

PHYSIO  
CONTROL

MAN\_0333

# LIFEPAK<sup>®</sup> 9 defibrillator/monitor



## Service Manual

Manual No. 803763-05

November 1991

**Corporate Headquarters:**  
11811 Willows Road Northeast  
Post Office Box 97006  
Redmond, WA 98073-9706 USA  
Telephone: 206/867-4000  
Toll Free: 800/442-1142 or 800/426-8047  
Telex: 990211 D PHYSIO RDMD  
Telefax: 206/883-2988

# Table of Contents

---

## Safety Information

Introduction .....	xii
Terms .....	xii
Warnings .....	xiii
Symbols .....	xiv

---

## General Information

Service Information .....	xv
Effective Pages .....	xvi
Configuration Information .....	xvii
Overview .....	xix

---

## Description 1

Introduction .....	1-1
Physical Description .....	1-1
Functional Description .....	1-5
Theory of Operation .....	1-7
Power Supply PCB Assembly (803726) .....	1-7
Power-On .....	1-7
Regulation .....	1-7
Overvoltage Protection .....	1-7
Output Isolation .....	1-7
Battery .....	1-7

BATT CHRG Indicator .....	1-8
Power Conversion PCB Assembly (803724) .....	1-8
Power Control .....	1-8
Logic Power Monitor .....	1-8
Switching Power Supply .....	1-10
External Control Input .....	1-10
Energy Storage Capacitor Charger .....	1-10
Low Energy Charge Rate .....	1-11
Capacitor Charge Control .....	1-11
Energy Transfer .....	1-12
Energy Dump .....	1-13
Energy Monitor .....	1-13
Serial Data Interface .....	1-14
Analog Voltage Evaluation .....	1-14
Charge LED Drive .....	1-14
Interconnect PCB Assembly (803761) .....	1-15
LED Drive .....	1-15
Audio Generation .....	1-15
ECG Out .....	1-15
Main PCB Assembly (803715) .....	1-16
Preamp .....	1-18
System Controller .....	1-23
Display/Recorder Interface .....	1-24
Display Assembly (803706) .....	1-32
Video Signal Amplifier .....	1-33
Frame Sweep Generator .....	1-33
Raster Scan Oscillator .....	1-33
Raster Voltage Generator .....	1-34
Raster Generator .....	1-34
CRT Bias Generator .....	1-35

---

## Operation      2

Introduction .....	2-1
Controls and Indicators .....	2-1
Options .....	2-7
Setup .....	2-7
Info .....	2-8
Clock Setting Procedure .....	2-9

# Test and Calibration

3

<b>Introduction</b> .....	3-1
<b>Performance Inspection Procedure (PIP)</b> .....	3-1
PIP-Physical Inspection .....	3-2
PIP-Battery Charge Legend .....	3-2
PIP-AC Power .....	3-2
PIP-Battery Power .....	3-2
PIP-Test Setup .....	3-3
PIP-Keypad Test .....	3-3
PIP-Lead Select .....	3-4
PIP-Recorder Speed/Baseline Centering .....	3-4
PIP-ECG Display .....	3-4
PIP-1mV CAL .....	3-4
PIP-CRT Gain/Aspect Ratio .....	3-5
PIP-Heart Rate .....	3-5
PIP-Rate Alarms/Alarm-Activated Record .....	3-5
PIP-Recorder Annotation .....	3-6
PIP-Test Load .....	3-6
PIP-Sync/Sync Annotation .....	3-7
PIP-Recorder/CRT Noise .....	3-7
PIP-Defib Disarm .....	3-8
PIP-Paddle Polarity .....	3-8
PIP-Charge Time .....	3-8
PIP-Discharge Control/Open Air Discharge .....	3-9
PIP-Energy Dump .....	3-9
PIP-Charge Reduction .....	3-9
PIP-Delivered Energy .....	3-10
PIP-CODE SUMMARY .....	3-10
PIP-Leakage .....	3-11
<b>PIP Checklist</b> .....	3-12
<b>Test and Calibration (TC) Procedures</b> .....	3-15
TC-Servicing Guidelines .....	3-15
TC-Test Equipment .....	3-15
TC-Voltage Checks .....	3-16
TC-Sync and HR Alarm LED Checks .....	3-17
TC-Defib Disarm and CHARGE LEDs check .....	3-18
TC-Test Mode .....	3-18
TC-Defibrillator Calibration .....	3-19
TC-Test Load Calibration .....	3-20
TC-Charge Time .....	3-20
TC-Charge Reduction .....	3-21
TC-Energy Dump .....	3-21
TC-Output Waveform .....	3-21
TC-Display Calibration .....	3-22

TC-Power Supply Calibration .....	3-25
TC-Recorder Calibration .....	3-26
TC-Recorder Frequency Response .....	3-27
TC-CRT Frequency Response .....	3-29
TC-ECG Output (when applicable) .....	3-29
Error Codes .....	3-29

## Service and Maintenance 4

Introduction .....	4-1
Battery Maintenance .....	4-1
Recharging Batteries .....	4-2
Recycling Batteries .....	4-2
General Maintenance .....	4-3
Power Source, AC or DC Operation .....	4-3
Strip Chart Recorder .....	4-3
Loading Paper .....	4-3
Cleaning .....	4-3
Protecting Printouts .....	4-4
Fuse Replacement .....	4-4
Disassembly Procedures .....	4-4
Special Handling for Static Sensitive Devices .....	4-4
Battery Pack Removal .....	4-5
Front Panel Removal .....	4-5
Strip Chart Recorder Removal .....	4-6
Case Separation .....	4-6
Power Conversion PCB Removal .....	4-6
Main PCB Removal .....	4-8
Display Assembly Removal .....	4-8
Power Supply Removal .....	4-8
Interconnect PCB Removal .....	4-8
Inspection Techniques .....	4-9
Exterior Inspection .....	4-9
Interior Inspection .....	4-9
Tools and Materials for Cleaning and Repair .....	4-10
Cleaning Procedures .....	4-11
External Cleaning .....	4-11
Interior Cleaning .....	4-11
Printed Circuit Repair Techniques .....	4-12
PCB Component Replacement .....	4-13
PCB Repair .....	4-13
Shipping Assembly .....	4-14

---

**Parts Lists and  
Schematics 5**

**Introduction** ..... 5-1  
**Parts List** ..... 5-1  
**Component Layouts or Exploded Views** ..... 5-2  
**Schematic Diagrams** ..... 5-2  
**How to Order Parts** ..... 5-2  
**Supplies and Accessories** ..... 5-5

---

**Component  
Reference  
Diagrams 6**

**Introduction** ..... 6-1  
**Component Reference Diagrams** ..... 6-3

---

**Index** ..... Index-1

## List of Figures

<b>Description</b>	<b>1</b>	Figure 1-1	LIFEPAK 9 defibrillator/monitor .....	1-2
		Figure 1-2	LIFEPAK 9 defibrillator/monitor Functional Block Diagram .....	1-6
		Figure 1-3	Power Conversion PCB Block Diagram .....	1-9
		Figure 1-4	Main PCB Block Diagram .....	1-17
		Figure 1-5	Preamplifier Timing .....	1-19
		Figure 1-6	Echo Period .....	1-22
		Figure 1-7	Control Line Timing .....	1-27
		Figure 1-8	Character Cell Locations .....	1-27
		Figure 1-9	Video Intensity .....	1-28
		Figure 1-10	Printhead Assembly .....	1-31
		Figure 1-11	Display Assembly Block Diagram .....	1-32
		Figure 1-12	Display Scanning .....	1-33
<b>Operation</b>	<b>2</b>	Figure 2-1	Front Panel Controls and Indicators .....	2-2
		Figure 2-2	Rear Panel Controls and Indicators .....	2-6
		Figure 2-3	Top-Level Menu .....	2-7
		Figure 2-4	Setup Menu .....	2-8
		Figure 2-5	Info Menu .....	2-9
		Figure 2-6	Clock Set Display .....	2-10
<b>Test and Calibration</b>	<b>3</b>	Figure 3-1	Power-On Display .....	3-2
		Figure 3-2	1mV CAL Pulse (DIAG mode) .....	3-5
		Figure 3-3	CODE SUMMARY Printout .....	3-11
		Figure 3-4	Test Connector J3 Pinout .....	3-16
		Figure 3-5	Top-Level Menu .....	3-18
		Figure 3-6	Output Waveform .....	3-22
		Figure 3-7	Display Assembly PCB Potentiometer Locations ..	3-23
		Figure 3-8	Main PCB Recorder Calibration .....	3-27
		Figure 3-9	Test Signal Setup .....	3-28
<b>Service and Maintenance</b>	<b>4</b>	Figure 4-1	Front Panel Removal .....	4-5
		Figure 4-2	Connector Locations .....	4-7
		Figure 4-3	LIFEPAK 9P defibrillator/monitor Shipping Assembly .....	4-14

## Parts Lists and 5 Schematics

Figure 5-1	LIFEPAK 9 defibrillator/monitor Final Assembly .....	5-13
Figure 5-2	Interconnect Diagram .....	5-14
Figure 5-4	Power Supply Assembly .....	5-32
Figure 5-5	Power Conversion PCB Assembly .....	5-41
Figure 5-6	Display Assembly .....	5-46
Figure 5-7	Interconnect PCB Assembly .....	5-57
Figure 5-8	Front Panel Assembly .....	5-60
Figure 5-9	Keypad Assembly .....	5-61
Figure 5-10	Rear Panel Membrane Switch .....	5-62
Figure 5-11	Strip Chart Recorder Assembly .....	5-64
Figure 5-12	Transfer Relay Assembly .....	5-66
Figure 5-13	Paddle Assembly .....	5-67
Figure 5-14	Power Supply PCB/AC Receptacle/Ground Wire Harness .....	5-69
Figure 5-15	Power Conversion PCB/Power Supply PCB/ Battery Wire Harness .....	5-70
Figure 5-16	Battery Sensor/Power Supply PCB Wire Harness ..	5-71
Figure 5-17	High Voltage Connector Cable Assembly .....	5-72
Figure 5-18	Main PCB/Display Cable Assembly .....	5-73
Figure 5-19	Main PCB/Recorder Cable Assembly .....	5-74
Figure 5-20	Interconnect PCB/Front Panel Cable Assembly ..	5-75
Figure 5-21	Main PCB/Patient Connector Wire Harness .....	5-76
Figure 5-22	AC Receptacle/Ground Wire Harness .....	5-77
Figure 5-23	AC Receptacle Wire Harness .....	5-77
Figure 5-24	Test Load Contact/Resistor Wire Harness .....	5-78
Figure 5-25	Power Conversion PCB/Reed Assembly Wire Harness .....	5-78
Figure 5-26	Power Conversion PCB/Dump Relay Wire Harness .....	5-79
Figure 5-27	Power Conversion PCB/Charge Relay Negative Wire Harness .....	5-80
Figure 5-28	Power Conversion PCB/Charge Relay Positive Wire Harness .....	5-81
Figure 5-29	Main PCB/Sternum Relay Wire Harness .....	5-82
Figure 5-30	Main PCB/Apex Relay Wire Harness .....	5-82
Figure 5-31	Storage Capacitor Positive/Relay Wire Harness ..	5-83
Figure 5-32	Storage Capacitor Negative/Relay Wire Harness ..	5-83
Figure 5-33	ECG Out Wire Harness .....	5-84
Figure 5-34	Recorder/Bracket Ground Wire Harness .....	5-85
Figure 5-35	Defibrillation Adapter .....	5-87
Figure 5-36	Test Load High Voltage Wire Harness .....	5-89
Figure 5-37	Test Load High Voltage Wire Harness .....	5-89
Figure 5-38	Pushbutton Switch Wire Harness .....	5-90
Figure 5-39	High Voltage Connector Cable Assembly .....	5-91



**Component  
Reference  
Diagrams**      **6**

Figure 6-1	Buffer .....	6-3
Figure 6-2	Real-Time Clock .....	6-3
Figure 6-3	A/D Converter .....	6-4
Figure 6-4	D/A Converter .....	6-4
Figure 6-5	Counter .....	6-5
Figure 6-6	Counter .....	6-5
Figure 6-7	Decoder .....	6-6
Figure 6-8	Decoder .....	6-6
Figure 6-9	Deflection Circuit .....	6-7
Figure 6-10	EPROM .....	6-7
Figure 6-11	D-Type Flip-Flop .....	6-8
Figure 6-12	D-Type Flip-Flop .....	6-8
Figure 6-13	D-Type Flip-Flop .....	6-9
Figure 6-14	J-K Flip-Flop .....	6-9
Figure 6-15	Display Gate Array .....	6-10
Figure 6-16	Recorder Gate Array .....	6-10
Figure 6-17	Microprocessor .....	6-11
Figure 6-18	Pulse-Width Modulator .....	6-11
Figure 6-19	Multivibrator .....	6-12
Figure 6-20	Multivibrator .....	6-12
Figure 6-21	Oscillator .....	6-13
Figure 6-22	Shift Register .....	6-13
Figure 6-23	Pulse-Width Regulator .....	6-14
Figure 6-24	Static RAM, 32k x 8 .....	6-14
Figure 6-25	Analog Switch .....	6-15
Figure 6-26	Analog Switch .....	6-15
Figure 6-27	Voltage Regulator .....	6-16

# Safety Information

---

## Introduction

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

Refer to NFPA 99-1984, **Health Care Facilities**, and NFPA 70-1987, **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 which will result in severe personal injury or death.

**Warning:** Hazards or unsafe practices which could result in severe personal injury or death.

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

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

# List of Tables

<b>Description</b>	1	Table 1-1	General Specifications .....	1-3
		Table 1-2	Main PCB Functional Circuits .....	1-16
		Table 1-3	Preamp Pulse Widths .....	1-20
		Table 1-4	Display/Recorder Microprocessor I/O Lines .....	1-25
<b>Operation</b>	2	Table 2-1	Front Panel Controls and Indicators .....	2-3
		Table 2-2	Rear Panel Controls and Indicators .....	2-6
<b>Test and Calibration</b>	3	Table 3-1	Delivered Energy Tolerances .....	3-10
		Table 3-2	Test Equipment .....	3-16
		Table 3-3	Power Conversion PCB Voltage Checks .....	3-17
		Table 3-4	Low Battery Thresholds .....	3-17
		Table 3-5	Error Codes .....	3-30
<b>Service and Maintenance</b>	4	Table 4-1	Inspection Techniques .....	4-9
		Table 4-2	Tools and Materials for Cleaning and Repair .....	4-10
<b>Parts Lists and Schematics</b>	5	Table 5-1	Major Assemblies .....	5-3
		Table 5-2	Defibrillation Adapter Assemblies .....	5-4
		Table 5-3	Reference Designator Key .....	5-4
		Table 5-4	Supplies and Accessories .....	5-5
<b>Component Reference Diagrams</b>	6	Table 6-1	Component Reference Diagrams .....	6-1

## Warnings

Following are descriptions of general hazards and unsafe practices that could result in death, severe injury or product damage. Specific warnings and cautions not appearing in this section may be found throughout the manual.

### Fire or Explosion Hazard

Do not operate this product in the presence of flammable gases or anesthetics. Explosion or fire can result. Refer to safety documents NFPA 99-1984, *Use of Inhalation Anesthetics (Flammable and Nonflammable)*, and NFPA 70-1987, *National Electrical Code (Health Care Facilities section)*, before operating this product in the proximity of flammable gases or anesthetics.

### Safety Hazard

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

### Electrical Hazard

Do not operate equipment using damaged cables and wires. Broken or frayed wires, or loose snap fittings may cause interference or loss of signal. Perform frequent electrical and visual inspections on cables and wires. 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. Do not immerse any portion of the instrument in water. Fluid spills and splashes may damage the instrument's electrical components.

### Shock or Fire Hazard

Do not sterilize this product. Sterilization environments can cause severe damage. Do not autoclave or gas sterilize accessories unless manufacturer instructions clearly approve it.

### Possible Equipment Damage

Do not substitute accessories. Use only recommended accessories listed in Table 5-4 shown on page 5-5. Substitution may cause the instrument to work improperly.

### Safety Risk

Do not use unsafe equipment interconnections. It is extremely important that equipment interconnections be made in accordance with NFPA No. 70-1987 *National Electrical Code*, Article 517, *Health Care Facilities*. Compliance with articles 517-80 and 517-120 is especially important.

### Shock or Fire Hazard

**Note:** Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. Check leakage current and grounding requirements after interconnecting this instrument with accessory equipment.

# Symbols

Any or all of the following symbols may appear in this manual or on the equipment:

Static Sensitive Device (SSD)	
Additional information in Section 6, Component Reference Diagrams	
DANGER — high voltage present	
ATTENTION — refer to manual for more information	
Defibrillation protected, type CF patient connection	
Defibrillation protected, type BF patient connection	
Protective ground (earth) terminal	
Fusible link	
Equipotentiality connector	
Off (Power: disconnection from the mains)	
On (Power: connection to the AC mains)	
ECG output	
Recyclable 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.

If the instrument has been dropped, damaged, or severely abused, a qualified technician should complete the Performance Inspection Procedure (PIP) in Section 3, beginning on page 3-12, to verify that all instrument functions are working properly.

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

The use of defibrillation electrodes and adapter devices from sources other than Physio-Control is not recommended. *If instrument failure is attributed to defibrillation electrodes not manufactured by Physio-Control, the warranty may be voided.*

If assistance in servicing the instrument is needed, contact Physio-Control at 1-800-442-1142.

## Effective Pages

Title	Page	Date
Trademark and Warranty	ii	Nov 1991
Table of Contents	iii thru vii	Nov 1991
List of Figures	viii thru x	Nov 1991
List of Tables	xi	Nov 1991
Safety Information	xii thru xiv	Nov 1991
Terms	xii	Nov 1991
Warnings	xiii	Nov 1991
Symbols	xiv	Nov 1991
General Information	xv thru xix	Nov 1991
Service	xv	Nov 1991
Effective Pages	xvi	Nov 1991
Configuration Information	xvii thru xviii	Nov 1991
Overview	xix	Nov 1991
1 Description	1-1 thru 1-35	Nov 1991
2 Operation	2-1 thru 2-10	Nov 1991
3 Testing	3-1 thru 3-30	Nov 1991
4 Service and Maintenance	4-1 thru 4-14	Nov 1991
5 Part Lists and Schematics	5-1 thru 5-91	Nov 1991
6 Component Reference Diagrams	6-1 thru 6-16	Nov 1991
Index	Index-1 thru Index-4	Nov 1991

## Configuration Information

This manual is current with the listed revision level of the following part numbers. The assemblies appear in the same order as in Table 5-1.

Assembly Name	Part Number	Rev
LIFEPAK 9 defibrillator/monitor	803800	D13
Main PCB Assembly	803715-11	B10
Power Supply PCB Assembly	803726-01	Orig4
Power Conversion PCB Assembly	803724-03	C15
Display Assembly	803706-00	Orig5
Interconnect PCB Assembly	803761-02	B3
Front Panel Assembly	803745-00	Orig8
Rear Panel Switch Membrane	803741-01	Orig3
Strip Chart Recorder Assembly	804189-00	P(GS1)
Transfer Relay Assembly	800240-11	R12
Paddle Assembly	802901-06	C2
Power Supply PCB/AC Receptacle/Ground Wire Harness	803783-18	A
Power Conversion PCB/Power Supply PCB/Battery Wire Harness	803783-23	A
Battery Sensor/Power Supply PCB Wire Harness	803783-24	A
High Voltage Connector Cable Assembly	803756-13	C5
Main PCB/Monitor PCB Cable Assembly	803733-00	Orig
Main PCB/Recorder Cable Assembly	803773-00	Orig
Interconnect PCB/Front Panel Cable Assembly	803772-00	Orig2
Main PCB/Patient Connector Wire Harness	803783-00	A
AC Receptacle/Ground Wire Harness	803783-04	A
AC Receptacle Wire Harness	803783-05	A
Test Load Contact/Resistor Wire Harness	803783-06	A
Power Conversion PCB/Reed Assembly Wire Harness	803783-07	A
Power Conversion PCB/Dump Relay Wire Harness	803783-08	A
Power Conversion PCB/Charge Relay Negative Wire Harness	803783-09	A
Power Conversion PCB/Charge Relay Positive Wire Harness	803783-10	A
Main PCB/Sternum Relay Wire Harness	803783-11	A
Main PCB/Apex Relay Wire Harness	803783-12	A
Storage Capacitor Positive/Relay Wire Harness	803783-13	A
Storage Capacitor Negative/Relay Wire Harness	803783-14	A
ECG Out Wire Harness	803783-15	A



Assembly Name	Part Number	Rev
Defibrillation Adapter	803747	A6
Test Load High Voltage Wire Harness	803774-03	0hg3
Test Load High Voltage Wire Harness	803774-04	0hg3
Pushbutton Switch Wire Harness	803774-05	0hg3
High Voltage Connector Cable Assembly	803756-09	C5

## Overview

Physio-Control Corporation provides a service manual with each instrument. The following is a summary of the information contained in each section:

**Section 1** **Description:** This section details how the instrument works. Input signals, power supplies, PCB functions, and instrument outputs are described. Each PCB circuit description is accompanied by a block diagram to illustrate the major circuits. Circuit names in these block diagrams also appear in the appropriate schematics in Section 5.

**Section 2** **Operation:** This section familiarizes the user with basic equipment function. It identifies Controls, Indicators, and Connectors. This section is not intended to instruct the operator in the clinical use of the instrument; a separate *Operating Instructions* booklet is available for that purpose.

**Section 3** **Test and Calibration:** This section contains Performance Inspection Procedures (PIP)—the sequential steps to follow when performing an operational closed-case check of the equipment. A PIP checklist is provided which can be duplicated and used during testing. Functional test and calibration instructions are also provided so a service technician can fully test and calibrate an instrument to the component or subassembly level using commonly available bench equipment.

**Section 4** **Service and Maintenance:** This section provides Disassembly/Assembly Procedures for removing all major subassemblies in logical sequence. The procedures are referenced to numbered parts in the Final Assembly drawing in Section 5, Figure 5-1, located on page 5-13. This section includes instructions for inspecting, cleaning, maintaining, and repairing the instrument.

**Section 5** **Parts Lists and Schematics:** This section contains Supplies and Accessories, Illustrated Parts Lists, PCB Component Layouts, and Schematic Diagrams for all repairable assemblies.

**Section 6** **Component Reference Diagrams:** An aid to troubleshooting, this section consists of Component Reference Diagrams for selected Integrated Circuits (ICs). The ICs in Section 6 are identified with a large asterisk\* on the schematic diagrams in Section 5.



## Introduction

This section describes the LIFEPAK 9 defibrillator/monitor as follows:

- Physical Description and Features including specifications
- Functional Description of operation and major assemblies
- Theory of Operation to the component level of major assemblies.

## Physical Description

The LIFEPAK 9 defibrillator/monitor, Figure 1-1, provides a monitor-quality cardiograph, strip chart recorder including CODE SUMMARY, 3-lead ECG selection, heart rate display and alarms, multiple energy selection and synchronous cardioversion. The ECG signal is detected through patient cable electrodes, QUICK-LOOK paddles, or FAST-PATCH disposable defibrillation electrodes.

The instrument operates on either ac power or internal battery power. The battery pack, accessible from the bottom of the instrument, allows operation even if ac power fails. With the instrument plugged into ac power the battery pack continually charges even with power off.

The cardiograph uses a non-fade ECG display with a sweep rate of 25mm  $\pm$  1mm/s. The cathode ray tube (CRT) displays heart rate, systole indicator, selected lead, ECG gain, heart-rate violations, messages pertaining to the patient's condition, defibrillator information, sync markers, and status of the instrument.

The instrument delivers a controlled monophasic dc defibrillating pulse to the patient with a delivered energy content ranging from 1 to 360 joules. Both selected energy and the available energy are displayed on the cardiograph.

The recorder can print the alphanumeric information anywhere on the paper. It operates automatically for 20s when a heart rate violation occurs. The recorder also prints the ECG trace, a copy of the stored CODE SUMMARY data, including code abstract, defibrillation, and recorder usage.

Menus display on the cardioscope allowing the operator to set default parameters at power-on. The menus include: alarm limits, lead selection, keypad test, display or recorder, and delivered energy calibration.



Figure 1-1 LIFEPAK 9 defibrillator/monitor

Table 1-1 General Specifications

		Specifications*
<b>General</b>	<b>AC Input Options</b>	Nominally 120Vac (90Vac minimum, 129Vac maximum) or 240Vac (198Vac minimum, 264Vac maximum), 50 or 60Hz
	<b>Battery Type</b>	Sealed lead-acid
	<b>Capacity</b>	A minimum of twenty 360J discharges before low battery indicator comes on, or 90min of cardioscope monitoring.
	<b>Charge time</b>	24hr to 100% capacity.
	<b>Maximum Power Consumption</b>	30W while monitoring, 50W while monitoring with recorder on, 160W while monitoring with recorder on and charging energy storage capacitor (160W assumes a completely depleted battery)
	<b>Size</b>	35.3cm (13.9in) H x 29.7cm (11.7in) W x 31cm (12.2in) D
	<b>Weight</b>	12.7kg (28lb)
<b>Monitor</b>	<b>Input</b>	Isolated ECG through QUIK-LOOK defibrillator paddles or 3-lead patient cable
	<b>Common Mode Rejection</b>	100dB minimum with respect to chassis ground at 60Hz; 65dB minimum with respect to isolated ground; common mode range for patient cable input is $\geq 10V$ peak with respect to isolated ground (with notch filter engaged)
	<b>Patient Cable Length</b>	4m (13 ft)
	<b>Cardioscope Display Size</b>	76mm (3in) x 102mm (4in), non-fade
	<b>Sweep speed</b>	25mm/s $\pm 1$ mm/s
	<b>Frequency response (-3dB)</b>	0.5Hz to 40Hz
	<b>Recorder</b>	
	<b>Paper size</b>	50mm x 30m (100 ft)
	<b>Paper speed</b>	25mm/s $\pm 1$ mm/s
	<b>Recorder mode</b>	8s delay
<b>Frequency response (-3dB)</b>	0.5Hz to 40Hz (0.05Hz to 100Hz option through SETUP menu)	
<b>Annotation</b>	Includes date, time, lead, gain, heart rate, and defibrillation parameters	
<b>Heart Rate Meter</b>	3-digit display indicates rates from 20bpm to 300bpm	

Table 1-1 General Specifications

	Specifications*
Heart Rate Alarms	User-selectable alarm limits: three high-low settings: 150-40, 120-60, 160-90; other alarm-limit options available through SETUP menu
Calibration	Momentary pushbutton switch on rear panel simulates 1mV signal to preamplifier
ECG Output	1V/mV at 1.0 gain
<b>Defibrillator</b>	
Waveform	5ms monophasic pulse (Edmark) per AAMI standard
Output Energy (Delivered)	External paddles: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50, 100, 200, 300, and 360J; internal paddles: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, and 50J; defibrillator output electrically isolated.
Charge Time	Charge to 360J in less than 10s at 25° C (77°F) when ac operated or dc operated from a fully charged battery
Output Paddle	
Electrode area	82cm <sup>2</sup>
Cord length	3m (10ft)
Discharge control	Discharge controls on both paddles in series
Frequency response (-3dB)	2.2Hz to 20Hz
Test Load	Verifies energy delivery accuracy (±15%) at 200J
Defibrillator Synchronizer	Synchronizes defibrillator pulse to patient-generated R wave
Sync indicator	Marker on cardioscope identifies synchronizer trigger point. Defibrillator will discharge within 20ms after marker. Marker also appears on recorder.
Sensitivity control	ECG SIZE pushbuttons act as threshold controls
<b>Environmental</b>	
Atmospheric Pressure	97mmHg to 500mmHg (-570ft to 11,000ft)
Relative Humidity	0 to 95% (non-condensing) at 0°C to 34°C (0°F to 93.2°F) 0 to 80% (non-condensing) at 35°C to 45°C (95°F to 113°F)
Temperature	
Operating	0°C to 45°C (0°F to 113°F)
Storage	-30°C to 65°C (-23.8°F to 149°F)

\*All specifications at 20°C unless otherwise stated. Specifications subject to change without notice.

## Functional Description

The LIFEPAK 9 defibrillator/monitor consists of five printed circuit board (PCB) assemblies:

- Power Supply
- Power Conversion
- Interconnect
- Main
- Display.

The Functional Block Diagram shown in Figure 1-2 provides an overall view of the instrument operation.

The Power Supply PCB functions over the full range of input voltages from 90Vac to 270Vac at 50Hz or 60Hz without input line voltage selection. The Power Supply PCB converts the ac-line power to a nominal +18.8Vdc used by the instrument.

The Power Conversion PCB implements a variety of power-handling functions: power on/off switching, additional voltage generation, defibrillation charging, and stored energy transferring. A test load circuit is also present on the Power Conversion PCB.

The Interconnect PCB provides the electrical connection between the Main PCB and the Power Conversion PCB. It also contains circuitry to produce the audible tones and to drive the front panel LEDs.

The Main PCB has three major sections of circuitry: the Preamplifier, the System Controller, and the Display/Recorder Interface. The Preamplifier is used for both the 3-lead patient cable and QUIK-LOOK paddles inputs. The System Controller directs the operation of the instrument. QRS detection, rate calculation and alarms, and synchronous cardioversion are all implemented in the System Controller software. The current state of the system microprocessor and the ECG data are transmitted from the system microprocessor to the display/recorder microprocessor, allowing the display/recorder microprocessor to select and format the appropriate CRT messages and recorder annotations.

The Display Assembly contains a Monitor PCB that drives the 5-inch diagonal cathode ray tube (CRT). It uses electromagnetic beam deflection and incorporates vertical and horizontal deflection circuitry to produce a raster scan.



LIFEPAK 9 defibrillator/monitor

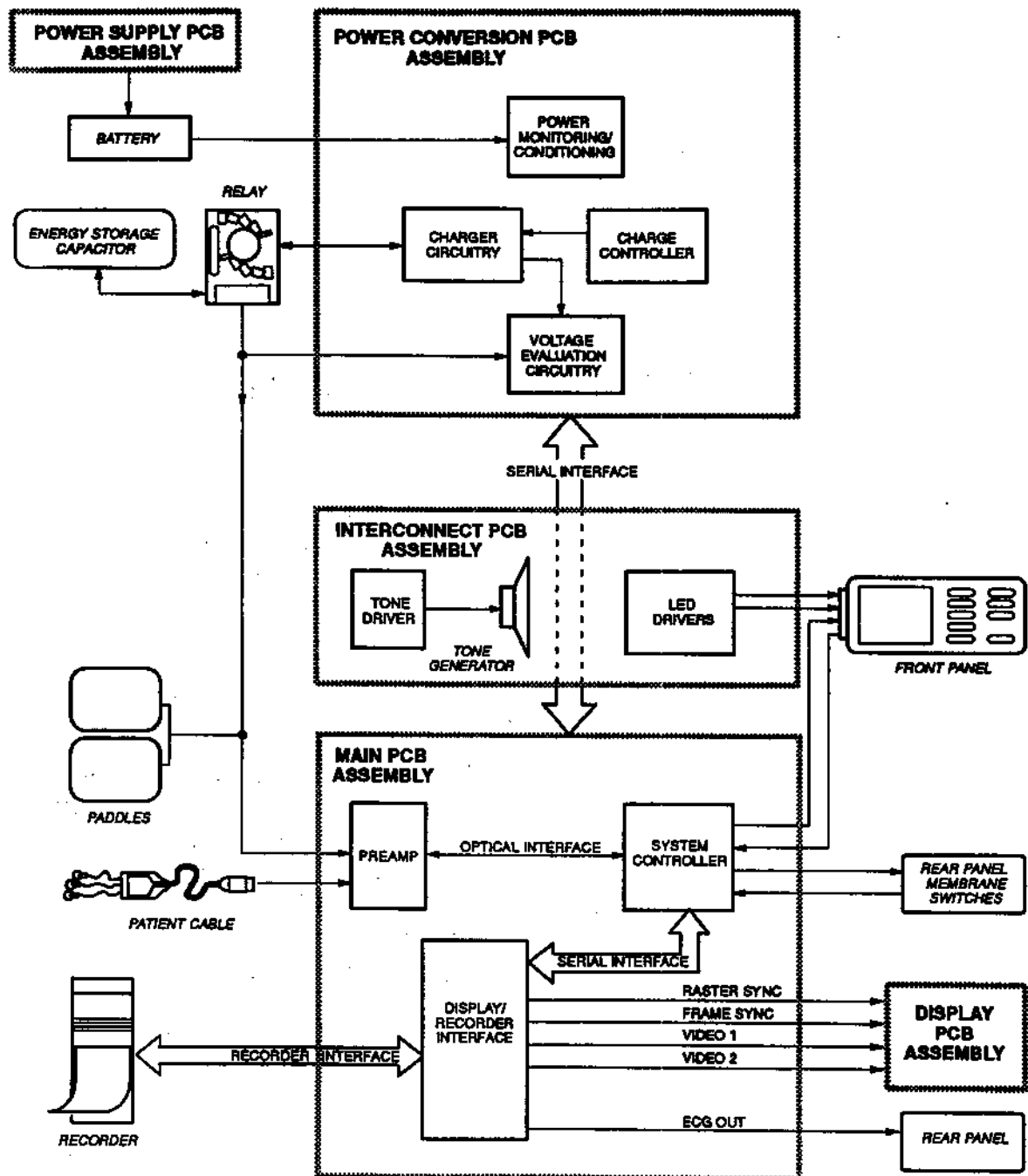


Figure 1-2 LIFEPAK 9 defibrillator/monitor Functional Block Diagram

## Theory of Operation

The following paragraphs contain detailed descriptions of the LIFEPAK 9 defibrillator/monitor Power Supply PCB, Power Conversion PCB, Interconnect PCB, Main PCB, and Display PCB Assemblies. Schematic diagrams of these electrical circuits, provided in Section 5, should be referred to while reading the circuit descriptions. Information about selected integrated circuits (indicated by a \* on the schematic) appears in Section 6.

### Power Supply PCB Assembly (803726)

The Power Supply PCB converts input ac voltage to a nominal dc voltage for the Power Conversion PCB and for charging the battery.

#### Power-On

When ac current flows through J1, it is conditioned by RT1, L1, C2, C3, and CR1. Resistor divider R1, R3, and R4 in series with parallel resistors R11 and R12 turn on Q1. Current builds in T1 primary windings (pins 4 and 6) and is coupled with pins 1 and 2. C6 couples the current build-up into Q1, causing saturation.

Increasing current through the T1 primary produces voltage on the base of Q2 and a voltage drop across parallel resistors R11 and R12. Q2 activation overrides Q1 and terminates the primary current. Transformer T2 sustains base drive current to Q2.

#### Regulation

When battery voltage exceeds the voltage threshold set by VR1, Q4 turns on and couples the voltage from T2 pins 4 and 5 to T2 pins 2 and 7. When current subsides to proper levels, Q4 turns off, providing current feedback for regulation.

#### Overvoltage Protection

If the regulation circuit fails, silicon controlled rectifier (SCR) CR12, together with CR13, R17, and R18 protects the load from damage. CR13 sets a voltage threshold which, when exceeded, triggers SCR CR12 to short the Power Supply circuit output. The operator monitors the Power Supply status from the +18V LINE STATUS signal and may reset the protection circuit by removing ac power to the instrument.

#### Output Isolation

CR11 isolates the Power Supply output from the filter network to protect it from the battery voltage when ac power is removed. This is necessary because the battery is connected in parallel with the Power Supply.

#### Battery

The +16Vdc, lead-acid battery pack is wired directly to the Power Supply output. The battery receives a constant charging current whenever the instrument is connected to ac power. (International configurations also require that the MAINS POWER switch is on.) As the battery approaches

full charge, the supply operates in constant voltage mode. Current limiting sets the maximum charge current available to the battery at about +4.5A. This limit is implemented when the Power Supply continues to source current into a dead short, a requirement for charging a severely depleted battery.

#### BATT CHRГ Indicator

The battery charging LED signal illuminates the BATT CHRГ indicator whenever the ac power is connected to the instrument. An interlock in the battery harness prevents the indicator from lighting if the battery is not installed.

#### Power Conversion PCB Assembly (803724)

The Power Conversion PCB contains circuitry for: power on/off switching, additional voltage generation and monitoring, energy storage capacitor charging, and defibrillation-energy transferring. Refer to Figure 1-3, page 1-9.

#### Power Control

The Power Control circuit regulates battery voltage to the circuits which control instrument operation. The circuits directly affected by the Power Control circuit are: Switching Power Supply, Logic Power Monitor, External Control Input, Low Energy Charge Rate, and Energy Storage Capacitor Charger circuits.

The Front Panel ON momentary pushbutton provides a start-up signal for the Power Control circuit. When ON is pressed, voltage is applied to the gate of Q11. Q11 turns on Q10, and provides the SWBATT voltage for the rest of the Power Conversion PCB Assembly circuits.

The power switch toggles the Power Control circuit on and off. When the power switch is first pressed, V BATT passes to the gate of Q11, causing Q11 to conduct, which causes Q10 to conduct. A portion of V BATT is held on the gate of Q11 by R52, which keeps Q10 conducting. During this phase the PWR SW MONITOR line is low. When ON is pressed a second time, V BATT is divided by R108 and R109, forward biasing CR44 and switching the PWR SW MONITOR line high. The system microprocessor reads the low-to-high transition and activates the Logic Power Monitor circuit, disabling the Power Control circuit.

#### Logic Power Monitor

The Logic Power Monitor checks the logic supply voltage. If the logic voltage is above or below normal limits, it deactivates Q11 and disables the Power Control circuit. Comparator U5 functions as a window detector for high voltages (U5A) and low voltages (U5B). The comparator reference voltages are set by diode IC U4 at +2.5V. The output of the Power Control circuit, SWBATT, generates the operating voltage for U5, U4, and the Switching Power Supply.

The system microprocessor shuts down the instrument by sending a low signal to the POWER ENABLE line. This switches the open collector output of USB to ground, which turns off Q11, disabling the Power Control circuit. Electrical isolation is provided by CR24 and R39.

A time delay function in the Logic Power Monitor circuit prevents the Power Control circuit from shutting down while operating voltages are still rising during initial power-on. Capacitor C26 accomplishes this for the high-limit detector (USA) and C18 for the low-limit detector (USB).

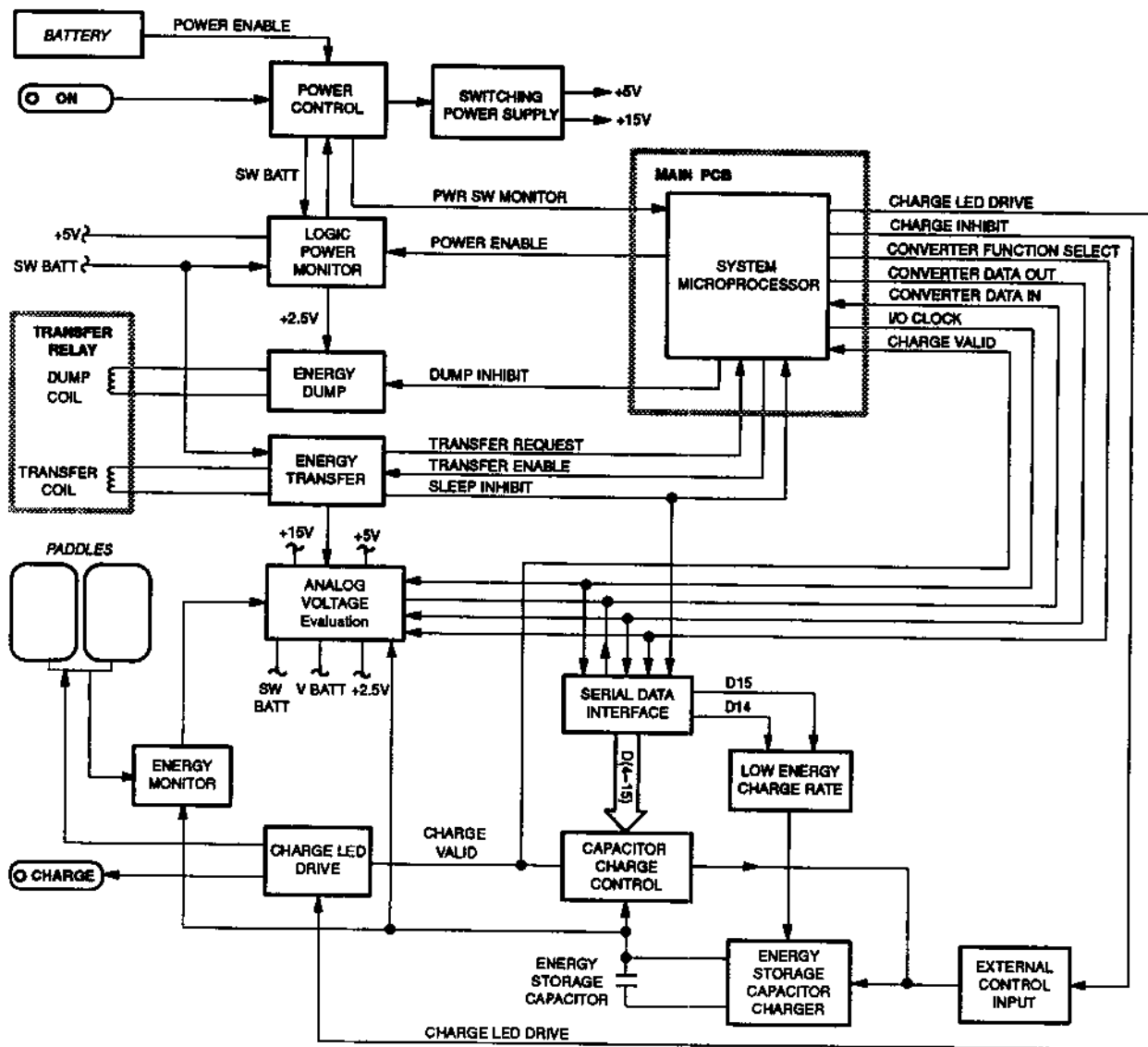


Figure 1-3 Power Conversion PCB Block Diagram

The low- and high-limit detector inputs to the test connector are used to check circuit performance by serving as test points to measure voltage. Voltage measurements check the accuracy of voltage dividers R41, R42, R43, and R56 (relative to the +5V supply).

#### Switching Power Supply

The Switching Power Supply using a pulse-width regulator (U3) and a flyback-coupled inductor (T2) produces the +5V to +15V supply voltages used by the rest of the equipment.

The pulse-width regulator (U3) contains an oscillator, reference voltages, an error amplifier, and drive circuitry for Q12. Oscillation frequency is set at 90Hz by R30 and C12. The +15V output feedback at U3 pin 2 determines the outgoing pulse-width. The pulse output at U3 pin 6 provides a constant frequency pulse by driving an N-channel FET (Q12) and dumping the V BATT voltage into the primary of T2. Two diodes, CR28 and CR29, protect Q12 from high voltages caused by leakage inductance from the primary.

#### External Control Input

The Energy Storage Capacitor Charger circuit is externally controlled by the N-channel MOSFET, Q9. Two resistors (R58 and R59) provide forward biasing for Q9 whenever power is applied to the instrument. A charge cycle for the energy storage capacitor initiates when the system microprocessor on the Main PCB sets the CHARGE INHIBIT line at low voltage, turning Q9 off. The inverting input of U2A rises to the required +5V minimum.

#### Energy Storage Capacitor Charger

The Energy Storage Capacitor Charger circuit uses a flyback transformer to charge the energy storage capacitor through the Transfer Relay. The core of the circuit consists of the following components: T1, U2A and U2B, Q1, Q2, Q5-Q7, and C17.

Amplitude comparators U2A and U2B determine the drive pulse for the primary of T1. The input to the energy storage capacitor at U2A pin 2 is controlled by the External Control, Low Energy Charge Rate, and Capacitor Charge Control circuits. If any of these incoming signals fall below the +2.5V reference at U2A pin 3, the output switches high, inhibiting the drive to the primary of T1.

Once a charge cycle initiates at U2A pin 2, the active low output turns on transformer driver Q5 which shuts off Q7. Timing for the transformer drive pulse-width is provided by Q7, U2B, C17, and R23. While Q7 conducts, the voltage across C17 is zero. When Q7 shuts off, the voltage at SWBATT starts charging C17. When the voltage at C17 exceeds +2.5V, the output of U2B switches low, forcing U2A output high, preventing current flow to the primary of T1.

The power circuit to the primary of T1 consists of two stages: Q5 and Q6 function as push-pull drivers, Q1 and Q2 provide improved current handling for the drive pulse.

The secondary winding of T1 supplies the energy stored on the energy storage capacitor for patient defibrillation. The output is therefore subject to potentials of up to +4.5kV under normal operating conditions. C1 limits the single pulse voltage rise to about +1.5kV, providing circuit-response time for control of the output voltage.

#### Low Energy Charge Rate

This circuit is centered around op amp U17A and is active only during low battery voltage levels, or when an energy level below 30J is selected. When a low battery voltage is detected, the Low Energy Charge Rate circuit slows the charge rate for the energy storage capacitor, reducing the amount of power required for charging. Similarly, the charge rate is slowed when a low charge energy setting is selected, ensuring the energy storage capacitor will not charge too quickly for the Capacitor Charge Control circuit to detect the energy level.

A signal from the system microprocessor at the energy request register, U20, determines the output of U17B. When an energy level of less than 30J is selected, low signals are applied to the inputs of U15D from U20. U15D output then switches low, forcing CR45 to reverse-bias. This pulls the noninverting input of U17A to +5V, changing the output of U17A.

The signal from U17A controls the charge timing circuit (U2B, C17, and R23), and in turn, the output of U2A. During normal charging, the effect of this signal is blocked by CR46. When U17A pin 1 is driven high, additional current is supplied to C17. This reduces the on-time of U2A, reducing current to the primary circuit and slowing the rate of charge of the energy storage capacitor. This reduces the power consumption of the Energy Storage Capacitor Charger to less than half of normal. At 360J, the charge time is increased to 30s.

The instrument can be operated with low battery voltage if the power required for charging the energy storage capacitor is reduced. Op amp U17A detects low battery levels by monitoring the SWBATT voltage at the inverting input and comparing it with the +2.5V at the noninverting input. When the threshold limit set on the noninverting input of U17A exceeds the SWBATT voltage on the inverting input, it indicates a failing battery. The output of U17A then functions as in the previous paragraph.

#### Capacitor Charge Control

The Capacitor Charge Control circuit controls the Energy Storage Capacitor Charger. It achieves and maintains a selected voltage on the energy storage capacitor and reports the capacitor voltage status to the Main PCB system

microprocessor. The circuit core consists of op amp U17B and comparators U8A, U8B, and U8C.

Op amp U17B sets and maintains the selected voltage to the energy storage capacitor by controlling an inhibit signal to pin 2 of U2A. When a selected voltage is achieved, U17B shuts down U2A, disabling the Energy Storage Capacitor Charger.

To set the gain for a particular charge voltage, digital-to-analog (D/A) converter U18 is connected between the inverting input and the output of U17B. The output of the D/A converter is controlled by selection of a 12-bit word by the system microprocessor on the Main PCB. Resistors R2 and R4 function as voltage dividers for the energy storage capacitor output voltage. When this divided voltage is applied to the noninverting input of U17B, the gain of U17B rises correspondingly.

Comparator U8C provides switching for the Energy Storage Capacitor Charger in response to input from U17B. When the output of U17B rises above +2.5V, U8C switches low. This low inhibit signal switches the output of U2A high, shutting down the Energy Storage Capacitor Charger.

Comparators evaluate the charge stored on the energy storage capacitor with respect to the defibrillation energy selected. U8B detects values greater than the minimum required for in-tolerance energy; U8A detects values less than the maximum allowed for the same energy setting. The outputs from U8A and U8B form the CHARGE VALID signal, indicating valid energy charge levels. This signal informs the Main PCB system microprocessor about the status of the selected charge energy.

## Energy Transfer

The Energy Transfer circuit transfers the energy stored in the energy storage capacitor to the patient. The circuit is centered around U6, Q4, C9, and CR4.

When the sternum and apex discharge pushbuttons on the paddles are pressed, the STERNUM TRANSFER and APEX TRANSFER lines at J17 produce the TRANSFER REQUEST signal from the output of U15A which is sent to the Main PCB system microprocessor. If all energy transfer parameters are correct, the system microprocessor returns a TRANSFER ENABLE signal through U11A and U14C.

The TRANSFER ENABLE signal initiates two functions; it enables and maintains a constant current to the transfer relay drive. The SWBATT voltage is stored in C9, enabling energy transfer to occur with minimum battery voltage dissipation. Transistor Q4 and SCR CR4 control this voltage and direct it to the transfer relay. To enable the relay drive, the signal from U14C turns on CR4. The signal from U11A forces U6A low, causing Q4 to conduct. With both CR4 and Q4 conducting, current starts to flow through

R62. To maintain a constant current to the transfer relay when current through R62 increases, the noninverting input of U6A goes higher than the reference voltage at the inverting input and the output switches high. This turns off Q4, causing the current to decrease through R62, switching U6A output low.

The high noise levels involved in the transfer of stored defibrillation energy can jeopardize the function of many types of logic signals, particularly if any are in transition from one state to another. To overcome this effect, the system and display/recorder microprocessors and other high speed logic are rendered inactive during transfer. To accomplish this, U6B discharges C35 at the input of comparator U8D and holds U8D low during the time that the Transfer Relay coil is energized. The output of the U8D remains low for an additional period to allow the Transfer Relay to reopen and any stray current to dissipate. This signal, SLEEP INHIBIT, is used as a logic activity enable.

SLEEP INHIBIT also clears shift registers, U19 and U20. This sets all inputs to U17B at 0V, which inhibits the drive to the Energy Storage Capacitor Charger. Inadvertent deactivation of the charge inhibit will then cause no hazard due to stored voltage on the energy storage capacitor.

#### Energy Dump

The Energy Dump circuit provides a current path for unused energy stored in the energy storage capacitor. If the paddles are charged but not discharged within one minute, the Energy Dump circuit is activated.

The internal dissipation of stored energy is accomplished with the dump relay and a power resistor located within the Transfer Relay Assembly. The dump relay is held in the normally closed condition by a permanent magnet. When a charge is initiated, the contact opens to prevent the stored energy from draining.

The system microprocessor controls Q3, preventing the paddles from being charged for longer than one minute. Prior to any charge activity, the system microprocessor on the Main PCB holds the DUMP INHIBIT line low, keeping Q3 turned off and the dump relay closed. During charging, the DUMP INHIBIT line is switched high, turning on Q3 and opening the dump relay. If the one minute charge time-out expires or a different energy setting is chosen, the system microprocessor turns Q3 off, closes the dump relay, and dissipates the stored energy.

#### Energy Monitor

The Energy Monitor circuit checks the energy level that goes to the internal test load. When energy is transferred as a test, this circuit senses the energy across the test load and informs the Main PCB system microprocessor what energy level was transferred. The system microprocessor then displays that information (e.g., 200J DELIVERED).



The value representing the defibrillation pulse is acquired by monitoring the path of the delivered energy with a current transformer, T3. A current of the same proportions is generated in the secondary with each transfer pulse. Half-wave rectifier CR8 delivers the secondary current to C10. This voltage is indexed in the system microprocessor to a specific delivered energy.

C10 must start each transfer cycle with 0V for accurate evaluation of the delivery. FET Q8 is in parallel with C10, resetting the capacitor before each charge energy pulse. The gate of Q8 is driven by the inverted CHARGE INHIBIT signal. Q8 shorts C10 when the charge is enabled, so the Energy Monitor circuit can determine the correct energy level each time the instrument is ready to deliver energy. Op amp U1A functions as a noninverting buffer, providing high-impedance isolation from the rest of the signal processing circuitry.

#### Serial Data Interface

The Serial Data Interface consists of four lines; CONVERTER DATA IN and CONVERTER DATA OUT provide full communication while CONVERTER FUNCTION SELECT and I/O CLOCK are used for data flow control. The Analog Voltage Evaluation circuit and the D/A converter U18, used with the Capacitor Charge Control circuit, share this common set of serial lines for communication with the system microprocessor.

A low on the CONVERTER FUNCTION SELECT line at P14 pin 7A enables the Analog Voltage Evaluation circuit for data transfer. The data flow rate is set by I/O CLOCK at P14 pin 6A. A high on the CONVERTER FUNCTION SELECT line at P14 enables 8-bit shift registers U19 and U20, allowing I/O CLOCK access to the register clock inputs. Information on the CONVERTER DATA OUT line is stored in the low-order location and all other bits are advanced one position during the positive-going transitions of I/O CLOCK. At the same time, U12A through U12C route the output data on the CONVERTER DATA IN line. A logic high at U11C pin 8 following a byte transfer indicates a communication failure.

#### Analog Voltage Evaluation

The Analog Voltage Evaluation circuit monitors a number of functional and operating voltages in the Power Conversion PCB. An analog-to-digital (A/D) converter, U9, is used to convert these voltages to digital code for evaluation by the Main PCB system microprocessor. The system microprocessor accesses the appropriate voltage inputs to U9 and evaluates them for correct tolerances.

#### Charge LED Drive

The CHARGE LED DRIVE signal from the Main PCB system microprocessor controls Q14 when the energy storage capacitor is charging. Q14 drives the front panel CHARGE LED and the paddle LED. R128 on the

drain of Q14 limits the current to the paddle LED. The gate of Q13 is connected to the CHARGE VALID signal. When the voltage for the selected energy level has been reached, Q13 conducts. Q14 then clamps the charge LEDs on continuously.

### Interconnect PCB Assembly (803761)

The Interconnect PCB provides electrical connection between the Main PCB and the Power Conversion PCB, drives the front panel LEDs, generates the audible tones, and provides the ECG Out signal.

### LED Drive

The LED drive circuitry consists of Q4, Q5, Q13, R14, R15, and R11. Static protection is provided by R9, R21, R22, C6 through C8, and CR1 through CR11.

### Audio Generation

The Main PCB system microprocessor chooses 1 of 8 volume levels by writing the appropriate binary number; 000 for the loudest and 111 for the softest. These 3 lines VOL CONTROL BIT (1 through 3) are routed to 3-to-8 decoder U1 on the Interconnect PCB. Static protection is provided by R1 through R4, C1 through C3, and C5.

The decoder sets the voltage required for the volume level selected by the system microprocessor. When the decoder output turns on one of the transistors, the corresponding resistor is in series with R8. The center tap of the resistor divider is routed to the input of either U2A or U2B as determined by Q11, Q12, and Q6. The output of U2A or U2B applies the voltage to the piezoelectric transducer, X1.

The free-running oscillator in the system microprocessor generates the desired tone frequency. This oscillator generates a square wave, AUDIO DRIVE, which is routed to the gate of Q11. If the voltage at the gate of Q11 is low, Q12 conducts, grounding U2A pin 3. Q6 then shuts off, applying the selected voltage to U2B pin 5. If the voltage at the gate of Q11 is high, Q11 switches on and Q12 switches off, applying the selected voltage to U2A pin 3. Q6 turns on, grounding U2B pin 5. In this way, the frequency of the oscillator controls transistors Q11, Q12, and Q6, providing drive to the transducer. Op amps U2A and U2B provide buffering and high current drive to X1.

### ECG Out

The ECG signal produced by this circuit is for display on an external monitor and is separate from the ECG signal seen on the display or recorder of this instrument. The PREAMP CONTROL signal from the Main PCB system microprocessor connects to JK flip-flop U4 pin 1. The falling edge of this signal starts an A/D conversion in the Main PCB preamp and sets the Q output of the flip-flop. PREAMP INPUT (from Main PCB U23) connects to U4 pin 3. The falling edge of this signal indicates the end of A/D conversion

and resets the Q output of the flip-flop. The resulting output at U4 pin 15 is a 540Hz pulse-width-modulated (PWM) square wave that is passed through a Butterworth filter consisting of R24 through R26, C9 through C11 and U3A. The output of the filter is the average amplitude of the PWM square wave. The signal is centered at 7.5V by C12, R27, and R28, then amplified by U3B, and R29 through R31 providing the 1V/mV output.

### Main PCB Assembly (803715)

The Main PCB Assembly consists of three major circuits: the Preamp, the System Controller, and the Display/Recorder Interface. The Preamp circuitry converts the ECG from the patient cable to sampled ECG. The converted ECG signal is optically connected to the system microprocessor which does the initial ECG signal processing. The system microprocessor is central to the System Controller circuitry. The System Controller provides the interface between the operator inputs and the functions of the instrument. The Display/Recorder Interface formats the CRT and recorder displays using the information from the system microprocessor.

Three major circuits control many functions. Table 1-2 groups these functions under the appropriate major circuit name. Paragraph descriptions for each function follow in the order listed. Refer to Figure 1-4, page 1-17.

