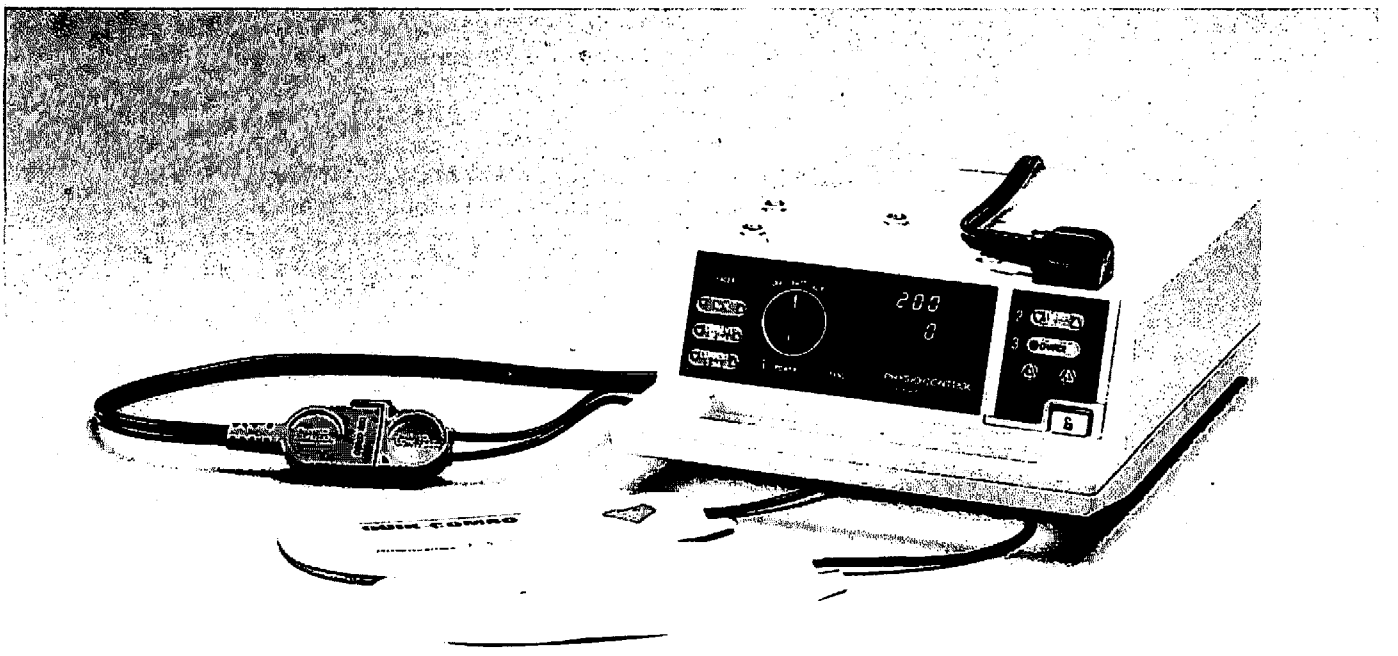
Service Manual

LIFEPAK ® 11 defibrillator/pacemaker



Manual No. 3006038-00
January 1996

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Part No. _____

Serial No. _____

About This Manual: This Service Manual is intended for use by technical service personnel. It describes how to maintain, test, troubleshoot, and repair the LIFEPAK 11 defibrillator/pacemaker. *It is the responsibility of our customers to ensure that the appropriate person(s) within their organization have access to this information.*

A separate publication, the ***Operating Instructions***, is intended for use by physicians, clinicians, and emergency care personnel. It provides step-by-step instructions for all operating features of the LIFEPAK 11 defibrillator/pacemaker as well as operator-level testing and maintenance.

Trademarks

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QUIK-COMBO, CODE SUMMARY, and PARTSLINE are trademarks of Physio-Control Corporation.
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Warranty

Refer to the product warranty statement included in the accessory kit shipped with the product. Duplicate copies may be obtained by contacting your local Physio-Control sales or service office.

Defibrillator Tracking

US only, including US government-owned units:
Under the Safe Medical Devices Act of 1990, defibrillator manufacturers and distributors are required to track the location of defibrillators. If your defibrillator has been sold, donated, lost, stolen, exported, or destroyed, or if it was not obtained directly from Physio-Control, please notify Physio-Control at 800.442.1142, extension 4530.

Responsibility for Information

It is the responsibility of our customers to ensure that the appropriate person(s) within their organization have access to the information in this manual.

Device Recycling

Recycle the device at the end of its useful life.

- **Preparation**
  The device should be clean and contaminant-free prior to being recycled.
- **Recycling Assistance**
  The device should be recycled according to national and local regulations. Contact your local Physio-Control representative for assistance.
- **Recycling of Disposable Electrodes**
  After using disposable electrodes, follow your local clinical procedures for recycling.
- **Packaging**
  Packaging should be recycled according to local and national regulations.

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Safety Information

Introduction

This safety information includes terms and symbols used in this manual or on the equipment. The information alerts both operating and service personnel of recommended precautions in care, use, and handling of this specialized medical equipment.

Refer to NFPA (National Fire Protection Association) 99-1990, **Health Care Facilities**, and NFPA 70-1994, **National Electrical Code** for specific guidelines on the standards and practices for health-care instruments and environments.

Terms

Certain terms are used in this manual or on the equipment. Familiarize yourself with their definitions and significance.

Danger: Immediate hazards that **will** result in serious personal injury or death.

Warning: Hazards or unsafe practices that **could** result in serious personal injury or death.

Caution: Hazards or unsafe practices which **could** result in minor personal injury or product damage.

Note: Points of particular interest for more efficient or convenient instrument operation; additional information or explanation concerning the subject under discussion.

General Warnings and Cautions

The following describes general hazards that could result in death, serious injury, or product damage. Specific warnings and cautions that do not appearing in this section can be found throughout the manual.

⚠ WARNINGS

Possible fire or explosion. Do not use this device in the presence of flammable gases or anesthetics. Use care when operating this device close to oxygen sources (such as bag-valve-mask devices or ventilator tubing). Refer to safety documents NFPA 99-1990, **Health Care Facilities**, and NFPA 70-1994, **National Electrical Code** (Health Care Facilities section).

Shock or fire hazard. Do not immerse any portion of this device in water or other fluids. Avoid spilling any fluids on the device or accessories.

Patient hazard. Do not mount device directly above patient. Place the device in a location where it cannot harm the patient should it fall from its shelf or other mount.

Shock or fire hazard. Equipment or accessories improperly interconnected to each other can be a source of ignition or cause a shock. Make sure that all equipment is interconnected safely in accordance with NFPA 70-1994, **National Electric Code**.

Note. Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. It is important that you verify and observe the required applications in your location. Check leakage current and grounding requirements after interconnecting this device with accessory equipment.

⚠ CAUTIONS

Possible device damage. This device may be damaged by mechanical/physical abuse (e.g., immersion in water, drop exceeding 30 inches with carrying case, drop exceeding 18 inches without carrying case).

Possible component damage. Do not mount the device near vibration sources such as engine struts and landing gear.

Possible device damage. Broken or frayed wires, or loose snap fittings may cause interference or loss of signal. Pay particular attention to the point at which the wires enter the terminals. Repeated flexing at these points eventually causes the wire strands to break. Perform frequent electrical and visual inspections of cables and wires.

Symbols

The following list includes symbols that may be used in this manual or on the equipment.


Off (power: disconnection from the AC mains)

On (power: connection to the AC mains)


Defibrillation protected, type CF patient connection


Defibrillation protected, type BF patient connection


On labels: Attention, consult accompanying documents
On status display: Contact qualified service technician


Caution, high voltage

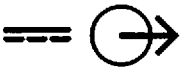

Protective earth (ground)


Fuse


Equipotentiality connector

\+ Positive input terminal

\- Negative input terminal


12V DC Output cable


12V DC Input cable


Output


AC current

Static Sensitive Device (SSD)

Recycle battery

Recycle battery

General Information

Service Information

Before attempting to clean or repair any assembly in this instrument, the technician should be familiar with the information provided in Section 4, **Service and Maintenance.**

A qualified technician should inspect any defibrillator that has been dropped, damaged, or abused to verify that the instrument is operating within performance standards listed in Section 3, **Performance Inspection Procedure (PIP)**, and that the leakage current values are acceptable.

Component replacement and internal adjustments must be made by service personnel qualified by appropriate training and experience.

If assistance in servicing the instrument is needed, contact your local Physio-Control service or sales representative. In the USA, contact Physio-Control at 1-800-442-1142.

Effective Publication Dates

The effective publication date for each page of this manual is listed below.

Title		Page			Date
Trademark and Warranty					January 1996
Table of Contents		iii	thru	viii	January 1996
Safety Information		ix	thru	xi	January 1996
General Information		xii	thru	xiv	January 1996
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Configuration Information

This manual is current with the following revision level: final assembly, part number 806545, revision A7.

Overview

This manual contains the following information:

Section 1

Description: This section describes how the defibrillator works. Topics include: input signals, subassembly functions, and instrument outputs.

Section 2

Operation: This section familiarizes the operator with basic equipment functions and it identifies Controls, Indicators, and Connectors. This section is not intended to instruct the operator how to use the instrument. A separate *Operating Instructions* manual is available.

Section 3

Testing and Troubleshooting: This section contains a Performance Inspection Procedure (PIP). The PIP is a series of steps to follow when performing an operational closed-case check of the equipment. A PIP checklist that can be duplicated and used during testing is provided. Test and Calibration Procedures (TCP) are provided so that a service technician can test and calibrate an instrument. Troubleshooting aids are also included.

Section 4

Service and Maintenance: This section provides instructions for inspecting, cleaning, and maintaining the instrument.

Section 5

Parts Lists/Schematics: This section lists supplies, equipment, and accessories and contains a final assembly illustrated parts list.

Section 1

Description

Introduction

This section describes LIFEPAK 11 defibrillator/pacemaker features, functions, and theory of operation. Topics include:

- Physical description that includes general features and specifications
- Interconnection and operation with the companion LIFEPAK 11 diagnostic cardiac monitor
- Theory of operation to the assembly level that includes block diagrams and circuit descriptions.

Physical Description and Features

The LIFEPAK 11 defibrillator/pacemaker (Figure 1-1) is a portable, battery-powered instrument. The device can deliver defibrillation, synchronized cardioversion, or pacing therapies. It can be used as a stand-alone defibrillator. However, the defibrillator must be connected to a LIFEPAK 11 diagnostic cardiac monitor to deliver synchronized cardioversion and pacing.

Battery

A single, rechargeable +12Vdc nickel-cadmium FASTPAK® battery powers the instrument. An optional, Auxiliary Power Supply can connect to the defibrillator to power the instrument and to trickle-charge the installed battery. The optional Battery Support System can recharge and recondition the FASTPAK batteries.

Power Switch

The three-position rotary POWER switch on the front panel selects the defibrillator battery or Auxiliary Power Supply. When the instrument is equipped with the pacemaker option, there are an additional four buttons on the left front panel.

Therapy Modules

Two therapy modules, which deliver the defibrillation, monitoring, and pacing therapies, plug directly into the instrument. The QUIK-COMBO module uses the same set of combination electrodes for defibrillation, monitoring, or pacing. The Standard Paddles module uses standard paddles for defibrillation and monitoring and uses QUIK-PACE electrodes for pacing.

Carrying Case

A removable carrying case that can be used to operate the defibrillator with a LIFEPAK 11 diagnostic cardiac monitor is also available. The case provides detachable pouches for storing accessories such as batteries, cables, and electrodes.

Carrying Handle

The defibrillator/pacemaker has a carrying handle in front and a retractable bail underneath for tilting up the instrument.

Optional Cardiac Monitor

The LIFEPAK 11 diagnostic cardiac monitor provides the LIFEPAK 11 defibrillator/pacemaker with the following features and capabilities:

- Display screen that shows LIFEPAK 11 defibrillator/pacemaker pacing pulse status
- R-wave detection packets that control the timing of LIFEPAK 11 defibrillator/pacemaker synchronous cardioversion energy and the application of trans-thoracic pacing pulses
- Defibrillation and pacing information that is included in the CODE SUMMARY™ critical event record.

The LIFEPAK 11 defibrillator/pacemaker, in turn, provides the LIFEPAK 11 diagnostic cardiac monitor with the following capabilities:

- Isolated ECG (delivered through the hard paddles or the defibrillation electrodes)
- Defibrillation and pacing capabilities.

For complete information about LIFEPAK 11 defibrillator/pacemaker operation, refer to the defibrillator Operating Instructions.

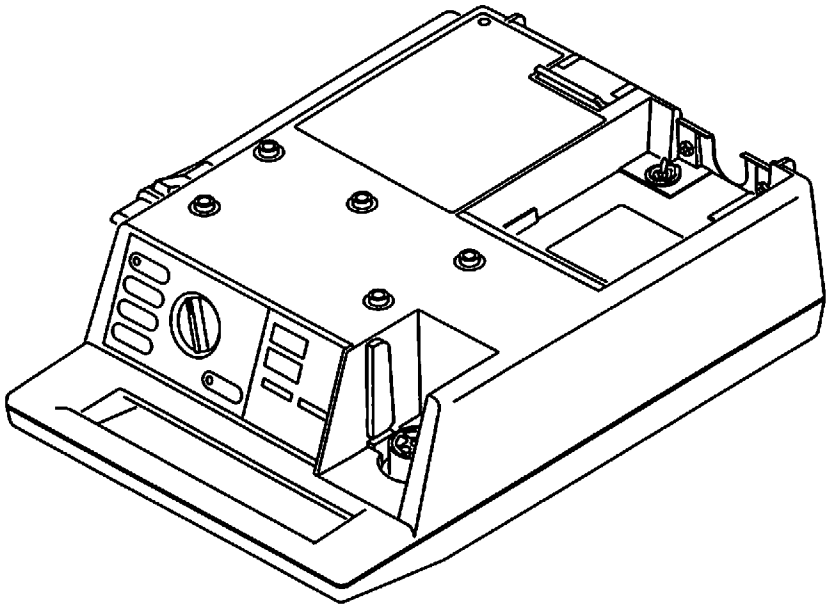


Figure 1-1 LIFEPAK 11 defibrillator/pacemaker

Operating with the LIFEPAK 11 diagnostic cardiac monitor

The LIFEPAK 11 defibrillator/pacemaker is designed to operate with the LIFEPAK 11 diagnostic cardiac monitor. In this configuration, the monitor stores, prints, and transmits patient reports via telecommunications to a Physio-Control RS 100 receiving station.

The defibrillator and monitor are joined by mechanical slides and an electrical interface (Figure 1-2). The defibrillator and monitor can pass electrical signals through the electrical contacts. When connected, however they do not share power from the batteries located in each unit. If the proper cable is used, a single Auxiliary Power Supply can power both the monitor and defibrillator.

Note: The display of the defibrillator LOW BATT message applies only to the defibrillator and not to the monitor. (The monitor has its own low battery message.)

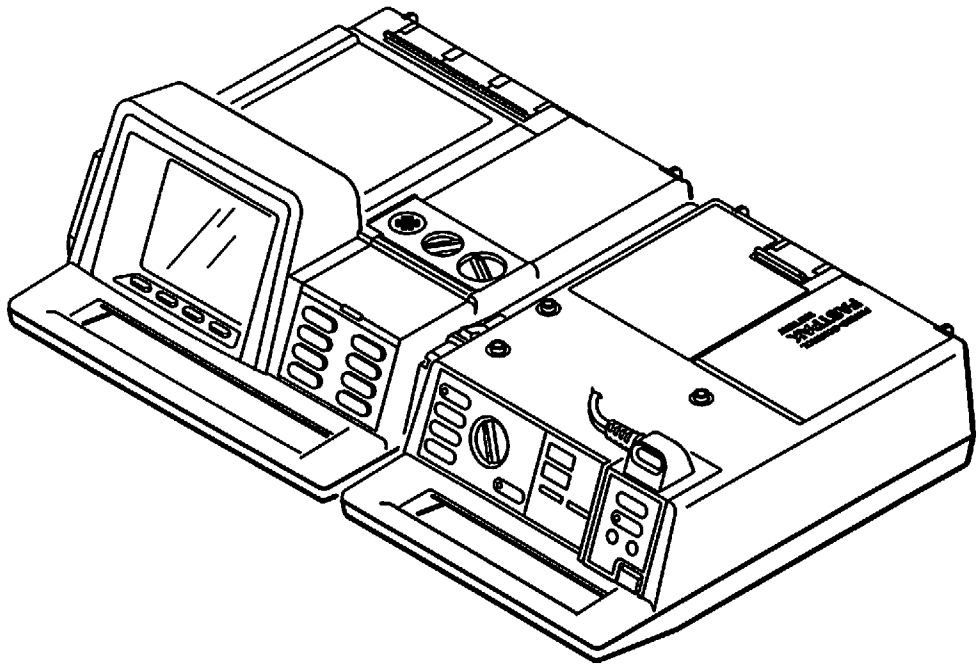


Figure 1-2 LIFEPAK 11 defibrillator/pacemaker and LIFEPAK 11 diagnostic cardiac monitor

Therapy Connections

The LIFEPAK 11 defibrillator/pacemaker provides defibrillation and external pacing therapy through:

- Standard paddles
- QUICK-PACE® electrodes
- QUIK-COMBO™ pacing/defibrillation/ECG electrodes.

The defibrillation controls are located on the selected therapy module. The red connector at the front of the defibrillator connects the defibrillator with the therapy module.

Specifications

The LIFEPAK 11 defibrillator/pacemaker specifications are listed in Table 1-1.

Table 1–1 Specifications

Power	Power Consumption	4.5 watts (idle mode). 120 watts peak (defibrillator charging). 11.5 watts (Pacing at 170ppm, 200mA).
	AC Input Options	Compatible with Physio-Control AC Auxiliary Power Supply.[1]
	Battery	One nickel-cadmium FASTPAK battery.
	Battery Operating Time	A new fully-charged battery provides the following prior to shutdown: At least 25 360-joule discharges. 60 minutes of pacing at the maximum rate.
	Low Battery Indicator	Flashing LOW BATT indicator on instrument front panel.
	Service Indicator	Flashing SERVICE indicator on instrument front panel.
Size	Height	10.2cm (4.0in).
	Width	23.6cm (9.3in).
	Depth	33.8cm (13.3in).
	Weight	4.1kg (9.25lbs) without battery or other accessories.
Pacing	Current	10 to 200mA, selected in 20mA and 5mA steps. Accurate to +5% or +5mA of the current selected (whichever is greater) for a nominal load of 700 ohms in parallel with 3μ F.
	Pulses per minute	40 to 170 PPM.
Defibrillation	Energy Settings	Standard-paddles; 0, 5, 10, 20, 50, 100, 200, 300 and 360 joules*. QUIK-COMBO; 0, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50, 100, 200, 300 and 360 joules*. *Accurate to 10% or 1 joule, whichever is greater.
	Charge Time	Charges to 360 joules in less than 10 seconds.
	Synchronous	Less than 25ms from Sync indication to peak discharge (LIFEPAK 11 diagnostic cardiac monitor required).
	Waveform	Edmark in shape. Satisfies requirements of AAMI DF2-1989 Defibrillator Standard.
	Polarity	Apex or Anterior (+), Sternum or Posterior (-).
Communications	Monitor	Communications are via the LIFEPAK 11 diagnostic cardiac monitor.
Environmental	Operating Temperature	-10 to +55°C (+14 to +131 °F) Operation below 0°C (+32°F) assumes that the unit has been stored (2 hours minimum) at +20°C (+68°F) or greater prior to typical clinical use.
	Storage Temperature	-20 to +60°C (-4 to +140F).
	Atmospheric Pressure	797 to 439mmHg (-570 to +15000ft).
	Relative Humidity	0 to 95% (non-condensing).
	Water Resistance	IPX4 (splash-proof) per IEC 529.

All specifications at 25° C unless otherwise stated.
1. The Auxiliary Power Supply may not be available for use in all countries; contact your local Physio-Control representative for more information.

Functional Description

The LIFEPAK 11 defibrillator/pacemaker consists of three Printed Circuit Board (PCB) assemblies and a Transfer Relay Assembly. The assemblies include the following:

- Main PCB (A1)
- Pacer PCB (A2)
- Keypad PCB (A3)
- Transfer Relay (A4)

For a block diagram of the defibrillator/pacemaker, refer to Figure 1-3. The assembly descriptions presented in the following paragraphs are made to the block level. Refer to Section 5 for an interconnection diagram of the assemblies.

A1 Main PCB

The Main PCB provides the electrical circuitry for all instrument functions, including power supply conversions. The PCB consists of the following six subcircuits:

- Power Selection
- Low Voltage Power Supply
- Microprocessor and Memory
- Capacitor Energy Management
- 10-bit Analog-to-Digital Converter
- ECG Isolation Amplifier

Power Selection

The Power Selection circuits consist of electronic switches. These switches route the +12Vdc power from either the battery or from the auxiliary power connector to the instrument. The position of the POWER select switch turns the appropriate switches either on or off. The Main PCB Contains two fuses (15A, 32V, fastblow).

Low Voltage Power Supply

The Low Voltage Power Supply receives a +12Vdc input from the battery or auxiliary power supply and sources regulated +15Vdc, -15Vdc and +5Vdc to operate circuits within the LIFEPAK 11 defibrillator/ pacemaker. The low-voltage supply provides power and bias voltages to low-power circuits only. The supply does not power the high-voltage capacitor charger and trans-thoracic pacer. The +12Vdc generated by either the battery or the auxiliary power supply powers these circuits directly.

Microprocessor and Memory

The Microprocessor and Memory assembly and its related digital components control all instrument functions, including:

- Connecting the assembly with the operator controls and displays
- Providing bidirectional serial data communications with the monitor
- Maintaining the instrument's energy and pacer calibrations
- Performing and controlling the instrument's self-test function

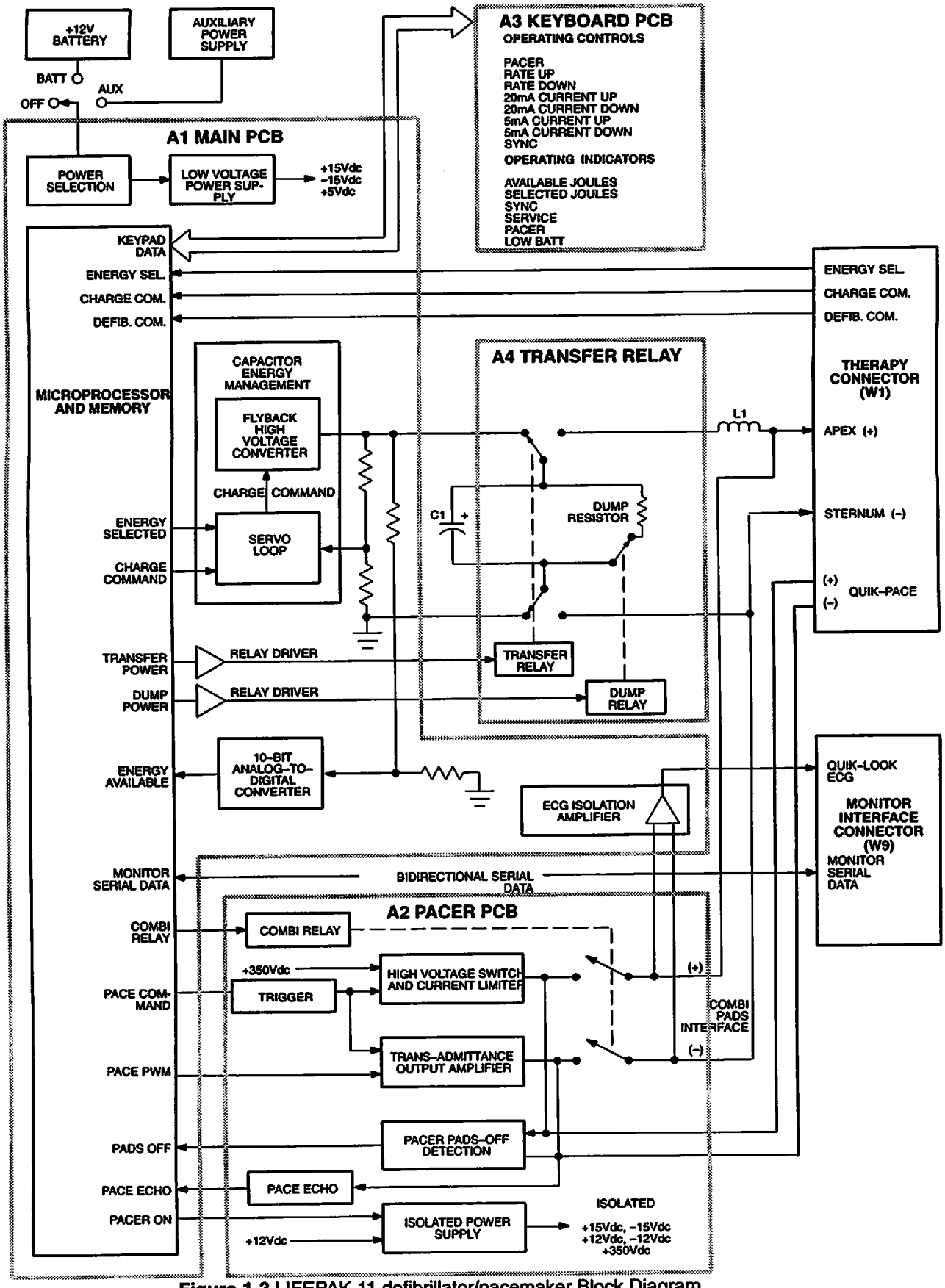


Figure 1-3 LIFEPAK 11 defibrillator/pacemaker Block Diagram

Capacitor Energy Management

The Capacitor Energy Management circuitry is a servo loop and high-voltage source that controls the amount of energy stored in the C1 capacitor. The operator selects the energy level with the energy selector located on the sternum hard paddle or the controls on the QUIK-COMBO therapy module. The microprocessor processes the energy selection by generating a pulse train, whose duty cycle is a function of the energy level requested. The circuit extracts the dc component of this pulse train and uses it as the set point for the servo loop. The other servo loop input is the capacitor voltage, which is obtained through a voltage divider.

