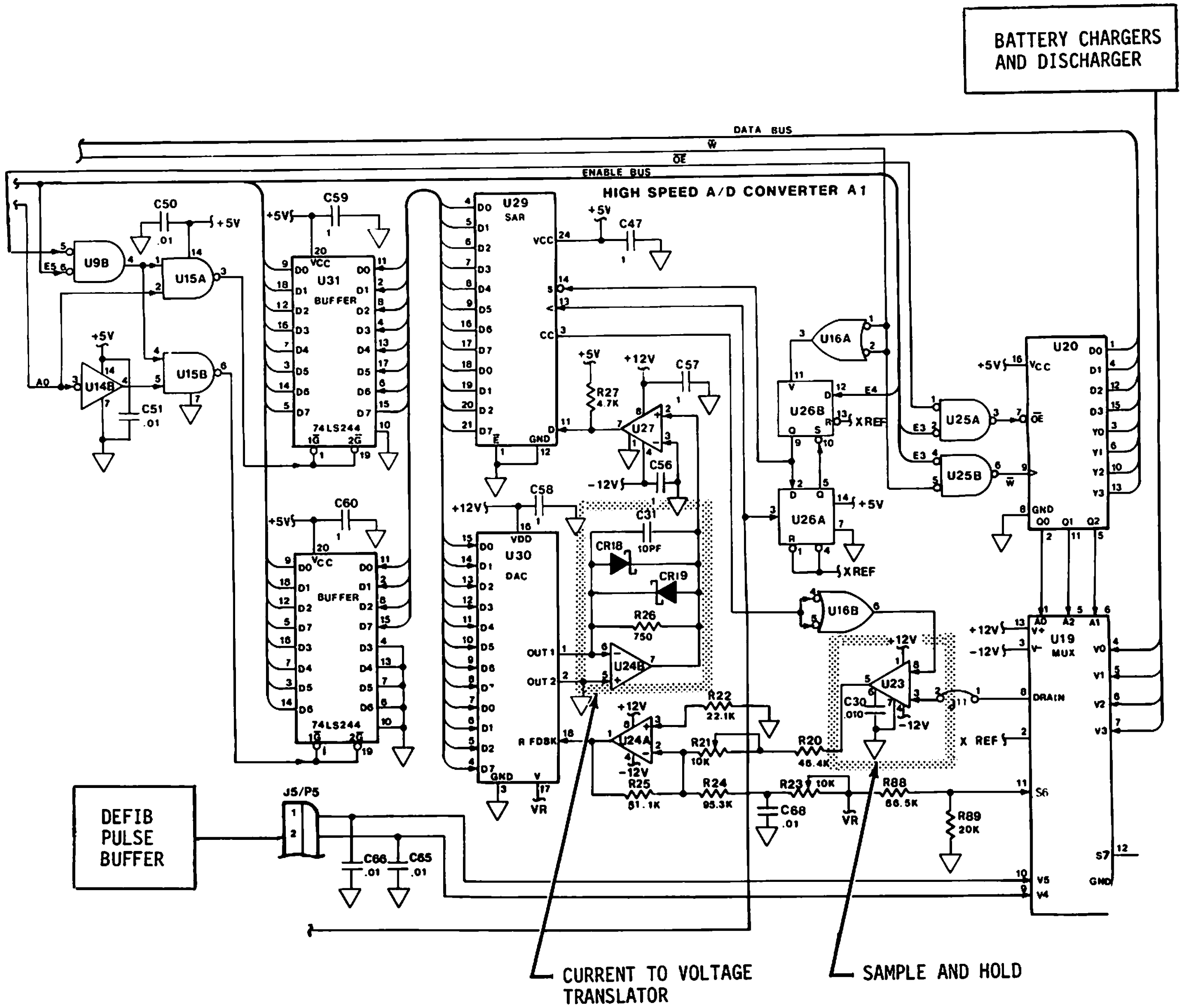


FIGURE 3-3. ANALOG/DIGITAL CONVERTER SCHEMATIC

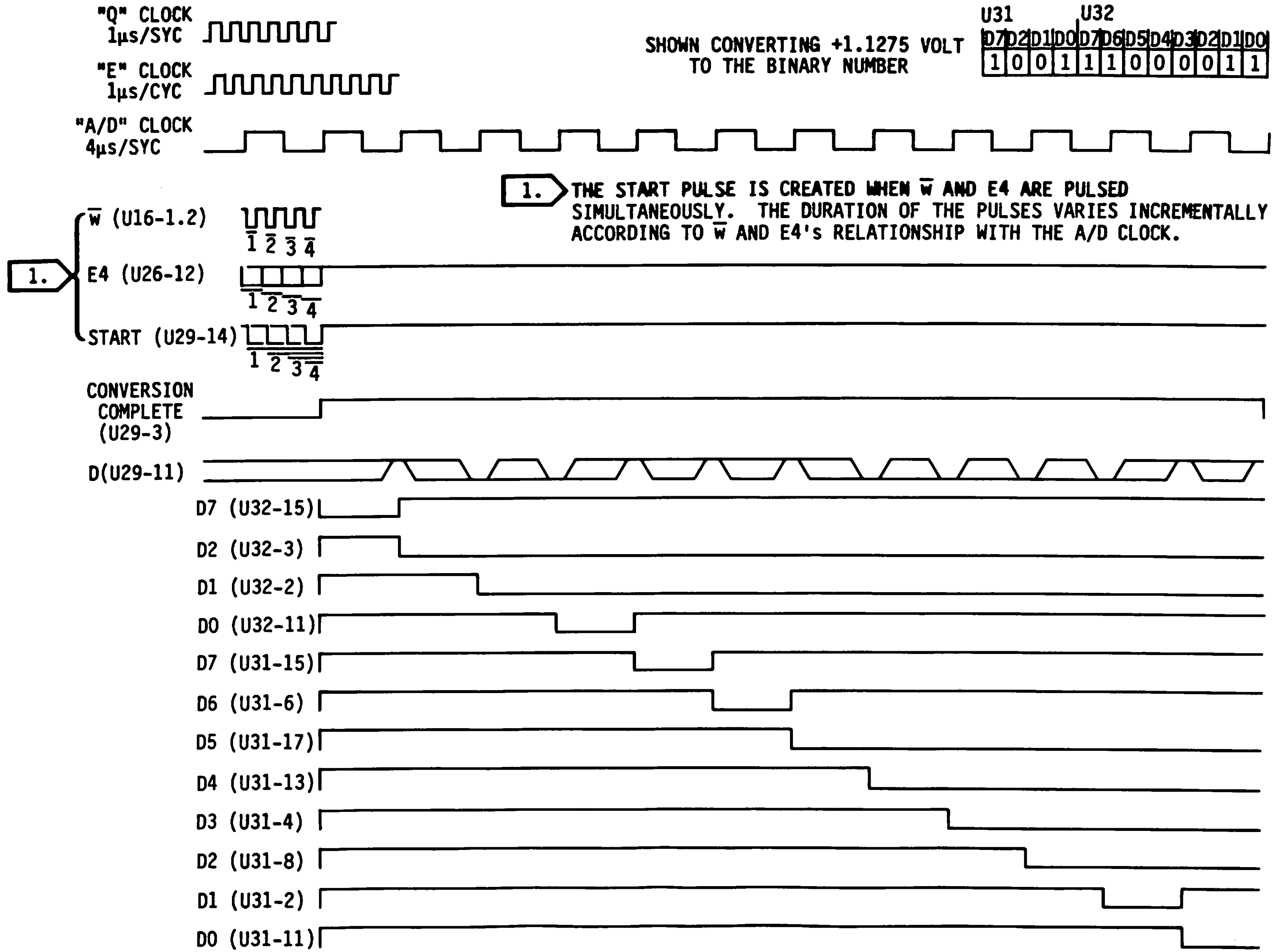


FIGURE 3-4. A/D CONVERTER TIMING DIAGRAM

2. The clock used by the SAR is derived from the second stage of the real time clock dictating the conversion rate of four microseconds per bit.

   With the one clock cycle maximum necessary to synchronize the start command, conversion is completed within 52 microseconds from the start command.

3. The positioning of the processor write command relative to E clock which drives the SAR clock assures a minimum of 250 nanoseconds prior to a clock edge, but the total access time of 500 nanoseconds cannot assure the inclusion of the required positive clock edge. This is assured with a pair of bistable multivibrators functioning as a pulse stretcher. E4 is applied to the D input of the first flip-flop and is clocked to the Q output, as a low, on the leading edge of the inverted write command. This Q is applied to the start pin of the SAR and the D input of a second flip-flop which is driven by the SAR clock, hence on the next positive SAR clock edge Q number two is set low setting the first flip-flop to initial conditions and removing the start command. The second flip-flop is restored on the next SAR clock cycle.

C. The input to the analog to digital converter is through an eight channel multiplexer, a sample and hold circuit and an operational amplifier.

   1. The multiplexer is an eight channel to one channel device in which control is accomplished by a three bit binary code. This code is transmitted by the processor to be stored for continuous application by a four bit latch, U20. The low order three bits of this latch are low order bits of the associated processor byte with controls the multiplexer gating. The information is latched by a signal composed of the negative ANDing of E3 and $\overline{W}$. This latch has a second set of outputs which are buffered so they may be paralleled with the inputs on the bi-directional data bus. These outputs are normally in the high impedance state however the negative AND of E3 and $\overline{OE}$ shall allow a read of the multiplexer routing status.

   2. The sample and hold (S/H) circuit, U23, accepts the output from the multiplexer. When the hold line is pulled low by the inversion of the conversion complete (CC) signal from the SAR the instantaneous analog voltage is maintained on the S/H output. The S/H voltage is allowed to slew to the current input value at the completion of each analog to digital conversion.

   3. An operational amplifier forms the interface between the S/H and the input at the DAC. This circuit provides gain compensation with calibration provided by a potentiometer in the negative input. A bias signal is also provided at this input.

4. Access to the analog to digital converter output data is available at the output of buffers U31 and U32.

   a. The buffer holding the four high and low bits is enabled by logic circuit which negatively NANDs E5 with $\overline{OE}$ to define an address chapter and positive NANDs this result with the inverse of A0.

   b. The buffer holding the low eight bits is enabled by the same chapter selection logic NANDed with A0 (not inverted).

3-6. <u>Charge Selector</u>.

The battery interface circuitry is located on the Computational/Power Supply PCB Assembly and consists of a charger circuit replicated for each of the three batteries, a discharge circuit for battery number three, and voltage sense network.

A. The charge select circuit consists of a pair of four bit latches, U21 and U22. The two latches switch control outputs S0 through S6 corresponding to data at D0 through D6. The charger functions are controlled as follows:

   1. S0 - Battery #1 charge inhibit.
   2. S1 - Battery #1 high charge enable.
   3. S2 - Battery #2 charge inhibit.
   4. S3 - Battery #2 high charge enable.
   5. S4 - Battery #3 charge inhibit.
   6. S5 - Battery #3 high charge enable.
   7. S6 - Battery #3 discharge enable.

   The NAND gate U34A prevents discharger operation during Charger No. 3 operation in the event of a microprocessor malfunction. Before this gate may be enabled it must have two low inputs in addition to the low going line derived by inverting S6 (discharger enable) through U14A. These two low inputs are derived from S4 and S5 (which is inverted by U14F).

   NOTE: In the following description only component reference designators from Battery No. 1 charger are used. The other two chargers are identical.

B. Each battery charge circuit consists of an operational amplifier with an NPN-PNP transistor pair on the output to provide the necessary power capability. The battery is charged in the current mode so a current sense resistor, R35, is in the negative lead of the circuit. The voltage across this resistor is monitored by the operational amplifier for potential voltage differences between the power circuit conducting the pulsed charging current and the reference circuit.

1. Unless charge inhibit or high charge signals are present, the charger maintains pulsed charge current at approximately 300mA for a LIFEPAK 5 Battery. Op amp, U33, controls the charge current by having its positive input set to 1V and 701mV applied to the negative summing control resistor, R42.

   NOTE: 300mA pulsed averages to 98mA over a 2 minute period.

2. The application of a high charge enable switch signal, S1, (FASTPAK only) grounds the control summing resistor, R42, and provides a one volt differential between the positive and negative control resistor inputs. Before the circuit can stabilize .5V must be dropped across the current sense resistor, R35. This requires 1A of charge current.

3. The capacitor directly connecting the operational amplifier output to its negative input forms an inner feedback loop. This causes the current feedback signal to be integrated about the positive input reference voltage. This averages the pulsed charge current to satisfy the input command requirements. At typical line voltage the charge current will be approximately 2A pulses at 50 percent duty cycle.

4. The drive signal from the operational amplifier to the first transistor stage is modified by grounding it through a VFET, Q7. This occurs when a charge inhibit signal appears on S0. A high on these switch control lines sinks drive current from the transistor base inhibiting all charge modes. The integrater circuit is not effected, so short duration charge inhibits, such as during a battery voltage read, are compensated for during subsequent current pulses.

5. When the battery is being read by the A/D converter, Q5 is turned off and a voltage that corresponds to the batteries status is measured by the A/D converter at the junction of R30 and R31. When the battery is removed R30 and CR31 provide an alternate current path around Q5 and cause the terminal voltage to increase near the 24V supply. This appears to the A/D converter as a substantial voltage increase which is easily recognized by the microprocessor as a missing battery.

C. The discharger circuit located with battery charger circuit number three operates in the constant current mode, and is independent of the charge circuit except at the interface circuit as described in paragraph 3-6, A.

   1. A separate current sense resistor is used at the emitter of the power transistor controlling current flow. By definition a discharged battery must exceed nine volts, so a higher sense

resistor value has been used and the high forward drop of the Darlington transistor is toleranced to take advantage of the high power gain.

2. The control bias to the positive summing junction of the operational amplifier, U33C, requires a 2V level from the stable reference voltage divider. This in conjunction with the two to one control to feed back resistor ratio allows a current of 1A to flow when the negative input of U33C is grounded by the field effect transistor switch, Q18. When the switch is open the negative input resistor is pulled to the reference voltage, VR, which drives the op-amp output negative, assuring that Darlington transistor is cut off.

3. The series resistor and capacitor connected across the input terminals of the operational amplifier forms a log network. This stabilizes the circuit by reducing loop gain and frequency response.

D. Each positive battery terminal voltage is monitored by the analog to digital converter via a four-to-one voltage divider. Since the current sense resistor is included in this voltage measurement, accurate voltage may only be read with the current source disabled or a known current flowing such that the sense resistor voltage drop may be taken into account. The only operating mode in which the instantaneous current is constant enough to utilize sequential readings is during discharge.

3-7. Defibrillator Pulse Attenuator.

The defibrillator pulse attenuator board provides for the detection of a defibrillator pulse and for the conditioning of the analog pulse shape for application to the analog-to-digital converter on the computational board. A 50-ohm, 50-watt load resistor is attached directly across the defibrillator test paddles. A differential input operational amplifier with a gain less than unity attenuates the defibrillator pulse to a level acceptable to conversion circuitry.

A. The window detector gets its input from the output of the differential amplifier. A gain amplifier, U1B, increases detection sensitivity while a pair of level detectors, U3A and U3B, form a window detector. The wired OR outputs of the window detector is filtered to provide noise suppression. A final level detector, U3C, with hysteresis provides the open collector drive necessary to interface with the Fast Interrupt Request (FIRQ) circuit on the computational board.

B. The conditioning of the analog input consists of a resistor-capacitor, R11 and C26, filter with a -3dB pole at two kilohertz and a buffer amplifier to provide minimum source impedance.

3-8. Output Drivers.

The switch interface/display board provides the necessary interface logic to connect the membrane switch assembly to the processor bus and provide storage, decoding, and display elements for user viewing.

A. Address decoding for the above functions is accomplished with a dual two-line to four-line decoder. The first decoder section is enabled by chapter enable, $\overline{E8}$, with $\overline{W}$ and $\overline{OE}$ as data inputs. With $\overline{E8}$ low $\overline{W}$ high and $\overline{OE}$ (read status), the 1Y1 and 1Y2 lines of the decoder are activated low, which enables the inverting buffer and allows the membrane switches to be read by the processor.

B. With $\overline{W}$ and $\overline{E8}$ the $\overline{OE}$ high decodes to "1" line which is applied to the enable of the second decoder stage. Activation of the second decoder stage allows further decoding to occur for a processor write command.

C. To actuate light bar drivers and digital display the data inputs to the second decoder stage use address lines A0 and A1.

D. Each of the three display elements, DS6, DS7, DS8, are driven by a binary coded decimal to seven segment decoder, U1, U2, U3, containing latches to retain the display information. The decoder blanks the display for all values outside the valid BCD codes range. The decoder is capable of sourcing the required drive current for the display elements when a series current limiting resistor is used. The display current is approximately 15 milliamperes non-multiplexed.

E. Each light bar contains four light emitting diodes connected in series. Each one back lights a word on the front panel. Power for the light bars is derived from the unfiltered 24 volt supply. All light bars in a group are mutually exclusive so only one current limiting resistor per group is needed. Display control data is loaded into two latches, U4 and U5, which controls light bar driver transistors, Q1-Q14.

3-9. Battery Detection.

The Battery Support System is capable of charging two types of batteries. The LIFEPAK 5 Battery Pak, which is charged at a C/3 rate or the FASTPAK Battery, which is charged at a C/1 rate.

Battery "type" detection is provided by a reed switch mounted adjacent to each battery well. Installation of a FASTPAK, which contains a magnet, into the battery well will result in a reed closure. Installation of a LIFEPAK 5 Battery, which contains no magnet, will not.

The microprocessor reads the status of the reed switch by providing active lows on the $\overline{E9}$ and the $\overline{OE}$ lines enabling the tri-state buffer U8. The reed switch inputs provided to U8 are now read by the microprocessor on data lines D0-D2. If any reed switch is closed, providing a low on the respective data line, the microprocessor selects a high charge rate (C/1). If any reed switch is open, providing a high on the respective data line the microprocessor will select a low charge rate (C/3).

SECTION 4
MAINTENANCE

4-1. INTRODUCTION

4-2. General. This section provides maintenance procedures for LIFEPAK 5 Battery Support System. Subsequent parts of the section are: Periodic Maintenance Check, Disassembly Procedure, Inspection Check, Cleaning, Functional Test, Fault Isolation, Test Points, Troubleshooting Guide, Calibration, Repair Procedures, and Reassembly.

4-3. Warranty. LIFEPAK 5 Battery Support System is warranted against all defects in parts and workmanship for a period of 1 year from the date of delivery; line cord - 90 days. Physio-Control will repair or replace any products which prove to be defective during the warranty period, provided proper use and maintenance procedures are followed as prescribed in the operating and service manual.

All defective products or components must be returned to Physio-Control, or its authorized service center, with a detailed explanation of the failure. Transportation charges must be prepaid.

Service performed, by other than Physio-Control or its authorized agents may, at the discretion of Physio-Control, be cause to void this warranty.

No other party is authorized to make any other warranty or to assume any liability for Physio-Control products. No other warranty, either implied or in writing, will be recognized.

4-4. Periodic Maintenance Check. The following outline provides a procedure for verifying the basic functions of the Battery Support System. These procedures may be performed with a minimum of test equipment and without disassembling the instrument. If a malfunction is discovered while performing these checks, a more complete functional test should be performed.

A. Power.

1. Connect the instrument to AC power and verify the words "POWER ON" appear on the control panel.

B. Test Load.

NOTE: The Test Load on this instrument is designed to measure the output energy of the LIFEPAK 5 Defibrillator. Measuring the output energy of other defibrillators may yield false data.

NOTE: The output energy of the Defibrillator being used in the Test Load checks should be known before the checks are performed.