**Table 1-2 Main PCB Functional Circuits**

Preamp	System Controller	Display/Recorder Interface
Isolated Power Supply	System Controller	Display/Recorder Controller
Front-End Protection	Front and Rear Panel Controls Interface	System Clock
Lead Select	Audio Alarms	Address Decode
Optical Interface	Charge Control	Display Gate Array
Instruction Decoding	I/O Protection	Video RAM
Instrumentation Amplifier		Font EPROM
Filtering		Program EPROM
DC Restore		Program RAM
Echo		Recorder Power
		Motor Speed Control
		Printhead Control
		Printhead Resistance Evaluation

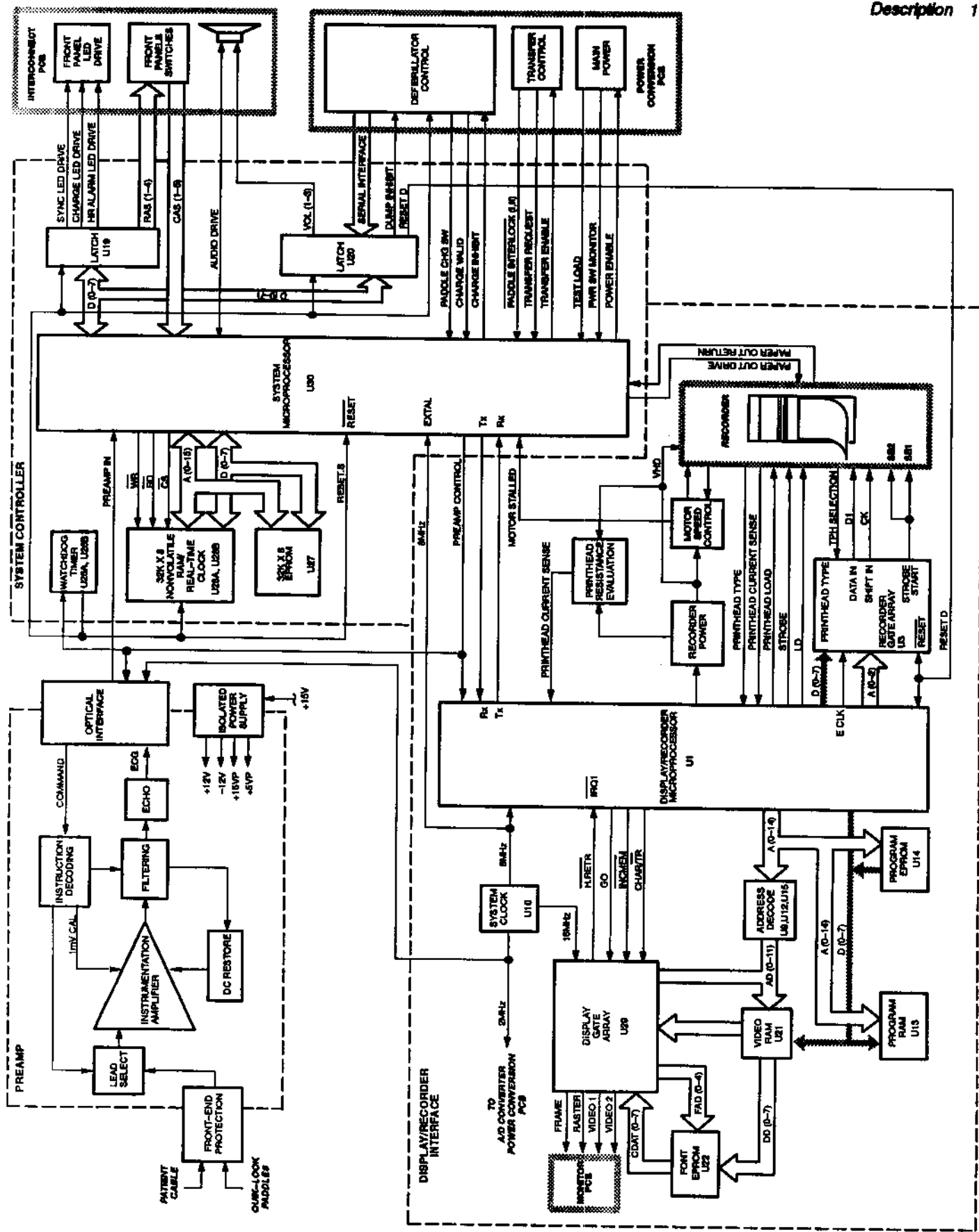


Figure 1-4 Main PCB Block Diagram

## Preamp

**Isolated Power Supply.** The Preamp circuitry requires +15Vdc, +12Vdc, -15Vdc, +5Vdc, and -12Vdc supplies. The drive for transformer T1 is generated by pulse-width modulator U5. C12 and R28 set the frequency between 12kHz and 24kHz. The secondary of T1 is applied to full-wave bridge CR20. The positive half of the ac input waveforms are stored at C87, forming the isolated +15V supply. The negative ac waveforms are stored at C86, forming the isolated -15V supply. Regulators U38 and U39 provide isolation for the more sensitive circuitry from the heavier loads. Since the +5Vdc loads are synchronous and small, U37 doubles as a regulated supply and a reference source.

**Front-End Protection.** VSP1 through VSP3 limit the input current to 2mA protecting against voltage surges. Isolation for the paddles input is provided by R131 and R132, which guard against excessive charge being introduced to the Preamp. Diodes CR18, CR19, and CR28 clamp the differential paddle voltage when K1 is switched to the leads mode.

**Lead Select.** To select between paddles and the different patient leads, latch U33 is loaded with the decoded data from counter U32. U33 controls relay K1, U43A, and analog switches U42 and U41. To select between patient leads or paddles, U33 causes Q8 or Q9 to conduct, switching the state of K1 to the desired position. Patient leads are selected when Q8 conducts; paddles are selected when Q9 conducts. If patient leads are selected, analog switch U42 selects the lead (I,II,III, or STD) requested by the output of U33.

**Optical Interface.** Command pulses from the system microprocessor pass through the optical interface and perform three different functions: synchronize the ECG conversion, select 1 of 5 patient cable leads, and induce a +1mV calibration signal. The system microprocessor uses an internal timer to transmit a pulse of variable duration (about 80ms to about 1.2ms) and a fixed-frequency period (540Hz). The variable-duration pulse from the system microprocessor enables U4 to start counting, creating a 16kHz pulse train at U4 pin 4.

The system microprocessor controls the count of the pulse train by interrupting the output with a CLR signal (see TP6, Figure 1-5). The 16kHz pulse drives the infrared-emitting diode in U7 providing pulse isolation. Comparator U34D provides waveform conditioning for the pulse train as it passes to the Instruction Decoding circuit, U32 and U33.

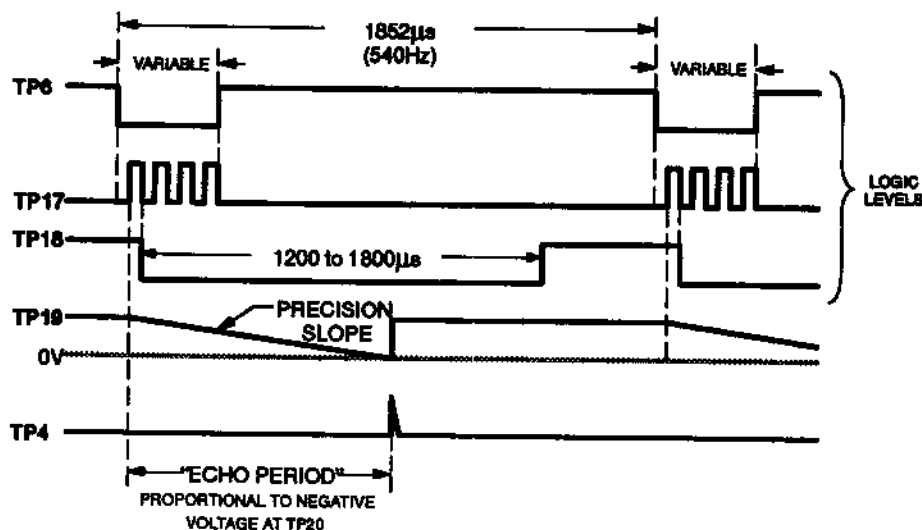


Figure 1-5 Preamp Timing

**Instruction Decoding.** The pulse train commands from the system microprocessor are coded by the number of pulses (see Table 1-3). The number of pulses represents a binary number, each number corresponds to a particular command function. Each set of pulses performs two tasks; application of a specific preamp setup, and initiation of ECG signal conversion to a digital equivalent. The rising edge of the first pulse is detected by U31A, which responds by sending a pulse to U34A. This initiates the ECG conversion. Monostable multivibrator U31B detects the falling edge of the first pulse and clears U31A so that ECG conversion is not initiated with every pulse on the pulse train.

Flip-flop U36A and counter U32 form a five-stage counter that responds to the pulses from the pulse train (see TP17, Figure 1-5). The first rising edge of the pulse train causes the five-stage counter to load from the preset inputs (pins 6, 5, 3, and 4). Subsequent edges count up from the preset inputs. Because of the timing of RC network R101 and C74, U31B times out at about 1.5ms and sends a positive edge to U33, latching the decoded command signals. These command signals select between the leads and paddles.

**Instrumentation Amplifier.** The typical ECG signal at U41 and U42 is no more than 16mV p-p and requires amplification for further signal processing. Together U44A and U44B form a differential input amplifier with the gain set by RN2 pins 1 and 2, R144, and RN2 pins 3 and 4. Op amp U44D amplifies the differential signal and rejects a common-mode signal from U44A and U44B. This common-mode signal (mainly 60Hz) is generated from the outputs of U44A and U44B through voltage dividers R148 and R149. Next, the common-mode signal is inverted and amplified by U35D.

This signal then passes through analog switch U41 and relay K1, which routes it to the unused patient lead (LL) cancelling common-mode signals at the patient source.

**Table 1-3 Preamp Pulse Widths**

Pulses at Tp17	Pulse Duration At Tp6	Result on Preamp Setup
1	64msec	Not used
2	128msec	Not used
3	192msec	Not used
4	256msec	Lead III
5	320msec	Lead II
6	384msec	Lead I
7	448msec	Std
8	512msec	Lead III + Cal
9	576msec	Lead II + Cal
10	640msec	Lead I + Cal
11	704msec	Std + Cal
12	768msec	Lead III + Leads Coil Drive and Switch Smooth
13	832msec	Lead II + Leads Coil Drive and Switch Smooth
14	896msec	Lead I + Leads Coil Drive and Switch Smooth
15	960msec	Std + Leads Coil Drive and Switch Smooth
16	1024msec	Lead III + Cal + Leads Coil Drive and Switch Smooth
17	1088msec	Lead II + Cal + Leads Coil Drive and Switch Smooth
18	1152msec	Lead I + Cal + Leads Coil Drive and Switch Smooth
19	1216msec	Std + Cal + Leads Coil Drive and Switch Smooth
20	1280msec	Lead III + Paddles Coil Drive and Switch Smooth
21	1344msec	Not used
22	1408msec	Not used

The +1mV calibration signal is created by an instruction from the system microprocessor which sets U33 pin 7 high. When U43A closes, a -5V offset signal is applied to U44A pin 2 and U44B pin 6. This adds about a +1mV differential offset to the input without changing the gain of the input stages.

**Filtering.** Filtering provides a uniform signal bandwidth during normal operation. The preamp filtering is comprised of two stages centered around op amps U44C, U45D, U45A, and U45B. In the first stage, U44C and U45D function as a high-pass filter for Preamp, DC Restore, and switch smoothing,

blocking frequencies below 0.024Hz. In the second stage, low-pass filter U45A removes frequencies above 200Hz. U45B functions as a 540Hz notch filter.

**DC Restore.** The DC Restore circuit compensates for any unwanted dc offset originating from switch smoothing, defibrillation, or motion artifact. This preserves the dc offset level required by the Echo circuit. DC Restore controls any transient signals, otherwise the high potential gain of the Instrumentation Amplifier would greatly amplify the dc level input for conversion. Under normal operation, the A/D conversion dc level at TP19 is +1V to +11V.

Switch smoothing is the process of limiting the response of the preamp to dc offset voltages when switching from one lead (I, II, III, or STD) to another. This function is initiated when the appropriate number of pulses at TP17 (see Table 1-3, pulses 12 thru 20) turns on Q8 or Q9 and switches U42 to the selected lead. When Q8 switches on, C90 discharges from +12V, causing Q11 to conduct. Q11 changes the high-pass filter by switching R161 in parallel with R165. This filter, because of R161, limits the signal passband to above 40Hz.

Transient signals associated with defibrillation are sensed by op amp U45C. U45C functions as a window comparator and responds with a positive output when the voltage at its input exceeds  $\pm 2V$ . R172 and R147 apply a negative bias to the noninverting input of U45C; R171 and R143 apply a positive bias to the inverting input. C104 and R151 are a low-pass filter that prevents very short spikes (such as an internal pacing spike) from inducing DC Restore. The output of U45C drives transistor Q10, routing the signal through high-pass filter U44C and U45D. Resistor R160, with U44C and U45D, limits the signal passband to 5Hz.

When PADDLES is selected, further passband limiting is required to eliminate motion artifact introduced by the paddles when used in the QUIK-LOOK mode. A command pulse selects paddles mode, (see Table 1-3, pulse 20), turning Q9 on. When Q9 conducts, flip-flop U36B is loaded so that the next clock pulse at pin 6 switches the Q output high. Analog switch U43B then closes, bringing R155 in parallel with R165 in the high-pass filter, and limiting the ECG signal passband to above 2Hz.

**Echo.** The ECG signal is converted to a pulse-delay period on command from the system microprocessor. This period is from the time the system microprocessor receives the convert command until the "echo" pulse is sent back to the system microprocessor. It is proportional to a sample of the ECG signal (see Figure 1-6). When the echo pulse is sent back to the system microprocessor (across an opto-isolator), the system microprocessor converts the pulse-delay period to a number.



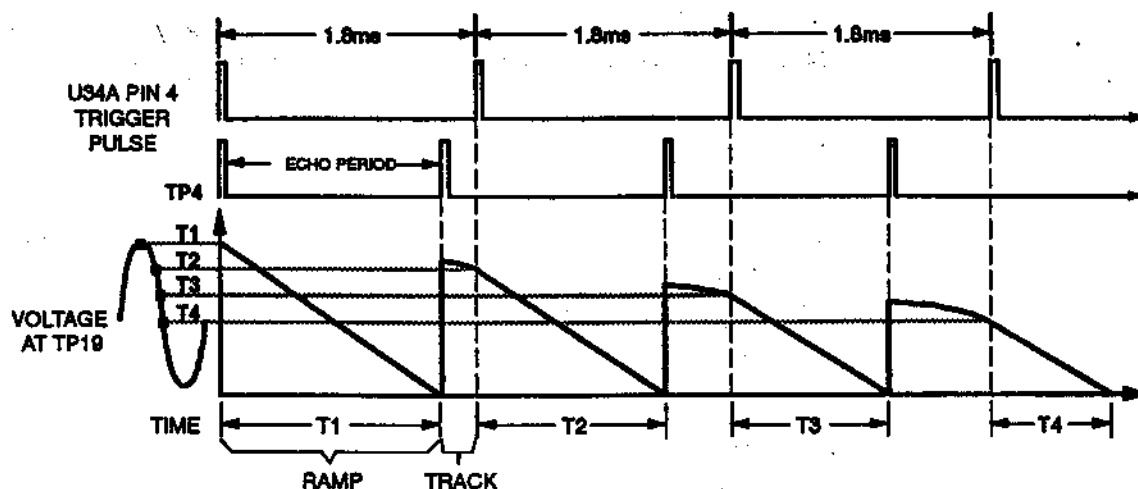


Figure 1-6 Echo Period

ECG conversion begins when the pulse train at the output of counter U4 passes to U32 pin 2. The rising edge of the first pulse clocks U31A, which sends a trigger pulse every 1.8ms to U34A. The ECG signal is offset to  $-6.3\text{V}$  at the output of U35A, providing a signal range of  $-1\text{V}$  to  $-11\text{V}$  for conversion.

The ECG signal from U35A passes to a track and ramp circuit consisting of U35B, U35C, Q7, and C76. This circuit controls the duration of the echo period. The track phase begins when Q7 conducts, which causes the ECG signal at U35B to charge sampling capacitor C76. The ramp phase starts when comparator U34A receives the trigger pulse (every 1.8ms), driving the output to  $-12\text{V}$ . This voltage passes to the gate of Q7 turning Q7 off. The  $+5\text{V}$  line and R122 provide a constant current source to the inverting input of U35C. When Q7 turns off, the constant current source causes a linear discharge from C76. This discharge produces a ramp output from U35C (see Figure 1-6).

While the track and ramp circuit is tracking, comparator U34A receives the trigger pulse from U31A. This drives the output of U34A to  $-12\text{V}$ , turns off Q6, and allows the  $+15\text{V}$  supply to charge C72 through voltage dividers R100 and R99. The output of comparator U34C controls the on-time of Q6, which discharges C72 through opto-isolator U6 and creates the echo signal.

The duration of the track and ramp circuit's ramp output determines how long the output of U34C is low and sets the duration of the echo period. When the ramp output of U35C reaches  $0\text{V}$ , the output of comparator U34B switches to  $-12\text{V}$ , presenting this voltage at the inverting input of U34C.

This causes the output of U34C to switch to high impedance, turning on Q6, and allowing the echo signal to be coupled through opto-isolator U6.

The System Controller circuit receives input signals from the front panel and sends commands to the CRT, recorder, and defibrillation circuits. The central component of this circuit is system microprocessor U30, together with external RAM and ROM devices. The system microprocessor primarily converts the ECG echo pulse widths to sample values for the CRT and recorder. These ECG samples are then sent to the display/recorder microprocessor for filtering and display of the CRT.

U30 communicates with the display/recorder microprocessor through two asynchronous serial transmit and receive lines at pins 12 and 13. In addition to the three 8-bit I/O ports contained in U30, 16 extra output lines are created by routing D0 through D7 in parallel out to octal latches U19 and U20. The operating software for the System Controller is contained in U27, a 32k x 8 EPROM. Battery-backed RAM U28A, provides data storage, including the calibration constants. DIP socket U28B, contains the lithium energy cell and real-time clock information. Address decoding is performed by 3-to-8 decoder U25, using only the outputs at pins 12, 13, and 14.

Multivibrator U26 and flip-flop U16 form the watchdog circuit for the system microprocessor (U30) and the display/recorder microprocessor (U1). The watchdog circuit monitors the 1.8ms preamp trigger pulse and resets both microprocessors if the pulse width is out of tolerance. An RC network consisting of R46 and C31 is used by U26 to detect a pulse width that is too short; R47 and C33 detect a pulse width that is too long. Controller U46 monitors the +5V supply and a system reset as needed. This protects the RAM memory and prevents spurious microprocessor activity. If the controller detects that the +5V supply is out of tolerance, the output at NOT CEO switches high and causes Q5 to conduct. Q5 conducts, pulling the voltage at R45 low. This low logic level (through U23C, U18A, and U17A) goes to the NOT RESET lines for the system microprocessor and the display/recorder microprocessor.

Front and Rear Panel Controls Interface. Signals from the front and rear panels are distributed to the system microprocessor, which determines what function(s) to activate. Input from the pushbuttons on the front and rear panels are arranged in a matrix of five columns (CAS 1 through 5) and three rows (RAS 1 through 3). The system microprocessor functions as a multiplexer, providing a high logic level for each row. In this way, the system microprocessor senses any closed column switch.

Audio Alarms. The system microprocessor switches the audio alarm on and off and controls the volume. A piezoelectric transducer on the Interconnect

PCB produces an audible tone in response to input from the system microprocessor. An internal oscillator in the system microprocessor provides four tone frequencies, including the key-click response when a pushbutton is pressed. Three output lines, VOL CONTROL BIT (1 thru 3), produce eight volume levels. The audio is silenced by turning off the system microprocessor's internal oscillator.

**Charge Control.** The system microprocessor initiates and monitors charge requests to the D/A converter U18 on the Power Conversion PCB. I/O, CLOCK, CONVERTER FUNCTION SELECT, CONVERTER DATA IN, and CONVERTER DATA OUT lines accomplish serial communication with the D/A converter. Pressing CHARGE on the keypad transmits the coded selected energy value from the system microprocessor to the Power Conversion PCB over the CONVERTER DATA OUT line. Status information on the decoding process on the Power Conversion PCB is sent back to the system microprocessor over CONVERTER DATA IN. The I/O CLOCK provides synchronous timing for serial communication.

Following the charge initiation, the system microprocessor runs a set of self-tests. These self-tests are completed before the selected energy is available. If self-test fails, the CRT displays the SERVICE legend.

The energy stored on the energy storage capacitor is monitored through a 10-bit analog-to-digital (A/D) converter located on the Power Conversion PCB. The A/D converter shares the four-line, serial-communication interface with the D/A converter. If the system microprocessor indicates that the energy stored is out of tolerance, an ENERGY FAULT message is displayed. The system microprocessor controls the CONVERTER FUNCTION line and controls whether the communication is with the D/A or the A/D converter, since they share the same communication lines.

**I/O Protection.** Electrostatic discharge protection is provided by the resistors and capacitors on all the I/O lines that run off the Main PCB. Additional protection is provided by 6.2V zener diodes, CR7 through CR9, on the VIDEO 1, VIDEO 2, and RASTER lines directed to the Monitor PCB.

**Display Recorder Controller.** The central component of this circuit is the display/recorder microprocessor U1. It receives the digitized ECG signal data from the system microprocessor and controls the input of this data to the Display Assembly CRT and the recorder. Because the CRT screen resolution is not as high as the recorder resolution, the display/recorder microprocessor compresses ECG data for the CRT display. The recorder receives all incoming ECG data samples. The display/recorder microprocessor also formats the ECG data so waveforms do not have gaps or overlapping segments on the CRT screen.

Display/Recorder  
Interface

**System Clock.** Crystal-controlled multiple-output oscillator U10 provides a 16MHz square wave to the Display Gate Array. It also supplies 8MHz to both the system and display/recorder microprocessors (U30 and U1), and 2MHz to A/D converter U9 on the Power Conversion PCB.

**Address Decode.** Programmable logic array U9 controls the reading from and the writing to all external memory and the recorder gate array, U3. It is used as an address decoder and is programmed to enable certain devices when the display/recorder microprocessor addresses different areas in memory. U9 is permanently programmed passing only the desired data to the devices being addressed.

Buffers U11, U12, and U15 isolate the appropriate RAM/ROM memory devices from interaction with the display/recorder microprocessor. U11 buffers the data bus. Buffers U12 and U15 control interaction on the address

I/O Line	Signal	Direction
IRQ1	H.RETR	In
P52	GO	Out
P53	INCMEM	Out
P54	TR/CHAR	Out
P21	STROBE	Out
P60	RCDR.PWR	Out
P61	PRNTHD.CURR.SNS	In
P66	PRNTHD.TYPE	In
P67	PRNTHD.LOAD	Out

Table 1-4 Display/Recorder Microprocessor I/O Lines

ECG sample data is transmitted from the system microprocessor to the display/recorder microprocessor through the Tx serial communication line approximately every 1.8ms. Other data/command bytes from the system microprocessor bulletin board are also transmitted to the display/recorder microprocessor when they are required for a particular function. This data is transmitted in packets containing a header byte, followed by two ECG sample bytes and, if required, a data/command byte from the system microprocessor.

The first four I/O lines listed in Table 1-4 communicate with the Display Gate Array, driving the input for the display on the Monitor PCB. The other five I/O lines control the operation of the recorder. Refer to schematic, page 5-26.

bus between the display/recorder microprocessor, the Display Gate Array, and the RAM/ROM memory devices.

Display Gate Array. Display Gate Array U29, is a custom IC containing many blocks of standard OR and AND gate circuits (counters, multivibrators, flip-flops, etc.). A metallic layer added on top of the gate circuits connects circuits for: Monitor PCB sync timing, ECG memory addressing, ECG display trace generation, video intensity, and additional timing signal generation. Two different internal counters control the timing of the Video RAM and Font EPROM addressing during CRT scan periods, and control the Video RAM addressing during CRT retrace periods.

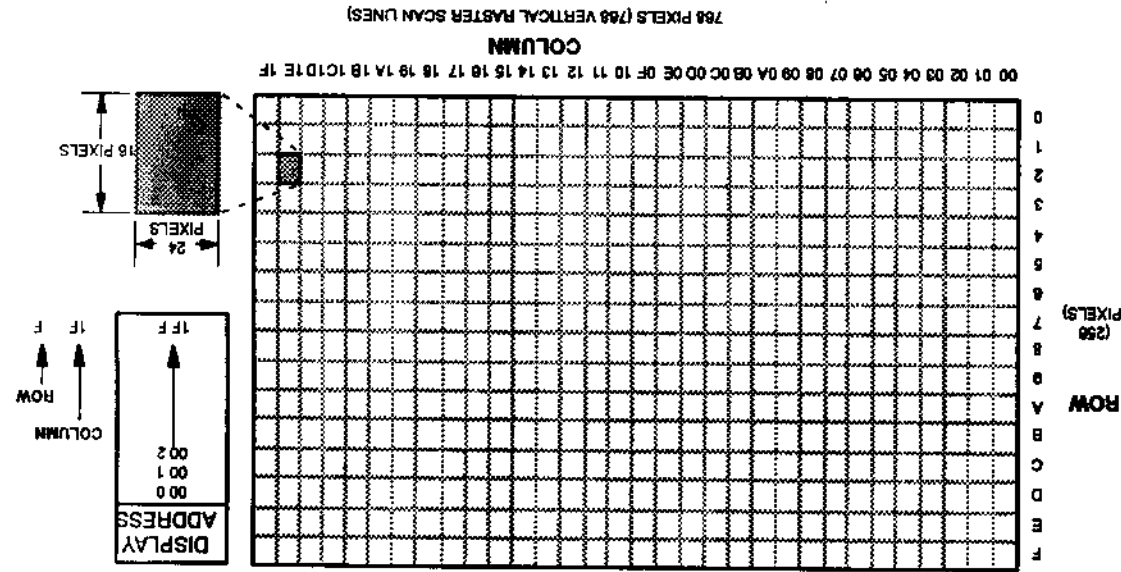
The Display Gate Array uses an 18-bit counter to control the timing of the vertical and horizontal retrace on the Display CRT. The lower 8 bits correspond to 256 rows and the upper 10 bits correspond to 768 columns (scan lines). When a count of 256 occurs, the gate array initiates a vertical retrace. When a count of 196,608 (256 x 768) occurs, the gate array starts horizontal retrace.

Four separate memory loops for two separate trace generators in the Display Gate Array format the ECG signal in memory. Formatting occurs during horizontal retrace. An internal 11-bit counter addresses each memory loop. Each trace generator, uses one memory loop for the high point of the scan and another memory loop for the low point of the scan. The trace appearing on the CRT screen is created by turning the video on at the screen location that corresponds to the low point, and turning the video off at the screen location that corresponds to the high point. The only data loaded in memory are the high and low point addresses for each scan, saving memory space in Video RAM U21.

Serial communication between the Display Gate Array and the display/recorder microprocessor is accomplished by the following control lines: H/RBTR, GO, INCMEM, and TR/CHAR. These lines enable the Display Gate Array and the display/recorder microprocessor to coordinate the storage and retrieval of ECG and character data in the Video RAM during horizontal retrace. Figure 1-7 shows the control line timing sequence.

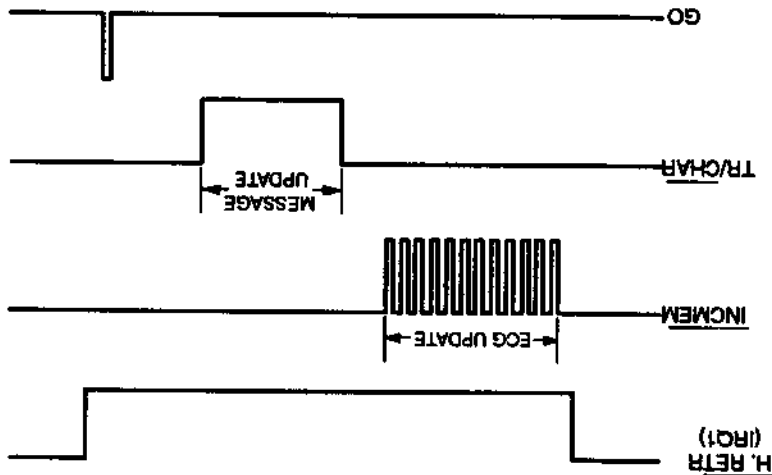
Data from the display/recorder microprocessor loads into the Video RAM memory during horizontal retrace. Six ECG samples update during horizontal retrace to smooth scrolling of the trace displayed on the CRT monitor. Coded character address data used by the Font EPROM also loads into the video RAM at this time.

Figure 1-8 Character Cell Locations



ECG trace and messages display during raster scan. The Video RAM sends ECG data to the Display Gate Array through EDAT(0-7); character address information passes to the Font EPROM through DD(0-7). Character pattern data stored in the Font EPROM is addressed and routed to the Display Gate Array as CDAT(0-7). The Display Gate Array sends the character data out to the proper address on the display (see Figure 1-8).

Figure 1-7 Control Line Timing



The Display Gate Array also functions as a video intensity circuit, producing four levels of brightness for the trace and characters. Two video outputs from the Display Gate Array, VIDEO1 and VIDEO2, generate the appropriate brightness level for the digitized display data by transmitting the data in two digit code to the Video Signal Amplifier circuit on the Monitor PCB. This code determines if the addressed pixel will be at full intensity, normal video, half-tone, or off (see Figure 1-9). Half-tone is used only for the points of the ECG waveform segments; full brightness is used only for the sync marks. The rest of the ECG waveform and all the characters are transmitted with normal brightness.

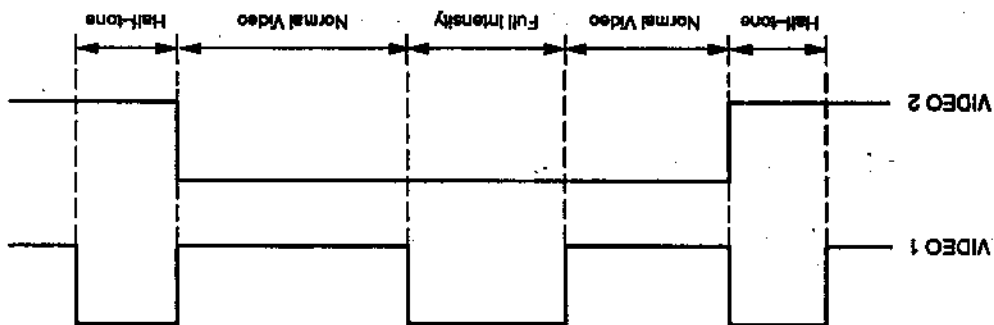


Figure 1-9 Video Intensity

Character dot information merges with trace information to create the video input signal. Messages have priority over waveforms when the two types of data are mapped to the same point on the CRT.

**Video RAM.** Trace and character data are stored in a 32k x 8 static RAM U21. New ECG data is installed during the horizontal retrace and consists of twelve bytes. Horizontal retrace provides an interrupt to the display/recorder microprocessor which signals permission for a memory access. The display/recorder microprocessor stores new data and increments the memory address counter.

An additional 512 bytes are used for storage of the character address codes (similar to ASCII codes). The screen can be configured into a matrix of 16 x 32 character cells, each cell accepting character information from the Font EPROM. The message content is updated as needed by the display/recorder microprocessor during horizontal retrace.

**Font EPROM.** A 32k x 8 EPROM U22 contains character font patterns, with memory for 256 characters. Each character is 16 pixels high and 24 pixels wide to fit in the screen character cells (see Figure 1-8). The displayable character set includes single-sized numerals, punctuation, and uppercase letters in normal, inverse, and boldface video. Special characters and double-sized numerals are in normal video display.

**Program EPROM.** Another 32k x 8 EPROM U14, contains the operating software for the display/recorder microprocessor. Included in the software is a list of codes representing all of the words and phrases used in the annotated recorder text.

**Program RAM.** The Program RAM U13 is used by the display/recorder microprocessor as a scratch-pad while performing program functions. Additionally, all CODE SUMMARY data and the display/recorder microprocessor bulletin board is stored in the Program RAM.

**Recorder Power.** The Recorder Power circuit provides operating voltage for the Printhead and the Motor Speed Control circuits by responding to a high logic signal from the display/recorder microprocessor at the base of Q2. This logic signal causes Q2 to conduct, turning on Q4, supplying power for the recorder motor and printhead.

**Motor Speed Control.** Regulation of the recorder speed is necessary because of the variable drag on the recorder motor caused by the thermal printhead and the lack of a spindle on the paper roll. The paper speed of the recorder is regulated by a variable-frequency, pulse-width-modulation circuit that compares the back-EMF (electromotive force) on the motor to a reference voltage. If an adjustment is needed, the circuit varies the frequency of the motor speed drive pulse enough to maintain the 25mm/s paper speed. The back-EMF produced in the motor when the drive pulse switches off determines the speed of the recorder motor. The voltage present at voltage dividers R18, R17, and C4 is directly proportional to the speed of the motor when Q3 is off.

A frequency-modulated pulse from transistor Q3 drives the recorder paper motor. The pulse has a fixed on-time and a variable off-time. The off-time is set by comparator U2B and capacitor C4 and determines how much power Q3 conducts to the paper motor.

The fixed on-time is determined by U2C. C2 charges to about 75% of VBATT during the off-time period. At the next on-time cycle, the output of U2B switches to ground, U2C pin 10 goes to about 1/3 of VBATT, and C2 starts discharging through R7. U2C changes states and ends the pulse on-time when the voltage on C2 drops below the voltage on pin 10.

Off-time is determined by comparing the voltage on U2B pin 7 to a calibrated reference voltage at pin 6. During the on-time, C4 is charged to a voltage proportional to the battery voltage. During the off-time, C4 discharges toward a voltage that is proportional to the back-EMF of the motor. Under normal operating conditions, the voltage on C4 discharges over several time constants before the voltage on U2B pin 7 is equal to the reference voltage on pin 6. When the voltages are equal, the output of U2B



switches low and Q3 conducts, supplying voltage to the paper motor. As the load on the motor increases, the back-EMF voltage decreases and the pulse-width off-time gets shorter.

**Printhead Control.** Control of the data to the recorder printhead is accomplished by the display/recorder microprocessor in conjunction with recorder gate array U3, program RAM U13, and program EPROM U14. The display/recorder microprocessor receives data from the system microprocessor and formats it for transmission to the recorder printhead.

The recorder gate array receives parallel data from the display/recorder microprocessor and transmits this data in serial form to the recorder printhead. The printhead prints an array of 384 bits from top to bottom of the recorder paper. The recorder gate array translates the two ECG signal data bytes from hexadecimal code to the 320 bits required by the printhead. Bytes for generating hexadecimal characters are mapped to the remaining 64 bits (32 for the top, 32 for the bottom) since text for the recorder always appears at fixed locations at the top or bottom of the recorder paper. As in the Display Gate Array, two internal trace generators receive high and low address inputs for the ECG trace and the SYNC marks.

The thermal printhead is an array of 384 switches and dots. An internal 384 bit shift register (see Figure 1-10) receives data input to the printhead. The recorder gate array sends clock pulse CK to the printhead, which enters data on the DI line into the shift register and converts the data from serial to parallel. The CK pulse is active only when data is sent to the printhead, preventing the printhead shift register from running continuously. The source of the CK pulses is the E clock used by the system microprocessor and the display/recorder microprocessor.

The display/recorder microprocessor moves the data stored in the printhead shift register into the printhead latch LD line. Data in the shift register is loaded into a 384 bit latch with a high LD signal from the display/recorder microprocessor. The output of the latch is gated by 384 AND gates; the drive for the dot heating elements is provided by 384 NPN transistors. After the data is loaded into the latch, the display/recorder microprocessor STROBE line switches one input of the AND gates high. This causes the gates switched high (data = 1) on the other input to switch their outputs high. The selected transistors conduct, drop a voltage across their respective heating elements, and activate the selected printhead dots.

Monitoring the current through the printhead while increasing the number of dots turned on determines the printhead resistance. As the number of dots turned on increases, the combined resistance of the printhead decreases. Comparator U2A monitors the load on the Vhd line at pin 5, through current sense resistor R27 and voltage divider R13 and R16. The VBATT line is monitored at pin 4, through voltage dividers R10 and R15. As the load on the printhead increases, the voltage across R16 decreases. When the voltage across R16 drops lower than the voltage across R15, U2A switches low. This directs the display/recorder microprocessor to stop sending strobe signals to the recorder array at the STROBE input. The display/recorder

Microprocessor starts energizing the printhead dots. When the motor speed calibration test runs, the display/recorder circuit is active only when the instrument is in motor speed calibration mode. Printhead Resistance Evaluation. The Printhead Resistance Evaluation printing determine the optimum duty cycle of the printhead. The printhead duty cycle is the time period that the printhead dots are energized. This is regulated by the width of the printhead strobe pulse, SB (see Figure 1-10). If the strobe pulse is too short, the print will be light; if it is too long, the excessive heat on the dots will greatly shorten the life of the printhead. The system microprocessor (U1) collects the printhead resistance, the battery voltage, and the printhead temperature, and calculates the optimum printhead strobe width.

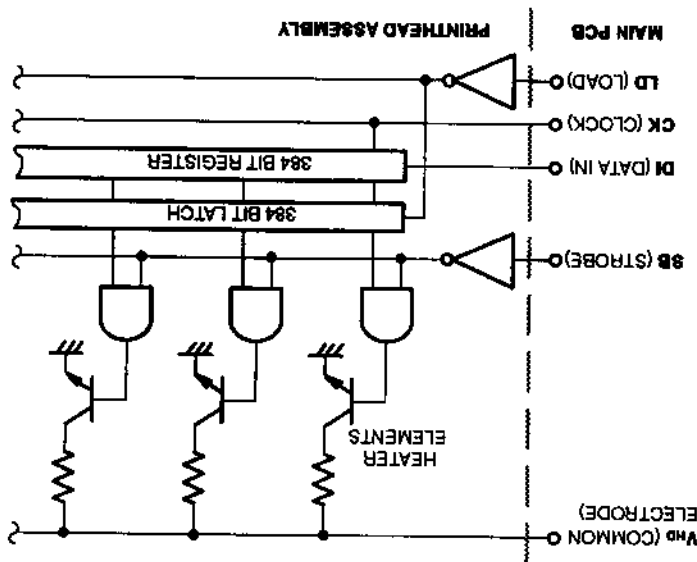


Figure 1-10 Printhead Assembly

microprocessor then determines the printhead resistance from the number of dots burned on and passes this information to the system microprocessor. A thermistor in the recorder produces a voltage that varies with the printhead temperature. This voltage is routed to A/D converter U9 on the Power Conversion PCB. The converted temperature voltage and the battery voltage are read by the system microprocessor from U9. The system microprocessor also receives the printhead resistance data from the display/recorder microprocessor and calculates the optimum strobe width from these three parameters. The data code representing the optimum strobe width is then transmitted to the display/recorder microprocessor.

The Display Assembly (Figure 1-11) contains a CRT and a Monitor PCB Assembly.

Display Assembly  
(803706)

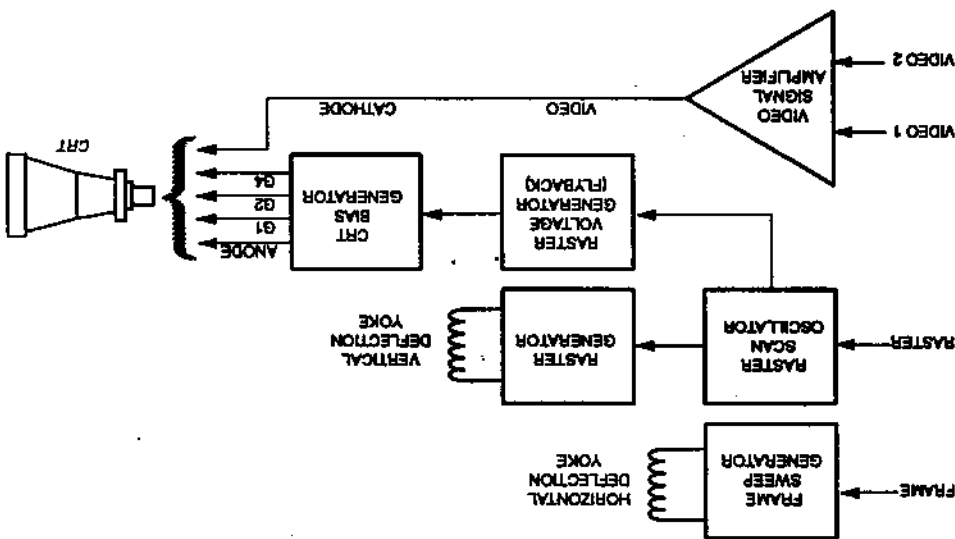


Figure 1-11 Display Assembly Block Diagram

The Monitor PCB Assembly processes video information and synchronization signals from the Main PCB Assembly and transmits them to the CRT. These signals are VIDEO 1, VIDEO 2, and synchronization signals FRAME SYNC and RASTER SYNC. Two separate circuits provide horizontal and vertical CRT beam deflection. The CRT raster consists of 768 scan lines in one complete frame and 256 pixels per line. The CRT screen is scanned by a vertical raster, bottom to top, left to right (see Figure 1-12). There is no interlacing during the raster scan.

The Raster Scan Oscillator sets the sweep frequency for the Raster Generator and the switching frequency for the Raster Voltage Generator power supply. The circuit is designed around voltage regulator U201.

Raster Scan Oscillator

To sweep the CRT accurately, U101 requires biasing by a number of external components. The RC combination, R105, R106, and C102, sets the frequency of the hybrids internal oscillator. Horizontal Hold R106 is adjusted to prevent the display from rolling. R111 provides a width adjustment and R113 calibrates the CRT beam linearity. R128 senses deflection current and feeds back to U101 pin 10 to help control both width and linearity. R117 and C112 form a damping circuit to eliminate yoke ringing (oscillation).

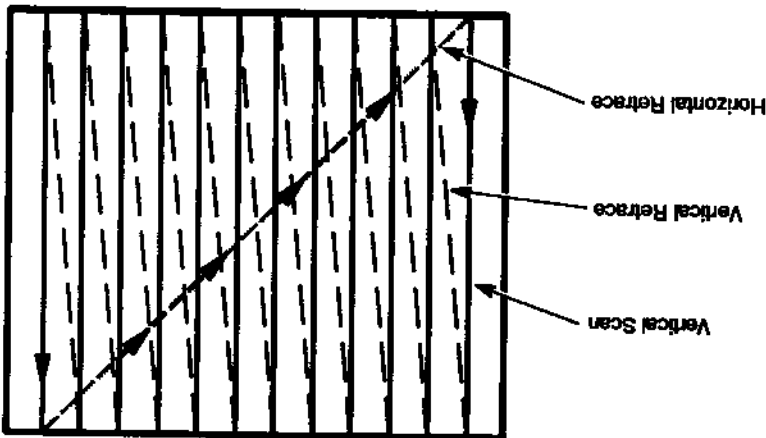
A deflection hybrid IC, U101, drives the frame yoke to sweep the CRT during horizontal retraces. The Display Gate Array on the Main PCB supplies the synchronizing signal (about 60Hz), FRAME SYNC, for this circuit.

Frame Sweep Generator

This circuit receives video information at VIDEO 1 and VIDEO 2 inputs, controlling voltage to the CRT cathode at the video output (J902 pin 2). The Main PCB at TTL levels (J4). The outputs of U401A, U401B, and U401C provide biasing for Q401, causing Q401 to conduct and supply a normal +40V to the video output. Four levels of video intensity are available by switching the outputs of U401A, U401B, and U401C. Brightness is adjustable through Video Gain Adjust, R402.

Video Signal Amplifier

Figure 1-12 Display Scanning



The voltage regulator oscillator frequency is set by the RASTER signal at about 52kHz. This signal is sent from the Display Gate Array on the Main PCB to Q201, causing Q201 to conduct and pass the signal to U201 pin 5. Resistor R217 and capacitor C203 function as an RC network, slowing the current at power-on. Resistor R209 decouples the +15V supply voltage so that display size will be minimally affected by changes in the +15V supply. Input over-voltage protection is provided by Q201, Q202, and D201. If the input voltage climbs to 18V or greater, D201 starts to conduct. This signal forward biases Q203, which routes it to the gate of Q202. When Q202 conducts, it inhibits the internal oscillator in U201 by applying +5V to the input at pin 4.

Vertical Size adjustment is controlled by R224. Vertical Size controls the width of the pulse from the output stage of U201, which determines the amount of energy delivered to transformer T301.

The Raster Voltage Generator supplies the input voltage for the primary of T301, and provides overall CRT bias voltages as well. The input signal for the circuit comes from the output of voltage regulator U201 pin 10, the Raster Scan Oscillator circuit.

The Raster Voltage Generator circuit is designed around transformer T501 and transistors Q501 and Q502. The oscillating output of U201 drives Q501, providing additional current for Q502. The output of Q502 sets the voltage for the primary of T301. The +15V input at T501 pin 4 produces  $\pm 15V$  (30V total) output at pin 5. A tap at T501 pin 6 supplies +24V. The secondary winding on T1 adds +14V to boost the +24V to +40V output at T501 pin 8. This voltage provides a ground reference for biasing grid 2, grid 4, and to a lesser extent, grid 1.

### Raster Generator

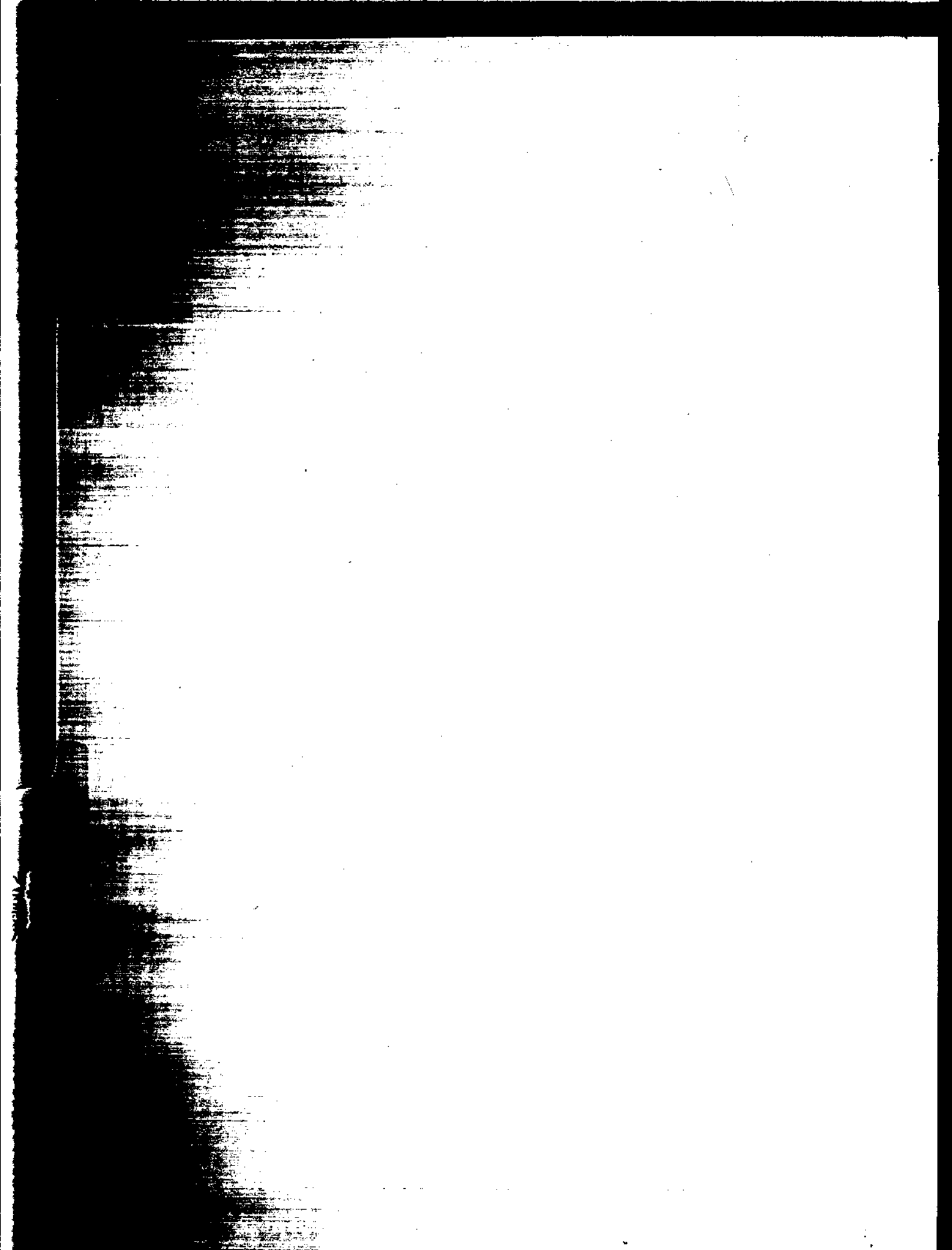
Vertical deflection for the raster yoke is provided by the Raster Generator circuit. Because of high current and voltage requirements, the vertical deflection circuit consists of discrete components, forming a resonant circuit. The Raster Voltage Generator, like the Raster Generator, is driven from the Raster Scan Oscillator circuit. The Raster Generator circuit includes transformer T301, which is shared with the CRT Bias Generator and provides the drive signal for the 88mH yoke coil. This creates the vertical scan drive for the CRT.

The Display Gate Array on the Main PCB supplies the synchronizing signal, RASTER SYNC, which is passed to voltage regulator U201. The output of U201 pin 9 causes Q204 to conduct, providing additional current for Q205. The output of Q205 controls the charge and discharge of C208 through C212. The precise values of these capacitors are essential for maintaining the proper

### CRT Bias Generator

resonance while charging and discharging. Transformer T301 provides high voltage for charging the capacitors.

The CRT Bias Generator supplies half-wave rectified voltage for the CRT anode and grid from the output of transformer T301. It provides up to -150V for bias of G1, up to +700V for bias of G2 and G4, and between +8.5kV and +11.6kV for anode bias. R302 adjusts the brightness which determines the general background brightness of the CRT. R306 adjusts the focus. R315 is a secondary brightness control for fine adjustment of the CRT background.



## Introduction

This section provides information about the basic operation of the instrument. It is not intended to instruct an operator in the clinical use of the instrument; refer to the separate *Operating Instructions* for that information. Basic information provided in this section covers:

- Front Panel Controls and Indicators, including Paddles Area
- Rear Panel Controls and Indicators
- Set-up and Info Options
- Clock Setting Procedures.

## Controls and Indicators

LIFEPAK 9 defibrillator/monitor controls and indicators are identified in Figures 2-1 and 2-2 and corresponding Tables 2-1 and 2-2.

**Note:** Pushbuttons are indicated in CAPITAL LETTERS and displayed in messages are indicated in BOLD CAPITAL LETTERS.



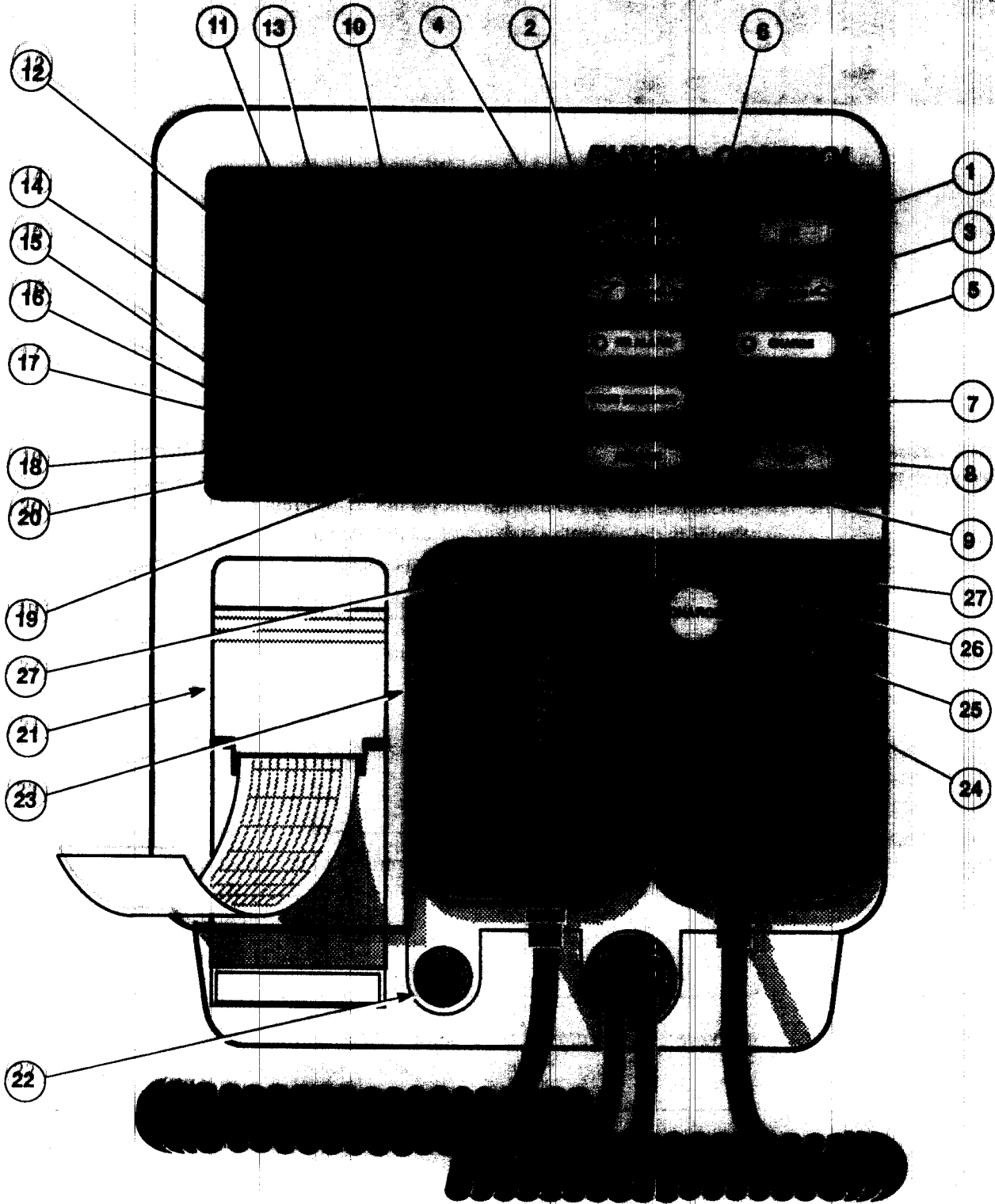


Figure 2-1 Front Panel Controls and Indicators

Table 2-1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
1	ON	Toggles instrument power on and off. Power-on illuminates the LED.
2	LEAD SELECT	Selects <b>PADDLES</b> input or patient cable leads ( <b>STD</b> , <b>LEAD I</b> , <b>LEAD II</b> , and <b>LEAD III</b> ). Switches the selected lead display to reverse video and advances to the next lead selection. Defaults to <b>LEAD II</b> at power-on unless <b>PADDLES</b> is specified in the <b>SETUP</b> menu.
3	▼ ENERGY ▲ SELECT	Displays the energy selection range incrementally. Select <b>LOW</b> on the high range menu to display the low range selections from 0 to 9 joules. Select <b>HIGH</b> on the low range menu to display the high range selection from 0 to 360 joules. Selecting <b>0J</b> inhibits energy charging. Pressing during charging or prior to energy transfer internally dumps stored energy.
4	▼ ECG ▲ SIZE	Changes the displayed ECG size to reverse video and increases or decreases the gain by one setting. ECG size is adjustable from 0.2cm/mV to 4.0cm/mV. Defaults to gain of <b>X1.0</b> at power-on. Affects gain of ECG OUTPUT.
5	CHARGE	Initiates defibrillation charge cycle. Existing defibrillator status message is replaced with <b>XXX JOULES CHARGING</b> message, where <b>XXX</b> displays the stored energy as it ramps up to the selected value. LED flashes during charge. At charge completion <b>XXX JOULES AVAILABLE</b> message displays while LED remains on steadily.
6	HR ALARM	Displays the preset alarm limits in reverse video and lights the LED. Incrementally steps through the three default limit selections (150/40, 120/60, and 160/90), or the values set by the operator in the <b>SETUP</b> menu when pressed again.
7	CODE SUMMARY	Starts the recorder and produces a summarized printout of critical events (defibrillation/cardioversion and selected ECG segments). Stops recorder when pressed again.
8	SYNC	Activates sync mode message display and LED light. LED flashes with each QRS detection. Returns to defibrillate (asynchronous) mode when pressed again. Also used in the test mode option.

Table 2-1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
9	RECORD	Toggles the recorder on and off.
10	Cardioscope	Nonfade CRT display. ECG trace moves from right to left.
11	QRS Indicator	Heart symbol flashes with each QRS detection.
12	Heart Rate	Displays digital QRS rate (20bpm to 300bpm).
13	Heart Rate Alarm Limits	Display indicators for high/low alarm settings which cannot be adjusted during normal operation. Limits flash if violated and alarm sounds.
14	Trace	Nonfade display trace moves from right to left.
15	Lead Select Indicator	Display indicates lead selected.
16	Calibrated Gain	Display indicates actual gain selected.
17	Status Message Display	Indicates instrument status: <b>SYNC MODE, FOR SYNC: USE LEADS, NO PAPER, LOW BATTERY: CONNECT AC POWER, and SERVICE.</b>
18	Energy Selection Display	Menu for high energy selection range shown. Select <b>LOW</b> to display menu for low energy selection range. Energy selection range stays on screen for 10s following the last energy level selected or until pressing another pushbutton.
19	<b>JOULES SELECTED</b> Indicator	On-screen indication of energy level selected in joules. Number scrolls up as energy is stored. Defaults to 200J at power-on.
20	<b>BATT CHRG</b> Indicator	LED indicates battery is charging.
21	Recorder	Records ECG and annotation in delay ECG mode only. Prints date, time, sync mode (if active), ECG lead, ECG gain, and heart rate. Prints selected energy and defibrillate mode during defibrillation. Prints automatically for 16s whenever alarm violation occurs.