The defibrillator charge command releases the servo loop and causes a flyback high-voltage converter to generate current into the capacitor. Current continues to flow until the capacitor voltage reaches the desired value. The servo loop then stops the flyback converter. If the operator selects a lower energy level when the capacitor is charged, the servo loop reduces the capacitor voltage. This circuitry momentarily energizes the dump relay on the A4 Transfer Relay, which puts the dump resistor across the capacitor terminals, reducing the voltage.

To make the selected energy dose available for 60 seconds, the servo loop maintains the charge on C1. If the energy is not delivered within 60 seconds, the microprocessor energizes the dump relay, which connects the dump resistor R1 across C1 and discharges the stored energy.

10-bit Analog-to-Digital Converter

The 10-bit Analog-to-Digital Converter:

- Monitors the C1 voltage (and thereby the stored energy)
- Applies the result to the microprocessor in the form of parallel, 10-bit data

The circuit operates by scaling the C1 voltage with a voltage divider and then converting the voltage into a digital representation with the A-to-D converter. The microprocessor processes the 10-bit digital data and presents the results on the defibrillator/pacemaker front panel Energy Available display.

ECG Isolation Amplifier

The Isolation Amplifier routes a patient's ECG from the Therapy Connector (W1) to the Monitor Interface Connector (W9) so it can interface with the LIFEPAK 11 diagnostic cardiac monitor. In the PADDLES monitoring mode, the monitor takes the ECG signal and displays it on the screen. The isolation amplifier provides at least 7.5kV of isolation between the connections on W1 and W9.

A2 Pacer PCB

The Pacer PCB (A2) provides the electrical circuits for all of the instrument pacing functions, including power supply conversions. The PCB consists of five subcircuits:

- Isolated Power Supply
- Pacer Pads-Off Detection
- High Voltage Switch and Current Limiter
- Trans-Admittance Output Amplifier
- Pace Echo

Isolated Power Supply

The Isolated Power Supply receives a +12Vdc input from either the battery or auxiliary power supply to generate the following isolated and regulated voltages for use on the Pacer PCB (A2):

- +15Vdc
- -15Vdc
- +12Vdc
- -12Vdc
- +350Vdc

The microprocessor turns all voltage sources on or off. The power supply is turned on only when the operator requests pacing therapy. The pacer output is "patient connected", so the isolated power supply can stand off 7.5KV between its isolated outputs and the +12Vdc power input.

Pacer Pads-Off Detection

The Pace Pads-Off Detection circuits prevent generation of pacing pulses when the pacing pads are not attached to a patient. The circuit drives a nominal 4μA at 2kHz between the pads and measures the resultant voltage. For a nominal 10kΩ pads-on impedance, the developed voltage is 40mV. This voltage is compared with a reference voltage. If the developed voltage is zero (pads off), the Pads-Off Detection Circuit sends a signal to the microprocessor, which prevents pacer operation.

High Voltage Switch and Current Limiter

When triggered by the microprocessor, the High Voltage Switch and Current Limiter applies +350Vdc to the pacer Posterior pad and limits the output current to 250mA. Connecting the +350Vdc source to the pad for the duration of the pace pulse avoids interference with the pads-off detector. The Trans-Admittance Output Amplifier provides a current sink for the +350V pulse.

Trans-Admittance Output Amplifier

When triggered by the microprocessor, the Trans-Admittance Output Amplifier sinks current from the Anterior pacer pad and reflects the pacing parameters selected by the operator. The amplifier remains connected to the Anterior pad without interfering with the Pacer Pads-Off Detection circuits. The connection is maintained because the amplifier has an extremely high output impedance.

Pace Echo

The Pace Echo circuit monitors each pace pulse that is applied to the patient. The circuit encodes pulse width and amplitude into a Pace Echo pulse, and sends the data to the microprocessor. If the pacer has a failure, the Pace Echo pulse has the wrong form. When this occurs, the software lights the Service indicator and sounds an alarm.

A3 Keypad PCB

The Keypad PCB (A3) provides the electrical circuits for all instrument operating controls and indicators. The PCB consists of two subcircuits:

- Operating Controls
- Operating Indicators

Operating Controls

The eight Operating Controls supplied by the PCB include:

- Pacer
- Rate Up
- Rate Down
- Current 20mA Up
- Current 20mA Down
- Current 5mA Up
- Current 5mA Down
- Sync

The switch arrangement is a 3x3 matrix (one position is not used). The microprocessor scans the switches for key closures.

Operating Indicators

The six Operating Indicators supplied by the PCB are:

- SYNC
- SERVICE
- PACER
- SELECTED ENERGY (seven-segment display)
- LOW BATT
- AVAILABLE ENERGY (seven-segment display)

The indicators are LEDs, which are illuminated by the microprocessor. Two are seven-segment displays; the rest are light bars. However, hardware voltage and timing monitors can also light up the SERVICE indicator during the self-tests.

A4 Transfer Relay Assembly

The Transfer Relay Assembly (A4) provides the switching functions for the C1 capacitor. The relay assembly consists of two separate relays:

- Transfer Relay
- Dump Relay

Transfer Relay

The Transfer Relay is a solenoid-activated double-pole, double-throw switch. In its normal (non-energized) position, the relay connects one side of C1 to the system ground. The relay connects the other side of the capacitor to the Capacitor Energy Management charging output.

When the relay is energized, it:

- Disconnects both C1 terminals from Main PCB
- Connects the terminals to the patient through the L1 inductor

The relay remains closed long enough to allow the capacitor C1 to completely discharge its energy into the patient. The C1 and L1 values provide an Edmark defibrillation pulse (Figure 1-4).

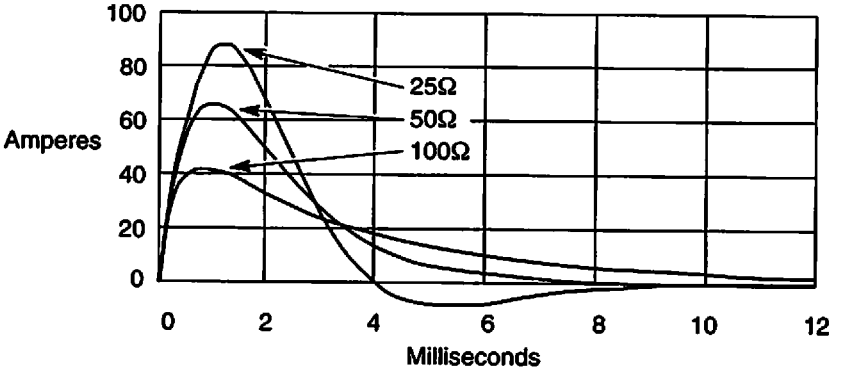


Figure 1-4 Edmark Defibrillation Pulse

Dump Relay

The Dump Relay is a single-pole, single-throw switch. In its normal (closed or non-energized) position, the relay connects a dump resistor across the C1 terminals. This arrangement ensures that the capacitor remains discharged, except when an operator specifically requests otherwise. When the operator requests to charge the capacitor, the dump relay is first energized (to open it). Then, the capacitor charge circuit is activated. An energy dump is performed whenever:

- The energy selection is changed while the capacitor is charging or when it is fully charged.
- The capacitor has been charged and ready for more than 60 seconds but not more than 65 seconds.
- The PACER button is pressed.
- The instrument is turned off.
- The therapy module is disconnected while the capacitor is charging or when it is fully charged.
- A service fault occurs.

Section 2

Operation

Introduction

This section of the manual provides information about the basic operation of the instrument, including:

- Controls, indicators, and connectors
- Input power
- Installing and removing therapy modules
- Connecting the defibrillator to the monitor
- Service mode

Controls, Indicators, and Connectors

Figure 2-1 and Table 2–1 provide an overview of LIFEPAK 11 defibrillator/pacemaker controls, indicators, and connectors.

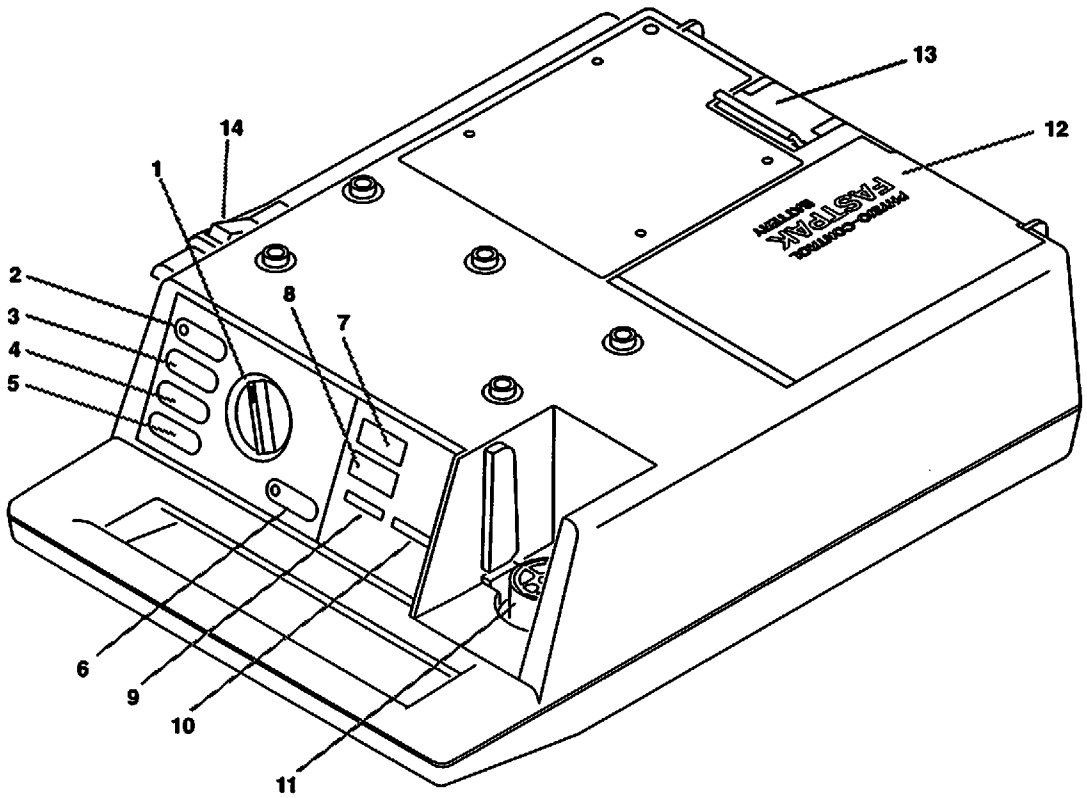


Figure 2-1 LIFEPAK 11 defibrillator/pacemaker controls, indicators, and connectors

Table 2–1 Defibrillator controls, indicators, and connectors

1	1 POWER	Switches between OFF, battery power (BATT), and auxiliary power (AUX) settings.
2	PACER (optional pacemaker function)	Turns the pacer function on and off. When the pacer function is on, an LED lights steadily.
3	▼ RATE ▲	Selects the pacing rate which ranges from 40ppm to 170ppm. Pressing the up symbol increases the rate; pressing the down symbol decreases the rate.
4	▼ 20 mA CURRENT ▲	Increases or decreases the pacing current in 20mA increments.
5	▼ 5 mA CURRENT ▲	Increases or decreases the pacing current in 5mA increments.
6	SYNC	Enables the synchronized cardioversion mode. The LED flashes each time the defibrillator detects a QRS complex. Pressing SYNC again returns the defibrillator to the asynchronous mode and turns off the LED.

Table 2–1 Defibrillator controls, indicators, and connectors, continued

7	JOULES SELECTED Indicator	Indicates the selected energy level. In the Standard Paddles module, selected energy levels are: 0, 5, 10, 20, 50, 100, 200, 300, and 360 joules. In the QUIK-COMBO module, selected energy levels are: 0, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50, 100, 200, 300, and 360 joules. Shows "– – –" if module not installed.
8	JOULES AVAILABLE Indicator	Indicates energy available for discharge. Until defibrillator is charged, the indicator shows 0.
9	SERVICE Indicator	Flashes and sounds a tone when the defibrillator senses a condition that requires service. The indicator continues to flash until the defibrillator power is switched off. Remove the defibrillator from service as soon as possible. Every time the service indicator is active (flashing), there is a service code associated with it. When the defibrillator is in the service mode, the indicator lights but does not flash on and off.
10	LOW BATT Indicator	Flashes when the battery power level is nearly depleted. The light will continue to flash until the battery is completely depleted and the defibrillator shuts down. The defibrillator may shut down with no LOW BATT indication if the battery has been damaged, improperly maintained, or depleted (if battery is very low on charge and the operator attempts to charge defibrillator).
11	Therapy module connector	Connects the Standard Paddles module or the QUIK-COMBO module to the defibrillator.
12	Battery	Provides a replaceable, rechargeable power source. Use only Physio-Control FASTPAK® batteries.
13	AUX POWER Connector	Connects to the optional AC or DC Auxiliary Power Supply.
14	Lock button	Locks the defibrillator and the monitor together.
15	Bail Incline (on bottom panel)	Extends to tilt the device up.

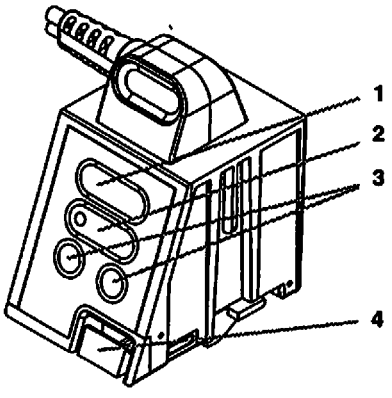


Figure 2-2 QUIK-COMBO module controls and indicators

Table 2–2 QUIK-COMBO module controls and indicators

1	▼ ENERGY SELECT ▲	Pressing the side of the button marked ▼ decreases the selected energy which is shown in the defibrillator ENERGY SELECTED display. Pressing the side of the button marked ▲ increases the selected energy which is shown in the defibrillator ENERGY SELECTED display. At power-on, the selected energy is 200 joules.

2	CHARGE Button	Charges the defibrillator to the selected energy. While the defibrillator is charging, the indicator light flashes. When charging is complete, the indicator lights steadily.
3	Discharge Buttons	Pressing both buttons simultaneously discharges the stored energy.
4	Release button	Pressing this button and simultaneously pulling the module up releases the module from the therapy module connector. For more details, see page 2-7.

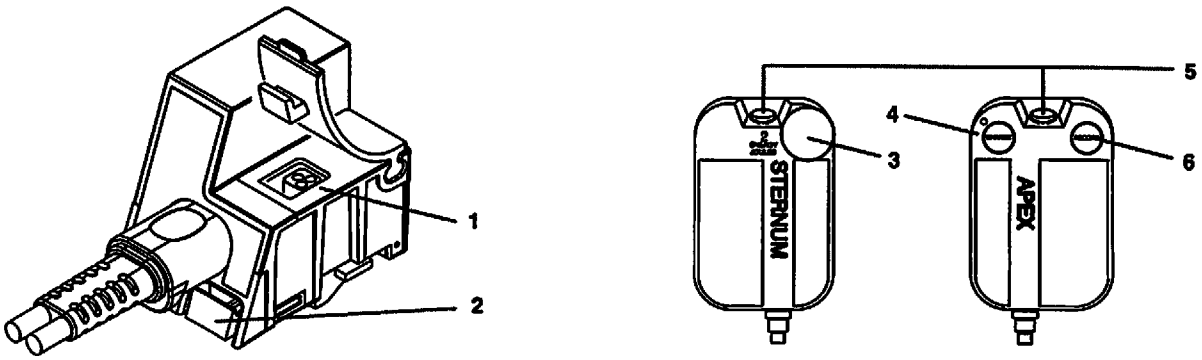


Figure 2-3 Standard Paddles module controls and connectors

Table 2–3 Standard Paddles module controls and connectors

1	QUIK-PACE connector	Connects the QUIK-PACE cable to the Standard Paddles module. Lift the protective cover for access to the connector.
2	Release button	Pressing this button while pulling the module up releases the module from the therapy module connector on the defibrillator. For more details, see page 2-7.
3	ENERGY JOULES Rotary Control	Selects one of the following energy settings: 0J, 5J, 10J, 20J, 50J, 100J, 200J, 300J, and 360J. Rotating this switch discharges any available energy internally. When 0J is selected, the defibrillator will not charge.
4	CHARGE Button	Charges the defibrillator to the selected energy level. Pressing this button also deactivates the pacemaker and resets pacing modes, if selected.
5	Discharge Buttons	Press both discharge buttons (red color–U.S.; black/amber–international) to discharge the device. During synchronized cardioversion, both buttons must remain pressed down until the pacemaker detects a QRS.
6	RECORD	This button functions identically to the RECORD button on the monitor. It is active only when the monitor and defibrillator are connected.

Input Power

Either a rechargeable, nickel-cadmium FASTPAK® battery or an Auxiliary Power Supply (AC or DC) can provide power for the LIFEPAK 11 defibrillator. Promptly replace the battery when the LOW BATT message displays. Always keep additional, fully-charged FASTPAK batteries available for replacement.

To apply power, turn the POWER switch to BATT (battery power) or AUX (Auxiliary Power Supply). When the devices are attached, they *do not* share power.

FASTPAK Battery

A new, fully-charged FASTPAK battery installed in the LIFEPAK 11 defibrillator provides power for at least 60 minutes of monitoring and 20 minutes of recorder operation within the operating temperature of 15° to 35°C (59 to 95°F). When the battery needs to be replaced, the defibrillator flashes the LOW BATTERY message and beeps. Replace the battery promptly when the LOW BATTERY message appears.

Perform these steps to install the battery:

1 Align the battery with the battery well so that the battery clip faces the connector pins.
2 Insert the end of the battery opposite the battery clip into the battery well.
3 Firmly press the other end of the battery into the battery well until it clicks into place.

To remove the battery, push in the clip at the rear of the battery and lift it up and out of the battery compartment.

⚠ WARNING

Possible loss of power during patient care. Using an improperly maintained battery to power the LIFEPAK 11 defibrillator/pacemaker may cause premature power loss. Use the Physio-Control® Battery Support System to properly maintain the batteries.

To properly maintain the FASTPAK batteries and maximize battery life and performance, it is very important to use the Physio-Control Battery Support System. For detailed information about battery recharging and maintenance, refer to Battery Maintenance, Section 4.

AC and DC Auxiliary Power Supplies

The AC Auxiliary Power Supply and DC Auxiliary Power Supply provide an alternative power source to the LIFEPAK 11 defibrillator. Either Auxiliary Power Supply:

- Powers the defibrillator
- Slow-charges the FASTPAK battery installed in the defibrillator.

The Auxiliary Power Supply can also power the defibrillator without a battery installed. For service information, refer to either of the separate AC or DC Auxiliary Power Supply service manuals.

To connect and operate the defibrillator with the AC or DC Auxiliary Power Supply:

1 Connect the Auxiliary Power Supply to an appropriate ac power source.
2 Lift the AUX POWER cover.
Connect the Auxiliary Power Supply cable to the LIFEPAK 11 monitor AUX POWER connector.

3 Make sure that the Auxiliary Power Supply rear panel MAINS POWER switch is set to I (ON). The green POWER light on the power supply front panel indicates that:

- The ac power is connected.
- The Auxiliary Power Supply is on and ready to supply power.

4 Rotate the monitor POWER switch to AUX.

The AC Auxiliary Power Supply can recharge a fully-depleted FASTPAK battery in 24 hours. The Auxiliary Power Supply may be connected to the monitor at all times. The Auxiliary Power Supply will not overcharge the installed battery. For service information, refer to the *AC Auxiliary Power Supply Service Manual.*

Note. The Auxiliary Power Supply may not be available for use in all countries. Contact your local Physio-Control representative.

For auxiliary power to the defibrillator, use only:

- AC Auxiliary Power Supply (part number 806311)
- DC Auxiliary Power Supply (part number 3005494).

The older AC and DC Auxiliary Power Modules should not be be used with the LIFEPAK 11 defibrillator because the output cable connectors do not fit into the AUX connector.

Only the DC output Y-cable (part number 3006462) can connect the Auxiliary Power Supply output to the LIFEPAK 11 defibrillator. The same DC output Y-cable also allows connection and simultaneous auxiliary power output to the LIFEPAK 11 monitor. This cable has two unique connectors, each of which is configured to fit only in the proper AUX connector for each device.

Note. When both the LIFEPAK 11 defibrillator and LIFEPAK 11 monitor are connected, use only the DC output Y-cable to supply auxiliary power. Do not to use the DC output Y-cable to connect the Auxiliary Power Supply to any other device. Also, when the defibrillator and monitor are connected, do not use the single-connector DC output cable from the older Auxiliary Power Module to power the monitor and the DC output Y-cable from an Auxiliary Power Supply to power the defibrillator.

Installing/Removing a Therapy Module

Before installing or removing a module, always turn the defibrillator power switch to OFF. If the module is not installed or is not seated properly in the defibrillator, "– – –" displays next to JOULES SELECTED.

Installing a Therapy Module

To install a module:

1. Grasp the module from the top and slide it straight down into the module well.
2. Press the module down until the module release button pops out flush with the face of the module.

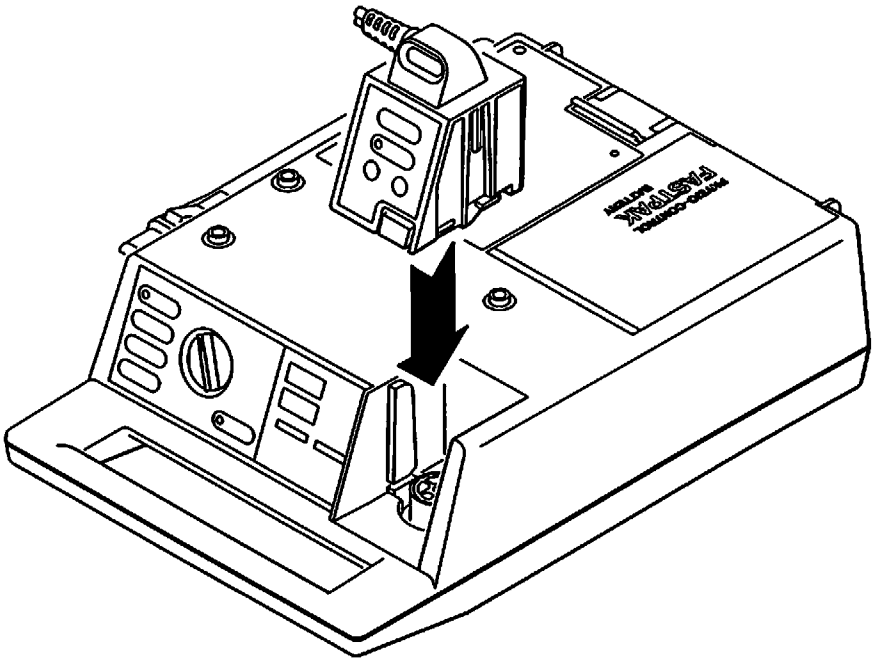


Figure 2-4 Installing a module

Removing a Therapy Module

To remove a Standard Paddles module, remove the paddles tray and the electrode bag before removing the module.

To remove a module:

1. Press the release button (located at the bottom right of the module) in until it stops. Pressing the button pushes the module up and frees it from the connector.
2. Grasp the top of the module and pull it up to release it from the defibrillator.

In some countries, the therapy module does not include the release button. A tool must be used to release the module from the defibrillator. Both the QUIK-COMBO and Standard Paddles therapy modules have a built-in module release tool. This tool is a lever on the back of the module. When that lever is lowered, insert it into the module you want to remove.

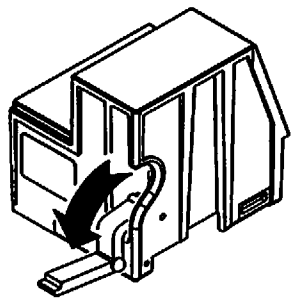


Figure 2-5 Module removal tool

To remove a module without a release button:

1. Obtain a second module.
2. Lower the release tool on the back of this module (the lever in Figure 2-5) and insert it into the cavity on the bottom right of the module installed in the defibrillator. (The cavity is the area of the module left vacant by the missing release button.)
3. Push the release tool straight back until the module pops up. Remove the release tool.
4. Grasp the top of the module and pull it up to free it from the defibrillator.
5. Raise the tool back into the recessed area of the module to prevent damage to the tool.

Connecting the Defibrillator to the Monitor

To connect the LIFEPAK 11 defibrillator/pacemaker and the LIFEPAK 11 monitor:

1. Place the defibrillator behind the monitor as shown in Figure 2-6. Align the slide connectors.
2. Slide the defibrillator forward until the lock button clicks in place; the monitor and defibrillator are now locked together.