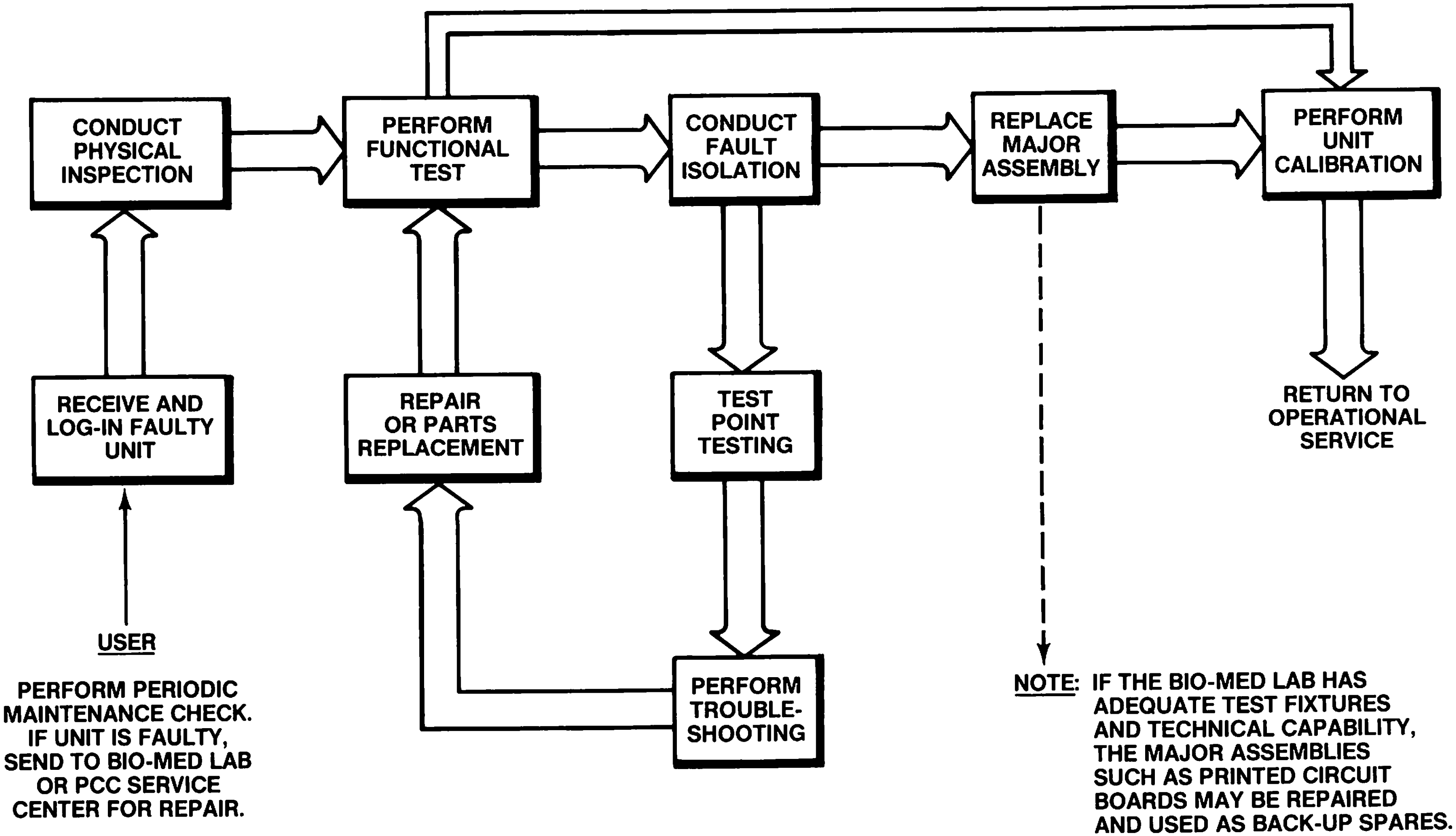


FIGURE 4-0. MAINTENANCE FLOW DIAGRAM

1. Place the Defibrillator paddles on the Test Load contact plates. Insure the paddles are making good contact with the contact plates.

2. Select 100 joules on the Test Load.

3. Select 100 joules on the Defibrillator.

4. Immediately after pressing the Charge button, hold down both discharge buttons until the Defibrillator discharges into the Test Load and causes JOULES DELIVERED to light.

5. If the Defibrillator output energy is within 10% of the displayed energy the display will not change. If the difference between the actual delivered energy and the displayed energy is greater than 10% the display will change to the actual delivered energy.

6. Repeat the above steps, but substitute maximum energy.

C. Battery Charger.

1. Before installing any batteries into the instrument observe the control panel. None of the Charge, Ready, Faulty, or Discharge indicators should be illuminated.

2. Short the positive and negative battery terminals at each battery location and verify the word "FAULTY" appears in the corresponding Control Panel location.

3. Install a "depleted" battery into each battery location and verify the word "CHARGE" appears in the corresponding Control Panel location.

4. Install a fully charged battery into each battery location and verify the word "READY" appears in the corresponding Control Panel location after a short charge cycle.

NOTE: For a fully depleted FASTPAK Battery the appearance of a "READY" will take approximately 70 minutes. For the purpose of this test the use of a fully charged FASTPAK battery may shorten this time to as low as 5 minutes.

D. Battery Discharger.

1. Install a battery into the right hand battery location.

2. The word "CHARGE" will appear in the corresponding Control Panel location.

3. Press DISCHG-CHARGE. The indicator will light and the word "DISCHARGE" will appear just below the DISCHG-CHARGE control.

4. When the Discharge/Charge cycle is completed, verify the words "% CAPACITY" appear to the right of the display. The display will show some number value between 0 and 130.

4-5. Disassembly Procedure. The following procedures provide the most logical sequence of removing the major components of the Battery Support System. The (numbers) in the following steps correspond to the Figure and Item numbers from Figure 5-1.

A. Case Separation.

1. Disconnect the line cord from the rear of the unit.

2. Remove the Battery Paks from the battery compartments.

3. Place the unit upside down and remove eight screws (12).

4. Hold the upper (10) and lower (11) case halves together and turn the unit over to its upright position.

5. Lift the upper case (10) straight up until it clears the top of the heatsink, then rotate it so it sets on its rear side behind the lower case (11).

B. Defib Pulse Attenuator PCB Assy Removal. After performing Case Separation, proceed as follows:

1. Disconnect P1 from J1.

2. Disconnect P2 from J2.

3. Remove two screws (15) and two standoffs.

4. Remove the high voltage wires one at a time replacing the screw and nut before proceeding to the next wire.

C. Switch Interface Display PCB Assy Removal. After performing Case Separation, proceed as follows:

1. Disconnect J2 (membrane switches) (3).

2. Remove five screws and washers (17, 18). Pull the circuit board back slightly and disconnect the three remaining cables.

D. Computational/Power Supply PCB Assy Removal. After performing Case Separation, proceed as follows:

1. Disconnect J2, P1, P2, P3, P4, P5, P6, P7, P8, P12, P13 from the circuit board.

2. Remove three screws and washers (42, 43) and lift the assembly up and to the left slightly exposing the terminal strip (51).

3. Remove the two screws (52) that hold the terminal strip (51) in place and the kepnut (50) from the heat sink ground stud.

4. Remove the ground wire from the heat sink ground stud.

5. Lift the Computational/Power Supply PCB Assy from the lower case.

E. Transformer Assy Removal. After performing Case Separation, proceed as follows:

1. Disconnect P3 form the Computational/Power Supply PCB Assy.

2. Remove the transformer secondary cable retainer (40).

3. remove two screws and washers (37, 38) that hold the transformer in place.

4. Move the transformer to the right to gain access to the terminal strip.

CAUTION

BEFORE DISCONNECTING THE WIRES FROM THE TERMINAL STRIP, NOTE THE LOCATION OF EACH WIRE COLOR.

5. Loosen the left column of screws on the terminal strip and remove the wires from the terminal strip.

6. Lift the transformer out.

F. Membrane Switch Removal. After performing Case Separation and Switch Interface/Display PCB Assy Removal, proceed as follows:

CAUTION

DAMAGE TO THE MEMBRANE SWITCH WILL RESULT BY ITS REMOVAL. VERIFY THAT IT IS DEFECTIVE BEFORE REMOVING.

1. Carefully pry up a corner of the right side of the Membrane Switch.

2. Peel it off toward the left side so the interconnect cable may be pulled out of its hole.

4-6. Inspection/Check.

A. Exterior Visual Checks.

1. Visually inspect the entire Battery Support System for wear, maintenance damage, corrosion, deterioration, and damage resulting from extreme temperature or droppage.

B. Interior Visual Checks.

1. Use a minimum of five-power magnification to check components, wiring, solder joints, and printed circuit conductor patterns.

2. Inspect for the following conditions:

   a. Check all connectors for loose, bent, or corroded contact pins.

   b. Check wires, harnesses, and cables for signs of wear or deterioration.

   c. Check that battery charge terminals are present and are not damaged.

   d. Inspect sleeving and tubing for proper installation or evidence of damage.

   e. Inspect components and their leads for security of mounting, deterioration, or leakage.

   f. Check terminals and connections for proper installation, faulty soldering, loss, or wear.

   g. Inspect printed circuit board surfaces for charring, cracking, or brittleness.

NOTE: Some degree of discoloration to the PCB surface may be expected due to continued exposure to operating temperatures of some of the components mounted thereon.

   h. Check identification nameplate and other decals for legibility.

   i. Inspect chassis, covers, and brackets for warping, bending, surface damage, or missing captive hardware.

   j. Check all screws and nuts for tightness or signs of stripped or cross-threaded threads.

   k. Check for damaged traces on PCBs. Look for lifted conductors and inspect for breaks, scratches, nicks, or pinholes.

   l. Check transformer T1 for visible signs of deterioration such as peeling tape or varnish missing from windings.

   m. Check that the conductive coating on the upper and lower case halves measures less than 20Ω to TP3 on the Computational Power Supply PCB Assy.

C. <u>Special Check</u>.

1. Most failure-mode indications are electrical in nature and require testing and/or calibration per the TESTING section of this manual. Check for the following:

a. Gradual performance deterioration.

b. Abnormal sound levels.

c. Current and voltage overloads.

d. Erratic behavior.

4-7. Cleaning.

A. General.

1. This section contains instructions for periodic cleaning of the Battery Support System as a preventive maintenance measure and specific cleaning procedures to be conducted after disassembly and/or repair.

2. Parts having identical cleaning procedures are grouped under common headings.

3. No special tools are required.

B. List of Materials.

1. Cleaning Equipment.

a. Vacuum cleaner.

b. Nonmetallic, soft-bristle brush.

c. Clean, lint-free cloth.

d. Dry, low pressure compressed air (60 psi).

2. Cleaning Solvents.

a. Isopropyl alcohol, 99% pure (preferred solvent).

b. Ethyl alcohol, Fed-Std O-E-760, Grade 1, Class A or B.

c. Perchloroethylene.

NOTE: The above equipment and solvents are either standard shop commodities or are available from commercial sources.

C. Interior Cleaning.

WARNING

VENTILATE WORK AREA THOROUGHLY WHEN USING SOLVENTS. OBSERVE MANUFACTURERS' WARNINGS ON SOLVENT CONTAINERS WITH REGARD TO PERSONNEL SAFETY AND EMERGENCY FIRST AID. BE SURE FIRST AID EQUIPMENT IS AVAILABLE BEFORE USING CHEMICALS.

WARNING

OBSERVE SHOP SAFETY AND FIRE PRECAUTIONS. VENTILATE ALL WORK AREAS WHERE SOLVENTS ARE USED. STORE SOLVENTS AND SOLVENT SOAKED RAGS IN APPROVED CONTAINERS. REFER TO MANUFACTURERS' INSTRUCTIONS ON CONTAINERS FOR RECOMMENDED FIRE FIGHTING PROCEDURES AND NOTE THAT FIRE FIGHTING EQUIPMENT IS AVAILABLE.

1. Magnetics.

   Clean transformers and inductors with a dry nonmetallic soft-bristle brush.

CAUTION

DO NOT USE SOLVENTS TO CLEAN TRANSFORMERS OR INDUCTORS. THE CHEMICAL ACTION OF SOLVENTS MAY REMOVE THE VARNISH FROM THE WIRE COILS, RENDERING THE COMPONENT USELESS. THE SOLVENT ALSO NEUTRALIZES THE ADHESIVE OF THE COVER TAPE, RESULTING IN EVENTUAL TAPE SEPARATION FROM THE WINDINGS.

2. Printed Circuit Boards.

CAUTION

SOME PRINTED CIRCUIT BOARD ASSEMBLIES IN THE BATTERY SUPPORT SYSTEM CONTAIN STATIC SENSITIVE DEVICES. USE STATIC SENSITIVE DEVICES SPECIAL HANDLING PROCEDURES.

   a. Clean assemlbed parts with a vacuum cleaner or low pressure compressed air (60 psi).

   b. Prior to soldering, clean surfaces with nonmetallic, soft-bristle brush dipped in solvent.

   c. Dry with low pressure compressed air.

CAUTION

TAKE CARE WHEN CLEANING PRINTED CIRCUIT BOARDS THAT WIRES OR COMPONENT LEADS ARE NOT BENT BACK AND FORTH IN SUCH A MANNER AS TO WEAKEN THEM AND CAUSE THEM TO EVENTUALLY BREAK.

   d. Remove excess solder from solder joints and chassis components after repairs.

3. Metalic and Plastic Parts.

a. Brush all surfaces and parts with a nonmetallic, soft-bristle brush.

b. Wipe metal surfaces with soft, nonabrasive cloth dampened with isopropyl alcohol.

CAUTION

DO NOT WIPE OVER SURFACES OF NAMEPLATES OR LABELS WITH ABRASIVE CLEANERS OR MATERIALS, AS THIS WILL EVENTUALLY WEAR AWAY THE NAMEPLATE INFORMATION.

CAUTION

DO NOT USE SOLVENTS TO CLEAN PLASTIC PARTS.

c. Dry cleaned surfaces with clean cloth.

d. Wipe surfaces of nameplates and labels with clean dry cloth.

D. Exterior Cleaning Procedures.

1. Case and Display. Use soap and water to clean external covers and line cord. Do not use alcohol, solvents, or cleaning solutions. These cleaning agents may damage the surfaces of the instrument.

2. Contact Plates. Clean the contact plates while cleaning the Case and Display. If the contact plates are pitted, do not attempt to repair them, they must be replaced. Refer to paragraph 4-27 for replacement procedure.

4-8. FUNCTIONAL TEST AND CALIBRATION

4-9. General. The functional test is to be performed once it has been determined that the unit cannot pass the periodic maintenance check. In this case, it is performed to support fault isolation thereby locating problems to the replaceable assembly level. This test is also performed in its entirety after component replacement and/or extensive repairs in order to confirm that the Battery Support System operates within all design parameters.

4-10. Test Equipment Required. Table 4-1, Test Equipment list, contains a list of all test equipment required during functional testing. Substitutions may be made, but alternate equipment should be equivalent in range, frequency response, internal impedance, and accuracy. Extender cables may be fabricated at the user's option to facilitate separation of the top and bottom case assemblies in order to provide access to internal test points.

4-11. Test Setup. Assemble appropriate test setup per Figure 4-1. Separate top case from lower case and install extender cables as necessary to provide easy access to test points.

TABLE 4-1

TEST EQUIPMENT

NOMENCLATURE	CHARACTERISTICS	MANUFACTURER
Oscilloscope	100mHz Dual Trace	Hewlitt Packard Model 1741 A or equivalent
Frequency Counter	10mHz	Fluke Model 1911A or equivalent
Digital Multimeter (DMM)	4 1/2 Digit	Fluke Model 8050A or equivalent
Defib Energy Meter		Dempsey Model 492B or equivalent
LIFEPAK 5	Defibrillator	Physio-Control
Battery Pak (3 required)		Physio-Control 09-10424-02,-03
FASTPAK (3 required)		09-10424-04
Signal Generator	0.1Hz to 60Hz	Krohnhite Model 5400B or equivalent
Transformer, Power Line		Northlake Eng. Model P48-194 or equivalent
Extender Cables		Fabricate
Header	With 10K Resistors	Fabricate
Signature Analyzer		Hewlitt Packard Model 5004A or equivalent

WARNING

PERFORMANCE OF THE FUNCTIONAL TESTING REQUIRES PERIODIC USE OF A DEFIBRILLATOR. EXTREME CARE AND GOOD OPERATING PROCEDURES ARE MANDATORY WHEN USING THIS TYPE OF EQUIPMENT TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT. FOLLOW THE INSTRUCTIONS CONTAINED HEREIN.

CAUTION

DO NOT CONNECT LOADS OF ANY KIND TO THE BATTERY CHARGE TERMINALS OF THE UNIT UNDER TEST. UNLESS SPECIFICALLY REQUESTED IN THE TEST PROCEDURES. SELF-TEST SOFTWARE WILL CAUSE IT TO PERFORM NONSTANDARD HARDWARE PROCEDURES. DO NOT LEAVE SYSTEM UNATTENDED WHEN IN SELF-TEST AS BATTERY CHARGE CONTROL IS INHIBITED.

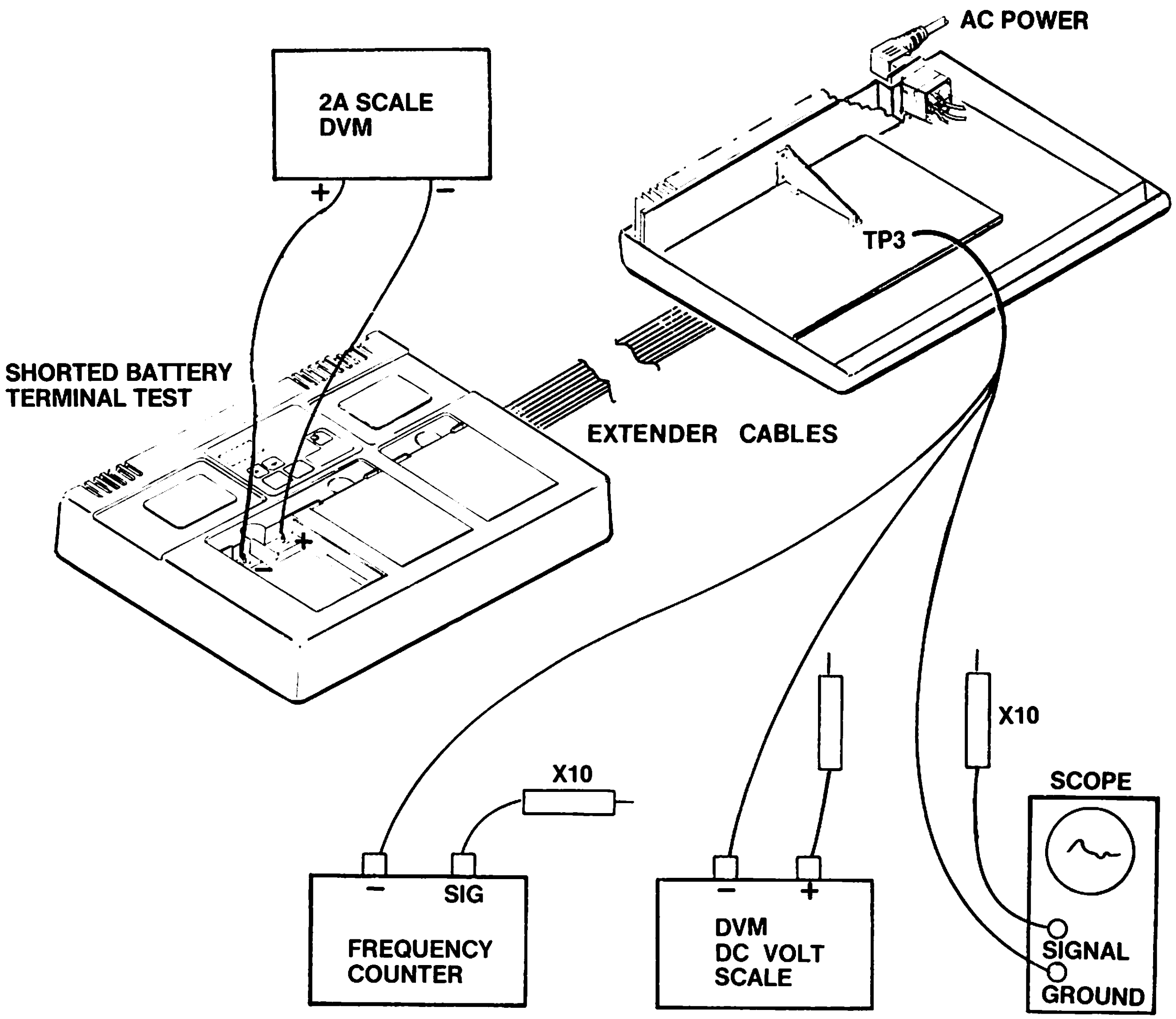


FIGURE 4-1. TEST SETUP

4-12. Assembly Check.

Before applying power, use a multimeter set at ohms to confirm that the tabs of all power transistors and regulators (except VR1 and VR3) are electrically isolated from the heat sink on which they are mounted. Verify DC resistance between AC power ground pin and the heat sink ground lug is less than 0.1.

Confirm initial jumper installation as follows: J9 - shorts J9-2 to J9-3, J10 - shorts J10-1 to J10-2, J11 - installed J11-1 to J11-2.