Table 2-1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
<b>PADDLES AREA</b>		
22	Patient Cable Connector	Connection for 6-pin patient cable. Use only Physio-Control 3-lead patient cable part number 9-10418.
23	STERNUM Paddle	Defibrillating electrode with one discharge pushbutton, usually placed to left of sternum (patient's right). Also serves as negative ECG electrode during QUIK-LOOK paddle monitoring.
24	APEX Paddle	Defibrillating electrode with QUIK-CHARGE control (CHARGE) and second discharge pushbutton, usually placed near cardiac apex. Also serves as positive ECG electrode during QUIK-LOOK paddle monitoring.
25	CHARGE (QUIK-CHARGE control)	Charges defibrillator from APEX paddle.
26	Charge Indicator	LED flashes during charge and glows steadily when energy has reached selected level.
27	Discharge Pushbuttons	Discharges energy. Both pushbuttons must be pressed <u>simultaneously</u> to deliver energy to the paddles. Energy will not be delivered unless the instrument is fully charged to selected level.
28	Test Load	50W defibrillator test load. Metal contacts (not shown, in paddles storage area) for receiving 200J defibrillation pulse from paddles.

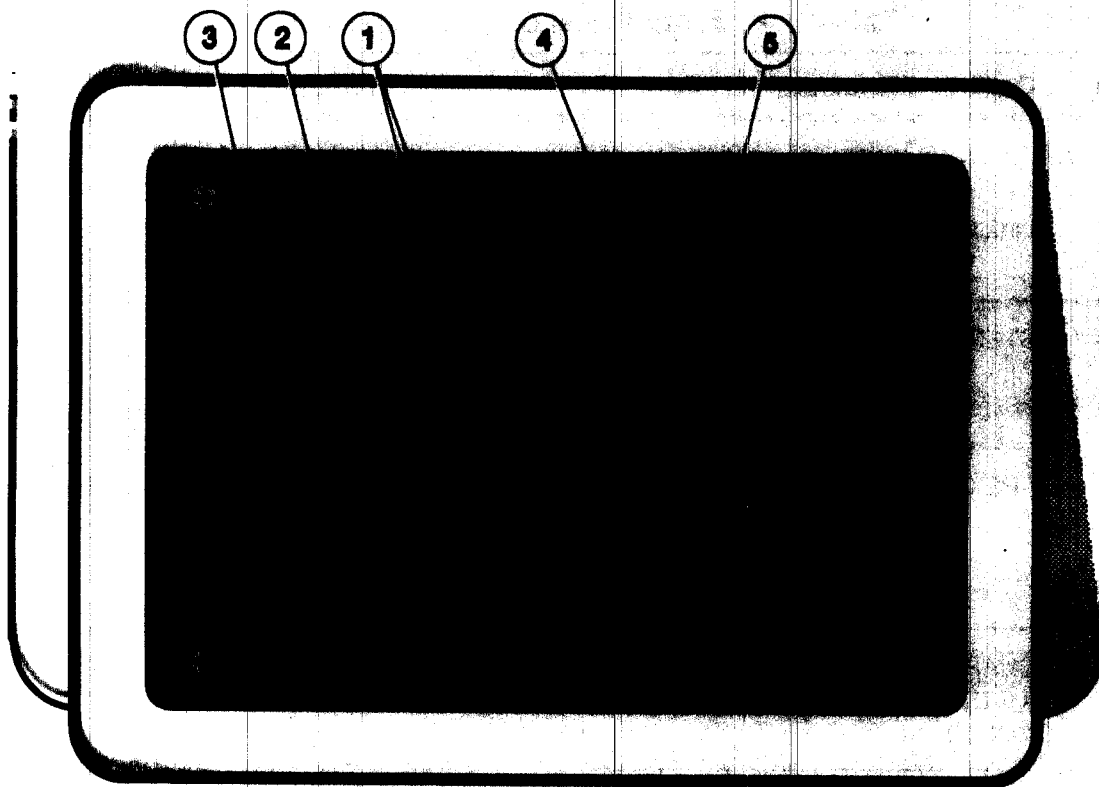


Figure 2-2 Rear Panel Controls and Indicators

Table 2-2 Rear Panel Controls and Indicators

Item	Control or Indicator	Function
1	TIME/DAY MODE  SET	Pushbuttons for setting the real-time clock.  Pressing the pushbutton once selects the clock set mode. Pressing repeatedly selects minutes, hour, year, month, and day fields. Press again to remove clock-setting display from the screen.  Pressing the pushbutton advances the data of the selected clock-set field. After the highest value is reached, it rolls over to the lowest value.
2	▼ QRS VOL ▲	Pressing the up or down scroll pushbutton increases or decreases the QRS volume. Setting at power-on is the same volume selected when the instrument was last turned off.
3	1mV CAL	Displays a 1mV calibration signal on the CRT and recorder.
4	Ground	Equipotential ground tie point
5	ECG OUTPUT	ECG out connector; 1V/1mV with gain of 1 (see ▼ ECG SIZE ▲ to set gain)

## Options

The LIFEPAK 9 defibrillator/monitor contains software for changing instrument settings, clearing or retaining stored data, and initiating selected tests. These options are selected from the test mode **SETUP** and **INFO** menus. Refer to Section 3, page 3-18 for more information about test mode menus.

## Setup

1. To access the setup menu, the instrument must be off. If the instrument is on, press **ON** so the green LED goes off.
2. Simultaneously press and hold **LEAD SELECT** and **HR ALARM**, then press **ON**.
3. Continue holding **LEAD SELECT** and **HR ALARM** until the message **SELECTED TEST:** and a list of options appear on the CRT. This list is the top-level menu. Refer to Figure 2-3.

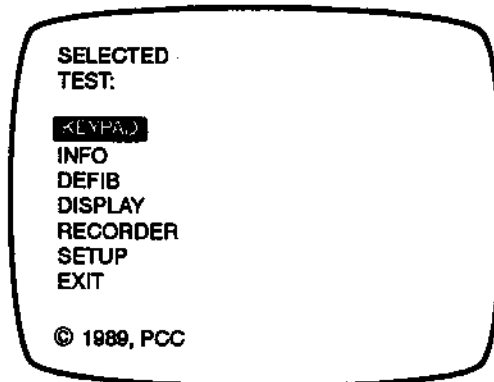


Figure 2-3 Top-Level Menu

4. Press ▼ **ECG SIZE** ▲ to scroll through the top-level menu. Scroll to **SETUP** and select by pressing **HR ALARM**.
5. Press **HR ALARM** to scroll through the available selections. Press ▼ **ECG SIZE** ▲ to change the options. Refer to Figure 2-4.

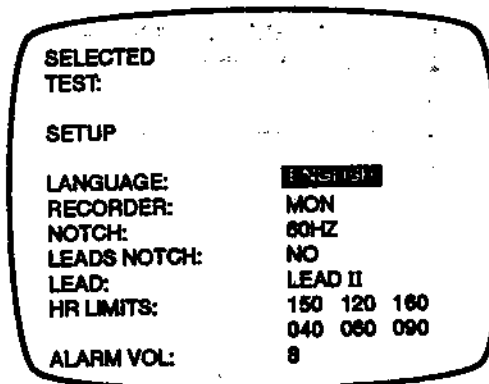


Figure 2-4 Setup Menu

Select from these parameters to reconfigure the instrument:

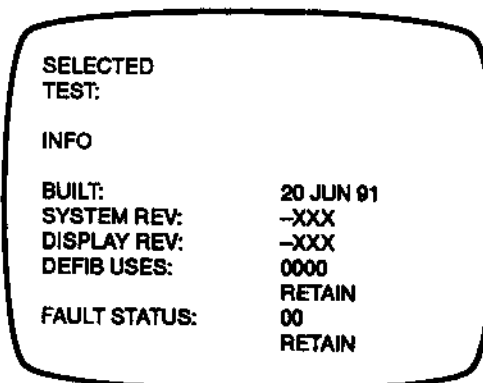
- LANGUAGE:** ENGLISH, FRENCH, GERMAN, or SPANISH
- RECORDER:** MONitor or DIAGnostic
- NOTCH:** 50Hz or 60Hz
- LEADS NOTCH:** YES or NO
- LEAD:** PADDLES or LEAD II
- HR LIMITS:** 3 ranges can be configured from the following limits:  
80bpm to 240bpm /upper limit (top row) and 20bpm  
to 100bpm/lower limit (bottom row).
- ALARM VOL:** 1 to 8 (A short tone sounds with each level change.)

6. Press HR ALARM until the menu returns to LANGUAGE: (to enter selection).
7. Press LEAD SELECT to return to the top-level menu.
8. Scroll to EXIT and press HR ALARM to resume normal operation.

**Info**

1. To access the info menu, the instrument must be off. If the instrument is on, press ON so the green LED goes off.
2. Simultaneously press and hold LEAD SELECT and HR ALARM, and then press ON.

3. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appear on the CRT. This is the top-level menu (refer to Figure 2-3, page 2-7).
4. Press ▼ ECG SIZE ▲ to scroll to **INFO**. Access the **INFO** menu by pressing HR ALARM.
5. Press HR ALARM to scroll through the available selections. Press ▼ ECG SIZE ▲ to toggle **CLEAR** or **RETAIN**. Refer to Figure 2-5.



**Figure 2-5 Info Menu**

<b>BUILT:</b>	Displays the manufacturing date and cannot be changed.
<b>SYSTEM REV:</b>	Displays the revision number for the system microprocessor EPROM and changes automatically with any EPROM update.
<b>DISPLAY REV:</b>	Displays the revision number for the display/recorder microprocessor EPROM and changes automatically with any EPROM update.
<b>DEFIB USES:</b>	Counts the number of defibrillator discharges and allows the operator to <b>RETAIN</b> or <b>CLEAR</b> the number.
<b>FAULT STATUS:</b>	Retains any coded instrument errors using the error codes listed in Section 3, Table 3-5, page 3-30. Operator may <b>RETAIN</b> or <b>CLEAR</b> codes.

### Clock Setting Procedure

The **MODE** and **SET** pushbuttons on the rear panel (page 2-6) of the instrument set the date and time displayed on the CRT and the recorder. Refer to Figure 2-6.



1. Press MODE to initiate the clock setting mode.
2. Press MODE again to successively select the minutes, hour, year, month, and day fields.
3. Press SET to advance value in the selected field.
4. Press MODE again after selecting the day field to exit the clock setting mode.

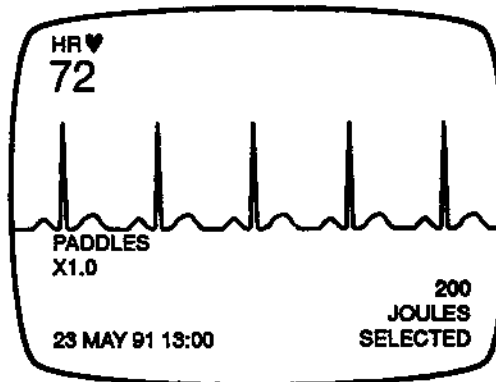


Figure 2-6 Clock Set Display



# Test and Calibration

## Introduction

This section provides the following information for the LIFEPAK 9 defibrillator/monitor:

- Performance Inspection Procedure (PIP), a closed-case test confirming basic instrument functions
- Test and Calibration Procedures, more extensive tests plus calibration requiring the instrument to be opened.

## Performance Inspection Procedure (PIP)

Perform the PIP every three months and after any service or repair to check instrument performance. Refer to Test and Calibration, page 3-15 for specific circuit test procedures. A PIP Checklist (page 3-12) is provided for convenience and may be copied when needed.

The following items are needed to complete the PIP:

Equipment Required	Part Number or Specification
ECG Simulator	Dynatech 215A or equivalent
ECG Paper	Box of 3 rolls, PCC No. 804700-003
Energy Meter	Electronics Unlimited DT650A or equivalent
Stopwatch	Accuracy: $\pm 0.25s$
Metric Ruler or ECG Paper	Dempsey 431 or equivalent
Safety Analyzer	

*Note: Pushbuttons are indicated in CAPITAL LETTERS and displayed messages are indicated in BOLD CAPITAL LETTERS.*

## Warning

**SHOCK HAZARD.** The defibrillator stores and delivers hazardous voltages. Test and service personnel must be familiar with this instrument before performing these procedures.

### PIP-Physical Inspection

Visually inspect all controls, indicators, and displays on the LIFEPAK 9 defibrillator/monitor for cracks, dents, loose or missing hardware, damaged labels, and contamination from foreign substances. Inspect the physical condition of the ac power cord and patient cable. Make sure the battery door is completely latched.

### PIP-Battery Charge Legend

Connect the instrument to the ac power source. Check that **BATT CHRG** illuminates.

### PIP-AC Power

1. Press **ON** to power the instrument. Check that the **ON LED** illuminates.
2. Check that within 10s after the instrument is turned on, **© 1989, PCC** displays for at least 5s.
3. Check that the power-on display appears on the CRT as shown in Figure 3-1.

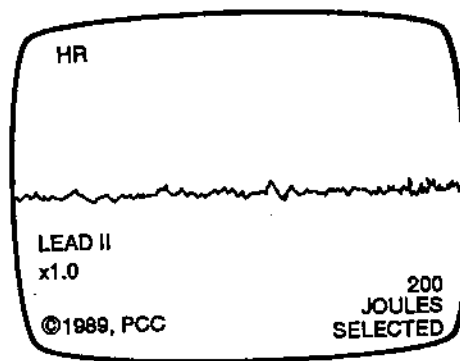


Figure 3-1 Power-On Display

### PIP-Battery Power

1. With instrument power on, disconnect the power cord from the ac power source. Check that the instrument remains on and that **BATT CHRG** is off.
2. Reconnect the ac power cord, press **ON** to switch instrument power off.

**PIP-Test Setup**

1. Use the Setup Menu (see page 2-7, Options) to select:  
**RECORDER:           DIAG**  
**LEADS NOTCH:       NO**
2. Use default parameters for remaining selections.

**PIP-Keypad Test**

1. To initiate test mode, press and hold LEAD SELECT and HR ALARM (for more information on test mode refer to page 3-18).
2. Press ON. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appears on the display.
3. Scroll to the **KEYPAD** test using ▼ ECG SIZE ▲ and press HR ALARM to start the test.
4. Press all front, then all rear panel pushbuttons in the following order:

**Front Panel:**

LEAD SELECT  
▼ ECG SIZE  
ECG SIZE ▲  
▼ ENERGY SELECT  
ENERGY SELECT▲  
HR ALARM  
CHARGE  
CODE SUMMARY  
RECORD  
SYNC

**Rear Panel:**

▼ QRS VOL  
QRS VOL ▲  
MODE  
1mV CAL  
SET

5. Press the APEX paddle CHARGE pushbutton. Press the APEX paddle discharge pushbutton. Confirm that no beep sounds.
6. Press the STERNUM paddle discharge pushbutton. Confirm that no beep sounds.
7. Simultaneously press both paddle discharge pushbuttons. Confirm that a beep sounds.
8. Confirm that the CRT displays **KEYPAD: OK**. If the pushbuttons are not pressed in the order given or if there is a pushbutton failure, the CRT displays **KEYPAD: FAULT**.
9. Press LEAD SELECT to return to the top-level menu. Select **EXIT** and press HR ALARM to resume normal operation.

**PIP-Lead Select**

1. Initial lead selection defaults to LEAD II. Check that repeatedly pressing and releasing LEAD SELECT consecutively displays LEAD III, STD, PADDLES and LEAD I in reverse video.
2. Use the patient cable to connect the ECG simulator to the instrument. Set the ECG simulator for a 60 beats-per-minute, normal-sinus-rhythm (bpm-NSR) signal.
3. Press LEAD SELECT and confirm that the signal is displayed in all lead configurations.

**PIP-Recorder  
Speed/Baseline  
Centering**

1. Place a new roll of ECG paper in the Strip Chart Recorder Assembly (see page 4-3, Loading Paper).
2. Set the ECG simulator for a 60bpm-NSR signal in LEAD II.
3. Press RECORD and let the recorder run for about 10s then select STD. Let the recorder run for an additional 10s.
4. Press RECORD to stop the recorder.
5. Measure the distance between the peaks of the recorded ECG trace. Check that the distance between consecutive peaks is  $25\text{mm} \pm 1\text{mm}$ .
6. Measure the baseline centering of the recorded STD trace. Check that the baseline is centered within  $\pm 1.5\text{mm}$ .

**PIP-ECG Display**

Confirm that the flatline display on the CRT is level and centered from end to end. Check that all messages are visible.

**PIP-1mV CAL**

1. LEADS NOTCH must be deselected and recorder set to DIAG (see page 2-7, Options). Select STD lead.
2. Press RECORD, then press 1mV CAL on the rear panel once. Confirm that a  $10\text{mm} \pm 0.5\text{mm}$  calibration pulse with less than 1.5mm overshoot is recorded (0.5mm overshoot if in MON mode). Refer to Figure 3-2.

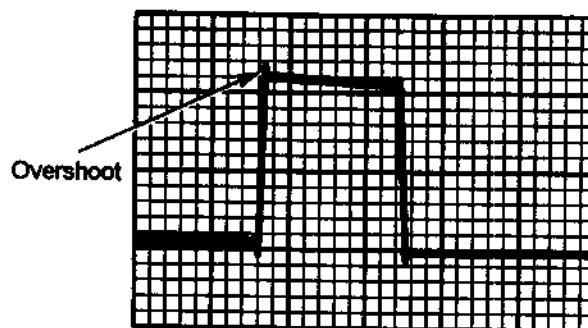


Figure 3-2 1mV CAL Pulse (DIAG mode)

#### PIP-CRT Gain/Aspect Ratio

1. Select LEAD II.
2. Set the ECG simulator for a 60bpm-NSR signal.
3. Adjust ▼ ECG SIZE ▲ for a  $3.4\text{cm} \pm 0.2\text{cm}$  p-p ECG display signal.
4. Press RECORD.
5. Confirm that the signal amplitude recorded on the ECG paper is  $2.0\text{cm} \pm 0.1\text{cm}$ .

#### PIP-Heart Rate

1. With LEAD II selected set ▼ ECG SIZE ▲ to X1.0.
2. Set the ECG simulator for the input rates listed. Check that the systole indicator flashes with each ECG waveform and that the displayed HR corresponds:

Input Rates	HR
30	$30 \pm 3\text{bpm}$
60	$60 \pm 3\text{bpm}$
240	$240 \pm 7\text{bpm}$

3. Return ECG simulator to 60bpm-NSR.

#### PIP-Rate Alarms/ Alarm-Activated Record

1. Press HR ALARM. Check that the HR ALARM LED is on and 150/40 is displayed in reverse video.
2. While the display is still in reverse video, press HR ALARM and check that 120/60 and 160/90 display consecutively.

3. Select 150/40. Check that after about 2s 150/40 displays in normal video.

*Note: Heart-rate alarm limits can be changed. Refer to page 2-7, Options.*

4. Set the ECG simulator rate to 160bpm. Check that the alarm sounds, the 150 flashes, and the recorder runs for 16s.
5. Check that the heart rate recorded is 151bpm or higher.
6. Check that the displayed HR is 160 bpm  $\pm$ 5bpm.
7. Press HR ALARM and confirm that the alarm stops.
8. Decrease the ECG simulator rate to 30bpm. Press HR ALARM. Confirm that the alarm sounds, 40 flashes, and the recorder runs.
9. Press HR ALARM and confirm that the alarm stops.

#### PIP-Recorder Annotation

1. Set the ECG simulator to 60bpm.
2. Set the instrument to local time. See page 2-9, Clock Setting Procedure.
3. Press RECORD. The recorder annotates the date and time. Confirm that after this initial annotation, the recorder annotates heart rate, time, and date approximately every 20s.
4. Confirm that the time is accurate to within  $\pm$ 1min.
5. Change the lead setting to LEAD III.
6. Confirm that the recorder annotates the new lead setting along with the heart rate, time, and date.
7. Press RECORD to stop the recorder.

#### PIP-Test Load

1. Place the paddles in the paddle storage area of the instrument.
2. Press  $\blacktriangledown$  ENERGY SELECT  $\blacktriangle$  if necessary to set the energy level to 200J.



### PIP-Sync/Sync Annotation

3. Press **CHARGE**. Wait until the instrument reaches full charge.
4. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the test load. Confirm that **TEST 200 JOULES DELIVERED** displays on the CRT and annotates on the recorder.
1. Press **LEAD SELECT** to set the instrument to **PADDLES** (external **STD**).
2. Press **SYNC** and check that **FOR SYNC: USE LEADS** message flashes five times on the CRT and three tones sound.
3. Press **LEAD SELECT** to set the instrument to **LEAD II**. Set the ECG simulator for a 60bpm-NSR signal.
4. Press **SYNC**. Confirm that **SYNC MODE** displays on the CRT, the sync marker is clearly visible on each displayed R-wave, and the **SYNC LED** flashes. Confirm that the warning message does not display and no tone sounds.
5. Press **RECORD**. Confirm that the annotated data includes **SYNC** and a sync marker is clearly visible on the recorded ECG trace.
6. Place the paddles in the paddle storage area of the instrument. Press **▼ ENERGY SELECT ▲** if necessary to set the energy level to 200J.
7. Press **CHARGE**. Wait until the instrument reaches full charge. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the test load.
8. Check that the recorder annotates **SYNC TEST 200 JOULES DELIVERED**.
9. Confirm that the **SYNC MODE** display and **LED** are off, and no sync markers are visible.

### PIP-Recorder/CRT Noise

1. Short the RA and LL leads of the patient cable together.
2. Set the ECG gain to **X4.0**. Select **LEAD II**.
3. Press **RECORD** to start the recorder.
4. Confirm that the CRT and recorder baseline noise is less than 3mm p-p (2mm if in **MON** mode).
5. Select **PADDLES**. Short the paddles and confirm that the CRT and recorder baseline noise is less than 3mm p-p.
6. Return the paddles to the paddle storage area.

### PIP-Defib Disarm

1. Press ▼ ENERGY SELECT ▲ and set the energy level to 0J.
2. Press the CHARGE pushbutton.
3. Confirm that the CHARGE LED does not light and that the CRT continues to display 0 JOULES SELECTED.

### PIP-Paddle Polarity

Paddle polarity confirms a positive-going QRS waveform.

#### Warning

**SHOCK HAZARD.** Always discharge the defibrillator by doing the Defib Disarm test before the Paddle Polarity test. Testing paddle polarity with a charged instrument could result in personal injury.

1. Remove the paddles from the paddle storage area.
2. Set the ECG gain to X1.0.
3. Place the paddles back-to-back with the electrodes out, pressing the left wrist against the APEX electrode and the right wrist against the STERNUM electrode.

*Note: Placing the paddles on the wrists will produce a more defined waveform, but polarity may be difficult to determine on some people. If so, be aware that the QRS waveform may appear negative-going.*

4. Check that a positive-going QRS waveform displays on the CRT.
5. Return the paddles in the paddle storage area.

### PIP-Charge Time

1. Press ▼ ENERGY SELECT ▲ to set the energy level to 360J. Place the paddles in the paddle storage area.
2. Simultaneously press CHARGE and start the stopwatch. Stop the watch when the instrument reaches full charge. Check that the charge time is less than 10s.
3. Simultaneously press paddle discharge pushbuttons to transfer the energy into the test load. Check that TEST USE 200 JOULES displays on the CRT and three tones sound.

### PIP-Discharge Control/Open Air Discharge

Open air discharges must be performed by service personnel familiar with this instrument.

#### Warning

**SHOCK HAZARD.** During open air discharges, potentially lethal voltages are present on the paddle electrodes. Hold paddles away from the body.

1. Press ▼ ENERGY SELECT ▲ to set the energy level to 360J. Press CHARGE.
2. Hold the paddles at least one foot apart and away from the body.
3. Shake the paddles and check that no discharge occurs.
4. Press the APEX discharge pushbutton and check that no discharge occurs.
5. Press the STERNUM discharge pushbutton and check that no discharge occurs.
6. Simultaneously press both discharge pushbuttons. Check that discharge occurs and the instrument continues normal operation.

### PIP-Energy Dump

1. Connect the paddles to the energy meter electrodes.
2. Press ▲ ENERGY SELECT ▼ and set the energy level to 360J.
3. Press CHARGE.
4. After the instrument charges to 360J, change the energy level to 300J.
5. Confirm that **CHARGE REMOVED** appears for 4s to 6s and three tones sound.

### PIP-Charge Reduction

1. Connect the paddles to the energy meter electrodes.
2. Press ▲ ENERGY SELECT ▼ and set the energy level to 360J. Press CHARGE.
3. When full charge is reached, immediately change the energy level to 1J and press CHARGE.
4. Confirm that full charge is reached in 20s or less after CHARGE is pressed.

**PIP-Delivered Energy**

Connect the paddles to the energy meter electrodes. Refer to Table 3-1 and confirm that the delivered energy is within tolerances for each energy level.

**Table 3-1 Delivered Energy Tolerances**

Energy Setting	Tolerance	Energy Setting	Tolerance
1J	±0.2J	10J	±1J
2J	±0.2J	20J	±2J
3J	±0.3J	30J	±3J
4J	±0.4J	50J	±5J
5J	±0.5J	100J	±10J
6J	±0.6J	200J	±20J
7J	±0.7J	300J	±30J
8J	±0.8J	360J	±36J
9J	±0.9J		

**PIP-CODE SUMMARY**

1. Press ON twice to switch instrument power off then on.
2. Place the paddles on the energy meter electrodes. Press LEAD SELECT to set the instrument to LEAD II.
3. Connect the ECG simulator to the patient cable and set for a 60bpm-NSR signal.
4. Press SYNC.
5. Press ▲ ENERGY SELECT ▼ and set the energy level to 200J.
6. Press CHARGE. When full charge is reached, simultaneously press both paddle discharge pushbuttons to transfer the energy into the energy meter.
7. Press RECORD twice to switch recorder on, then off quickly.
8. Press CODE SUMMARY.
9. Check that the recorded data matches the data shown in Figure 3-3. (The date, elapsed time, and ECG data of Figure 3-3 is representative of the actual data printed in the test sample.)

NAME	COMMENTS
CODE SUMMARY™	
CRITICAL EVENT RECORD	
19 NOV 91	
POWER ON	14:27:35
TOTAL SHOCKS	2
ELAPSED TIME	01:12:49

NAME	PRESHOCK LEAD II X1.0	POSTSHOCK LEAD II X1.0	
DEFIBRILLATION			
19 NOV 91			
SHOCK #1			14:27:35
Joules Selected			200
SYNC			
STANDARD PADDLES			

NAME	LEAD II X1.0	
RECORDED ECG		
19 NOV 91		
OPERATOR		15:31:00
HR. BPM		68
SUMMARY COMPLETED		

Figure 3-3 CODE SUMMARY Printout

**PIP-Leakage**

Check ac leakage in accordance with AAMI/ANSI standard ES1 F/1985. For 220V operation consult local guidelines.

- Lead Source/ Sink Current: 20µA or less
- Paddles: 100µA per paddle or less (typically 55µA)
- Chassis Leakage: less than 100µA (typically less than 40µA)
- Ground Resistance: 0.15Ω or less

## PIP Checklist

Name: \_\_\_\_\_

Location: \_\_\_\_\_

Date: \_\_\_\_\_

### Warning

**SHOCK HAZARD.** The defibrillator stores and delivers potentially hazardous voltages. Test and service personnel must be familiar with this instrument before performing these procedures.

- PIP-Physical Inspection       External case, controls, power cord, cables in good condition
- PIP-Battery Charge Legend       BATT CHRG legend illuminates when ac power connected
- PIP-AC Power       ON LED illuminates after pressing ON  
                                   ©1989, PCC displays for at least 5s within 10s  
                                   LEAD II, X1.0, 200 JOULES SELECTED displays
- PIP-Battery Power       Instrument stays on (BATT CHRG off) after disconnecting ac
- PIP-Keypad Test       No beep sounds when APEX discharge pushbutton is pressed  
                                   No beep sounds when STERNUM discharge pushbutton is pressed  
                                   Beep sounds when APEX and STERNUM discharge pushbuttons are pressed simultaneously  
                                   KEYPAD: OK displays
- PIP-Lead Select       All lead configurations display in reverse video (LEAD II, LEAD III, STD, PADDLES, LEAD I)  
                                   ECG signal displays on CRT in all lead configurations
- PIP-Recorder Speed/  
Baseline Centering       Distance between consecutive ECG peaks is 25mm ±1mm  
                                   Baseline centered within ±1.5mm
- PIP-ECG Display       CRT flatline is level and centered end to end, messages are visible
- PIP-1mV CAL       10mm ±0.5mm calibration pulse with less than 0.5mm overshoot
- PIP-CRT Gain/Aspect Ratio       CRT signal amplitude is 3.4cm ±0.2cm p-p  
                                   Recorded signal amplitude is 2.0cm ±0.1cm

**PIP-Heart Rate**

- \_\_\_ Systole indicator flashes, heart rate = 30bpm  $\pm$ 3bpm
- \_\_\_ Systole indicator flashes, heart rate = 60bpm  $\pm$ 3bpm
- \_\_\_ Systole indicator flashes, heart rate = 240bpm  $\pm$ 7bpm

**PIP-Rate Alarms/  
Alarm-Activated  
Record**

- \_\_\_ HR ALARM LED on and **150/40** displays
- \_\_\_ **120/60** and **160/90** displays consecutively
- \_\_\_ **150/40** displays in normal video
- \_\_\_ With ECG simulator set to 160bpm; alarm sounds, **150** flashes, and recorder runs for 16s
- \_\_\_ Recorded HR is 151bpm or higher
- \_\_\_ **160bpm  $\pm$ 5bpm** displays
- \_\_\_ Alarm stops when HR ALARM is pressed
- \_\_\_ With ECG simulator at 30bpm, HR ALARM pressed; alarm sounds, **40** flashes, and recorder runs
- \_\_\_ Alarm stops when HR ALARM is pressed

**PIP-Recorder  
Annotation**

- \_\_\_ Heart rate, time, and date annotate every 20s
- \_\_\_ Time is accurate  $\pm$ 1min
- \_\_\_ LEAD III, heart rate, time, and date annotate

**PIP-Test Load**

- \_\_\_ **TEST 200 JOULES DELIVERED** displays and records

**PIP-Sync/Sync  
Annotation**

- \_\_\_ **FOR SYNC: USE LEADS** legend flashes 5 times and, 3 tones sound
- \_\_\_ **SYNC MODE** displays on CRT, sync marker on trace SYNC LED flashes, no warning message displays, no tone sounds
- \_\_\_ SYNC and sync marker annotate on recorder
- \_\_\_ **SYNC TEST 200 JOULES DELIVERED** annotates on recorder
- \_\_\_ **SYNC MODE** display and LED are off, no sync markers visible

**PIP-Recorder/CRT  
Noise**

- \_\_\_ Less than 3mm p-p in all lead configurations
- \_\_\_ Less than 3mm p-p with paddles shorted

**PIP-Defib Disarm**

- \_\_\_ With CHARGE pressed; CHARGE LED does not light, CRT displays **0 JOULES SELECTED**

**PIP-Paddle Polarity**

<b>Warning</b>	<b>SHOCK HAZARD.</b> Always discharge the defibrillator by doing the Defib Disarm test before the Paddle Polarity test. Testing paddle polarity with a charged instrument could result in personal injury.
----------------	--

PIP-Paddle Polarity  
(continued)

\_\_\_ Positive QRS displays

PIP-Charge Time

\_\_\_ Charge time to 360J is less than 10s  
 \_\_\_ TEST USE 200 JOULES displays, three tones sound

PIP-Discharge  
Control/Open Air  
Discharge

**Warning**     **SHOCK HAZARD.** During open air discharges, potentially lethal voltages are present on the paddle electrodes. Hold paddles away from the body.

\_\_\_ No discharge when paddles are shaken  
 \_\_\_ No discharge when APEX discharge pushbutton is pressed  
 \_\_\_ No discharge when STERNUM discharge pushbutton is pressed  
 \_\_\_ Discharge when both discharge pushbuttons are pressed

PIP-Energy Dump

\_\_\_ CHARGE REMOVED displays for 4s to 6s, three tones sound

PIP-Charge Reduction

\_\_\_ Full charge in 20s or less

PIP-Delivered Energy

\_\_\_ Confirm that selected and delivered energy levels are within tolerances.

Energy Setting	Tolerance	Energy Setting	Tolerance
___ 1J	±0.2J	___ 10J	±1J
___ 2J	±0.2J	___ 20J	±2J
___ 3J	±0.3J	___ 30J	±3J
___ 4J	±0.4J	___ 50J	±5J
___ 5J	±0.5J	___ 100J	±10J
___ 6J	±0.6J	___ 200J	±20J
___ 7J	±0.7J	___ 300J	±30J
___ 8J	±0.8J	___ 360J	±36J
___ 9J	±0.9J		

PIP-CODE SUMMARY

\_\_\_ Recorded data matches data shown

PIP-Leakage

\_\_\_ Lead Source/Sink Current ( $\leq 20\mu\text{A}$ )  
 \_\_\_ Paddles ( $\leq 100\mu\text{A}$  per paddle)  
 \_\_\_ Chassis Leakage ( $< 100\mu\text{A}$ )  
 \_\_\_ Ground Resistance ( $\leq 0.15\Omega$ )



## Test and Calibration (TC) Procedures

These tests check that the LIFEPAK 9 defibrillator/monitor is operating within factory specifications. Perform the PIP after completing any of these tests.

Test and calibration, repair, and component removal should be attempted only by personnel qualified by training or experience.

### Warning

**SHOCK HAZARD.** Terminals and wires carrying high voltage are exposed with the instrument cases separated. Do not touch internal circuitry except as indicated in these procedures.

### Caution

**Avoid Component Damage.** Special handling of PCB assemblies containing static sensitive devices (SSDs) is required. Refer to page 4-4. Static sensitive devices are indicated in Section 5 parts lists with this symbol.



**TC-Servicing Guidelines** Some test and calibration procedures require opening the instrument case. Disassembly Procedures begin on page 4-4.

- Inspect the instrument for signs of damage before disassembling.
- Label each lead or draw a sketch showing the location of cables and wires before removing a PCB or mechanical assembly for repair or replacement.
- Repair procedures are discussed on page 4-12. Printed circuit boards (PCBs) that cannot be repaired in the field should be returned to Physio-Control for service.

### TC-Test Equipment

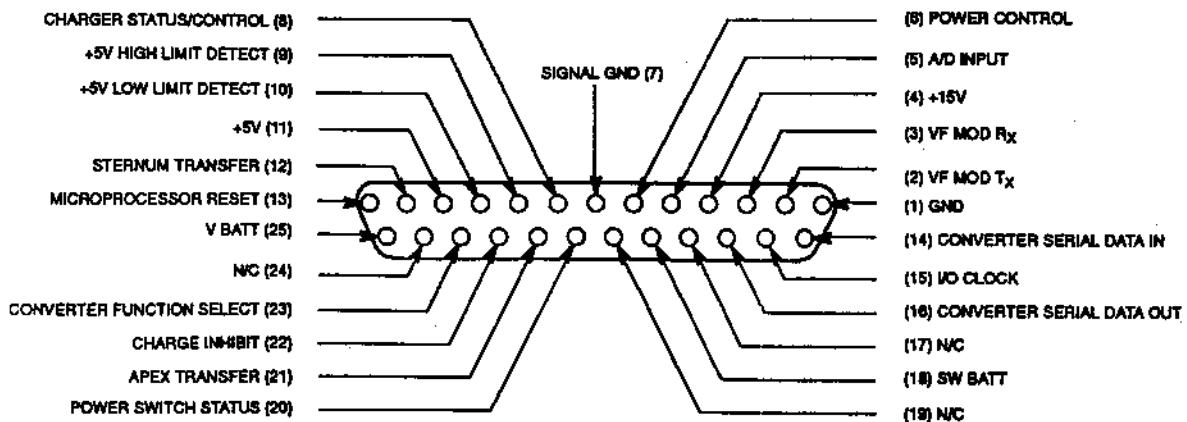
Test equipment suitable for maintenance and calibration of the LIFEPAK 9 defibrillator/monitor is listed in Table 3-2. Although specific, commercially available test instruments are recommended, test equipment with equivalent specifications may be used.

**Table 3-2 Test Equipment**

Nomenclature	Characteristics	Manufacturer
Digital Multimeter	Range: 0V to 1000V full scale 4.5 digit Accuracy: 0.5% of full scale on Vdc and resistance ranges, 1% of reading on Vac	Fluke 8050A
Energy Meter	Power range: 0J to 1000J Load resistance: 50Ω ±0.5% Accuracy: 2% of full scale for pulse width of 5ms	Electronics Unlimited DT 650A
Stopwatch	Accuracy: 0.25s	
Storage Oscilloscope	Bandwidth: dc to 100MHz Vertical sensitivity: 5mV/div to 50V/div Input impedance: 1MΩ/10MΩ Sweep range: 1μs/div to 1s/div	Tektronix model 2221
Function Generator	Frequency Range: 20-120 pulse position modulation	Krohn-Hite model 5400A
Photometer	To measure luminance in foot-lamberts	Tektronix J16 with J6503 luminance probe

**TC-Voltage Checks**

1. With the instrument off remove the front panel to access the test connector J3 on the Power Conversion PCB. See page 4-5, Front Panel Removal.
2. Connect the ground lead of the digital multimeter to pin 7 of J3. Refer to Figure 3-4.



**Figure 3-4 Test Connector J3 Pinout**

3. Turn the instrument on and check that the voltages are within the limits listed in Table 3-3.
4. Low battery operation can be checked by measuring the thresholds in Table 3-4.

*Note: Once illuminated, the LOW BATTERY: CONNECT AC POWER message will not reset until the battery voltage rises above 16.5V.*

**Table 3-3 Power Conversion PCB Voltage Checks**

Test Point	Signal Name	Nominal Voltage	Limits
Pin 4	+15V	+15.0V	±0.3V
Pin 11	+5V	+5.0V	±0.25V
Pin 9	+5V High Limit Detect	+2.25V	±0.15V
Pin 10	+5V Low Limit Detect	+2.625V	±0.125V
Pin 18	SW BATT	+18.0V	+2.0V to -2.4V
Pin 25	V BATT	+18.4V	+1.6V to -2.8V

**Table 3-4 Low Battery Thresholds**

Test Point	Function	Low Battery Limits	Shutdown Limits
Pin 25	Monitoring	+15.5V ±0.23V	+14.5V ±0.21V
Pin 25	Defib Charge	+15.0V ±0.22V	+13.5V ±0.20V

### TC-Sync and HR Alarm LED Checks

1. Press LEAD SELECT and select LEAD II.
2. Press SYNC. Check that the SYNC LED illuminates and SYNC MODE displays.
3. Press SYNC again and check that the SYNC LED and message go off.
4. Press HR ALARM. Check that HR ALARM LED illuminates and the alarm limits display on the CRT.
5. Press HR ALARM again and check that HR ALARM LED goes off.

**TC-Defib Disarm and  
CHARGE LEDs check**

1. With the instrument off, fasten the paddles to the energy meter electrodes.
2. Turn the instrument on. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 0J.
3. Press CHARGE. Check that the CHARGE LED does not illuminate and the CRT continues to display 0 JOULES SELECTED.
4. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 200J.
5. Press CHARGE and check that both the front panel and APEX paddle CHARGE LEDs flash during the charge cycle.
6. Confirm that the LEDs remain on and a tone sounds when full charge is reached.
7. Simultaneously press paddle discharge pushbuttons to transfer the charge. Check that the CHARGE LEDs go off.

**TC-Test Mode**

The LIFEPAK 9 defibrillator/monitor contains self-test software to identify problems and calibrate the instrument. To initiate test mode:

1. With the instrument power off, press and hold LEAD SELECT and HR ALARM.
2. Press ON. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appears on the CRT. This is the top-level menu (Refer to Figure 3-5).

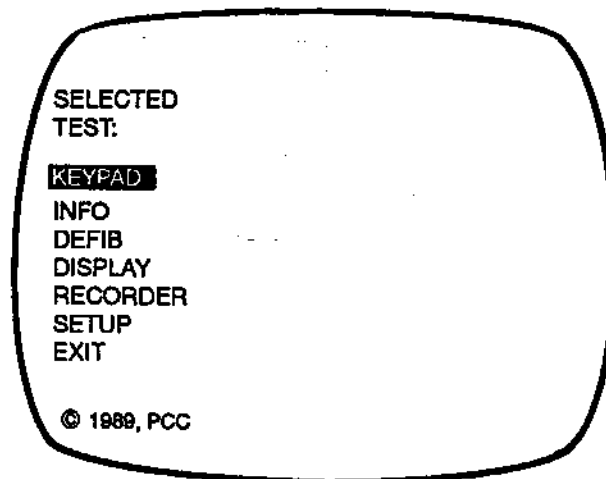


Figure 3-5 Top-Level Menu

The following front panel controls have a secondary function while the instrument is in the test mode.

**LEAD SELECT:** Press to interrupt test in progress and return to the top-level menu.

**▼ ECG SIZE ▲:** Press ▲ and ▼ to scroll through the available selections.

**HR ALARM:** Press to start test or to enter the selected option.

### TC-Defibrillator Calibration

1. With the instrument off, fasten the paddles to the energy meter electrodes.
2. Initiate test mode (refer to page 3-18).
3. Scroll to the **DEFIB** test using ▼ ECG SIZE ▲ .
4. Press HR ALARM to start the **DEFIB** test.
5. Use ▼ ENERGY SELECT ▲ to scroll to **LOW**. Select 1J.
6. Press the CHARGE pushbutton and wait until the instrument reaches full charge.
7. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the energy meter.
8. Confirm that the CRT displays the message **JOULES DELIVERED: XXX**, where XXX is the energy selected.
9. Read the value on the energy meter.
10. Use ▼ ECG SIZE ▲ to change the **JOULES DELIVERED: XXX** value until it matches the value on the energy meter.
11. Press HR ALARM to enter the adjusted value.
12. Press CHARGE and discharge the same energy level again into the energy meter. Check that the energy meter shows the selected value  $\pm 10\%$  ( $\pm 20\%$  for 1J setting).
13. Press HR ALARM to restart the **DEFIB** test.
14. Repeat steps 5 through 13 for each energy level.

#### Caution

**Avoid Energy Meter Damage.** Start each test at the lowest energy level to avoid overheating the energy meter. Test each energy level in successive order.

## TC-Test Load Calibration

**Note:** Complete Defibrillator Calibration before calibrating the test load.

1. Place the paddles in the paddles storage area of the instrument.
2. Turn off the instrument and initiate test mode (see page 3-18).
3. Scroll to the DEFIB test using ▼ ECG SIZE ▲.
4. Press HR ALARM to start the DEFIB test.
5. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 200J.
6. Press the CHARGE pushbutton.
7. After the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the test load.
8. When the CRT displays JOULES DELIVERED: 200, press HR ALARM.
9. Press LEAD SELECT to return to the top-level menu.
10. Select EXIT to resume normal operation. Select STD lead.
11. Press the CHARGE pushbutton. After the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the test load.
12. Check that the CRT displays TEST 200 JOULES DELIVERED.
13. Confirm that the recorder prints the time and date followed by TEST 200 JOULES DELIVERED.

## TC-Charge Time

1. Place the paddles in the paddles storage area of the instrument.
2. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
3. Simultaneously press CHARGE and start the stopwatch.
4. Check that the charge time is less than 10s.
5. Simultaneously press the paddles discharge pushbuttons to transfer the energy into the test load.

**TC-Charge Reduction**

1. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
2. Press the CHARGE pushbutton.
3. After the instrument reaches full charge, quickly select 1J delivered energy.
4. Simultaneously press the CHARGE pushbutton and start the stopwatch.
5. Confirm 1J is reached in less than 20s.
6. Simultaneously press the paddles discharge pushbuttons to transfer the energy into the test load.

**TC-Energy Dump**

1. Connect the paddles to the energy meter electrodes.
2. Use ▼ ENERGY SELECT ▲ to set the energy level to 360J.
3. Press the CHARGE pushbutton.
4. Change the energy level to 300J. Check that **CHARGE REMOVED** flashes for 4s to 6s.

**TC-Output Waveform**

1. Fasten the paddles to the energy meter electrodes.

*Note: The pulse polarity is positive with the APEX paddle on the right electrode of the energy meter.*

2. Connect the oscilloscope to the BNC connector on the energy meter.
3. Set the oscilloscope to 0.5V/div, 1ms/div, + slope, and dc trigger.

*Note: 0.5V on the oscilloscope = 10A defibrillator output.*

4. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
5. Press CHARGE.
6. When the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the energy meter.

7. Check that the waveform meets the following specifications. Refer to Figure 3-6.

Peak current	= 45A to 65A peak
Time above 50%	= 2.10ms to 4.20ms
Time above 10%	= 3.10ms to 9.20ms

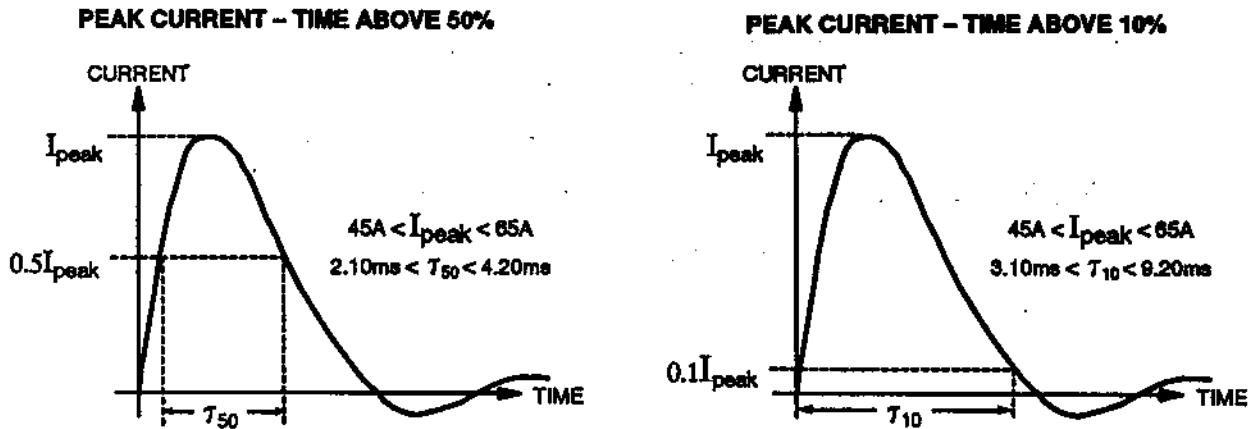


Figure 3-6 Output Waveform

**TC-Display Calibration**

The following paragraphs describe the calibration procedure for the Display Assembly PCB. Perform the tests in a dimly-lit room. Figure 3-7 shows the location of all Display Assembly PCB potentiometers.

1. Separate front and rear cases to adjust the potentiometers. See page 4-6, Case Separation.

**Warning**

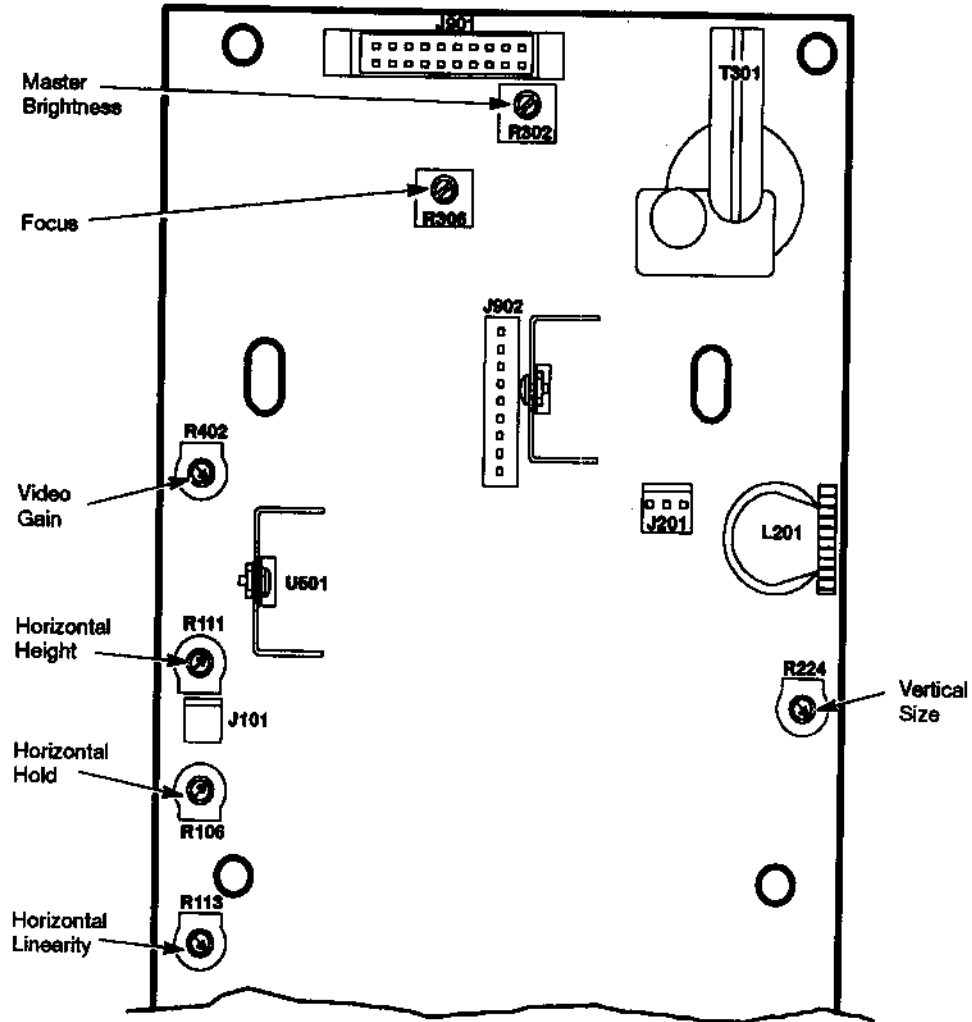
**SHOCK HAZARD.** The Display Assembly produces high voltages. Do not make contact with the CRT anode connector or the CRT bias generator circuitry when the instrument is on.

**Warning**

**FLYING GLASS HAZARD.** The CRT is made of glass and contains a vacuum which may implode if broken. Handle with care and wear safety glasses when removing the CRT from the Display Assembly PCB.



**Warning**                      **SHOCK HAZARD.** Dangerous voltages are present on the pins of R302 and R306. Use an insulated screwdriver for adjustment.



**Figure 3-7** Display Assembly PCB Potentiometer Locations

2. Reconnect ac input cord. Reconnect J1 on the front panel.

*Note: Reroute J1 ribbon cable underneath C32 on the Power Conversion PCB to prevent strain on the capacitor during the following tests.*

3. Press ON. Adjust R302, Master Brightness, until the vertical raster lines are visible behind the characters.
4. Adjust R106, Horizontal Hold, approximately 1/8 turn past the point where the horizontal rolling stops.
5. Turn the instrument off, then initiate test mode (see page 3-18) and select DISPLAY.
6. Use HR ALARM to start the DISPLAY test.
7. Select the PATTERN test using ▼ ECG SIZE ▲.
8. Adjust: R224, Vertical Size; L201; and R111, Horizontal Height, to obtain a display pattern that fills most of the screen.
9. Loosen the screw holding the yoke clamp.
10. Rotate the yoke until the display pattern is level.
11. Tighten the screw and check that the display pattern is still level.
12. Adjust the yoke rings to center the display pattern on the CRT.
13. Adjust R224, Vertical Size, for a display pattern grid height of 73.7mm  $\pm$ 2.5mm. Adjust L201 to make each box of the display pattern the same height.

*Note: The adjustments of R224 and L201 are interactive. Repeat the preceding step until both measurements are correct.*

14. Adjust R402, Video Gain, fully counterclockwise.
15. Turn the instrument off and allow the CRT to cool down for approximately 10min. Initiate test mode and select the DISPLAY pattern test.

### Warning

**SHOCK HAZARD.** Potentially dangerous voltages are present on the pins of R302 and R306. Use an insulated screwdriver for adjustment.

16. Adjust R302, Master Brightness (background), counterclockwise just until the raster disappears. Adjust R302 counterclockwise approximately 1/16 turn more. Turn the instrument off.

17. Initiate test mode and select the **DISPLAY** pattern test. Turn R402, Video Gain, clockwise until the normal display intensity is visible.

*Note: Raster will not reach normal intensity if R302 is turned too far counterclockwise.*

18. Adjust R111, Horizontal Height, for an overall pattern width of  $106.7\text{mm} \pm 2.5\text{mm}$ . Adjust R113, Horizontal Linearity, so that each box is the same width.

*Note: The adjustments of R111 and R113 are interactive. Repeat the above step until both measurements are correct.*

19. Adjust R402, Video Gain, for a dim display. Adjust R306, Focus, for maximum sharpness of the display characters.
20. Adjust the yoke rings to center the test pattern on the CRT within 2.5mm. Using a piece of recorder paper, confirm that the difference in height of the right side to the left side of the test pattern is less than or equal to 1.5mm. Check that the difference in width from the top to the bottom is less than or equal to 2.1mm.
21. Adjust R402, Video Gain, clockwise until the normal display intensity is visible.

*Note: When the case is installed, magnetic interference from the Power Supply PCB may offset the display horizontally. Return to display mode and rotate yoke rings to center display.*

### TC-Power Supply Calibration

1. Separate front and rear cases to reach R23. See page 4-6, Case Separation. Reconnect the battery to the instrument.

*Note: The Power Supply compensates for temperature fluctuations. The instrument must be powered-on for at least 30min prior to calibration so the temperature around thermistor RT2 stabilizes.*

2. Connect the digital multimeter between the positive and negative battery terminals.
3. Connect the ac power cord and press ON. Adjust R23 for  $+18.4V \pm 1\%$ .

### TC-Recorder Calibration

1. Initiate test mode (see page 3-18).
2. Select the RECORDER test.
3. Select the PATTERN test.

*Note: During this calibration procedure the printhead dot intensity is decreased to prevent damage to the printhead and drive roller. Consequently, print legibility may range from light to invisible.*

4. Rotate R176, Paper Out Sense, on the Main PCB, fully clockwise. See Figure 3-8 for potentiometer locations.
5. Place a roll of paper in the Strip Chart Recorder.
6. Press RECORD. Check that the recorder does not run.
7. Rotate R176 counterclockwise while pressing RECORD. Adjust R176 just to the point where the recorder turns on and stays on. Note the position of the potentiometer. This procedure may need to be repeated to determine the turn-on threshold.
8. Remove the paper from the recorder. Close the recorder doors.
9. Rotate R176 counterclockwise while pressing RECORD. Adjust R176 just to the point where the recorder turns on and stays on. Note the position of the potentiometer.
10. Adjust R176 to midpoint between the positions noted in steps 7 and 9.
11. Confirm that the recorder only runs when paper is loaded.

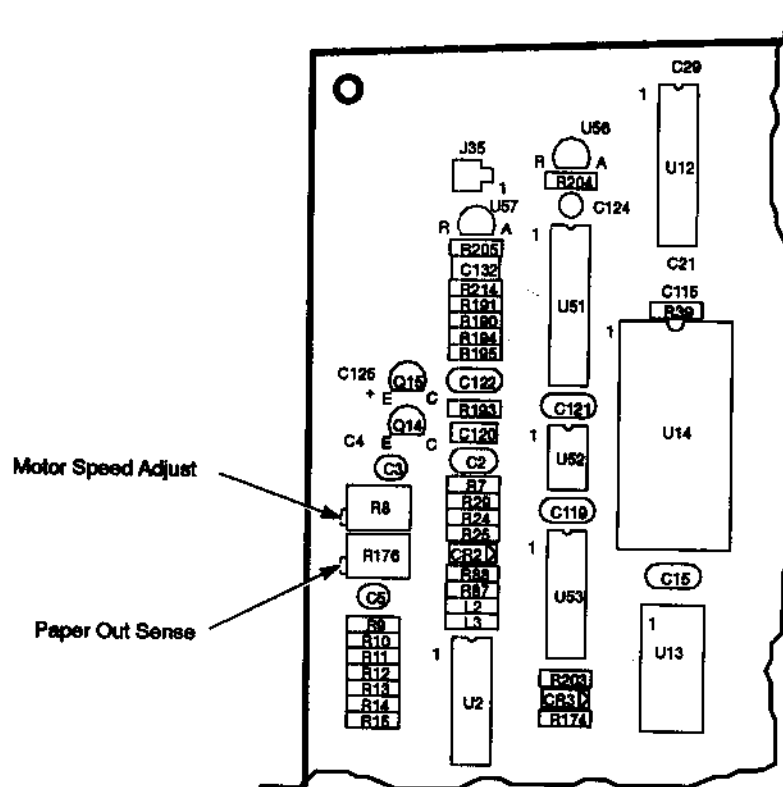


Figure 3-8 Main PCB Recorder Calibration

12. Select the **MOTOR SPEED** test.
13. Press **RECORD**. Check that the recorder produces a test pattern of bars that align with the paper grid when the motor speed is correctly adjusted. The bars may create a pattern of light and dark areas. Adjust R8, Motor Speed Adjust, on the Main PCB until these light and dark areas disappear.
14. Confirm that the period of the recorder sawtooth waveform is  $25\text{mm} \pm 1\text{mm}$ . Adjust R8 if necessary.