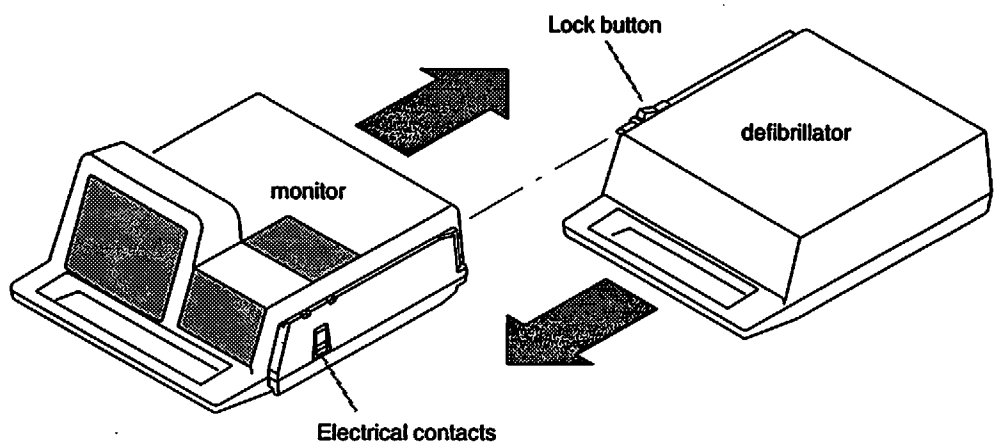


Figure 2-6 Connecting the defibrillator and monitor

To disconnect the monitor and defibrillator:

1 Press down and hold the lock button.

2 Slide the defibrillator back and away from the monitor.

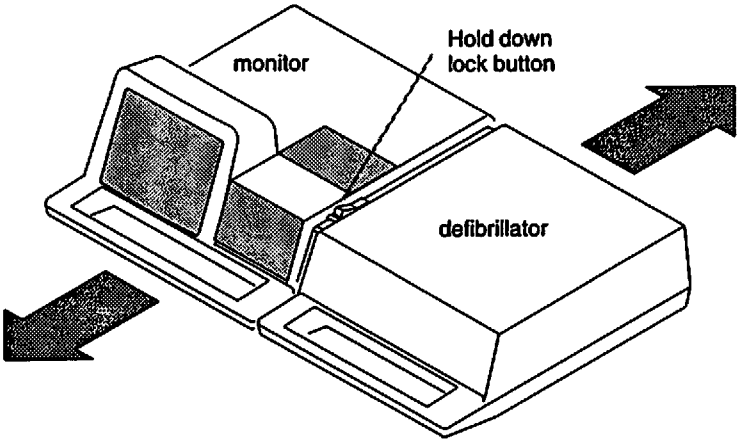


Figure 2-7 Disconnecting the monitor and defibrillator

The defibrillator and monitor can pass electrical signals through the electrical contacts when they are connected. However, they *do not* share power from each other's batteries. If the proper cable is used, a single Auxiliary Power Supply can power both the monitor and the defibrillator. The defibrillator LOW BATT message applies only to the defibrillator and *not* to the monitor (the monitor has its own low battery message).

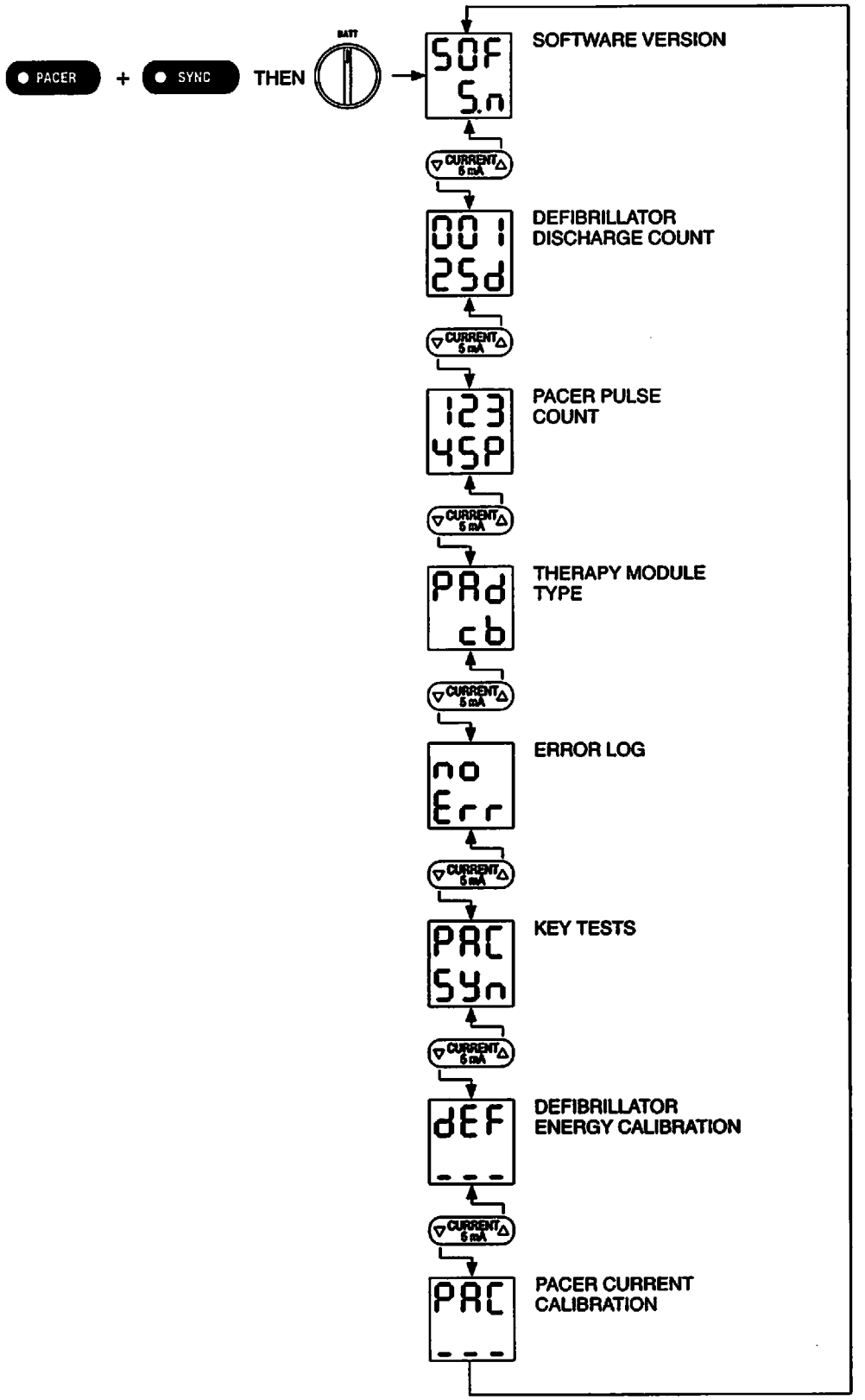
Service Mode

The service mode allows access to a number of service functions. Each service mode function is read from the JOULES AVAILABLE and JOULES SELECTED display on the front panel. Figure 2-8 shows how to access the service mode functions; subsequent figures provide more detail. The service mode functions include:

- Version of the software installed in the defibrillator
- Number of defibrillator discharges delivered
- Number of pacing pulses delivered
- Type of therapy module installed
- Error codes
- Keypad tests
- Defibrillation energy calibration
- Pacing current calibration

Access service mode functions by pressing the appropriate key on the front panel. For defibrillators without the pacing option, the keys used in the service mode that normally apply to pacing functions are present, but unmarked. For example, pressing the ▼ 5 mA CURRENT button advances the display to the next service function. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

Pressing the ▼ 5 mA CURRENT or 5 mA ▲ CURRENT button scrolls forward or backward to the next function.



PACEMAKER PANEL (REF)

NON-PACER PANEL SHOWING LOCATION OF KEYS FOR SERVICE MODE (REF)

Figure 2-8 Service mode functions

Software Version

This is the first display to appear in service mode. The numbers on the bottom line of the following display show the version of the software installed in the defibrillator.

Pressing the ▼ 5 mA CURRENT button advances the display to the Defibrillator Discharge Log. If the defibrillator has no pacer, press the left side of the bottom unmarked key located on the left side of the front panel.

Defibrillator Discharge Log

This log keeps count of how many times the defibrillator has been discharged. The display logs up to a total of twenty thousand discharges. The following display shows that the defibrillator has been discharged 125 times.

Pressing the ▼ 5 mA CURRENT button advances the display to the Pacer Pulse Log. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

Pacer Pulse Log

The defibrillator also keeps a log of how many hundreds of pacing pulses that have occurred. This display appears even if there is no pacer option in the defibrillator. The display logs up to a total of two million pulses. The following display shows that there have been 1,234,500 pulses (display X100).

Pressing the ▼ 5 mA CURRENT button advances the display to show the Therapy Module Type. If the defibrillator has no pacer, press the left side of the bottom unmarked key located on the left side of the front panel.

Therapy Module Type

This display identifies the type of therapy module installed. When a Standard Paddles module is installed, the lower display shows hP. When there is no module installed, the display shows three dashes (– – –). The following display shows a cb, which means that a QUIK-COMBO module (cb) is installed.

PAd
cb

Pressing the ▼ 5 mA CURRENT button advances the display to the Error Log. If the defibrillator has no pacer, press the left side of the bottom unmarked key located on the left side of the front panel.

Error Log

The Error Log contains a list of error codes (Figure 2-9). These codes indicate the different types of service errors. Troubleshooting Aids in Section 3 provide a complete list of error code definitions. The Error Log can contain up to16 error codes. If there is an error when the log already has16 error codes, the log eliminates the oldest code to make room for the new error code.

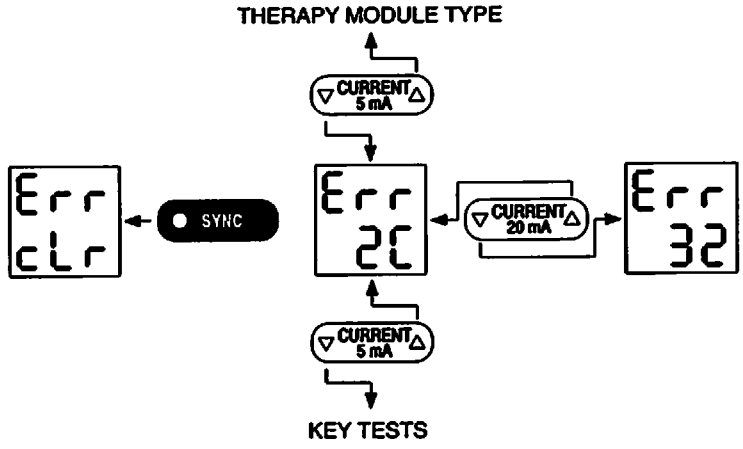


Figure 2-9 Error log

Press the ▼ 20 mA CURRENT ▲ button to scroll the display forward or backwards to the next error code display. The decimals light on the last error code. Pressing SYNC clears the entire Error Log.

Pressing the ▼ 5 mA CURRENT button advances the display to Keypad Tests. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

Keypad Tests

This function tests the keys on the front panel and the therapy module. Figure 2-10 shows the test sequence. Pressing the ▼ 20 mA CURRENT button advances the display to each button. Press the buttons in the following order:

- PACER
- SYNC
- ▼ RATE
- ▲ RATE

- CHARGE
- Both discharge buttons
- RECORD (Standard Paddles module only)

Pressing each button makes a decimal point appear or disappear at the lower right corner of each character. The decimal points confirm that the button is functioning properly. Because the discharge buttons are momentary switches, the decimals appear only as long as the buttons are pressed down.

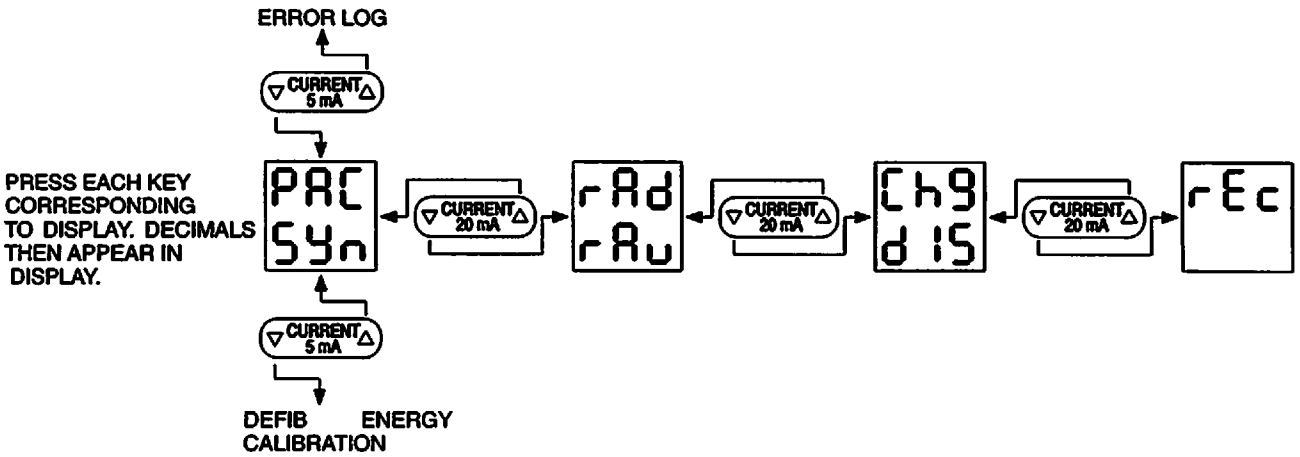


Figure 2-10 Keypad tests

Pressing the ▼ 5 mA CURRENT button advances the display to Defibrillator Energy Calibration. If the defibrillator has no pacer, press the left side of the bottom unmarked key located on the left side of the front panel.

Defibrillator Energy Calibration

To calibrate the defibrillation energy, connect the electrodes or standard paddles to an energy meter (2% accuracy). Figure 2-11 shows an example of the calibration sequence for 2 joules. When first entering the Defibrillation Energy Calibration mode (the lower display shows three dashes), press CHARGE twice and advance to the first energy level. All subsequent energy settings require pressing CHARGE once.

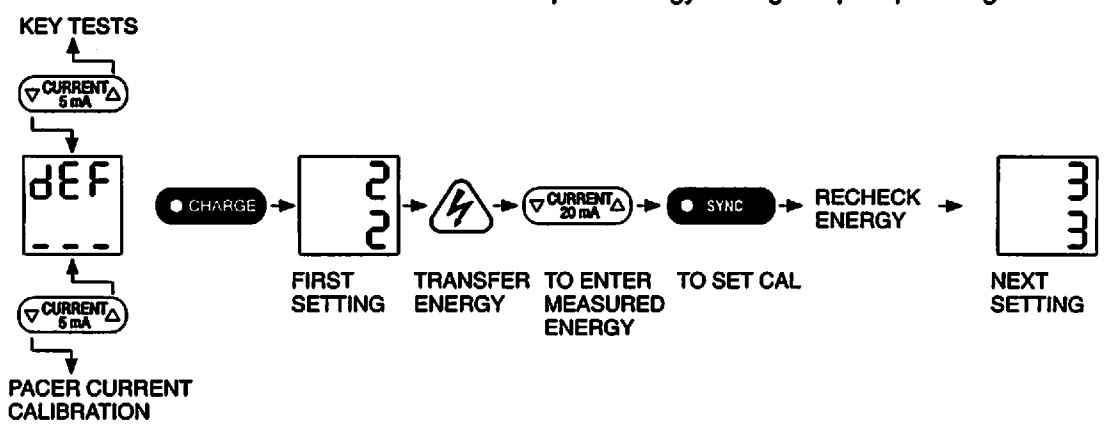


Figure 2-11 Defibrillation energy calibration

To begin the calibration sequence, press CHARGE and discharge the energy into the energy meter. Compare the reading on the energy meter with the selected energy on the defibrillator display. If there is a difference between the numbers, press the ▼ 20 mA CURRENT ▲ button until the available energy level matches the energy meter reading as closely as possible.

Once the energy level has been calibrated, pressing the SYNC button stores the calibration constant. Each level is calibrated independently. The energy level can be calibrated only by pressing SYNC. If no change is made to a particular energy level and SYNC is pressed, the existing calibration constant is saved.

Pressing the SYNC button before pressing CHARGE to calibrate clears the calibration constant for that particular energy level and uses the default values.

Pressing the ▼ 5 mA CURRENT button advances the display to Pacer Current Calibration. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

Pacer Current Calibration

For pacer calibration, the pacing cable must be connected to a pacing analyzer or pacing load. Press PACER to start calibration. If the leads are not connected to a pacing analyzer or pacing load, an alarm sounds and the display shows PACE OFF. To resume the pacer current calibration, reconnect the lead and press PACER. Figure 2-12 shows the sequence of steps in pacer current calibration.

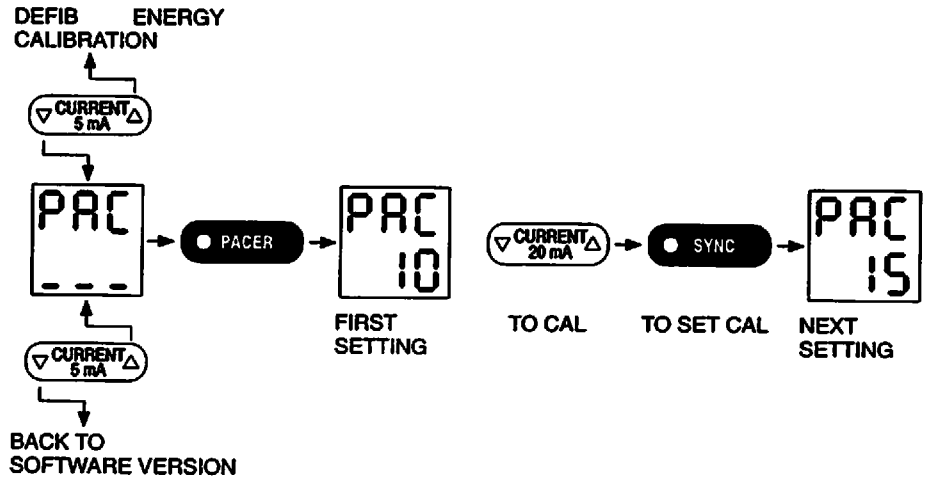


Figure 2-12 Pacer current calibration

After pressing PACER, compare the reading on the pacing analyzer with the selected pacing current on the defibrillator display. If there is a difference between the numbers, press ▼ 20 mA CURRENT ▲ until the available pacing current level matches the pacing analyzer reading.

Once the pacing current level is calibrated, press the SYNC button to temporarily store the calibration constant. Remember, the current level is calibrated only by pressing SYNC. If the Pacer Current Calibration is terminated before calibrating all of the current levels, a NO CAL message appears on the display.

Calibrate each level independently. When SYNC is pressed after the last current level (200mA), PAC CAL appears for approximately 10sec. During this time, the calibration constants for all the current levels are stored permanently. When the defibrillator has finished storing the calibration constants, the software version display reappears. Removing power from the defibrillator before the calibration constants are stored (while PAC CAL is displayed) causes the defibrillator to retain the previous calibration constants.

Section 3

Testing and Troubleshooting

Introduction

This section describes how to test, calibrate, and troubleshoot the LIFEPAK 11 defibrillator/pacemaker. Topics include:

- Performance Inspection Procedure (PIP)
- Test and Calibration Procedures (TCP)
- Troubleshooting Aids

Performance Inspection Procedure (PIP)

The Performance Inspection Procedure checks whether the LIFEPAK 11 defibrillator/pacemaker performs within specifications. The PIP includes the safety and performance tests recommended by AHA/AHSE *Maintenance Management for Medical Equipment* and IEC Technical Report 1288-2, *Maintenance of Cardiac Defibrillators-monitors*. The design of the LIFEPAK 11 defibrillator allows verification of IEC 1288- *Energy Loss Rate* concurrent with defibrillator charge time and energy output tests.

Perform the PIP regularly as a periodic maintenance check or after any repair or calibration procedure. The instrument case does not need to be opened to perform the PIP. The PIP Checklist (page 3-25 and 3-26) can be photocopied and used to record the PIP results.

PIP-Scope and Applicability

This PIP applies to the LIFEPAK 11 defibrillator/pacemaker. The procedure does not apply to the following devices:

- LIFEPAK 11 diagnostic cardiac monitor
- Physio-Control cellular modem
- RS 100 receiving station
- Physio-Control receiving station modem
- Other Physio-Control defibrillators

Refer to the separate tests provided in their respective device Service Manuals.

PIP-Definitions

This procedure uses the following acronyms:

bpm	beats per minute
DMM	Digital Multimeter
ECG	Electrocardiogram
ESD	Electrical Static Discharge
NSR	Normal Sinus Rhythm
PIP	Performance Inspection Procedure
p-p	peak-to-peak
QRS	Refers to portions of the ECG waveform
TCP	Test and Calibration Procedure

PIP-Resource Requirements

The following subsection describes PIP test equipment, workstation, and personnel requirements.

PIP-Equipment

The equipment listed in Table 3–1 is required to perform this PIP. Although the table lists specific test instruments by manufacturer and model, other test equipment with equivalent specifications may be used.

PIP-Test Equipment Verification

All test equipment used in the PIP must have a current calibration label on the device chassis. The calibration label must be issued by a certified calibration facility.

PIP-Workstation Power

The ac line power to this workstation must connect to a grounded power source. The workstation must have Electrical Static Discharge (ESD) protection.

Table 3–1 Test Equipment Required for the PIP

Equipment	Specifications	Recommended Model*
Digital Multimeter (DMM)	3 1/2-digit with 10ADC range Accuracy DC voltage: ±(0.1% of reading + 1 digit) Accuracy DC current (10A range): ±(0.5% of reading + 1 digit)	Fluke 8010A
DC Power Supply	Output: 0 to 20V, able to supply 8A surge current	Topward TPS 2000
Oscilloscope	Bandwidth: dc to 20MHz Vertical accuracy: ±3% (5mV-5V/division) Horizontal Time Base Accuracy: ±5%	Tektronix 2213
ECG/Pacing Simulator	Output: 2mVp-p 10Hz sine wave ±2% Amplitude: Lead II, RA-LL Amplitude accuracy: ±2% (RA-LL)	Bio-Tek QED-6
Timer	Resolution: 1-second	Aristo
Leakage Tester/Safety Analyzer	110VAC line voltage: Current range: 0-1999µA Current accuracy: 5% of reading or 1 digit (whichever is greater)	Dale 600
	220VAC line voltage: Current range: 0-1999µA Current accuracy: 5% of reading or 1 digit (whichever is greater)	Dale 600E
LIFEPAK 11 diagnostic cardiac monitor	Compatible with the LIFEPAK 11 defibrillator/pacemaker	Physio-Control 805300
QUIK-COMBO Module or Standard Paddles Module	Compatible with the LIFEPAK 11 defibrillator/pacemaker	Physio-Control 806588 or 806589
Defibrillator Energy Meter	Power Range: 0-100J ±2% ±0.1J 0-1000J ±2% ±2J Load Resistance: 50Ω	Bio-Tek QED-6
QUIK-COMBO test post adapter	For use with the QUIK-COMBO Module	Physio-Control 3005302

* Other test equipment that meets listed specifications can be used.

⚠ WARNING

Shock hazard. The defibrillator stores and delivers hazardous voltages. These voltages must be safely discharged as described in this PIP. Do not perform this procedure unless you are thoroughly familiar with the operation of the defibrillator.

PIP-Personnel

Technicians who perform this PIP must be thoroughly familiar with the operation of the LIFEPAK 11 defibrillator/pacemaker and any required accessories. Personnel performing this PIP must meet at least one of the following levels of education or experience:

- Associate of Applied Science degree with a major emphasis in biomedical electronics
- Certificate of Technical Training in electronics with a major emphasis in biomedical electronics
- Equivalent biomedical electronics experience

PIP-General Instructions

Perform the PIP sections in the order listed below. After completing a section, do not change the equipment settings and connections unless instructed to do so.

PIP-Testing with the QUIK-COMBO module

Perform the following tests with the QUIK-COMBO module. For an identical set of tests for the Standard Paddles module, see page 3-13.

Use the QUIK-COMBO test post adapter shown in Figure 3-1 to connect the defibrillator to the following devices:

- Energy meter
- ECG simulator
- Pacing simulator

The test post adapter part number is listed in Table 3–1.

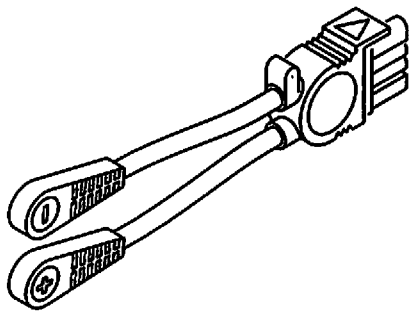


Figure 3-1 QUIK-COMBO test post adapter

PIP-Physical Inspection

Perform the exterior physical inspection as described below. If gel or foreign substances are present, follow the cleaning procedures described in Section 4.

1 Inspect all exterior surfaces of the defibrillator/pacemaker and accessories for the following:
Damage
Excessive wear, cracks, or dents
Improper mechanical function
Damaged connectors

2 Pick up and turn the defibrillator/pacemaker over. If loose or rattling hardware is heard, disassemble the defibrillator/pacemaker as described on page 4-8. Locate the loose hardware and tighten or replace it.

3 Inspect the defibrillator/pacemaker AUX connector cover for the following:
Proper opening and closing
Damage
Breaks, cracks, or excessive wear
Remove any visible foreign matter or dust.

4 Inspect the QUIK-COMBO module. Press all of the buttons and check for proper mechanical function. Inspect for tears, breaks,

cracks, or excessive wear. While bending and flexing each cable, inspect for the following:

- Damage
- Excessive wear
- Cuts or abrasions
- Cracks
- Exposed inner wires
- Broken or bent connectors or pins

5 If a battery is installed, remove it. Then perform the following:
Turn the POWER switch to confirm that the knob is installed tightly on the shaft.
Confirm that the switch aligns properly at the OFF, BATT, and AUX positions.
Turn the POWER switch back to the OFF position.

6 Inspect the battery connector pins. Perform the following:
Tighten loose pins.
Replace bent, broken, corroded, worn, or damaged pins, as shown in Figure 4-9.
Inspect each leaf on the connector pins to make sure it is not cracked or broken.
Inspect the battery latch for cracks or breaks.

7 Inspect the electrical slide contacts for corrosion, breaks, cracks, bends, or deformities. Look closely for breaks or cracks at the location where each contact enters the case.