4-13. Power Supply Check. Confirm power supply operation as follows:

A. Remove upper case to gain access to printed circuit boards.

B. Attach the ac power cord to the appropriate source.

C. Verify the dc voltages at identified test points per Tabel 4-2, DC Voltages During AC Operation.

TABLE 4-2

DC VOLTAGES DURING AC OPERATION

REFERENCE	TEST POINT	VOLTAGE LEVEL
+5V	U13-24	5.0 ± .25Vdc
+12V	J[illegible]7-1	12.0 ± .6Vdc
-12V	J[illegible]7-2	-12.0 ± .6Vdc
A/D ref	U30-17	10.24 ± .03Vdc
Cal ref	U19-11	2.37 ± .05Vdc
+24V Unreg	CR3 Cathode	24.5 ± 2.5 Vdc
Unreg V	C11+	11.0 ± 1 Vdc*

* Some units have SAR6936 transformers with unregulated output of 13.5 ± 1.0Vdc.

4-14. Microprocessor and Interrupt Clocks Verification. With ac power applied, perform the following checks:

A. Using a Frequency Counter, measure the "E" clock output at U4, pin 34. Observe that the frequency is 1.0mHz ± 500Hz (.05%).

B. Using Frequency Counter, measure the A/D Clock input at U29, pin 13. Observe that frequency is 250KHz ± 125Hz (.05%).

C. Using Oscilloscope, measure the Clock output at U10, pin 2. Observe that waveform time is 33 ± 1ms.

4-15. <u>Logic Check with Signature Analysis.</u> Perform the Logic Check with signature analysis as follows:

A. Disconnect ac power source but keep it available as it will be reconnected after the Signature Analyzer is attached.

B. Move jumper plug in J9 to short J9-1 to J9-2 (disables interrupt).

C. Connect the Signature Analyzer to the Computational Power Supply PCB (A1) and configure as follow:

Start at	P1-35	Rising Edge
Stop at	P1-35	Rising Edge
Clock at	U7-13	Falling Edge
Ground at	TP-3	

D. Reapply ac power to setup.

E. Simultaneously depress hidden keypad switches S4 and S6 to enter the on-board self test software (see Figure 4-2).

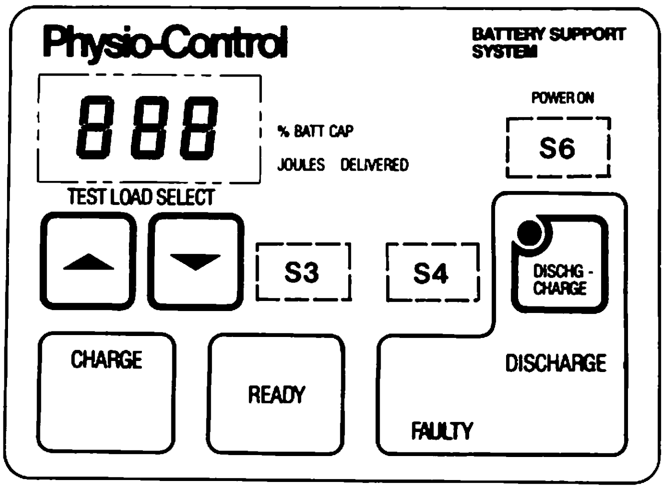


FIGURE 4-2. TEST SWITCH LOCATIONS

NOTE: Failure of the system to respond to the following TEST LOAD SELECT commands may be caused by faulty microprocessor (U4) or address buffers and decoders (U5, U6, U7). In this event, perform the Free Run Troubleshooting Test of paragraph 4-21. If the system responds to the TEST LOAD SELECT command, proceed with EPROM Code Check, paragraph 4-15, F.

F. TEST #0, EPROM Code Check.

1. Depress the TEST LOAD SELECT switch with the ▲ arrow. The Switch Interface/Display should indicate a singla digit "0" in the far right location. Internal software is now armed to perform Test #0.

2. Touch the Signature Analyzer probe to any +5V point (U13, pin 24). A signature of CH8P indicates correct EPROM function and code integrity.

G. TEST #1, RAM Read/Write Test

1. Depress the TEST LOAD SELECT switch with the ▲ arrow. The digital display should change to "1".

2. Touch the Signature Analyzer probe to any +5V point (U13, pin 24). A signature of 473C indicates a good RAM.

H. TEST #2, I/O Port Test.

1. Depress the TEST LOAD SELECT switch with the ▲ arrow. The digital display should change to "2".

2. Using the Signature Analyzer, probe the test points identified below to verify the following signatures.

SIGNAL	TEST POINT	SIGNATURE
+5V	U13-24	FPFP
EØ	U5-1	FPFU
E1	U5-2	8ØUA
E2	U5-3	3FCH
E3	U5-4	415H
E4	U5-5	52C2
E5	U5-6	522H
E6	U5-7	A229
E7	U5-8	CHA9
E8	U5-9	FPFP
E9	U5-10	C555
E1Ø	U5-11	7H12
E11	U5-13	Ø35Ø
E12	U5-14	3ØA2
E13	U5-15	8A98
E14	U5-16	937F
E15	U5-17	937F
U18 $\overline{CS}$	U18-19	P788
DATA DIR	U18-1	8375
D3	U18-11	7624
D2	U18-12	UØ92
D4	U18-13	P2PP
D1	U18-14	837A

SIGNAL	TEST POINT	SIGNATURE
D5	U18-15	89Ø1
DØ	U18-16	173F
D6	U18-17	ØHFA
D7	U18-18	394A
C2	U7-5	ØØØØ
CØ	U7-7	FPFP
C1	U7-9	4H99
C3	U7-16	ØØØØ
BS	J10-3	ØØØØ
$\overline{OE}$	U13-20	8357
$\overline{W}$	U13-21	FPFP
SØ	Q7 gate	798C
S1	Q8 gate	U51Ø
S2	Q11 gate	1A3H
S3	Q12 gate	C635
S4	Q15 gate	99FA
S5	Q16 gate	A613
S6	U14-1	U313
DISCHG	Q18 gate	4PØ4
U20 $\overline{OE}$	U25-3	FPFP
U20 $\overline{W}$	U25-6	FPFP
U21/22 $\overline{OE}$	U25-8	FPFP
U21/22 $\overline{W}$	U25-11	FPFP
U31 $\overline{OE}$	U15-3	FPFP
U32 $\overline{OE}$	U15-6	FPFP

I. TEST #3, and TEST #4, A/D Calibration.

1. Press the TEST LOAD SELECT switch with the ▲ arrow and hold until the display shows a single digit "3". Observe that the display will alternate between this "3" and a three digit number. The three digit number is the absolute value difference between the current A/D output and the correct A/D output with a grounded input applied.

2. Adjust R23 on the Computational Power Supply PCB Assembly (A1) to obtain an output voltage of (-)5.12 ± .02 volts at pin 1 of U24. This adjustment provides the correct offset for the A/D section.

3. Verify that the three digit flashing display is stable within the 000 to 025 range.

4. Press the TEST LOAD SELECT switch with the ▲ arrow until the display shows a single digit "4". Observe that the display will alternate between this "4" and a three digit number. The three digit number is the absolute value difference between the current A/D output and the correct A/D output with a calibration reference input of 2.37 ± .05 volts at U19 pin 11 applied.

5. Adjust R21 on the Computational Power Supply PCB Assembly (A1) to obtain an output voltage of(-)7.49 ± .01 volts at pin 1 of U24. This adjustment provides the correct gain for the A/D section.

6. Verify that the three digit flashing display is stable within the 000 to 025 range.

J. TEST #5, Display PCB Test.

1. Press the TEST LOAD SELECT switch with the ▲ arrow and hold in until the display board LED bars begin to flash on and off.

2. Observe that all the LEDs for the following test pattern are sequenced repeatedly.

   a. The green "POWER ON" led is illuminated, and the 3 digit display reads "0_5" (middle digit blank). The #5 is the self-test.

   b. All three "CHARGE" words illuminate for approximately one second.

   c. All three "READY" words illuminate for approximately one second.

   d. All three "FAULTY" words illuminate for approximately one second.

   e. "DISCHARGE" word and circular amber LED illuminate for approximately one second.

   f. "% BATT CAPACITY" and "JOULES DELIVERED" words illuminate for approximately one second.

   g. Seven segment displays count together from 000 to 999.

3. Verify that no status word (CHARGE, READY, FAULTY) is readable when commanded off.

4. Verify that each status word is uniformly illuminated when commanded on.

5. During steps J.2.b through J.2.f, the battery type sense input at J2 on the display PCB is being read. The decimal equivalent of this binary input is displayed in the left hand digit of the three digit display.

   a. With the battery charge wells empty, this digit should be "0".

   b. With a "standard" LP 5 BATTERY PAK installed in any of the charge wells, this digit should be "0".

   c. Place a "FASTPAK" LP 5 battery only in charge position #1 (left most) and verify this digit displays a "1".

d. Place a "FASTPAK" battery only in charge position #2 (middle) and verify this digit is a "2".

e. Place a "FASTPAK" battery only in charge position #3 (right most) and verify this digit displays a "4".

NOTE: Any other number indicates a faulty battery type sense circuit, if only one FASTPAK battery is installed.

K. TEST #6, Battery Charge/Discharge Circuit Test.

1. Press the TEST LOAD SELECT key with the ▲ arrow and hold until a right justified "6" is displayed. The bar LEDs for each charge position will:

   a. Illuminte CHARGE and command the chargers into the full charge mode for 10 seconds.

   b. Illuminate READY and command the chargers into the trickle charge mode for 10 seconds.

   c. Illuminate FAULTY and command the chargers off for 10 seconds.

2. Successively place a FASTPAK Battery Pak into each battery position.

   a. When the CHARGE LEDs light, verify that the current drawn by this load is 950 to 1050ma.

   b. When the READY LEDs light, verify the current drawn by the load is 265 to 335ma.

   c. When the FAULTY LEDs light, verify the current drops to less than 10ma.

   d. Repeat this test with a LIFEPAK 5 battery.

   e. When the CHARGE LEDs light, verify that the current drawn is 265 to 335mA.

   f. When the READY LEDs light, verify that the current drawn is 265 to 335mA (pulsed).

3. Press the TEST LOAD SELECT key with the ▲ arrow until a right justified "7" appears. The bar LEDs on the front panel will have the position #3 DISCHARGE illuminated for 10 seconds, followed by an equal period when the LED is extinguished.

4. Place a Battery Pak into battery position #3 and verify a current draw of 1000 ± 50ma, then remove battery from unit.

4-16. Watch Dog Timer Test.

A. Move jumper at J9 so that J9-2 is connected to J9-3.

B. Simultaneously depress and hold keypad switches S4 and S6 and observe that the 3-digit display shows a blinking single-digit 0. (Display must be blanked before this step is done.)

C. While still holding S4 and S6 down, verify that:

1. U4-2 is held inactive high.

2. U4-3 is pulsing.

3. U4-37 is held inactive high.

4-17. Shorted Battery Terminal Test.

A. Configure the digital voltmeter for dc amps and select the 20ma range.

B. Connect ammeter directly across the #1 battery charge terminals.

1. Verify #1 position FAULTY prompt is illuminated.

2. Verify current is less than 10ma.

C. Connect ammeter directly across the #2 battery charge terminals.

1. Verify #2 position FAULTY prompt is illuminated.

2. Verify current is less than 10ma.

D. Connect the ammeter directly across the #3 battery charge terminals.

1. Verify #3 position FAULTY prompt is illuminated.

2. Verify current is less than 10ma.

4-18. Check Keypad and Display Board Operation.

A. Press the TEST LOAD SELECT switch with the ▲ arrow and hold it down. Observe that the seven segment display should count up in intervals of 10 until the nearest 100 count is reached. The display should then continue to count by 100 and after reaching 500, should restart over at 00, still counting by 100.

B. Press the TEST LOAD SELECT switch with the ▼ arrow. The display operation should be identical to that of paragraph 4-18, A., except counting down.

C. Verify that the prompt JOULES is illuminated concurrently with the 3-digit display.

D. Verify that both the 3-digit display and JOULES prompt remain illuminated for 25 ± 5 seconds after the last time either TEST LOAD SELECT keys are pressed, before blanking out.

E. Press the DISCHARGE switch. With no battery installed in battery position #3, the display should not change in any way.

4-19. Pulse Attenuator Test

A. Disconnect 1 leg of the 50 ohm/50 watt load resistor from the attenuator board.

B. Connect the test adaptor as shown in Figure 4-3.

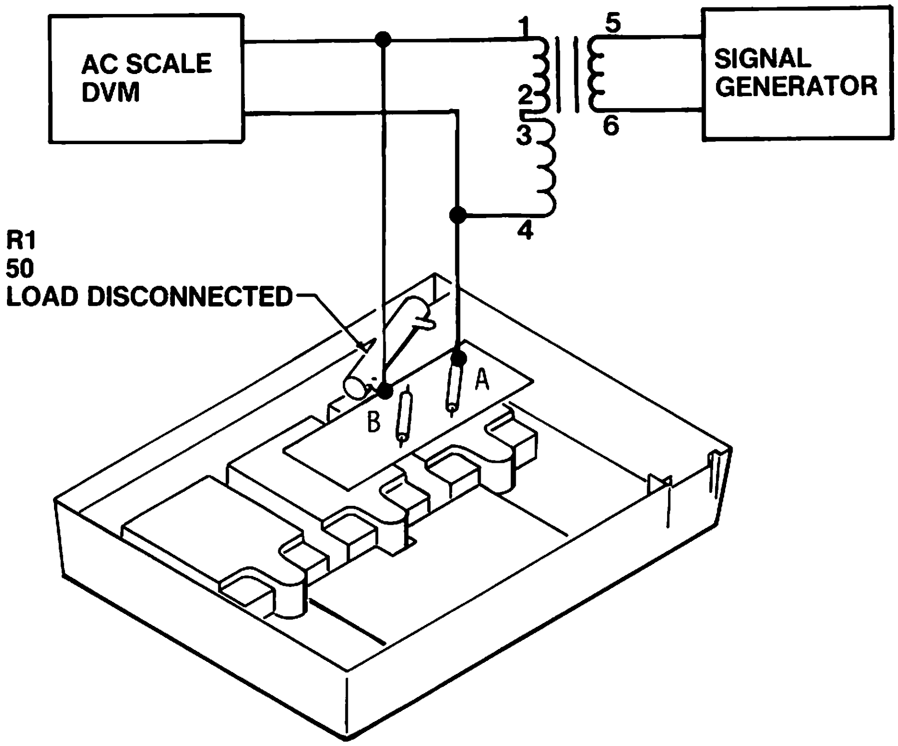


FIGURE 4-3. ATTENUATOR BOARD TEST SETUP

C. Adjust the signal generator for a 60Hz sinewave at 42.5 ± .5V RMS measured at points A to B using the AC Voltmeter.

1. Verify that U4-4 on the Computational Power Supply PCB is high.

D. Increase the signal generator amplitude to give 60.0 ± .5V RMS across points A to B.

1. Verify that J1-2 output is 0.20 ± .01V p-p.

2. Verify that U4-4 on the Computational Power Supply PCB falls to less than 0.8V during each half cycle concurrent with the peak of J1-2.

E. Reconnect load resistor.

4-20. Defibrillator Test Load and Energy Calculations.

WARNING

HAZARDOUS VOLTAGES ARE PRESENT ON THE DEFIBRILLATOR PADDLES. WHEN THE FOLLOWING TESTS ARE BEING PERFORMED, PLEASE USE EXTREME CAUTION.

CAUTION

BEFORE PERFORMING THESE TESTS, PLACE THE UPPER CASE ASSEMBLY OVER THE LOWER CASE ASSEMBLY IN ITS ORIGINAL SEATING POSITION.

A. Close the Battery Support System upper case over the lower, insuring all internal cables are correctly positioned and the upper case is stable.

1. Install three LIFEPAK 5 Battery Paks into the Battery Support System unit and place the LIFEPAK 5 Defibrillator directly on top of them. (This is the worst case position for coupling RF from the defibrillator into the Battery Support System unit.)

B. The following tests require the use of a properly calibrated LIFEPAK 5 Defibrillator and a Defibrillator Energy Meter.

NOTE: For the next tests, the following procedure is MANDATORY for accurate results.

1. Select the desired energy level.

2. Position the paddles on the test load plates.

3. Initiate the charge cycle.

4. Immediately depress the discharge buttons on both paddles and hold them.

5. The defibrillaor will automatically discharge upon reaching the selected energy level.

NOTE: When performing this test do not allow a charged defibrillator to sit. The stored charge decreases rapidly resulting in an unknown delivered energy.

C. Enter a display of 20 joules using the TEST LOAD SELECT switches, and charge the defibrillator to 20 joules. Discharge into the two test plates on the top of the BSS unit.

1. Verify the display does not change and the JOULES DELIVERED prompt is illuminated.

2. Verify the display and the words JOULES DELIVERED blanks within 5 ± 1 second.

D. Enter a display of 40 joules and charge the defibrillator to 20 joules. Again transfer into the Battery Support System test paltes.

1. Verify the display changes to approximately 20 and the JOULES DELIVERED prompt illuminates.

2. Verify the display and the words JOULES DELIVERED blank within 5 ± 1 second.

E. Set the display for an expected value of 20 joules and the defibrillator to the 100 joules setting. Set the Defibrillator Energy Meter to the 100 joule scale.

F. Discharge the defibrillator into the Defibrillator Energy Meter and note its reading. Then discharge into the Battery Support System and then again into the Defibrillator Energy Meter.

1. Verify the display energy on the Battery Support System is within 8% of the average of the before and after discharges into the Defibrillator Energy Meter. (0.92 to 1.08 times the Defibrillator Energy Meter average.) (Apex on right.)

2. Repeat step 1 with the paddles reversed (apex on left). The calculated energy on the Battery Support System with the apex paddle on the right should be within 3% of that with the apex paddle on the left.

G. Set the display for an expected value of 500 joules and the defibrillator to the 300 joule setting. Set the Defibrillator Energy Meter to the 400 joule scale following the above procedure.

1. Verify the display is within ± 9% of the average of the before and after Defibrillator Energy Meter readings (apex on right).

2. Repeat step 1 with the paddles reversed (apex on left). The calculated energy on the Battery Support System with the apex paddle on the right should be within 3% of that with the apex paddle on the left.

H. Energy Calculation Window.

1. Using the last value displayed in step G, scroll in the appropriate display per the graph below. Again, discharge the defibrillator into the test load. Verify the display setting remains unchanged and the JOULES DELIVERED prompt is illuminated.

DELIVERED ENERGY DISPLAYED	280/284	285/293	294/302	303/311	312/320
Selected Value	300	310	320	330	340

2. Still using the last value displayed in G, scroll in the appropriate display per the graph below. Discharge the defibrillator into the test load. Verify the display changes to the actual delivered energy and the JOULES DELIVERED prompt is illuminated.

DELIVERED ENERGY DISPLAYED	280/286	287/295	296/304	305/314	315/320
Selected Value	320	330	340	350	360

4-21. Free Run Troubleshooting Test. In the event that the system fails to respond to the TEST LOAD SELECT command during performance of the Logic Check, perform the Free Run Troubleshooting Test as follows:

A. Disconnect all power from system and remove batteries.

B. Remove IC chips U7, U11, and U12 from their sockets in the Computaitonal Power Supply PCB Assembly (A1).

C. If not already accomplished, move J9 jumper plug to short J9-1 to J9-2.

D. Install the Test Header configured to generate a NOP op code into U12's socket.

E. Connect the Signature Analyzer as follows:

Start at	U4-23	Rising Edge
Stop at	U14-9	Rising Edge
Clock at	U7-13	Rising Edge
Ground at	TP-3	

F. Apply power to setup and verify the following signatures.

SIGNAL	TEST POINT	SIGNATURE	SIGNAL	TEST POINT	SIGNATURE
+5V	U13-24	ØØØ3	EØ	U5-1	7Ø74
A2	U6-3,17	8484	E1	U5-2	PF63
A4	U6-5,15	1U5P	E2	U5-3	2J1U
A6	U6-7,13	U759	E3	U5-4	Ø9UA
A7	U6-9,11	6F9A	E4	U5-5	79CA
A5	U6-8,12	Ø356	E5	U5-6	AUCC
A3	U6-6,14	P763	E6	U5-7	2H91
A1	U6-4,16	FFFF	E7	U5-8	A8HP
AØ	U6-2,18	UUUU	E8	U5-9	7423
A1Ø	U7-3	37C5	E9	U5-1Ø	APC2
A9	U6-8,12	6321	E1Ø	U5-11	47UA
A8	U7-6,14	7791	E11	U5-13	54H4
A11	U4-19	6U28	E12	U5-14	4P23
A12	U4-2Ø	4FCA	E13	U5-15	A98A
A13	U4-21	4868	E14	U5-16	F4AC
A14	U4-22	9UP1	E15	U5-17	F4AC
A15	U4-23	ØØØ2	U13CS	U18-19	3281
A15	U5-19	ØØØ1	IRQCLK	U8-9	UUUP
			A11	U17-3	6U28

4-22. Fault Isolation. When the Battery Support System fails a functional test, the circuit at fault may be localized to a particular assembly. Use Table 4-3 to select an assembly. Find the test that was failed in the left column of Table 4-3 and substitute a known good assembly for the assembly listed in the right oclumn. When the faulty circuit is localized to an assembly, proceed to the Troubleshooting guide (paragraph 4-24) to find the faulty component.