**TC-Recorder  
Frequency Response**

1. Turn off the instrument. Initiate test mode (see page 3-18).
2. Select **SETUP** and then **RECORDER**. Select the **DIAG** option. Press **HR ALARM** to enter option change.
3. Press **LEAD SELECT** to return to the top-level menu and select **EXIT** to resume normal operation.

4. Press LEAD SELECT to set the instrument to LEAD II. Press ▼ ECG SIZE ▲ for X1.0 gain.
5. Connect the function generator to the patient cable input using the test signal setup shown in Figure 3-9.

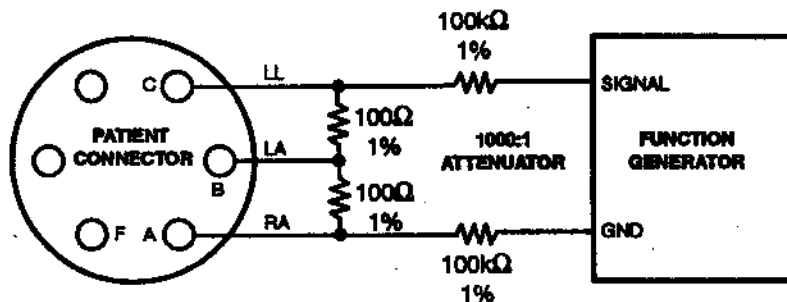


Figure 3-9 Test Signal Setup

6. Set the function generator for a 1V, 10Hz sinewave. Press the RECORD pushbutton to start the recorder.
7. Sweep the function generator from 0.05Hz to 0.5Hz and check that the recorded trace is between 7mm p-p and 10.5mm p-p.
8. Sweep the function generator from 0.5Hz to 60Hz and check that the recorded trace is between 9mm p-p and 10.5mm p-p.
9. Sweep the function generator from 60Hz to 100Hz and check that the recorded trace is between 7mm p-p and 10.5mm p-p.
10. Increase the frequency to 110Hz and check that the recorded trace is less than 7mm p-p.
11. Turn the instrument off then initiate test mode. Select SETUP and switch the LEADS NOTCH to YES. Press HR ALARM to enter the option change. Exit test mode.
12. Set the instrument to LEAD II. Set the function generator sinewave to 1V and match the input line frequency (50Hz or 60Hz).
13. Press RECORD. Check that the recorded trace is less than 1mm p-p.
14. Turn off the instrument then initiate test mode. Select SETUP and switch the RECORDER option to MON. Switch LEADS NOTCH to NO. Press HR ALARM to enter the option change. Exit test mode.

15. Set the function generator for a 1V, 10Hz sinewave.
16. Press LEAD SELECT to set the instrument to LEAD II.  
Press ▼ ECG SIZE ▲ to set the gain to X1.0.
17. Press RECORD. Sweep the function generator from 1Hz to 40Hz and confirm the recorded trace is 7mm p-p minimum.

### TC-CRT Frequency Response

1. Press ▼ ECG SIZE ▲ to increase the ECG gain to X1.4.
2. Connect the function generator to the patient cable using the test signal setup shown in Figure 3-9, page 3-28.
3. Set the function generator for a 1V, 10Hz sinewave.
4. Decrease the frequency to 1Hz. Confirm that the trace displayed on the CRT is 1.9cm p-p  $\pm 0.2$ cm.
5. Increase the frequency to 40Hz. Confirm that the trace displayed on the CRT is 1.9cm p-p  $\pm 0.2$ cm.
6. Disconnect the function generator.

### TC-ECG Output (when applicable)

1. Use LEAD SELECT to select LEAD II.
2. Connect the function generator to the patient cable. Input 1mV, 10Hz sinewave.
3. Connect a 1/4in phone plug to ECG output (on the rear panel of the instrument) and the oscilloscope to the phone plug.
4. Use ▼ ECG SIZE ▲ to set the gain to X1.0.
5. Check that a 1Vp-p  $\pm 0.15$ Vp-p sinewave shows on the oscilloscope.

### Error Codes

The LIFEPAK 9 defibrillator/monitor contains self-diagnostic software. When a failure is detected during the self-test, the **SERVICE** legend illuminates. For many failures, an error code is generated and displayed in the **INFO** menu.

To access the **INFO** menu, initiate test mode (see page 3-18). Use ▼ ECG SIZE ▲ and select **INFO**. The error code is listed after **FAULT STATUS**.

Refer to Table 3-5 for the software or circuit failure associated with each error code.

**Table 3-5 Error Codes**

<b>Error Code</b>	<b>Software or Circuit Failure</b>
1	Watchdog hardware failure (fast test)
2	Watchdog hardware failure (slow test)
3	Unknown transfer code
4	Unknown watchdog code
5	Recorder motor stalled/paper jam
6	SAS Adapter fault
7	System RAM test failure (U28)
8	System microprocessor RAM failure (U30)
9	System controller ROM failure (U27)
10	Critical ROM failure (U27)
11	Display interface RAM failure (U13)
12	Display/recorder microprocessor RAM failure (U1)
13	Display interface ROM failure (U14)
14	D/A converter CRC failure
15	Transfer switching failure (Q4,CR4)
16	Transfer enable stuck on
17	Charge reference out of tolerance
18	Preamp baseline out of tolerance
19	Clock failure
20	+5V supply out of tolerance
21	+15V supply out of tolerance
22	Defib cal factors out of tolerance
23	A/D converter (U9) self-test failure
24	Recorder printhead resistance out of tolerance





# Service and Maintenance

4

## Introduction

This section provides the following information:

- Battery Maintenance
- General Maintenance
- Disassembly Procedures
- Inspection Techniques
- Tools and Materials for Cleaning and Repair
- Cleaning Procedures
- Printed Circuit Repair Techniques
- Shipping Assembly.

Before servicing or repairing the instrument: become familiar with the information in this section; examine the instrument (see Inspection Techniques beginning on page 4-9); identify components, assemblies, and wire and cable harnesses using Section 5.

## Battery Maintenance

The LIFEPAK 9 defibrillator/monitor contains sealed lead-acid batteries. The life expectancy of lead-acid batteries depends primarily on temperature and use. They generally last two years.

### Warning

#### **POTENTIAL BATTERY DEPLETION DURING MONITORING.**

Use ac power for long-term patient monitoring. Using battery power for long-term monitoring decreases the stored battery charge and the available defibrillator discharges until the battery is recharged.

Batteries perform best when kept fully charged (charged for at least 24hrs). The batteries provide useful (not 100%) operating time after three hours of charging, but they should not be used in this manner on a routine basis.

### Warning

**POTENTIAL INSTRUMENT SHUTDOWN.** When the **LOW BATTERY: CONNECT AC POWER** message appears, connect the instrument to ac power for continuous operation and to recharge the battery. The message indicates that the battery is approaching full discharge and the instrument will soon shutdown.

### Caution

**Potential Battery Depletion.** Do not routinely operate the instrument after **LOW BATTERY: CONNECT AC POWER** displays. This discharges the battery to its reserve capacity and shortens battery life. Connect the instrument to ac power whenever possible to keep battery charged.

### Recharging Batteries

The internal batteries will continually charge when the instrument is connected to an ac power source, even with power off. Charge the batteries and operate the instrument at normal room temperature (25°C, 77°F) for optimum battery performance. Ambient temperatures greater than 40°C (129°F) may adversely affect battery life.

When not in use or during long periods of storage, connect the LIFEPAK 9 defibrillator/monitor to ac power. If this is not possible, fully charge the batteries before storage and again before use. Store at ambient room temperature.

### Recycling Batteries

In the United States, recycle battery packs locally according to national, state, and local regulations when batteries are no longer useful. If local recycling is not possible, contact Physio-Control customer service specialists at 1-800-442-1142 for information on returning battery packs.

Outside the United States, recycle battery packs according to local regulations, if possible. Otherwise, contact the local Physio-Control representative for information on returning battery packs.

Use the battery recycling shipping container listed in Table 5-4, page 5-5.

*Note: Battery packs manufactured after July, 1991 are labeled with recycle symbol.*



## General Maintenance

The following paragraphs contain routine maintenance procedures that can be performed either by an experienced operator or a technician.

### Power Source, AC or DC Operation

To operate on ac-line power, plug the ac power cord of the instrument into a three-pin grounded ac power source. Do not use a free-ground adapter. The instrument operates on ac power whenever it is plugged in as described and the ON LED is illuminated.

To operate the instrument on the internal dc battery source, disconnect the ac power cord from the ac power source. Press ON. When the instrument is connected to a proper ac power source, even with the ON pushbutton off, the internal batteries continually charge.

### Strip Chart Recorder

Maintenance on the Strip Chart Recorder consists of loading paper and cleaning. Parenthetical numbers refer to parts shown in Figure 5-11, page 5-64.

The message **NO PAPER** will appear when the recorder paper runs out.

### Caution

**Prevent Printhead Damage.** Use only Physio-Control printer paper (PN804700) Do not run the recorder without paper. Do not use waxed paper as this can damage the printhead.

### Loading Paper

1. Pull the latch (14) up and remove the empty paper spool.
2. Insert the new paper roll with the grid facing toward the front. Pull up a 2-inch length of paper.
3. Push the door (7) forward and the latch down until it latches.

### Cleaning

Clean the printhead and paper-out sensor periodically to remove paper dust and debris. At a minimum, clean after every 100 rolls of use. Perform these steps for cleaning:

1. Pull up the latch (14) and remove the paper roll.
2. Gently wipe the surface of the printhead and paper sensor with a cotton swab soaked in isopropyl alcohol. When cleaning the printhead, touch the printhead *only with the cotton swab*, not with your fingers.

### Protecting Printouts

Protect thermal paper printouts by following these guidelines:

- Do not apply tape or other adhesives over annotations or tracings on the front side of the paper. Apply adhesives only to the *back* of the paper.
- Do not store printouts in plastic folders. Store printouts in *paper* folders.
- Avoid extended exposure to sunlight, temperatures above 27°C (81°F), or humidity above 70 percent.

### Fuse Replacement

The fuses are located in the rear panel of the instrument.

1. Place a thin, flat-blade screwdriver in the recessed area under the retaining tab of the fuse holder. Twist the screwdriver to release the retaining tab.
2. Pull the fuse holder out. Replace fuses with the same type, voltage rating, and current rating. Refer to the parts list (pg. 5-9, item 16).

## Disassembly Procedures

These steps are a logical sequence for disassembling the major assemblies of LIFEPAK 9 defibrillator/monitor. Separate or disassemble only to the extent required. Parenthetical numbers refer to item numbers in the final assembly parts list (beginning on page 5-6), and Figure 5-1 (pg. 5-13). Figure 4-2 (pg. 4-7) shows "J" connector locations. Assembly procedures are the reverse unless otherwise noted.

### Warning

**SHOCK HAZARD.** Disconnect the ac power cord and remove the battery pack before disassembly.


### Caution

**Potential Component Damage.** This instrument contains static sensitive devices (SSDs). Use the following special handling procedures for SSDs. SSDs are indicated in Section 5 with this symbol:



### Special Handling for Static Sensitive Devices

Static discharge damages semiconductor devices such as MOS ICs, FETs, optical isolators, and film resistors. Static charges build up on the body and transfer to an object when touched. This discharge can damage or destroy static sensitive devices (SSDs) without the handlers knowledge. To prevent damage when working with the instrument open, note the following:

- SSDs are identified in the Section 5 parts list with this symbol: 
- Wear a conductive wrist strap attached to a static dissipating mat that is connected to earth ground.
- Keep static-generating products such as styrofoam cups or trays away from the work area.
- Transport PCBs inside labeled conductive bags.
- Label static SSDs before storing.

### Battery Pack Removal

1. Open and remove the battery door (13) at the bottom of the instrument (Figure 5-1).
2. Remove the battery pack (2).
3. Free the battery pack by pressing the locking tab on the battery harness and separating the two connectors.

### Front Panel Removal

1. Press in on the right edge of the front panel (A6) as shown in Figure 4-1 (arrow A).
2. While pressing the edge, push out (arrow B) until the right edge of the front panel releases.
3. Slide the front panel to the right slightly (arrow C) until the left tab clears the front case (5).
4. Place fingers under the released edge and pull the front panel away from the instrument (arrow D).
5. Press the quick-release levers and disconnect J20 from the front panel.

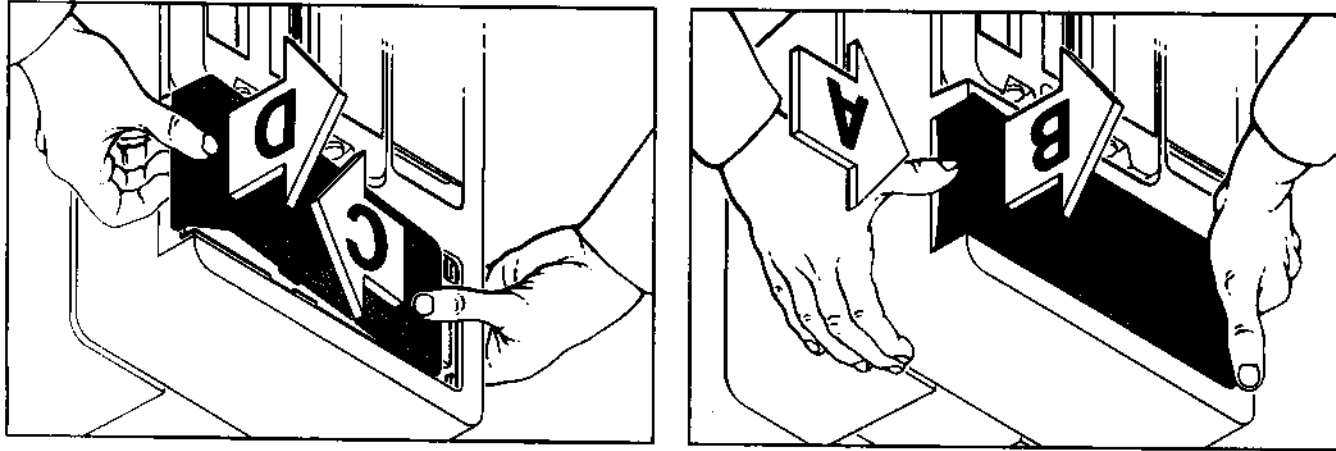


Figure 4-1 Front Panel Removal

Strip Chart Recorder  
Removal

1. Pull the upper edge of the top door to open the recorder (A8). See Figure 5-1.
2. Remove the paper roll.
3. Push down the paper carrier and remove the two screws (40) at the rear of the paper housing.
4. Grasp the recorder at the bottom then pull down and away from the instrument.

## Case Separation

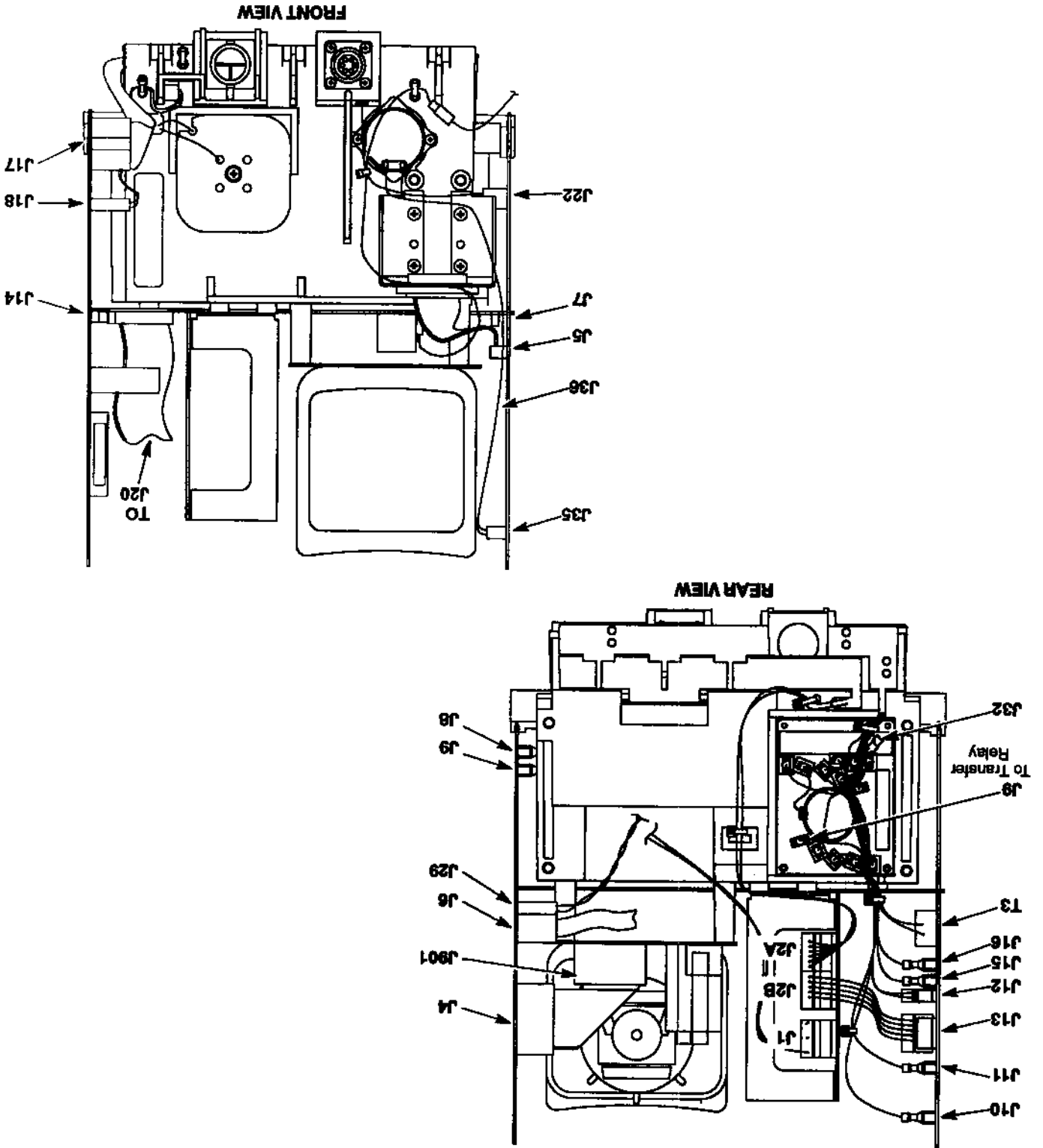
1. Remove the battery pack, front panel, and strip chart recorder.
2. Turn the paddles connector counterclockwise then pull to disconnect. Remove the paddles.
3. Remove three screws (40) from the bottom of the instrument, four screws (40) from the rear panel (31), and two screws (40) from the handle (see Figure 5-1).
4. Pull the front case (5) forward and disconnect J36 (see Figure 4-2, page 4-7) located on the Interconnect PCB.
5. Pull the chassis away from the rear case (6).

Power Conversion  
PCB Removal

## Complete Case Separation.

1. Disconnect J17 and J18 (see Figure 4-2, page 4-7), located on the Power Conversion PCB (A3).
2. Push the Interconnect PCB (A5) locking tabs up to clear the notches in the Power Conversion PCB.
3. Pull the Power Conversion PCB away from the Interconnect PCB to disconnect J14 and lift the Power Conversion PCB out of the board guide.
4. Disconnect J10 through J13, then J15 and J16.
5. Remove four screws (40) from the rear panel (31) and free the rear panel from the chassis (7). See Figure 5-1.
6. Disconnect J32 (wire labeled 2, goes to wave shaping inductor) and J9 (wire labeled 1 goes to Transfer Relay, A9).

Figure 4-2 Connector Locations





**Main PCB Removal**

Complete Case Separation.

1. Press down the quick-release levers and disconnect J4 and J5 (refer to Figure 4-2, page 4-7).
2. Disconnect J6, J29, and J22 on the Main PCB (A1).
3. Push the Interconnect PCB (A5) locking tabs up off of the notches in the Main PCB.
4. Pull the Main PCB away from the Interconnect PCB to disconnect P7 and lift the Main PCB out of the board guide.
5. Disconnect J8 and J9.

**Display Assembly Removal**

Complete Case Separation.

1. Press down the quick-release levers and disconnect J901 (refer to Figure 4-2, page 4-7) on the Display Assembly (A4).
2. Remove four screws (40) to remove the Display Assembly (see Figure 5-1).

**Power Supply Removal**

Complete Case Separation.

1. Disconnect J1 (see Figure 4-2, page 4-7) on the Power Supply PCB (A2).
2. Remove four screws (40) from the rear panel (31) and remove the rear panel (see Figure 5-1).
3. Disconnect J2(A and B) on the Power Supply.
4. Remove four screws (40) from the Power Supply and detach from chassis (7).

**Interconnect PCB Removal**

Complete Case Separation.

1. Remove the Power Conversion PCB, the Main PCB, the Display Assembly, and the Power Supply PCB.
2. Remove four screws (40) from the Interconnect PCB (see Figure 5-1).

## Inspection Techniques

When servicing or repairing the instrument, routinely begin with a visual inspection of the hardware and components for signs of damage. Signs of damage require further inspection of the surrounding area for peripheral breakage or damage.

### Exterior Inspection

Visually inspect the entire instrument for wear, corrosion, deterioration, and damage resulting from extreme temperatures or dropping. Lift and hold the instrument upside down while listening for loose hardware.

### Interior Inspection

Table 4-1, Inspection Techniques, lists the major hardware components of the instrument, possible problems associated with each item, and recommended corrective actions.

**Table 4-1 Inspection Techniques**

Hardware	Problem	Corrective Action
Chassis, covers, and brackets	Warped, bent, damaged surfaces, or missing hardware	Replace
Components (mechanical and electrical)	Loose mountings	Repair
	Broken or damaged leads	Replace
	Deterioration or leakage	Replace
Connector pins	Bent	Straighten (if slight)
	Loose or corroded	Replace
Nameplate, labels, and decals	Not legible	Replace
PCB surfaces	Charred, cracked, or brittle	Replace PCB
<p><i>Note: Due to high operating temperatures of certain components, the PCB surface may show some degree of discoloration.</i></p>		
Screws and nuts	Loose or cross-threaded	Tighten or replace
Terminals and connections	Installed incorrectly	Install correctly
	Lost or worn	Replace
	Failed solder connections	Resolder (if not damaged) or replace
Wire insulation and tubing	Deteriorated, worn, pinched, or damaged	Replace

## Tools and Materials for Cleaning and Repair

Table 4-2 lists recommended tools, materials, and chemicals required for cleaning and repair activities. Although specific items are recommended, tools and materials with specifications equivalent to those listed may be used.

Table 4-2 Tools and Materials for Cleaning and Repair

Description	Product
Static-protected work area	Electronic Supply Dealers
Grounded conductive surface and wrist strap	
	X-32B and Xersin® 2005
Low flux, no cleaning necessary	
(Refer to PCB Component Replacement, page 4-13 for correct solder choice.)	Multicore
	Westbury, NY 11590
Adhesive	5-Minute® Epoxy
	Devcon
	Danvers, MA 01923
Adhesive and 710 accelerator	Tak Pak®
	Loctite
	Newington, CT 06111
Desoldering tool model AS196	Silverstat Soldapull®
	Edsyn
	Van Nuys, CA 91406
	Crocus cloth
	Isopropyl alcohol
	Acid brush
	Cotton swabs
	Vacuum cleaner
	Soft-bristle brush
Nonmetallic	
Clean and lint-free	Cloth
Clean and dry (60psi, max.)	Compressed air

Note: ® This symbol indicates a registered trademark.

**Cleaning Procedures**  
**External Cleaning**  
Clean the instrument after maintenance, disassembly, or any repair procedure.  
Clean the instrument case, cables, and screen with mild soap and water. Use only a damp sponge or towel to clean.

**Warning**  
**SHOCK OR FIRE HAZARD.** Do not immerse any portion of the instrument in water. Fluid spills and splashes may damage electrical components.

**Warning**  
**SHOCK HAZARD FROM ACCUMULATED GEL.** Clean the instrument paddles after each use.

**Caution**  
Possible Instrument Damage. Do not autoclave the instrument.

**Interior Cleaning**  
Follow disassembly procedures (beginning page 4-4) to access instrument interior.

**Warning**  
**SAFETY HAZARD.** Ventilate work area when using solvents. Observe manufacturer warnings regarding personnel safety and emergency first aid. Keep first aid equipment available when using chemicals.

**Warning**  
**CHEMICAL FIRE HAZARD.** Observe shop safety and fire precautions. Store solvents and solvent-soaked rags in approved containers. Refer to manufacturers instructions on containers for recommended firefighting procedures. Keep firefighting equipment available.

**Caution**  
Possible Component Damage. This instrument contains static sensitive devices (SSDs). Use special handling procedures, page 4-4.

### Printed Circuit Repair Techniques

- Refer to Table 4-1 and follow corrective actions if necessary.
- Before removing an assembly for repair or replacement, label each lead or draw a sketch showing the location of cables and wires. Refer to Section 5 for details on wire and cable routing as well as assembly interconnection.

**Note:** Damaged assemblies may be returned to Physio-Control for repair or replacement. Customer repair of an instrument under warranty may void the warranty.

These repair procedures provide an alternative to replacing the assembly.

4. Clean surfaces of plastic parts with a mild soap and water solution. Dry with a clean cloth.
5. Clean soldering surfaces with a nonmetallic, soft-bristle brush dipped in isopropyl alcohol then wipe with absorbent cloth. Air dry 10 minutes or use low pressure compressed air before soldering.

**Caution**  
Possible Equipment Damage. Do not use solvents to clean plastic parts.

3. Wipe surfaces of nameplates and labels with a clean, dry cloth.

**Caution**  
Prevent Nameplate Damage. Do not use abrasive cleaners or solvents to wipe nameplates and labels.

2. Wipe metal surfaces with a soft, nonabrasive cloth dampened with isopropyl alcohol.
1. Brush surfaces and parts with a nonmetallic soft-bristle brush. Remove loosened dirt and dust using dry low pressure compressed air (60psi) or a vacuum cleaner.

**Caution**  
Possible Component Damage. Do not use solvents to clean transformers or inductors.

### Pcb Component Replacement

If replacing damaged or failing components observe the following:

**Caution**  
Possible Pcb Damage. Only skilled or trained personnel should attempt to solder or repair printed circuit boards.

- Some PCBs contain surface-mount components that require specialized equipment and techniques for replacement.
- Two types of solder are preferred because the flux residue is nonconductive and does not require cleaning: X-32B and Xersin 2005. Use X-32B on PCBs, and Xersin 2005 when connecting large surfaces to relatively small surfaces (e.g., connecting a wire to a transformer tab).

**Caution**  
Possible Component Damage. Use a heat sink when soldering semiconductor components. Apply the minimum heat necessary to properly solder components to PCBs.

- The soldering iron tip rating must not exceed 371°C (700°F). Use the minimum heat necessary to melt the solder and form a reliable solder joint. Use a solder vacuum for solder removal.

**Caution**  
Possible Component Damage. Install polarized components correctly. Do not repeatedly bend wires or component leads.

- Observe proper polarity before soldering polarized components in place. Refer to transistor indexing, tab positions, diode markings, and capacitor polarities illustrated on the component layout in Section 5.
- If replacing an electrically isolated heat-sink-mounted component, check isolation between the component tab and the heat sink with an ohmmeter before soldering the leads.

### Pcb Repair

Physio-Control recommends returning PCBs for repair or replacement. Multilayer PCBs contain alternate layers of conductive patterns and insulating material bonded together and interconnected with plated-through holes. The internal layers and connection points are quickly damaged by heat, rendering the entire PCB useless.

## Shipping Assembly

Save the original shipping box and packing for the LIFEPAK 9 defibrillator/monitor. If the instrument must be shipped to the service center or factory, the special packaging is required to prevent shipping damage. Refer to Figure 4-3 when packing.

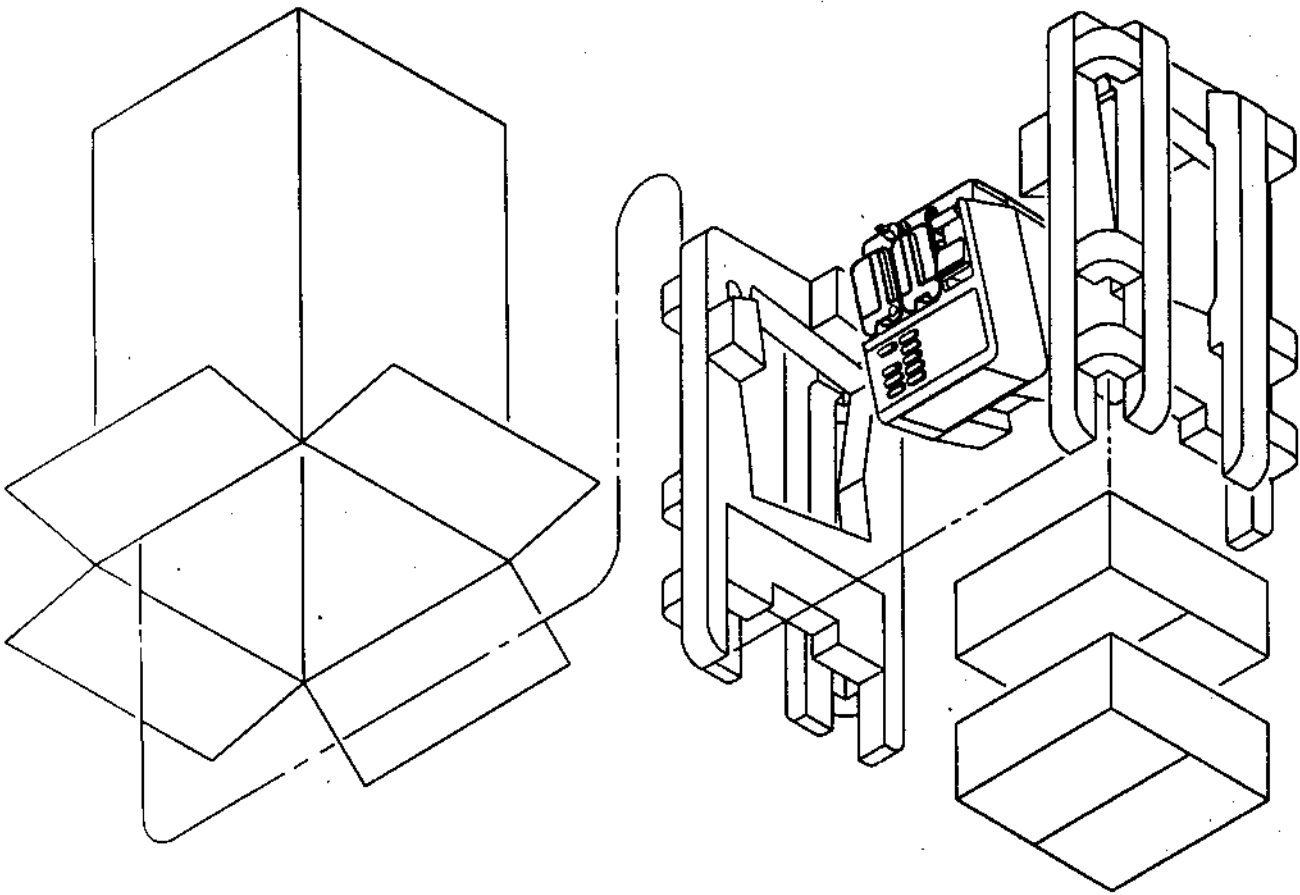


Figure 4-3 LIFEPAK 9P defibrillator/monitor Shipping Assembly

LIFEPAK 9 defibrillator/monitor

**Part No.** \_\_\_\_\_

**Serial No.** \_\_\_\_\_

**Trademarks**

PHYSIO-CONTROL<sup>®</sup>, LIFEPAK<sup>®</sup>, FAST-PATCH<sup>®</sup>, LIFE-PATCH<sup>®</sup>, QUIK-LOOK<sup>®</sup>, DERMA JEL<sup>®</sup>, Shock Advisory System<sup>™</sup>, CODE SUMMARY<sup>™</sup>, and PARTSLINE<sup>™</sup> are trademarks of the Physio-Control Corporation, 11811 Willows Road N.E., PO Box 97006, Redmond, WA 98073-9706.

**Warranty**

Refer to the product warranty statement included in the accessory kit shipped with the product. Duplicate copies may be obtained in the USA by calling the Physio-Control PARTSLINE at 1-800-442-1142. Outside the USA, contact your local Physio-Control sales or service office.





**Use Code:** Different hardware configurations and their corresponding letter codes are listed at the beginning of each parts list. 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.

### Component Layouts or Exploded Views

Use component layouts or exploded views to locate parts. The reference designator or assigned item number is listed in the REF column number on the parts list.

### Schematic Diagrams

Schematic diagrams depict circuit function and signal flow. Signal names, pin numbers, and polarities are labeled on the schematics as well as reference designators and values from the parts list.

- Signal flow is generally from left to right
- Circuit names on schematics correspond to descriptions in Section 1
- ICs marked with \* are detailed in Section 6
- To/From labels refer signals to the interconnect diagram.

---

## How to Order Parts

When ordering from Physio-Control Corporation call the toll free PARTSLINE number (1-800-442-1142). Give the instrument part number and serial number located on the bottom panel of your instrument. Then specify all part numbers, reference designations, and descriptions. Different parts may be substituted by Physio-Control to reflect modifications and improvements of instrument circuitry.

Table 5-1 Major Assemblies

Ref	Part Number	Nomenclature	Fig. No.	Page No.
REF	803800	LIFEPAK 9 defibrillator/monitor	5-1	5-13
		Interconnect Diagram	5-2	5-14
A1	803715	Main PCB Assembly ▲	5-3	5-24
A2	803726	Power Supply PCB Assembly	5-4	5-32
A3	803724	Power Conversion PCB Assembly ▲	5-5	5-41
A4	803706	Display Assembly	5-6	5-46
A5	803761	Interconnect PCB Assembly ▲	5-7	5-57
A6	803745	Front Panel Assembly	5-8	5-60
A7	803741	Rear Panel Membrane Switch	5-10	5-62
A8	804189	Strip Chart Recorder Assembly ▲	5-11	5-64
A9	800240	Transfer Relay Assembly	5-12	5-66
A10	802901	Paddle Assembly	5-13	5-67
A11		Chassis/Harness Assembly	N/A	N/A
W1	803783-18	Power Supply PCB/AC Receptacle/Ground Wire Harness	5-14	5-69
W2	803783-23	Power Conversion PCB/Power Supply PCB/Battery Wire Harness	5-15	5-70
W3	803783-24	Battery Sensor/Power Supply PCB Wire Harness	5-16	5-71
W4	803756-13	High Voltage Connector Cable Assembly	5-17	5-72
W5	803733-00	Main PCB/Display Cable Assembly	5-18	5-73
W6	803773-00	Main PCB/Recorder Cable Assembly	5-19	5-74
W7	803772-00	Interconnect PCB/Front Panel Cable Assembly	5-20	5-75
W8	803783-00	Main PCB/Patient Connector Wire Harness	5-21	5-76
W9	803783-04	AC Receptacle/Ground Wire Harness	5-22	5-77
W10	803783-05	AC Receptacle Wire Harness	5-23	5-77
W11	803783-06	Test Load Contact/Resistor Wire Harness	5-24	5-78
W12	803783-07	Power Conversion PCB/Reed Assembly Wire Harness	5-25	5-78
W13	803783-08	Power Conversion PCB/Dump Relay Wire Harness	5-26	5-79
W14	803783-09	Power Conversion PCB/Charge Relay Negative Wire Harness	5-27	5-80
W15	803783-10	Power Conversion PCB/Charge Relay Positive Wire Harness	5-28	5-81
W16	803783-11	Main PCB/Sternum Relay Wire Harness	5-29	5-82
W17	803783-12	Main PCB/Apex Relay Wire Harness	5-30	5-82
W18	803783-13	Storage Capacitor Positive/Relay Wire Harness	5-31	5-83
W19	803783-14	Storage Capacitor Negative/Relay Wire Harness	5-32	5-83
W20	803783-15	ECG Out Wire Harness	5-33	5-84
W21	803783-19	Recorder/Bracket Ground Wire Harness	5-34	5-85

Table 5-2 Defibrillation Adapter Assemblies

Ref	Part Number	Nomenclature	Fig. No.	Page No.
REF	803747	Defibrillation Adapter	5-35	5-87
W1	803774-03	Test Load High Voltage Wire Harness	5-36	5-89
W2	803774-04	Test Load High Voltage Wire Harness	5-37	5-89
W3	803774-05	Pushbutton Switch Wire Harness	5-38	5-90
W4	803756-09	High Voltage Connector Cable Assembly	5-39	5-91

Table 5-3 Reference Designator Key

Designator	Description
A	Main Assemblies
C	Capacitor
CR or D	Diode
F	Fuse
H	Heat Sink
J	Jack Connector
JP	Jumper Wire
K	Relay
L	Inductor
P	Plug Connector
Q	Transistors
R	Resistor
RN	Resistor Network
RV	Varistor
RT	Thermistor
S	Switch
T	Transformer
TP	Test Point
U	IC (Integrated Circuit)
VSP	Voltage Surge Protector
W	Wire Harness
Y	Crystal
XU	IC Socket

## Supplies and Accessories

Supplies and accessories for the LIFEPAK 9 defibrillator/monitor are listed in Table 5-4. the Physio-Control part number is listed for each item. To order an item, call the Physio-Control PARTSLINE at 1-800-442-1142.

**Table 5-4 Supplies and Accessories**

Description	Quantity	Part Number
Cable, Patient	3-lead, AHA	9-10418-02
	3-lead, IEC	800947-01
Cord, Power		803619-08
DERMA JEL Electrode Jelly	4 ounce tube	9-10236-00
	Case, (12 tubes)	9-10236-012
Electrode, FAST-PATCH disposable defibrillation (Use with LIFEPAK 9 defibrillation adapter PN803747.)	804545-001	1 set (2 electrodes)
	804545-010	10 sets (20 electrodes)
	804545-050	50 sets (100 electrodes)
Electrode, LIFE•PATCH, pre-gelled (disposable)	Box of 30	800139-030
	Case of 300	800139-300
Electrode, Welsh suction cup, 18mm		200521-000
Instruction Sheet, Internal Paddles		800806-04
Operating Instructions		803762-00
Paper, ECG, Chemical, 50 mm x 30mm (100ft), 40 mm grid	Box of 3 rolls	804700-003
	Case (150 rolls)	804700-150
Paddle, Internal, Specify Size (Use with handles and connector 800441-03.)	2.5cm (1.0in) dia., pair	802154-10
	3.8cm (1.5in) dia., pair	802154-11
	5.1cm (2.0in) dia., pair	802154-12
	6.4cm (2.5in) dia., pair	802154-13
	8.9cm (3.5in) dia., pair	802154-14
Paddle, Pediatric, external, 2 required		800418-00
Paddle, Posterior, external, adult		802461-00
Service Manual		803763-05
Shipping Container, Battery Recycling Pb		805984-01
Shock Advisory Adapter		803732-00

## LIFEPAK 9 defibrillator/monitor

5-1 Ref	Part Number	Description	Use Code	Qty
		<b>LIFEPAK 9 defibrillator/monitor:</b>		
	803800-01	French, 220V	A	REF
	803800-02	German, 220V	B	REF
	803800-03	Spanish, 220V	C	REF
	803800-04	Spanish, 110V	D	REF
	803800-05	French, 120V	E	REF
	803800-06	French, CSA, 120V	F	REF
	803800-07	English, CSA, 120V	G	REF
	803800-08	English, UK, 220V	H	REF
	803800-09	English, 120V	I	REF
	803800-10	French, 220V	J	REF
	803800-11	German, 220V	K	REF
	803800-12	Spanish, 220V	L	REF
	803800-13	Spanish, 110V	M	REF
	803800-14	French, 120V	N	REF
	803800-15	French, CSA, 120V	O	REF
	803800-16	English, CSA, 120V	P	REF
	803800-17	English, UK, 220V	Q	REF
	803800-18	English, 120V	R	REF
	803800-19	French, 220V	S	REF
	803800-20	German, 220V	T	REF
	803800-21	Spanish, 220V	U	REF
	803800-22	Spanish, 110V	V	REF
	803800-23	French, 120V	W	REF
	803800-24	French, CSA, 120V	X	REF
	803800-25	English, CSA, 120V	Y	REF
	803800-26	English, UK, 220V	Z	REF
	803800-28	English, 120V	AA	REF
	803800-29	French, 120V	AB	REF
	803800-30	German, 220V	AC	REF
	803800-31	Spanish, 220V	AD	REF
	803800-32	Spanish, 110V	AE	REF
	803800-33	French, 120V	AF	REF
	803800-34	French, CSA, 120V	AG	REF
	803800-35	English, CSA, 120V	AH	REF

5-1 Ref	Part Number	Description	Use Code	Qty
		<b>LIFEPAK 9 defibrillator/monitor:</b>		
	803800-01	French, 220V	A	REF
	803800-36	English, UK, 220V	AI	REF
	803800-300	English, 120V, ECG OUT	AJ	REF
	803800-301	French, 220V	AK	REF
	803800-303	Spanish, 220V	AL	REF
	803800-304	Spanish, 110V	AM	REF
	803800-305	French, 120V	AN	REF
	803800-306	French, CSA, 120V	AO	REF
	803800-307	English, CSA, 120V	AP	REF
	803800-308	English, UK, 220V	AQ	REF
	803800-309	Portuguese, 110V	AR	REF
	803800-310	Portuguese, 220V	AS	REF
	803800-311	Italian, 220V	AT	REF
	803800-312	Swedish, 220V	AU	REF
	803800-313	German, 220V	AV	REF
	803800-314	English (Japan), 120V, ECG OUT	AW	REF
A1	803715-11	Main PCB Assembly ▲ (pg. 5-24) <i>Note: If ordering a Main PCB Assembly, order U14 and U27 separately. See parts list.</i>		1
A2	803726-01	Power Supply PCB Assembly (pg. 5-32)		1
A3	803724-03	Power Conversion PCB Assembly ▲ (pg. 5-41)		1
A4	803706-00	Display Assembly (pg. 5-46)	AJ-AO, AQ-AT,AW	
	803706-01	Display Assembly	AU,AV	1
A5	803761-02	Interconnect PCB Assembly ▲ (pg. 5-57)	AJ-AW	1
A6	803745-00	Front Panel Assembly, English (pg. 5-60)	I,G,H,P-R,Y,Z,AA,AH,ALAJ,APAQ,AW	1
	803745-01	Front Panel Assembly, French	A,E,F,J,N,O,S,W,X,AB,AF,AG,AK,AN,AO	1
	803745-02	Front Panel Assembly, German	B,K,T,AC,AV	1
	803745-03	Front Panel Assembly, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803745-04	Front Panel Assembly, Portuguese	AR,AS	1
	803745-05	Front Panel Assembly, Italian	AT	1
	803745-06	Front Panel Assembly, Swedish	AU	1
A7	803741-01	Rear Panel Switch Membrane (pg. 5-62)		1

## LIFEPAK 9 defibrillator/monitor

5-1 Ref	Part Number	Description	Use Code	Qty
A8	804189-00	Strip Chart Recorder Assembly $\Delta$ (pg. 5-64)		1
A9	800240-11	Transfer Relay Assembly (pg. 5-66)		1
A10	802901-06	Paddle Assembly (pg. 5-67)		1
W1	803783-18	Power Supply/AC Receptacle/Ground Wire Harness (pg. 5-69)		1
W2	803783-23	Power Conversion PCB/Power Supply/Battery Wire Harness (pg. 5-70)		1
W3	803783-24	Battery Sensor/Power Supply PCB Wire Harness (pg. 5-71)		1
W4	803756-13	High Voltage Connector Cable Assembly (pg. 5-72)		1
W5	803733-00	Main PCB/Display PCB Cable Assembly (pg. 5-73)		1
W6	803773-00	Main PCB/Recorder Cable Assembly (pg. 5-74)		1
W7	803772-00	Interconnect PCB/Front Panel Cable Assembly (pg. 5-75)		1
W8	803783-00	Main PCB/Patient Connector Wire Harness (pg. 5-76)		1
W9	803783-04	AC Receptacle/Ground Wire Harness (pg. 5-77)		1
W10	803783-05	AC Receptacle Wire Harness (pg. 5-77)		1
W11	803783-06	Test Load Contact/Resistor Wire Harness (pg. 5-78)		1
W12	803783-07	Power Conversion PCB/Reed Assembly Wire Harness (pg. 5-78)		1
W13	803783-08	Power Conversion PCB/Dump Relay Wire Harness (pg. 5-79)		1
W14	803783-09	Power Conversion PCB/Charge Relay Negative Wire Harness (pg. 5-80)		1
W15	803783-10	Power Conversion PCB/Charge Relay Positive Wire Harness (pg. 5-81)		1
W16	803783-11	Main PCB/Sternum Relay Wire Harness (pg. 5-82)		1
W17	803783-12	Main PCB/Apex Relay Wire Harness (pg. 5-82)		1
W18	803783-13	Storage Capacitor Positive/Relay Wire Harness (pg. 5-83)		1
W19	803783-14	Storage Capacitor Negative/Relay Wire Harness (pg. 5-83)		1
W20	803783-15	ECG Out Wire Harness (pg. 5-84)	AJ-AW	1
W21	803783-19	Recorder/Bracket Bround Wire Harness (pg. 5-85)		1
2	803704-02	Battery Pack		1
3	803729-02	Bracket, Strip Chart Recorder		1
4	803705-00	Capacitor, storage		1
5	803749-03	Case, front, with inserts		1

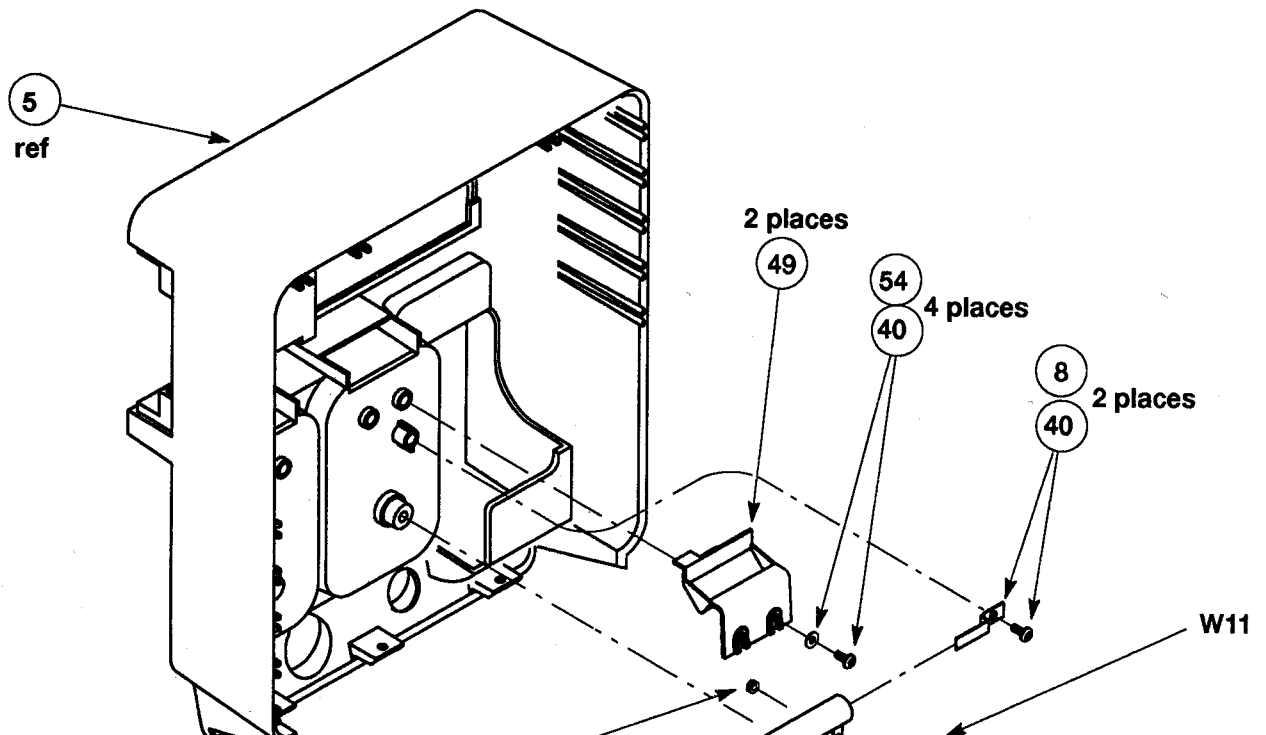
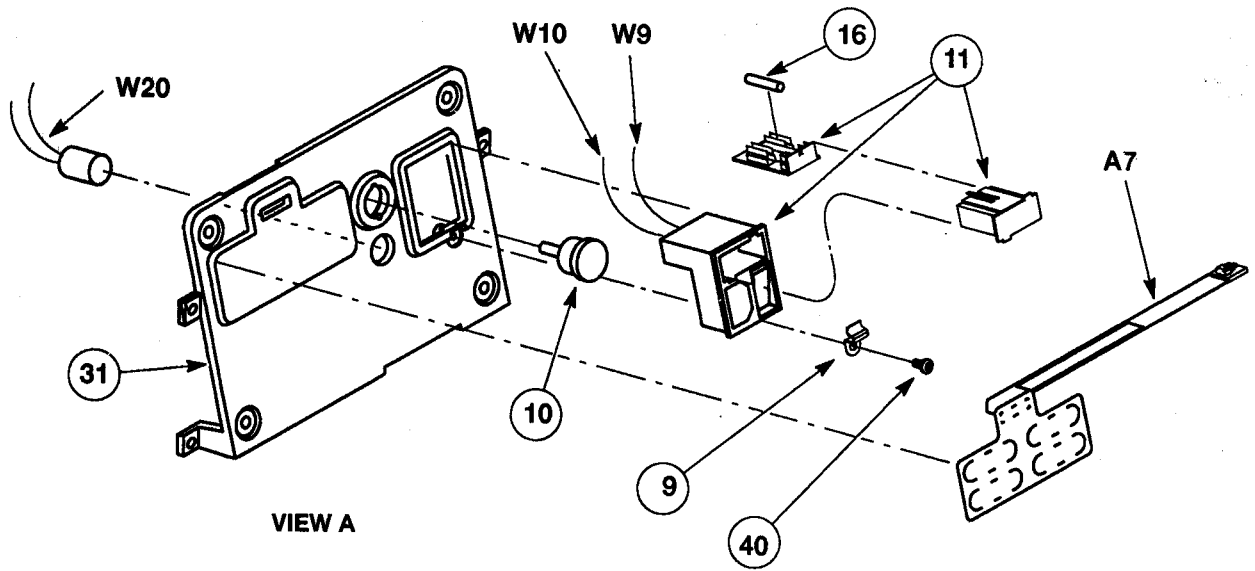


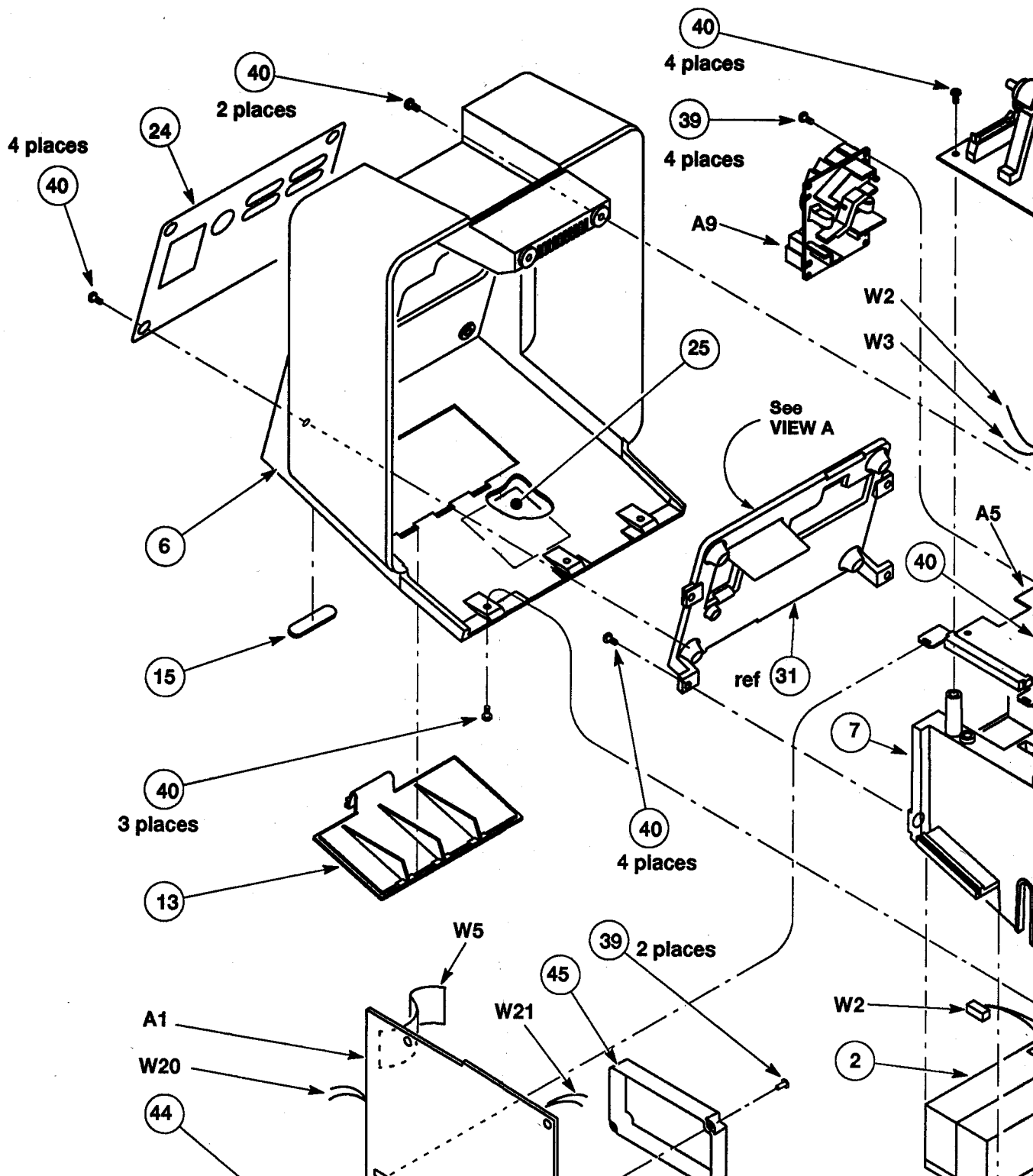
5-1 Ref	Part Number	Description	Use Code	Qty
6	803740-01	Case, rear, ECG Out		1
7	803722-05	Chassis, with inserts		1
8	803737-00	Clip, mounting, test-load resistor		2
9	803718-00	Clip, power entry module	AA,AJ,AR-AU,AW	1
10	201393-011	Connector, plug, equipotential		1
11	202110-000	Connector, receptacle, quick-connect, 6A/250V		1
12	803736-00	Contact, test load		2
13	803711-01	Door, battery		1
14	200363-025	Fastener, plastic rivet, 0.125 D		1
15	802885-00	Foot, mounting		4
16	200256-151	Fuse, slow blow, 4A/250V	D-G,J-L	2
	200619-021	Fuse, slow blow, 4A/250V	I,M-Z,AA,AE-AH,AJ,AM-AP,AW	2
	200619-044	Fuse, slow blow, 2A/250V	A-C,H,AB-AD,AI,AK,AL,AQ-AV	2
17	802793-05	Inductor, wave shaping		1
18	805531-00	Label, blank		1
19	803785-00	Label, CSA (not shown, next to serial number label)	AG,AH,AO,AP	1
20	803743-01	Label, front panel, French	A,E,F,J,N,O,S,W,X,AB,AF,AG,AK,AN,AO	1
	803743-02	Label, front panel, German	B,K,T,AC,AV	1
	803743-03	Label, front panel, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803743-04	Label, front panel, English	I,G,H,P-R,Y,Z,AA,AH,AI,AJ,APAQ,AW	1
	803743-05	Label, front panel, Portuguese	AR,AS	1
	803743-06	Label, front panel, Italian	AT	1
	803743-07	Label, front panel, Swedish	AU	1
21	803742-01	Label, instruction, French	A,E,I,N,S,W,AB,AF,AK,AN	1
	803742-02	Label, instruction, German	B,K,T,AC,AV	1
	803742-03	Label, instruction, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803742-04	Label, instruction, French	I,F,O,R,X,AG,AO	1
	803742-05	Label, instruction, English, CSA	G,I,H,P,Q,R,Y,Z,AA,AH,ALA J,APAQ,AW	1
	803742-06	Label, instruction, French	AR,AS	1
	803742-07	Label, instruction, Italian	AT	1
	803742-08	Label, instruction, Swedish	AU	1
22	802940-03	Label, paddle, APEX	A,I,R,AA	1