PIP-Service Mode and Power On

Perform this test in the Service Mode. For additional information about the Service Mode, see Section 2.

To enter the service mode or test the buttons, use the front panel keypad. These keys are:

- PACER
- ▼ RATE▲
- ▼ 20 mA CURRENT ▲
- ▼ 5 mA CURRENT ▲
- SYNC

In defibrillators that have no pacer, the keys that normally apply to pacing functions are present, but unmarked. For example, pressing the ▼ 5 mA CURRENT button in the service mode advances the defibrillator to the next function. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

1 Install a fully-charged battery in the defibrillator/pacemaker. Make sure that the POWER switch is set to OFF.

2 Connect the QUIK-COMBO module to the defibrillator.

3 Press and hold down both the PACER button and the SYNC button while. rotating the POWER switch to BATT. Continue to hold down the buttons until the JOULES display shows: SOF
5.x
The number on the bottom line indicates version of the software.

4 Record the software version on the PIP checklist.

PIP-Keypad

1 Press the ▼ 5 CURRENT button five times until the display shows: PAC
SYn

2 Press the PACER button on the keypad. The display shows: P.A.C. The decimal point that appears next to each character on the display confirms that the key functions properly.

3 Press SYNC. The display shows: S.Y.n. The decimal point that appears next to each character confirms that the key functions properly.

4 Press the ▼ 20 CURRENT button to advance to the next key test. The display shows: rAd
rAu

5 Press ▼ RATE. The display shows: r.A.d. The decimal point that appears next to each character confirms that the key functions properly.

6 Press ▲ RATE. The display shows: r.A.u. The decimal point that appears next to each charactor confirms that the key functions properly.

7 Press the ▼ 20 CURRENT button to advance to the next key test. The display shows: Chg
dIS

8 Press CHARGE. The display shows: C.h.g. The decimal point that appears next to each character confirms that the key functions properly.

9 Press one discharge button, then the other. Confirm that the display does not change.

10 Press both discharge buttons. The display shows: d.I.S. A decimal point appears *momentarily* next to each character to confirm that the key functions properly.

11 Rotate the POWER switch to OFF then back to BATT.

PIP-Defib Energy Output

1 Connect the QUIK-COMBO test post adapter to the defibrillation cable.

2 Connect the test post adapter to the energy meter (observe proper polarity).

3 Apply power to the energy meter.

4 Press ENERGY SELECT and select 2J.

5 Press CHARGE.

6 Confirm that the CHARGE indicator flashes. At higher energy levels, a ramping tone will be audible.

7 When the defibrillator is fully charged, confirm the following:
A ready tone sounds.
The CHARGE indicator stays on without flashing.
The AVAILABLE energy display shows 2J.

8 Press both discharge buttons and hold.

9 Confirm that the energy meter shows 2J ±1.6J.

10 Repeat Steps 4 through 9 for each of the energy settings listed in Table 3–2. If an energy setting is out of tolerance, perform the Defibrillation Calibration described on page 3-27.

Table 3–2 Defibrillation Energy Levels (QUIK–COMBO module)

Energy Setting	Tolerance	Energy Setting	Tolerance
2J	±1.6J	10J	±1.6J
3J	±1.6J	20J	±2J
4J	±1.6J	30J	±3J
5J	±1.6J	50J	±5J
6J	±1.6J	100J	±10J
7J	±1.6J	200J	±20J
8J	±1.6J	300J	±30J
9J	±1.6J	360J	±36J

PIP-Defib Energy Dump

1 Press ENERGY SELECT and select 360J.

2 Press CHARGE.

3 When the defibrillator is fully charged, perform the following:
Press ENERGY SELECT and start the timer. Continue to Press ENERGY SELECT and choose the 2J setting.
Press CHARGE.

4 Confirm that when the charge ready tone sounds, less than 18 seconds have elapsed.,

5 Press both discharge buttons to remove the charge.

PIP-Defib Charge Time

1 Press ENERGY SELECT and select 360J.

2 Press CHARGE and start the timer.

3 When the charge tone sounds, confirm that the defibrillator charges in less than 10sec.

4 Press both discharge buttons to remove the charge.

PIP-Open Air Discharge

1 Disconnect the test post adapter from the energy meter.

2 Press ENERGY SELECT and select 10J.

3 Press CHARGE.

⚠ WARNING

Shock hazard. There is hazardous voltage present at the connectors in the end of the test post adapter. Do not touch the cable or allow any conductive material near the cable.

4 Press both discharge buttons and confirm that three alarm tones sound. The tones indicate that an open air discharge occured.

PIP-Hold-Up Time

This procedure tests the defibrillator's ability to retain settings during a battery change.

1 Press ENERGY SELECT and select 100J.
2 Remove the battery for 15sec.
3 Reinstall the battery. Confirm that the selected energy remains at 100J.

PIP-Synchronized Cardioversion

1 Connect the LIFEPAK 11 diagnostic cardiac monitor to the defibrillator.
2 Install a fully-charged battery in the monitor. Make sure that the POWER switch is set to OFF.
3 Connect the test post adapter to the ECG simulator (observe the proper polarity).
4 Connect the monitor ECG cable to the ECG simulator.
5 Rotate the monitor POWER switch to BATT and apply power to the ECG simulator.
6 Press LEAD SELECT on the monitor to select LEAD II. Set the simulator for SYNC measurement.
7 Press SYNC on the defibrillator. Observe the monitor screen and confirm that the QRS markers appear with each QRS complex.
8 Press ENERGY SELECT and select 10J.
9 Press CHARGE.
10 Press both discharge buttons. Confirm that the ECG simulator indicates <25ms to energy peak.
11 Disconnect the test post adapter from the ECG simulator.

PIP-Pacer Output Current

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

1 Connect the test post adapter to the pacing simulator and apply power to the simulator.
2 Select pacing measurements on the ECG simulator.
3 Press PACER. The pacer rate on the monitor is 60ppm.
4 Press the ▲ 5 mA CURRENT button to select the 10mA current level as displayed on the monitor. Confirm that the pacing simulator shows 10mA ±5mA.
5 Press the ▲ 5 mA CURRENT button. Continue pressing the ▲ 5 mA CURRENT button to confirm each of the current output settings listed in Table 3–3. If any of the current settings are out of tolerance, perform the Pacing Current Calibration procedure described on page 3-27.
6 Set the current output to 10mA.

Table 3–3 Pacing output current (QUIK-COMBO module)

Current Setting	Tolerance	Current Setting	Tolerance	Current Setting	Tolerance
10mA	±5mA	75mA	±5mA	140mA	±7mA
15mA	±5mA	80mA	±5mA	145mA	±7mA
20mA	±5mA	85mA	±5mA	150mA	±8mA
25mA	±5mA	90mA	±5mA	155mA	±8mA
30mA	±5mA	95mA	±5mA	160mA	±8mA
35mA	±5mA	100mA	±5mA	165mA	±8mA
40mA	±5mA	105mA	±6mA	170mA	±9mA
45mA	±5mA	110mA	±6mA	175mA	±9mA
50mA	±5mA	115mA	±6mA	180mA	±10mA
55mA	±5mA	120mA	±6mA	185mA	±10mA
60mA	±5mA	125mA	±6mA	190mA	±10mA
65mA	±5mA	130ma	±7mA	195mA	±10mA
70mA	±5mA	135mA	±7mA	200mA	±10mA

PIP-Pacing Waveform

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

Confirm that the pacing simulator shows a pulse-width of 20ms ±1ms.

PIP-Pacing Leads Off

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

1. Disconnect one test post adapter lead from the pacing simulator Confirm that an alarm sounds.
2. Rotate the POWER switch to OFF on both the monitor and defibrillator.
3. Disconnect the monitor from the defibrillator.

PIP-Low Battery Detection

1. Remove the battery.
2. Connect the DMM to the DC power supply output. Leave the DMM connected to the power supply for the duration of this test.
3. Set the power supply to +12Vdc.
4. Connect the power supply leads to the battery posts (take care to observe the proper polarity).
5. Rotate the defibrillator POWER switch to BATT.
6. Slowly lower the power supply voltage until the LOW BATT message appears. Confirm that the power supply voltage is 10.1Vdc ±0.1Vdc.
7. Lower the power supply to 7.9Vdc. Confirm that the defibrillator has shut down.

PIP-Power Consumption

1. Rotate the defibrillator POWER switch to OFF.
2. Set the DC power supply to +12V.

3 Connect the DC power supply to the defibrillator battery posts with lead wires. Connect the DMM in series with the positive battery post. Set the DMM to measure dc current on the 10A scale.

4 Rotate the defibrillator POWER switch to ON and wait for the startup sequence to end (approximately 5sec).

5 Confirm that the measured current is <375mA.

6 Rotate the defibrillator POWER switch to OFF.

7 Remove power from the DC power supply and disconnect the lead wires.

PIP-QUIK-LOOK

1 Install the battery. Set the DC power supply to +1.2Vdc.

2 Connect the power supply leads to the ends of the test post adapter.

3 Measure the voltage at the slide contact pins A+ and B– (see Figure 3-2) with the DMM (observe proper polarity). Confirm that the voltage is –1.2Vdc ±0.2Vdc.

⚠ CAUTION

Possible contact damage. The slide contacts can be easily damaged or distorted. Do not attach clip leads to the contacts or otherwise apply excess pressure to the contacts.

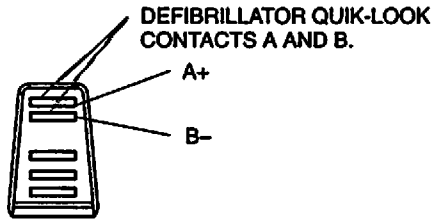


Figure 3-2 Defibrillator slide contacts

4 Repeat Steps 1 through 3 with the test post adapter leads reversed.

5 Confirm that the voltage is +1.2Vdc ±0.2Vdc.

6 Connect the monitor to the defibrillator.

7 Rotate the monitor POWER switch to ON.

8 Select PADDLES on the monitor.

9 Set the ECG SIZE to X4.

10 Short the test post adapter leads together.

11 Press RECORD and let the recorder run for several seconds.

12 Confirm that the baseline noise on the recorded strip is less than 3mm p-p.

13 Rotate the monitor POWER switch to OFF. Disconnect the monitor.

PIP-Defibrillator Isolation

⚠ WARNING

Shock hazard. Electrical energy is discharged during this procedure. Do not allow the electrodes to contact any person or conductive surfaces except as described below.

1 Connect a 10kV wire from slide contact C or battery – to one of the energy meter electrodes.
2 Install a fully-charged battery in the defibrillator.
3 Connect the defibrillator as shown in Figure 3-3.

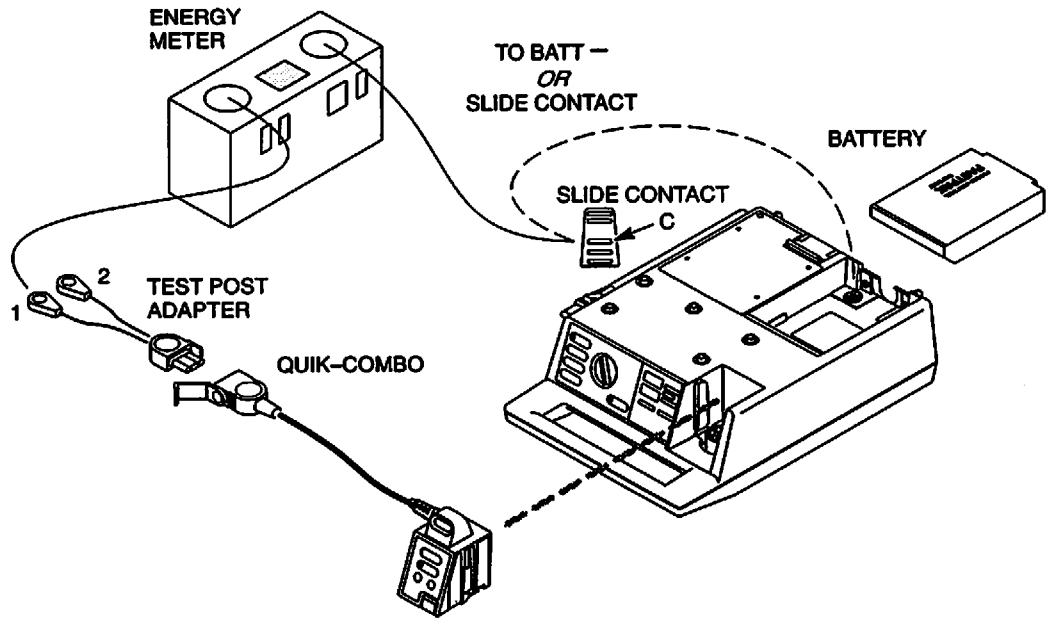


Figure 3-3 Connections for defibrillator insulation check

4 Apply power to the defibrillator and energy meter.
5 Select the maximum energy setting for the defibrillator.
6 Put on insulating gloves.
7 Attach the defibrillator electrode 1 on the other energy meter electrode (the one without the wire connected).
8 Initiate the defibrillator charging cycle and wait until the defibrillator is fully charged.
9 Verify that the defibrillator electrode does not make contact with a person or objects.
10 Discharge the defibrillator. An open air discharge alarm tone will sound.
11 Confirm that the energy discharged through the energy meter is less than 5% of the defibrillator energy setting.
12 Reverse the defibrillator electrode positions (electrode 2 on the energy meter and electrode 1 in the open air) and repeat steps 8 through 11.
13 Turn off power to the defibrillator and energy meter.

PIP-LEAKAGE Current

Check leakage current in accordance with the following standards:

- AAMI/ANSI (Association for the Advancement of Medical Instrumentation) ESI-1985
- AAMI/ANSI DF2-1989
- IEC (International Electrotechnical Commission) 601-1 and IEC 601-2-4

The variety of safety analyzers that may be used for these tests varies widely. Therefore, this manual provides only general instructions. Refer to your safety analyzer operator's manual for configuration and testing instructions.

The maximum allowable leakage current is summarized in Table 3–4 and Table 3–5. Figure 3-7 on page 3-23 and Figure 3-8 on page 3-23 show general leakage connections.

Note. The current range for the DALE 600 and 600E is 0 to 1.99mA. UL and IEC specify 5.0mA as the maximum earth leakage current. However, the actual earth leakage current for the Auxiliary Power Supply is less than 2mA. If you use the DALE 600 or 600E safety analyzer, use a 2mA maximum current.

⚠ WARNING

Electrical hazard. Failure to properly perform these tests could result in not detecting excessive leakage current. Make sure you are familiar with your test equipment and how to perform these tests.

Table 3–4 Maximum leakage current for patient contact tests (QUIK-COMBO module)

Patient Contact Tests	Battery or AC Auxiliary Power Supply (120Vac)	Battery or AC Auxiliary Power Supply (132Vac)	AC Auxiliary Power Supply (230Vac)	AC Auxiliary Power Supply (265Vac)
Patient Source, Ground Intact	9µA	10µA	87µA	100µA
Patient Source, Ground Open	9µA	10µA	436µA	500µA
Patient Sink	18µA	20µA	87µA	100µA

Table 3–5 Maximum leakage current for chassis leakage tests (QUIK-COMBO module)

Patient Contact Tests	Battery or AC Auxiliary Power Supply (120Vac)	Battery or AC Auxiliary Power Supply (132Vac)	AC Auxiliary Power Supply (230Vac)	AC Auxiliary Power Supply (265Vac)
Ground Intact	91µA	100µA	87µA	100µA
Ground Open	273µA	300µA	436µA	500µA

PIP-Testing with the Standard Paddles module

Perform the following tests with the Standard Paddles module. For an identical set of tests for the QUIK-COMBO module, see page 3-4.

PIP-Physical Inspection

Perform the exterior physical inspection as described below. If gel or foreign substances are present, follow the cleaning procedures described in Section 4.

1 Inspect all exterior surfaces of the defibrillator/pacemaker and accessories for the following:
Damage
Excessive wear, cracks, or dents
Improper mechanical function
Damaged connectors

2 Pick up and turn the defibrillator/pacemaker over. If loose or rattling hardware is heard, disassemble the defibrillator/pacemaker as described on page 4-8. Locate the loose hardware and tighten or replace it.

3 Inspect the defibrillator/pacemaker AUX connector cover for the following:
Proper opening and closing
Damage
Breaks, cracks, or excessive wear
Remove any visible foreign matter or dust

4 Inspect the Standard Paddles module. Press all of the buttons and check for proper mechanical function. Inspect for tears, breaks, cracks, or excessive wear. While bending and flexing each cable, inspect for the following:
- Damage
- Excessive wear
- Cuts or abrasions
- Cracks
- Exposed inner wires
- Broken or bent connectors or pins

5 If a battery is installed, remove it. Then perform the following:
Turn the POWER switch to confirm that the knob is installed tightly on the shaft.
Confirm that the switch aligns properly at the OFF, BATT, and AUX positions.
Turn the POWER switch back to the OFF position.

6 Inspect the battery connector pins. Perform the following:
Tighten loose pins.
Replace bent, broken, corroded, worn, or damaged pins, as shown in Figure 4-9.
Inspect each leaf on the connector pins to make sure it is not cracked or broken.
Inspect the battery latch for cracks or breaks.

7 Inspect the electrical slide contacts for corrosion, breaks, cracks, bends, or deformities. Look closely for breaks or cracks at the location where each contact enters the case.

PIP-Service Mode and Power On

Perform this test in the Service Mode. For additional information about the Service Mode, see Section 2.

To enter the service mode or test the buttons, use the front panel keypad. These keys are:

- PACER
- ▼ RATE▲
- ▼ 20 mA CURRENT ▲
- ▼ 5 mA CURRENT ▲
- SYNC

In defibrillators that have no pacer, the keys that normally apply to pacing functions are present, but unmarked. For example, pressing the ▼ 5 CURRENT button in the service mode advances the defibrillator to the next function. If the defibrillator has no pacer, press the left side of the bottom unmarked key on the left side of the front panel.

1. Install a fully-charged battery in the defibrillator/pacemaker. Make sure that the POWER switch is set to OFF.
2. Connect the Standard Paddles module to the defibrillator.
3. Press and hold down both the PACER button and the SYNC button while rotating the POWER switch to BATT. Continue to hold down the buttons until the JOULES display shows: SOF
   5.x
   The number on the bottom line is the version of the software.
4. Record the software version on the PIP checklist.

PIP-Keypad

1. Press the ▼ 5 mA CURRENT button five times until the display shows: PAC
   SYn
2. Press the PACER button on the keypad. The display shows: P.A.C. The decimal point that appears next to each character on the display confirms that the key functions properly.
3. Press SYNC. The display shows: S.Y.n. The decimal point that appears next to each character confirms that the key functions properly.
4. Press the ▼ 20 mA CURRENT button to advance to the next key test. The display shows: rAd
   rAu.
5. Press ▼ RATE. The display shows: r.A.d. The decimal point that appears next to each character confirms that the key functions properly.
6. Press ▲ RATE. The display shows: r.A.u. The decimal point that appears next to each character confirms that the key functions properly.
7. Press the ▼ 20 mA CURRENT button to advance to the next key test. The display shows: Chg
   dIS

8 Press CHARGE. The display shows: C.h.g. The decimal point that appears next to each character confirms that the key functions properly.

9 Press one discharge button, then the other. Confirm that the display does not change.

10 Press both discharge buttons. The display shows: d.I.S. A decimal point appears *momentarily* next to each character to confirm that the key functions properly.

11 Press the ▼ 20 mA CURRENT button to advance to the next key test. The display shows: rEc.

12 Press RECORD. The display shows: r.E.c. The decimal point that appears next to each character confirms that the key functions properly.

13 Rotate the POWER switch to OFF then back to BATT.

PIP-Defib Energy Output

1 Apply power to the energy meter.

2 Rotate the ENERGY switch and select 5J.

3 Secure the paddles to the energy meter (observe proper polarity).

4 Press CHARGE. Confirm that the CHARGE indicator flashes. At higher energy levels, a ramping tone will be audible.

5 When the defibrillator is fully charged, confirm the following:
A ready tone sounds.
The CHARGE indicator stays on without flashing.
The AVAILABLE energy display shows 5J.

6 Press and hold both discharge buttons.

7 Confirm that the energy meter shows 5J ±1.6J.

8 Repeat Steps 4 through 6 for each of the energy settings listed in Table 3–6. If an energy setting is out of tolerance, perform the Defibrillation Calibration described on page 3-27.

Table 3–6 Defibrillation Energy Levels (Standard Paddles module)

Energy Setting	Tolerance
5J	±1.6J
10J	±1.6J
20J	±2J
50J	±5J
100J	±10J
200J	±20J
300J	±30J
360J	±36J

PIP-Defib Energy Dump

1 Rotate the ENERGY switch and select 360J.

2 Press CHARGE.

3 When the defibrillator is fully charged, perform the following:
Rotate the ENERGY switch and start the timer.

Continue to rotate the ENERGY switch and choose the 5J setting. Press CHARGE.

4 Confirm that when the charge ready tone sounds, less than 18sec have elapsed.

5 With the paddles still secured to the energy meter, press both discharge buttons to remove the charge.

PIP-Defib Charge Time

1 Press ENERGY SELECT and select 360J.

2 Press CHARGE and start the timer.

3 When the charge tone sounds, confirm that the defibrillator charges in less than 10sec.

4 Press both discharge buttons to remove the charge with the paddles still secured to the energy meter.

PIP-Open Air Discharge

1 Remove the standard paddles from the energy meter. Hold the paddles in the air away from each other and the operator.

2 Rotate the ENERGY switch and select 5J.

3 Press CHARGE.

⚠ WARNING

Shock hazard. There is hazardous voltage present on the paddle electrode plates. Do not touch the plates together or hold near the operator. Do not allow any conductive material near the paddles or plates.

4 Press both discharge buttons and confirm that three alarm tones sound. The tones indicate that an open air discharge occurred.

PIP-Hold-Up Time

This procedure tests the defibrillator's ability to retain settings during a battery change.

1 Install a fully-charged battery in the monitor. Make sure that the POWER switch is set to OFF.

2 Connect the LIFEPAK 11 diagnostic cardiac monitor to the defibrillator. Set the POWER switch to BATT.

3 Press SYNC.

4 Remove the battery in the defibrillator for 15sec.

5 Reinstall the battery. Confirm that the SYNC LED lights.

PIP-Synchronized Cardioversion

1 Connect the monitor ECG cable to the ECG simulator.

2 Apply power to the ECG simulator.

3 Press LEAD SELECT on the monitor to select LEAD II. Set the simulator for SYNC measurement.

4 Press SYNC. Observe the monitor screen and confirm that the QRS markers appear with each QRS complex.

5 Rotate the ENERGY switch and select 10J.

6 Place the standard paddles on the energy meter.

7 Press CHARGE.

8 Press both discharge buttons. Confirm that the ECG simulator indicates <25ms to energy peak.

9 Remove the standard paddles from the energy meter.

PIP-Pacer Output Current

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

1 Connect the QUIK-PACE pacing cable to the pacing simulator and apply power to the simulator.

2 Select pacing measurements on the ECG simulator.

3 Press PACER. The pacer rate on the monitor is 60ppm.

4 Press the ▲ 5 mA CURRENT button to select the 10mA current level as displayed on the monitor. Confirm that the pacing simulator shows 10mA ±5mA.

5 Press the ▲ 5 mA CURRENT button. Continue pressing the ▲ 5 mA CURRENT button to confirm each of the current output settings listed in Table 3–7. If any current setting is out of tolerance, perform the Pacing Current Calibration procedure described on page 3-27.

Table 3–7 Pacing output current (Standard Paddles module)

Current Setting	Tolerance	Current Setting	Tolerance	Current Setting	Tolerance
10mA	±5mA	75mA	±5mA	140mA	±7mA
15mA	±5mA	80mA	±5mA	145mA	±7mA
20mA	±5mA	85mA	±5mA	150mA	±8mA
25mA	±5mA	90mA	±5mA	155mA	±8mA
30mA	±5mA	95mA	±5mA	160mA	±8mA
35mA	±5mA	100mA	±5mA	165mA	±8mA
40mA	±5mA	105mA	±6mA	170mA	±9mA
45mA	±5mA	110mA	±6mA	175mA	±9mA
50mA	±5mA	115mA	±6mA	180mA	±10mA
55mA	±5mA	120mA	±6mA	185mA	±10mA
60mA	±5mA	125mA	±6mA	190mA	±10mA
65mA	±5mA	130ma	±7mA	195mA	±10mA
70mA	±5mA	135mA	±7mA	200mA	±10mA

6 Set the current output to 10mA.

PIP-Pacing Waveform

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

Confirm that the pacing simulator shows a pulse-width of 20ms ±1ms.

PIP-Pacing Leads Off

Perform this test if the LIFEPAK 11 defibrillator includes the pacemaker option.

1. Disconnect one test post adapter lead from the pacing simulator. Confirm that an alarm sounds.
2. Rotate the POWER switch to OFF on the monitor and defibrillator.
3. Disconnect the monitor from the defibrillator.

PIP-Low Battery Detection

1. Remove the battery.
2. Connect the DMM to the DC power supply output. Select dc volts. Leave the DMM connected to the power supply for the duration of this test.
3. Set the power supply to +12Vdc.
4. Connect the power supply leads to the battery posts (take care to observe the proper polarity).
5. Rotate the defibrillator POWER switch to BATT.
6. Slowly lower the power supply voltage until the LOW BATT message appears. Confirm that the power supply voltage is 10.1Vdc ±0.1Vdc.
7. Lower the power supply to 7.9Vdc. Confirm that the defibrillator has shut down.

PIP-Power Consumption

1. Rotate the defibrillator POWER switch to OFF.
2. Set the DC power supply to +12V.
3. Connect the DC power supply to the defibrillator battery posts with the lead wires. Connect the DMM in series with the positive battery post. Set the DMM to measure dc current on the 10A scale.
4. Rotate the defibrillator POWER switch to ON and wait for the startup sequence to end (approximately 5sec).
5. Confirm that the measured current is <375mA.
6. Rotate the defibrillator POWER switch to OFF.
7. Remove power from the DC power supply and disconnect the lead wires.