TABLE 4-3

FAULT ISOLATION

Power Supply Check	Computational Power Supply PCB Assy
Microprocessor and Interrupt Clock Verification	Computational Power Supply PCB Assy
Logic Check with Signature Analysis	Computational Power Supply PCB Assy
Watch Dog Timer Test	Computational Power Supply PCB Assy
Shorted Battery Test	Switch Interface/Display PCB Assy or Computational Power Supply PCB Assy
Check Keypad and Display Board Operation	Switch Interface/Display PCB Assy, Membrane Switches, or Interconnection Cable
Pulse Attenuator Test	Defib Pulse Attenuator PCB Assy
Defibrillator Test Load and Energy Calculations	Computational Power Supply PCB Assy
Free Run Troubleshooting Test	Computational Power Supply PCB Assy

4-23. Calibration Procedure. The calibration procedure for the Battery Support System is part of Functional Test and Calibration, paragraph 4-15, I, entitled TEST #3 and TEST #4, A/D Calibration. No other calibration is required.

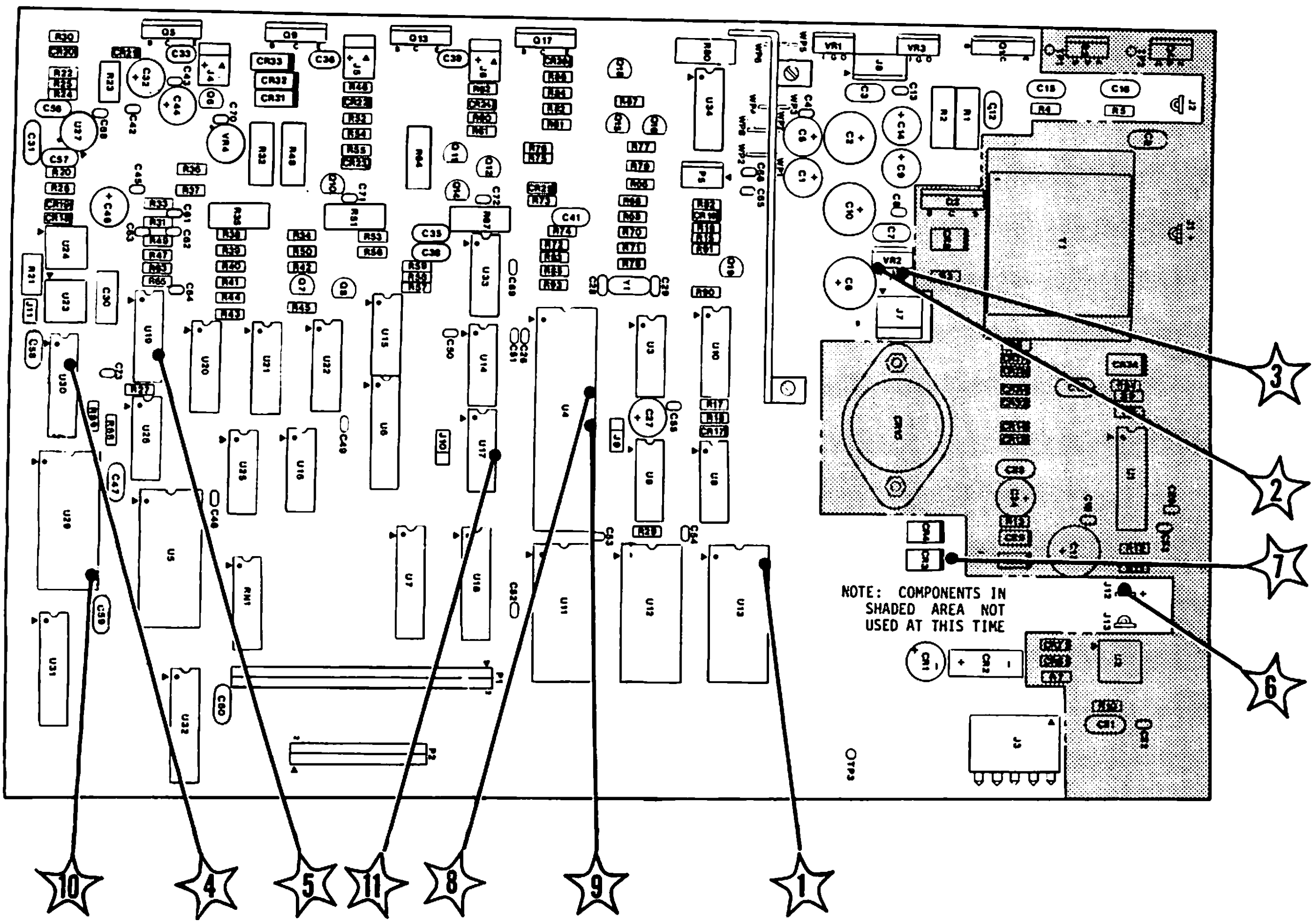


FIGURE 4-4. TEST POINT LOCATIONS

TABLE 4-4

TEST POINTS

TEST POINT	LOCATION	DESCRIPTION	SIGNAL & TOLERANCE
1	U13-24	+5V supply	+5V ± .25Vdc
2	J7-1	+12V supply	+12V ± .6Vdc
3	J7-2	-12V supply	-12V ± .6Vdc
4	U30-17	A/D Reference	+10.24V ± .03Vdc
5	U19-11	Cal Reference	+2.37V ± .05Vdc
6	CR3 Cathode	+24V unregulated	+24.5V ± 2.5Vdc
7	J12	Unregulated V	+11.0V ± 1Vdc*
8	U4-34	"E" Clock	1mHz ± 500Hz
9	U4-35	"Q" Clock	1mHz ± 500Hz
10	U29-13	A/D Clock	250KHz ± 125Hz
11	U17-11	IRQ Clock	33Hz ± 1ms

*Some units have SAR6936 transformers with unregulated output of 13.5 ± 1.0Vdc.

4-24. Troubleshooting Guide. When a malfunction is localized to a particular PCB assembly, the information in Table 4-5 may be used to locate the defective component. Find the symptom that most closely resembles the actual malfunction and follow the procedure in the right column.

TABLE 4-5

TROUBLESHOOTING GUIDE

SWITCH INTERFACE/DISPLAY PCB ASSEMBLY

SYMPTOMS	PROCEDURE
DIGITAL DISPLAY CIRCUIT	
Displays incorrect data	● Check +5V on U1, 2, 3, and 6. If bad, proceed to Power Supply Troubleshooting. ● Perform Signature Analysis on DØ-D7, A1, AØ, $\overline{OE}$, $\overline{W}$, E8 (see paragraph 4-15, H). If a signature is bad, proceed to Microprocessor Circuit Troubleshooting. If the signatures are correct, proceed to next step.
All segments off	● Check EL (enable line) on U1, 2, and 3 for an inactive line. If EL is inactive, replace U6. If all ELs are active, proceed to next step.
Segment missing	● Check for inactive segment drivers. If the line is active, replace display. If a line is inactive, replace the driver (U1, 2, or 3).
Displays incorrect data	● Check +5 volt on U4 and 5, R4, +24V on R9, 13, and 17. If voltages are out of tolerance, proceed to Power Supply Troubleshooting. If voltages are within tolerance, proceed to next step. Perform Signature Analysis on DØ-D7, A1, AØ, $\overline{OE}$, $\overline{W}$, E8 (see TEST #2 I/O Port Test, paragraph 4-15, H).

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

SWITCH INTERFACE/DISPLAY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
DIGITAL DISPLAY CIRCUIT (Continued)	
Displays incorrect data (Continued)	If a signature is incorrect, proceed to Microprocessor Circuit Troubleshooting. If the signatures are correct, proceed to next step. ● Check for an inactive clock line U4 and 5 pin 11. If a line is inactive, replace U6. If the lines are active, proceed to next step.
A single light bar is always on or always off	● Check for an inactive light bar drive line. If the drive line is inactive, replace either U4 or U5. If the drive line is active, check for a defective transistor (Q1-Q14). If the transistor is not defective, check for a defective light bar.
MEMBRANE SWITCH	
Incorrect response to entry	● Check +5 volts on U7. If incorrect, proceed to Power Supply Troubleshooting. If voltage is within tolerance, proceed to next step. ● Verify that +5 volts is present at each input (S1-S8). If not, check for an open pull up resistor (R21-R28). If all inputs are at +5 volts, proceed to next step.
A switch does not work	● Verify that +5 volts on the corresponding input line is pulled to less than .4V when the switch is pressed.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

SWITCH INTERFACE/DISPLAY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
	MEMBRANE SWITCH (Continued)
A switch does not work (Continued)	If not, disconnect the membrane switches by removing J2 and measure the resistance of the closed membrane switch. If the resistance of any closed switch contact exceeds 20Ω, replace the membrane switch. If the switch inputs are being pulled lower than .4V, proceed to next step. ● Perform Signature Analysis on DØ-D7. If a signature is incorrect, proceed to Microprocessor Troubleshooting.
ATTENUATOR, PULSE DEFIB PCB ASSEMBLY	
	DIFFERENTIAL AMPLIFIER
Output inactive	● Check +12V, -12V. If the voltages are out of tolerance, proceed to Power Supply Troubleshooting. If the voltages are in tolerance, proceed to the next step. ● Using the test setup in Figure 4-3 and the Pulse Attenuator Test (paragraph 4-19). Check for an active output at U1A pin 1. If the output is active, the test load contact plates are not properly connected to U1B's input. Check for an open wire. If the output is not active, measure the resistance of R2 or 3, they may be open. If R2 or 3 are not open, replace U1.
Output is offset	● Check for defective input diode CR1-4.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

ATTENUATOR, PULSE DEFIB PCB ASSEMBLY (Continued)

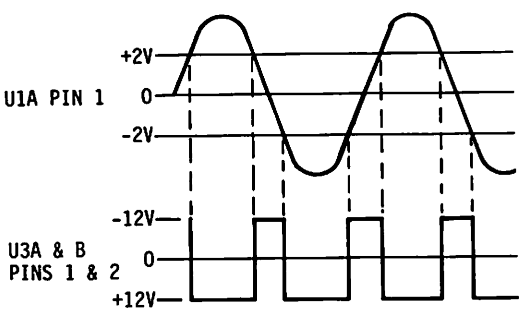
SYMPTOMS	PROCEDURE
DIFFERENTIAL AMPLIFIER (Continued)	
Incorrect gain	● Check the values of gain resistors R2, 3, 4, and 5. If they are in tolerance, replace U1.
DEFIBRILLATOR PULSE BUFFER	
output inactive	● Check +12V and -12V. If the power supplies are out of tolerance, proceed to Power Supply Troubleshooting. If the power supply is within tolerance, proceed to next step. ● Measure the resistance from U1A pin 1 to U2 pin 3. It should be approximately 15KΩ. If the meter overranges, R14 is open or a conductor is open. If the resistance is correct, replace U2.
Inacurrate output 	● Check the values of R14, 15, 16, 18, and 20, and C4 and replace if out of tolerance. If the values are within tolerance, replace U2. ● Using the test setup from Figure 4-3 and Pulse Attenuator Test, proceed to check for a waveform at U3A or B pins 1 or 2 shown below. If the waveform does not go to +12 volts, R10, R11, or U3B is defective. If the waveform does not go to -12 volts, R8, R9, or U3A is defective.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

ATTENUATOR, PULSE DEFIB PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
DEFIBRILLATOR PULSE BUFFER (Continued)	
Defib Pulse Buffer (To FIRQ) output inactive	● Using the test setup from Figure 4-3 and Pulse Attenuator Test procedure, check an active input at U3C pin 9. If the input is active, replace U3.
Defib Pulse Buffer (to A/D Converter) output inactive	● Using the test setup from Figure 4-3 and Pulse Attenuator Test procedure, check for an active input at U2. If the input is active, replace U2.
WINDOW DETECTOR	
Output inactive	● Check +12V and -12V. If the power supplies are out of tolerance, proceed to Power Supply Troubleshooting. If the power supplies are within tolerance, proceed to next step. ● Using the test setup in Figure 4-3 and the Pulse Attenuator Test procedure, check for an active output at U1B pin 7. If the output is not active, replace U1B. If the output is active, proceed to next step. ● Check for active outputs at U3A and B pin 1 and 2. If the outputs are not active, replace U3.
Output offset	● Check +12V and -12V. If the power supplies are out of tolerance, proceed to Power Supply Troubleshooting.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY

SYMPTOMS	PROCEDURE
MICROPROCESSOR SUPPORT CIRCUITRY	
No QCLK or ECLK	● Check +5V on U4. If +5V is out of tolerance, proceed to Power Supply Troubleshooting. If +5 volts is within tolerance, proceed to next step. ● Check HALT input to U4 pin 40. If HALT is not at +5V, resistor R29 may be defective. Measure its resistance and replace if necessary. If HALT is at its correct voltage, proceed to next step. ● Check MRDY and BUSY input to U4 pins 36 and 33. If MRDY or BUSY are not at +5V, R15 may be defective. Measure its resistance and replace if necessary. If MRDY and BUSY are at their correct voltages, proceed to next step. ● Check crystal Y1 for an active input at pins 38 or 39 with an oscilloscope equipped with a X10 probe. The loading effect of the oscilloscope will cause the frequency to change and yield any frequency measurements invalid. If pins 38 and 39 are not active, sustitute U4 with a known good component. If QCLK and ECLK are still not active, replace Y1.
$\overline{\text{RESET}}$ line inactive (does not go low)	● Check +5V on U10 pins 11 and 16. If +5 is out of tolerance, proceed to Power Supply Troubleshooting. If +5 is within tolerance, proceed to next step.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
MICROPROCESSOR SUPPORT CIRCUITRY (Continued)	
$\overline{\text{RESET}}$ line inactive (does not go low) (Continued)	● Check U4 pin 37 for a low 0.1 sec after power is applied. If a low does not appear at U4 pin 37, look for a high at U34 pin 3 and 4. If U34 pin 3 and 4 do not go high, replace U14. If U34 pins 3 and 4 go high, replace U34.
$\overline{\text{NMI}}$ line inactive	● Check +5V supply. If +5V is out of tolerance, proceed to Power Supply Troubleshooting. If +5V is within tolerance, proceed to next step. ● Check for an active input at U8A pin 3. It is normally 1MHz. If not, perform Signature Analysis for CØ. If 1MHz is present, proceed to next step. ● Check the divide by four output at U8B pin 9. If the frequency is substantially lower or nonexistent, replace U8. If the frequency is 250KHz, proceed to next step. ● Check the frequency at U10 pin 2. If this pin is not active, replace U10. If this pin has 30Hz squarewave, proceed to next step. ● Check for an active output at U17D, pin 11, it is normally 30Hz. If this pin is not active, replace U17. If this pin has 30Hz squarewave, replace U3.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
MICROPROCESSOR SUPPORT CIRCUITRY (Continued)	
$\overline{\text{IRQ}}$ line inactive	● Check +5V supply. If +5V is out of tolerance, proceed to Power Supply Troubleshooting. If +5V is within tolerance, proceed to next step. ● Perform Signature Analysis on E7 and $\overline{\text{W}}$ (See TEST #2 I/O Port Test, paragraph 4-15, H). If the signature is incorrect, proceed to Microprocessor Troubleshooting. If the signature is correct, proceed to next step. ● Check for an active output at U9D pin 13. If the output is inactive, replace U9. If the output is active, proceed to next step. ● Check for an active output at U9A. If the output is a constant low, the jumper at J9 may be in the wrong position. It should be across pins 3 and 2. If the output is active, replace U3.
A/D Clock inactive	● Perform Signature Analysis for CØ (see TEST #2 I/O Port Test, paragraph 4-15, H). If the signature is incorrect, proceed to Microprocessor Troubleshooting. If the signature is correct, replace U8.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
A/D CONVERTER	
Incorrect data	● Check 10.24V reference, +5V, +12V, and -12V supplies. If supplies are out of tolerance, proceed to Power Supply Troubleshooting. If supplies are within tolerance, proceed to next step. ● Check A/D clock input (250KHz squarewave). If the clock is defective, proceed to Microprocessor Support Circuitry Troubleshooting. If the clock is not defective, proceed to next step. ● Perform Signature Analysis of DØ-D7, AØ, E3-5, $\overline{OE}$, and $\overline{W}$. If the signatures are not correct, proceed to Microprocessor Troubleshooting. If the signatures are correct, proceed to next step. ● Perform Signature Analysis of U20 $\overline{OE}$ and U20 $\overline{W}$. If they are not correct, replace U25. If they are correct, replace U20. ● Check A/D calibration (see TEST #3 and #4, A/D Calibration). If out of calibration, perform calibration.
CHARGER SELECT CIRCUIT	
Select lines inactive	● Check +5V supply. If supply is not in tolerance, proceed to Power Supply Troubleshooting. If the supply is within tolerance, proceed to next step.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
CHARGER SELECT CIRCUIT (Continued)	
Select lines inactive (Continued)	● Check for active lines at the output of U25C and D pins 8 and 9. If these lines are not active, replace U25. If these lines are active, proceed to next step. ● Perform Signature Analysis on DØ-D7, $\overline{OE}$, $\overline{W}$, and SØ-S6 (see TEST #2, I/O Port test). If the signature on DØ-D7, $\overline{OE}$, or $\overline{W}$ is incorrect, proceed to Microprocessor Troubleshooting. If the signatures on DØ-D7, $\overline{OE}$, or $\overline{W}$ are correct and SØ-S3 are not correct, replace U21. If the signatures on DØ-D7, $\overline{OE}$, or $\overline{W}$ are correct and S4-S6 are incorrect, replace U22.
BATTERY CHARGER	
Incorrect charge current	● Check +24V, +5V, +10.25V. Reference and 12V supplies. If the voltages are out of tolerance, proceed to Power Supply Troubleshooting. If the currents are out of tolerance, check the Reed Switch Wire Harness.
MICROPROCESSOR	
E and Q clock inactive	● See Microprocessor Support Circuitry. ● Check the signature on C1 and C2, U7 pins 5 and 9. If C1 and C2 signatures are correct, replace U15. If C1 and C2 signatures are incorrect, check C1 and C2 signatures at U4 pin 32 and 35.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
MICROPROCESSOR (Continued)	
	If C1 and C2 are correct, replace U7; if not, replace U4.
OE incorrect signature	● Check the signature of CØ and C1 at U7 pins 7 and 9. If they are correct, proceed to next step. ● Check the signatures of CØ and C1 at U4 pin 34 and 35. If the signatures are correct, replace U7. If the signatures are not correct, replace U4.
EØ-E15 incorrect signature	● Perform Signature Analysis on A12-A14 (see Free Run Troubleshooting Test, paragraph 4-21). If they are incorrect, replace U4. If they are correct, replace U5. ● Perform Signature Analysis on A15 (see Free Run Troubleshooting Test, paragraph 4-21). If the signature is correct, replace U5. If the signature is incorrect, analyze the signature for A15 on U4 pin 23. If the signature is correct, replace U14. If the signature is incorrect, replace U4.
AØ-A11 incorrect signature	● Check signatures of AØ-1 on U6 pins 2, 4, 17, 6, 15, 8, 13, 11, and A8-A11 on U7 pins 6, 8, 17, 2. If the signatures are correct, replace U6 or U7. If the signatures are incorrect, replace U4.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
MICROPROCESSOR (Continued)	
DØ-D7 incorrect signatures	● Replace U4.
Fails TEST #0 EPROM Code Check	● Replace U11.
Fails TEST #1 RAM Read/Write Test	● Replace U12.
POWER SUPPLY	
+5V out of tolerance	● Lift jumper from WP7, connect a 10Ω, 20W resistor from WP7 to ground and measure the voltage at VR3 pin 1. If the voltage is not +5V ± .25V, replace CR3. If the voltage is +5V ± .25V, proceed to next step. ● Connect a 100Ω, 1W resistor from WP7 to ground. If the output voltage is within tolerance, replace Q1. If the output voltage is out of tolerance, proceed to next step. ● Examine the ripple voltage that appears on the unregulated voltage at P12. If the ripple is 60Hz, replace CR2.
+12V out of tolerance	● Examine the ripple voltage that appears on the unregulated voltage at VR1 pin 1. If the ripple is 120Hz, replace VR1. If the ripple is 60Hz, replace CR1.
-12V out of tolerance	● Examine the ripple voltage that appears on the unregulated voltage at VR2 pin 1. If the ripple is 120Hz, replace VR2. If the ripple is 60Hz, replace CR1.