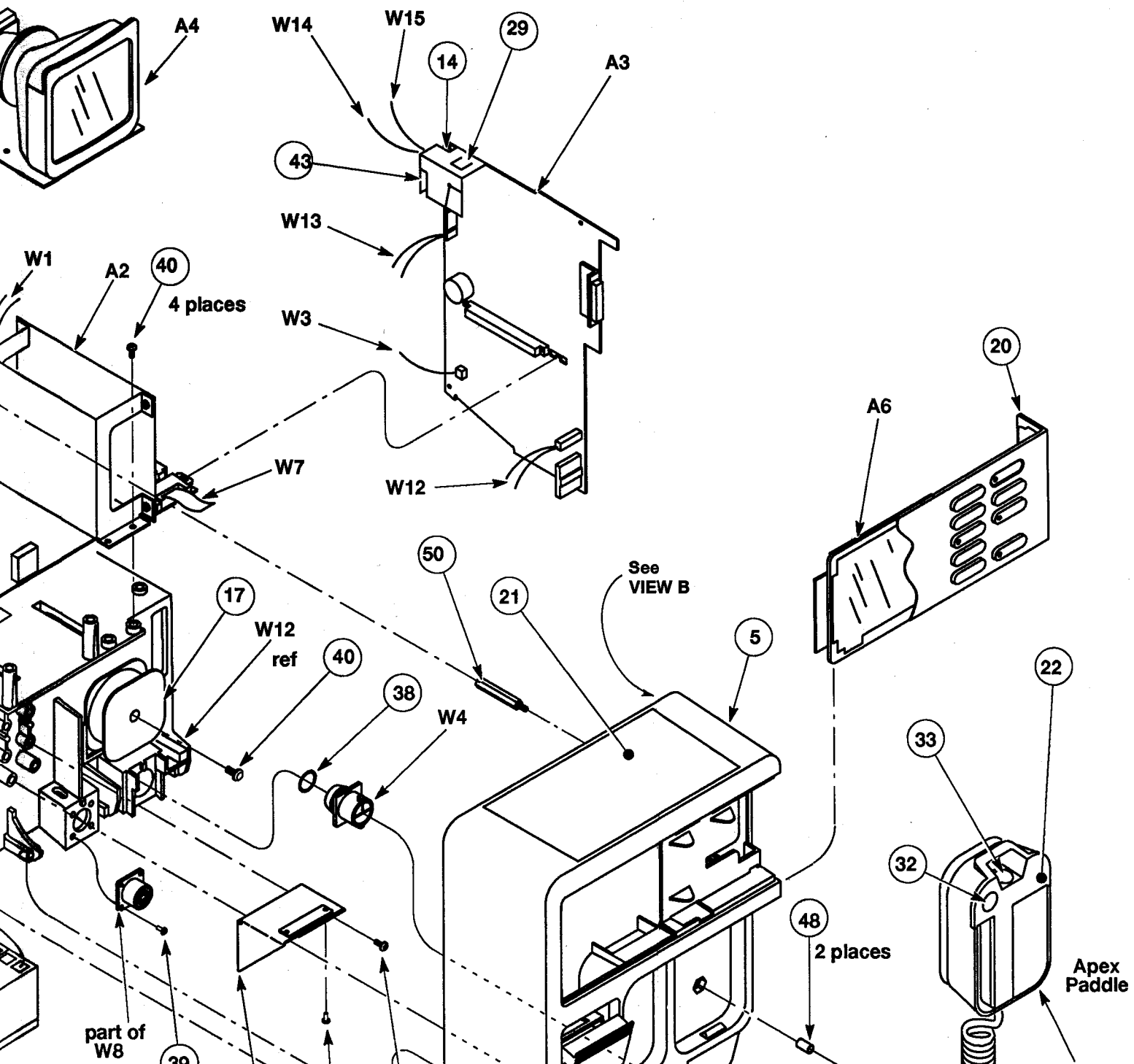
5-1 Part	Ref Number	Description	Use Code
	802940-08	Label, paddle, APEX, Domestic	AJAW
	802940-11	Label, paddle, APEX, International	JRKL, MNOP, QAM
	802940-07	Label, paddle, STERNUM, Domestic (not shown, used on A10)	ABE-HJKS, N
	802940-09	Label, paddle, STERNUM, Spanish (not shown, used on A10)	CDL, M, U, V, A, B, A
	802940-10	Label, paddle, STERNUM, International (not shown, used on A10)	JR, K, N, O, P, Q, T, W, Z
24	803739-03	Label, rear panel, French	A, E, J, N, S, W, A, R, A
	803739-04	Label, rear panel, German	B, K, T, A, C
	803739-05	Label, rear panel, Spanish	C, D, L, M, U, V, A, B, A
	803739-06	Label, rear panel, English, UK	H, Q, Z, A
	803739-07	Label, rear panel, French, CSA, 120V	F, O, X, A, G
	803739-08	Label, rear panel, English	I, G, R, Y, A, A, A, H
	803739-10	Label, rear panel, English, CSA, ECG Out	A, J, A, P, A, W
	803739-11	Label, rear panel, French, 110V/220V, ECG Out	A, R, K, A, N
	803739-12	Label, rear panel, German	A, V
	803739-13	Label, rear panel, Spanish, 110V/220V, ECG Out	A, L, A, M
	803739-14	Label, rear panel, UK, 220V, ECG Out	A, Q
	803739-15	Label, rear panel, French, CSA, 110V, ECG Out	A, O
	803739-16	Label, rear panel, Portuguese	A, R, A, S
	803739-17	Label, rear panel, Italian	A, T
	803739-18	Label, rear panel, Swedish	A, U
25	803727-07	Label, serial number, French, International	A
	803727-08	Label, serial number, German, International	B
	803727-09	Label, serial number, Spanish, International	C
	803727-10	Label, serial number, Spanish, Domestic	D
	803727-11	Label, serial number, French, Domestic	E
	803727-12	Label, serial number, French, CSA	F
	803727-13	Label, serial number, English, CSA	G
	803727-14	Label, serial number, English, UK	H
	803727-15	Label, serial number, English, Domestic	I
	803727-16	Label, serial number, French, International	J
	803727-17	Label, serial number, German, International	K
	803727-18	Label, serial number, Spanish, International	L

5-1 Ret	Part Number	Description	Use Code
	803727-19	Label, serial number, Spanish, Domestic	M
	803727-20	Label, serial number, French, Domestic	N
	803727-21	Label, serial number, French, CSA	O
	803727-22	Label, serial number, English, CSA	P
	803727-23	Label, serial number, English, UK	Q
	803727-24	Label, serial number, English, Domestic	R
	803727-25	Label, serial number, French, International	S
	803727-26	Label, serial number, German, International	I
	803727-27	Label, serial number, Spanish, International	T
	803727-28	Label, serial number, Spanish, Domestic	V
	803727-29	Label, serial number, French, Domestic	W
	803727-30	Label, serial number, French, CSA	X
	803727-31	Label, serial number, English, CSA	Y
	803727-32	Label, serial number, English, UK	Z
	803727-34	Label, serial number, English, Domestic	A A, A1, A W
	803727-35	Label, serial number, French, International	AB, AR
	803727-36	Label, serial number, German, International	AC, AV
	803727-37	Label, serial number, Spanish, International	AD, AI
	803727-38	Label, serial number, Spanish, Domestic	AE, AM
	803727-39	Label, serial number, French, Domestic	AF, AN
	803727-40	Label, serial number, French, CSA	AG, AO
	803727-41	Label, serial number, English, CSA	AH, AP
	803727-42	Label, serial number, English, UK	AI, AQ
	803727-44	Label, serial number, Portuguese	AR
	803727-46	Label, serial number, Italian	AT
	803727-48	Label, serial number, Swedish	AU
	803727-72	Label, serial number, Portuguese, 220V	AS
26	805377-06	Label, reference, Japanese (not shown, next to serial number label)	AW
27	801517-04	Label, UL (not shown, next to serial number label)	AI
28	803456-15	Label, specification, battery (not shown, next to battery pack)	
29	800943-09	Label, high voltage symbol, International (not shown, used on A4 and A9)	
30	201508-002	Nut, kep, locking, #6-32	

5-1 Part	Number	Description	Use Code
31	803713-01	Panel, rear, ECG Out	AT-AW
32	802935-05	Pushbutton, paddle, charge, Domestic	A-E-HJJN-QRKS-AF-ALAKAN
	802935-06	Pushbutton, paddle, charge, German	B-K,TACAV
	802935-07	Pushbutton, paddle, charge, Spanish	C-D,T,M,U,V,AD,AR
	802935-18	Pushbutton, paddle, charge, Italian	AT
	802935-19	Pushbutton, paddle, charge, Swedish	AU
33	802935-08	Pushbutton, paddle, discharge, Domestic	D-E-GJN-PR,W,Y
	802935-09	Pushbutton, paddle, discharge, International	AH,AJ,AM-AP,AR,AS A-C,H,I,L-S-U,Q,Z,AD,AK,AL,AQ,AV
34	800516-02	Resistor, defibrillator (not shown, behind inductor)	
35	802608-00	Resistor, 50Ω, 50W, 5%	
36	200536-001	Retainer, cable tie, nylon, 0.10 W x 4 L (not shown)	
37	200536-011	Retainer, cable tie, nylon, 0.35 W x 20.9 L	
38	200040-019	Retaining Ring, steel, 1.127 OD	
39	201874-270	Screw, pan head, #4-40 x 0.312 L	
40	201874-277	Screw, pan head, #8-32 x 0.375 L	A-Z,AB-AI,AK-AQ
	201874-277	Screw, pan head, #8-32 x 0.375 L	AA,AJ,AR-AU,AW
41	201874-276	Screw, pan head, #6-32 x 0.375 L	
42	803768-00	Shield, recorder bracket	
43	803759-00	Shield, high voltage, Power Conversion PCB	
44	803717-01	Shield, preamp, circuit-side	
45	803716-01	Shield, preamp, component-side	
46	202250-003	Sleeve, ferrite snap (not shown, near connector, REF 11, receptacle on rear panel)	AU,AV
47	803730-00	Spacer, battery pack (not shown, under battery door)	
48	201625-171	Spring, compression, 0.300 OD, 0.562 L	
49	803735-01	Spring, paddle retention	
50	200192-294	Standoff, hex, 0.312 W x 1.875 L	
51	201501-012	Tape, adhesive foam, 0.125 THK x 1 W (not shown, under W12)	
52	200283-005	Tubing, heat shrink, red, 0.250 ID (not shown, used on connector receptacle)	
53	90-04053	Washer, flat, 0.375 OD, 0.152 ID, 0.045 T	
54	200804-101	Washer, flat, #8	

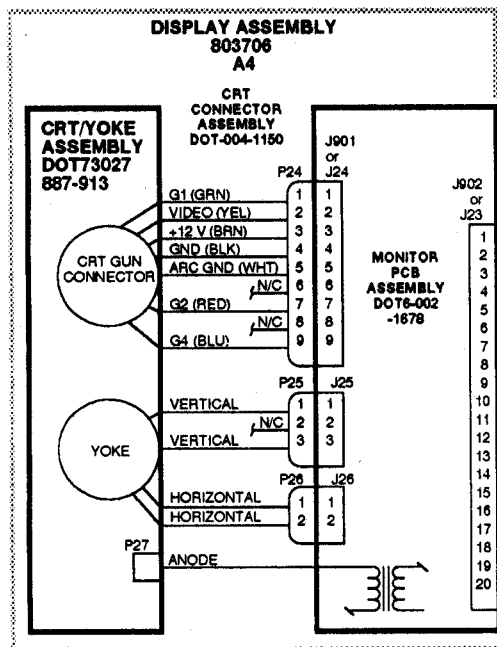




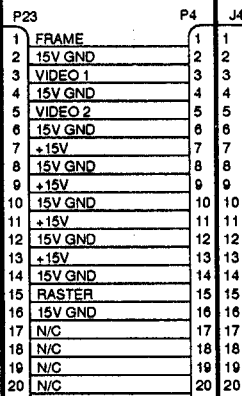


LIFEPAK 9 defibrillator/monitor

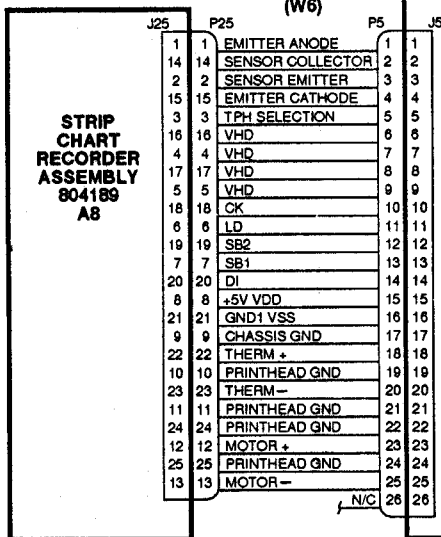
POWER SUPPLY/AC RECEPTACLE  
GROUND WIRE HARNESS  
803783-18  
(W1)



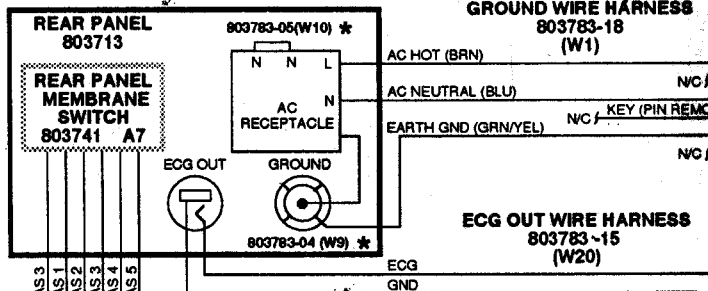
**MAIN PCB/ DISPLAY CABLE ASSEMBLY 803733 (W5)**



**MAIN PCB/ RECORDER CABLE ASSEMBLY 803773 (W6)**

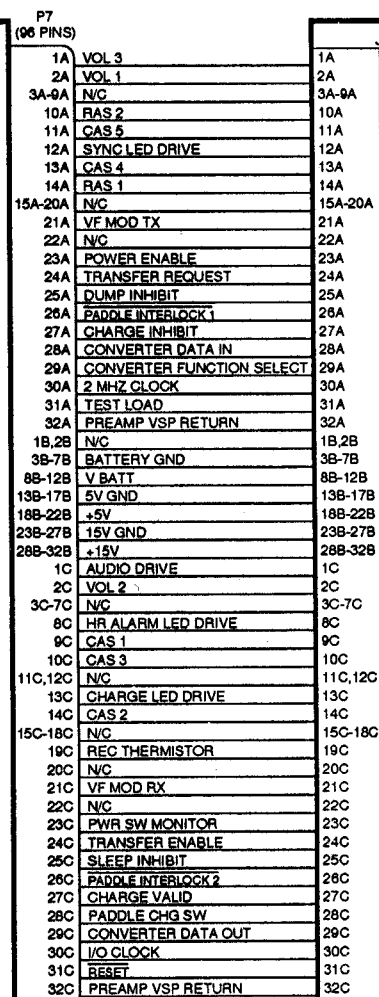


**STRIP CHART RECORDER ASSEMBLY 804189 A8**



**EGG OUT WIRE HARNESS 803783-15 (W20)**

**MAIN PCB ASSEMBLY 803715 A1**



**INTERCONNECT PCB/ FRONT PANEL CABLE ASSEMBLY 803772 (W7)**

H1  
H2  
D ANODE  
D CATHODE



**POWER CONVERSION PCB/POWER  
SUPPLY PCB/BATTERY WIRE HARNESS**

803783-23  
(W2A)

BATTERY PACK  
803704

**POWER  
SUPPLY PCB  
ASSEMBLY  
803726  
A2**

BATTERY GND (BLK)  
BATTERY GND (BLK)  
VBATT (RED)  
VBATT (RED)  
18V LINE STATUS (WHT)  
BATTERY INTERLOCK INPUT (WHT)

**POWER CONVERSION PCB/  
POWER SUPPLY PCB/ BATTERY  
WIRE HARNESS  
803783-23 (W2B)**

**BATTERY SENSOR/  
POWER SUPPLY PCB  
WIRE HARNESS  
803783-24 (W3)**

WAVE-  
SHAPING  
INDUCTOR

**INTERCONNECT  
PCB ASSEMBLY  
803761  
A5**

**POWER CONVERSION  
PCB ASSEMBLY  
803724  
A3**

**TRANSFER  
RELAY  
ASSEMBLY  
800240  
A9**

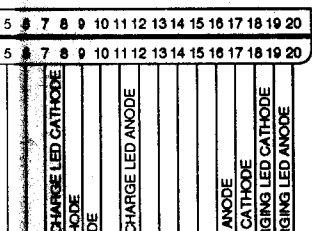
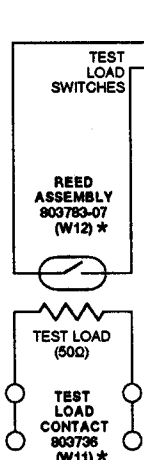
**ENERGY  
STORAGE  
CAPACITOR  
803705**

**HIGH  
VOLTAGE  
CONNECTOR  
CABLE  
ASSEMBLY  
803756-13  
(W4)**

**TO  
PADDLE  
ASSEMBLY  
802901  
A10**

1A,2A	PREAMP VSP RETURN	1A,2A
3A	TEST LOAD	3A
4A	RESET	4A
5A	2 MHZ CLOCK	5A
6A	I/O CLOCK	6A
7A	CONVERTER FUNCTION SELECT	7A
8A	CONVERTER DATA OUT	8A
9A	CONVERTER DATA IN	9A
10A	PADDLE CHG SW	10A
11A	CHARGE INHIBIT	11A
12A	CHARGE VALID	12A
13A	PADDLE INTERLOCK 1	13A
14A	PADDLE INTERLOCK 2	14A
15A	DUMP INHIBIT	15A
16A	SLEEP INHIBIT	16A
17A	TRANSFER REQUEST	17A
18A	TRANSFER ENABLE	18A
19A	POWER ENABLE	19A
20A	PWR SW MONITOR	20A
21A, 22A	N/C	21A, 22A
23A	VF MOD TX	23A
24A	VF MOD RX	24A
25A-27A	N/C	25A-27A
28A	REC THERMISTOR	28A
29A	PADDLES CHARGE LED DRIVE	29A
30A	BATTERY CHARGING LED	30A
31A	POWER SWITCH 1	31A
32A	POWER SWITCH 2	32A
1B-5B	+ 15 V	1B-5B
6B-10B	15 V GND	6B-10B
11B-15B	+ 5 V	11B-15B
16B-20B	5 V GND	16B-20B
21B-25B	VBATT	21B-25B
26B-30B	BATTERY GND	26B-30B
31B-32B	SW BATT	31B-32B

1	GND
2	VF MOD Tx
3	VF MOD Rx
4	+15V
5	A/D INPUT
6	POWER CONTROL
7	SIGNAL GND
8	CHARGER STATUS/CONTROL
9	+5V HIGH LIMIT DETECT
10	+5V LOW LIMIT DETECT
11	+5V
12	STERNUM TRANSFER
13	MICROPROCESSOR RESET
14	CONVERTER SERIAL DATA IN
15	I/O CLOCK
16	CONVERTER SERIAL DATA OUT
17	N/C
18	SW BATT
19	N/C
20	POWER SWITCH STATUS
21	APEX TRANSFER
22	CHARGE INHIBIT
23	CONVERTER FUNCTION SELECT
24	N/C
25	V BATT



1	1	STERNUM GND	5
2	2	PADDLE INTERLOCK 1	3
3	3	STERNUM TRANSFER	4
4	4	CHARGE LED	7
5	5	PADDLE CHG SW	8
6	6	APEX TRANSFER	9
7	7	PADDLE INTERLOCK 2	2
8	8	APEX GND	10
9	9	VF MOD TX	11
10	10	VF MOD RX	12
11	11	TEST LOAD	13
12	12	SW BATT	14
13	N/C		
14	N/C		

TO  
STERNUM  
PADDLE  
PLATE

TO  
APEX  
PADDLE  
PLATE

5-3 Ref	Part Number	Description	Use Cont.
A1	803715-11	Main PCB Assembly and U27 separately, order U14	
C2	201628-006	Capacitor, 0.01µF/50V, 5%	
C3		NOT INSTALLED	
C4		(Same as C2)	
C5	200901-026	Capacitor, 220pF/50V, 5%	
C6	202102-032	Capacitor, electrolytic, 100µF/35V, 100%	
C7	200701-006	Capacitor, electrolytic, 33µF/16V, 100%	
C8,11	200893-042	Capacitor, 0.47µF/50V, 10%	
C12	201628-000	Capacitor, 0.001µF/50V, 5%	
C13-15		(Same as C8)	
C16	200901-046	Capacitor, 0.01µF/50V, 10%	
C17		(Same as C12)	
C18		(Same as C8)	
C19		(Same as C12)	
C20	200893-051	Capacitor, 100pF/100V, 10%	
C21,22		(Same as C8)	
C23-27		(Same as C12)	
C28,29		(Same as C8)	
C30	201628-018	Capacitor, 1.0µF/50V, 5%	
C31	201628-012	Capacitor, 0.1µF/50V, 5%	
C32		(Same as C16)	
C33		(Same as C31)	
C34		(Same as C12)	
C35		(Same as C8)	
C36,37		(Same as C12)	
C38-42		(Same as C8)	
C43-51		(Same as C12)	
C52		(Same as C8)	
C53-56		(Same as C12)	
C57		(Same as C8)	

PPF  
Qty

5-3 Ref	Part Number	Description	Use Code
C59	200205-028	Capacitor, electrolytic, 100µF/25V, 10%	
C60	(Same as C8)		
C61-71	(Same as C12)		
C72	201628-008	Capacitor, 0.022µF/50V, 5%	
C73	200049-039	Capacitor, 0.1µF/100V, 20%	
C74	(Same as C2)		
C75	(Same as C73)		
C76	200901-274	Capacitor, 0.001µF/50V, 1%	
C77	(Same as C2)		
C78,79	(Same as C73)		
C80	(Same as C8)		
C81-83	(Same as C73)		
C84	(Same as C8)		
C85	(Same as C20)		
C86,87	200701-021	Capacitor, electrolytic, 10µF/35V, 20%	
C88,90	(Same as C30)		
C91-93	(Same as C2)		
C94	(Same as C12)		
C95,96	(Same as C73)		
C97	(Same as C72)		
C98	(Same as C12)		
C99	201628-002	Capacitor, 2200pF/50V, 5%	
C100, 101	(Same as C73)		
C102, 103	200901-134	Capacitor, 22pF/50V	
C104	201628-016	Capacitor, 0.47µF/50V, 5%	
C105	(Same as C12)		
C106	200744-021	Capacitor, 2µF/50V, 5%	
C107,108	(Same as C102)		
C109	200901-013	Capacitor, 18pF/50V, 5%	
CRI	200658-002	Diode, fast recovery, MR812, 200ns, PIV 200	
CR2	200971-000	Diode, switching, IN914B, 8ns, PIV 75	
CR3	200086-006	Diode, Zener, IN4620, 80mA/3.3V	

5-3 Ref	Part Number	Description	Use Cont.
CR4-6	200605-010	(Same as CR2) Diode, Zener, 1N4738A, 550mA/8.2V	
CR7-9	200605-010	(Same as CR2) Diode, Zener, 1N4738A, 550mA/8.2V	
CR10-17	200086-019	(Same as CR2) Diode, Zener, 1N4104, 24.8mA/10V	
CR18,19	200086-019	(Same as CR2) Diode, Zener, 1N4104, 24.8mA/10V	
CR21-28		(Same as CR2)	
CR31		(Same as CR7)	
J4	201191-221	Connector, locking, 20 contact	
J5	201191-222	Connector, locking, 26 contact	
J6	202128-028	Connector, header, 6 contact	
J8	201504-003	Connector, spade terminal, 0.187	
J9	201504-004	Connector, spade terminal, 0.25	
J22	202128-026	Connector, 4 contact	
K1	202045-000	Relay, 1500V, 60W	
L1	201409-036	Inductor, 100mH, 5%	
L2,3	200808-000	Inductor, ferrite bead	
P7	201678-022	Connector, 96 contact	
Q1	200585-001	Transistor, FET, VN0106N3, TO-92	
Q2	200942-001	Transistor, NPN, PN2222, TO-92	
Q3	202155-000	Transistor, FET, IRFD9010	
Q4	200994-001	Transistor, FET, IRF9531, TO-220	
Q5,6		(Same as Q1)	
Q7	200885-000	Transistor, FET, U1898, TO-92	
Q8,9		(Same as Q1)	
Q10	200582-004	Transistor, FET, VCR7N, TO-72	
Q11	202179-001	Transistor, FET, J175, TO-92	
R1,2	200054-257	Resistor, 4.7kΩ, 1/8W, 1%, RN55C	
R3	200054-384	Resistor, 100kΩ, 1/8W, 1%, RN55C	
R4-6		(Same as R1)	

5-3 Ref	Part Number	Description	Use Code
R7	200054-363	Resistor, 60.4k $\Omega$ , 1/8W, 1%, RN55C	
R8	200527-009	Potentiometer, 10k $\Omega$ , 1/2W	
R9	200054-480	Resistor, 1M $\Omega$ , 1/8W, 1%, RN55C	
R10	200054-222	Resistor, 2k $\Omega$ , 1/8W, 1%, RN55C	
R11	200054-288	Resistor, 10k $\Omega$ , 1/8W, 1%, RN55C	
R12	200054-259	Resistor, 4.99k $\Omega$ , 1/8W, 1%, RN55C	
R13		(Same as R10)	
R14	200054-417	Resistor, 221k $\Omega$ , 1/8W, 1%, RN55C	
R15	200054-279	Resistor, 8.06k $\Omega$ , 1/8W, 1%, RN55C	
R16		(Same as R11)	
R17		(Same as R7)	
R18	200054-317	Resistor, 20k $\Omega$ , 1/8W, 1%, RN55C	
R19	200270-048	Resistor, 10 $\Omega$ , 2W, 5%	
R20		NOT INSTALLED	
R21	200054-126	Resistor, 200 $\Omega$ , 1/8W, 1%,	
R22	200054-073	Resistor, 56.2 $\Omega$ , 1/8W, 1%, RN55C	
R23		(Same as R10)	
R24	200054-193	Resistor, 1k $\Omega$ , 1/8W, 1%, RN55C	
R25		(Same as R18)	
R26		(Same as R9)	
R27	200216-002	Resistor, 0.2 $\Omega$ , 1W, 1%	
R28	200054-345	Resistor, 39.2k $\Omega$ , 1/8W, 1%, RN55C	
R29,30		(Same as R18)	
R31,32		(Same as R1)	
R33	200054-164	Resistor, 499 $\Omega$ , 1/8W, 1%, RN55C	
R34		(Same as R3)	
R35		(Same as R18)	
R36	200471-031	Resistor, 20 $\Omega$ , 1/2W, 5%	
R37	200054-097	Resistor, 100 $\Omega$ , 1/8W, 1%, RN55C	
R38		(Same as R12)	
R39		(Same as R1)	
R40	200054-226	Resistor, 2.21k $\Omega$ , 1/8W, 1%, RN55C	

5-3 Ref	Part Number	Description	Use Code
R41	200054-413	Resistor, 200kΩ, 1/8W, 1%, RN55C	
R42-44	(Same as R40)		
R45	200054-451	Resistor, 499kΩ, 1/8W, 1%, RN55C	
R46	200054-318	Resistor, 20.5kΩ, 1/8W, 1%, RN55C	
R47	200054-335	Resistor, 30.9kΩ, 1/8W, 1%, RN55C	
R48	200054-321	Resistor, 22.1kΩ, 1/8W, 1%, RN55C	
R49	(Same as R41)		
R50	(Same as R48)		
R51,52	(Same as R40)		
R53	(Same as R48)		
R54	(Same as R40)		
R55	200054-105	Resistor, 121Ω, 1/8W, 1%, RN55C	
R56	(Same as R1)		
R56-58	(Same as R40)		
R59	(Same as R48)		
R60	(Same as R40)		
R61	(Same as R48)		
R62-66	(Same as R40)		
R67	(Same as R41)		
R68	(Same as R1)		
R70	(Same as R3)		
R71-76	(Same as R40)		
R77	(Same as R55)		
R78-86	(Same as R40)		
R87,88	200054-139	Resistor, 274Ω, 1/8W, 1%, RN55C	
R89,90	(Same as R24)		
R91	(Same as R1)		
R92,93	(Same as R40)		
R94	(Same as R11)		
R95	(Same as R41)		
R96	(Same as R40)		
R97	(Same as R41)		
R98	201155-003	Resistor, 1000MΩ, 1W, 10%	

5-3 Ref	Part Number	Description	Use Code
R99	200054-114	Resistor, 150Ω, 1/8W, 1%, RN55C	
R100	(Same as R18)		
R101	200054-401	Resistor, 150kΩ, 1/8W, 1%, RN55C	
R102	(Same as R18)		
R103,104	(Same as R11)		
R105	(Same as R18)		
R106	200054-165	Resistor, 511Ω, 1/8W, 1%, RN55C	
R107,108	(Same as R41)		
R109	(Same as R24)		
R110	(Same as R41)		
R111	(Same as R24)		
R112	(Same as R12)		
R113-115	(Same as R11)		
R116,117	(Same as R18)		
R118	(Same as R37)		
R119	200054-143	Resistor, 301Ω, 1/8W, 1%, RN55C	
R120	(Same as R41)		
R121	(Same as R45)		
R122	200054-469	Resistor, 768kΩ, 1/8W, 1%, RN55C	
R123	(Same as R45)		
R124	200054-426	Resistor, 274kΩ, 1/8W, 1%, RN55C	
R125	(Same as R106)		
R126,127	NOT INSTALLED		
R128	200054-334	Resistor, 30.1kΩ, 1/8W, 1%, RN55C	
R129	200054-344	Resistor, 38.3kΩ, 1/8W, 1%, RN55C	
R130	(Same as R18)		
R131,132	201155-000	Resistor, 500kΩ, 1W, 1%	
R133	NOT INSTALLED		
R134-136	201969-313	Resistor, 51.1kΩ, 1/4W, 1%	
R137,138	201969-361	Resistor, 5.11MΩ, 1/4W, 1%	
R139	200054-508	Resistor, 2MΩ, 1/8W, 1%, RN55C	
R140	200054-538	Resistor, 4.12MΩ, 1/8W, 1%, RN55C	

5-3 Ref	Part Number	Description	Use Code
R141,142		(Same as R3)	
R143	200054-395	Resistor, 130kΩ, 1/8W, 1%, RN55C	
R144	200054-254	Resistor, 4.2kΩ, 1/8W, 1%, RN55C	
R145	200054-575	Resistor, 10MΩ, 1/8W, 1%, RN55C	
R146		(Same as R9)	
R147		(Same as R143)	
R148,149		(Same as R18)	
R150		(Same as R145)	
R151		(Same as R41)	
R152	200054-328	Resistor, 26.1kΩ, 1/8W, 1%, RN55C	
R153,154		(Same as R145)	
R155	200054-392	Resistor, 121kΩ, 1/8W, 1%, RN55C	
R156		(Same as R7)	
R157	200054-068	Resistor, 49.9Ω, 1/8W, 1%, RN55C	
R158		(Same as R128)	
R159		(Same as R157)	
R160	200054-353	Resistor, 47.5kΩ, 1/8W, 1%, RN55C	
R161	200054-267	Resistor, 6.04kΩ, 1/8W, 1%, RN55C	
R162	200054-373	Resistor, 76.8kΩ, 1/8W, 1%, RN55C	
R163	200054-402	Resistor, 154kΩ, 1/8W, 1%, RN55C	
R164	200054-427	Resistor, 280kΩ, 1/8W, 1%, RN55C	
R165		(Same as R145)	
R166		(Same as R164)	
R167		(Same as R11)	
R168	200054-387	Resistor, 107kΩ, 1/8W, 1%, RN55C	
R169		(Same as R12)	
R170		(Same as R21)	
R171,172	200054-525	Resistor, 3.01MΩ, 1/8W, 1%, RN55C	
R173		(Same as R40)	
R174,175		(Same as R18)	
R176	200527-012	Potentiometer, 50 kΩ, 1/2W, PCB	
R177		(Same as R40)	

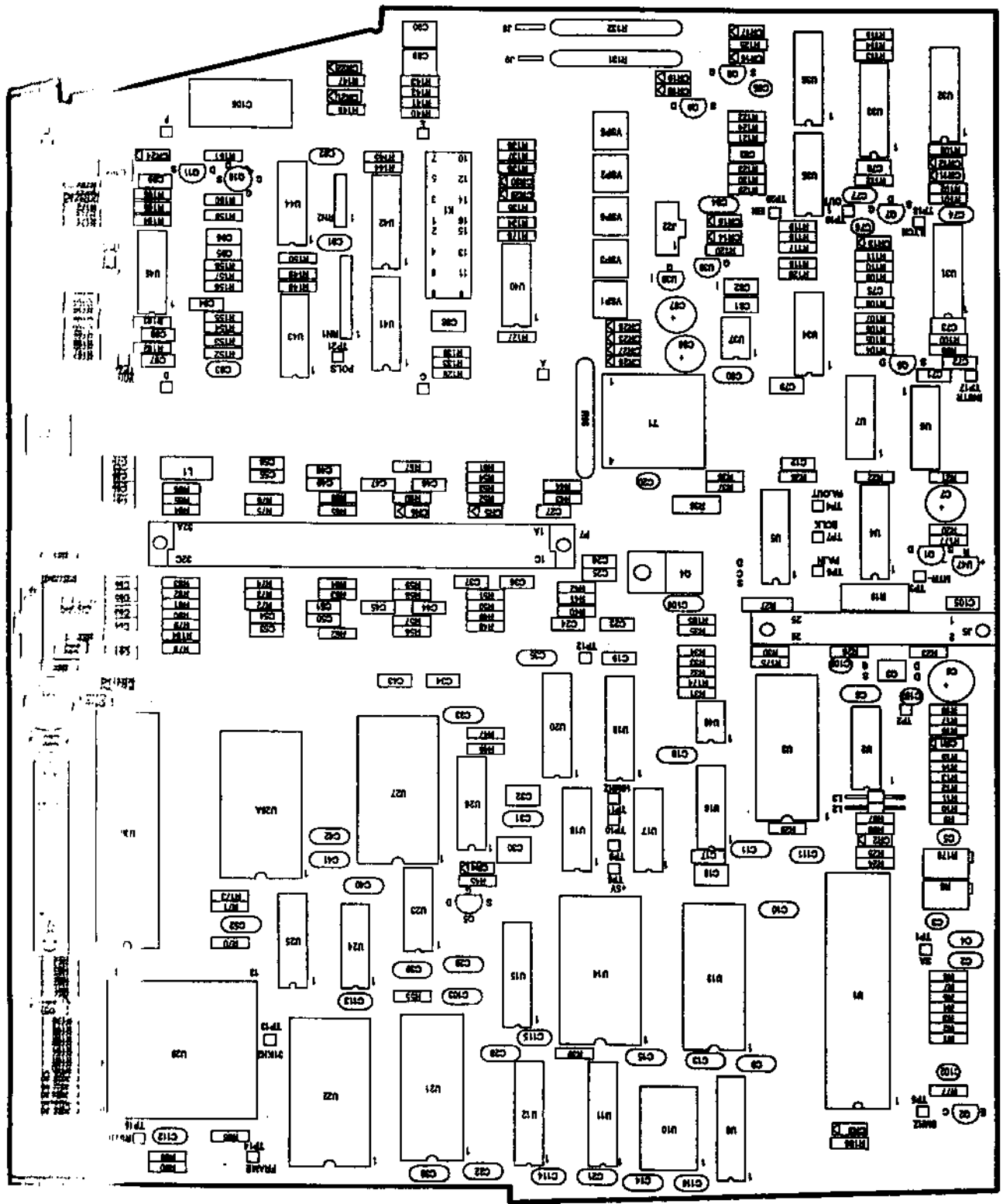


Ref	Part Number	Description	Use Coll.
R178	(Same as R11)		
R179-183	(Same as R1)		
R184	(Same as R11)		
R185	200054-130	Resistor, 221Ω, 1/8W, 1%, RN55C	
R186	(Same as R11)		
RN1	201425-018	Resistor Network, 4 x 20 kΩ, 1W, 1%	
RN2	201425-004	Resistor Network, 4 x 20 kΩ, 1W, 1%	
T1	803089-02	Transformer, isolation, 10KV, 290T-CT	
U1	202052-000	IC, digital, HD63B03Y, microprocessor	
U2	200669-002	IC, linear, LM339N, comparator	
U3	804280-00	IC, digital, recorder gate array	
U4	201703-000	IC, digital, 74HC4040, counter	
U5	201126-000	IC, linear, 3525AN, pulse-width modulator	
U6,7	201597-000	IC, linear, CNY65, opto-isolator	
U9	803703-00	IC, digital, 12L6, programmable array logic	
U10	202087-000	IC, digital, NCM031C, oscillator	
U11,12	201511-001	IC, digital, 74HCT244, buffer	
U13	202143-002	IC, digital, HM62256LP-12, static RAM, 32k x 8	
U14	803710-111	IC, digital, 27C256, programmed display EPROM	
U15	(Same as U11)		
U16	201588-000	IC, digital, 74HC74, D-type flip-flop	
U17	201608-001	IC, digital, 74HCT02, NOR gate	
U18	201469-001	IC, digital, 74HCT00, NAND gate	
U19,20	201638-001	IC, digital, 74HCT374, D-Type flip-flop	
U21	(Same as U13)		
U22	803710-200	IC, digital, 27C256, EPROM, 32k x 8	
U23	201705-000	IC, digital, 74HC14, inverter	
U24	(Same as U18)		
U25	201609-001	IC, digital, 74HCT138, decoder	
U26	201774-000	IC, digital, 74HC4538N, multivibrator	

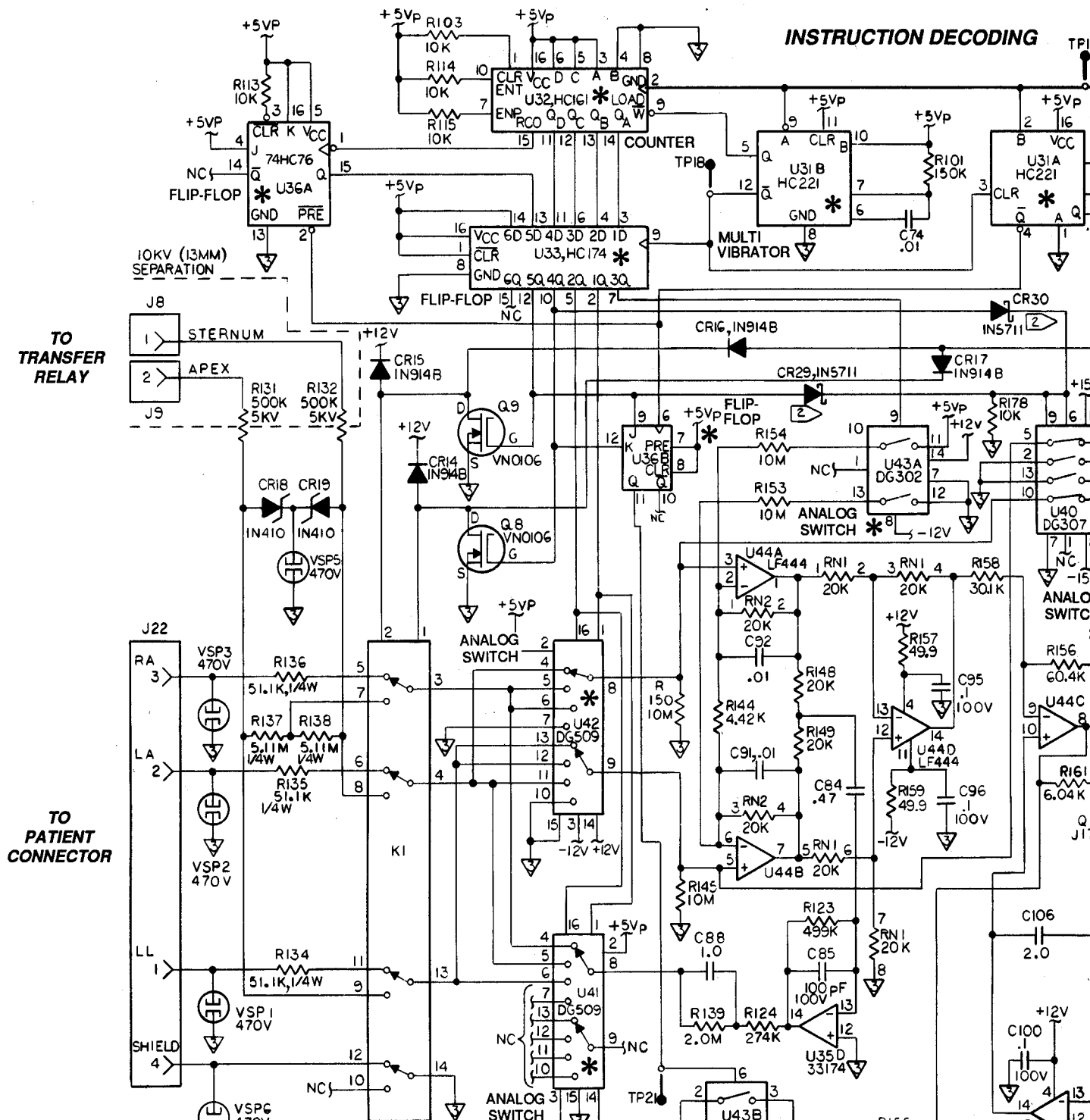
5-3 Ref	Part Number	Description	Use Code
U27	803710-318	IC, digital, 27C256, programmed system EPROM	
U28A,28B	202227-000	IC, digital, smartwatch RAM, 256k	
U29	803720-00	IC, digital, display gate array	
U30	(Same as U1)		
U31	201611-000	IC, digital, 74HC221, multivibrator	
U32	201616-002	IC, digital, 74HC161, counter	
U33	200165-000	IC, digital, 74C174N, D-type flip-flop	
U34	(Same as U2)		
U35	202211-000	IC, linear, 33174, quad op amp	
U36	201641-000	IC, digital, 74HC76, J-K flip-flop	
U37	200359-003	IC, linear, MC1404U5, voltage reference	
U38	200673-007	IC, linear, UA78L12ACLP, voltage regulator, 12V, TO-92	
U39	200706-053	IC, linear, 79L12, voltage regulator, -12V, TO-92	
U40	NOT INSTALLED		
U41,42	201743-001	IC, linear, DG509, multiplexer	
U43	201342-070	IC, linear, analog switch, DG302	
U44,45	201214-002	IC, linear, LF444, quad op-amp	
U46	202156-000	IC, digital, DS1210, nonvolatile controller	
U47	200854-006	IC, linear, LM3342, adjustable current source, TO-92	
VSP1-3	200324-011	Voltage Surge Protector, 470V, 1pF	
VSP4	200324-016	Voltage Surge Protector, 8-10.3kV, 2pF	
VSP5,6	(Same as VSP1)		
XU1	202054-000	Socket, dip, 64 contact	
XU14	200675-026	Socket, dip, 28 contact	
22,27,28	(Same as XU14)		
XU30	(Same as XU1)		
2	202245-001	Rivnut, dome head, 3/32 D x 0.187 L (used on P7)	
3	90-09138	Wire, AWG#22 (not shown, used on L2, L3)	

Figure 5-3 Main PCB Assembly  
Part Number 803715-11  
(Sheet 1 of 5)