PIP-QUIK-LOOK

1. Install the battery. Set the power supply to +1.2Vdc.
2. Connect the power supply leads to the ends of the standard paddles.
3. Measure the voltage at the slide contact pins A+ and B– (see Figure 3-4) with the DMM (observe proper polarity). Confirm that the voltage is –1.2Vdc ±0.2Vdc.

⚠ CAUTION

Possible contact damage. The slide contacts can be easily damaged or distorted. Do not attach clip leads to the contacts or otherwise apply excess pressure to the contacts.

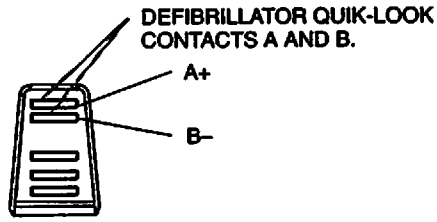


Figure 3-4 Defibrillator slide contacts

4 Repeat Steps 1 through 3 with the standard paddles reversed.
5 Confirm that the voltage is +1.2Vdc ±0.2Vdc.
6 Connect the monitor to the defibrillator.
7 Rotate the monitor POWER switch to ON.
8 Select PADDLES on the monitor.
9 Set the ECG SIZE to X4.
10 Short the standard paddles together.
11 Press RECORD and let the recorder run for several seconds.
12 Confirm that the baseline noise on the recorded strip is less than 3mm p-p.
13 Rotate the monitor POWER switch to OFF. Disconnect the monitor.

PIP-Defibrillator Isolation

⚠ WARNING

Shock hazard. Electrical energy is discharged during this procedure. Do not allow the paddle electrodes to contact any person or conductive surfaces except as described below.

1 Connect a 10kV wire from slide contact C or the battery to one of the energy meter electrodes.
2 Install a fully-charged battery in the defibrillator.
3 Connect the defibrillator as shown in Figure 3-3.

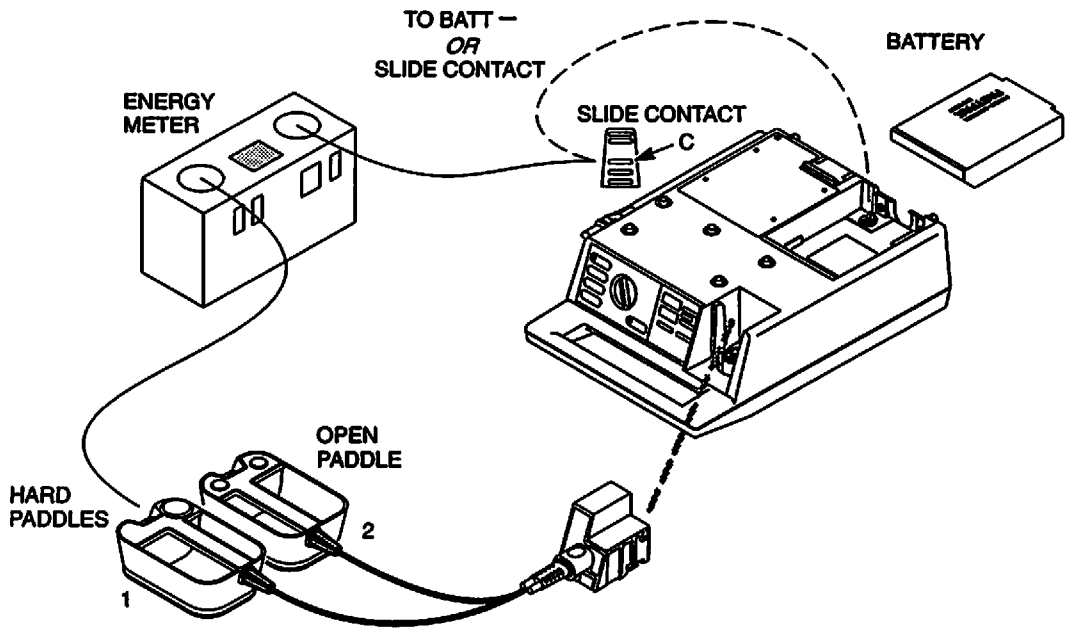


Figure 3-5 Connections for defibrillator insulation check

4 Apply power to the defibrillator and energy meter.

5 Select the maximum energy setting for the defibrillator.

6 Put on insulating gloves.

7 Place and firmly hold the defibrillator Paddle 1 on the other energy meter electrode (the one without the wire connected).

8 Initiate the defibrillator charging cycle and wait until the defibrillator is fully charged.

9 Hold the defibrillator Paddle 2 in the open air (away from any contact with a person or object).

10 Discharge the defibrillator. An open air discharge alarm tone will sound.

11 Confirm that the energy discharged through the energy meter is less than 5% of the defibrillator energy setting.

12 Reverse the defibrillator paddle positions (Paddle 2 on the energy meter and Paddle 1 in the open air) and repeat steps 8 through 11.

13 Turn off power to the defibrillator and energy meter.

PIP-LEAKAGE Current

Check leakage current in accordance with the following standards:

- AAMI/ANSI (Association for the Advancement of Medical Instrumentation) ESI-1985
- AAMI/ANSI DF2-1989
- IEC (International Electrotechnical Commission) 601-1 and IEC 601-2-4

The variety of safety analyzers that may be used for these tests varies widely. Therefore, this manual provides only general instructions.

Refer to your safety analyzer operator's manual for configuration and testing instructions.

The maximum allowable leakage current is summarized in Table 3–8 and Table 3–9. The following figures show general leakage connections:

- Figure 3-6
- Figure 3-7
- Figure 3-8

Note. The current range for the DALE 600 and 600E is 0 to 1.99mA. UL and IEC specify 5.0mA as the maximum earth leakage current. However the actual earth leakage current for the Auxiliary Power Supply is less than 2mA. If you use the DALE 600 or 600E safety analyzer, use a 2mA maximum current.

⚠ WARNING

Electrical hazard. Make sure you are familiar with your test equipment and how to perform these tests. Failure to properly perform these tests could result in not detecting excessive leakage current.

Table 3–8 Maximum leakage current for patient contact tests (Standard Paddles module)

Patient Contact Tests	Battery or AC Auxiliary Power Supply (120Vac)	Battery or AC Auxiliary Power Supply (132Vac)	AC Auxiliary Power Supply (230Vac)	AC Auxiliary Power Supply (265Vac)
Patient Source, Ground Intact	9μA	10μA	87μA	100μA
Patient Source, Ground Open	9μA	10μA	436μA	500μA
Patient Sink	91μA	100μA	174μA	200μA
Pacer Source, Ground Intact	9μA	10μA	87μA	100μA
Pacer Source, Ground Open	9μA	10μA	436μA	500μA
Pacer Sink	18μA	20μA	87μA	100μA

Table 3–9 Maximum leakage current for chassis leakage tests (Standard Paddles module)

Patient Contact Tests	Battery or AC Auxiliary Power Supply (120Vac)	Battery or AC Auxiliary Power Supply (132Vac)	AC Auxiliary Power Supply (230Vac)	AC Auxiliary Power Supply (265Vac)
Ground Intact	91μA	100μA	87μA	100μA
Ground Open	273μA	300μA	436μA	500μA

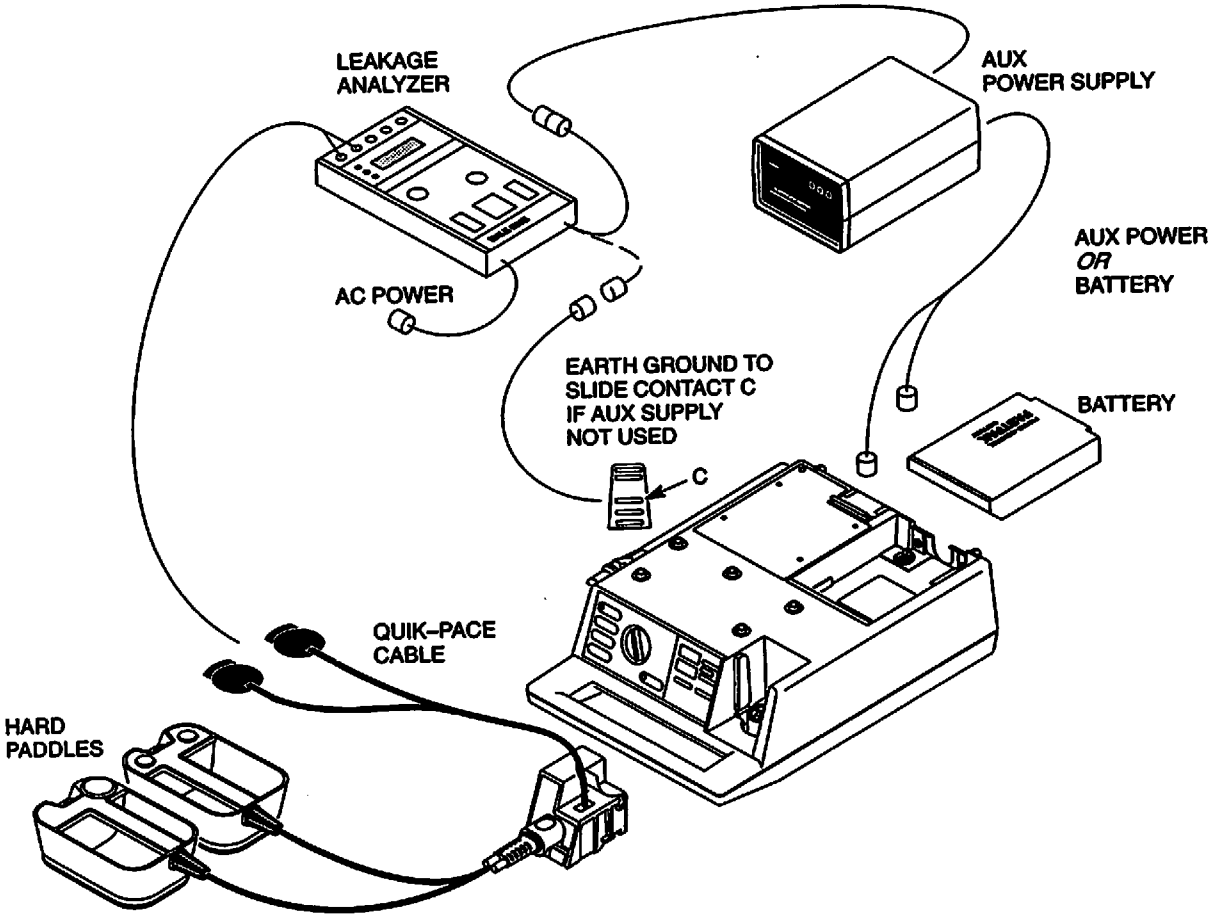


Figure 3-6 Pacer source and sink connections (Standard Paddles module)

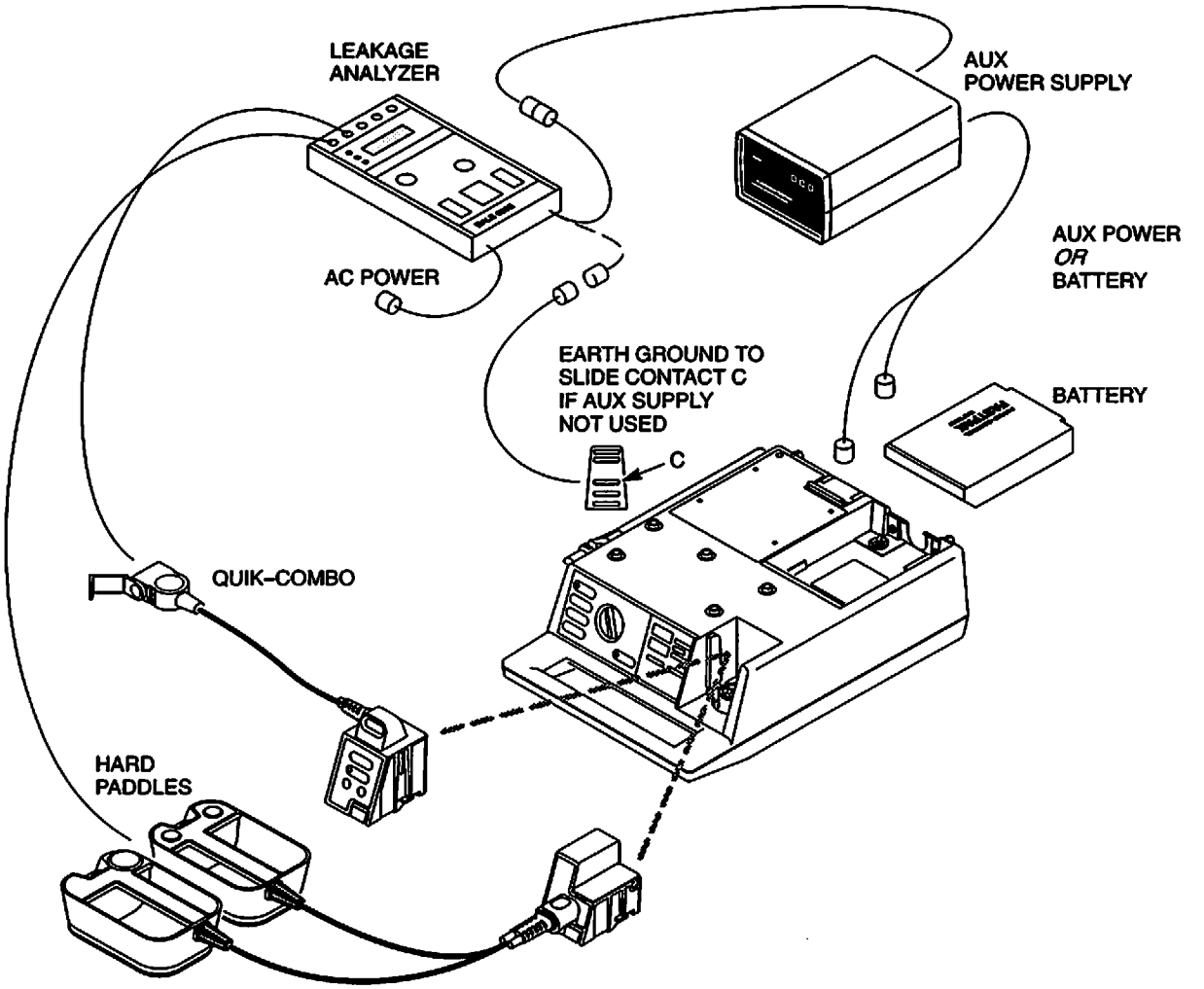


Figure 3-7 Patient source and sink connections

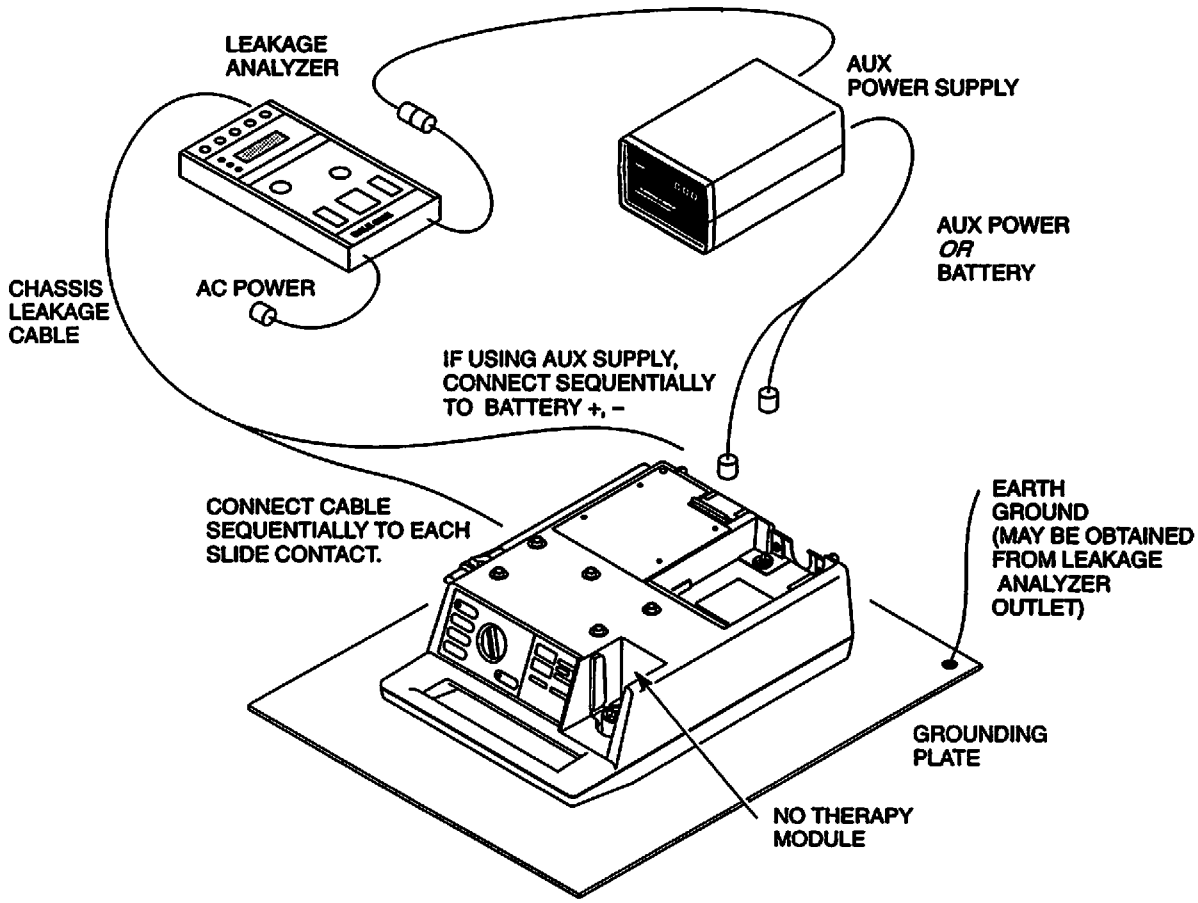


Figure 3-8 Chassis leakage

PIP Checklist for QUIK-COMBO module

Customer: _____ Date: _____
Dept/Location: _____
Instrument Type: _____ Model: _____
Serial Number: _____
Frequency: _____ Last Insp: _____
Tech. Name/ID: _____

Performance Inspection	Page	Pass	Fail	Comments
Physical Inspection	3-4	☐	☐	
Service Mode and Power On	3-5	☐	☐	
Software Version	3-6	☐	☐	
Keypad	3-6	☐	☐	
Defib Energy Output	3-6	☐	☐	
Defib Energy Dump	3-7	☐	☐	
Defib Charge Time	3-7	☐	☐	
Open Air Discharge	3-7	☐	☐	
Hold-up Time	3-8	☐	☐	
Synchronized Cardioversion	3-8	☐	☐	
Pacer Output Current	3-8	☐	☐	
Pacing Waveform	3-9	☐	☐	
Pacing Leads Off	3-9	☐	☐	
Low Battery Detection	3-9	☐	☐	
QUIK-LOOK	3-10	☐	☐	
Power Consumption	3-9	☐	☐	
Defibrillator Isolation	3-11	☐	☐	
Leakage Current	3-12	☐	☐	

Signature _____
Date _____

PIP Checklist for Standard Paddles module

Customer: _____ Date: _____
Dept/Location: _____
Instrument Type: _____ Model: _____
Serial Number: _____
Frequency: _____ Last Insp: _____
Tech. Name/ID: _____

Performance Inspection	Page	Pass	Fail	Comments
Physical Inspection	3-13	☐	☐	
Service Mode and Power On	3-14	☐	☐	
Software Version	3-14	☐	☐	
Keypad	3-14	☐	☐	
Defib Energy Output	3-15	☐	☐	
Defib Energy Dump	3-15	☐	☐	
Defib Charge Time	3-16	☐	☐	
Open Air Discharge	3-16	☐	☐	
Hold-up Time	3-16	☐	☐	
Synchronized Cardioversion	3-16	☐	☐	
Pacer Output Current	3-17	☐	☐	
Pacing Waveform	3-17	☐	☐	
Pacing Leads Off	3-18	☐	☐	
Low Battery Detection	3-18	☐	☐	
QUIK-LOOK	3-18	☐	☐	
Power Consumption	3-18	☐	☐	
Defibrillator Isolation	3-19	☐	☐	
Leakage Current	3-20	☐	☐	

Signature _____
Date _____

Test and Calibration Procedures (TCP)

If the LIFEPAK 11 defibrillator/pacemaker fails the Defibrillation Energy Calibration or Pacing Current Calibration, perform the applicable tests in this section.

Each TCP test may be performed separately. If the instrument fails a test, refer to Troubleshooting on page 3-32. Remember, none of these tests require opening the instrument case. After performing any of these tests, perform the PIP. To perform service or repair, contact a qualified service technician.

TCP-Scope and Applicability

This TCP applies to the LIFEPAK 11 defibrillator/pacemaker. The procedure does not apply to the following devices:

- LIFEPAK 11 diagnostic cardiac monitor
- Physio-Control cellular modem
- RS 100 receiving station
- Physio-Control receiving station modem
- Other Physio-Control defibrillators

Refer to the separate tests provided in their respective Service Manuals.

TCP-Definitions

These procedures use the following acronyms:

bpm	beats per minute
DMM	Digital Multimeter
ECG	Electrocardiogram
ESD	Electrical Static Discharge
NSR	Normal Sinus Rhythm
PIP	Performance Inspection Procedure
p-p	peak-to-peak
QRS	Refers to portions of the ECG waveform
TCP	Test and Calibration Procedures

TCP-Resource Requirements

The following subsection describe TCP test equipment, workstation, and personnel.

TCP-Equipment

The equipment listed in Table 3–10 is required to perform the TCP. Although the table lists specific test instruments by manufacturer and model, other test equipment with equivalent specifications may be used.

TCP-Test Equipment Verification

All test equipment used in the TCP must have a current calibration label on the device chassis. The calibration label must be issued by a certified calibration facility.

TCP-Workstation Power

The ac line power to this workstation must connect to a grounded power source. The workstation must have Electrical Static Discharge (ESD) protection.

Table 3–10 Test Equipment Required for the TCP

Equipment	Specifications	Recommended Model*
Oscilloscope	Bandwidth: dc to 20MHz Vertical accuracy: ±3% (5mV-5V/division) Horizontal Time Base Accuracy: ±5%	Tektronix 2213
LIFEPAK 11 diagnostic cardiac monitor	Compatible with LIFEPAK 11 defibrillator/pacemaker	Physio-Control 805300
Defibrillator Energy Meter	Power Range: 0-100J ±2% ±0.1J 0-1000J ±2% ±2J Load Resistance: 50Ω	Bio-Tek QED-6
ECG/Pacing Simulator	Output: 2mVp-p 10Hz sine wave ±2% Amplitude: Lead II, RA–LL Amplitude accuracy: ±2% (RA–LL)	Bio-Tek QED-6
QUIK-COMBO test post adapter	For use with QUIK-COMBO module	Physio-Control 3005302

* Other test equipment which meets listed specifications can be used.

⚠ WARNING

Shock hazard. The defibrillator stores and delivers hazardous voltages. These voltages must be safely discharged as described in this TCP. Do not perform this procedure unless you are thoroughly familiar with the operation of the defibrillator.

TCP-Personnel

Technicians who perform this TCP must be thoroughly familiar with the operation of the LIFEPAK 11 defibrillator/pacemaker and any required accessories. Personnel performing this TCP must meet at least one of the following levels of education or experience:

- Associate of Applied Science degree with a major emphasis in biomedical electronics
- Certificate of Technical Training in electronics with a major emphasis in biomedical electronics
- Equivalent biomedical electronics experience

TCP-Defibrillation Calibration

Perform this test in Service Mode. For additional information concerning Service Mode, see Section 2.

1 Install a fully-charged battery in the defibrillator/pacemaker. Make sure that the POWER switch is set to OFF.

2 Connect a therapy module to the defibrillator.

3 Connect the defibrillation cable to the energy meter.

4 Press and hold down both the PACER button and the SYNC button while rotating the POWER switch to BATT. Continue to hold down the buttons until the JOULES display shows: S0F.
5.x
The number on the bottom line is the version of the software.

5 Press the ▼ 5 mA CURRENT button 6 times until the display shows: dEF
– – –

6 Press CHARGE. The defibrillator will not charge at this point.

7 For tests using the QUIK-COMBO module, select 2J. For tests using the Standard Paddles module, select 5J.

8 Press CHARGE.

9 Press both discharge buttons.

10 Compare the reading on the energy meter with the selected defibrillator energy. If there is a difference between the two numbers, press the ▼ 20 mA CURRENT ▲ button until the available energy reading matches the energy meter reading.

11 Press SYNC to temporarily store the calibration adjustment. The display briefly shows: CAL. Do not turn defibrillator off while CAL displays (the calibration constants will be lost).

12 Confirm the calibration by repeating steps 8 through 11.

13 Repeat Steps 7 through 11 for each of the energy settings listed in Table 3–11.

Note. When using the Standard Paddles Module, the 3J, 4J, 6J, 7J, 8J, 9J, and 30J energy settings are not available.

Table 3–11 Defibrillation Energy Levels

Energy Setting	Tolerance	Energy Setting	Tolerance
2J	±1.6J	10J	±1.6J
3J	±1.6J	20J	±2J
4J	±1.6J	30J	±3J
5J	±1.6J	50J	±5J
6J	±1.6J	100J	±10J
7J	±1.6J	200J	±20J
8J	±1.6J	300J	±30J
9J	±1.6J	360J	±36J

14 Rotate the POWER switch to OFF, then to BATT. This updates the calibration constants into the defibrillator memory.

15 Select 200J and press CHARGE.

16 Immediately press both discharge buttons.

17 Confirm that the energy meter shows 200J ±20J.

TCP-Pacer Current Calibration

Perform this test in Service Mode. For additional information about Service Mode, see Section 2.