TABLE 4-5 (Continued)

TROUBLESHOOTING GUIDE

COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY (Continued)

SYMPTOMS	PROCEDURE
POWER SUPPLY (Continued)	
A/D Converter reference out of tolerance	● Measure the voltage at VR4, pin 1. If the voltage is +12V ± .6V, replace VR4. If the voltage is not +12V ± .6V, proceed to +12V Out Of Tolerance in this table.

4-25. Repair.

A. General.

1. Instructions contained in this section provide the information necessary to return the LIFEPAK 5 Battery Support System units and its subassemblies to serviceable condition.

2. Conduct the necessary level of disassembly and inspection to identify all areas requiring repair.

3. Before removing an assembly for repair or replacement, label each lead or draw a sketch showing the location of each lead.

B. List of Materials. Following is a list of recommended materials, tools, and chemicals to have available when conducting repair activities.

1. Crocus cloth, available from commercial sources.

2. Solder, activated resin-core, tin-lead wire Sn 60 or Sn 63 Type R or RMA per Federal Specification QQ-S-571d.

3. Sleeving, silicone-treated fiberglass, Class HA1 or HC1 per MIL-I-3190 or equivalent.

4. 5-Minute Epoxy - Manufactured by Devcon Corporation, 59 Endicott Street, Danvers, Massachusetts, 01923.

5. Solder vacuum Part Number LTS13 - Manufactured by EDSYN Inc., 15954 Arminta Street, Van Nuys, California, 91406.

6. Isopropyl alcohol, 99% pure, available from commercial sources.

7. Trichloroetheylene.

8. Acid brush and cotton swabs.

9. RTV Silicon Rubber, Sealant - General Electric RTV 102, White.

C. Repair Procedures.

NOTE: Repair procedures contained here are recommended only as an alternative to complete assembly replacement.

1. Do not attempt to straighten bent connector pins or chassis frame members unless the bending or warpage is slight. Parts damaged beyond this level should be replaced.

2. PCB installed components are normally nonrepairable and must be replaced when found faulty.

3. PCB Component Replacement.

   a. Replace all electronic components not meeting the requirements outlined in Testing and Calibration.

   b. Replace electrical wire as required with wire of same length, color, and gage as that being replaced. Install the terminations identified on the applicable wire list.

   c. Remove excess solder from pad by wicking or vacuuming.

   d. Grasp the component with pliers and use a 60 watt soldering iron to remove components from circuit board being careful not to lift solder pads.

CAUTION

WHEN INSTALLING COMPONENTS ON PRINTED CIRCUIT BOARD, REFER TO TRANSISTOR INDEXING, TAB POSITIONS, DIODE MARKINGS AND CAPACITOR POLARITIES ILLUSTRATED IN SECTION 5 IPLs.

   e. Bend new component leads to fit mounting solder pads on PCB and trim leads to desired length. Be sure component is oriented in the proper polarity position and install it on the board, then solder in place.

NOTE: On Heat sink mounted components, verify the isolation between component tab and heat sink with an ohmmeter before soldering the leads.

CAUTION

USE A HEAT SINK WHEN SOLDERING DIODES AND TRANSISTORS, AND USE A MINIMUM OF HEAT WHEN SOLDERING COMPONENTS TO PRINTED CIRCUIT BOARDS.

f. Clean residual flux from soldered areas with an acid brush and isopropyl alcohol then dry with compressed air.

g. Test before reassembly.

4. Repair of Damaged or Defective Trace. A damaged trace may be a complete break or scratches, nicks, or pinholes which reduce the cross-sectional area of the conductor beyond original design specifications. (See Figure 4-5.)

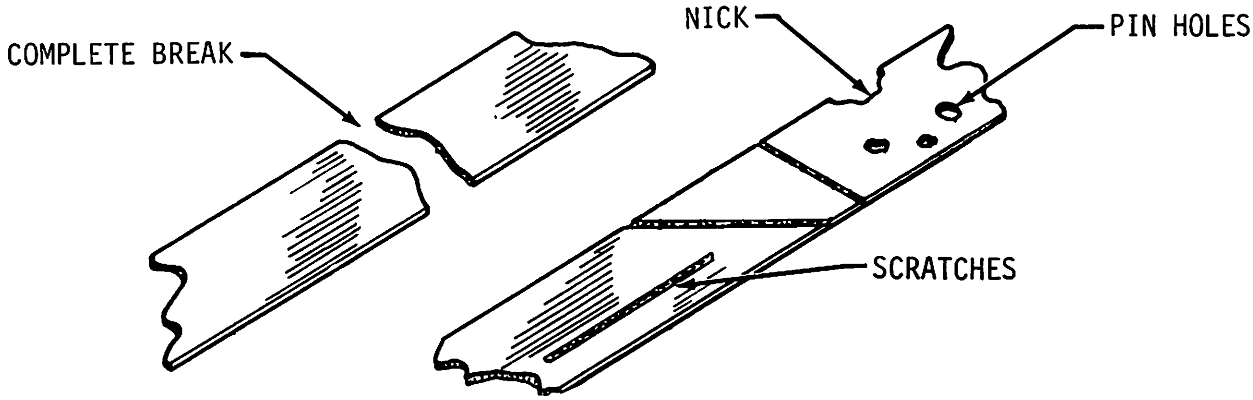


FIGURE 4-5. TYPICAL PRINTED WIRING DAMAGE

NOTE: Repair should be limited to two repairs per board. The damaged section of the conductor should not exceed five times the conductor width.

a. Clean both sides of break in conductor, at least 1/4 inch on each side, with a rubber eraser, then clean with an acid brush and isopropyl alcohol.

b. Cut a piece of 22 or 24 gage solid, tinned copper wire a minimum of 1/4 inch longer than the break. The wire may optionally be flattened by placing it between smooth metal plates and pressing with a bench vise.

c. Hold the wire on the centerline of the conductor, across the break, and solder in place. (See Figure 4-6.)

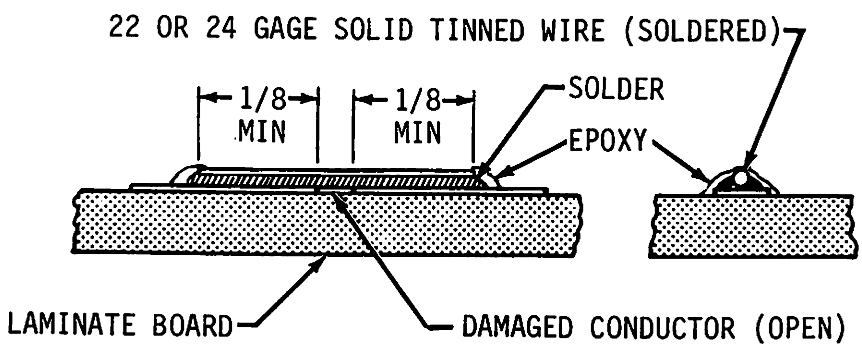


FIGURE 4-6. REPAIRING DAMAGED CONDUCTOR

d. Remove solder flux with cloth dampened with isopropyl alcohol and dry with compressed air.

e. Flow a small amount of 5-minute epoxy cement over the entire repair and allow to dry at room temperature for 15 minutes.

5. Repairing Lifted Conductors. a lifted conductor is present when a portion of the conductor is separated from the PC board surface, but is not broken. (See Figure 4-7.)

a. Rinse area to be repaired with isopropyl alcohol and dry with compressed air. Be sure that underside of lifted conductor is clean and remove any obstacles which prevent the lifted conductor from making total contact with the substate surface.

b. Apply 5-minute epoxy to surface of lifted conductor and to a distance of at least 1/8 inch in all directions from the damaged area.

c. Dry at room temperature for one hour.

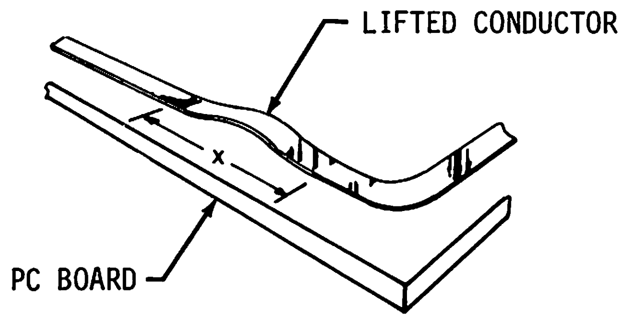


FIGURE 4-7. TYPICAL LIFTED CONDUCTOR

NOTE: The length of the lifted conductor which is repairable shall not exceed one half the length of the conductor path between two terminal areas or one half inch, whichever is smaller. See dimension X in Figure 4-7.

4-26. Case Repair. Case repair should be attempted only if the damage is minor; otherwise the damaged case part should be replaced. Minor damage is damage that does not affect the structural integrity of the case.

NOTE: Do not attempt to straighten severe bends or to repair severely cracked case halves. Should any damage of this nature be present, replace defective part.

A. Remove all traces of grease, dirt, or other foreign matter from the damaged area with isopropyl alcohol.

B. Apply trichloroethylene with a cotton swab along the line where the pieces meet.

C. If the joint being repaired is closed, such as a crack, clamping is not necessary; however, if a separate piece is being rejoined that will not hold itself together, clamping is necessary. Allow either joint to set for 24 hours before reassembly.

D. Should the cases be nicked, scratched, or burred, the damaged area can be refinished as follows:

   1. Using crocus cloth, work burrs, or nicks down to the level of the surrounding area.

   2. Brush apply a coat of matching color model paint to the repaired surface.

4-27. Test Load Contact Plate Replacement. If a contact plate is pitted as a result of arcing, it must be replaced. After performing the Case Separation procedure of paragraph 4-5, A, proceed as follows:

A. Carefully pry off the terminal guard (20) (see Figure 5-1), the terminal guard is held on with RTV adhesive/sealant and may be difficult to remove.

B. Remove the kepnut (21).

C. Replace the contact plate.

D. Place the high voltage lead over the threaded shaft and install the kepnut.

E. Apply a liberal amount of RTV to the contact plate threads and kepnut, and push the terminal guard over the threads.

NOTE: If the terminal guard was damaged as a result of its removal, replace it. Do not attempt to reuse it.

WARNING

INSURE THAT ALL CONDUCTIVE SURFACES ARE COVERED.

4-28. Reassembly Procedure. The following procedures provide the most logical sequence of reassembling the major assemblies of the Battery Support System.

A. Switch Interface/Display PCB Assy.

   1. Connect the membrane switch interface cable to P2.

2. Connect P1 to J1.

3. Place the circuit, component side down into the Upper Case Assembly aligning the mounting holes with the threaded screw holes.

4. Install five screws (17, Figure 5-1).

5. Connect the flat cable to P1.

B. Membrane Switch Installation.

NOTE: All references to the orientation of the membrane switches, such as front, back, left, or right, will be made with the interface cable on the lower left side.

1. Remove the tab from the lower right side of the membrane switch and save it.

2. Bend the interface cable down so it will enter its access hole.

3. Remove the adhesive backing from the back side of the switch.

4. Feed the interface cable through the access hole and align the top edge of the membrane switch with top edge of the membrane switch recess and rub it down starting at the top edge and working towards the bottom edge.

5. Remove the adhesive backing from the tab (see step A, 1) and stick it to the area to the left of the access hole that is not covered. Rub it down.

6. Remove the adhesive backing from the top of the membrane switch.

7. Align the top edge of the overlay with the top edge of the membrane switch and rub it down starting at the top edge working towards the bottom edge.

C. Defib Pulse Attenuator PCB Assy.

1. Attach high voltage wires to R1 mounting screws.

2. Align the PCB Assy mounting holes over the threaded screw holes.

3. Install two screws and two hex standoffs.

4. Connect P1 and P2.

D. Transformer Assy.

1. Attach the primary wires to their appropriate positions on the barrier strip (see Figure 6-1).

2. Align the Transformer Assy holes over the threaded mounting holes.

3. Install two mounting screws.

4. Connect secondary windings to J3 on the Computational Power Supply PCB Assembly.

5. Install secondary winding cable retainer.

E. Computational Power Supply PCB Assembly.

1. Place the PCB Assembly in the Lower Case Assembly two inches to the left of its normal mounting position.

2. Attach the barrier strip to the heat sink with the two mounting screws.

3. Move the PCB Assembly to its normal mounting position and install three mounting screws into three threaded holes.

4. Connect three green ground wires from the ac connector, PCB Assembly, and the Upper Case Assembly to the ground stud on the heat sink.

5. Connect J2, J3, J5, P3, P4, P5, P6, P7, P8, P12, and P13 to the appropriate connectors (see Figure 5-2).

F. Case Assembly.

1. Place the Upper Case Assembly on the Lower Case Assembly.

CAUTION

BEFORE JOINING THE TWO CASE HALVES VERIFY THAT NO CABLES ARE BEING PINCHED.

2. Align the two case halves so the heat sink will fit into its bosses. If the case halves are properly aligned, very little effort is needed to get them to connect evenly.

3. While holding the two case halves together, turn the unit over and place it upside down on the bench.

4. Install eight screws that hold the case halves together.

SECTION 5

ILLUSTRATED PARTS LISTS

5-1. GENERAL

This section provides the illustrated parts breakdown and describes the parts for the LIFEPAK 5 Battery Support System.

5-2. Parts Lists.

1. **FIG-ITEM.** This column contains the figure number of the illustrated assembly and the assigned item number of each part.
2. **PART NUMBER.** Physio-Control Corporation (PCC) part number or standard part number is contained in this column for each part listed.
3. **DESCRIPTION.** This column contains the nomenclature and descriptive information for each part listed. Static Sensitive Devices (SSDs) are identified in this column by this symbol ATTENTION. Special handling of PCB assemblies containing SSDs is required.
4. **USE CODE.** This column contains an alphabetical code which indicates configuration differences. Consult the first entry in the parts list for code effectivity.
5. **QTY.** This column lists the total quantity of parts for each particular assembly. The abbreviation "REF" (reference) indicates that the part has been listed for reference purposes.

5-3. Part Ordering. Some parts may be purchased locally. When ordering from Physio Control Corporation, give the instrument model and serial number. Include information listed in the parts list under heading: PCC PART NO., REF DES., COMPONENT VALUE, and DESCRIPTION. Different parts may be substituted by Physio Control to reflect modifications and improvements of instrument circuitry.

TABLE 5-1

BATTERY SUPPORT SYSTEM ASSEMBLY DRAWINGS AND PARTS LISTS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
801807	BATTERY SUPPORT SYSTEM FINAL ASSEMBLY	5-1
802166	COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY	5-2
802174	ATTENUATOR, PULSE DEFIB PCB ASSEMBLY	5-3
801894	SWITCH INTERFACE DISPLAY PCB ASSEMBLY	5-4
803061	REED SWITCH HARNESS ASSEMBLY	5-5