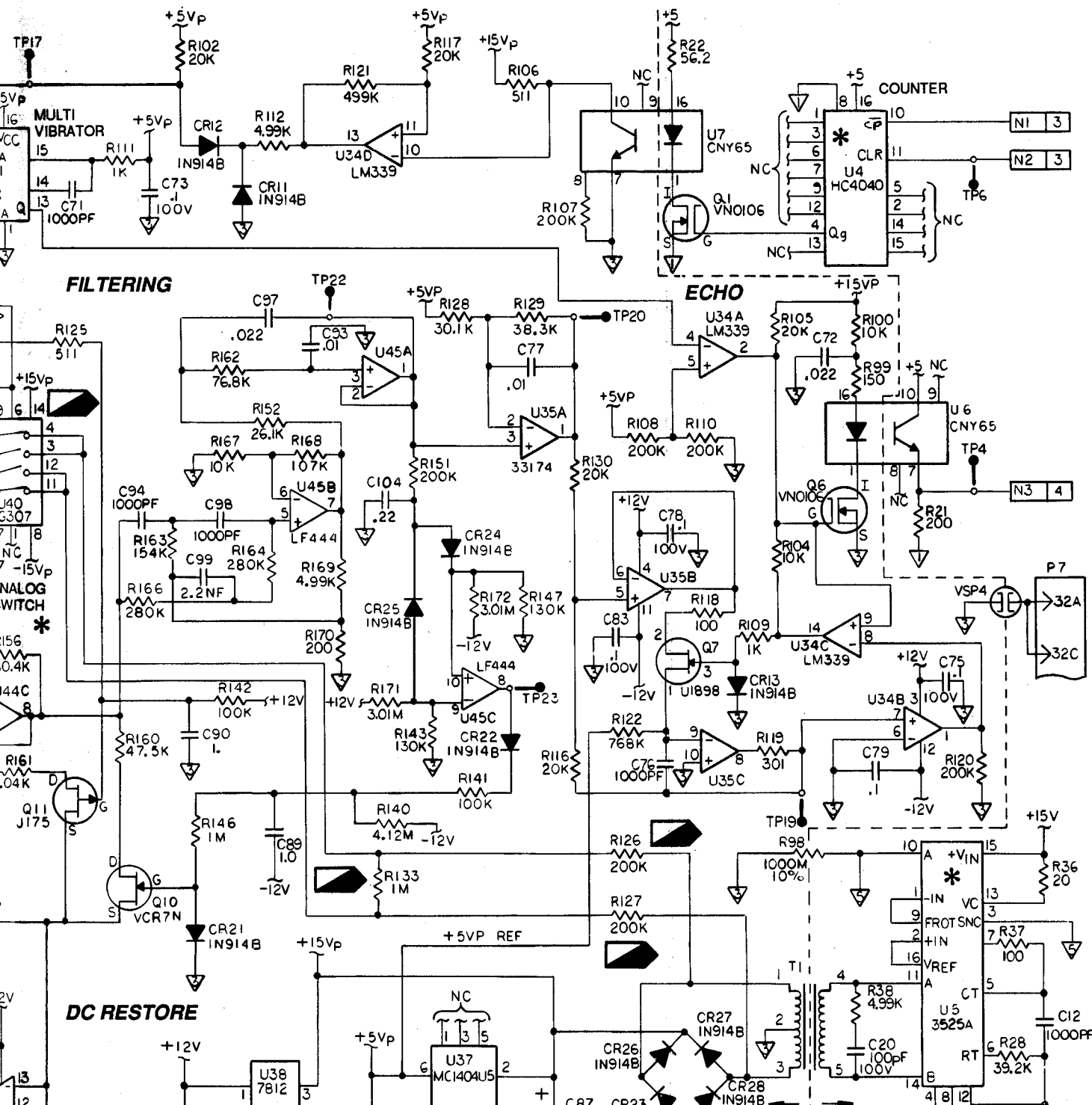
A1



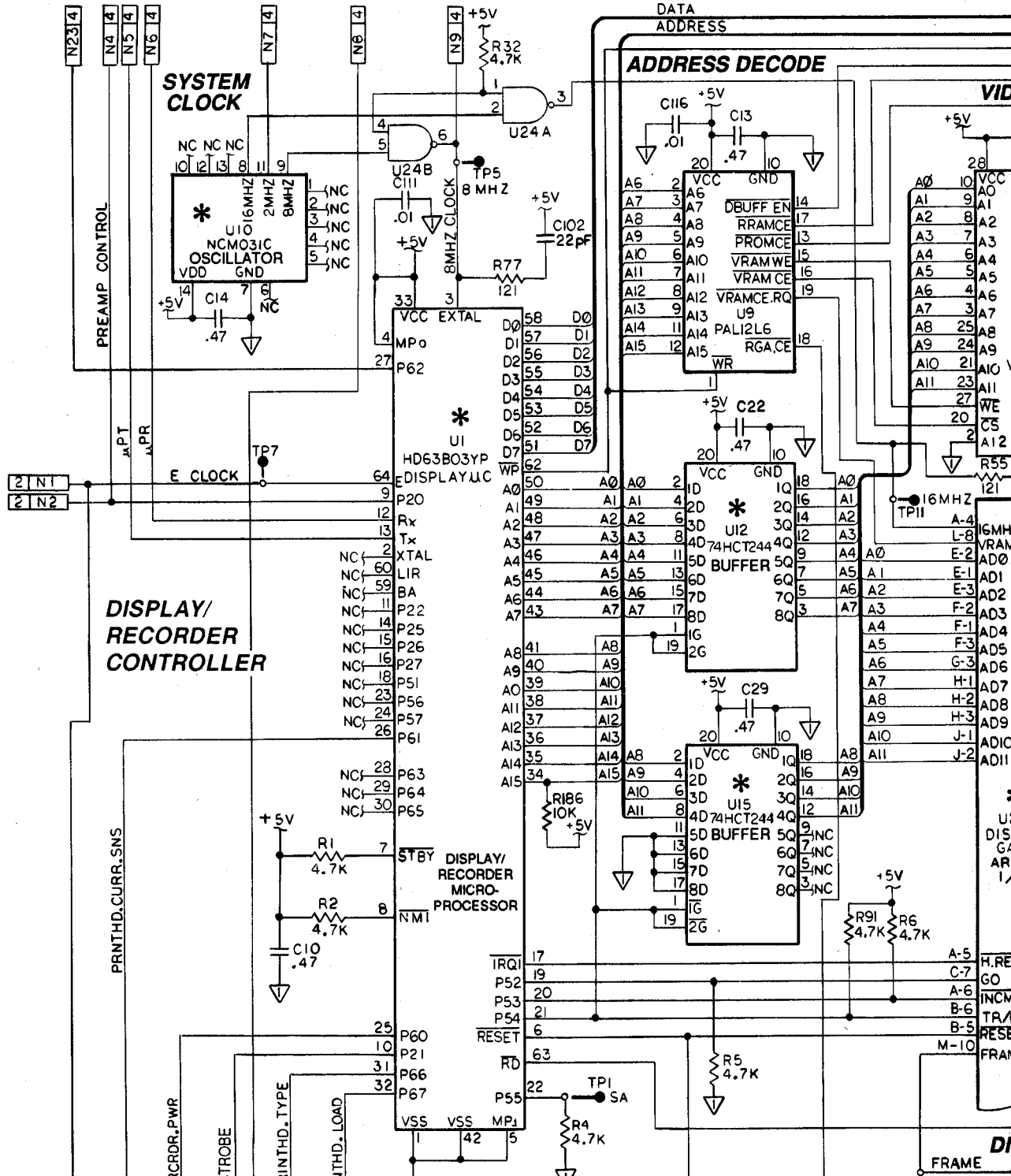
LIFEPAK 9 defibrillator/monitor

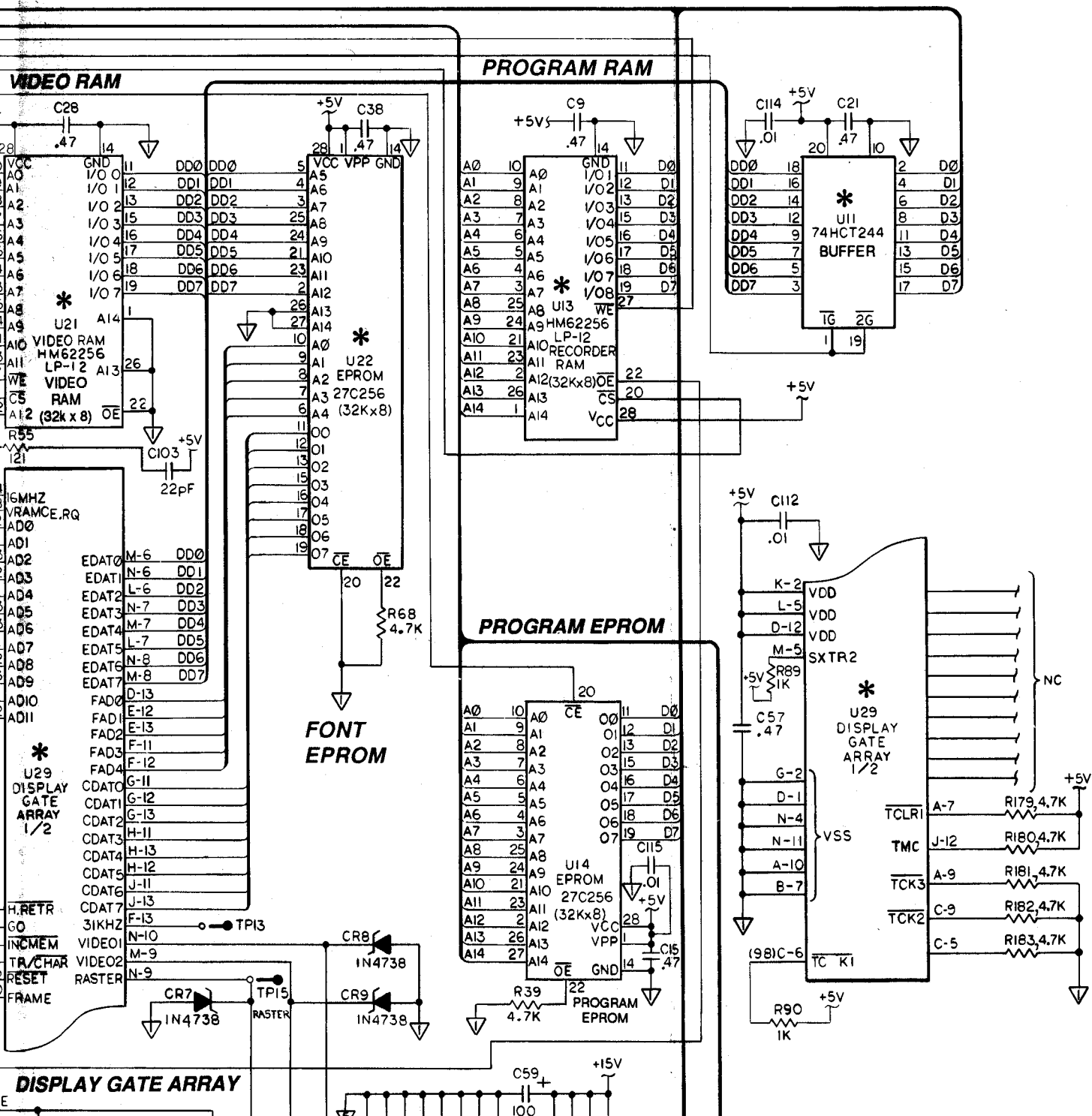


## OPTICAL INTERFACE



LIFEPAK 9 defibrillator/monitor



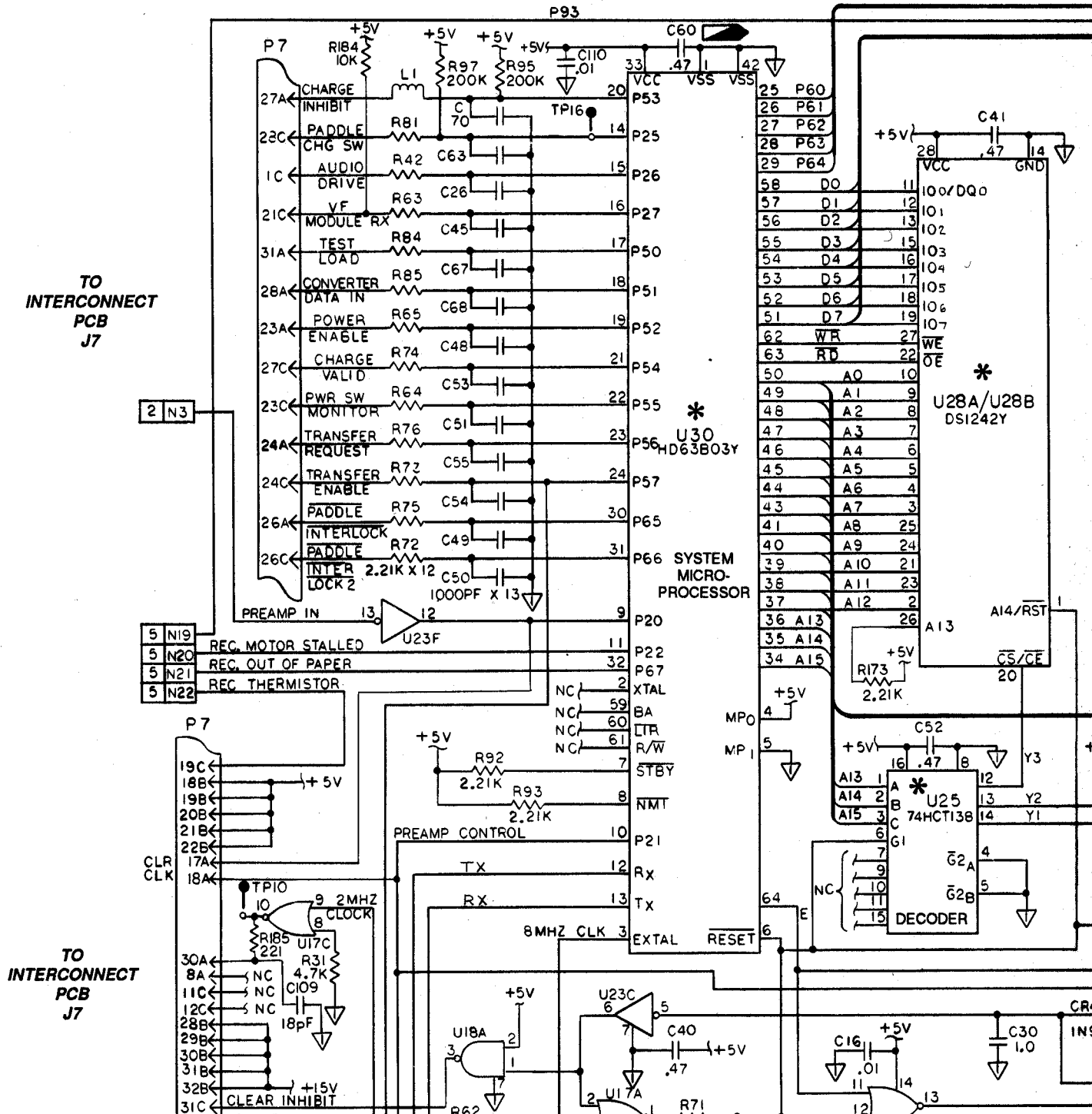


I/O PROTECTION

CHARGE CONTROL

SYSTEM CONTROLLER

AUDIO



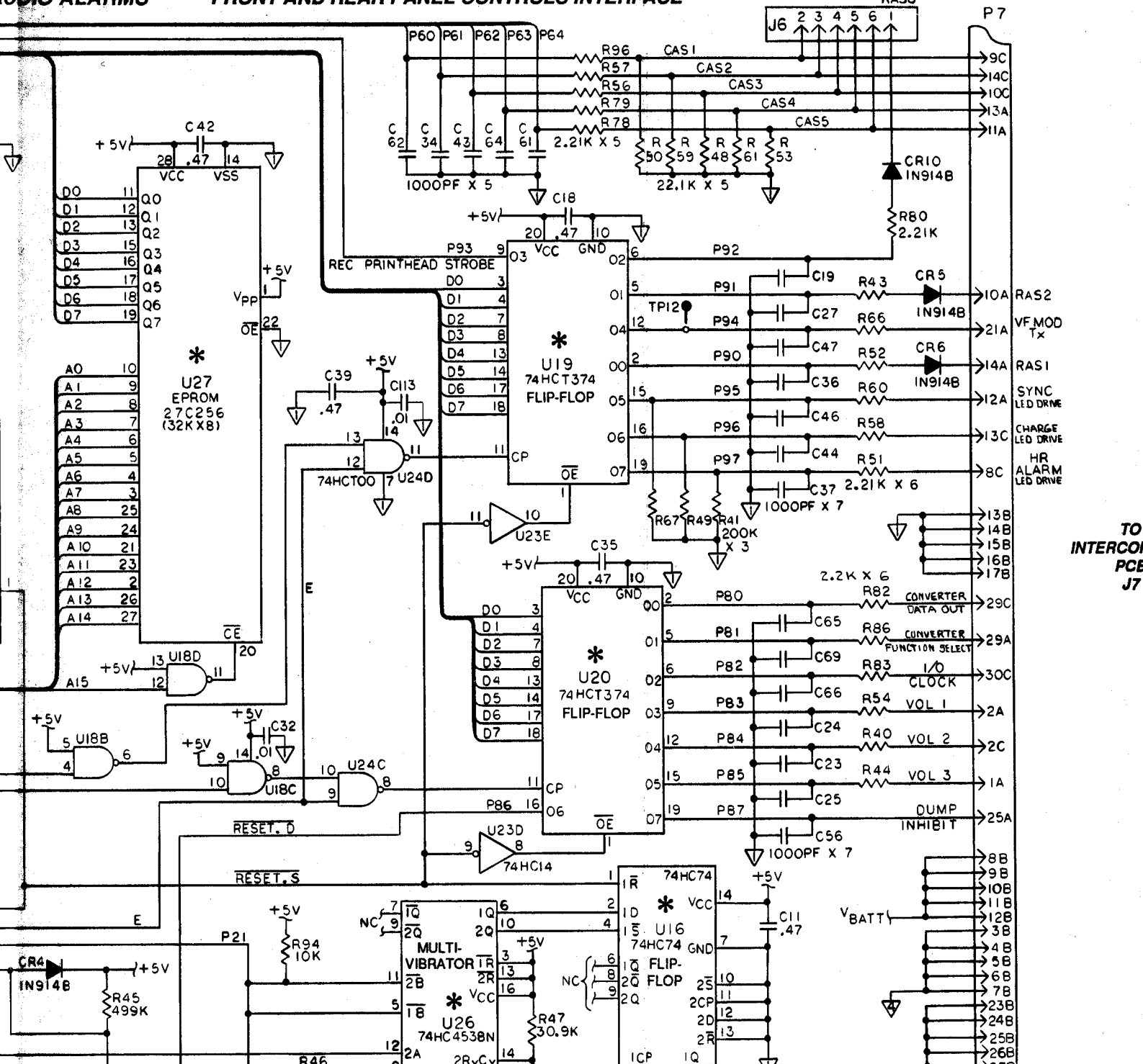


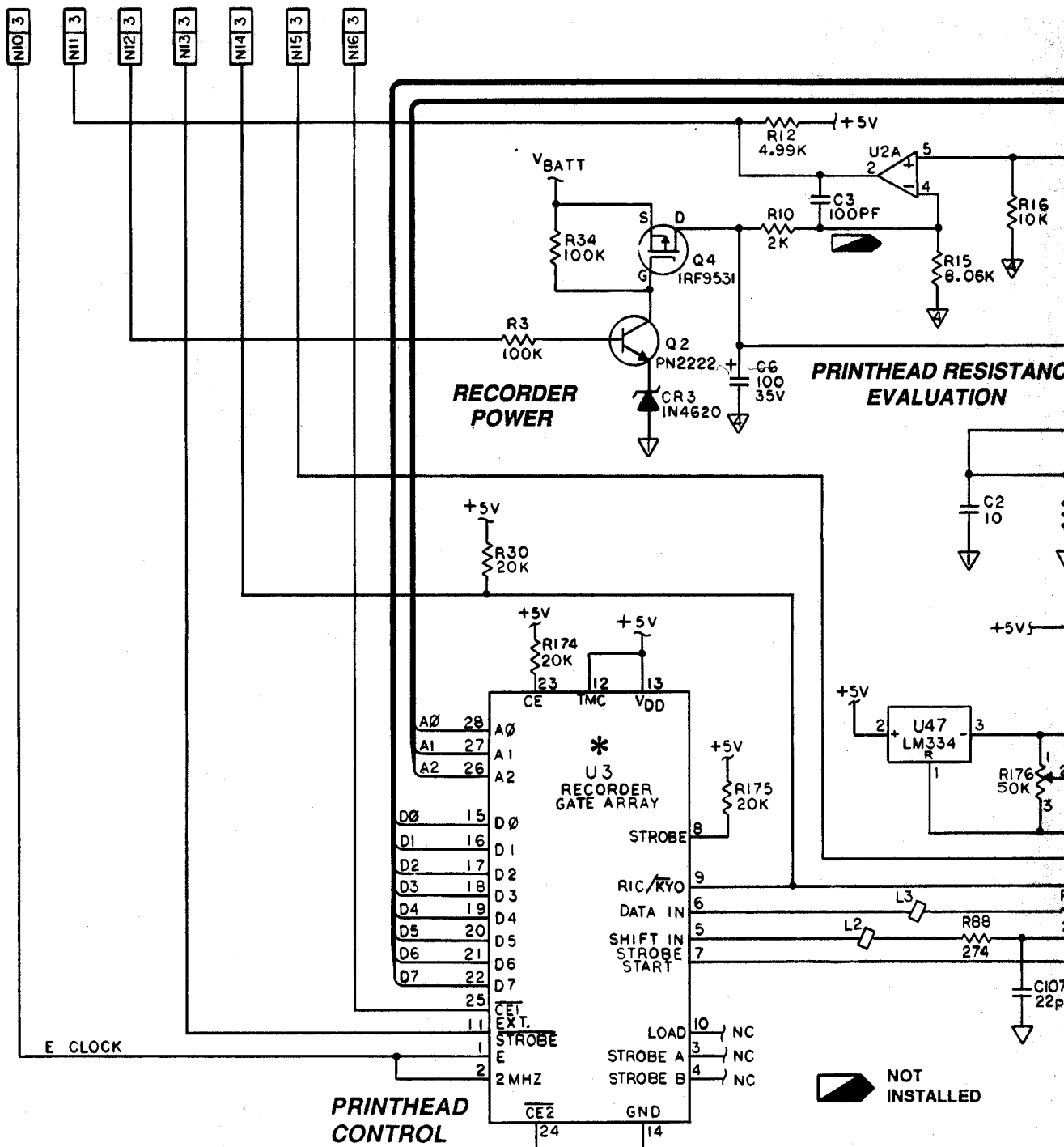
**AUDIO ALARMS**

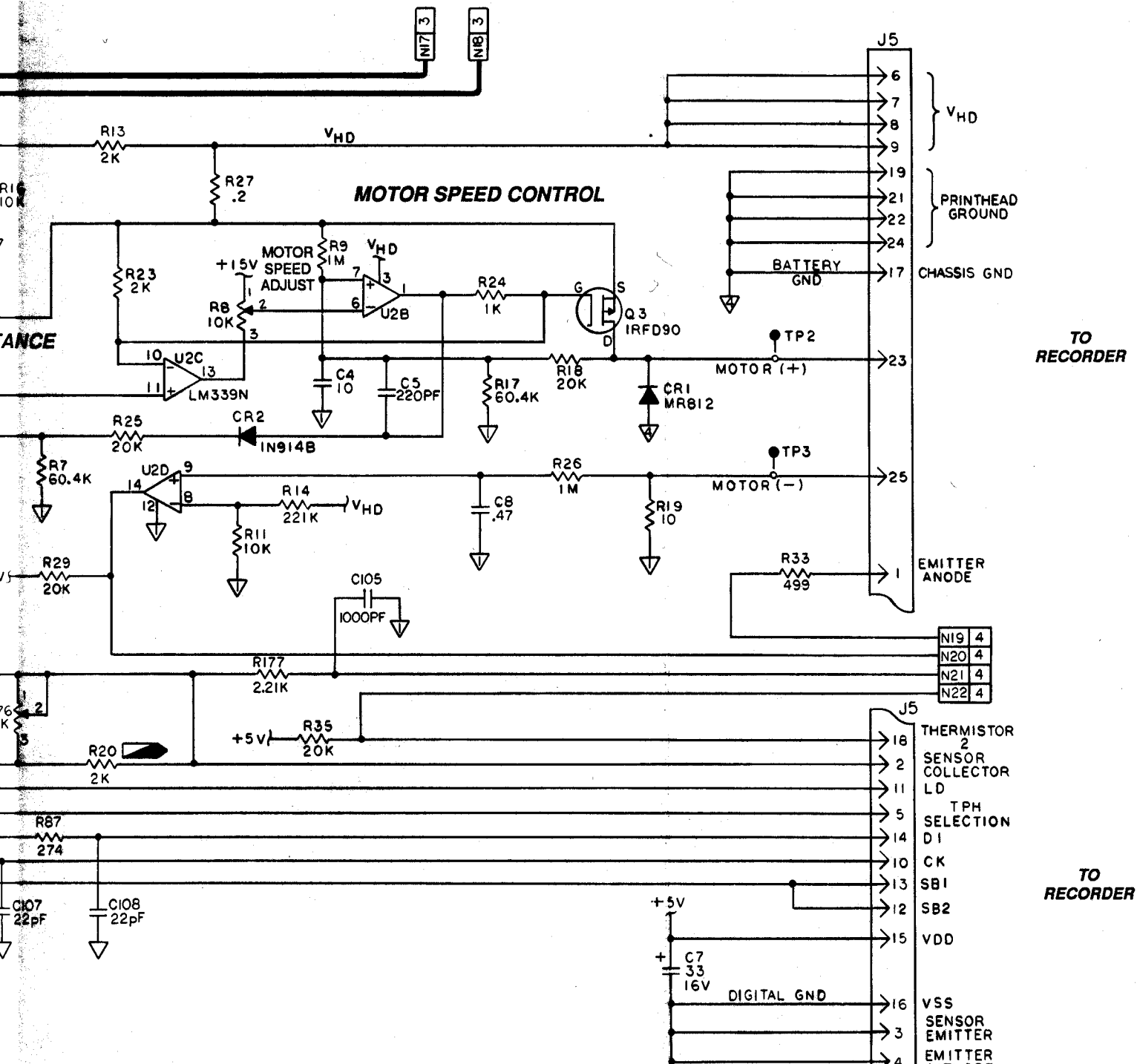
**FRONT AND REAR PANEL CONTROLS INTERFACE**

**TO REAR PANEL**

Parts Lists and Schematic







5-4 Ref	Part Number	Description	Unit
A2	803726-01	Power Supply PCB Assembly	RPF
C1	BOS240005-221	Capacitor, 220pF/250V, 20%	
C2	BOS220073-473	Capacitor, 0.047µF/250V, 20%	
C3	BOS200113-227	Capacitor, 200µF/400V	
C4	BOS230001-473	Capacitor, 0.047µF/630V	
C5	BOS220019-681	Capacitor, 680pF/1.5kV, 10%	
C6	BOS210031-336	Capacitor, 33µF/50V	
C7	BOS240011-221	Capacitor, 220pF/50V, 10%	
C8	BOS220010-104	Capacitor, 0.1µF/63V, 5%	
C10-13	BOS210046-108	Capacitor, 1000µF/35V	
C14	BOS220071-105	Capacitor, 1µF/63V, 10%	
C15	(Same as C8)		
C18	(Same as C8)		
C19	BOS220041-332	Capacitor, 3300pF/100V, 5%	
C20	BOS220011-224	Capacitor, 0.22µF/63V, 5%	
C21,22	(Same as C1)		
C23	BOS220075-334	Capacitor, 0.33µF/250V, 20%	
CR1	BOS10006-600	Diode, bridge, 600V, 4A	
CR2	BOS100014-600	Diode, BYV26C, 600V, 1A	
CR3	BOS100015-600	Diode, IN4937, 600V, 1A	
CR4	BOS110005-015	Diode, Zener, IN4744A, 15V/17mA, 1W, 5%	
CR5-8	BOS100065-075	Diode, IN4448, 0.2W	
CR10	BOS100038-200	Diode, BYV72-200, 200V, 30A	
CR11	BOS100049-045	Diode, 45V, 16A	
CR12	BOS150002-100	Diode, MCR72-3, 100V, 8A	
CR13	BOS110005-020	Diode, Zener, IN4747A, 20V, 1W, 5%	
CR14-16	(Same as CR5)		
J1	BOS450089-06	Connector, locking, 6 contact	
J2	BOS450089-12	Connector, locking, 12 contact	
JP1-3	BOS430064-22	Wire, bus, 22 AWG	
L1	BOS800279	Inductor, balanced	
L2	BOS800280	Inductor, common mode	
Q1	BOS130092	Transistor, HEXFET, IRF840, N-channel	

Ref	Part Number	Description
Q2	BOS130060	Transistor, NPN, ZTX649, TO-92
Q3	BOS130080	Transistor, FET, 2N7000, N-channel
Q4	BOS120024	Transistor, PNP, MPS4250, TO-92
R1	BOS300040-105	Resistor, 1 M $\Omega$ , 1/2W, 5%
R2	BOS300020-182	Resistor, 1.8k $\Omega$ , 1/4W, 5%
R3	BOS300040-471	Resistor, 470 $\Omega$ , 1/2W, 5%
R4	BOS300020-393	Resistor, 39k $\Omega$ , 1/4W, 5%
R5	BOS300020-750	Resistor, 75 $\Omega$ , 1/4W, 5%
R6	BOS300020-4.7	Resistor, 4.7 $\Omega$ , 1/4W, 5%
R7	BOS300020-102	Resistor, 1k $\Omega$ , 1/4W, 5%
R8	BOS320010-7680	Resistor, 768 $\Omega$ , 1/4W, 1%
R9, 10	BOS300020-130	Resistor, 13 $\Omega$ , 1/4W, 5%
R11, 12	BOS330020-15	Resistor, 0.15 $\Omega$ , 1W, 5%
R13	BOS330031-331	Resistor, 330 $\Omega$ , 1/4W, 5%
R14	BOS330031-472	Resistor, 4.7k $\Omega$ , 5W, 5%
R15	(Same as R5)	
R16	BOS330031-151	Resistor, 150 $\Omega$ , 5W, 5%
R17	BOS300020-330	Resistor, 33 $\Omega$ , 1/4W, 5%
R18	BOS300020-100	Resistor, 10 $\Omega$ , 1/4W, 5%
R19	BOS300020-103	Resistor, 10k $\Omega$ , 1/4W, 5%
R20	BOS300040-151	Resistor, 150 $\Omega$ , 1/2W, 5%
R21	BOS320010-6341	Resistor, 6.34k $\Omega$ , 1/4W, 1%
R22	BOS320010-6490	Resistor, 649 $\Omega$ , 1/4W, 1%
R23	BOS380002-201	Potentiometer, 200 $\Omega$
R24	(Same as R7)	
R25	BOS300020-682	Resistor, 6.8k $\Omega$ , 1/4W, 5%
R26	BOS300040-751	Resistor, 750 $\Omega$ , 1/2W, 5%
R27, 28	BOS300020-332	Resistor, 3.3k $\Omega$ , 1/4W, 5%
R29	(Same as R26)	
R30	(Same as R7)	
R31	BOS300020-560	Resistor, 56 $\Omega$ , 1/4W, 5%
R32	BOS300020-752	Resistor, 7.5k $\Omega$ , 1/4W, 5%
R33	BOS300020-622	Resistor, 6.2k $\Omega$ , 1/4W, 5%
R11	BOS390013	Thermistor, 10 $\Omega$ , 4A, 15%
R12	BOS390002	Thermistor, 220 $\Omega$ , 5%
R11	BOS390020	Varistor, 751, 387V/min

Use  
Date

OH

5-4 Ref	Part Number	Description	Use Comp.
T1	BOS800278	Transformer, UL544/VDE	
T2	BOS800056	Transformer, pulse	
VR1	BOS140017	IC, linear, TL431, adjustable shunt regulator	
2	BOS640007	Adhesive, RTV	
3	BOS500319	Cover (not shown)	
4	BOS500318	Heat Sink, diode	
5	BOS500133	Heat Sink, transistor	
6	BOS220058	Insulator (not shown, used on Q1, CR10-12)	
7	BOS530008	Label, model number (not shown, used on C3)	
8	BOS530072	Label, serial number (not shown, used on item 5)	
9	BOS600006-0375	Screw, pan head, 8-32 x 0.375 L (not shown, used on item 3)	
10	BOS610011	Spacer, glass, 0.220 x 0.062	
11	BOS500062	Spring Clip (used on Q1, CR10 to 12)	
12	BOS610059-2200	Standoff	
13	BOS840021	Tape, 0.0625 x 0.500 L (not shown, used on L2)	
14	BOS600067	Washer, flat, #8 (not shown, used on item 3)	
15	BOS600083	Washer, lock, #8 (not shown, used on item 3)	

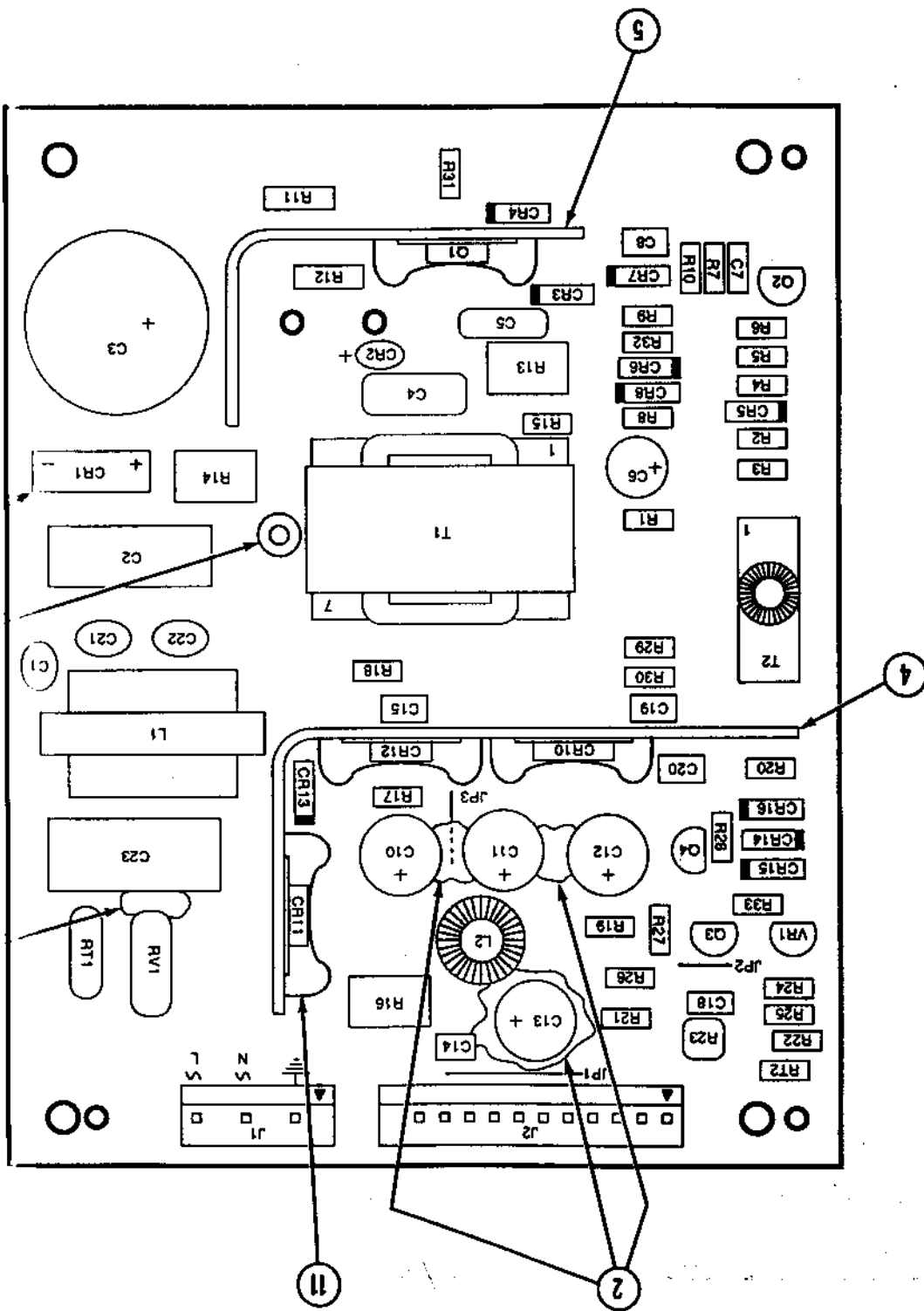
(Sheet 1 of 2)

Part Number 803726-01

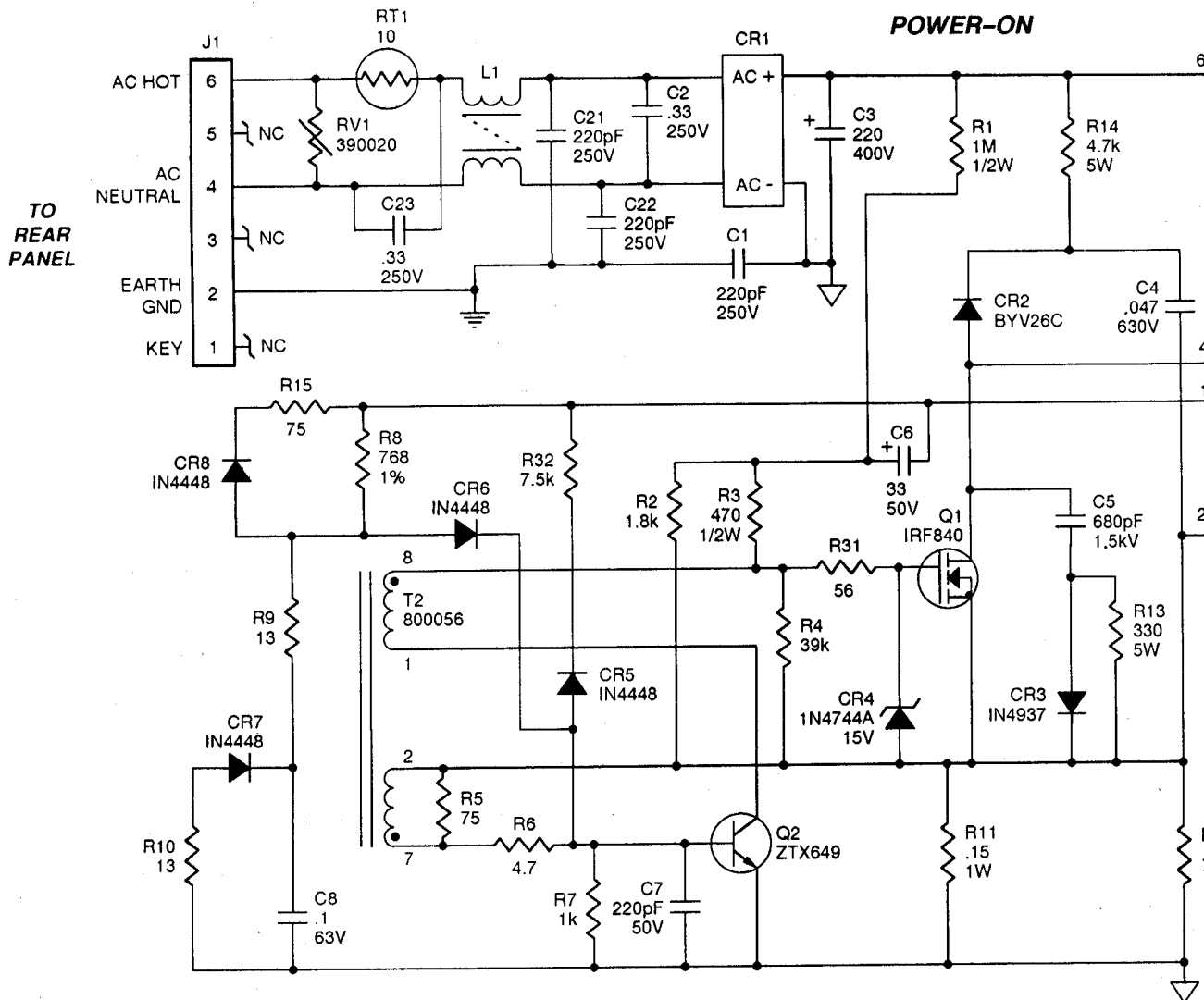
Power Supply Assembly

Figure 5-4

A2

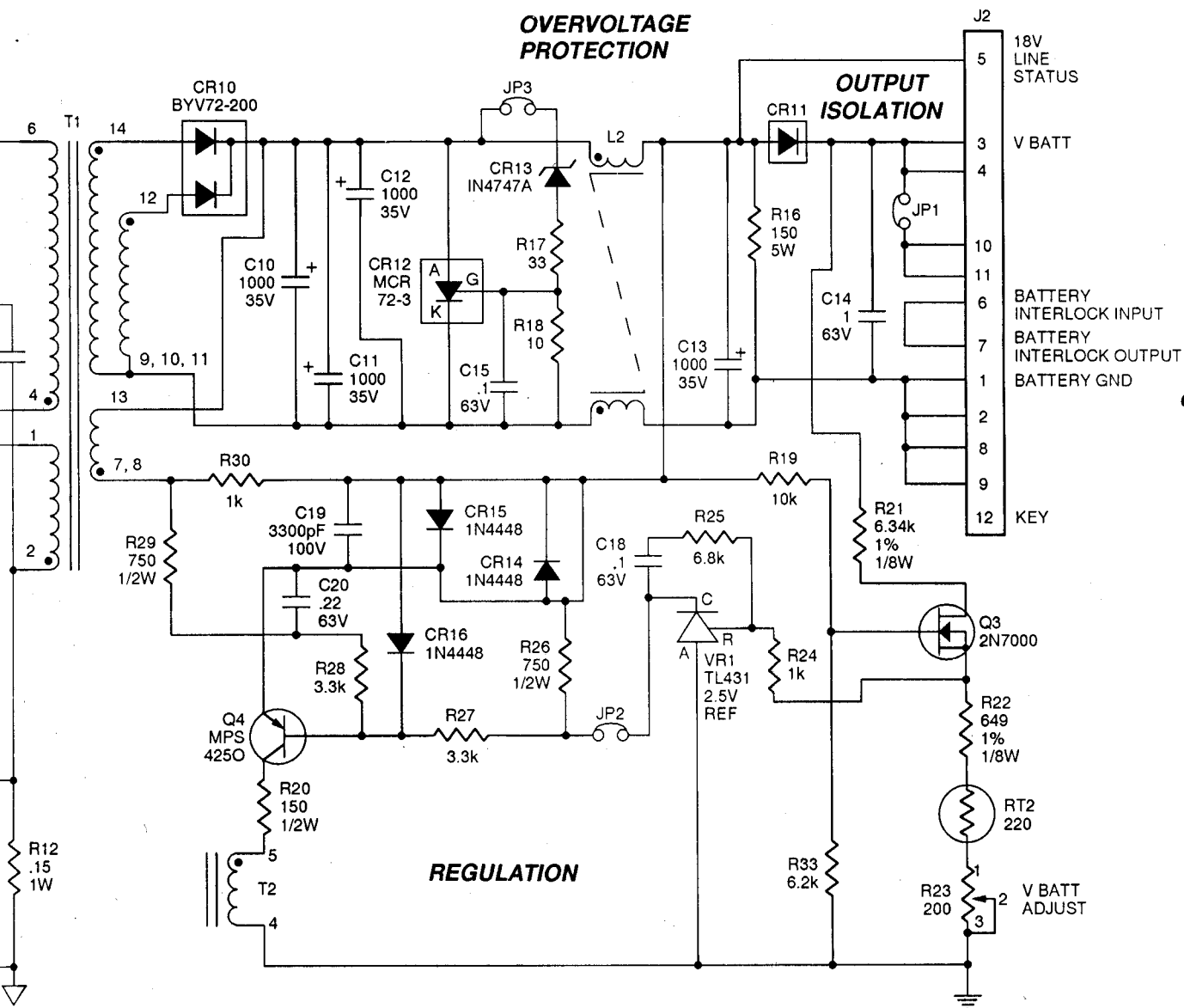


LIFEPAK 9 defibrillator/monitor





### BATTERY AND BATTERY CHARGE INDICATOR



TO  
BATTERY  
PACK  
P28  
and  
POWER  
CONVERSION  
PCB  
P13

5-5 Ref	Part Number	Description	Use
---------	-------------	-------------	-----

A3	803724-03	Power Conversion PCB Assembly	
C1	202210-000	Capacitor, 4700pF, 9kV	
C2	201628-018	Capacitor, 1.0µF/50V, 5%	
C3,4	200893-046	Capacitor, 1.0µF/50V, 10%	
C5	201628-077	Capacitor, 0.68µF/50V, 10%	
C6	200264-010	Capacitor, 0.01µF/50V, 20%	
C7,8	202102-030	Capacitor, electrolytic, 3300µF/25V, 20%	
C9	201554-068	Capacitor, electrolytic, 22000µF/25V, 100%	
C10	202068-001	Capacitor, 20µF/50V, 5%	
C11,12	201628-000	Capacitor, 0.001µF/50V, 5%	
C13	(Same as C2)		
C14	202068-027	Capacitor, 20µF/50V, 20%	
C15	200901-031	Capacitor, 560pF/50V, 5%	
C16	(Same as C6)		
C17	(Same as C11)		
C18	200205-035	Capacitor, electrolytic, 10µF/35V, +50%	
C19	201628-072	Capacitor, 0.1µF/50V, 10%	
C20	200901-030	Capacitor, 470pF/50V, 5%	
C21	(Same as C6)		
C22	200901-058	Capacitor, 0.1µF/50V, 5%	
C23	NOT INSTALLED		
C24,25	(Same as C7)		
C26	(Same as C18)		
C27,28	(Same as C6)		
C29	(Same as C22)		
C30	(Same as C14)		
C31	202102-004	Capacitor, electrolytic, 3300µF/6.3V, 20%	
C32	202102-021	Capacitor, electrolytic, 2200µF/16V, 20%	
C33	(Same as C19)		
C34	(Same as C5)		
C35	(Same as C3)		
C36,37	(Same as C6)		
C38	201628-006	Capacitor, 0.01µF/50V, 5%	
C39	(Same as C6)		
C40	(Same as C22)		
C41	(Same as C38)		
C42	(Same as C6)		

5-5 Ref	Part Number	Description	Qty
C43	(Same as C22)		
C44/45	(Same as C6)		
C46	(Same as C22)		
C47-50	(Same as C6)		
C51	201628-060	Capacitor, 0.001µF/50V, 10%	
C52,53	(Same as C6)		
C54	(Same as C38)		
C55	(Same as C22)		
C56	(Same as C38)		
C57,58	(Same as C6)		
C59	(Same as C2)		
C60	(Same as C19)		
C61	(Same as C32)		
CR1	200881-004	Diode, RA2813, 250ns, PIV 12K	
CR2	200635-053	Diode, 1.5KE82A, 113V	
CR3	200971-000	Diode, IN914B, 8ns, PIV 75	
CR4	200959-003	Diode, 2N2324, 100V	
CR5	(Same as CR3)		
CR6	200083-002	Diode, 1N5819, 1A/40V	
CR7	201528-005	Diode, rectifier, 8A/100V	
CR8	(Same as CR3)		
CR9,10	NOT INSTALLED		
CR11	201527-000	Wire, jumper, 0 Ω, 1/4W, 5%	
CR12	201128-000	Diode, 3XF1, 300ns, PIV 100	
CR13-15	(Same as CR3)		
CR17-19	(Same as CR3)		
CR20-23	200605-010	Diode, Zener, 1N4738A, 55mA/8.2V	
CR24	(Same as CR3)		
CR25	200086-019	Diode, Zener, 1N4104, 24.8µA/10V	
CR26	201391-005	Diode, SB320, 3A, PIV 80	
CR27	200083-004	Diode, 1N5821, 3A/30V	
CR28	200103-015	Diode, Zener, MPTF-22, 40A/22V	
CR29	200658-002	Diode, MR812, 200ns, PIV 200	
CR30	NOT INSTALLED		
CR31	(Same as CR3)		
CR32	200086-011	Diode, Zener, 1N4625, 55mA/5.1V	
CR33-36	(Same as CR3)		
CR37-41	200991-000	Diode, 1N5711, 15mA	
CR42/43	(Same as CR20)		

Use  
C43-50

5-5 Ref	Part Number	Description
CR44,45	(Same as CR37)	
CR46	(Same as CR3)	
CR47-53	(Same as CR20)	
CR54	200605-018	Diode, Zener, IN4746A, 250mA/18V
CR55	(Same as CR20)	
CR56	(Same as CR37)	
CR57	(Same as CR3)	
CR58	(Same as CR20)	
CR59	(Same as CR37)	
F1	202293-000	Fuse, fast blow, 10A/125V, pigtail
J3	201582-002	Connector, receptacle, 25 contact
J10,11	201504-003	Terminal, quick connect, 0.187 W/0.020 T
J12	202151-200	Connector, locking, 2 contact
J13	202151-204	Connector, locking, 6 contact
J15,16	(Same as J10)	
J17	201191-219	Connector, 14 contact
J18	202128-024	Connector, 2 contact
P14	201678-015	Connector, DIP, 64 contact
Q1,2	201696-000	Transistor, FET, IRF540, TO-220AB
Q3	200942-000	Transistor, NPN, 2N2222A, TO-18
Q4	200994-001	Transistor, FET, IRF9531, TO-220
Q5	201738-001	Transistor, FET, VP0106N3, TO-92
Q6-9	200585-001	Transistor, FET, VN0106N3, TO-92
Q10	(Same as Q4)	
Q11	202076-000	Transistor, FET, IRFD120, N-channel
Q12	(Same as Q1)	
Q13	(Same as Q6)	
Q14	(Same as Q5)	
Q15	(Same as Q11)	
R1,2	801884-00	Resistor, 64MΩ, 1W, 1%
R3	200054-370	Resistor, 71.5KΩ, 1/8W, 1%, RN55C
R4	200054-341	Resistor, 35.7KΩ, 1/8W, 1%, RN55C
R5	200054-288	Resistor, 10KΩ, 1/8W, 1%, RN55C
R6	200676-030	Resistor, 120Ω, 3W, 5%

11-6  
CHDR

CR4

5-5 Ref	Part Number	Description	11-27 CMTA
R7	200054-193	Resistor, 1k $\Omega$ , 1/8W, 1%, RN55C	
R8	200054-091	Resistor, 86.6 $\Omega$ , 1/8W, 1%, RN55C	
R9		(Same as R7)	
R10	200054-317	Resistor, 20k $\Omega$ , 1/8W, 1%, RN55C	
R11	200054-388	Resistor, 110k $\Omega$ , 1/8W, 1%, RN55C	
R12	200054-250	Resistor, 4.02k $\Omega$ , 1/8W, 1%, RN55C	
R13	200054-538	Resistor, 4.12M $\Omega$ , 1/8W, 1%, RN55C	
R14	200054-126	Resistor, 200 $\Omega$ , 1/8W, 1%, RN55C	
R15	200054-222	Resistor, 2k $\Omega$ , 1/8W, 1%, RN55C	
R16,17	200054-001	Resistor, 10.0 $\Omega$ , 1/8W, 1%, RN55C	
R18		(Same as R5)	
R19		(Same as R7)	
R20	200054-480	Resistor, 1M $\Omega$ , 1/8W, 1%, RN55C	
R21,22		(Same as R3)	
R23		(Same as R15)	
R24	200054-328	Resistor, 26.1k $\Omega$ , 1/8W, 1%, RN55C	
R25		(Same as R7)	
R26	200054-239	Resistor, 3.01k $\Omega$ , 1/8W, 1%, RN55C	
R27	200054-353	Resistor, 47.5k $\Omega$ , 1/8W, 1%, RN55C	
R28		(Same as R15)	
R29		(Same as R5)	
R30	200054-306	Resistor, 15.4k $\Omega$ , 1/8W, 1%, RN55C	
R31		(Same as R7)	
R33	200054-259	Resistor, 4.99k $\Omega$ , 1/8W, 1%, RN55C	
R34		(Same as R7)	
R35		(Same as R5)	
R36	200054-384	Resistor, 100k $\Omega$ , 1/8W, 1%, RN55C	
R37,38		(Same as R5)	
R39	200054-355	Resistor, 49.9k $\Omega$ , 1/8W, 1%, RN55C	
R40		(Same as R15)	
R41	200054-348	Resistor, 42.2k $\Omega$ , 1/8W, 1%, RN55C	
R42		(Same as R39)	
R43		(Same as R41)	
R44	200054-244	Resistor, 3.40k $\Omega$ , 1/8W, 1%, RN55C	
R45		(Same as R16)	
R46,47		(Same as R7)	
R48,49	200270-000	Resistor, 0.10 $\Omega$ , 2W, 5%	
R50		(Same as R5)	

1974  
 Non  
 Guide

5-5 Ref	Part Number	Description
R51	(Same as CR11)	
R52	(Same as R5)	
R53	200054-310	Resistor, 16.9kΩ, 1/8W, 1%, RN55C
R54,55	(Same as R7)	
R56	(Same as R39)	
R57	(Same as R7)	
R58-60	(Same as R5)	
R61	(Same as R7)	
R62	(Same as R48)	
R63	(Same as R36)	
R64	(Same as R20)	
R65	(Same as R12)	
R66	200054-413	Resistor, 200kΩ, 1/8W, 1%, RN55C
R67	(Same as R20)	
R68	200054-265	Resistor, 5.76kΩ, 1/8W, 1%, RN55C
R69	(Same as R5)	
R70	(Same as R20)	
R71	(Same as R10)	
R72,73	(Same as R20)	
R74	(Same as R5)	
R75	(Same as R10)	
R76	(Same as R5)	
R77	(Same as R33)	
R78	(Same as R10)	
R79	200054-334	Resistor, 30.1kΩ, 1/8W, 1%, RN55C
R84	(Same as R15)	
R85	(Same as R7)	
R86	(Same as R10)	
R87	200054-508	Resistor, 2MΩ, 1/8W, 1%, RN55C
R88,89	(Same as R20)	
R90	(Same as R10)	
R91	(Same as R7)	
R92	(Same as R5)	
R93	200054-412	Resistor, 196kΩ, 1/8W, 1%, RN55C
R94	(Same as R7)	
R95	(Same as R26)	
R96	(Same as R7)	
R97	(Same as R5)	
R98,99	200054-226	Resistor, 2.21kΩ, 1/8W, 1%, RN55C

5-5 Ref	Part Number	Description
R100,101		(Same as R5)
R102		(Same as R7)
R103		(Same as R98)
R104		(Same as R5)
R105		(Same as R7)
R106		(Same as R5)
R107		(Same as R7)
R108-111		(Same as R5)
R112,113		(Same as R7)
R114		(Same as R98)
R115		(Same as R7)
R116		(Same as R98)
R118	200054-097	Resistor, 100Ω, 1/8W, 1%, RN55C
R119		(Same as R5)
R120		(Same as R7)
R121		(Same as R5)
R123		(Same as R44)
R124		(Same as R5)
R126,127		(Same as R5)
R128		(Same as R7)
R129		(Same as R5)
R130		(Same as R98)
R131		(Same as R5)
R132		(Same as R33)
R133	200054-280	Resistor, 8.25kΩ, 1/8W, 1%, RN55C
T1	804295-01	Transformer, flyback
T2	804294-01	Transformer, power supply
T3	801853-02	Transformer, test load
U1	201444-000	IC, linear, LM358N, op amp
U2	200345-000	IC, linear, LM393, op amp
U3	202050-001	IC, linear, 2843N, pulse-width modulator
U4	200933-000	IC, linear, LM336BZ, voltage regulator, 2.5V, TO-92
U5,6		(Same as U2)
U7	202086-000	IC, linear, AD584JH, voltage regulator, TO-99
U8	200669-002	IC, linear, LM339, comparator
U9	202078-003	IC, interface, TLC1541, A/D converter
U10	201577-000	IC, digital, 74HC08, NAND gate

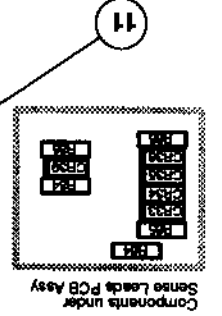
5-5 Ref	Part Number	Description	Use Code
U11,12	201469-000	IC, digital, 74HC00, NAND gate	
U13	201705-000	IC, digital, 74HC14, inverter	
U14	202142-000	IC, digital, 74HC27, NOR gate	
U15	201608-000	IC, digital, 74HC02, NOR gate	
U16	201945-000	IC, digital, 74HC86, exclusive OR gate	
U17	(Same as U1)		
U18	200361-001	IC, digital, 7541KN, D/A converter	
U19,20	202085-000	IC, digital, 74HC164, shift register	
U21	(Same as U4)		
2	202221-000	Adhesive, hot melt (not shown, used on C7-9, C24-25)	
3	202091-035	Heat Sink	
4	201152-002	Insulator, component mount, TO-5 (not shown, used on CR4)	
5	201797-003	Insulator, slip-pad, transistor, TO-220	
6	800943-09	Label, symbol, international, high voltage (not shown, used on T1)	
7	201508-00	Nut, kep, lock, 4-40 x 0.312 L	
8	202245-001	Rivnut, dome head, 3/32 D x 0.187 L (not shown, used on P14)	
9	201111-038	Screw, binding head, nylon, 4-40 x 0.375 L	
10	201874-005	Screw, pan head, 4-40 x 0.312 L	
11		Sense Leads PCB Assembly (NOT REPAIRABLE)	
12	201756-012	Tabing, PVC, clear #10, 105°C (used on CR1)	
13	201535-027	Wire, 300V, AWG 22, white (used on CR1)	



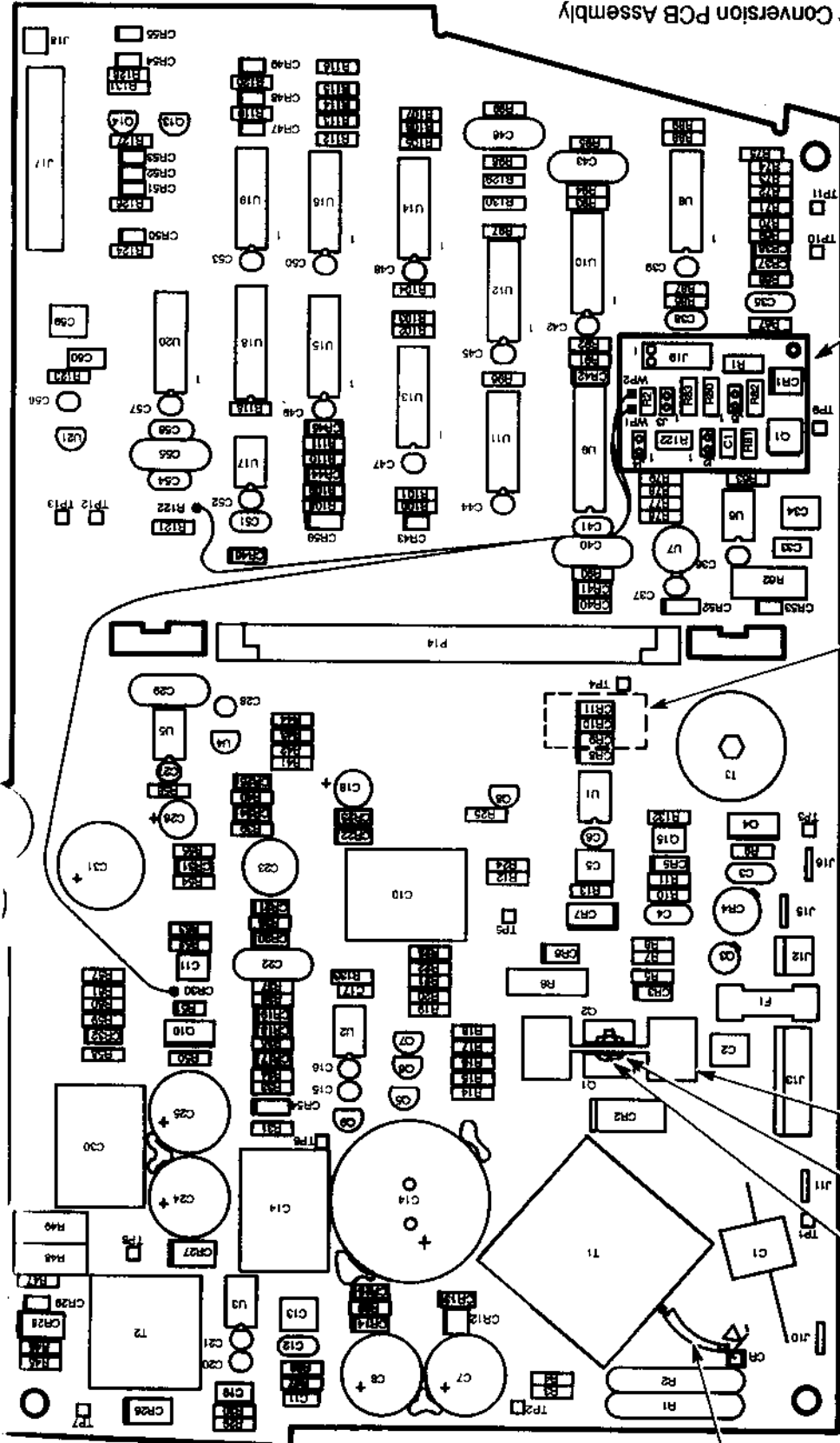
Figure 5-5 Power Conversion PCB Assembly  
Part Number 803724-03  
(Sheet 1 of 4)