1 Install a fully-charged battery in the defibrillator/pacemaker. Make sure that the defibrillator POWER switch is set to OFF.

2 Connect the therapy module to the defibrillator.

3 Rotate the defibrillator POWER switch to BATT.

4 Press and hold down both the PACER button and the SYNC button while rotating the POWER switch to BATT. Continue to hold down the buttons until the JOULES display shows: S0F
5.x
The number on the bottom line is the version of the software.

5 Press the ▼ 5 mA CURRENT button seven times until the display shows:
PAC
– – –

6 Connect the defibrillation cable to the pacing simulator (when using the Standard Paddles module, connect the QUIK-PACE cable to the pacing simulator). Apply power to the simulator.

7 Press PACER.

8 Confirm that the defibrillator displays the10mA current level.

9 Compare the reading on the pacing simulator with the pacing current on the defibrillator. If there is a difference between the two numbers, press the ▼ 20 CURRENT ▲ button until the numbers match.

10 Press SYNC to temporarily store the calibration adjustment and advance to the next setting.

11 Press the ▲ 20 CURRENT buttons to check each of the current output settings listed in Table 3–12. All the settings must be checked and then SYNC pressed after each setting. After calibrating 200ma, CAL will appear briefly on the display. Press SYNC to store *all* the calibration constants for each setting. Do not remove power until CAL is no longer displayed. (the calibration constants are stored in memory).

12 When the calibration sequence is finished, the current calibration can be verified by performing the entire calibration again, starting with the 10mA current level and ending with the 200mA level.

Table 3–12 Pacing output current

Current Setting	Tolerance	Current Setting	Tolerance	Current Setting	Tolerance
10mA	±5mA	75mA	±5mA	140mA	±7mA
15mA	±5mA	80mA	±5mA	145mA	±7mA
20mA	±5mA	85mA	±5mA	150mA	±8mA
25mA	±5mA	90mA	±5mA	155mA	±8mA
30mA	±5mA	95mA	±5mA	160mA	±8mA
35mA	±5mA	100mA	±5mA	165mA	±8mA
40mA	±5mA	105mA	±6mA	170mA	±9mA
45mA	±5mA	110mA	±6mA	175mA	±9mA
50mA	±5mA	115mA	±6mA	180mA	±10mA
55mA	±5mA	120mA	±6mA	185mA	±10mA
60mA	±5mA	125mA	±6mA	190mA	±10mA
65mA	±5mA	130ma	±7mA	195mA	±10mA
70mA	±5mA	135mA	±7mA	200mA	±10mA

Troubleshooting Aids

This subsection contains a defibrillator output waveform test and a listing of service mode error codes. For additional troubleshooting information about defibrillator/pacemaker screen messages or problems with operating functions, refer to the *LIFEPAK 11 defibrillator/pacemaker Operating Instructions.*

If disassembly is required, refer to Disassembly Procedures in Section 4. For information about ordering parts, refer to page 5-1.

⚠ CAUTION

Possible PCB damage. The Printed Circuit Boards (PCBs) are multi-layered boards with surface-mounted components. During field-repair, excessive heat from a soldering iron can easily damage these PCBs and components. Component-level troubleshooting and repair is neither supported nor recommended.

Defibrillation Output Waveform

This test helps to troubleshoot for failure symptoms in the following:

- Defibrillator capacitor
- Waveshaping inductor
- Transfer relay

It also helps check that the output energy was properly calibrated during defibrillation calibration.

⚠ WARNING

Shock hazard. Keep away from the energy meter. Dangerous voltages are present on energy meter electrode plates.

1 Connect the defibrillation cable to the energy meter.

2 Connect the oscilloscope to the energy meter scope output connector.

3 Set the oscilloscope as follows:
   - 0.5V/div
   - 1ms
   - +slope
   - Store mode
   - Single sweep

   Note. When using the QED-6 energy meter, 1V on the oscilloscope = 29A defibrillator output. When using other energy meters, refer to the manufacturer's specifications.

4 Press ENERGY SELECT and select 360J.

5 Press CHARGE.

6 When 360J are available, press both discharge buttons.

7 Confirm that the waveform meets the specifications shown in Figure 3-9.

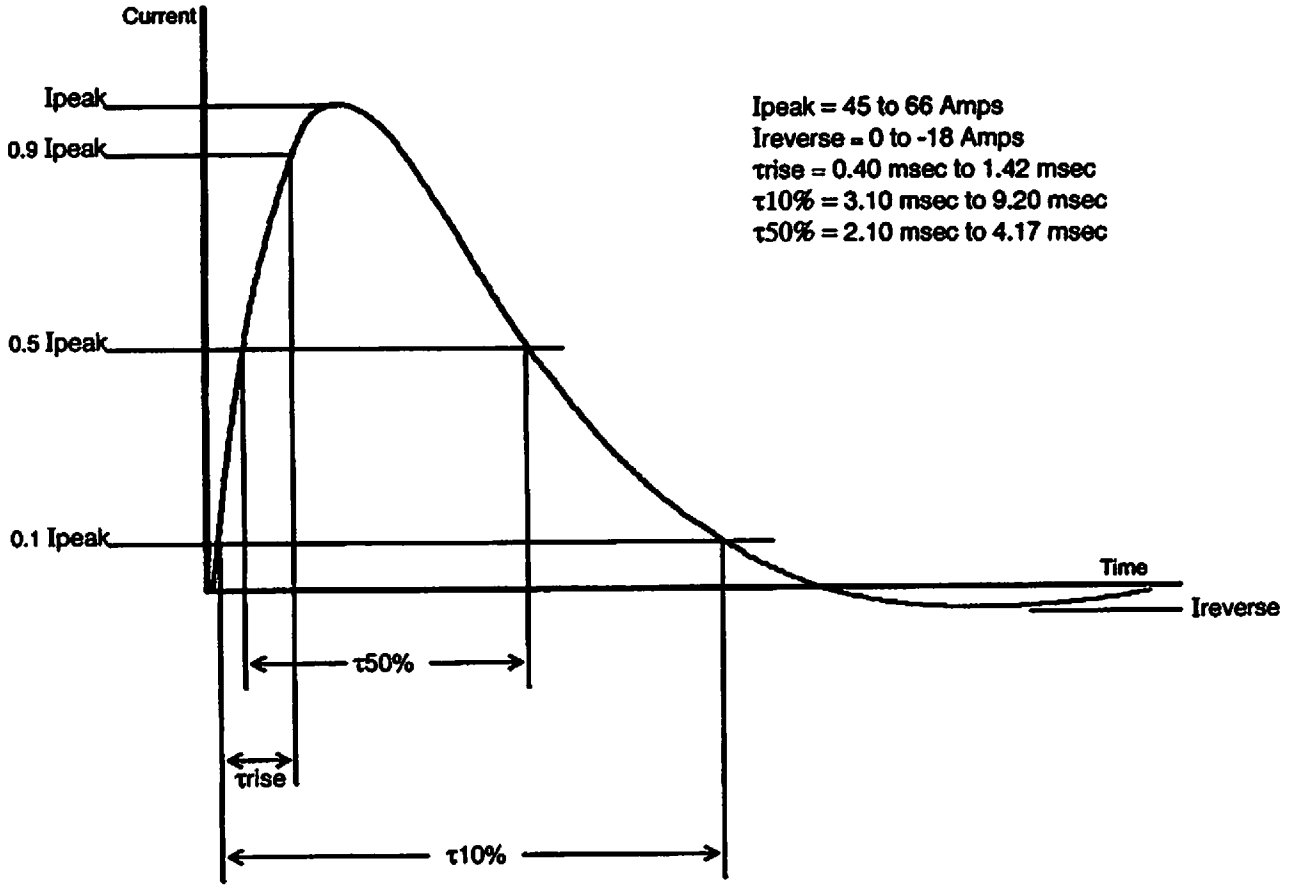


Figure 3-9 Energy output waveform

Service Mode Error Codes

The following list of error codes may indicate that the defibrillator requires servicing. Table 3–13 shows the error codes and the subassembly that may be responsible for the error code. Access these codes while the defibrillator is in service mode.

The appearance of an error code does not necessarily indicate that there is a permanent error condition. An error code could indicate a temporary EMI (electromagnetic interference) or ESD (electrostatic discharge) transient. After the defibrillator shows an error code, clear the error code log. If the defibrillator does not display the error code again when the defibrillator is performing the same operation, the error code may be the result of EMI or ESD.

The suspect assemblies in Table 3–13 are listed in the order of most likely failure (top to bottom).

Table 3–13 Service mode error codes

Error Code	Suspected Subassembly
02	a. Main PCB b. Wire Harness c. Transfer Relay
04	a. Main PCB b. Transfer Relay c. Display PCB
0F	a. Main PCB b. Transfer Relay Wire Harness c. Transfer Relay
10	Main PCB
11	a. Main PCB b. Note code and recalibrate
20	a. Pacer PCB b. Main PCB c. Main PCB/Pacer PCB Ribbon Cable
21	a. Note code and calibrate b. Pacer PCB c. Main PCB d. Main PCB/Pacer PCB Ribbon Cable
25	a. Pacer PCB b. Main PCB c. Main PCB/Pacer PCB Ribbon Cable
26	a. Pacer PCB b. Main PCB
27	a. Pacer PCB b. Main PCB
28	Pacer PCB
29	a. Slide Contacts b. Main PCB
2A	a. Slide Contacts b. Main PCB
2B	a. Slide Contacts b. Main PCB
2C	a. Slide Contacts b. Main PCB
2E	a. Slide Contacts b. Main PCB
30	Pacer PCB
32	Main PCB
33	Main PCB
35	a. ESD or Noise b. Pacer PCB c. Main PCB/Pacer PCB Ribbon Cable c. Main PCB
36	Main PCB
41	Main PCB
42	Main PCB
43	Main PCB
44	Main PCB

Error Code	Suspected Subassembly
45	Main PCB
46	Main PCB
47	Main PCB
48	Main PCB
49	Main PCB
4A	Main PCB
4B	Main PCB
4C	Main PCB
4F	Main PCB
57	Main PCB
58	a. Main PCB b. Pacer PCB c. Display PCB
59	Main PCB
67	a. Slide Contacts b. Pacer PCB d. Main PCB e. Main PCB/Pacer PCB Ribbon Cable
6E	Main PCB
6F	Main PCB
72	Main PCB
73	Main PCB
74	Main PCB
75	Main PCB
80	a. Battery b. Main PCB c. Battery Wire Harness
81	a. Main PCB b. Pacer PCB c. Display PCB
82	Main PCB
83	a. Main PCB b. Pacer PCB
91	a. Battery b. Transfer Relay/Dump Relay c. Main PCB d. Transfer Relay Wire Harness
92	a. Slide Contacts b. Main PCB
A0	Main PCB

Section 4

Service and Maintenance

Introduction

This section provides the following information:

- Maintenance and Testing Guidelines
- Battery Maintenance
- Disassembly Procedures
- Reinstallation Procedures
- Battery Pin Replacement
- Fuse Replacement
- Inspection
- Cleaning
- Warranty
- Preparation for Shipping

Before servicing or repairing the LIFEPAK 11 defibrillator/pacemaker, become familiar with all the information in this section. For servicing and maintaining the defibrillator/pacemaker, contact a local Physio-Control service representative. In the USA, call Physio-Control Technical Services at 1-800-442-1142.

Maintenance and Testing Guidelines

Periodic maintenance, inspection, and testing of the LIFEPAK 11 defibrillator/pacemaker and accessories help prevent and detect possible electrical and mechanical problems. Table 4–1 presents a maintenance and testing schedule for service personnel. The Performance Inspection Procedure (PIP) and Test and Calibration Procedures (TCP) are provided in Section 3.

Table 4–1 Maintenance and Testing Schedule for Service Personnel

Activity	As Needed	3 Months	6 Months	12 Months	24 Months
Performance Inspection Procedure (PIP)			●		
Test and Calibration Procedures (TCP)	●				
Inspection – Exterior (Table 4–2; included with PIP)	●				
Inspection – Interior (Table 4-3)	●				
Cleaning – Exterior (Table 4–4)	●				
Cleaning – Interior (page 4-20)	●				
Battery Reconditioning (Figure 4-1)		●			
Battery Shelf Life Test (Figure 4-2; includes Battery Reconditioning)			●		
Battery Connector Pin Replacement Figure 4-9; inspection included with PIP)	●				●

Useful Life

During product development, the LIFEPAK 11 defibrillator/pacemaker and subassemblies are subjected to rigorous life testing. This testing and the routine testing and maintenance program recommended in this manual will help to provide reliable device operation for many years.

However, both rapid technological changes and the availability of older replacement parts limit the useful life of all modern medical devices. The American Hospital Association suggests a 5-year useful life expectancy for defibrillators and external pacemakers (*Estimated Useful Lives of Depreciable Hospital Assets, Revised 1993 Edition*). Similarly, the U.S. Army lists an eight-year life expectancy for defibrillators (technical bulletin: *TB MED 7, Maintenance Expenditure Limits for Medical Materiel, TB MED 7, Rev. 8 October 1993*). Physio-Control Corporation recommends that you adopt a 5-to-8 year useful life expectancy for this device.

Product Support Policy

Physio-Control Corporation provides full technical support and replacement parts for a period of 8 years from the date of shipment from our manufacturing facility. After this 8-year period, Physio-Control provides technical support and replacement parts as available.

Battery Maintenance

The LIFEPAK 11 defibrillator/pacemaker uses FASTPAK and Battery Pak Nickel-Cadmium (NiCad) batteries. To help maximize battery life and performance, these NiCad batteries must be properly maintained with the Battery Support System.

⚠ WARNINGS

Possible power failure. Using a battery affected by voltage depression may result in power failure during patient care without warning. Be sure to properly maintain batteries as described in this section.

Possible instrument failure. Physio-Control has no information regarding the performance or effectiveness of the LIFEPAK 11 defibrillator/pacemaker if used in conjunction with non-Physio-Control batteries or remanufactured or alternate source batteries or chargers from other sources. Use only the Physio-Control batteries and the Battery Support System.

Possible battery damage. The two-well Battery Charger (Physio-Control Part Numbers 9-00284, 9-00288, and 801530) is not designed to charge FASTPAK batteries. Charging the FASTPAK battery in the two-well standard Battery Charger may reduce battery life and create a risk of fire or explosion. Do not charge the FASTPAK battery in the standard Battery Charger.

Possible instrument failure. The AC Auxiliary Power Supply does not maintain batteries. Use only the Battery Support System to maintain batteries. The AC Auxiliary Power Supply does not replace the Battery Support System.

Possible instrument failure. Failure to charge a stored battery before returning it to active service may result in premature power failure of the defibrillator/pacemaker or defibrillator during patient care. Always charge a stored battery before returning it to active service.

NiCad Battery Performance Factors

Three major factors affect the performance of NiCad batteries:

- Temperature
- Voltage Depression
- Self-discharge rate

Temperature

Charging a battery at temperatures below 20°C (68°F) or above 25.5°C (78°F) will prevent the battery from reaching its full capacity and may lead to *irreversible* cell damage.

Voltage Depression

Voltage depression is a condition that reduces battery performance, particularly when charging the defibrillator. This condition is often mistakenly called "memory." Voltage depression can usually be reversed by reconditioning the battery every 3 months as described in Figure 4–1. Voltage depression is caused by either:

- Repeated attempts to add more charge to a fully-charged or an almost fully-charged battery

- Extended charging at temperatures above the maximum recommended 25.5°C (78°F).

Self-Discharge Rate

Like most batteries, NiCad batteries self-discharge when they are not used. When stored at room temperature, a new NiCad battery self-discharges approximately 1% of its capacity each day. In 10 days, a new NiCad battery not installed in the defibrillator/pacemaker loses approximately 10% of its capacity. Evaluate the self-discharge rate of the battery by performing a Shelf Life Test. The actual battery self-discharge rate depends on these factors:

- Battery age
- Temperature
- Frequency of use
- Length of time in storage
- Physical battery condition.

These factors can combine to significantly increase the battery discharge rate. For example, an older battery stored in higher temperatures may have an accelerated self-discharge rate much greater than 1% per day.

⚠ CAUTION

Possible battery damage. Remove and replace a battery when the LOW BATTERY message first appears. Over-discharging can shorten battery life.

Charging a Battery with the Battery Support System

To charge a battery in the Battery Support System:

1 Insert the battery in one of the three battery compartments. Confirm that the CHARGE light is on indicating the charge cycle has begun.

2 Periodically, check on the battery until the READY light is on (a full charge requires approximately 70 minutes). The battery is now fully charged and ready for use.

The FAULTY Light

If the Battery Support System displays the FAULTY light when a battery is installed, leave the battery installed for up to 30 minutes. Then, remove and reinsert the battery to restart the charge cycle. If the FAULTY light remains on, discard the battery.

Use the Battery Support System to Maintain Batteries

To properly maintain batteries, use only the Battery Support System and the following guidelines:

- Charge batteries at the proper temperature.

  The optimum charging temperature is room temperature (20° to 25.5°C or 68° to 78°F). Batteries charged outside room temperature may not reach full capacity, even if the charge time is increased. Incomplete battery charging may lead to *irreversible* cell damage.

- Place the Battery Support System in the proper location.
  - Place in a well-ventilated area.
  - Keep at room temperature.
  - Do not place in direct sunlight.
  - Do not place near a heat source or air conditioner.
- Rotate the batteries so that all batteries in active service are used equally.

Recondition Batteries Every Three Months

Reconditioning is a succession of discharge and charge cycles. This process can be performed on a battery inserted into the far right compartment of the Battery Support System. Reconditioning a battery helps prevent or reverse the effects of voltage depression and helps keep track of battery capacity.

Recondition batteries *every 3 months* by using the Reconditioning Procedure in Figure 4–1. Discard any battery with a capacity reading of less than 80% on the third cycle. For information about ordering copies of the Reconditioning Procedure form, refer to Section 5.

RECONDITIONING PROCEDURE

For use with the Physio-Control® Battery Support System, FASTPAK® and Battery Pak batteries.
- 80% or greater battery capacity is acceptable
- Alternate every 90 days with Shelf Life Test
- Use Battery Support System at 68–78° F
- For Technical Support, call (800)442-1142 USA

Test Date _____ Battery ID _____

Performed by _____

CHECKLIST (√ circle when done)

○ 1 Charge battery until READY light appears
○ 2 Cycle #1: DISCHG–CHARGE–READY; disregard reading
○ 3 Cycle #2: DISCHG–CHARGE–READY; disregard reading
○ 4 Remove battery for 1 – 4 hrs Begin _____ End _____
○ 5 Cycle #3: DISCHG–CHARGE–READY; bat. cap. =_____%
○ 6 Log Cycle #3 bat. cap.% on back of battery

Cycle #3 bat. cap. 80% or greater?
○ Yes–acceptable
○ No–unacceptable/discard battery

P/N 806017-001 © 1993 Physio-Control Corporation

Figure 4–1 Reconditioning Procedure form

Perform Shelf Life Test Every Six Months

The Shelf Life Test evaluates the self-discharge rate of a stored battery. Perform the Shelf Life Test described in Figure 4–2 *every six months, or alternate it with the Reconditioning Procedure in Figure 4–1 every three months.* Discard any battery with a Shelf Life Test value of more than 20. For information about ordering copies of the Shelf Life Test form, refer to Section 5.

SHELF LIFE TEST

For use with the Physio-Control® Battery Support System, FASTPAK® and Battery Pak batteries.
- Shelf Life Test Value of 20 or less is acceptable
- Alternate every 90 days with Reconditioning Procedure (Note: Steps 1–5 equals Reconditioning Procedure)
- Use Battery Support System at 68–78° F
- For Technical Support, call (800)442-1142 USA

Test Date _____ Battery ID _____

Performed by _____

CHECKLIST (√ circle when done)

O 1 Charge battery until READY light appears
O 2 Cycle #1: DISCHG–CHARGE–READY; disregard reading
O 3 Cycle #2: DISCHG–CHARGE–READY; disregard reading
O 4 Remove battery for 1 – 4 hrs Begin _____ End _____
O 5 Cycle #3: DISCHG–CHARGE–READY; bat. cap. =____%
O 6 Log Cycle #3 bat. cap.% on back of battery
O 7 Remove battery for 7–8 days and store on shelf
Begin ___/___/___ End ___/___/___
O 8 Cycle #4: DISCHG–CHARGE–READY; bat. cap. =____%

Record: Cycle #3 bat. cap. _____ %
Subtract: Cycle #4 bat. cap. —_____ %
Result: Shelf Life Test Value =_____ %

Shelf Life Test Value 20 or less?
O Yes–acceptable O No–unacceptable/discard battery

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Figure 4–2 Shelf Life Test form

Use Battery Maintenance Log

The Battery Maintenance Log shown in Figure 4–3 helps to track battery maintenance procedures. For information about ordering copies of the Battery Maintenance Log, refer to Section 5.

BATTERY MAINTENANCE LOG

For use with the Battery Support System for Physio-Control

DATE	I.D. NUMBER	BATTERY TEST PERFORMED	BATTERY TEST RESULTS	BATTERY ACCEPTABLE?	
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery
		☐ Faulty ☐ Reconditioning Procedure ☐ Shelf Life Test ☐ Visual Inspection (case not cracked or broken)	Battery Capacity ______ % Shelf Life Test Value ____ Case OK ☐ Case not OK ☐	☐ YES	☐ NO Discard Battery

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Figure 4-3 Battery Maintenance Log

Receiving New Batteries

When newly-purchased batteries arrive:

- Promptly label each new battery. Use a unique identification number to easily track the battery through all maintenance and rotation procedures.
- Recondition each new battery.

Because NiCad batteries self-discharge, a new battery may not be fully charged by the time it is received. Recondition a newly purchased

battery according to the Reconditioning Procedure described in Figure 4–1.

Storing Batteries

Store batteries in the Battery Support System or on a shelf. Batteries still require routine maintenance, even while they are in storage. When storing batteries on a shelf:

- Store batteries between 4.4° and 26.7°C (40° and 80°F). Cooler temperatures reduce the battery self-discharge rate.
- Never freeze batteries.

Discarding Batteries

When properly maintained, Physio-Control FASTPAK NiCad batteries should have a battery life of approximately 2 years. Discard batteries in an environmentally safe manner if *one or more* of the following circumstances occur:

- The battery capacity is less than 80% *after* reconditioning.
- There is a difference of *greater than 20* after performing a battery Shelf Life Test.
- There is physical damage to the battery case.
- The Battery Support System indicates FAULTY when the battery is recharged.

Recycling Batteries

Recycle discarded NiCad batteries locally according to national, state, and local regulations. If local recycling is not possible, contact your local Physio-Control representative. In the USA, contact a Physio-Control service representative at 1-800-442-1142.

Disassembly Procedures

The following procedures describe how to disassemble the major assemblies of the LIFEPAK 11 defibrillator/pacemaker. Numbers in parentheses ( ) refer to item numbers in the Final Assembly Parts list and Figure 5-1. Whenever the case must be opened for service or repair, perform an interior inspection as described in Table 4-3.

When disconnecting cables and wire harnesses, label the cables and connections so that they match easily during reassembly, e.g., A1P2, A2P14, etc. Each "P" connection mates to a corresponding "J" connector with the same number. For example, P3 mates with J3. Refer to the Interconnect Diagram (Figure 5-2), for additional connection information. For reinstallation procedures, refer to page 4-14.

Unless otherwise specified, directions (such as left, right, front or back) are referenced from the front of the defibrillator/pacemaker.

⚠ WARNING

Possible shock and instrument damage. Unless reassembled properly, it is possible to pinch and damage wires during reassembly. To avoid pinching wires, carefully follow the Reinstallation Procedures on page 4-14.

⚠ CAUTION

Possible component damage. Some PCB assemblies in the instrument contain static sensitive devices (SSDs). To avoid damage, observe the special handling for static sensitive devices as described below.

Note. Two types of screw used in the assembly of the defibrillator/pacemaker (items 42 and 43 on the Final Assembly Parts List) have plastic coatings on the threads to help secure the screws. These screws should be used only once. Discard and replace all screws that have been removed.

Special Handling for Static Sensitive Devices

Many electronic semiconductor devices (such as MOS ICs, FETs, optical isolators, or film resistors) can be damaged by the discharge of static electricity. Static charge buildup is very common. Static discharges commonly occur when the operator wears synthetic clothes and transfers the charge to any object touched. These discharges can damage or destroy Static Sensitive Devices (SSDs). In most cases, the discharge is not even perceptible to the person who causes it.

To prevent static discharge damage to SSDs, observe the following precautions during any open-case test, maintenance, or repair procedures:

Look for SSD Symbol

Note that SSDs such as PCBs are indicated in this service manual with the following warning symbol: 

Use Static-Dissipative Mat

Always perform repair or maintenance on a static-dissipative mat that is connected to earth ground.

Wear Wrist Strap

Always wear a conductive wrist strap connected to the mat and to ground except when working on energized equipment or when discharging high voltage circuits. The strap must be snug enough to make good contact against bare skin.

⚠ WARNING

Shock hazard. Remove the wrist strap when working on energized equipment or when discharging high voltage circuits.

Transport and Store PCBs Properly

Transport and store PCBs in anti-static racks or inside conductive bags. Label the package that contains the PCBs as static-sensitive.

Keep Work Area Static-Free

Keep static-generating products such as styrofoam cups or trays away from the work area. Connect all electrical equipment such as soldering irons and test equipment to ground with a three-prong plug.

Test Work Area Routinely

Test all the anti-static parts of the work area (mat, straps, cables) routinely. Keep a log of the test results.