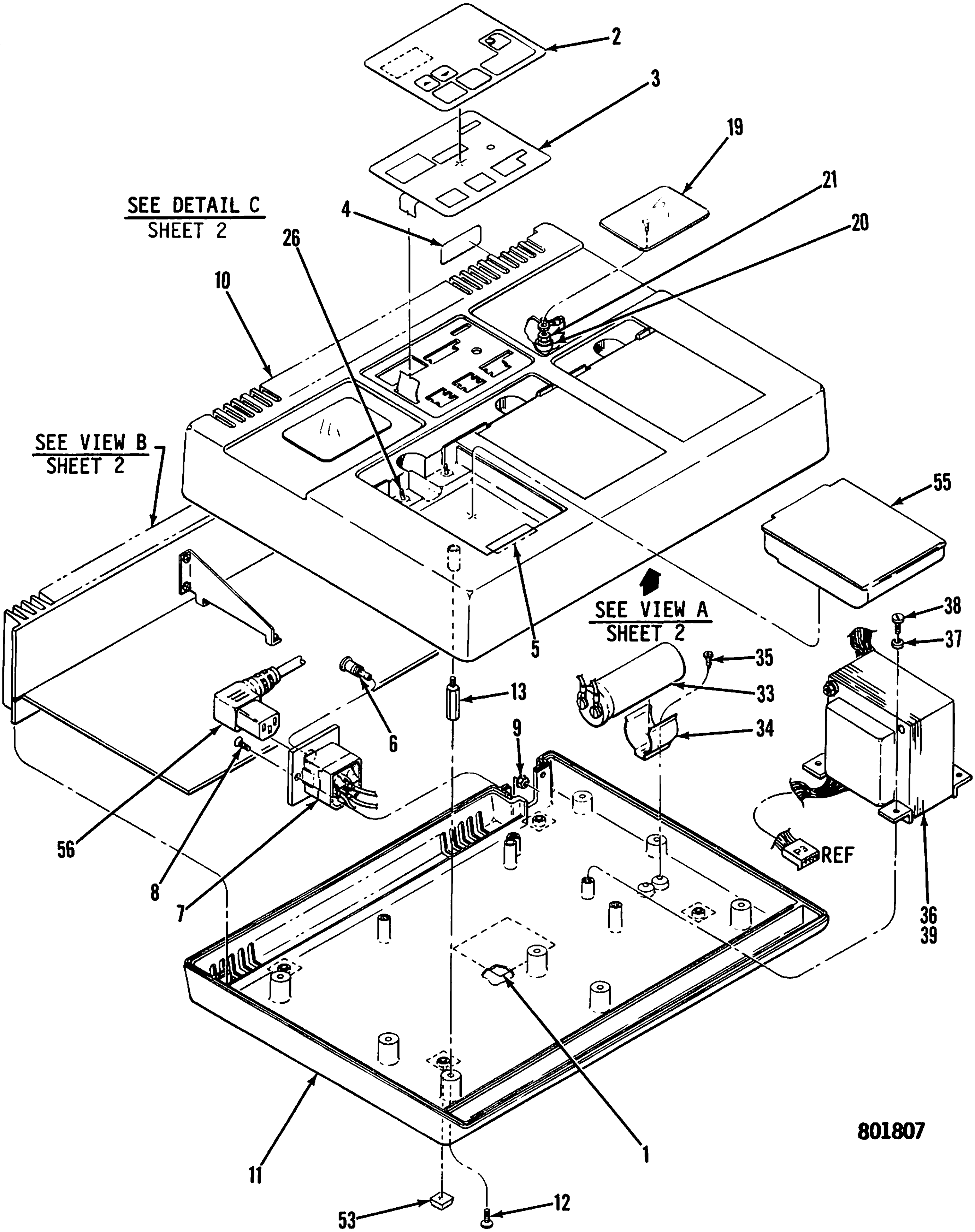


FIGURE 5-1. BATTERY SUPPORT SYSTEM FINAL ASSY
SHEET 1 OF 2

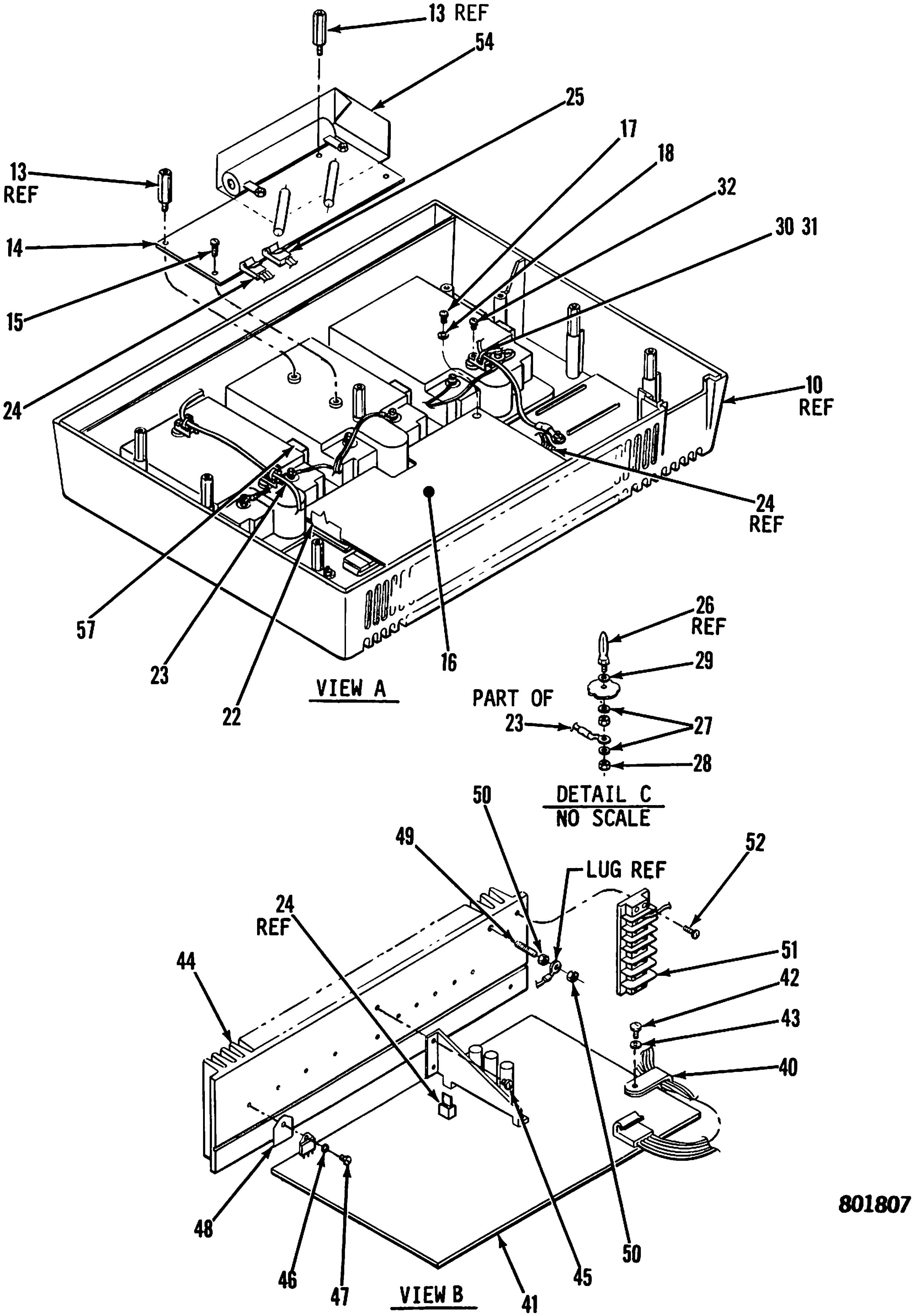


FIGURE 5-1. BATTERY SUPPORT SYSTEM FINAL ASSY
SHEET 2 OF 2

PARTS LIST

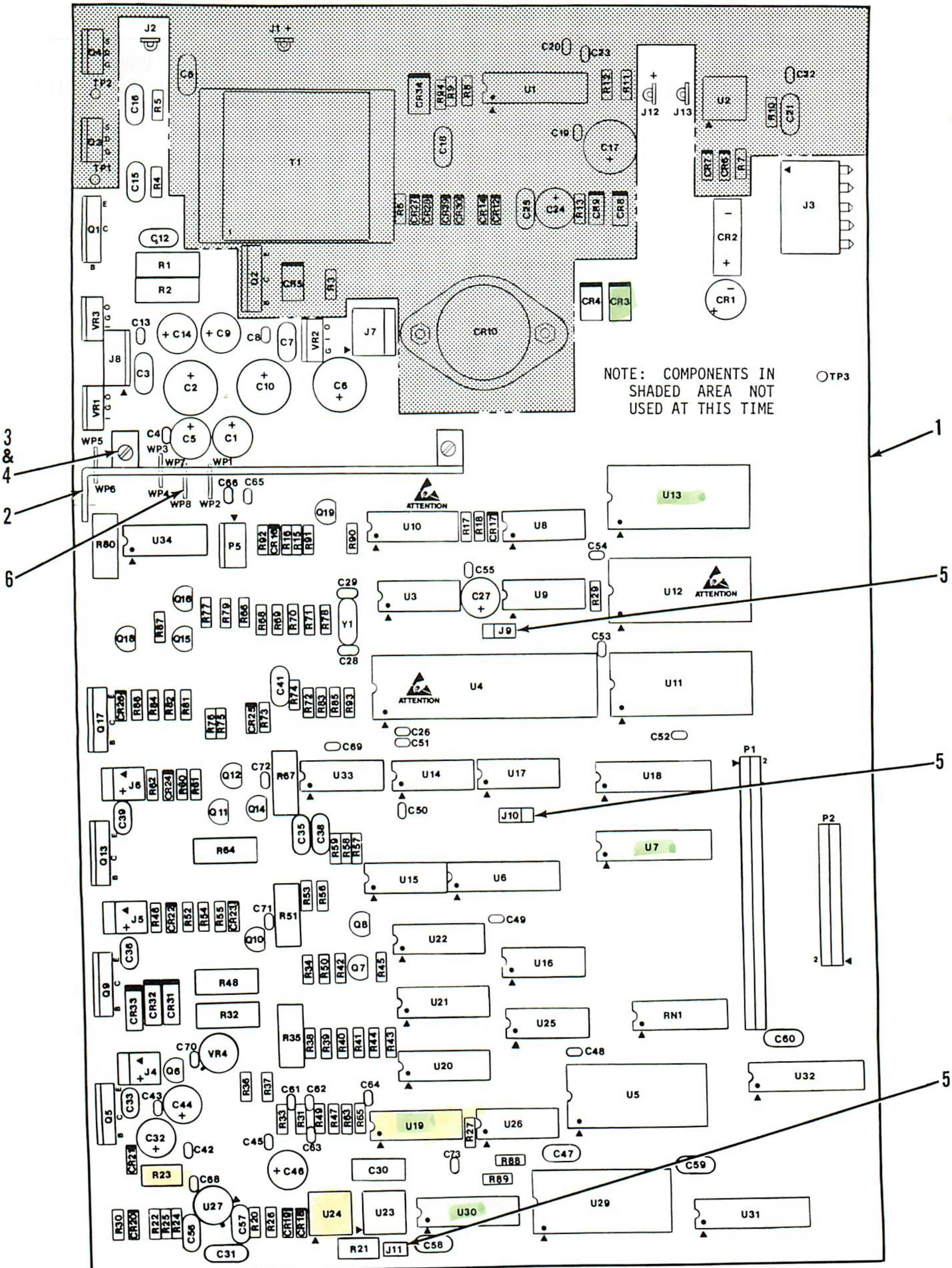
FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1	801807-10	BATTERY SUPPORT SYSTEM, 117V, English	A	REF
	801807-11	BATTERY SUPPORT SYSTEM, 117V, French, CSA	B	
	801807-12	BATTERY SUPPORT SYSTEM, 117V, English, CSA	C	
	801807-13	BATTERY SUPPORT SYSTEM, 117V, Spanish	D	
	801807-14	BATTERY SUPPORT SYSTEM, 100V, English	E	
	801807-15	BATTERY SUPPORT SYSTEM, 235V, English	F	
	801807-16	BATTERY SUPPORT SYSTEM, 235V, French	G	
	801807-17	BATTERY SUPPORT SYSTEM, 235V, German	H	
	801807-18	BATTERY SUPPORT SYSTEM, 235V, Spanish	I	
1	802117-00	. LABEL, Serial No., English	A,E,F	1
	802117-01	. LABEL, Serial No., French	G	
	802117-02	. LABEL, Serial No., French, CSA	B	
	802117-03	. LABEL, Serial No., German	H	
	802117-04	. LABEL, Serial No., Spanish	D,I	
	802117-05	. LABEL, Serial No., English, CSA	C	
2	801879-00	. LABEL, Switch/Display overlay, English	A,C,E,F	1
	801879-01	. LABEL, Switch/Display overlay, French	B,G	
	801879-02	. LABEL, Switch/Display overlay, German	H	
	801879-03	. LABEL, Switch/Display overlay, Spanish	D,I	
	801879-04	. LABEL, Switch/Display overlay	A,C,E,F	
	801879-05	. LABEL, Switch/Display overlay	B,G	
	801879-06	. LABEL, Switch/Display overlay	H	
	801879-07	. LABEL, Switch/Display overlay	D,I	
	801879-08	. LABEL, Switch/Display overlay	H	
3	801878-00	. SWITCH, Membrane		1
4	802153-06	. LABEL, Warning, Fuse, English	A,C,E,F	1
	802153-07	. LABEL, Warning, Fuse, French	G	
	802153-08	. LABEL, Warning, Fuse, German	H	
	802153-09	. LABEL, Warning, Fuse, Spanish	I	
	802153-10	. LABEL, Warning, Fuse, French, CSA	B	
	802153-11	. LABEL, Warning, Fuse, Spanish	D	
	802153-12	. LABEL, Warning, Fuse	F	
	802153-13	. LABEL, Warning, Fuse	A,C,E	
	802153-14	. LABEL, Warning, Fuse	G	
	802153-15	. LABEL, Warning, Fuse	H	
	802153-16	. LABEL, Warning, Fuse	I	
	802153-17	. LABEL, Warning, Fuse	B	
	802153-18	. LABEL, Warning, Fuse	D	
	802153-19	. LABEL, Warning, Fuse	F	
5	802195-00	. LABEL, Warning, Battery, English	A,C,E,F	3
	802195-01	. LABEL, Warning, Battery, French	B,G	
	802195-02	. LABEL, Warning, Battery, German	H	
	802195-03	. LABEL, Warning, Battery, Spanish	D,I	
6	200619-015	. FUSE, Slow-blow, 1 amp, 250V	F-I	2
	200619-012	. FUSE, Slow-blow, 500mA, 250V	F-I	2
	200619-018	. FUSE, Slow-blow, 2 amp, 250V	A-E	1
7	200602-002	. CONNECTOR, Fuseholder, Single fuse	A,B,D,E	1
	200602-000	. CONNECTOR, Fuseholder, Double fuse, 3 con.	C,F-I	1
		. ---Attaching Parts		
8	201105-541	. SCREW, Flathead, 4-40 X 5/8, CSK, B/OX		2
9	90-03019	. NUT, Hex Kep, 4-40		2
		. ---*---		
10	801948-03	. CASE, Upper		1
11	801933-03	. CASE, Lower		1
		. ---Attaching Parts		
12	200476-796	. SCREW, Panhead, 6-32 X 1/2		8
		. ---*---		
13	200302-026	. STANDOFF, Hex, 6-32 X 1" Lg		8

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
14	802174-00	. PCB ASSY, Attenuator, Pulse, Defib (See		1
		. Figure 5-3)		
		. ---Attaching Parts		
15	200476-793	. SCREW, Panhead, 6-32 X 5/16		2
		. ---*---		
16	801894-01	. PCB ASSY, Switch Display (See Figure 5-4)		1
		. ---Attaching Parts		
17	200476-793	. SCREW, Panhead, 6-32 X 5/16		5
18	90-04064	. WASHER, Flat #6		5
		. ---*---		
19	801790-00	. PLATE, Paddle Test		2
		. ---Attaching Parts		
20	800256-01	. GUARD, Terminal, Electrode Plate		2
	800265-02	. GUARD, Terminal, Electrode Plate		2
21	90-03021	. NUT, Kep, 6-32		4
		. ---*---		
22	802024-00	. CABLE, Ribbon, Assy		1
23	802009-00	. HARNESS, Battery/Comp PCB		1
24	802034-02	. HARNESS, Power Supply, A1/A2/A3		1
25	802045-01	. HARNESS, Atten to Comp PCB		1
25A	802519-00	. HARNESS, Assy, Battery Support System		1
		(Replaces items 23, 24, 25)		
26	802278-00	. CONNECTOR, Mini banana, 4-40		6
		. ---Attaching Parts		
27	90-04005	. WASHER, Lock, Internal tooth, #4		12
28	90-03005	. NUT, Hex, 4-40		12
29	90-04060	. WASHER, Flat #4		6
		. ---*---		
30	90-10055	. RETAINER, Cable tie		3
31	90-10034	. FASTENER, Mount, Cable tie		3
		. ---Attaching Parts		
32	200531-012	. SCREW, Panhead, 6-19		3
		. ---*---		
33	200100-023	. CAPACITOR, 15000µF, 15V, +75%		1
34	201358-011	. RETAINER, Clip, Spring steel		1
		. ---Attaching Parts		
35	200531-012	. SCREW, Panhead, 6-19 X 1/4		2
		. ---*---		
36	802007-00	. TRANSFORMER ASSY, 100/117/235V, 50/60Hz		1
		. ---Attaching Parts		
37	90-04064	. WASHER, Flat, #6		2
38	200476-794	. SCREW, Panhead, 6-32 X 3/8		2
39	90-10055	. RETAINER, Cable tie		4
		. ---*---		
40	200530-005	. RETAINER, Cable Clamp		1
41	802166-01	. PCB ASSY, Computational Power Supply		1
		. (See Figure 5-2)		
		. ---Attaching Parts		
42	200476-794	. SCREW, Panhead, 6-32 X 3/8		3
43	90-04064	. WASHER, Flat, #6		1
		. ---*---		
44	801791-00	. HEATSINK, Aluminum		1
		. ---Attaching Parts		
45	200476-792	. SCREW, Panhead, 6-32 X 1/4		2
46	2-35506-00	. WASHER, Shoulder, #4		7
47	200476-760	. SCREW, Panhead, 4-40 X 1/4		7
48	90-09227	. INSULATOR, Transistor, TO-220		2
	800814-05	. INSULATOR, Silpad, .80 X .94		5
		. ---*---		
49	201173-027	. FASTENER, Set screw, 6-32 X 1/2		1
50	90-03021	. NUT, Kep, 6-32		2
51	200970-004	. TERMINAL, Barrier strip, 6 contact		1
		. ---Attaching Parts		
52	200476-796	. SCREW, Panhead, 6-32 X 5/8		2
		. ---*---		
53	802489-02	. FOOT, Adhesive, Black rubber		4
54	802247-00	. SHIELD, Nomex		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
55	9-10424-02	BATTERY PAK, LP/5		3
	9-10424-03	BATTERY PAK, LP/5		
	9-10424-04	BATTERY PAK, LP/5, FASTPAK		
56	801726-01	CORD, Power, Detachable	A-D	1
	801901-04	CORD, Power, Detachable	E	
	801901-00	CORD, Power, Detachable	F-I	
	801901-01	CORD, Power, Detachable, UK	F	
	801901-02	CORD, Power, Detachable, AUS	F	
	801901-08	CORD, Power, Detachable, SAF	F	
	801901-03	CORD, Power, Detachable, Unterminated	F	
57	803061-00	SWITCH ASSY, Magnetic Reed (See Figure 5-5)		1



802166

FIGURE 5-2. COMPUTATIONAL POWER SUPPLY PCB ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-2	802166-01	PCB ASSY, Computational/Power Supply, AC only, A1		REF
1	802165-02	. BOARD, Printed Circuit		1
2	802039-00	. BRACKET, Mounting		1
		. ---Attaching Parts		
3	200476-792	. SCREW, Panhead, 6-32 X 1/4		2
4	90-03021	. NUT, Kep, 6-32		2
		. ---*---		
5	201176-000	. CONNECTOR, Receptacle, Jumper, 2 contact		3
6	201301-605	. JUMPER, Wire, 22 AWG, Teflon insulated		4
CR1	200510-000	. DIODE, Bridge Rectifier, 1A, 50V		1
CR2	200499-020	. DIODE, Bridge Rectifier, 4A, 50V		1
CR3,4	201303-003	. DIODE, Rectifier, .8MA, PIV400		2
CR16,17	200971-000	. DIODE, Fast Rcvry, .8NS, PIV75		9
CR18,19	200991-001	. DIODE, Schottky, 35MA, 20V		2
CR20-26		. Same as CR16		
CR31-33	200789-003	. DIODE, HV Power, 3A, 400V		3
Y1	200417-004	. CRYSTAL, Microprocessor, 4MHz		1
P1	200397-024	. CONNECTOR, Plug, 50 contact, PCB		1
P2	200397-012	. CONNECTOR, Plug, 26 contact, PCB		1
P5	200534-002	. CONNECTOR, Plug, 4 contact, PCB		1
J2	2-20171-00	. CONNECTOR, Plug, Crimp		3
J3	200663-003	. CONNECTOR, Plug, 5 contact, PCB		1
J4-J6	200096-000	. CONNECTOR, Plug, 2 contact, PCB		3
J7	200096-001	. CONNECTOR, Plug, 3 contact, PCB		1
J8	200534-003	. CONNECTOR, Plug, 5 contact, PCB		1
J9,10	200396-036	. CONNECTOR, Plug, 3 contact, PCB		2
J11	200396-035	. CONNECTOR, Plug, 2 contact, PCB		1
J12,13		. Same as J2		
U3	200335-000	. IC, Dig, TTL, F/F, D, LP5, 74LS74		3
U4	201318-000	. IC, Dig, HMOS, UPROC, 6809P — ATTENTION		1
U5	201357-000	. IC, Dit, TTL, 4-16 DEC, 74159		1
U6,7	201305-000	. IC, Dig, TTL, Buffer, 74LS244		4
U8		. Same as U3		
U9	200587-000	. IC, Dig, TTL, QUAD, NOR, 74LS02N		1
U10	201313-000	. IC, Dig, CMOS, BIN/CTR, 4020 — ATTENTION		1
U11	802244-03	. IC, Dig, EPROM, 32K Bit, Prog		1
U12	201348-002	. IC, Dig, CMOS, RAM, 2016 — ATTENTION		1
U14	201378-000	. IC, Dig, TTL, Buffer/Inverter, 74LS14		1
U15,16	200342-000	. IC, Dig, TTL, QUAD, NAND, 74LS00		2
U17	201312-000	. IC, Dig, TTL, Gate, 74LS86		1
U18	201309-000	. IC, Dig, TTL, Buffer, 74LS245		1
U19	201327-000	. IC, Lin, TTL, MUL/PLEX, LF13508		1
U20-22	201356-000	. IC, Dig, TTL, 4 DRGSTR, 25LS2518		3
U23	200855-000	. IC, Lin, Sample & Hold, LF398N		1
U24	201324-000	. IC, Lin, Op-Amp, Dual, LF353AN		1
U25	201310-000	. IC, Dig, TTL, QUAD, 74LS32		1
U26		. Same as U3		
U27	200806-000	. IC, Lin, Voltcomp, LM311		1
U29	201308-000	. IC, Dig, TTL, SAR, 2504		1
U30	801194-00	. IC, Inf, D/A, CMOS, XT, 7541		1
U31,32		. Same as U6		
U33	200199-000	. IC, Lin, Op-Amp, JFET, TL084		1
U34	200446-000	. IC, Dig, TTL, TRI, NOR, 74LS27		1
VR1	200227-003	. IC, Lin, Volt Regulator, +12V POS, LM340T-12		1
VR2	200209-004	. IC, Lin, Volt Regulator, -12V POS, LM320T		1
VR3	200227-000	. IC, Lin, Volt Regulator, +5V POS, LM340T-5		1
VR4	201369-003	. IC, Lin, Volt Ref, 10.24V, LH0071		1
Q1	201355-000	. TRANSISTOR, PNP, VCEO		4
Q5		. Same As Q1		
Q6	200942-001	. TRANSISTOR, NPN, VCEO, 40V		4

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-2				
Q7,8	200585-001	. TRANSISTOR, VFET, VGS, 60V		7
Q9		. Same As Q1		
Q10		. Same As Q6		
Q11,12		. Same As Q7		
Q13		. Same As Q1		
Q14		. Same As Q6		
Q15,16		. Same As Q7		
Q17	201354-000	. TRANSISTOR, NPN, VCEO		1
Q18		. Same As Q7		
Q19		. Same As Q6		
XU3	200033-000	. SOCKET, IC (under U3)		1
XU4	200675-009	. SOCKET, IC (under U4)		1
XU11,12	200675-005	. SOCKET, IC (under U11 & U12)		2
XU18	200033-004	. SOCKET, IC (under U18)		1
XU19	200033-001	. SOCKET, IC (under U19)		1
XU30	200033-006	. SOCKET, IC (under U30)		1
TP3	801959-00	. TERMINAL, Test Point		1
C1	200500-012	. CAPACITOR, 10µF, 50V, 20%		1
C2	200322-004	. CAPACITOR, 270µF, 25V, 100%		3
C3	200893-034	. CAPACITOR, .10µF, 50V, 10%		6
C4	200893-222	. CAPACITOR, .01µF, 50V, 10%		26
C5	200280-053	. CAPACITOR, 10µF, 35V, 10%		7
C6		. Same As C2		
C7		. Same As C3		
C8		. Same As C4		
C9		. Same As C5		
C10		. Same As C2		
C12		. Same As C3		
C13		. Same As C4		
C14		. Same As C5		
C26		. Same As C4		
C27		. Same As C5		
C28,29	200274-011	. CAPACITOR, 24pF, 500V, 5%		2
C30	200790-042	. CAPACITOR, .010µF, 200V, 1%		1
C31	200274-005	. CAPACITOR, 10pF, 500V, 5%		1
C32		. Same As C5		
C33		. Same As C3		
C35	200901-107	. CAPACITOR, .01µF, 100V, 5%		3
C36		. Same As C3		
C38		. Same As C35		
C39		. Same As C3		
C41		. Same As C35		
C42,43		. Same As C4		
C44		. Same As C5		
C45		. Same As C4		
C46		. Same As C5		
C47	200264-024	. CAPACITOR, 1µF, 50V, 20%		6
C48-55		. Same As C4		
C56-60		. Same As C47		
C61-66		. Same As C4		
C68		. Same As C4		
C69	200901-022	. CAPACITOR, 100pF, 50V, 5%		1
C70-73		. Same As C4		
RN1	200424-033	. RESISTOR, Network, 15 X 4.7K, .10W, . 2%, 16 Pin, Dip		1
R1	200121-003	. RESISTOR, .5, 3W, 1%, PWR		4
R2	200120-014	. RESISTOR, 10, 1W, 5%, CC		1
R15	200470-072	. RESISTOR, 1K, 1/4W, 5%, CF		1
R16	200470-074	. RESISTOR, 1.2K, 1/4W, 5%, CF		2
R17	200470-096	. RESISTOR, 10K, 1/4W, 5%, CF		1
R18	200470-103	. RESISTOR, 20K, 1/4W, 5%, CF		9
R20	200054-352	. RESISTOR, 46.4K, 1/8W, 1%, MF		1
R21	200527-028	. RESISTOR, Pot, 10K, 1/2W, 10%, Cermet		2