A3

SENSE LEADS PCB ASSY



NOT INSTALLED



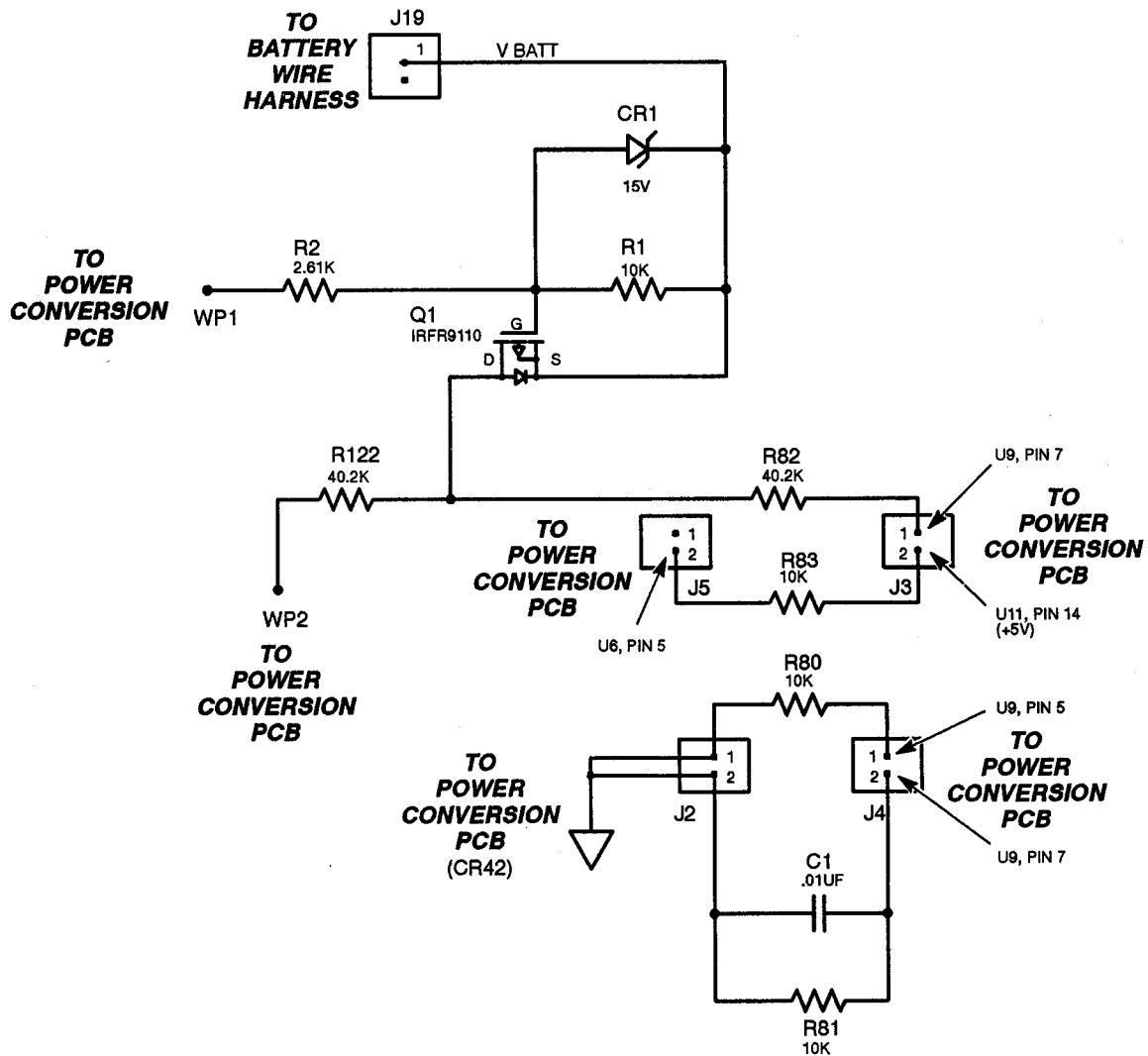
3

5

7

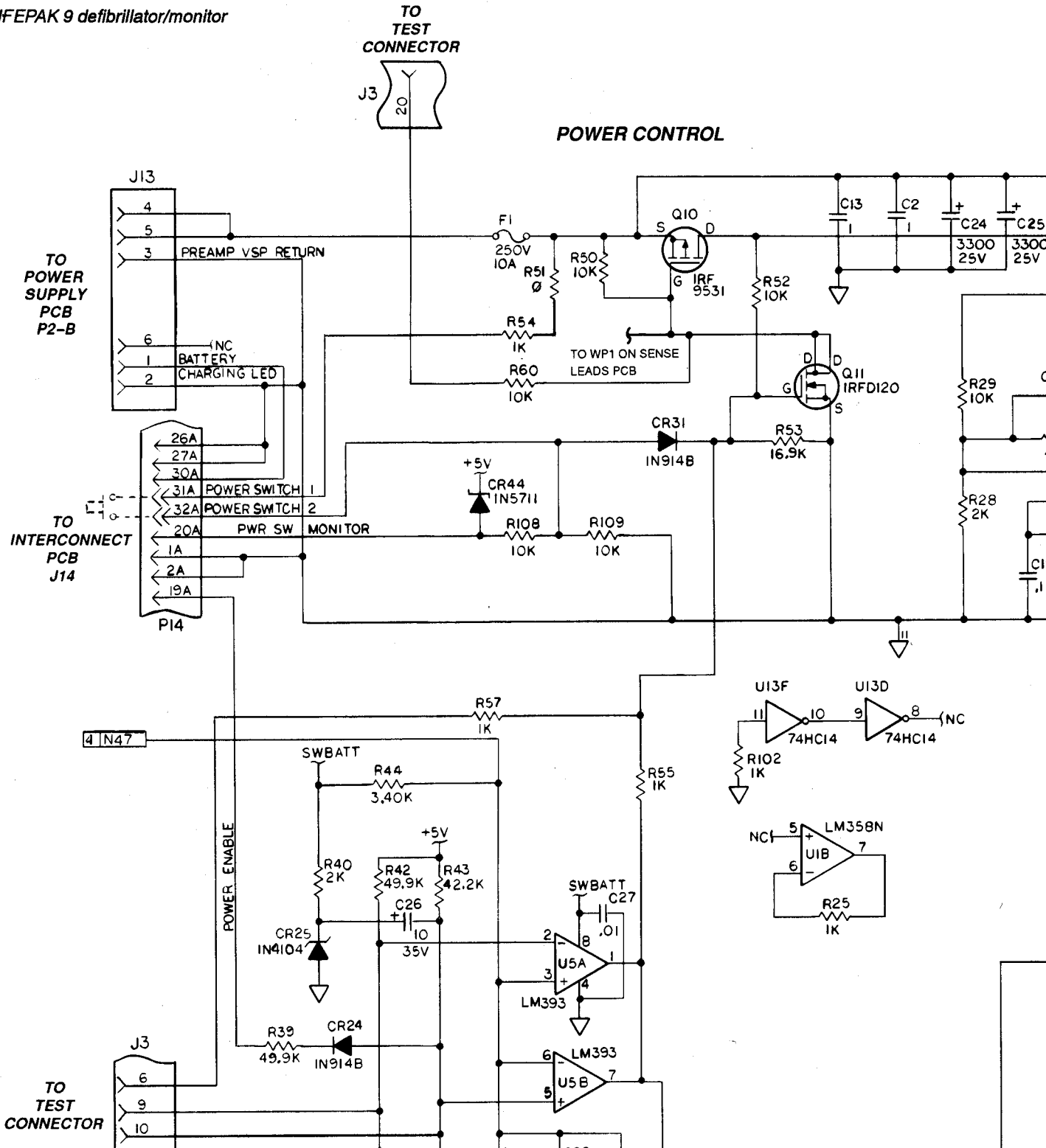
12

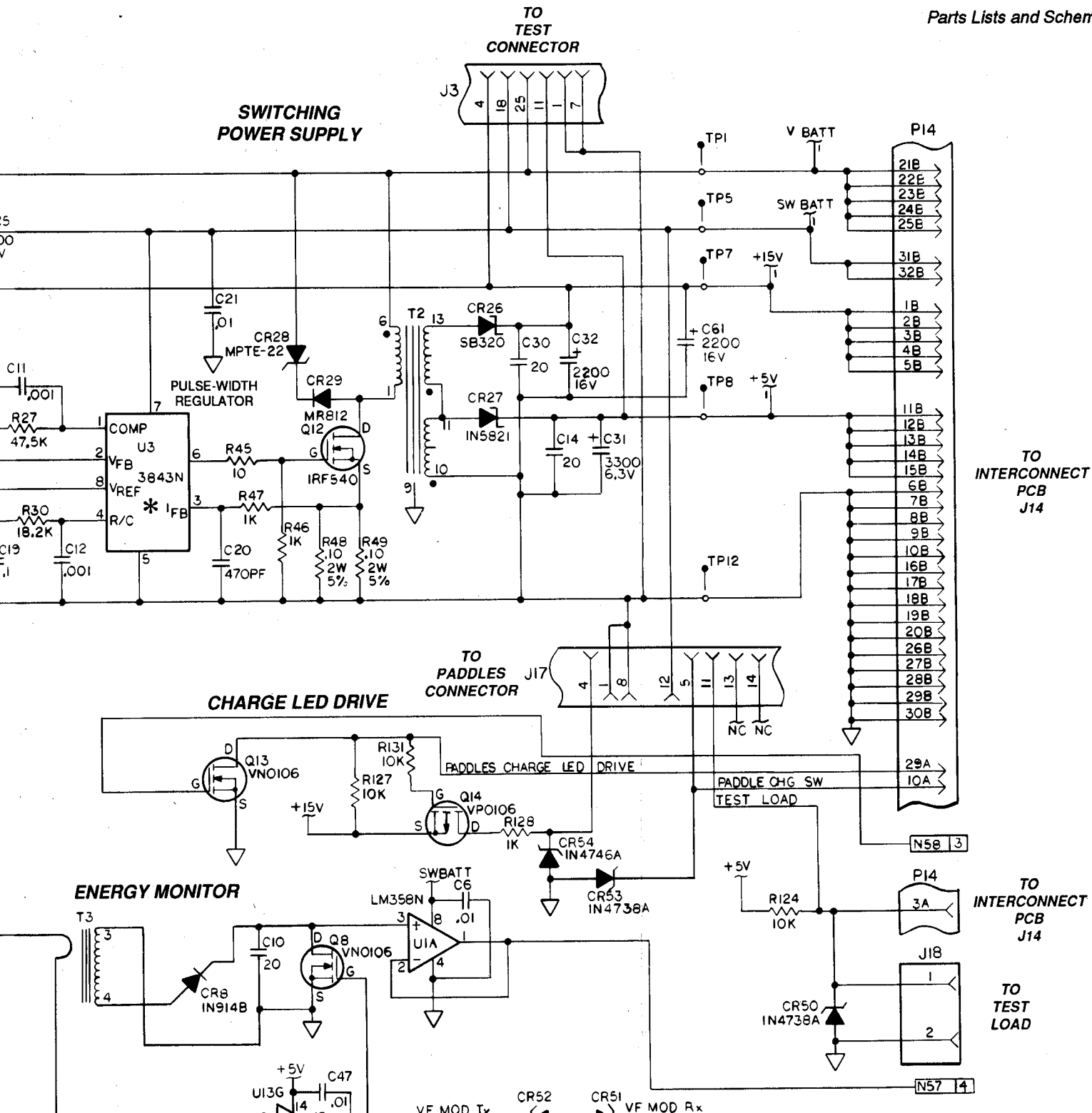
13



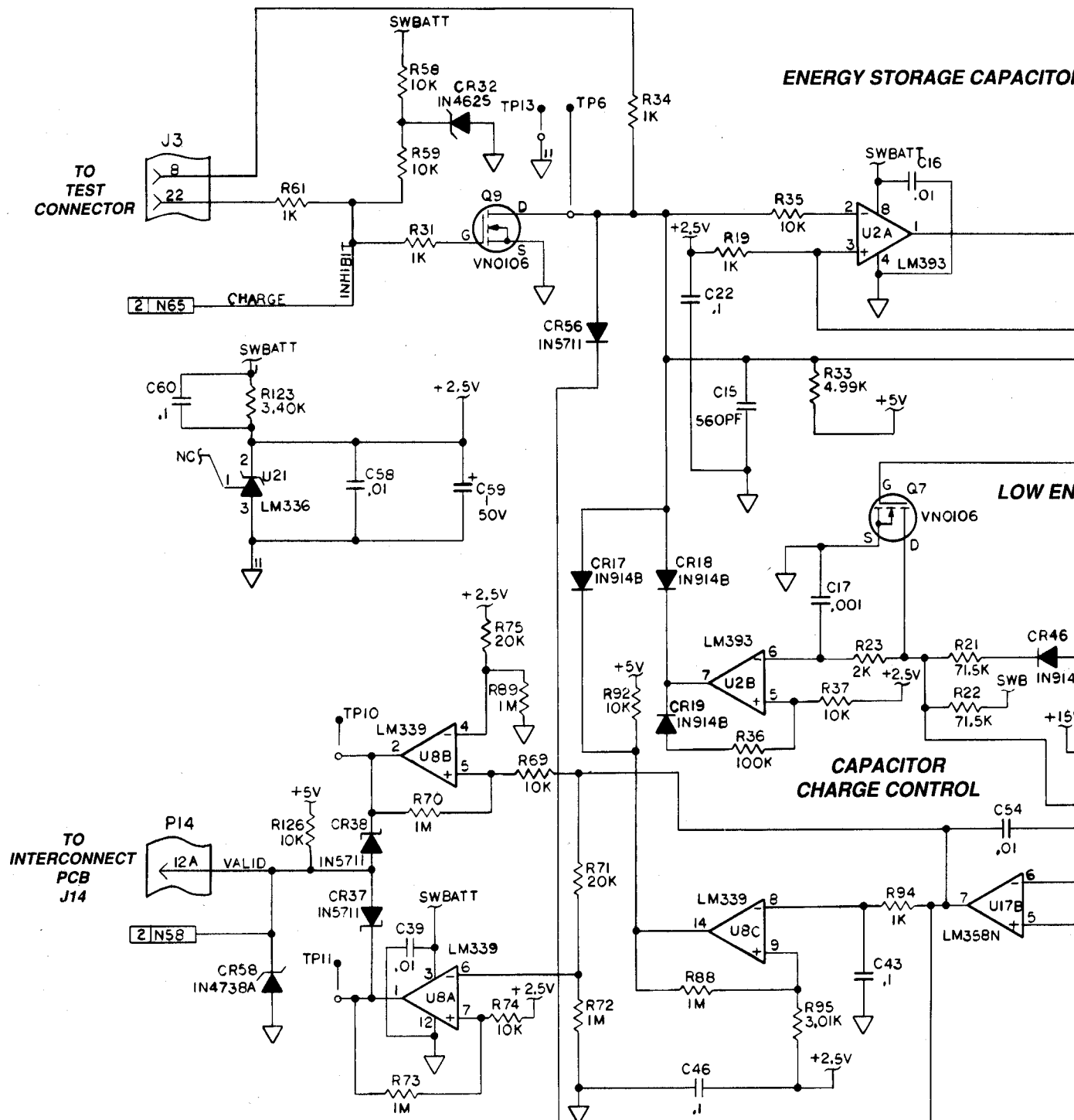
Sense Leads PCB Assembly

LIFEPAK 9 defibrillator/monitor

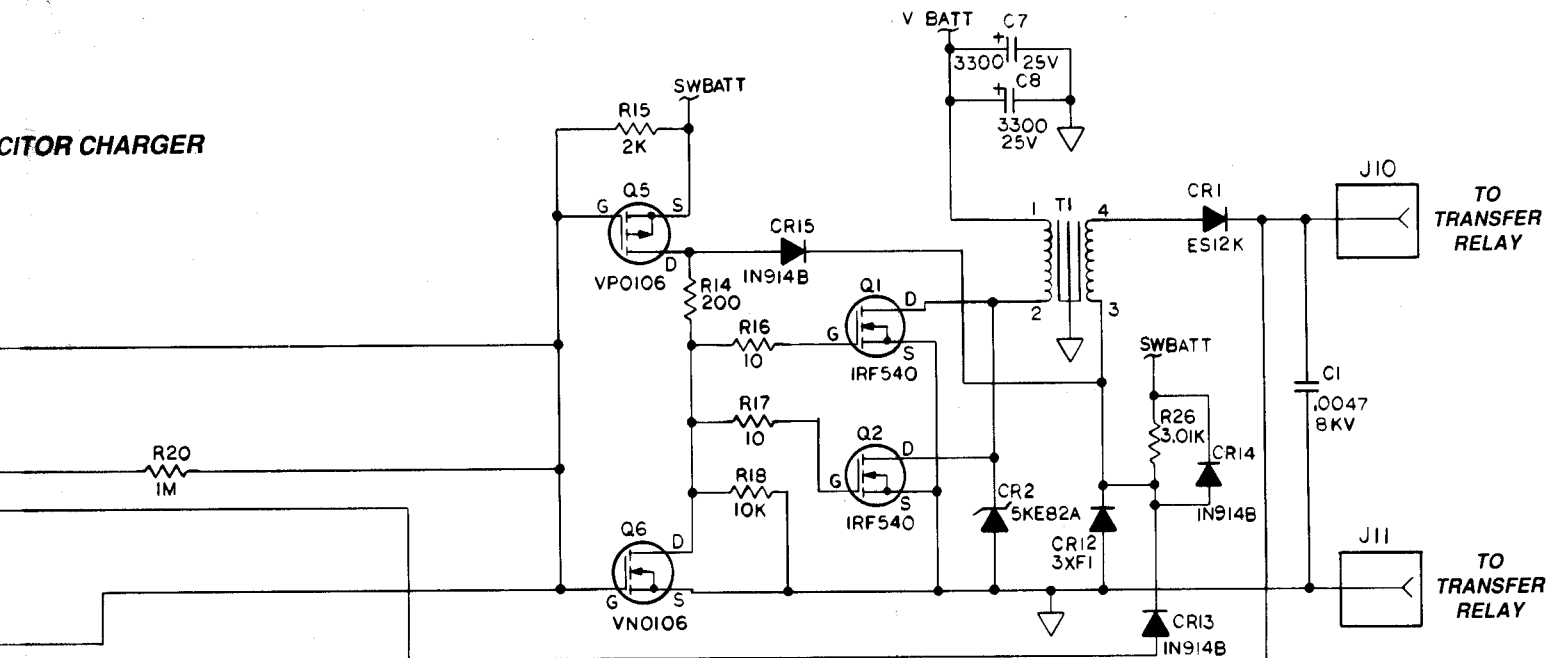




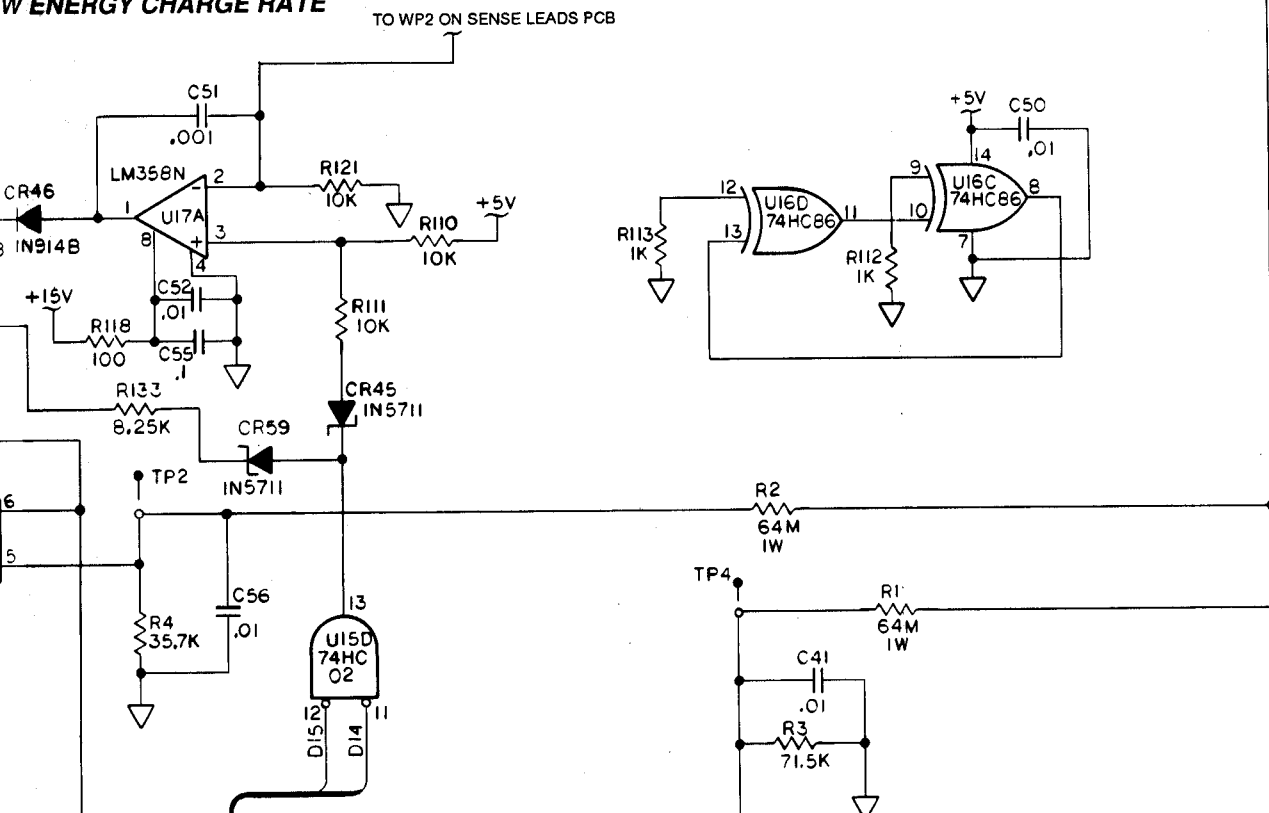
EXTERNAL CONTROL INPUT



CAPACITOR CHARGER



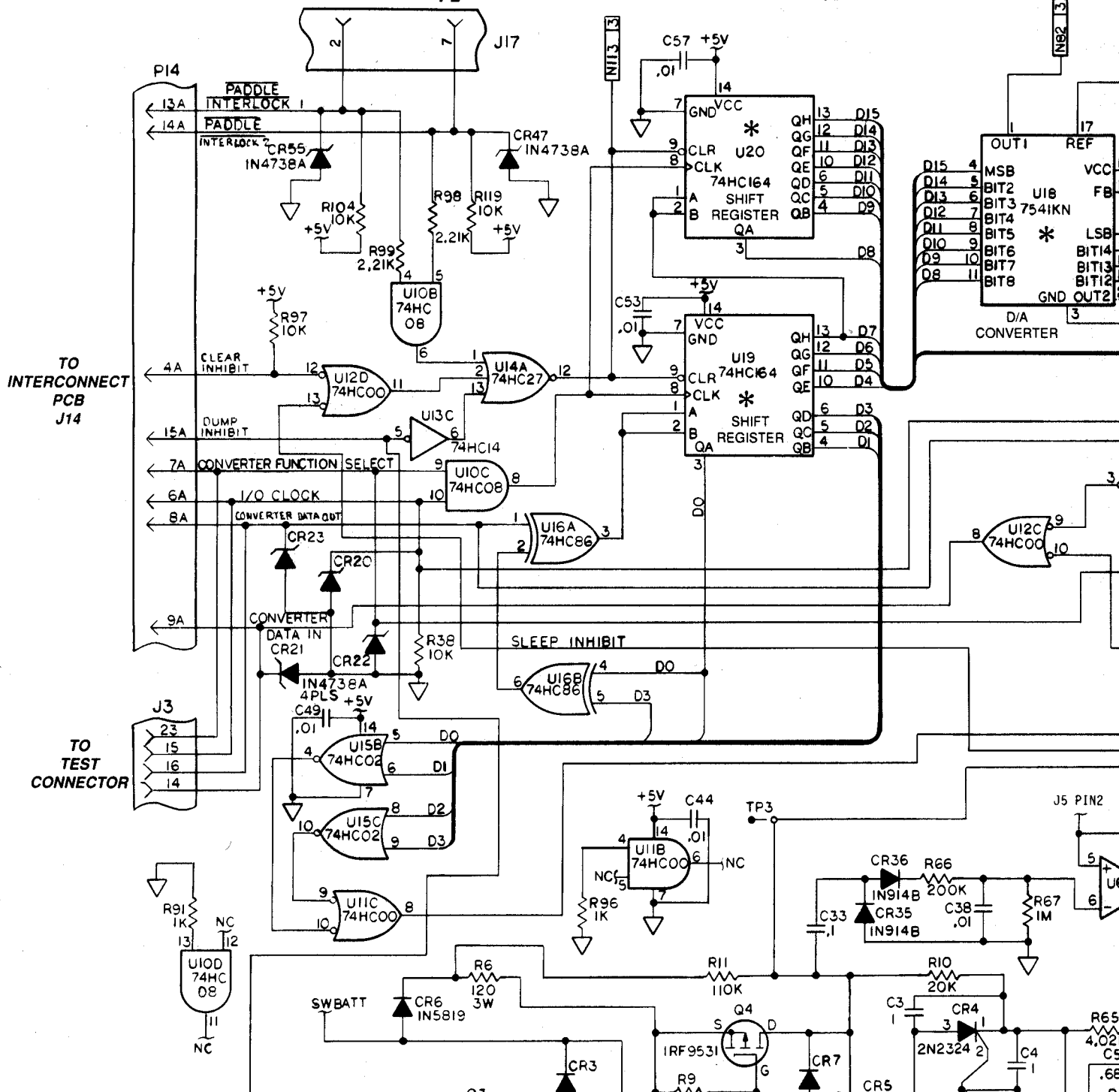
W ENERGY CHARGE RATE



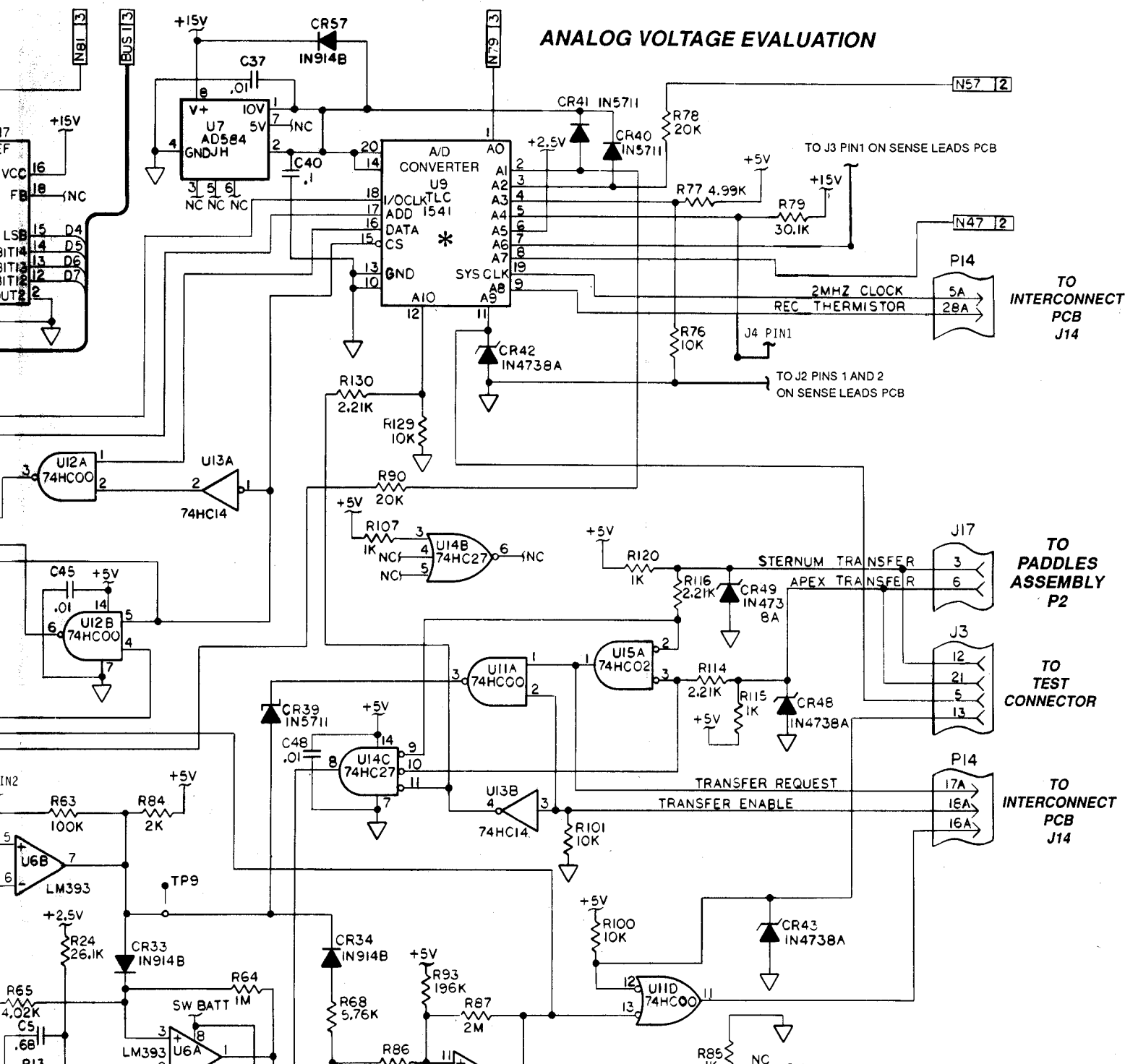
LIFEPAK 9 defibrillator/monitor

TO  
PADDLES  
ASSEMBLY  
P2

SERIAL DATA INTERFACE



### ANALOG VOLTAGE EVALUATION

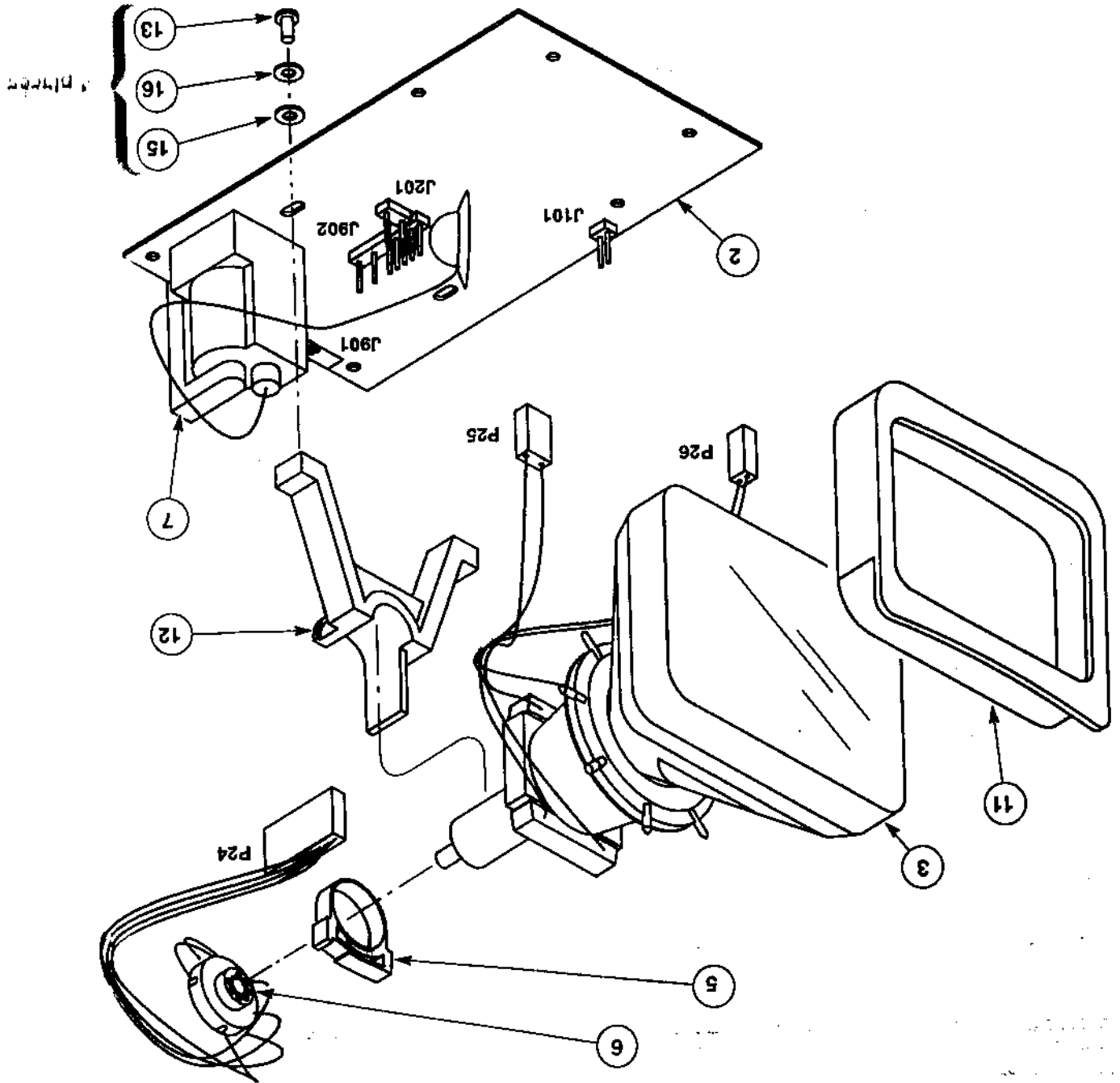




5-6 Ref	Part Number	Description	Use Cont.
A4	803706-00	Display Assembly	REF
2	DOT6-002-1678	Monitor PCB Assembly	
3	DOT73027887-913	CRT/Yoke Assembly	
4	DOT-048-0110	Cable Tie, nylon (not shown, used in five places)	
5	DOT15005406-000	Clamp, hose, nylon	
6	DOT6-004-1150	CRT Connector Assembly	
7	DOT6-004-0452	Deflection Coil Assembly	
8	DOT5-014-0393	Label, HV caution (not shown, used on item 3)	
9	DOT5-014-0430	Label, model, serial number (not shown, used in item 3)	
10	DOT32028970-007	Label, X-ray warning (not shown, used in item 3)	
11	804117-00	Mount, CRT, front	
12	804118-00	Mount, CRT, rear	
13	DOT3-011-0520	Screw, pan head, 8-32 x 0.357 L	
14	DOT2-049-0256	Tape, 3/4in adhesive (not shown, used in item 3)	
15	DOT3-013-0190	Washer, flat, #8	
16	DOT3-013-0182	Washer, lock, #8	

Figure 5-6  
Display Assembly  
Part Number 803706-00  
(Sheet 1 of 4)

A4



Use  
Code  
Qty  
Ref

5-6 Ref	Part Number	Description	Use Code
C101	DOT1-012-2455	Capacitor, 0.1µF, 50V, 20%	
C102	DOT1-012-2341	Capacitor, 1000µF, 25V	
C103	DOT1-012-2359	Capacitor, 0.15µF, 100V, 5%	
C104	DOT1-012-2454	Capacitor, 0.01µF, 50V, 20%	
C105	DOT1-012-2358	Capacitor, 100µF, 50V	
C106, 107	DOT61220027-000	Capacitor, 0.1µF, 50V	
C108	DOT1-012-2511	Capacitor, 5600pF, 50V, 5%	
C109	DOT1-012-0300	Capacitor, 100pF, 500V, 5%	
C110	(Same as C101)		
C111	DOT61025449-019	Capacitor, electrolytic, 22µF, 16V, 20%	
C112	DOT1-012-2444	Capacitor, 1000µF, 16V, 20%	
C201	DOT1-012-2403	Capacitor, 1000pF, 100V	
C202	DOT1-012-2680	Capacitor, 1000pF, 100V, 5%	
C203	DOT1-012-2211	Capacitor, 10µF, 25V	
C204	DOT1-012-2347	Capacitor, 470µF, 35V	
C205-207	(Same as C101)		
C208	DOT61220013-002	Capacitor, 0.0047µF, 1kV, 5%	
C209	DOT61220013-001	Capacitor, 0.01µF, 1kV, 5%	
C210	DOT61220016-010	Capacitor, 2.2µF, 160V, 5%	
C211	DOT61220016-009	Capacitor, 1µF, 160V, 5%	
C212	DOT1-012-2419	Capacitor, 220pF, 500V, 5%	
C213	(Same as C101)		
C214	(Same as C105)		
C301	(Same as C104)		
C302	DOT1-012-2214	Capacitor, 0.01µF, 1000V, 20%	
C303	DOT1-012-2228	Capacitor, 3.3µF, 250V	
C304, 305	(Same as C302)		
C306	DOT1-012-2375	Capacitor, 0.1µF, 500V, 20%	
C307	(Same as C303)		
C401	(Same as C203)		
C402	(Same as C101)		
C406, 407	(Same as C101)		
C408	DOT1-012-2250	Capacitor, 47µF, 100V	
C501, 502	(Same as C101)		
C503	DOT1-012-2627	Capacitor, 100µF, 35V, 20%	
C504	(Same as C101)		
DOT6-002-1678 Monitor PCB Assembly (part of Display Assembly)			

5-6 Ref	Part Number	Description	Use Cable
C505	(Same as C503)	(Same as C101)	
D101	DOT1-021-0545	Diode, 1N4002, 100V, 1A	
D201	DOT1-021-0517	Diode, Zener, Z0517, 18V	
D202	DOT1-021-0497	Diode, 1N5282	
D203	DOT1-021-0542	Diode, UF5404	
D301	DOT58026488-002	Diode, RGF01-018, 1800V, 100mA	
D302	DOT1-021-0507	Diode, 1N4937, 600V, 1A	
D303	DOT58005767-019	Diode, Zener, 1N997, 33V, 5%	
D401-404	DOT1-021-0550	Diode, 1N916, 100V, 75mA, 2%	
D501	(Same as D101)		
D502, 503	DOT1-021-0543	Diode, UF4004, 400V	
D506	(Same as D202)		
H201	DOT1-015-5081	Heat Sink	
H401	DOT1-015-5134	Heat Sink	
H501	(Same as H201)		
J101	DOT30005029-002	Connector, 2 contact	
J201	DOT30005029-003	Connector, 3 contact	
J901	DOT30257732-020	Connector, 20 contact	
J902	DOT1-034-0416	Connector, 9 contact	
L201	DOT1-016-0463	Coil, horizontal linearly	
L401	DOT1-016-0397	Coil, fixed, 8.2µH	
L501	DOT29002450-005	Ferrite Bead	
Q201	DOT1-015-1144	Transistor, 2N3904, NPN	
Q202	DOT1-015-1145	Transistor, 2N3906, PNP	
Q203	(Same as Q201)		
Q204	(Same as Q202)		
Q205	DOT58025451-025	Transistor, FET, BUZ60, 400V, TO 220	
Q401	DOT1-015-1205	Transistor, 2N3053A, NPN	
Q501	(Same as Q202)		
Q502	DOT58025451-026	Transistor, FET, MTP10N15, 10A, 150V	
R102	DOT1-011-2597	Resistor, 330Ω, 1/4W, 5%	
R104	DOT1-011-2551	Resistor, 10Ω, 1/4W, 5%	
R105	DOT1-011-2555	Resistor, 100kΩ, 1/4W, 5%	

5-6 Ref	Part Number	Description	Use Code
R106	DOT1-011-5758	Potentiometer, 100k $\Omega$ , 1/8W, 20%	3
R107	DOT1-011-2553	Resistor, 1k $\Omega$ , 1/4W, 5%	3
R108	DOT1-011-2613	Resistor, 4.7k $\Omega$ , 1/4W, 5%	3
R109	DOT1-011-2862	Resistor, 300k $\Omega$ , 1/4W, 5%	3
R110	DOT1-011-2608	Resistor, 390k $\Omega$ , 1/4W, 5%	3
R111	DOT1-011-5759	Potentiometer, 250k $\Omega$ , 1/8W, 20%	3
R112	DOT1-011-2556	Resistor, 1M $\Omega$ , 1/4W, 5%	3
R113	(Same as R106)		
R114	DOT1-011-2599	Resistor, 33k $\Omega$ , 1/4W, 5%	3
R115	DOT1-011-2614	Resistor, 47k $\Omega$ , 1/4W, 5%	3
R116	DOT1-011-2582	Resistor, 220k $\Omega$ , 1/4W, 5%	3
R117	DOT1-011-2702	Resistor, 3.3k $\Omega$ , 1/4W, 5%	3
R118-120	DOT1-011-2620	Resistor, 5.6k $\Omega$ , 1/4W, 5%	3
R121	DOT1-011-2704	Resistor, 1 $\Omega$ , 1/2W, 5%	3
R122	DOT1-011-2258	Resistor, 330 $\Omega$ , 1/2W, 5%	3
R201	DOT1-011-2579	Resistor, 220 $\Omega$ , 1/4W, 5%	3
R202	(Same as R102)		
R203	DOT1-011-2552	Resistor, 100 $\Omega$ , 1/4W, 5%	3
R204	(Same as R107)		
R205	(Same as R108)		
R206	(Same as R105)		
R207	(Same as R107)		
R208	DOT1-011-2580	Resistor, 2.2k $\Omega$ , 1/4W, 5%	3
R209	(Same as R104)		
R210	(Same as R203)		
R211	DOT1-011-2619	Resistor, 560 $\Omega$ , 1/4W, 5%	3
R212	(Same as R107)		
R213	(Same as R118)		
R214	DOT1-011-2554	Resistor, 10k $\Omega$ , 1/4W, 5%	3
R215	(Same as R107)		
R216	(Same as R214)		
R217	(Same as R105)		
R218	(Same as R112)		
R219	(Same as R114)		
R220	DOT69008520-025	Resistor, 24.9k $\Omega$ , 1/4W, 1%	3
R221	DOT1-038-0212	Jumper Wire, 22 AWG	3
R223	(Same as R107)		
R224	DOT1-011-5822	Potentiometer, 1k $\Omega$ , 1/8W, 20%	3

5-6 Ref	Part Number	Description	Use Code
R225	(Same as R107)	(Same as R107)	
R226	(Same as R104)	(Same as R104)	
R227	(Same as R107)	(Same as R107)	
R228	DOT1-011-2878	Resistor, 0.22Ω, 1W, 5%	
R301	(Same as R214)	(Same as R214)	
R302	DOT1-011-5783	Potentiometer, 7.5MΩ, 1W, 20%	
R303, 304	DOT1-011-2570	Resistor, 150kΩ, 1/4W, 5%	
R305	DOT1-011-2353	Resistor, 3MΩ, 1/2W, 5%	
R306	(Same as R302)	(Same as R302)	
R307	DOT1-011-2639	Resistor, 820kΩ, 1/4W, 5%	
R308	(Same as R214)	(Same as R214)	
R309	(Same as R214)	(Same as R214)	
R310	(Same as R107)	(Same as R107)	
R311	DOT1-011-2615	Resistor, 470kΩ, 1/4W, 5%	
R312	(Same as R214)	(Same as R214)	
R313	DOT1-011-2745	Resistor, 4.7MΩ, 1/4W, 5%	
R401	DOT1-011-2713	Resistor, 56Ω, 1/4W, 5%	
R402	DOT1-011-5755	Potentiometer, 500Ω, 1/8W, 20%	
R403	DOT1-011-2628	Resistor, 680Ω, 1/4W, 5%	
R404	(Same as R104)	(Same as R104)	
R406	DOT1-011-2567	Resistor, 150Ω, 1/4W, 5%	
R407	DOT69008520-027	Resistor, 340Ω, 1/4W, 1%	
R409	(Same as R406)	(Same as R406)	
R410	DOT69008520-024	Resistor, 169Ω, 1/4W, 1%	
R411	DOT1-011-2835	Resistor, 118Ω, 1/4W, 1%	
R412, 413	DOT1-011-2893	Resistor, 300Ω, 2W, 5%	
R414	DOT1-011-2596	Resistor, 33Ω, 1/4W, 5%	
R415	DOT1-011-2294	Resistor, 10kΩ, 1/4W, 5%	
R501, 502	DOT1-011-2635	Resistor, 82Ω, 1/4W, 5%	
R503	(Same as R203)	(Same as R203)	
R504	(Same as R107)	(Same as R107)	
T301	DOT1-017-5574	Transformer, flyback, HFS, 32kHz	
T501	DOT1-017-5573	Transformer, DC-DC, HFS-5	
U101	DOT64025455-002	IC, TDA1170N, deflection circuit	
U201	DOT1-025-0206	IC, TL494CN, voltage regulator	
U401	DOT64200005-053	IC, 74128 quad 2-Input NOR	
U501	DOT1-025-0143	IC, 78M05CT, voltage regulator, +5V, TO-2	

Q14

5-6 Ref	Part Number	Description	Use Code
W203	DOT1-045-5000	Jumper Wire, 22 AWG	2
W205		(Same as W203)	2
W301, 302	DOT1-038-0212	Solid Wire, 22 AWG	2
2	DOT3-012-0140	Nut, hex, 4-40	2
3	DOT3-011-1044	Screw, 4-40 x 5/16	2
4	DOT3-015-0125	Spring, DAG, 1/4 OD	2
5	DOT3-013-0140	Washer, lock #4	2

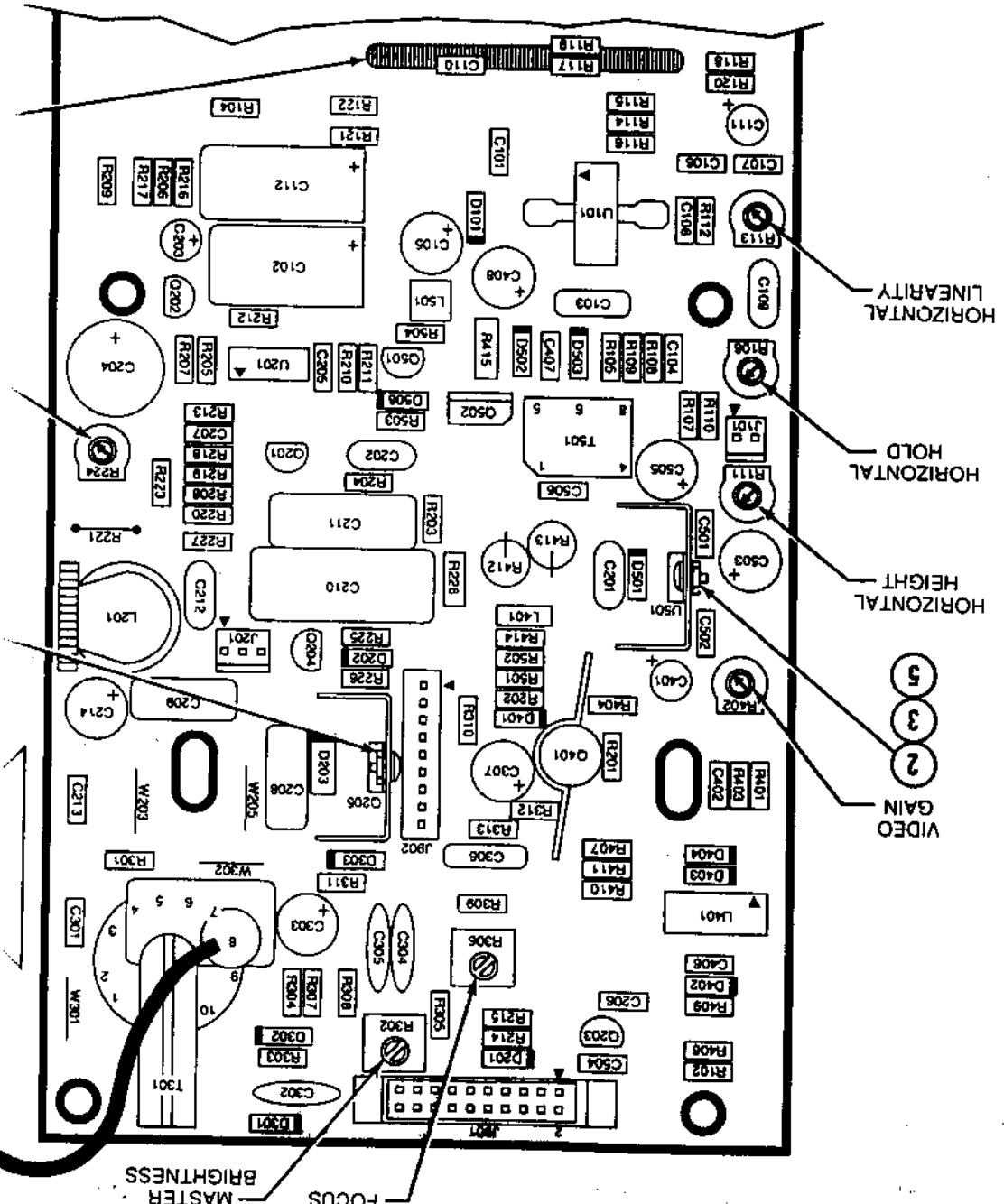
(Sheet 2 of 4)

(part of Display Assembly)  
Part Number 803706

Figure 5-6

Monitor PCB

A4



HORIZONTAL LINEARITY

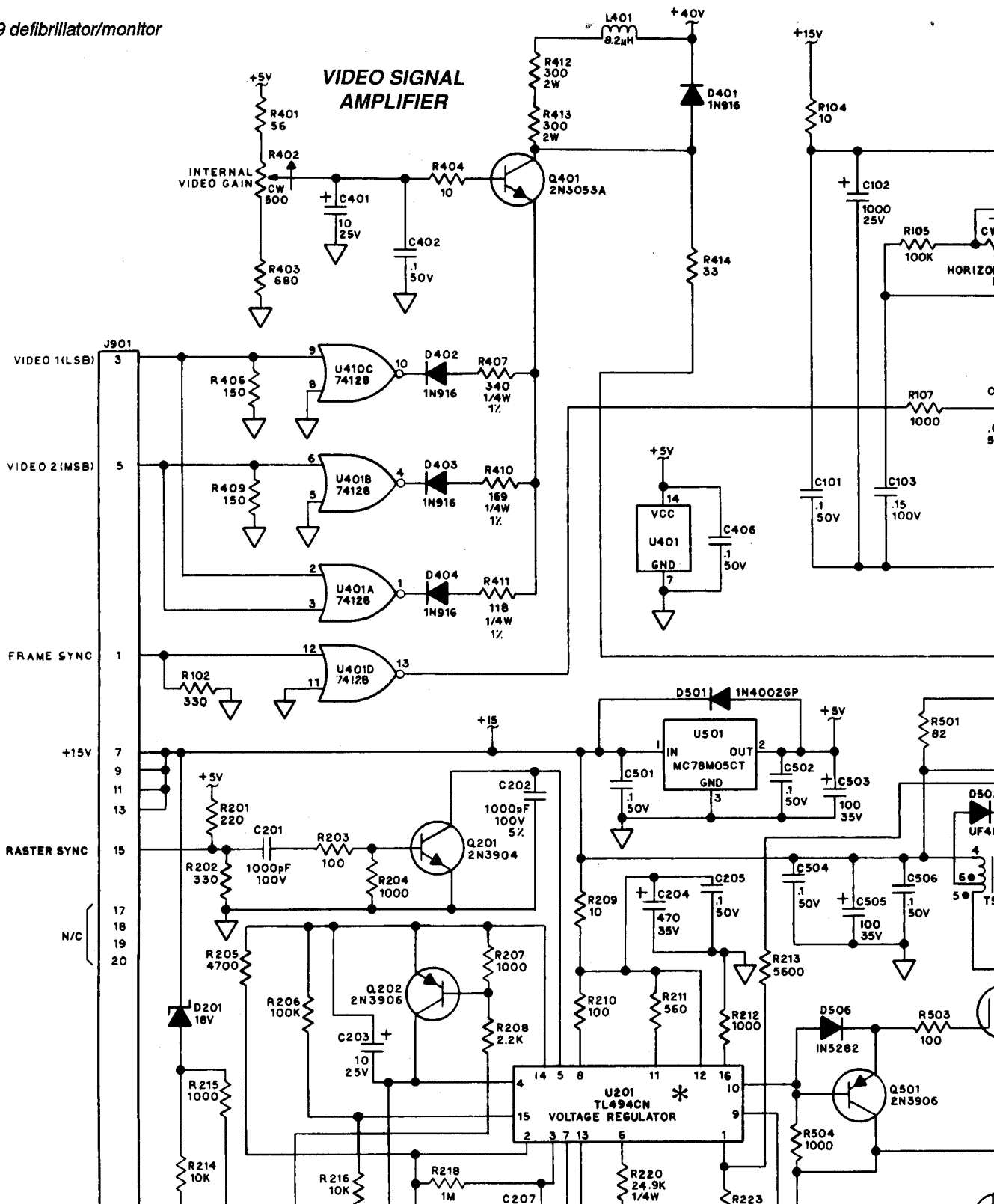
HORIZONTAL HOLD

HORIZONTAL HEIGHT

5  
3  
2  
VIDEO GAIN

FOCUS  
MASTER BRIGHTNESS





### FRAME SWEEP GENERATOR

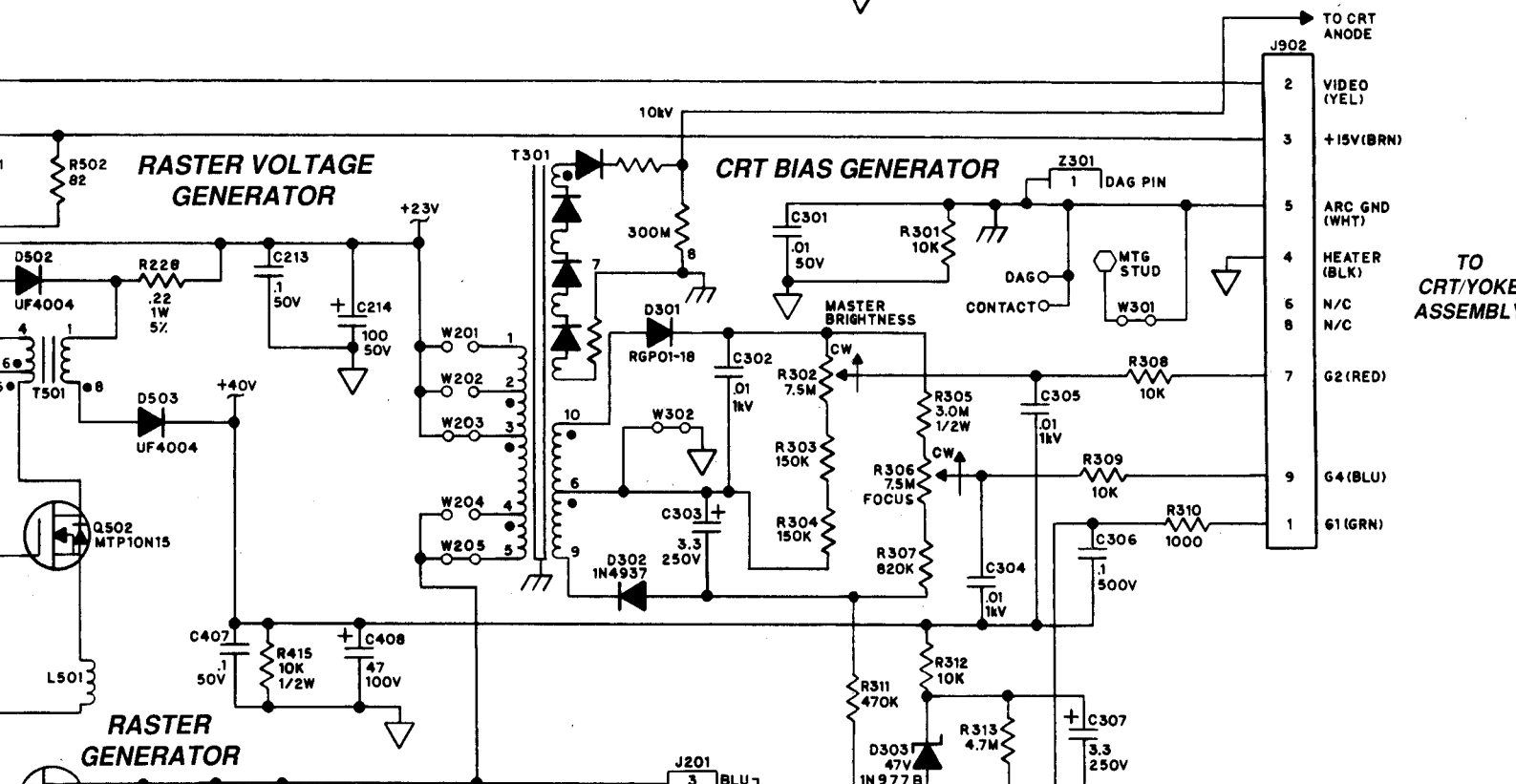
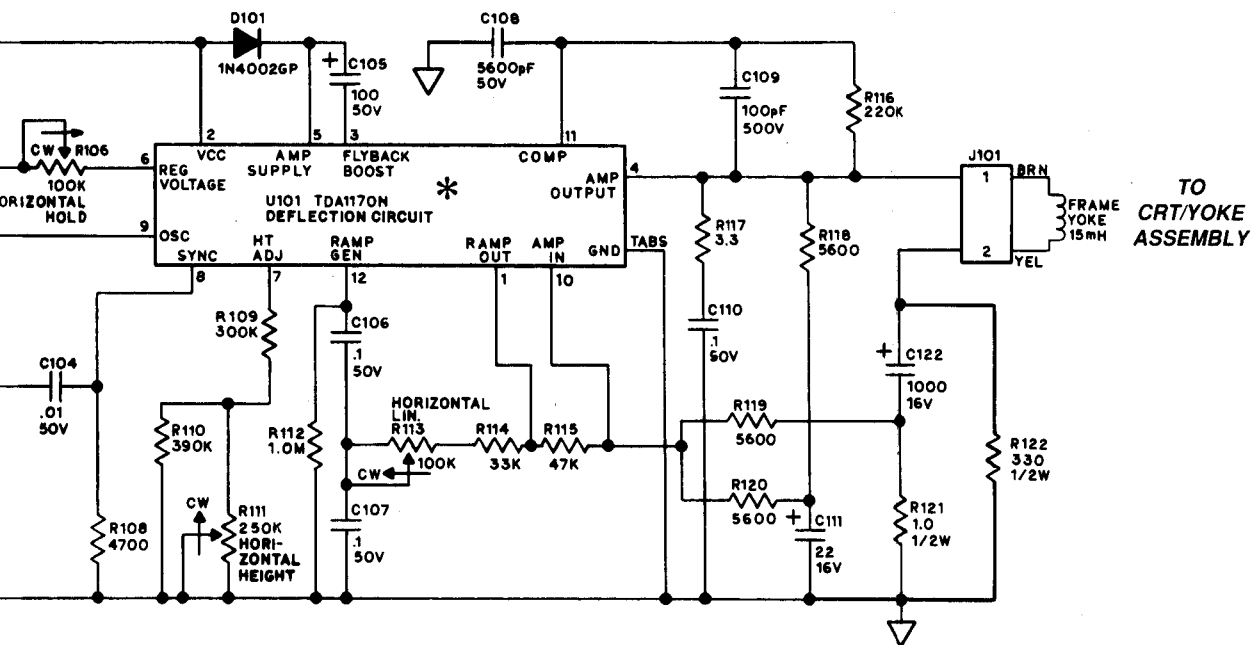
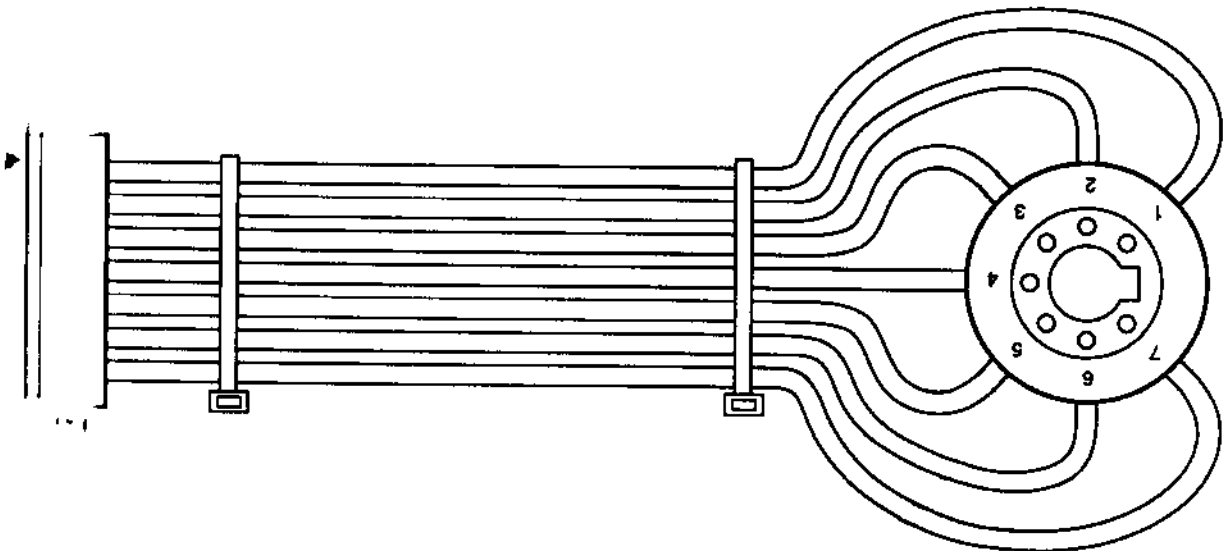
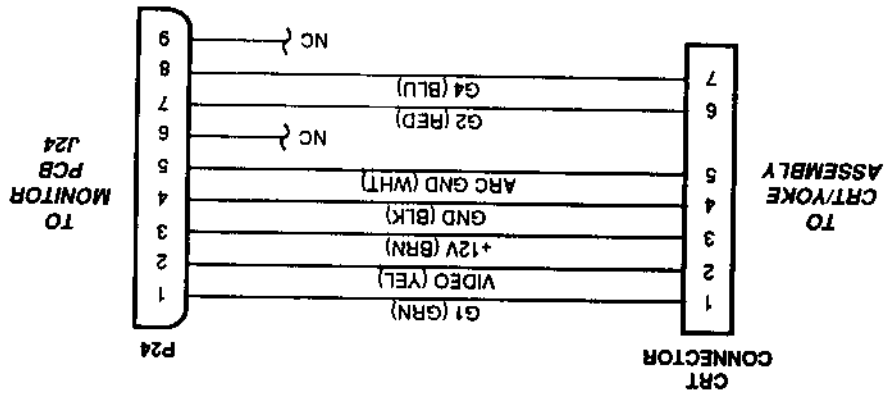


Figure 5-6  
 Display Assembly  
 Part Number 010  
 (Sheet 4 of 4)

A4



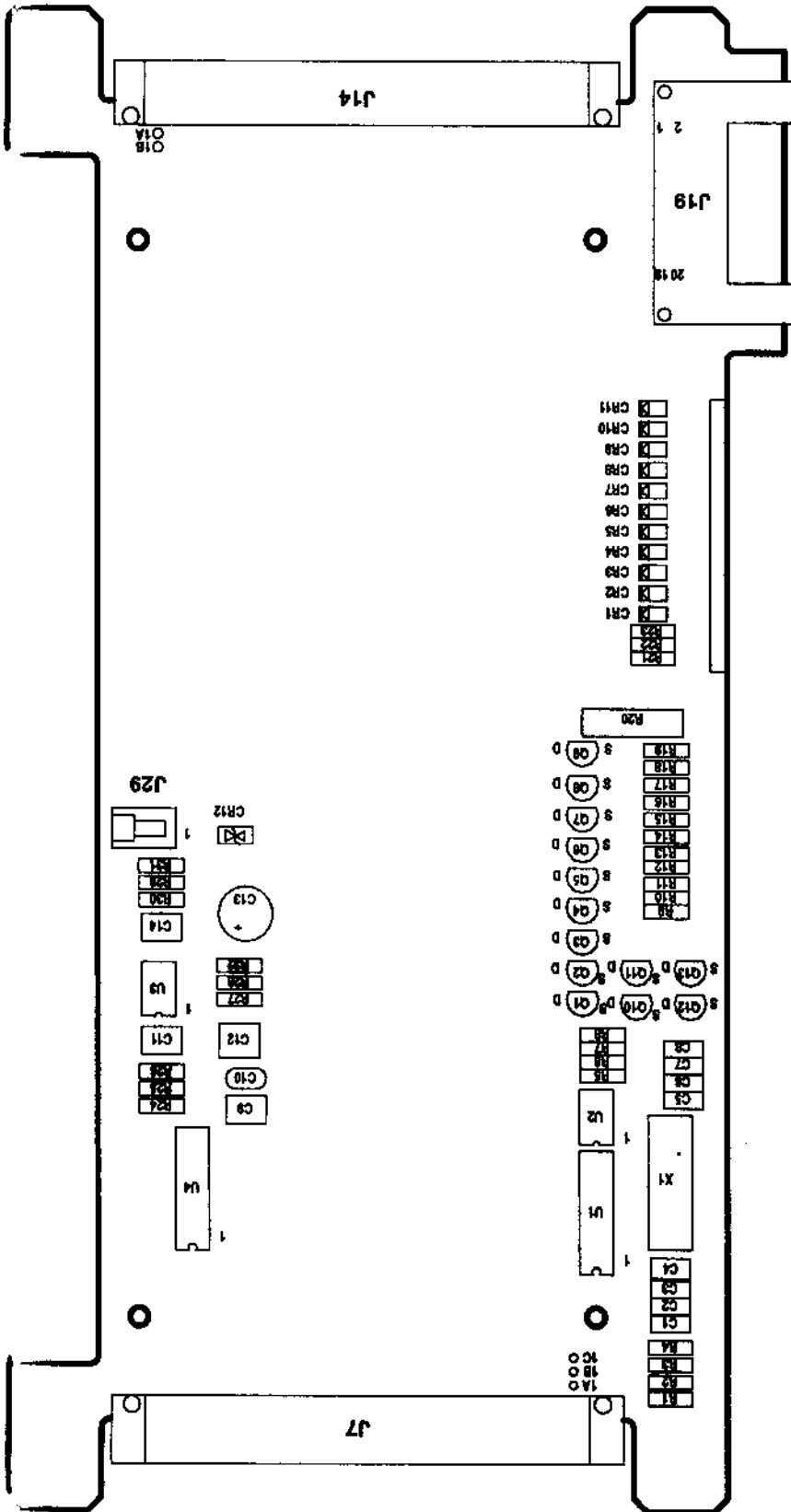
Ref	Part Number	Description	Use Code
5-6	DOT6-004-1150	CRT Connector Assembly (part of Display Assembly)	010

5-7 Ref	Part Number	Description	Use Code
A5	803761-00	Interconnect PCB Assembly	REF
C1-3	201628-120	Capacitor, 0.001µF/50V, 20%	
C4	201628-132	Capacitor, 0.1µF/50V, 20%	
C5-8		(Same as C1)	
C9	201628-012	Capacitor, 0.1µF/50V, 5%	
C10	201628-007	Capacitor, 0.015µF/50V, 5%	
C11	201628-014	Capacitor, 0.22µF/50V, 5%	
C12	201628-018	Capacitor, 1µF/50V, 5%	
C13	202102-024	Capacitor, electrolytic, 330µF/25V	
C14		(Same as C9)	
CR1,2	200605-010	Diode, Zener, 1N4738A, 550mA/8.2V	
CR3	200605-018	Diode, Zener, 1N4746A, 250mA/18V	
CR4		(Same as CR1)	
CR5		(Same as CR3)	
CR6-9		(Same as CR1)	
CR10,11		(Same as CR3)	
CR12	201749-012	Diode, transistor, SA176	
J7	201678-035	Connector, plug, 90°, 96 contact	
J14	201678-028	Connector, plug, 90°, 64 contact	
J19	201191-230	Connector, plug, 90°, 20 contact	
J29	202128-048	Connector, header, 90°, 2 contact	
Q1-13	200585-001	Transistor, FET, VN1016N3, TO-92 ▲	
R1-4	200054-226	Resistor, 2.21kΩ, 1/8W, 1%, RN55C	
R5	200054-315	Resistor, 19.1kΩ, 1/8W, 1%, RN55C	
R6	200054-275	Resistor, 7.32kΩ, 1/8W, 1%, RN55C	
R7	200054-256	Resistor, 4.64kΩ, 1/8W, 1%, RN55C	