Power Disconnection

Before any disassembly, be sure to turn the POWER switch to OFF. Remove the battery and disconnect the AC Auxiliary Power Supply (if it is connected).

Case Separation

To remove internal, replaceable assemblies, separate the Upper and Lower Cases. Before starting this procedure, be sure to have a quantity of cable ties (PN 200536-001 or equal) and a quantity of lithium grease (PN 202434-000 or equal). Label cable routing and cable ties throughout and note where cable tie replacements are required. To separate the cases:

1 Turn the instrument upside down.
2 Remove the ten 6-32 screws (43) and the three 4-40 screws (42) that secure the Upper and Lower Cases. (Discard these screws and replace them during reassembly.)
3 Lift the Lower Case away from the Upper Case.

Main PCB Assembly Removal

Before removing the Main PCB Assembly (A1), observe the following caution:

⚠ CAUTION

Possible component damage. Do not pull hard on the ribbon cable connector release tabs for connectors P3, P8, and P11. Pull only with enough force to release the connectors.

1 Remove two 4–40 screws (42) and one 4–40 nut (33) that secure the Main PCB . (Discard these screws and replace them during reassembly.)
2 Label and disconnect P10 and P13.
3 Gently lift the PCB from its cradle to gain access to the wiring connections on the component side.
4 Label and disconnect connectors P1 through P9, and P11 from the J portions of the connections on the PCB (see below). Label the lead connected to A4– 8, cut the tie wrap, and disconnect. Note that P1, P6, P7, P9, and P13 have release tabs on the "P" portion of the connection while P2, P3, P4, P5, P8, P10, and P11 have release tabs on the "J" portion of the connection.
5 Lift the Main PCB away from the Upper Case.

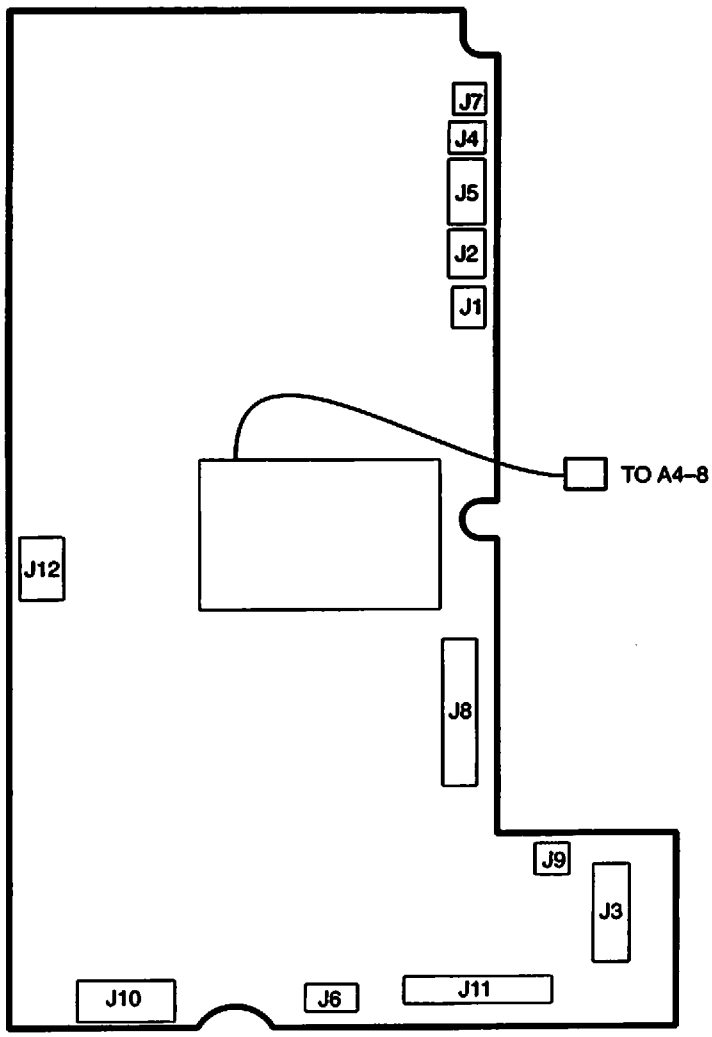

Figure 4–4 Main PCB Assembly

Pacer PCB Assembly Removal

First, remove the Main PCB and W9 Monitor Interface Connector to provide access to the A2 Pacer PCB.

1. Position the Upper Case wiring harness assemblies to provide clear access to the Pacer PCB.
2. Loosen the POWER switch by removing the mounting nut behind the switch.
3. Label and disconnect the P14 and P15 connectors from the corresponding J14 and J15 connectors on the PCB (see below).
4. Remove the foam tape (17) between the Pacer PCB and the Transfer Relay. Replace this foam when reinstalling the Pacer PCB.
5. Remove the four 4-40 screws (42) and the 4-40 standoff (56) that secure the PCB.

6 Remove the Upper Case standoff (55) near A2J14 to create enough space to remove the PCB.

7 Tilt and lift the A2 Pacer PCB away from the Upper Case.

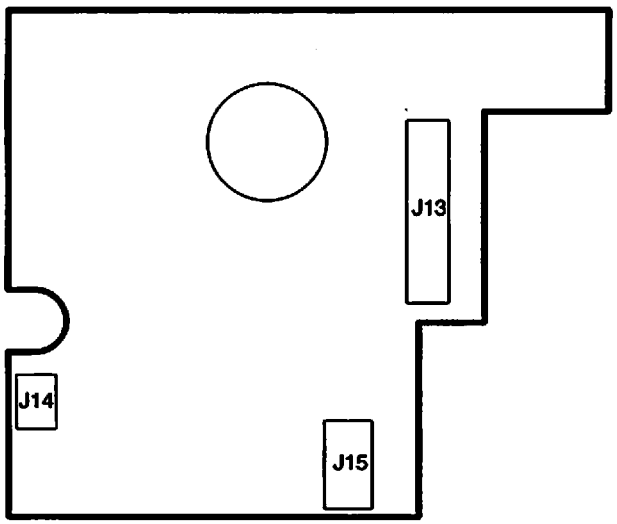

Figure 4–5 Pacer PCB

Keypad Assembly Removal

First, remove the Pacer PCB (A2) to provide access to the Keypad PCB (A3).

1 Tilt back and lift the Keypad Bracket (6) away from the Keypad PCB.

2 Tilt back and lift the Keypad PCB away from the Upper Case.

Transfer Assembly Removal

First, remove the A1 Main PCB (A1) to gain access to the Transfer Relay (A4).

1 Label and disconnect the wires from the Transfer Relay terminals as shown in Figure 4–6 below. The terminal numbering corresponds to the numbers on the Interconnect Diagram (Figure 5-2).

⚠ CAUTION

Possible component damage. Pay special attention to labeling terminals A4–6 (white wire) and A4–9 (red wire) to make sure these terminals are not interchanged in reassembly.

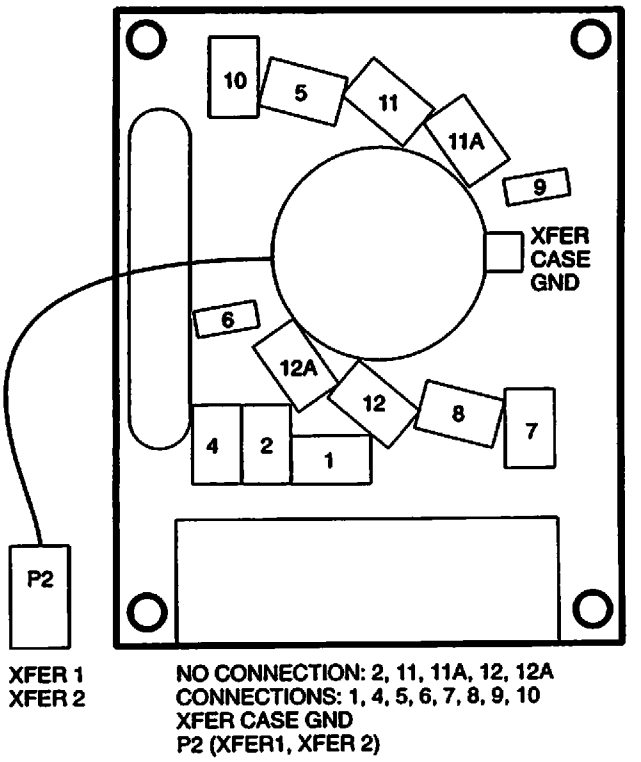

Figure 4–6 A4 Transfer Relay

2 Remove the four 4-40 screws (42) and the washers (58) that secure the Transfer Relay. Cut the remaining tie wraps.

3 Lift the Transfer Relay away from the Upper Case.

Capacitor Removal

When disconnecting the wires from C1, be sure to label each wire to match the capacitor polarity (red +, black -).

1 Cut the cable tie that secures C1 to the Upper Case.

2 Grasp C1 and carefully lift it from the case.

3 Disconnect the push-on terminals from the wires to C1+ and C1 -. Do not disturb the bleeder resistor (37) that is connected to the other C1+ and C1 - terminals.

4 Remove C1. Observe that the capacitor is protected with a plastic sleeve (13) and plastic end-cap (47). Keep these items with C1 for later reassembly.

Inductor Removal

First, remove C1 and the Main PCB to provide access to Inductor L1.

1 Cut the cable tie that secures the J22 and J23 connectors.

2 Slide back the protective sleeve. Then, label and disconnect J22 and J23.

3 Label and disconnect the Inductor (W3) lead at terminal 7 of the Transfer Relay.

4 Unbundle the wire assemblies as needed to free the Inductor leads.

5 Lift the Inductor away from the Upper Case.

Therapy Connector Removal

First remove the Main PCB to provide access to the Therapy Connector (W1).

1 Label and disconnect the following wiring harness connectors: P3, P10, P14, P15, P22, P23, and terminal A4–6.
2 Unbundle the wire assemblies as needed to free the Therapy Connector leads.
3 Remove the retainer ring (41) that secures the Therapy Connector.
4 Push the wire through the mounting hole and lift the Therapy Connector from the Upper Case.

Monitor Interface Connector Removal

First, remove the Main PCB to gain access to the Monitor Interface Connector(W9).

1 Cut the cable tie (9) that secures the ferrite ring adjacent to the W9 Monitor Interface Connector.
2 Unbundle the wire assemblies as needed to free the Monitor Interface Connector leads.
3 Lift the Monitor Interface Connector from the Upper Case.

Reinstallation Procedures

To reinstall assemblies, perform the disassembly steps described in the preceding paragraphs in the reverse order. Numbers in parentheses ( ) refer to item numbers in the Final Assembly Parts List and Figure 5-1. However, the following assemblies require additional reinstallation instructions, which are described below:

- Monitor Interface Connector
- Therapy Connector
- Inductor
- Capacitor
- Transfer Relay
- Transfer Relay
- Keypad PCB
- Pacer PCB
- Main PCB
- Upper and Lower Case.

⚠ WARNING

Possible shock and instrument damage. Unless reassembled properly, it is possible to pinch and damage cable wires when joining the Upper and Lower Case. To avoid pinching wires, carefully follow the reassembly instructions.

W9 Monitor Interface Connector

During reinstallation, apply lithium grease (PN 202434-000 or equivalent) along the edge of the connector body. Then, reinsert the

connector in the Upper Case. The grease helps maintain the water-resistant integrity of the LIFEPAK 11 defibrillator/pacemaker. After installing the connector, secure the ferrite ring with a cable-tie as shown In Figure 4–7. The connector end (P12), connects to the Main PCB (P13).

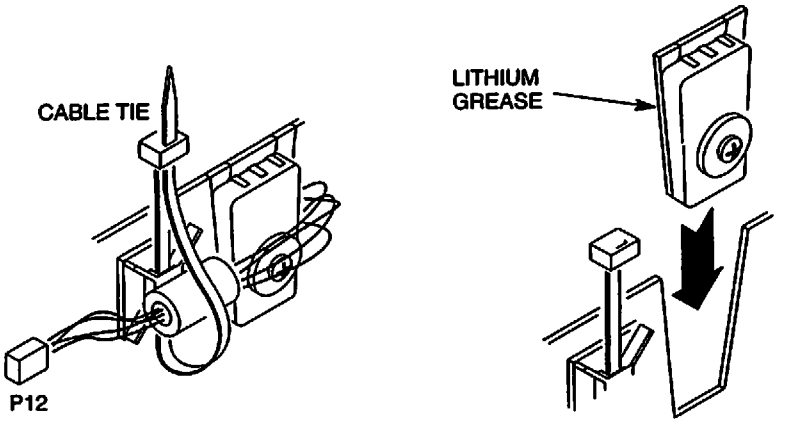

Figure 4–7 Monitor Interface Connector reinstallation

W1 Therapy Connector

During reinstallation, feed the connector wires back through the mounting hole and rotate the Therapy Connector until the keyway settles into place. While holding the connector in place, slide the retainer ring (41) into place on the rear of the connector. Route the connection wires to their corresponding connection points on the Main PCB, Pacer PCB, and Transfer Relay.

L1 Inductor

During reinstallation, place the L1 Inductor (W1) in the Upper Case. Route the connection wires to their corresponding connection points on the Transfer Relay (A4–9) and P22/P23.

C1 Capacitor

During reinstallation, make sure that the wire connections are made to the correct capacitor polarity. Route the wires between the Therapy Connector and the Main PCB in the space underneath the Capacitor. Secure the capacitor in place with a tie wrap.

A4 Transfer Relay

During reinstallation, be sure that the Transfer Relay is mounted correctly (the black device on the A4 Transfer Relay faces the inside of the case). For terminal connections and wire routing, refer to Figure 4–8.

⚠ CAUTION

Possible instrument damage. Improper wire routing could compromise isolation between high-voltage and low-voltage wires. During reinstallation, observe proper wire routing as detailed in Figure 4–8.

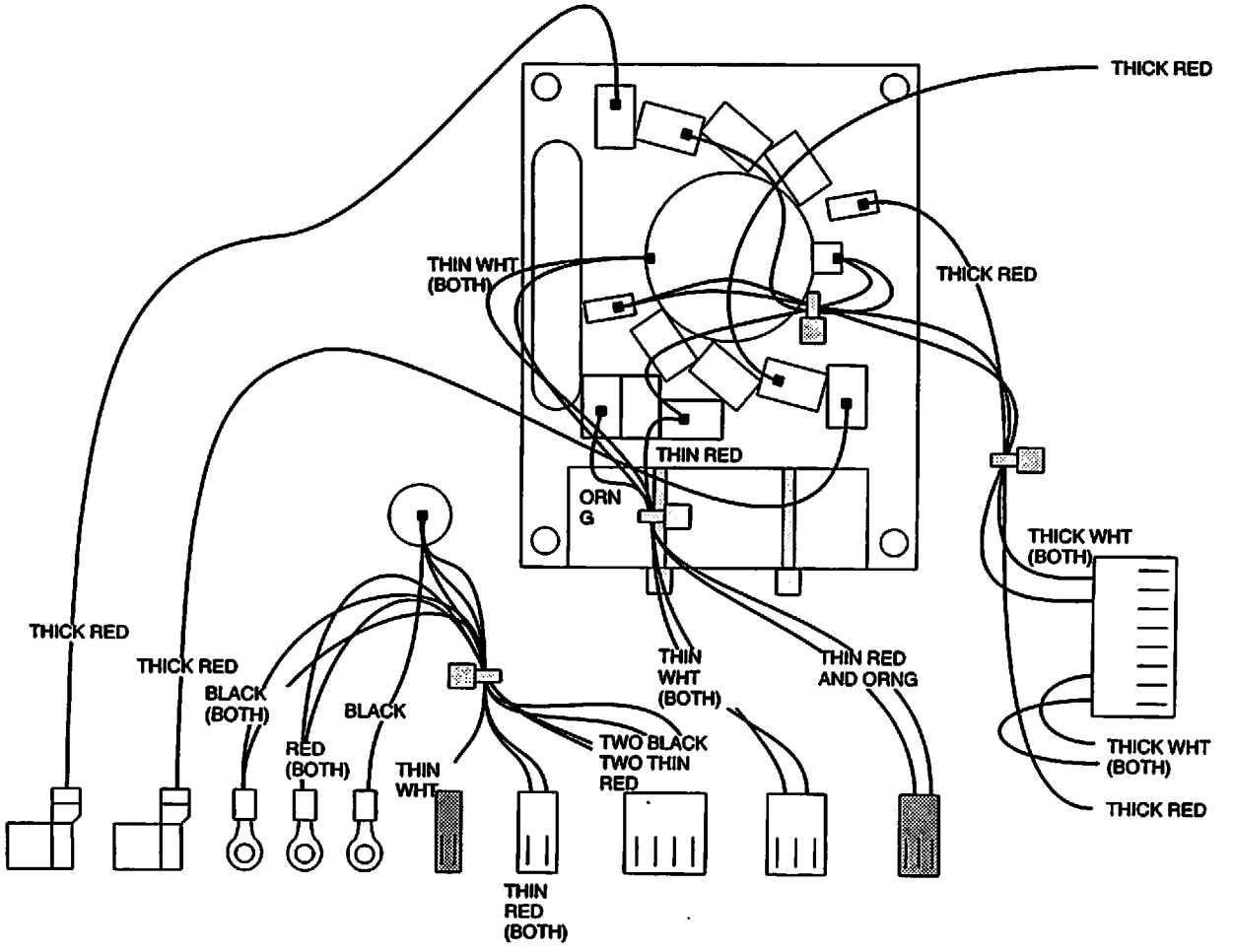

Figure 4–8 Transfer relay wire routing

A3 Keypad PCB

During reinstallation, be sure that the keypad portion is flush with the front panel. Then, reinstall the Keypad Bracket (6) making sure that the switch is fully seated in the A3 Keypad PCB (42). If the keypad is bumped or dislodged while the instrument cover is off, remove the keypad PCB and Keypad Bracket, then reinstall first the keypad PCB and then the Keypad Bracket.

A2 Pacer PCB

During reinstallation, tilt the Pacer PCB so that it installs just beneath the switch portion of W8. The foam tape (17) between the Pacer PCB and the Transfer Relay is nonreusable and must be replaced.

A1 Main PCB

During reinstallation, be sure that all wiring harnesses are in place before installing the PCB. Dress the wires and use cable ties as needed to prevent pinching wires.

Upper and Lower Case

During reinstallation, make sure that:

- Connections between assemblies are complete.
- Wires are dressed to prevent pinching or stretching.

Then attach the Lower Case.

Battery Connector Pin Replacement

Inspect the battery connector pins as a part of routine physical inspection. Be sure to examine each leaf on the pins to make sure that they are not cracked or broken. Tighten any pins that are loose. Replace any pins that are bent, broken, corroded, worn, or damaged.

The pins can be replaced without opening the case. Use a 5/32-inch nut driver to unscrew the threaded shaft. Then, remove the pin as shown in Figure 4–9. When installing a pin, make sure that the threads are properly aligned. Tighten the pin firmly, but do not overtighten.

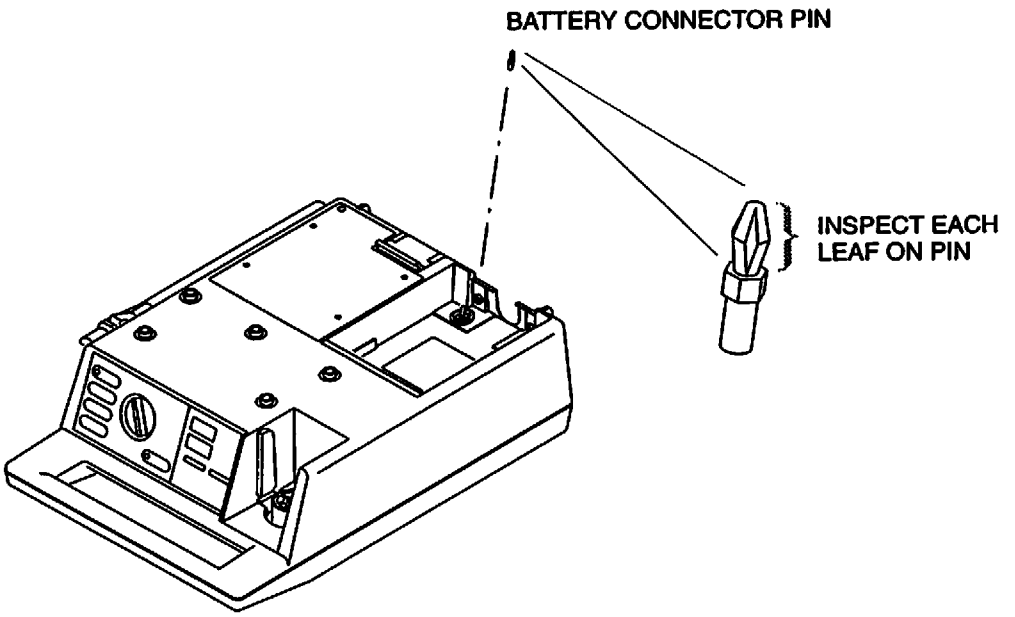

Figure 4–9 Inspecting and Removing Battery Connector Pin

Fuse Replacement

The defibrillator has two 15A, 32V, fastblow fuses (Physio-Control part number 200281-037) mounted on the Main PCB. To replace the fuses, first separate the case halves as described in Case Separation on page 4-10. Then, follow these steps:

1 Disconnect P10 and P11 on the Main PCB.
2 Hold the Main PCB on edge. the fuses are next to P4, under the relay shield.
3 Remove the existing fuses from the fuse clips and install the replacement fuses.

Inspection

During any service or repair, inspect the exterior of the defibrillator/pacemaker. If the case must be opened during service or repair, inspect the defibrillator/pacemaker interior.

Exterior Inspection

Inspect the exterior of the defibrillator/pacemaker case, accessories, and cables as described in Table 4–2.

During exterior inspection:

1 Lift and turn the defibrillator/pacemaker upside down while listening for loose hardware.
If loose hardware is detected, open the case and thoroughly inspect the interior.
2 Locate and tighten or replace any loose hardware.

Table 4–2 Exterior Inspection

Items	Inspect for	Corrective Action
Case, Patient Connector, Auxiliary Power Supply connector, connector cover	Gel or foreign substances. Damage or excessive wear, cracks, dents, improper mechanical function, damaged connectors (including broken or bent pins). Proper opening, closing, turning, or latching action; check for damage, breaks or cracks, excessive wear.	Clean as described in Table 4-4. Replace damaged part.
Keypad assemblies	Gel or foreign substances. Press all buttons and check for proper mechanical response. Inspect for tears, breaks, cracks, or excessive wear.	Clean as described in Table 4-4. Replace damaged part.
POWER switch	Gel or foreign substances. With no battery installed, turn the switch and confirm that the knob is installed tightly on shaft. Proper switch alignment at every position.	Clean as described in Table 4-4. Repair or replace damaged part.
Battery connector pins	Loose pins. Bent, broken, corroded, worn, or damaged pins. Cracked or broken connector leaves.	Tighten if loose. Replace pins as described in Table 4-4.
Electrical slide contacts	Gel or foreign substances. Corrosion, breaks, cracks, bends or deformities. Breaks or cracks at the location where each contact enters the case.	Clean as described in Table 4-4. Replace damaged contacts.
Interconnect Latch	Damage, cracks, misalignment, and proper action.	Replace damaged parts.
Cables, Standard paddles module cable, QUIK-PACE cable	Gel or foreign substances. While bending and flexing the cable, inspect for damage, extreme wear, cuts or abrasions, cracks, exposed inner wires, broken or bent connectors and pins.	Clean as described in Table 4-4. Replace damaged cable.

Interior Inspection

Inspect the interior whenever the defibrillator/pacemaker case must be opened for service or repair. Table 4–3 describes interior inspection methods. If physical abuse such as a dropped case, extended exposure to extreme heat or cold, or immersion in fluids is detected or suspected, inspect the defibrillator/pacemaker interior.

Table 4–3 Interior Inspection

Hardware	Inspect for	Corrective Action
Chassis, covers, and brackets.	Bent, or damaged surfaces, or missing hardware.	Replace damaged or missing hardware.
Mechanical and electrical components.	Loose mountings. Broken, or damaged leads. Deteriorating or leaky components.	Replace PCB. Replace PCB. Replace PCB.
Connector pins (other than battery connector pins).	Bent pins. Loose or corroded pins.	Straighten pins (if damage is slight) Replace loose or corroded pins.
Nameplate, labels, and decals.	Illegible information.	Replace damaged nameplates, labels, or decals.
PCBs.	Charred, cracked, or brittle surfaces. **Note:** Some discoloration of the PCB surface can be expected due to high operating temperatures of some components.	Replace damaged PCBs.
Screws and nuts.	Loose or cross–threaded.	Tighten or replace hardware.
Terminals and connections.	Improperly installed, missing, or worn.	Replace entire PCB. Replace or install connectors correctly.
Wire insulation and tubing.	Deterioration, wear, pinching, or damage.	Replace insulation or tubing.

Cleaning

The following paragraphs describe exterior and interior cleaning practices.

Exterior Cleaning

Clean the exterior of the defibrillator/pacemaker, cables, and accessories as described in Table 4–4. Use only the cleaning agents listed in the table. If evidence of dust or dirt is found, clean the interior as described on page 4-20. Determine and correct the cause of the dust and dirt (if possible). Replace parts as necessary.

⚠ CAUTION

Possible equipment damage. Do not clean any part of the defibrillator/pacemaker or cables with bleach, bleach dilution, or phenolic compounds. Do not use abrasive cleaning agents. Do not steam, autoclave, or gas-sterilize the LIFEPAK 11 defibrillator/pacemaker or accessories unless otherwise stated in accessory Operating Instructions.

Table 4–4 Exterior Cleaning

Item	Cleaning Practice	Recommended Cleaning Agents
Case, display, crevices, cracks, and therapy cable	Clean with a damp sponge or cloth.	• Quaternary ammonium compounds • Isopropyl alcohol • Peracetic (peroxide) acid solutions
Accessories	Refer to Accessory Operating Instructions.	Refer to Accessory Operating Instructions.