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-2				
R22	200054-321	. RESISTOR, 22.1K, 1/8W, 1%, MF		1
R23		. Same As R21		
R24	200054-383	. RESISTOR, 97.6K, 1/8W, 1%, MF		1
R25	200054-356	. RESISTOR, 51.1K, 1/8W, 1%, MF		1
R26	200470-108	. RESISTOR, 33K, 1/4W, 5%, CF		4
R27	200470-088	. RESISTOR, 4.7K, 1/4W, 5%, CF		8
R29		. Same As R27		
R30		. Same As R26		
R31	200054-481	. RESISTOR, 1.02M, 1/8W, 1%, MF		3
R32	200676-039	. RESISTOR, 390, 3W, 5%, WW		3
R33	200054-435	. RESISTOR, 340K, 1/8W, 1%, MF		3
R34		. Same As R27		
R35		. Same As R1		
R36,37	200054-480	. RESISTOR, 1M, 1/8W, 1%, MF		8
R38	200054-226	. RESISTOR, 2.21K, 1/8W, 1%, MF		3
R39	200054-317	. RESISTOR, 20K, 1/8W, 1%, MF		8
R40	200054-508	. RESISTOR, 2M, 1/8W, 1%, MF		8
R41		. Same As R39		
R42		. Same As R40		
R43	200054-209	. RESISTOR, 1.47K, 1/8W, 1%, RN55C		3
R44,45		. Same As R18		
R46		. Same As R26		
R47		. Same As R31		
R48		. Same As R32		
R49		. Same As R33		
R50		. Same As R27		
R51		. Same As R1		
R52,53		. Same As R36		
R54		. Same As R38		
R55		. Same As R39		
R56		. Same As R40		
R57		. Same As R39		
R58		. Same As R40		
R59		. Same As R43		
R60,61		. Same As R18		
R62		. Same As R26		
R63		. Same As R31		
R64		. Same As R32		
R65		. Same As R33		
R66		. Same As R27		
R67		. Same As R1		
R68,69		. Same As R36		
R70		. Same As R38		
R71		. Same As R39		
R72		. Same As R40		
R73		. Same As R39		
R74		. Same As R40		
R75		. Same As R43		
R76,77		. Same As R18		
R78,79		. Same As R36		
R80	200121-005	. RESISTOR, 1, 3W, 1%, PWR		1
R81	200054-259	. RESISTOR, 4.99K, 1/8W, 1%, MF		1
R82		. Same As R39		
R83		. Same As R40		
R84		. Same As R18		
R85		. Same As R40		
R86		. Same As R27		
R87		. Same As R18		
R88	200054-367	. RESISTOR, 66.5K, 1/8W, 1%, MF		1
R89		. Same As R39		
R90		. Same As R27		
R91		. Same As R16		
R92		. Same As R27		
R93	200470-111	. RESISTOR, 43K, 1/4W, 5%, CF		1

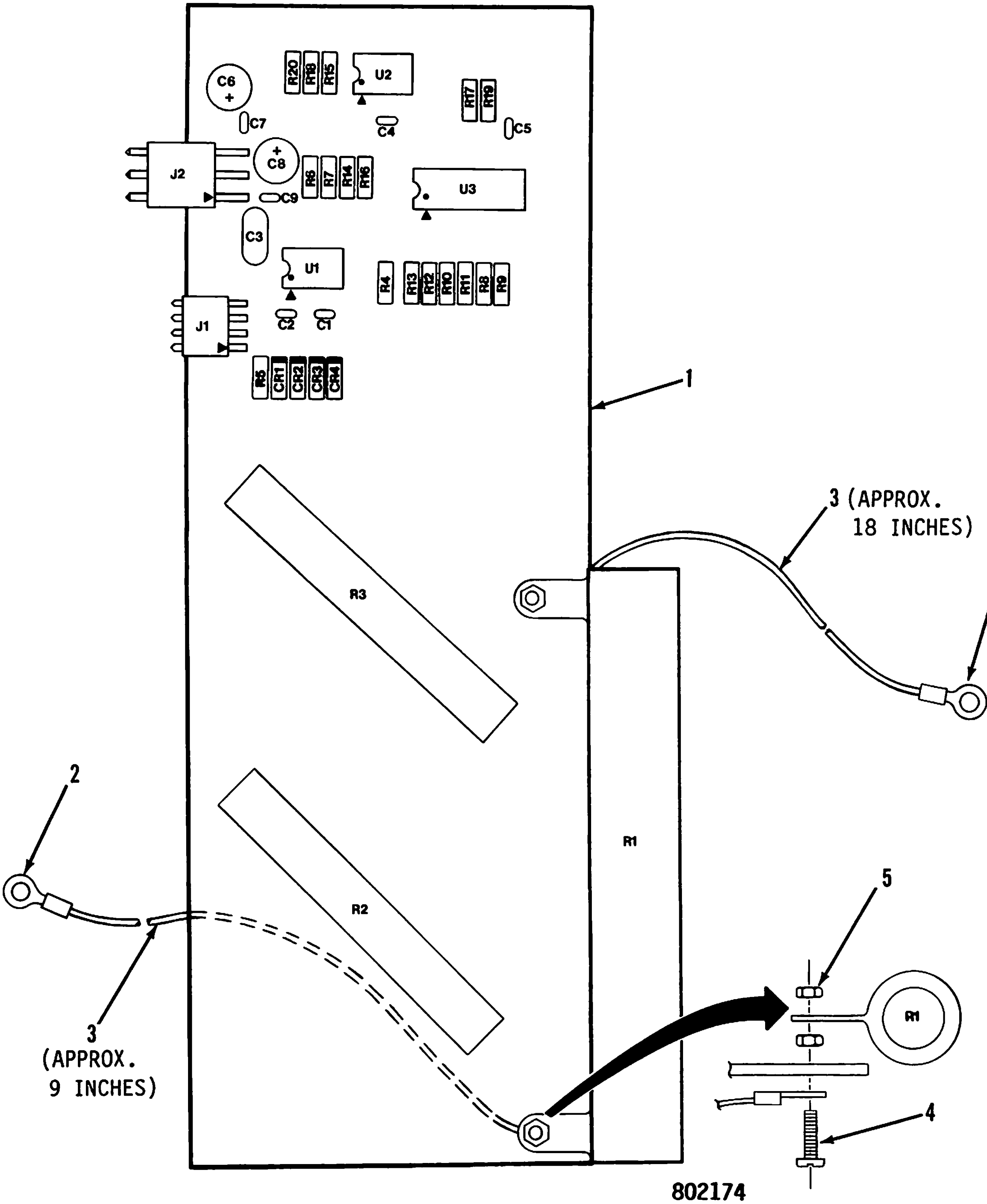


FIGURE 5-3. ATTENUATOR, PULSE DEFIB PCB ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-3	802174-00	PCB ASSY, Attenuator, Pulse, Defib, A2		REF
1	802173-00	. BOARD, Printed Circuit		1
2	200276-211	. LUG, Terminal, Ring, AWG 22-16 #6		4
C1,2	200264-004	. CAPACITOR, .0018μF, 50V, 20%		2
C3	200274-005	. CAPACITOR, 10pF, 500V, 5%		1
C4	200264-010	. CAPACITOR, .01μF, 50V, 20%		3
C5	200264-014	. CAPACITOR,.033μF, 50V, 20%		1
C6,8	200205-049	. CAPACITOR, 10μF, 50V, 10%		2
C7		. Same As C4		
C9		. Same As C4		
CR1-4	200971-000	. DIODE, Fast Recover, PIV75, IN914B		4
U1	200487-000	. IC, Lin, Op-Amp, JFET, LF353N		1
U2	200254-000	. IC, Lin, Op-Amp, JFET, LF355N		1
U3	200669-002	. IC, Lin, QUAD, Compar, LM339N		1
R1	200783-000	. RESISTOR, 50, 50W, 5%		1
		. ---Attaching Parts		
3	200405-020	. CABLE, Unshielded, #22 stranded		A/R
4	200476-794	. SCREW, Panhead, 6-32 X 3/8		2
5	90-03021	. NUT, Kep, 6-32		4
		---*---		
R2,3	201141-000	. RESISTOR, 8M, 3W, 1%, MF		2
R4,5	200054-285	. RESISTOR, 9.31K 1/8W, 1%, MF		2
R6	200470-113	. RESISTOR, 51K, 1/4W, 5%, CF		1
R7	200470-079	. RESISTOR, 2K, 1/4W, 5%, CF		3
R8	200470-096	. RESISTOR, 10K, 1/4W, 5%, CF		3
R9		. Same As R7		
R10		. Same As R8		
R11		. Same As R7		
R12	200470-072	. RESISTOR, 1K, 1/4W, 5%, CF		1
R13	200470-103	. RESISTOR, 20K, 1/4W, 5%, CF		1
R14,16	200054-305	. RESISTOR, 15K, 1/8W, 1%		2
R15	200054-193	. RESISTOR, 1K, 1/8W, 1%, MF		1
R17		. Same As R8		
R18	200054-190	. RESISTOR, 931, 1/8W, 1%, MF		1
R19	200470-120	. RESISTOR, 100K, 1/4W, 5%		1
R20	200470-041	. RESISTOR, 51, 1/4W, 5%		1
J1	200534-029	. CONNECTOR, Plug, PCB, 4 contact		1
J2	200663-001	. CONNECTOR, Plug, PCB, 3 contact		1

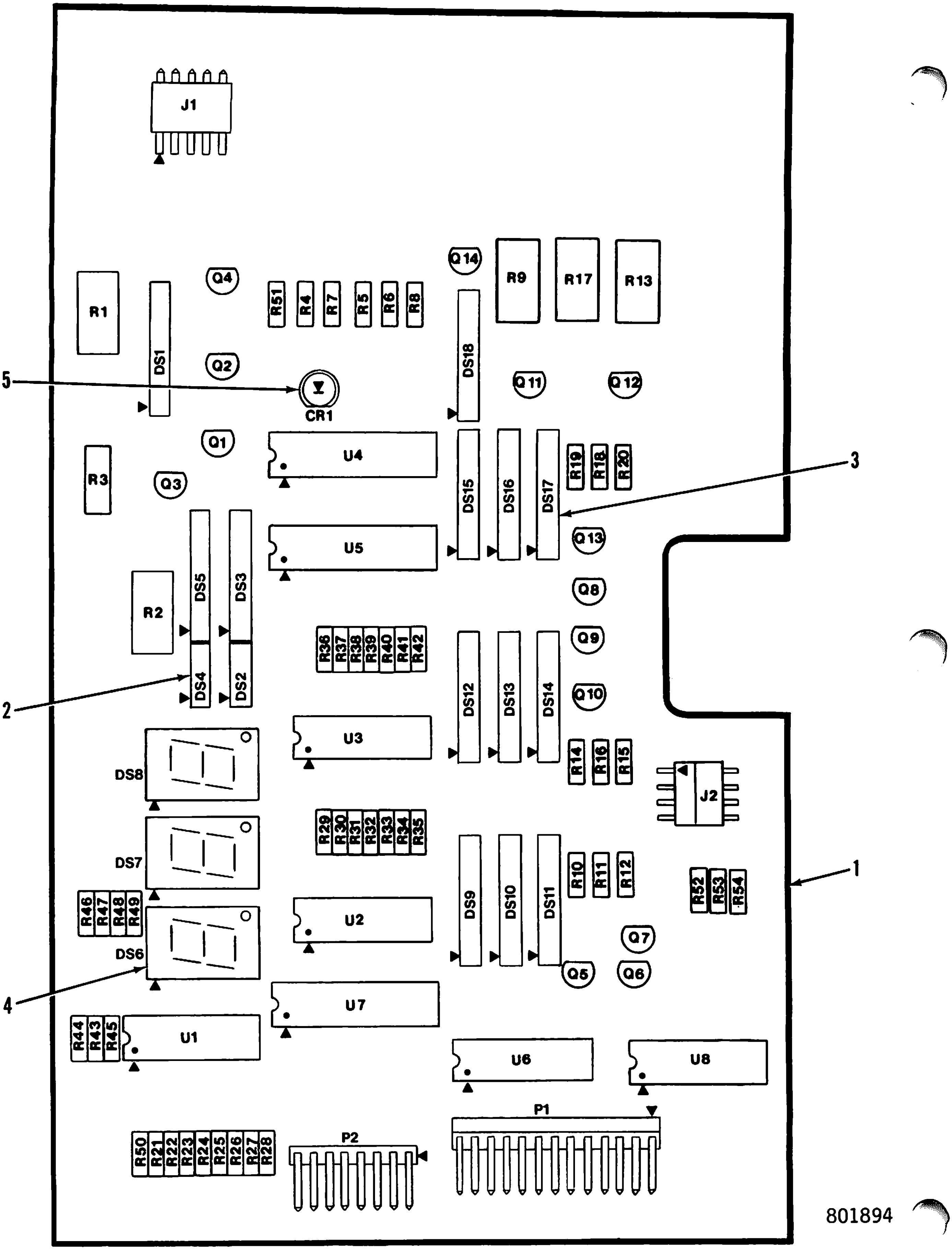


FIGURE 5-4. SWITCH INTERFACE DISPLAY PCB ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4	801894-01	PCB ASSY, Switch Interface/Display		REF
1	801893-05	. BOARD, Printed Circuit		1
2	201362-010	. SOCKET, Elevator stripline (under . DS4-5/DS2-3)		2
3	201362-006	. SOCKET, Elevator stripline (under . DS9 - DS18)		11
4	200298-001	. SOCKET, IC, W/W, Dip (under DS6, DS7 & DS8)		3
5	201434-002	. SOCKET, LED, 2 pin (under CR1)		1
U1-U3	201304-000	. IC, Dig, DCDR/Driver, CD4511		3
U4,5	201300-000	. IC, Dig, OCTAL LATCH, 74LS374		2
U6	201299-000	. IC, Dig, DCDR/DEMUX, 2, 74LS139		1
U7	201298-000	. IC, Dig, Buffer, 8 Bit, 74LS240		1
U8	201686-000	. IC, Dig, Buffer, 4 Bit, 74LS365A		1
DS1	802349-12	. LED, Display, Light bar, 4 LED, Green		1
DS2,4	802349-18	. LED, Display, Light bar, 2 LED, Red		2
DS3	802349-02	. LED, Display, Light Bar, 4 LED, Red		12
DS5		. Same As DS3		
DS6-8	801957-02	. LED, Display, Numeric, 7 segment, Red		3
DS9-18		. Same As DS3		
CR1	200491-039	. LED, Yellow, 2.5V		1
R1	200120-059	. RESISTOR, 750, 1W, 5%, CC		4
R2	200120-057	. RESISTOR, 620, 1W, 5%, CC		1
R3	200124-063	. RESISTOR, 430, 1/2W, 5%, CC		1
R4	200470-052	. RESISTOR, 150, 1/2W, 5%, CF		1
R5-8	200470-088	. RESISTOR, 4.7K, 1/4W, 5%, CF		25
R9		. Same As R1		
R10-12		. Same As R5		
R13		. Same As R1		
R14-16		. Same As R5		
R17		. Same As R1		
R18-28		. Same As R5		
R29-49	200470-055	. RESISTOR, 200, 1/4W, 5%, CF		21
R50	200470-072	. RESISTOR, 1K, 1/4W, 5%, CF		1
R51-54		. Same As R5		
Q1-14	200942-001	. TRANSISTOR, NPN, VCEO, 40V, PN2222A		14
J1	200534-030	. CONNECTOR, Plug, PCB, 5 contact		1
J2	200534-029	. CONNECTOR, Plug, PCB, 4 contact		1
P1	201338-005	. CONNECTOR, Header, PCB		1
P2	200534-033	. CONNECTOR, Plug, PCB, 8 contact		1

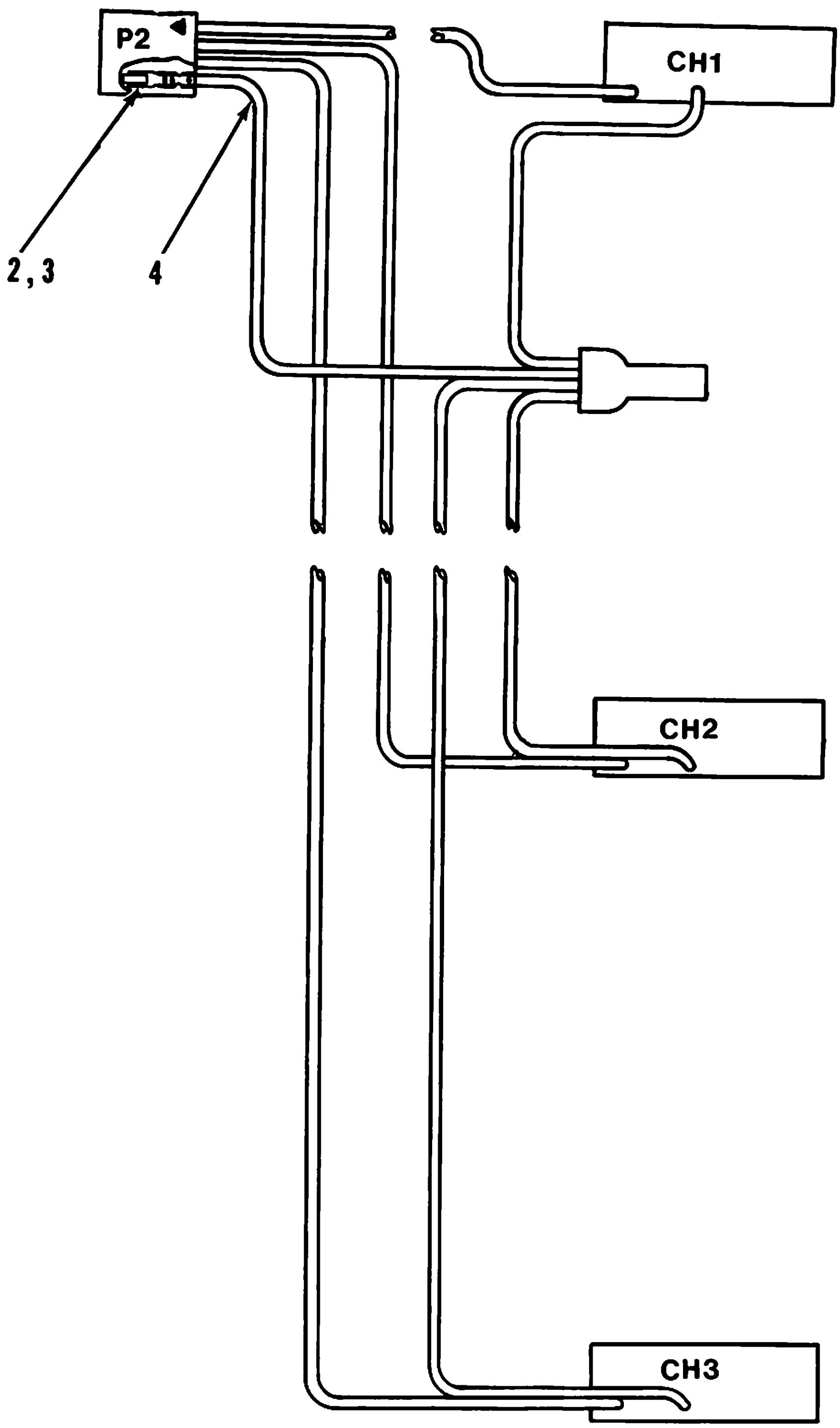


FIGURE 5-5. REED SWITCH HARNESS ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5				
1	803061-00	HARNESS ASSY, Reed Switch		REF
CH1-3	803060-00	. SWITCH, Magnetic Reed		3
P2	200419-021	. CONNECTOR, Housing, 4-Contact		1
2	200390-000	. TERMINAL, Socket		4
3	200992-000	. TERMINAL, Splice, Closed End		1
4	200357-163	. WIRE, Stranded, PVC, 300V, CSA, Blk		A/R

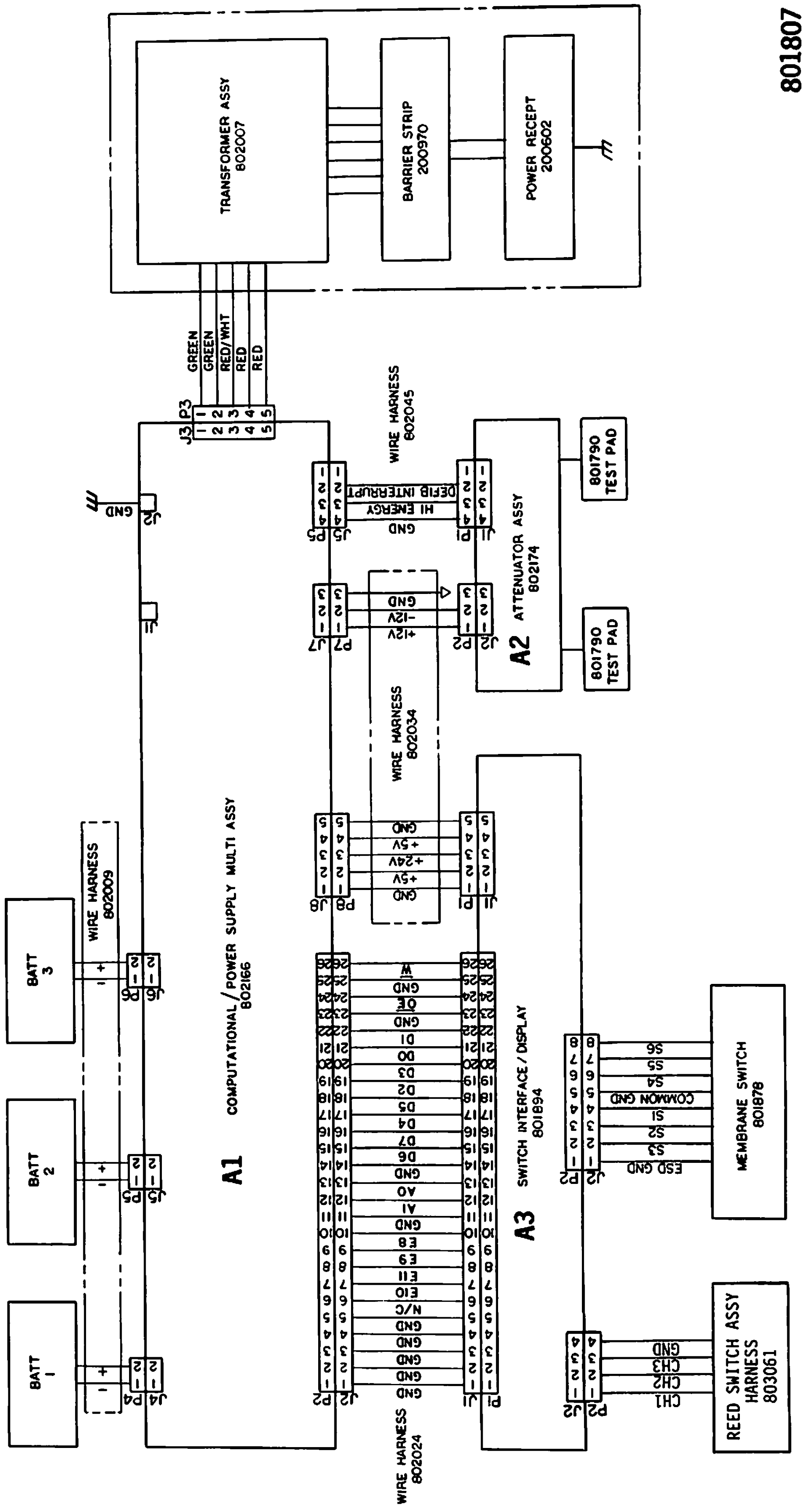
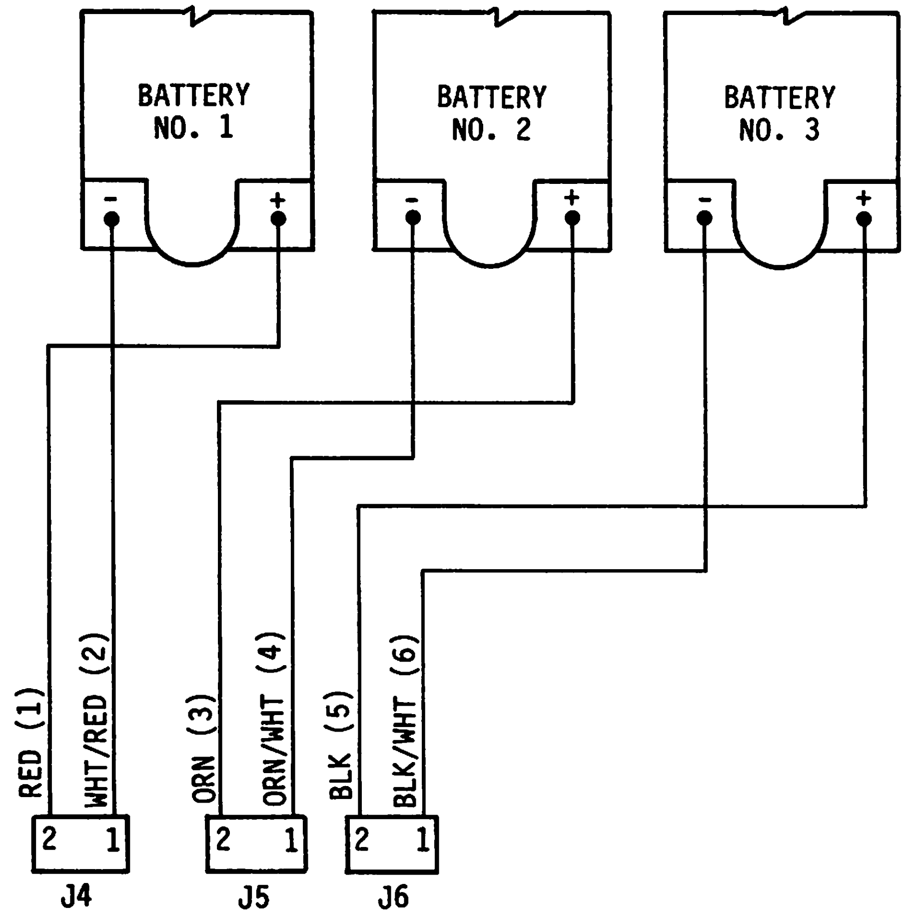


FIGURE 6-5. INTERCONNECTION DIAGRAM

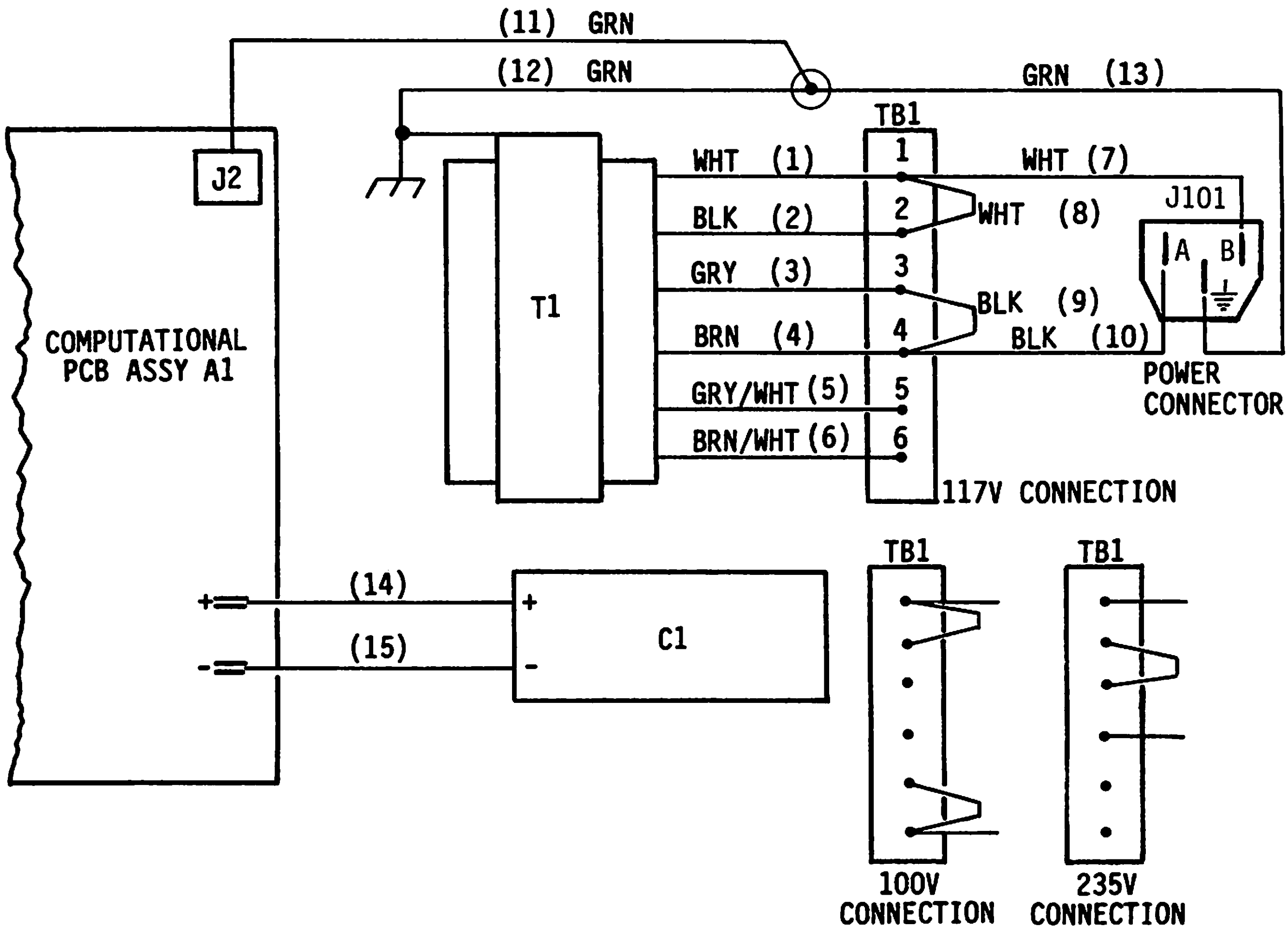


WIRE LIST

WIRE NO.	ORIGIN	TERMINATION	COLOR	GAGE	DESTINATION	TERMINATION
1	J4-1	200390-016	RED/WHT	#22	BATT 1 -	200276-210
2	J4-2	200390-016	RED	#22	BATT 1 +	200276-210
3	J5-1	200390-016	ORN/WHT	#22	BATT 2 -	200216-210
4	J5-2	200390-016	ORN	#22	BATT 2 +	200216-210
5	J6-1	200390-016	BLK/WHT	#22	BATT 3 -	200216-210
6	J6-2	200390-016	BLK	#22	BATT 3 +	200216-210

802009

FIGURE 6-4. BATTERY CONNECTION WIRING DIAGRAM

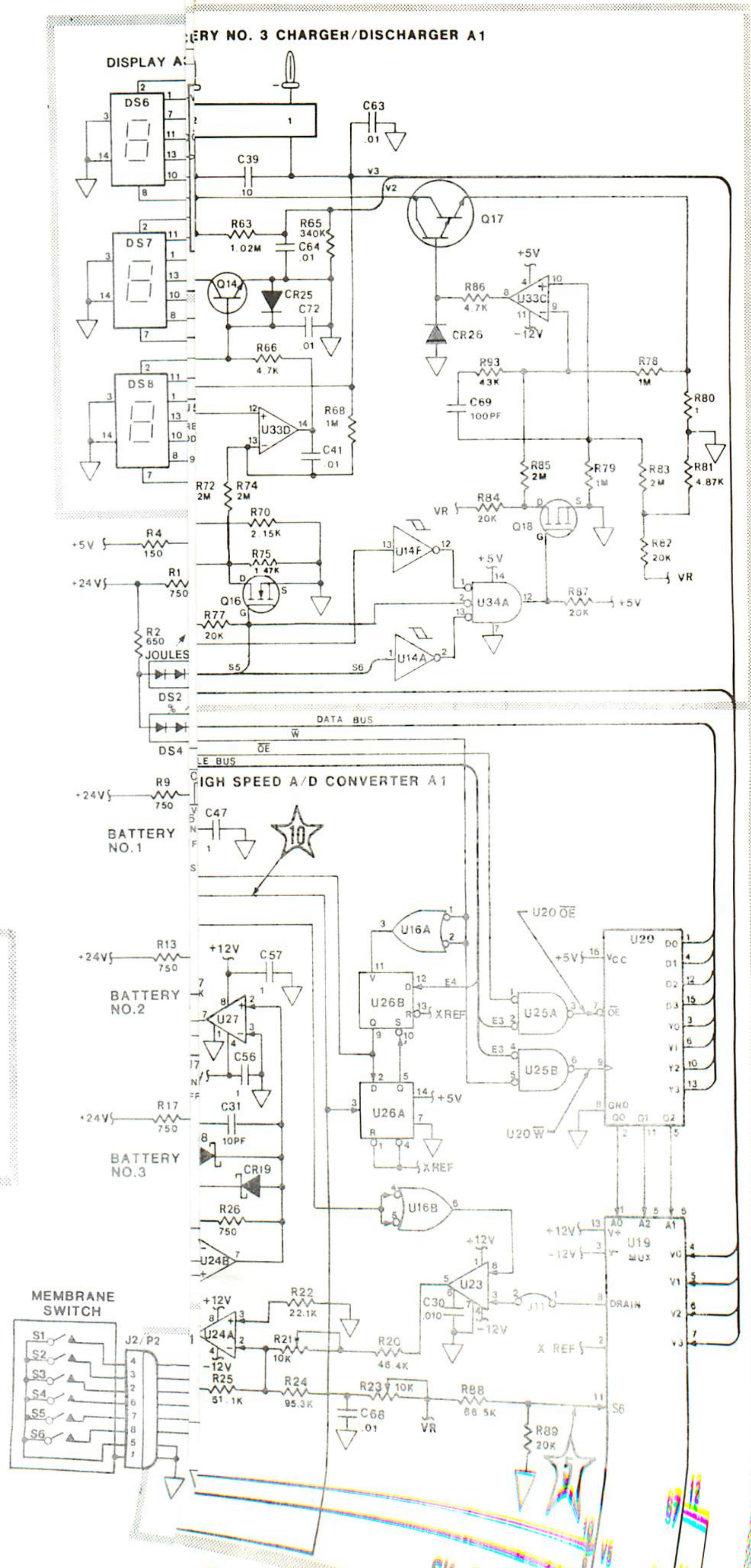


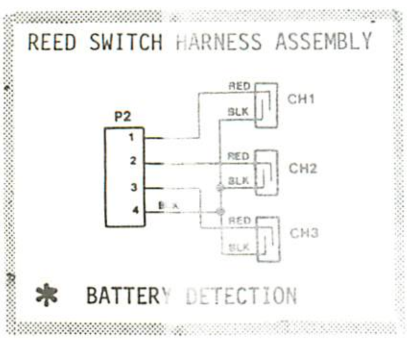
WIRE LIST

WIRE NO.	ORIGIN	TERMINATION	COLOR	GAGE	DESTINATION	TERMINATION
1	T1	PART OF T1	WHT	PART OF T1	TB1-1	200671-034
2	T1	PART OF T1	BLK		TB1-2	
3	T1	PART OF T1	GRY		TB1-3	
4	T1	PART OF T1	BRN		TB1-4	
5	T1	PART OF T1	GRY/WHT		TB1-5	
6	T1	PART OF T1	BRN/WHT		TB1-6	200671-034
7	TB1-1	200671-034	WHT	#18	J101B	200916-002
8	TB1-1	200671-034	WHT	#18	TB1-2	200671-034
9	TB1-3	200671-034	BLK	#18	TB1-4	200671-034
10	TB1-4	200671-034	BLK	#18	J101A	200671-034
11	A1J2	201129-000	GRN	#18	CHASS GND	200276-211
12	T1-GND	200276-211	GRN	#18	CHASS GND	200276-211
13	J101 GND	200671-034	GRN	#18	CHASS GND	200276-211
14	A1+	201129-000	RED	#22	C1 +	200276-209
15	A1-	201129-000	BLK	#22	C1 -	200276-209

801807

FIGURE 6-3. AC POWER WIRING DIAGRAM





SK 50444

FIGURE 6-2. SYSTEM FUNCT

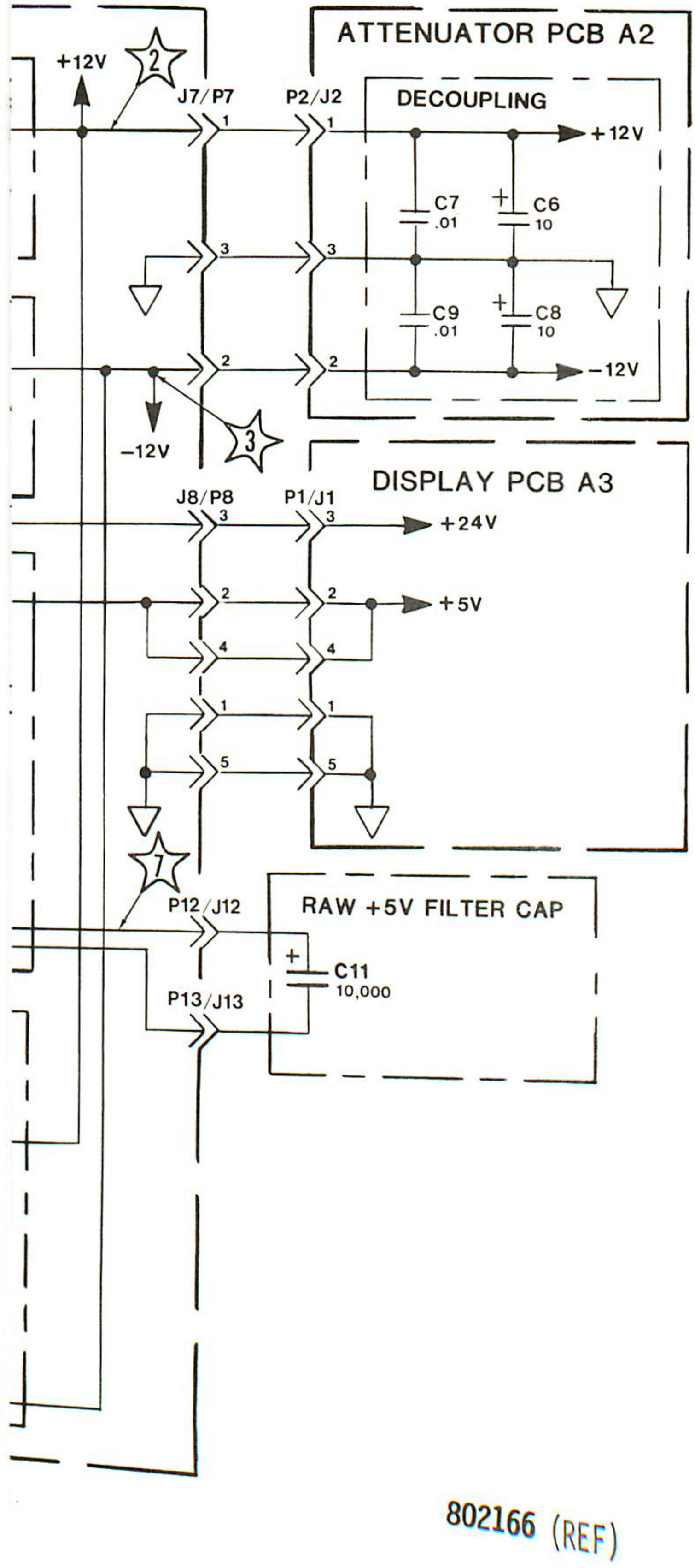


FIGURE 6-1. SYSTEM POWER SUPPLY SCH

6-3/6-4

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SECTION 6

SCHEMATICS

6-1. GENERAL

This section provides schematic drawings for the Battery Support System. Table 6-1 lists the schematic drawings for the LIFEPAK 5 Battery Support System.

TABLE 6-1

SCHEMATIC DRAWINGS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
802166	SYSTEM POWER SUPPLY SCHEMATIC	6-1
SK 50444	SYSTEM FUNCTIONAL SCHEMATIC	6-2
801807	AC POWER WIRING DIAGRAM	6-3
802009	BATTERY CONNECTION WIRING DIAGRAM	6-4
801807	INTERCONNECT DIAGRAM	6-5