⚠ WARNING

Shock or fire hazard. Do not immerse any portion of the defibrillator/pacemaker or therapy modules in water or other fluids. Do not use chemicals, solvents, or other fluids to clean internal components. Fluid spills or splashes may damage the electrical components.

Interior Cleaning

To clean the defibrillator/pacemaker interior:

- Brush the surfaces and parts with a non-metallic, soft-bristle brush.
- Remove loosened dirt and dust by using dry, low-pressure compressed air (maximum 60 pounds per square inch).

Warranty

The accessory kit that is shipped with the LIFEPAK 11 defibrillator/pacemaker includes a warranty statement. To obtain another copy of the warranty, contact the local Physio-Control Corporation representative. In the USA, call 1-800-442-1142.

Preparation for Shipping

Save the original shipping box and packing material for later use.

Section 5

Parts Lists and Schematics

Introduction

This section includes the parts list and exploded views that describe major assemblies of the LIFEPAK 11 defibrillator/pacemaker. This information is provided to assist in troubleshooting and repair. Table 5–1 lists the figure and page numbers for the major assemblies. Table 5–2 provides standard reference designators for components. Table 5–3 lists supplies and accessories.

This manual documents the current assemblies in production at Physio-Control. However, modifications to the assemblies may have occurred. Since the manual was published. To obtain updated information, contact your local Physio-Control representative. Call 1-800-442-1142 in the USA.

Parts List

Use the parts list to identify *replaceable* parts. The format for each list is the same:

Ref: This column contains the reference designators or the assigned item numbers. Reference designators are abbreviated (see Table 5–2) and are listed alphanumerically by this abbreviation. Assigned item numbers are listed numerically, starting with 2. The number in the column heading indicates the figure to which the parts list corresponds.

Part Number: The Physio-Control Corporation part number is listed in this column. Part ordering information is provided on page 5-2.

Description: Descriptive information for a part that is used more than once refers to the initial listing with a "Same as ___" citation. This citation may also list a component value when necessary.

Static Sensitive Devices (SSDs) are identified in this column by this symbol: ⚠ For information about proper handling of SSDs during repair or replacement, refer to Section 4.

Use Code: Different hardware configurations and their corresponding letter codes are listed at the beginning of each parts list. Subsequent use of any letter code indicates which part is used in a particular configuration. A blank in this column indicates that the part is used in all configurations.

Qty: The quantity column specifies the *total* quantity used for each part number listed. The abbreviation REF indicates a major assembly or subassembly.

Exploded Views

Use exploded views to physically locate parts. The assigned item number on the drawing corresponds to the REF column entry on the parts list.

How to Order Parts

To order parts, contact your local Physio-Control representative. In the USA, call the PARTSLINE number (1-800-442-1142). When ordering parts, provide the instrument part number and serial number located on the bottom panel of your instrument. Specify all assembly numbers, part numbers, reference designations, and descriptions. Physio-Control Corporation may substitute different parts to reflect modifications and improvements of instrument circuitry.

Table 5–1 Major Assemblies and Cables

Ref	Part Number	Nomenclature	Fig. No.	Page No.
REF	806545	LIFEPAK 11 defibrillator/pacemaker	5-1	5-8
		Interconnect Diagram	5-2	5-11
A1	806584	Main PCB Assembly ⚠	5-1	5-8
A2	806586	Pacer PCB Assembly ⚠	5-1	5-8
A3	806605	Keypad Assembly	5-1	5-8
A4	800240	Transfer Relay	5-1	5-8
W1	805945-06	Therapy Connector Receptacle	5-1	5-8
W2	806596-01	Speaker/Main PCB Wire Harness	5-1	5-8
W3	806596-02	Inductor/Transfer Relay/Therapy Connector Wire Harness	5-1	5-8
W4	806611-01	Auxiliary Power Connector Receptacle Wire Harness	5-1	5-8
W5	806596-04	Main PCB/Battery Wire Harness	5-1	5-8
W6	806596-05	Relay/Capacitor, Negative Wire Harness	5-1	5-8
W7	806596-06	Main PCB/Transfer Relay Wire Harness	5-1	5-8
W8	806596-08	Power Switch/Main PCB Wire Harness	5-1	5-8
W9	806596-13	Main PCB/Interface Monitor Wire Harness	5-1	5-8
W10	806596-11	Relay/Capacitor, Positive Wire Harness	5-1	5-8
W11, 12	3005179-00	Main Defib Ribbon Cable	5-1	5-8

Table 5–2 Reference Designator Key

Designator	Description
A	Main Assemblies
C	Capacitor
CR	Diode
F	Fuse
J	Jack Connector
K	Relay
L	Inductor
P	Plug Connector
Q	Transistors
R	Resistor
RN	Resistor Network
RV	Varistor
S	Switch
T	Transformer
TP	Test Point
U	IC (integrated circuit)
VSP	Voltage Surge Protector
W	Wire Harness
Y	Crystal

Table 5–3 Supplies, Training Tools, and Accessories

Description	Part Number
Battery Support System	801807
LIFEPAK 11 diagnostic cardiac monitor	805300
QUIK-COMBO module	806588
Standard Paddles module	806589
AC Auxiliary Power Supply (requires DC output Y-cable for use with LIFEPAK 11 defibrillator)	806311
DC Auxiliary Power Supply (requires DC output Y-cable for use with LIFEPAK 11 defibrillator)	3005494
Hard Paddles Tray	806709
Battery Support System wall bracket assembly	802562
FASTPAK battery	09-10424
Cables:	
QUIK-PACE pacing cable	802905
DC output Y-cable (allows simultaneous DC power output from Auxiliary Power Supply to LIFEPAK 11 monitor and LIFEPAK 11 defibrillator)	3006462
Literature:	
LIFEPAK 11 defibrillator/pacemaker Operating Instructions	3005970
Reconditioning Procedure check sheet	806017
Shelf Life Test check sheet	806018
Battery Maintenance Log check sheet	806019

5-1 Ref	Part Number	Description	Use Code	Qty
5-1	806545-00	**LIFEPAK 11 defibrillator, with Pacing, English**	A	REF
	806545-01	**LIFEPAK 11 defibrillator, without Pacing, English**	B	REF
	806545-02	**LIFEPAK 11 defibrillator, with Pacing, English, International**	C	REF
	806545-03	**LIFEPAK 11 defibrillator, without Pacing, English, International**	D	REF
	806545-04	**LIFEPAK 11 defibrillator, with Pacing, German**	E	REF
	806545-05	**LIFEPAK 11 defibrillator, without Pacing, German**	F	REF
	806545-06	**LIFEPAK 11 defibrillator, with Pacing, French**	G	REF
	806545-07	**LIFEPAK 11 defibrillator, without Pacing, French**	H	REF
	806545-08	**LIFEPAK 11 defibrillator, with Pacing, Spanish**	I	REF
	806545-09	**LIFEPAK 11 defibrillator, without Pacing, Spanish**	J	REF
A1	806584-04	Main PCB Assembly ⚠		1
A2	806586-02	Non-pacer PCB Assembly ⚠	B,D,F,H,J	1
	806586-06	Pacer PCB Assembly ⚠	A.C.E.G.I	1
A3	806605-02	Keypad Assembly-Defib/Pacer Control, English	A,C	1
	806711-01	Keypad Assembly-Defib Control, English	B,D	1
	806605-05	Keypad Assembly-Function Control, German	E	1
	806711-03	Keypad Assembly-Function Control, German	F	1
	806605-04	Keypad Assembly-Function Control, French	G	1
	806711-02	Keypad Assembly-Function Control, French	H	1
	806605-06	Keypad Assembly-Function Control, Spanish	I	1
	806711-04	Keypad Assembly-Function Control, Spanish	J	1
A4	800240-15	Transfer Relay		1
C1	804285-02	Capacitor, Energy Storage		1
W1	805945-06	Therapy Connector Receptacle		1
W2	806596-01	Speaker/Main PCB Wire Harness		1
W3	806596-02	Inductor/Transfer Relay/Therapy Connector Wire Harness		1
W4	806611-00	Auxiliary Power Connector Receptacle Wire Harness		1
W5	806596-04	Main PCB/Battery Wire Harness		1
W6	806596-05	Relay/Capacitor, Negative Wire Harness		1
W7	806596-06	Main PCB/Transfer Relay Wire Harness		1
W8	806596-08	Power Switch/Main PCB Wire Harness		1
W9	806596-13	Main PCB/Interface Monitor Wire Harness		1
W10	806596-11	Relay/Capacitor, Positive Wire Harness		1
W11	3005179-00	Main Defib Ribbon Cable	B,D,F,H,J	1
W11,12	3005179-00	Main Defib Ribbon Cable	A,C,E,G,I	2
2	201501-006	**Adhesive,** Double-sided Tape		A/R
3	201765-015	**Adhesive,** Foam Tape, 0.062T x 0.50W (not shown, part of W11)		A/R
4	201765-002	**Adhesive,** Foam Tape, 0.125T x 1.00W		A/R

5-1 Ref	Part Number	Description	Use Code	Qty
5	806051-00	**Bracket,** Auxiliary Power Cover		1
6	806610-05	**Bracket,** Keypad		1
7	806610-08	**Button,** Latch		1
8	200536-012	**Cable Tie,** 0.10W x 14.7L		1
9	200536-001	**Cable Tie,** 0.10W x 4L	A,C,E,G,I	11
	200536-001	**Cable Tie,** 0.10W x 4L	B,D,F,H,J	12
10	806582-02	**Case,** Lower		1
11	806581-02	**Case,** Upper		1
12	800222-01	**Clip,** Bail		1
13	804194-00	**Cover,** Capacitor Mount		1
14	805262-30	**Cover,** Connector, Rear, Power, English	A-D	1
	805262-31	**Cover,** Connector, Rear, Power, French	G,H	1
	805262-32	**Cover,** Connector, Rear, Power, German	E,F	1
	805262-33	**Cover,** Connector, Rear, Power, Spanish	I,J	1
15	200025-000	**Dowel,** Pin 0.062D x 0.63L		1
16	201457-001	**Fastener,** Cable Tie, Adhesive Mount, White		2
17	201765-008	**Foam,** Adhesive, Tape, 1.0W x 0,250T		A/R
18	800223-00	**Foot,** Bail		2
19	202236-000	**Foot,** Mounting, Rubber, Black		4
20	804206-01	**Grommet,** Battery Post		2
21	800221-00	**Handle,** Bail		1
22	806126-002	**IC,** EPROM, Main PCB (not shown, part of A1)		1
23	805519-02	**Knob,** Power Switch		1
24	806609-00	**Label,** Dead Front, Pacing, English	A,C	1
	806609-01	**Label,** Dead Front, Without Pacing, English	B,D	1
	806609-02	**Label,** Dead Front, Pacing, French	G	1
	806609-03	**Label,** Dead Front, Pacing, German	E	1
	806609-04	**Label,** Dead Front, Pacing, Spanish	I	1
	806609-05	**Label,** Dead Front, Without Pacing, French	H	1
	806609-06	**Label,** Dead Front, Without Pacing, German	F	1
	806609-07	**Label,** Dead Front, Without Pacing, Spanish	J	1
25	806708-00	**Label,** Operating Instructions, Pacing, English	A,C	1
	806708-02	**Label,** Operating Instructions, Pacing, French	G	1
	806708-03	**Label,** Operating Instructions, Pacing, German	E	1
	806708-04	**Label,** Operating Instructions, Pacing, Spanish	I	1
	806708-05	**Label,** Operating Instructions, Without Pacing, French	H	1
	806708-06	**Label,** Operating Instructions, Without Pacing, German	F	1
	806708-07	**Label,** Operating Instructions, Without Pacing, Spanish	J	1
	806708-08	**Label,** Operating Instructions, Without Pacing, English	B,D	1
26	806170-00	**Label,** Warning, Shock Hazard, English	A,B	1
	806170-05	**Label,** Warning, Shock Hazard, International	C-J	1
27	805638-22	**Label,** Serial Number, CE		1
28	800943-09	**Label,** Symbol, International, High Voltage		1

5-1 Ref	Part Number	Description	Use Code	Qty
29	800224-01	**Leg**, Bail		2
30	202434-000	**Lubricant**, Grease, Lithium		A/R
31	201457-001	**Mount**, Cable Tie, White		2
32	806091-00	**Nut**, Aux/System Connector		1
33	201508-000	**Nut**, Locking, KEP 4-40		9
34	805087-01	**Plate**, Latch, w/Studs		1
35	805487-00	**Plate**, Seal, Connector, Rear		1
36	802278-02	**Plug**, Banana, Mini		2
37	800516-02	**Resistor**, Defibrillator		1
38	800225-01	**Retainer**, Bail		1
39	01-41540-01	**Retainer**, Battery Box		1
40	200040-000	**Retainer**, Rings, 0.126ID x 0.015T		2
41	200040-019	**Retainer**, Rings, 1.01ID x 0.042T		2
42	202253-537	**Screw**, Pan Head, Nylock, 4-40, x 0.312L		17
43	202253-570	**Screw**, Pan Head, Nylock, 6-32, x 0.312L		17
44	200060-011	**Seal**, O-Ring, Silicone, 0.551ID x 0.070T		1
45	200060-014	**Seal**, O-Ring, Silicone, 1.051ID x 0.070T		1
46	804234-00	**Seal**, Perimeter (case)		1
47	3005814-00	**Shield**, Cover Cap		1
48	806704-02	**Shield**, EMI/RFI		1
49	805542-00	**Shield**, End Cap		1
50	3005846-00	**Shield**, Relay		1
51	804447-16	**Spacer**, Foam, 0.375 x 1.0W x 2.5L		A/R
52	804447-17	**Spacer**, Foam, 0.500 x 0.50W x 0.75L		A/R
53	804447-18	**Spacer**, Foam, 0.500 x 1.0W x 1.5L		A/R
54	01-41490-02	**Spring**		1
55	804205-03	**Standoff**, Spacer, Molded 1.5L		6
56	3005815-00	**Standoff**, Spacer, Nylon 2.67L		1
57	202271-000	**Stud**, Snap		5
58	200804-016	**Washer**, Flat, 4-40		6
59	200624-049	**Tubing**, Teflon, 0.38OD x 2.0L		2

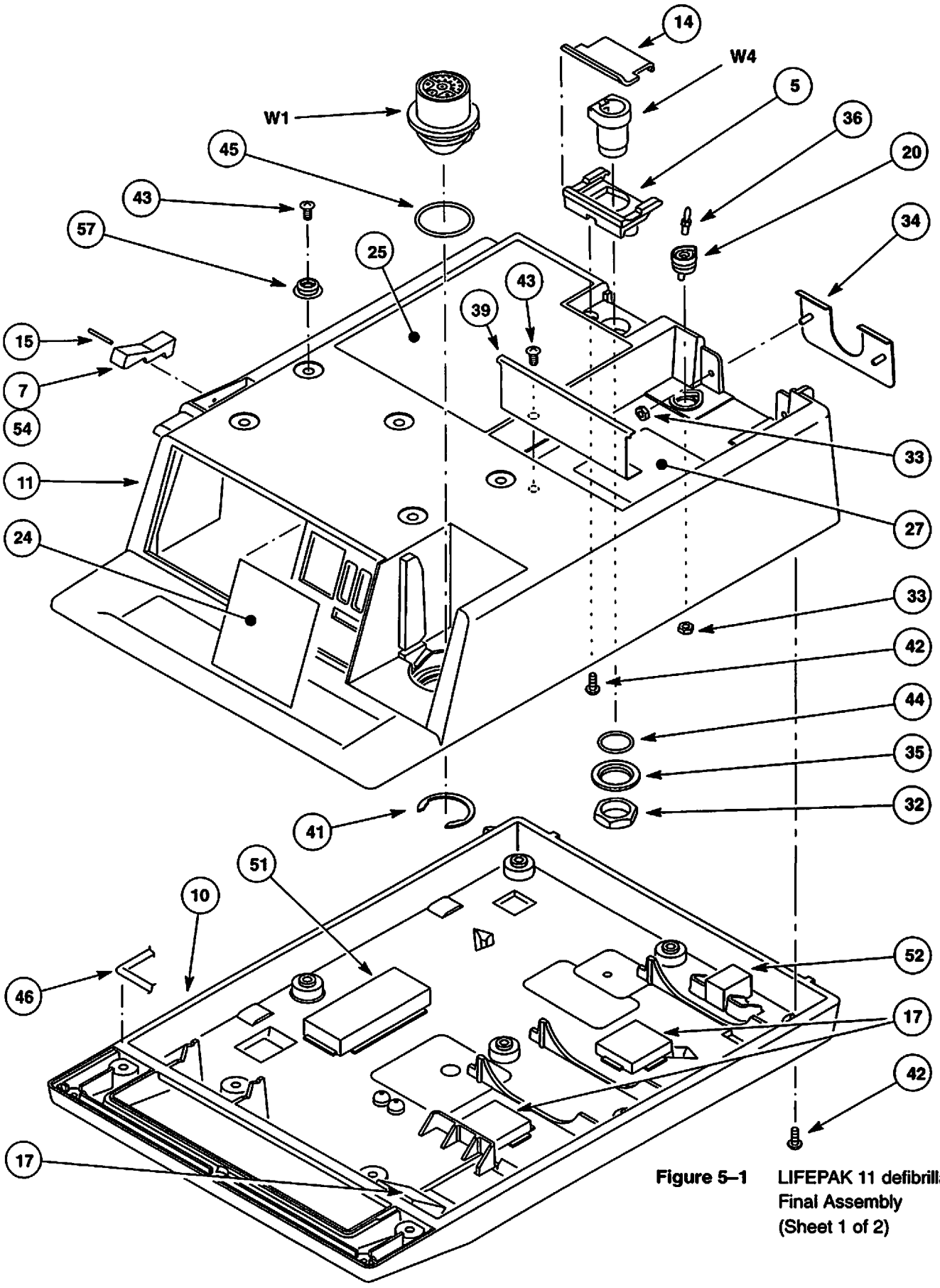

Figure 5–1 LIFEPAK 11 defibrillator/pacemaker Final Assembly (Sheet 1 of 2)

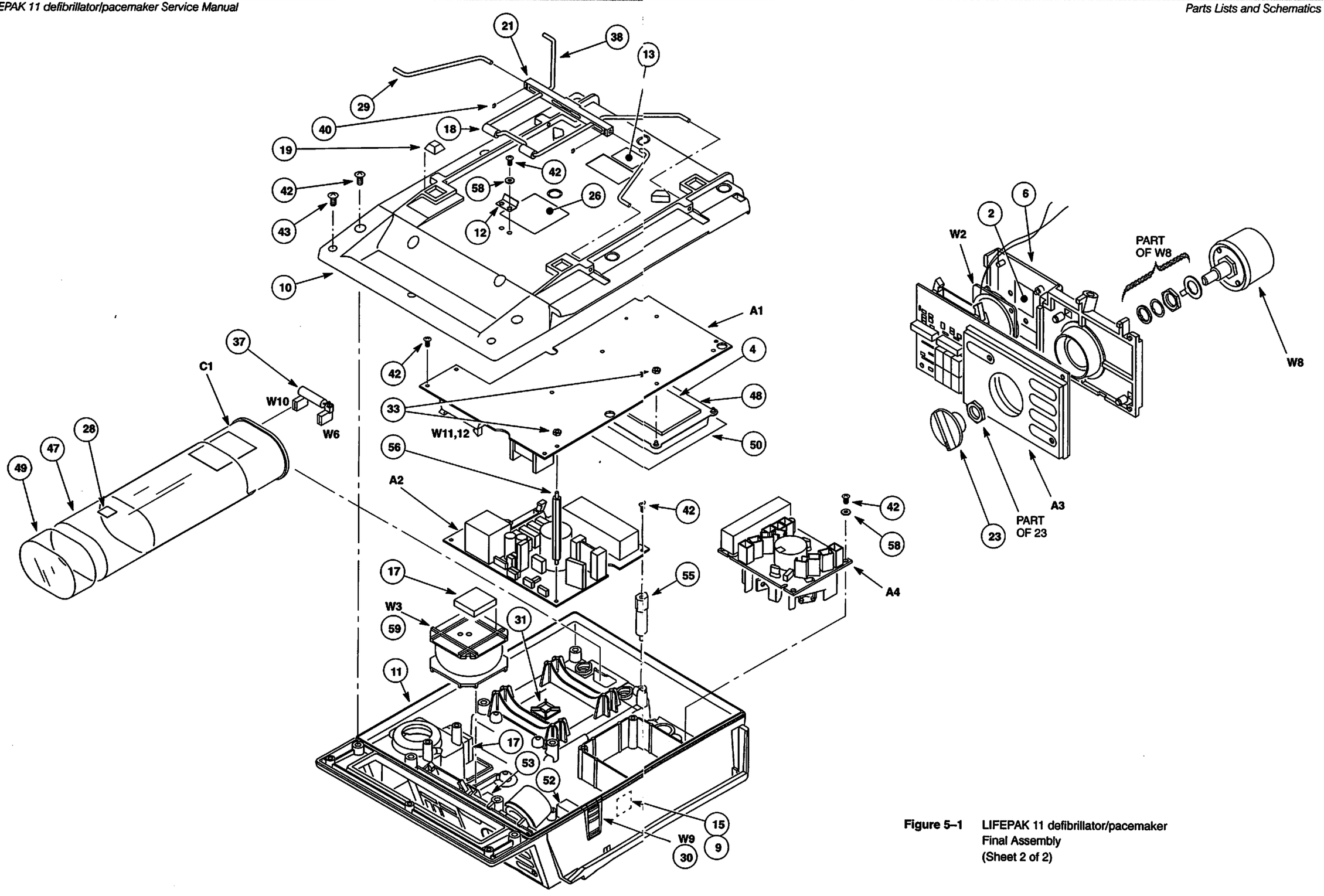

Figure 5–1 LIFEPAK 11 defibrillator/pacemaker Final Assembly (Sheet 2 of 2)

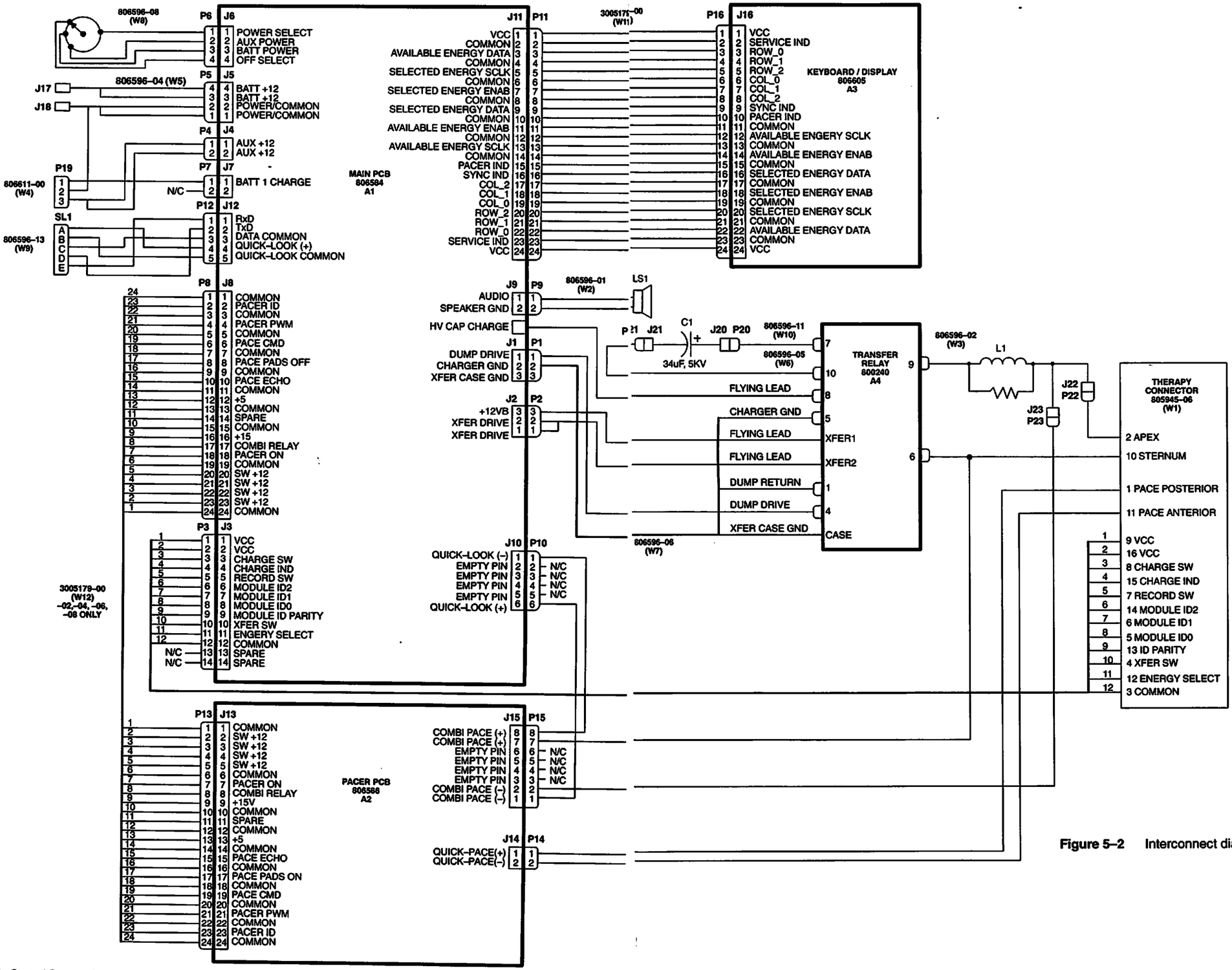

Figure 5–2 Interconnect diagram

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