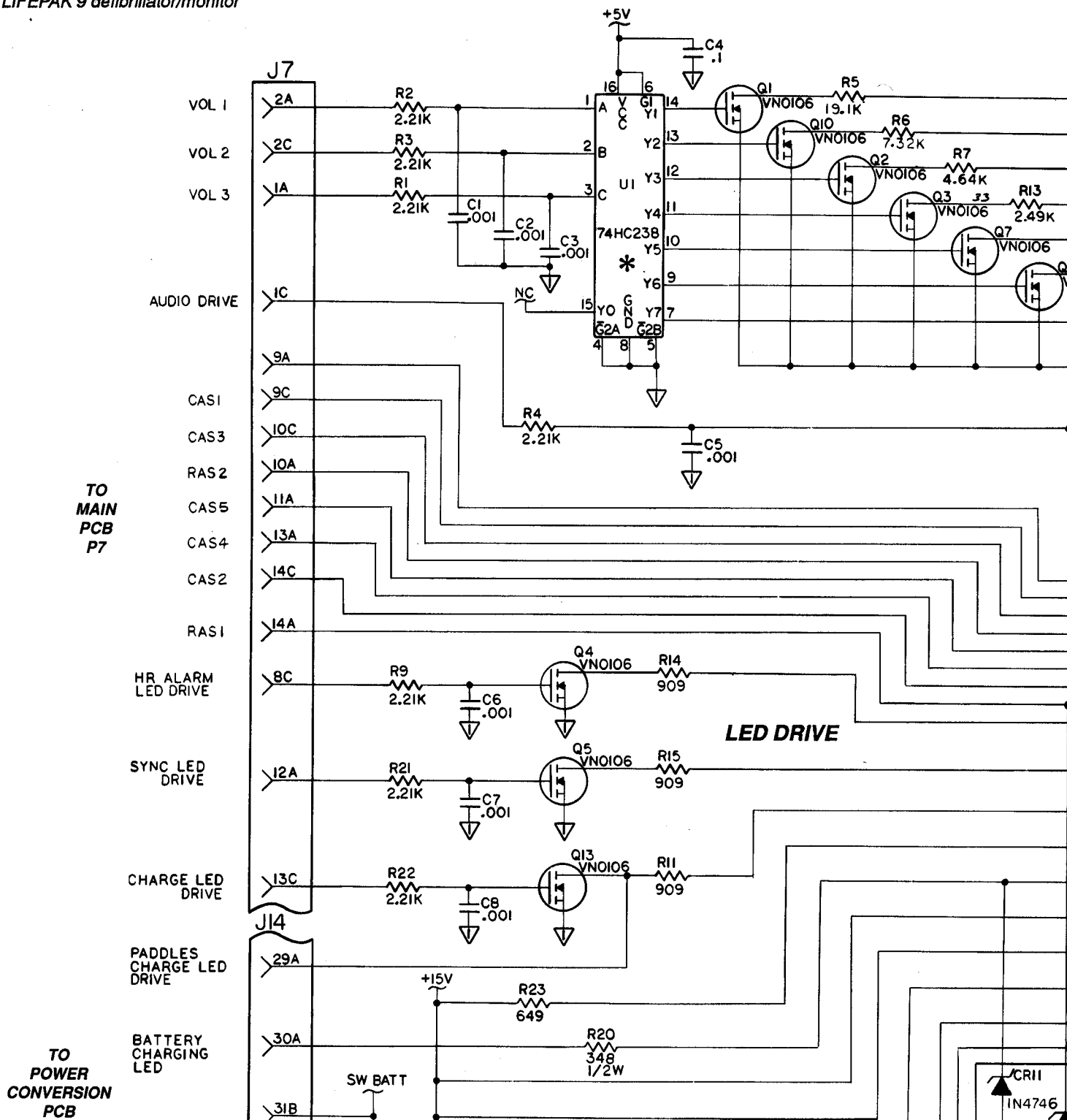
5-7 Ref	Part Number	Description	Use Code
R8	200054-288	Resistor, 10k $\Omega$ , 1/8W, 1%, RN55C	
R9		(Same as R1)	
R10		(Same as R8)	
R11	200054-189	Resistor, 909 $\Omega$ , 1/8W, 1%, RN55C	
R12	200054-364	Resistor, 61.9k $\Omega$ , 1/8W, 1%, RN55C	
R13	200054-231	Resistor, 2.49k $\Omega$ , 1/8W, 1%, RN55C	
R14,15		(Same as R11)	
R16		(Same as R12)	
R17	200054-203	Resistor, 1.27k $\Omega$ , 1/8W, 1%, RN55C	
R18	200054-183	Resistor, 787 $\Omega$ , 1/8W, 1%, RN55C	
R19	200054-172	Resistor, 604 $\Omega$ , 1/8W, 1%, RN55C	
R20	200850-149	Resistor, 348 $\Omega$ , 1/2W, 1%	
R21,22		(Same as R1)	
R23	200054-175	Resistor, 649 $\Omega$ , 1/8W, 1%, RN55C	
R24-26	200054-357	Resistor, 52.3k $\Omega$ , 1/8W, 1%, RN55C	
R27,28	200054-438	Resistor, 365k $\Omega$ , 1/8W, 1%, RN55C	
R29,30	200054-265	Resistor, 5.76k $\Omega$ , 1/8W, 1%, RN55C	
R31		(Same as R8)	
R32	200054-222	Resistor, 2k $\Omega$ , 1/8W, 1%, RN55C	
U1	202051-000	IC, digital, 74HC238, decoder	
U2,3	201444-000	IC, linear, LM358, dual op amp	
U4	201641-000	IC, digital, 74HC76, J-K flip-flop	
X1	200115-007	Transducer, audio, piezoelectric	
2	201773-000	Rivet, semi-tubular (used on J7,14)	

Figure 5-7 Interconnect PCB Assembly  
Part Number 803761-00  
(Sheet 1 of 3)

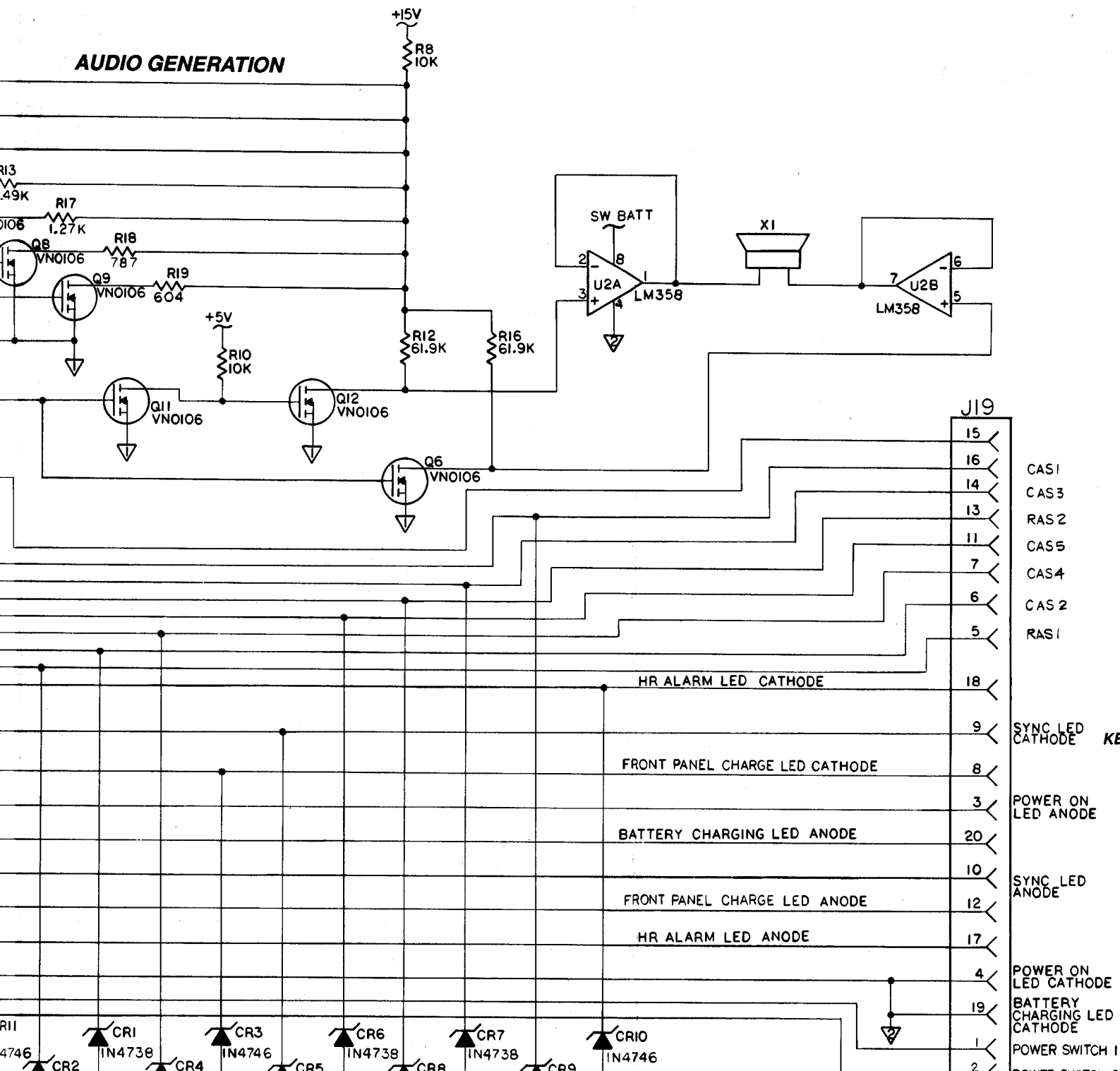
A5



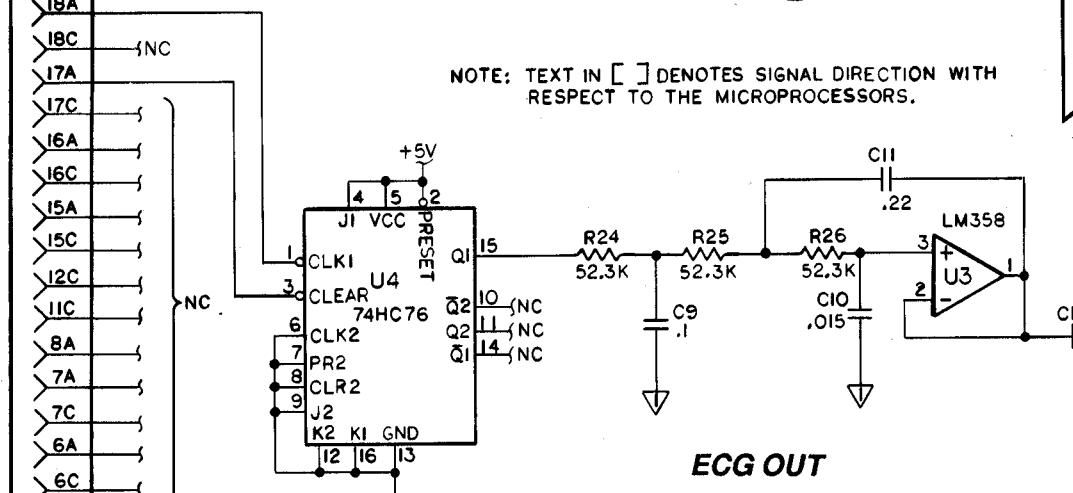
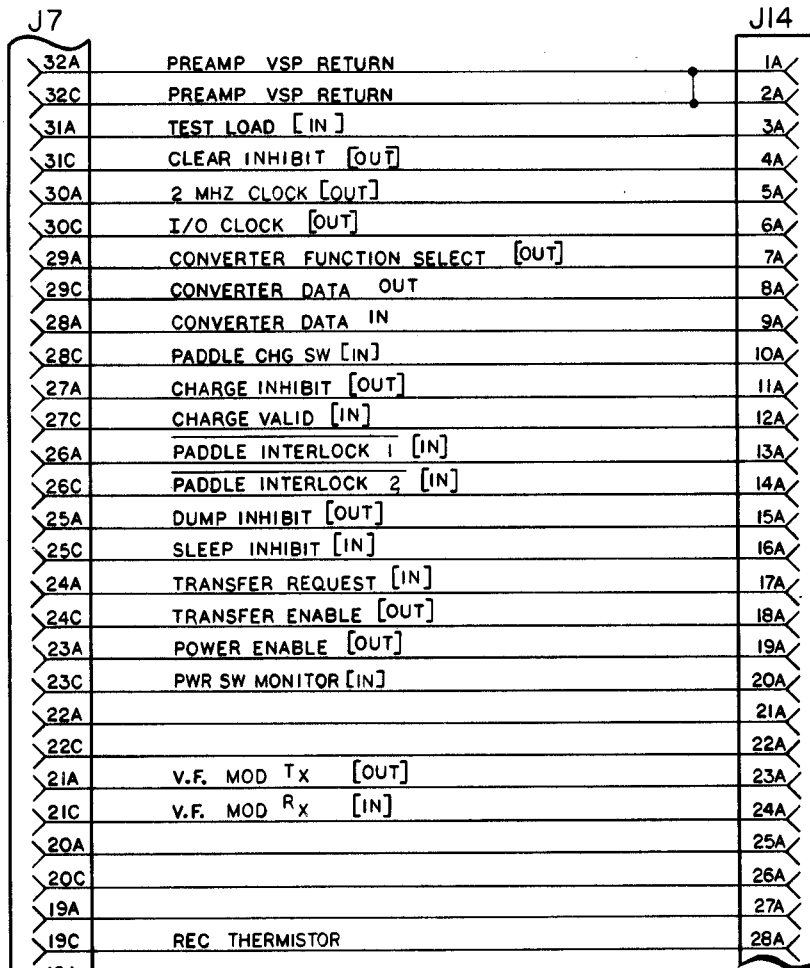
LIFEPAK 9 defibrillator/monitor

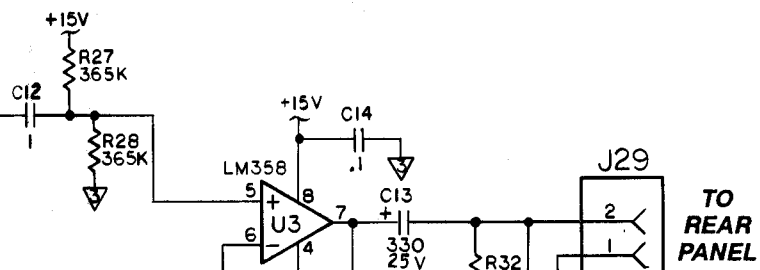
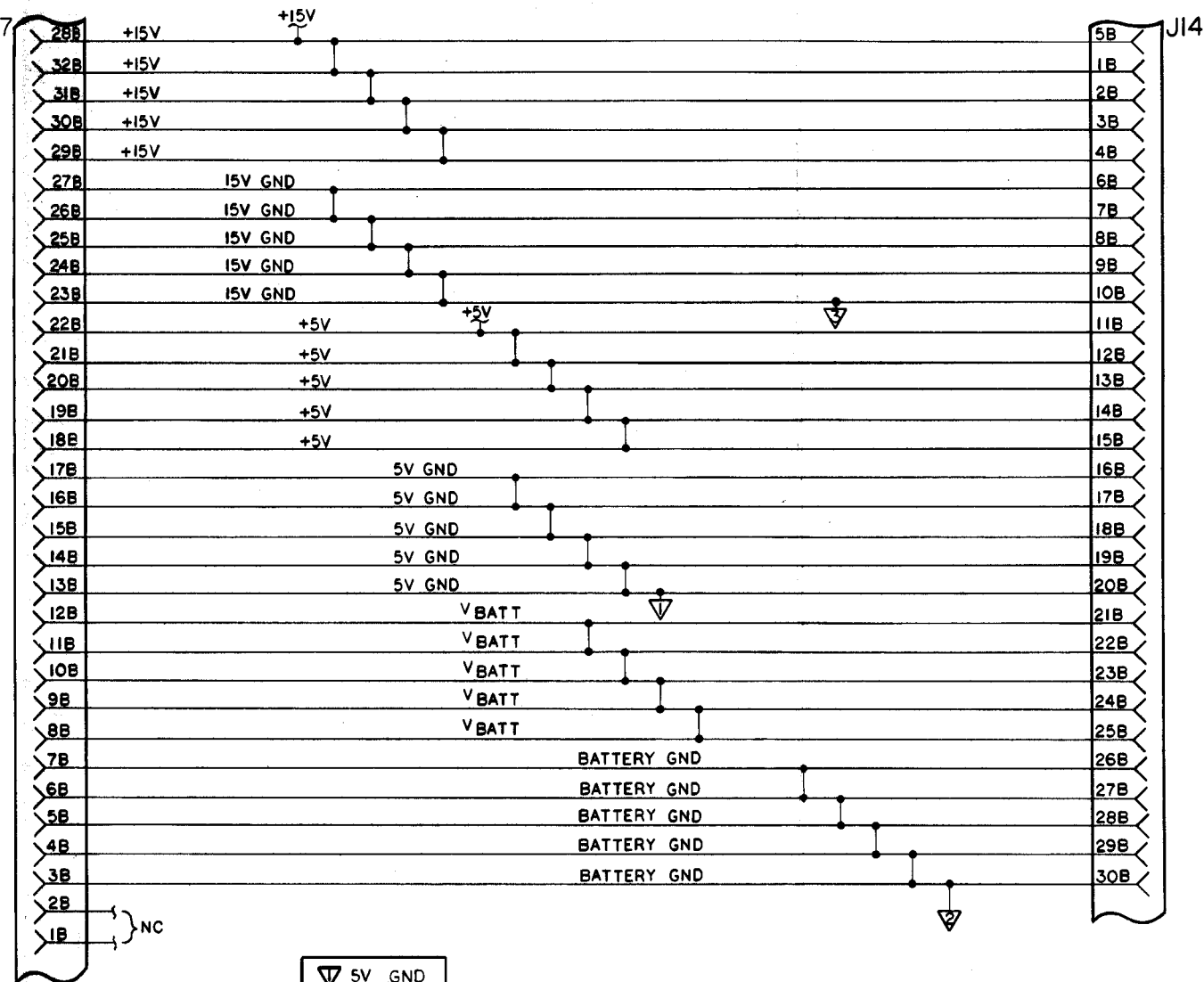


**AUDIO GENERATION**









5-8 Ref	Part Number	Description	Qty
A6	803745-00	Front Panel Assembly, English	A
	803745-01	Front Panel Assembly, French	B
	803745-02	Front Panel Assembly, German	F
	803745-03	Front Panel Assembly, Spanish	F
	803745-04	Front Panel Assembly, Portuguese	F
	803745-05	Front Panel Assembly, Italian	F
	803745-06	Front Panel Assembly, Swedish	F
2	803744-00	Bezel	A
3	803771-01	Keypad Assembly, English	A
	803771-02	Keypad Assembly, French	B
	803771-03	Keypad Assembly, German	F
	803771-04	Keypad Assembly, Spanish	F
	803771-05	Keypad Assembly, Portuguese	F
	803771-06	Keypad Assembly, Italian	F
	803771-07	Keypad Assembly, Swedish	F
4	201874-012	Screw, pan-head, 8-32 x 0.375 L	6
5	803770-01	Shield, CRT implosion	1
6	200804-101	Washer, flat, #8	1

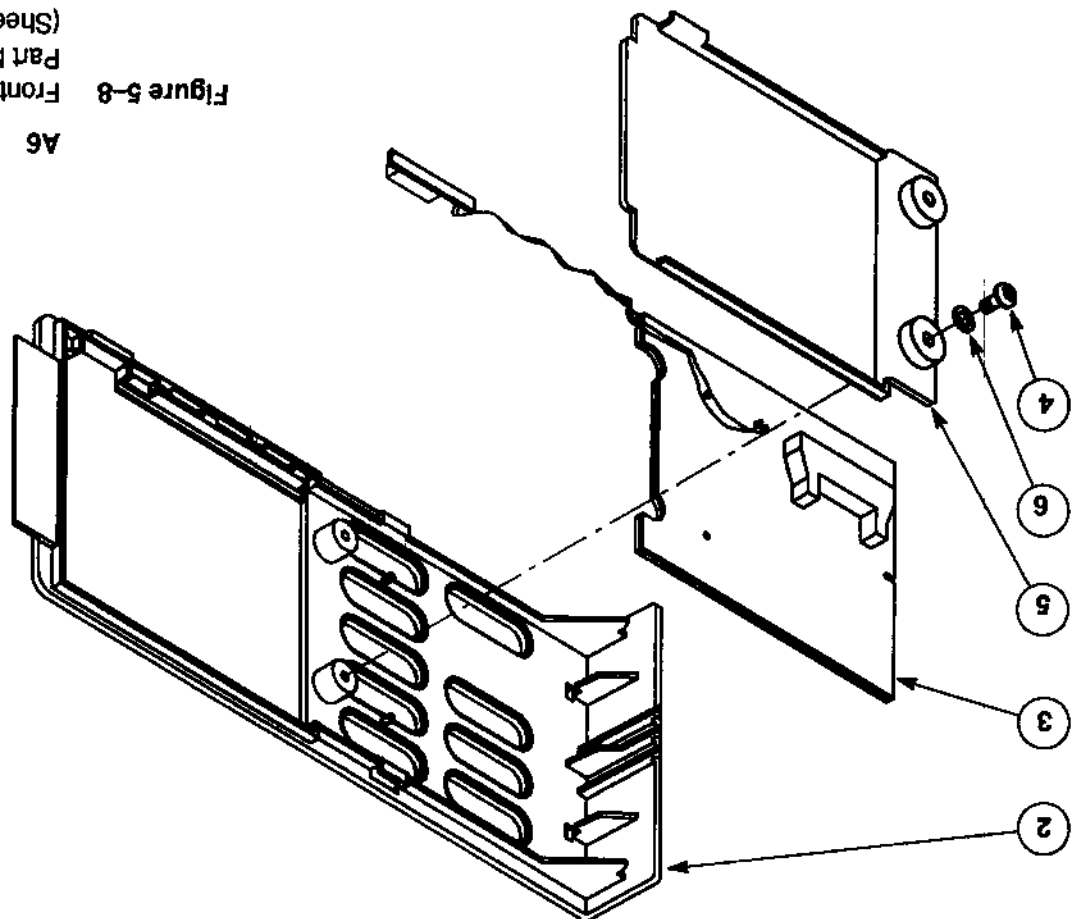
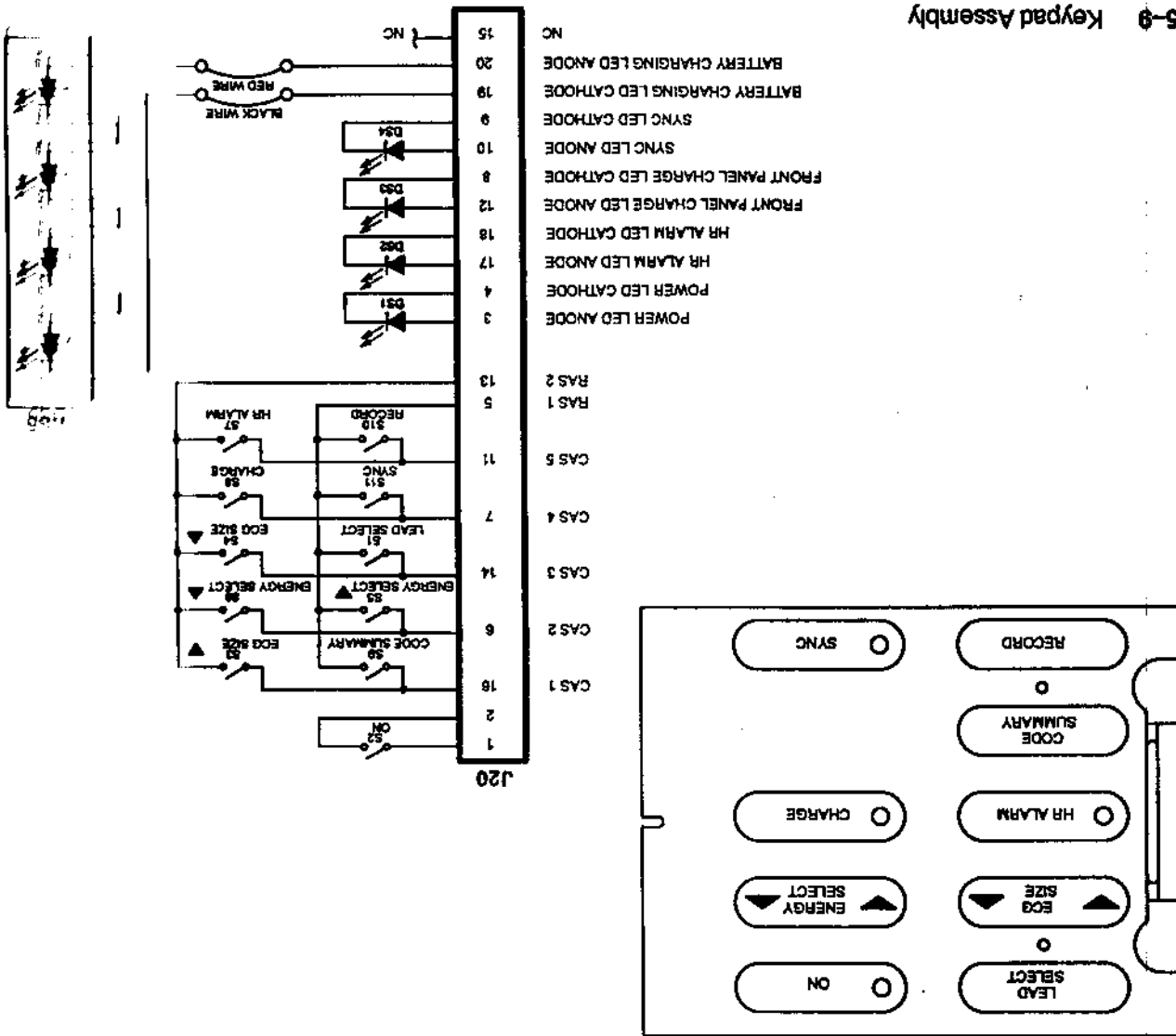


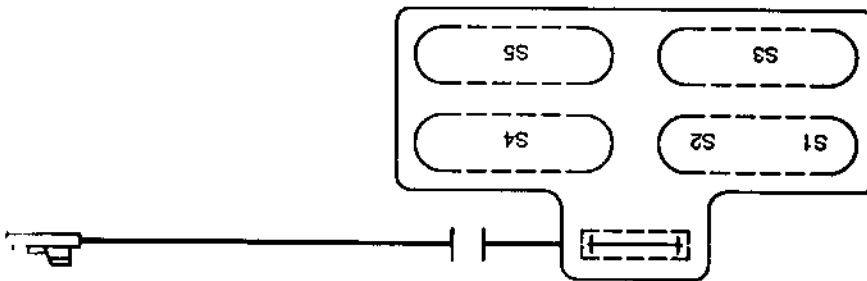
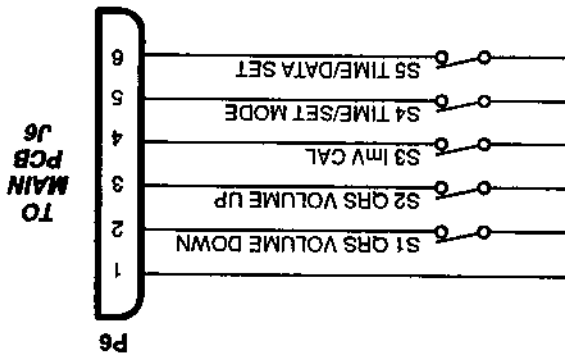
Figure 5-8  
Front Panel Assembly  
Part Number 803745-00  
(Sheet 1 of 1)  
A6

Figure 5-9  
 Keypad Assembly  
 Part Number 803771  
 (Sheet 1 of 1)



Ref	Part Number	Description
5-9	803771-01	Keypad Assembly, English (part of A6, Front Panel Assembly)
RF#	803771-02	Keypad Assembly, French
RF#	803771-03	Keypad Assembly, German
RF#	803771-04	Keypad Assembly, Spanish
RF#	803771-05	Keypad Assembly, Portuguese
RF#	803771-06	Keypad Assembly, Italian
RF#	803771-07	Keypad Assembly, Swedish

**A12**  
**Figure 5-10** Rear Panel Membrane Switch  
 Part Number 803741-01  
 (Sheet 1 of 1)



5-10 Ref A7	Part Number 803741-01	Description Rear Panel Membrane Switch	REF Qty Cont
-------------------	--------------------------	---	--------------------

5-11 Ref	Part Number	Description
A8	804189-00	Strip Chart Recorder Assembly, GSI
2	GSI624-10256	Base, chassis
3	GSI624-11759	Bracket Mod, printhead (pre-assembled at GSI)*
4	GSI624-10278	Bracket, pivot head
5	GSI624-10253	Bumper, printhead
6	GSI624-10270	Cover, gear
7	GSI624-10254	Door, chassis
8	GSI624-10260	Ejector Assembly, paper
9	GSI625-10268	Gear, idler 108T
10	GSI625-10266	Gear, motor 15T
11	GSI625-10267	Gear, motor 31T
12	GSI624-10224	Keyshim Gear
13	GSI624-10225	Label, paper feed
14	GSI624-10255	Latch, chassis
15	GSI624-10257	Link, latch plate
16	GSI624-10258	Link, printhead
17	GSI610-102341	Motor Assembly/Gear
18	GSI420-06175	Nameplate, label
19	GSI624-41003	O-Ring, IB Moore #2-104
20	GSI625-00007	Printhead, KST 488MPDI (pre-assembled at GSI)*
21	GSI615-200051	Printer Assembly
22	GSI625-513	Ring, ring TRU 5100-18
23	GSI625-519	Ring, ring TRU 5133-9
24	GSI624-22001	Screw, flat head, 90 M2, OX, 4 x 6mm
25	GSI624-50083	Screw, pan head, 4-40 x 0.25
26	GSI624-50082	Screw, pan head
27	GSI624-10246	Shaft
28	GSI625-10263	Shaft Roller
29	GSI624-10262	Shaft, linkage
30	GSI620-10244	Spring
31	GSI615-102331	Spring Assembly
32	GSI624-11893	Tubing (not shown, used on item 17)
*Specialized alignment equipment required. Replacement of entire Strip Chart Recorder is recommended.		

REF

REV

Line  
Code

Figure 5-11 Strip Chart Recorder  
Part Number 804111  
(Sheet 1 of 2)

A8

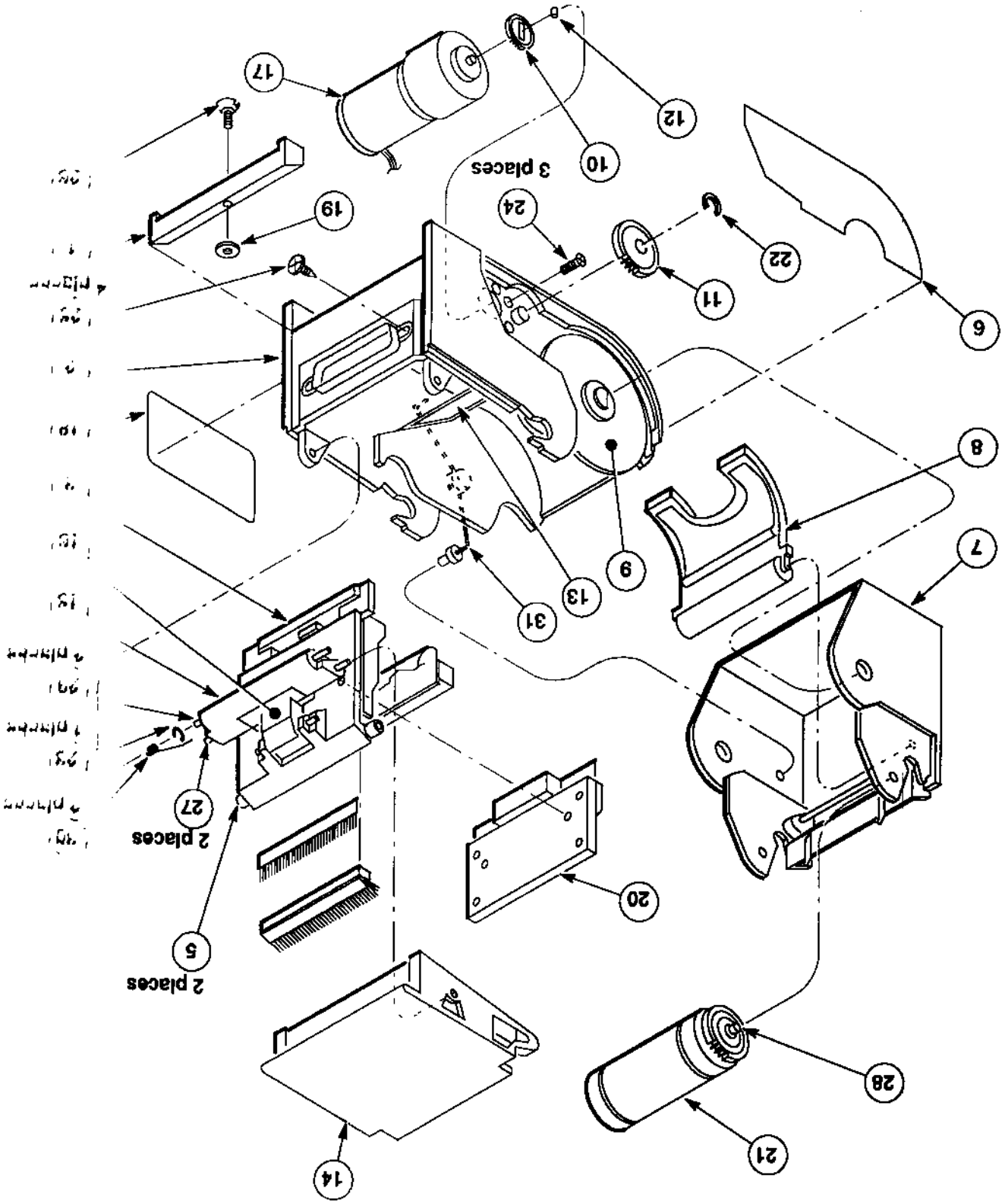


Figure 5-11 Strip Chart Recorder Assembly  
Part Number 804189-00  
(Sheet 2 of 2)

A8

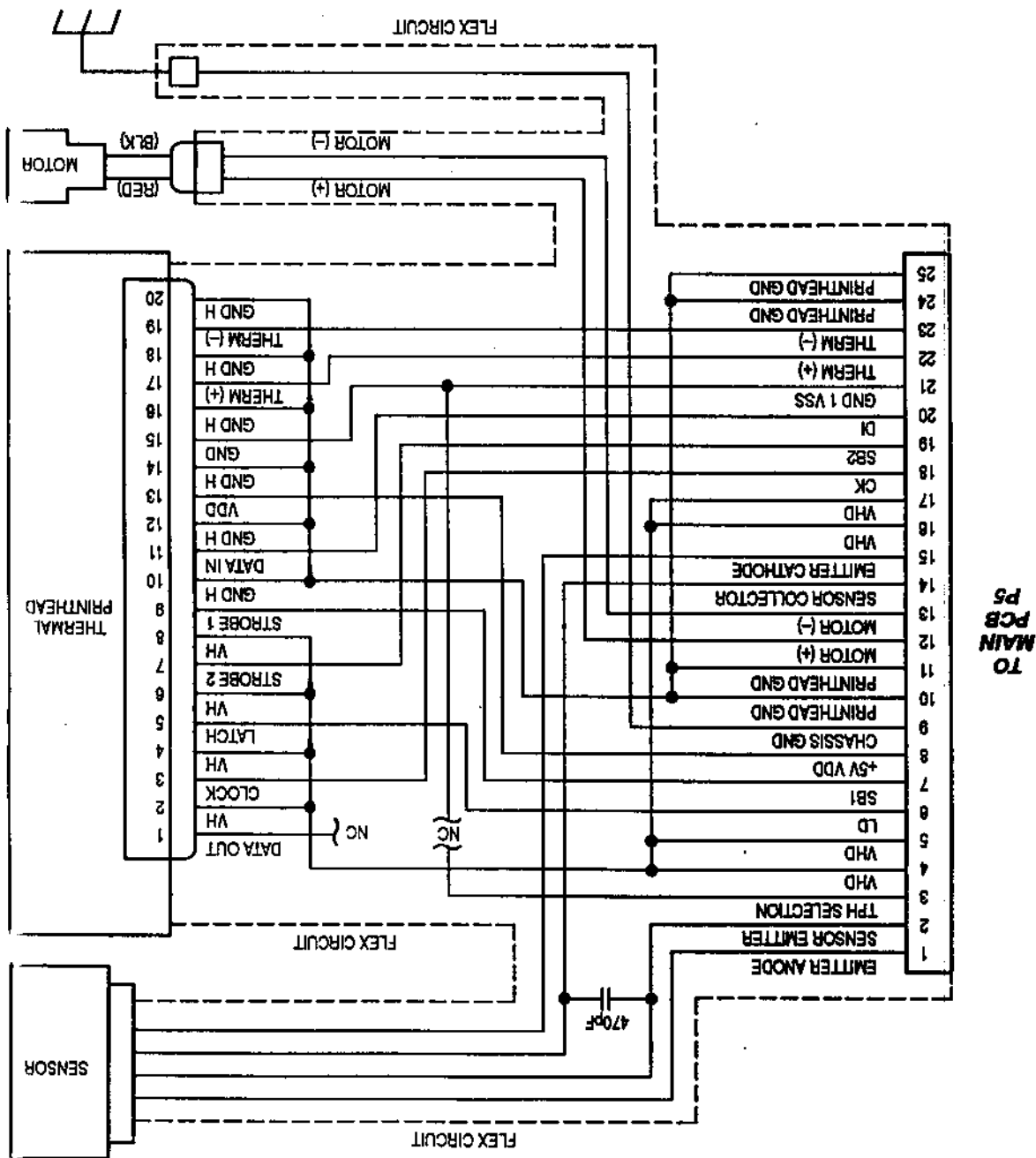
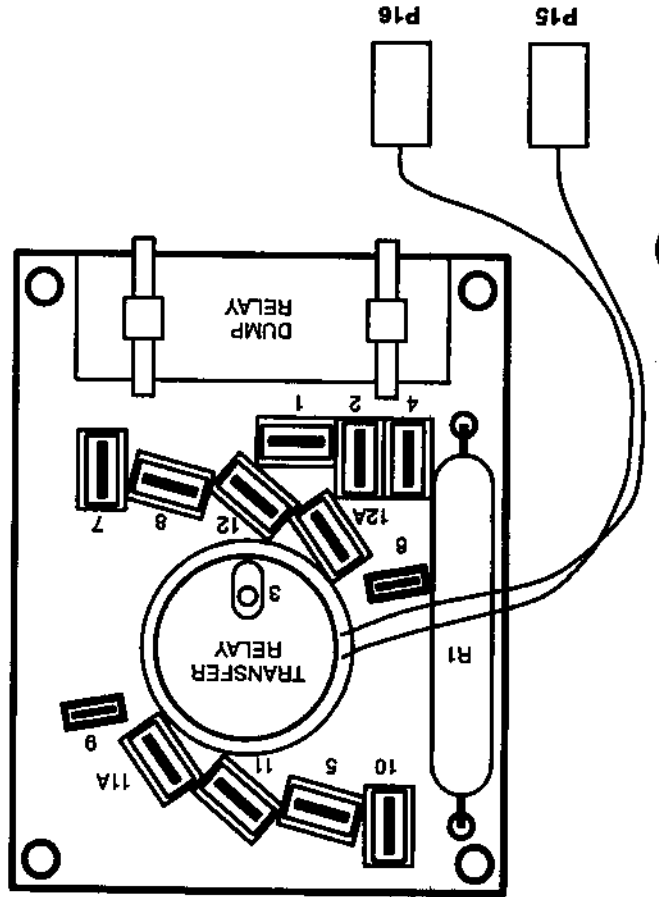
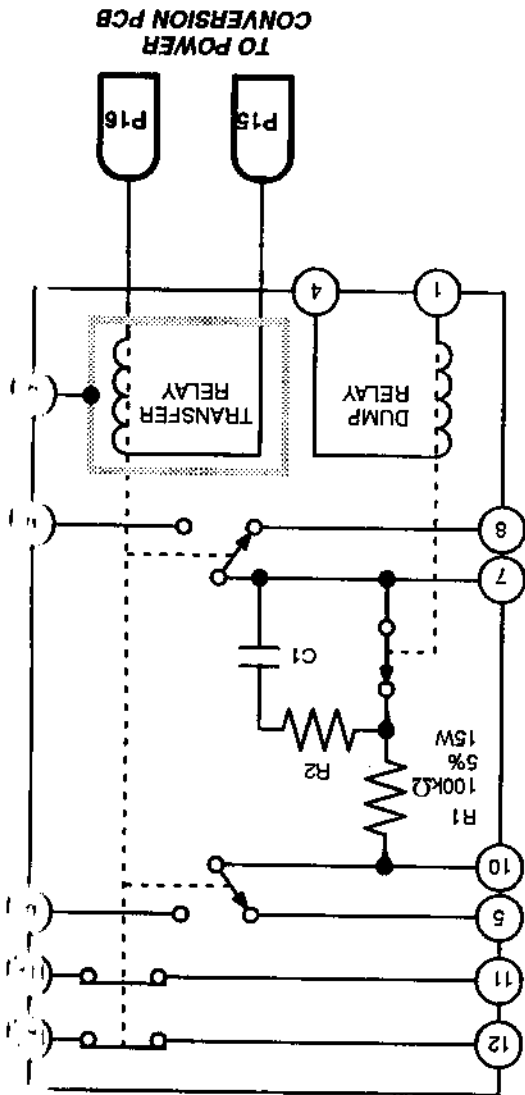




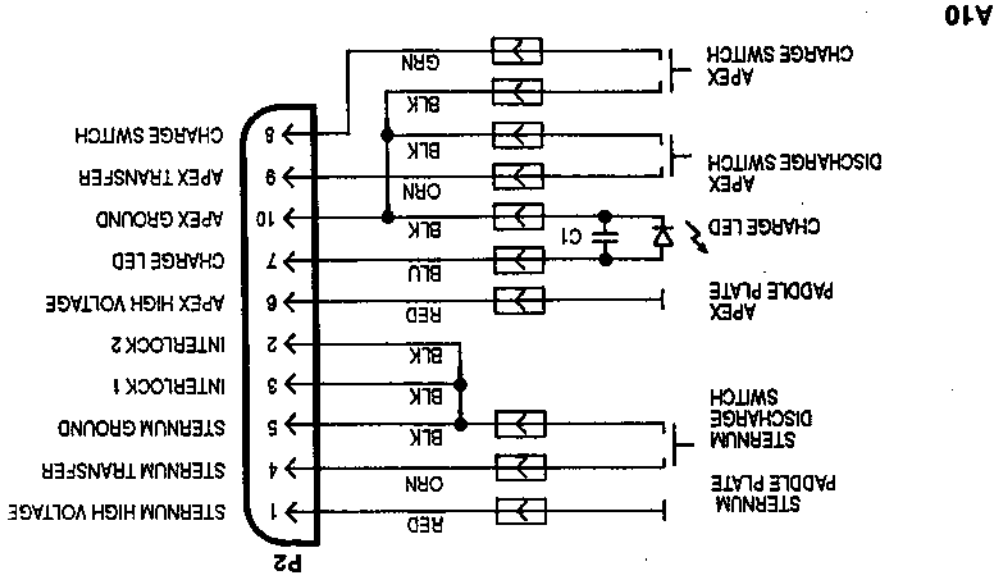
Figure 5-12 Transfer Relay Assembly  
Part Number 800240-11  
(Sheet 1 of 1)

A9



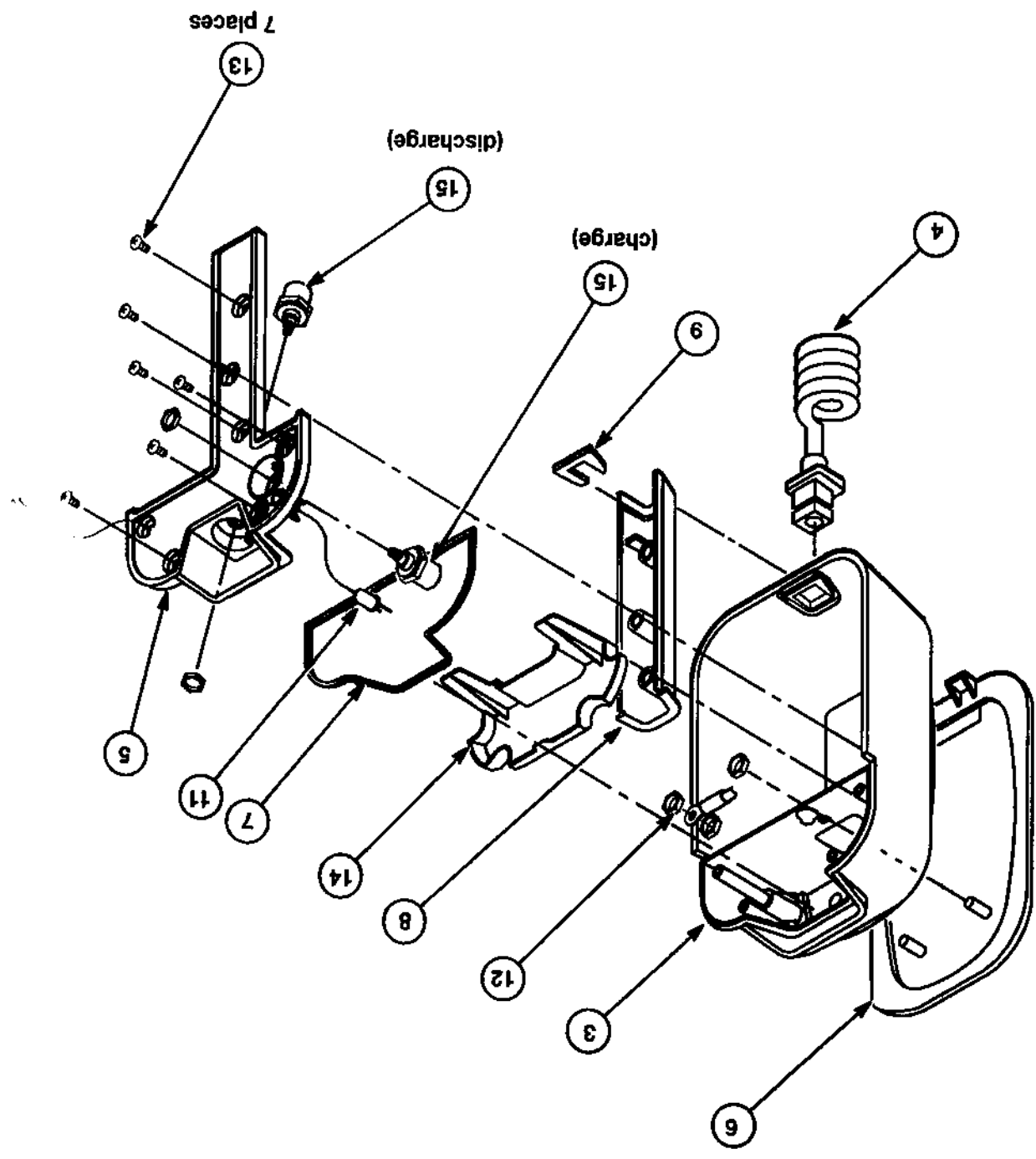
Ref	Part Number	Description	Use Code	Qty
5-12	800240-11	Transfer Relay Assembly		1

Figure 5-13 Paddle Assembly  
Part Number 802901-06  
(Sheet 1 of 2)



10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

Ref	Part Number	Description
A10	802901-06	Paddle Assembly
2	202221-00	Adhesive, hot melt, thermoplastic (not shown, used on item 8)
3	802930-06	Base, apex paddle
	802930-05	Base, sternum paddle
4	803728-01	Cord Assembly, terminated, high voltage
5	802934-04	Cover, apex paddle
	802934-05	Cover, sternum paddle
6	802902-02	Electrode Plate Assembly, apex paddle
	802902-03	Electrode Plate Assembly, sternum paddle
7	802944-00	Gasket, paddle
8	802931-00	Handle, apex paddle (label not shown, see Figure 5-1)
	802931-01	Handle, sternum paddle (label not shown, see Figure 5-1)
9	802932-00	Key, retainer, coil cord
10	800819-01	Label, serial number (not shown)
11	200491-048	LED, panel mount (on apex paddle only)
12	201508-004	Nut, lock, kep, 8-32 x 0.312/0.100 T
13	201103-537	Screw, pan head, black oxide, 4-40 x 0.312 L
14	804231-00	Shield, high voltage
15	804697-03	Switch, SPST (pushbutton not shown, see Figure 5-1)
16	200283-005	Tubing, heat shrink, red, 0.250 ID (on apex paddle only)



A10

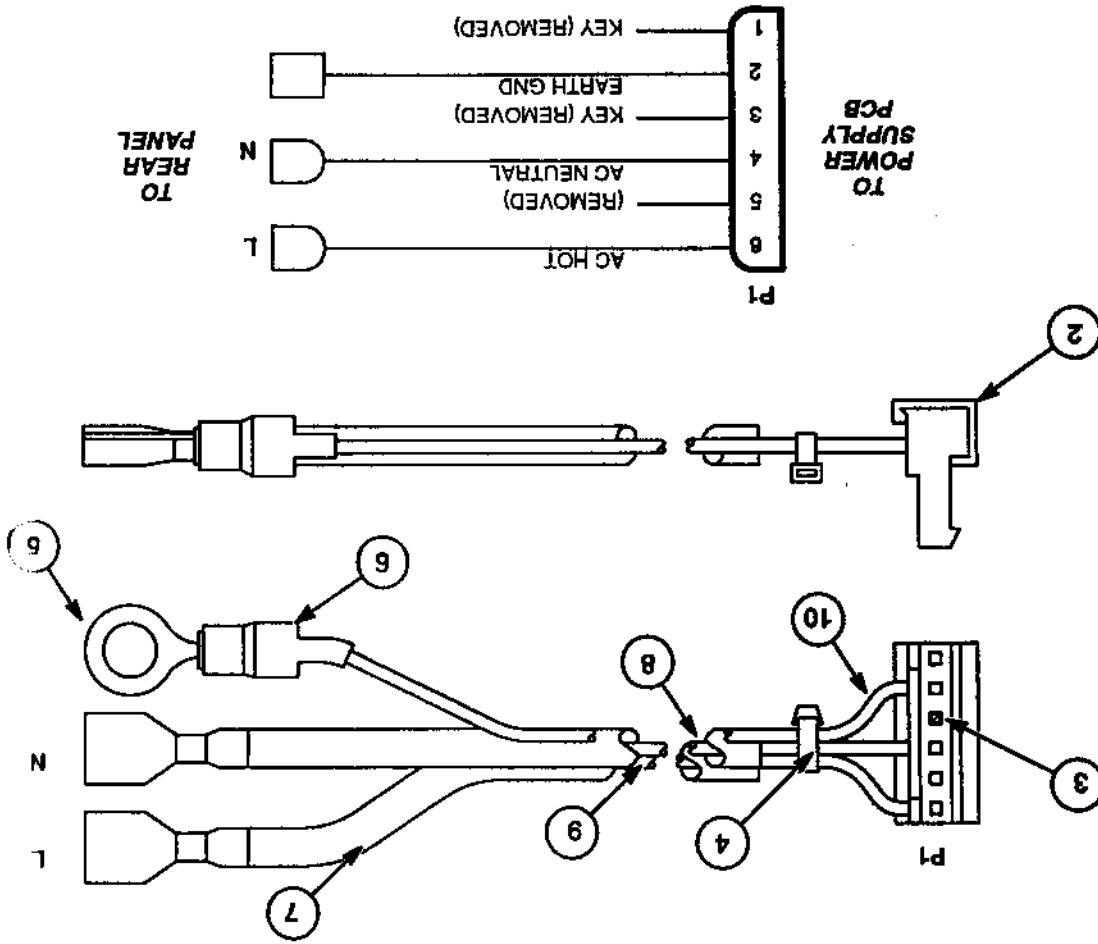
Figure 5-13 Paddle Assembly

Part Number 810001 114

(Sheet 2 of 2)

Figure 5-14 Power Supply PCB/AC Receptacle Ground Wire Harness

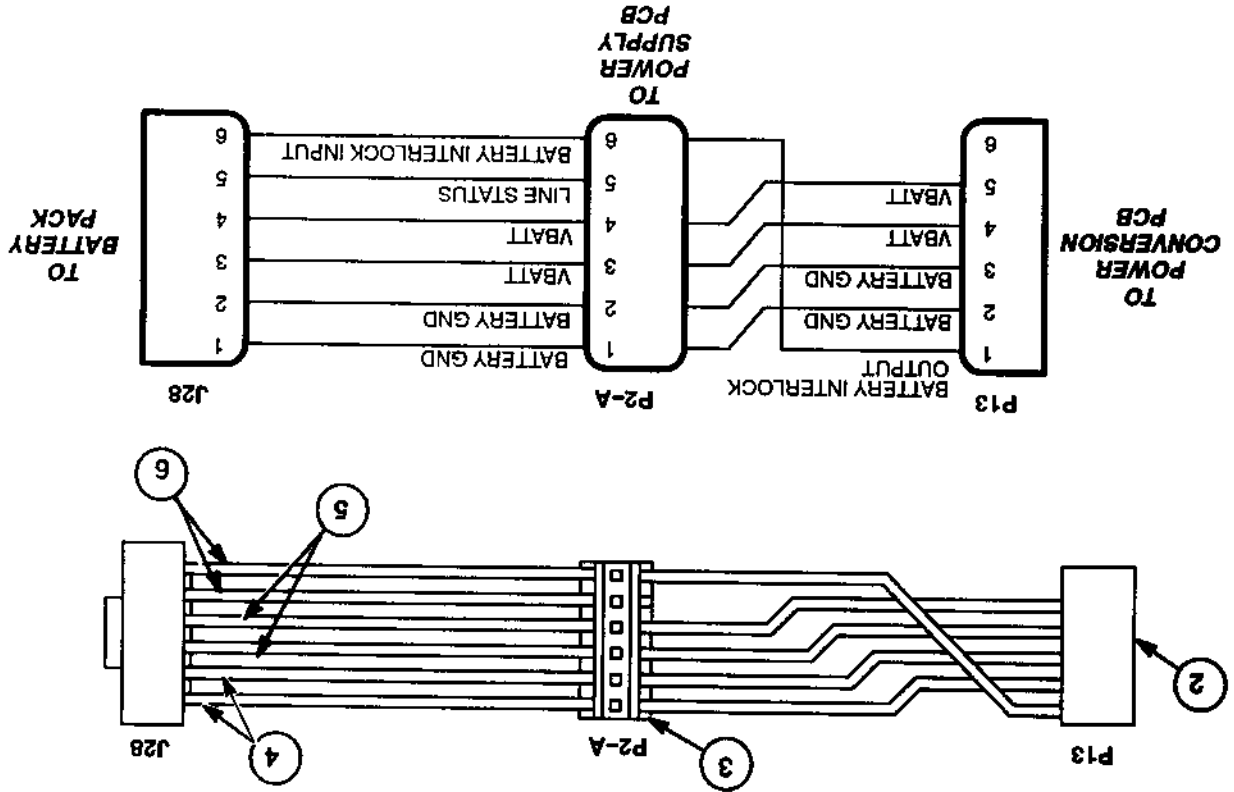
W1



5-14 Ref	Part Number	Description	Qty
W1	803783-18	Power Supply PCB/AC Receptacle/Ground Wire Harness	1
L, N	200267-026	Terminal, receptacle, insulated, 22-18 AWG	2
P1	202151-056	Connector, housing, 18 AWG, 6 contact	1
2	202151-117	Cover, housing, strain relief, 6 contact	1
3	202151-500	Plug, keying	1
4	200536-001	Retainer, cable tie, nylon, 0.1 W x 4 L	2
5	200276-212	Terminal, lug, ring tongue, 22-16 AWG	1
6	200283-018	Tubing, heat shrink, black, 0.187 ID	1
7	201756-016	Tubing, PVC, clear, 0.166 ID	1
8	201535-084	Wire, semirigid, PVC, 300V, 18 AWG, blue	1
9	201535-080	Wire, semirigid, PVC, 300V, 18 AWG, brown	1
10	201535-090	Wire, semirigid, PVC, 300V, 18 AWG, green/yellow	1

Figure 5-15 Power Conversion PCB/Power Supply PCB/Battery Wire Harness

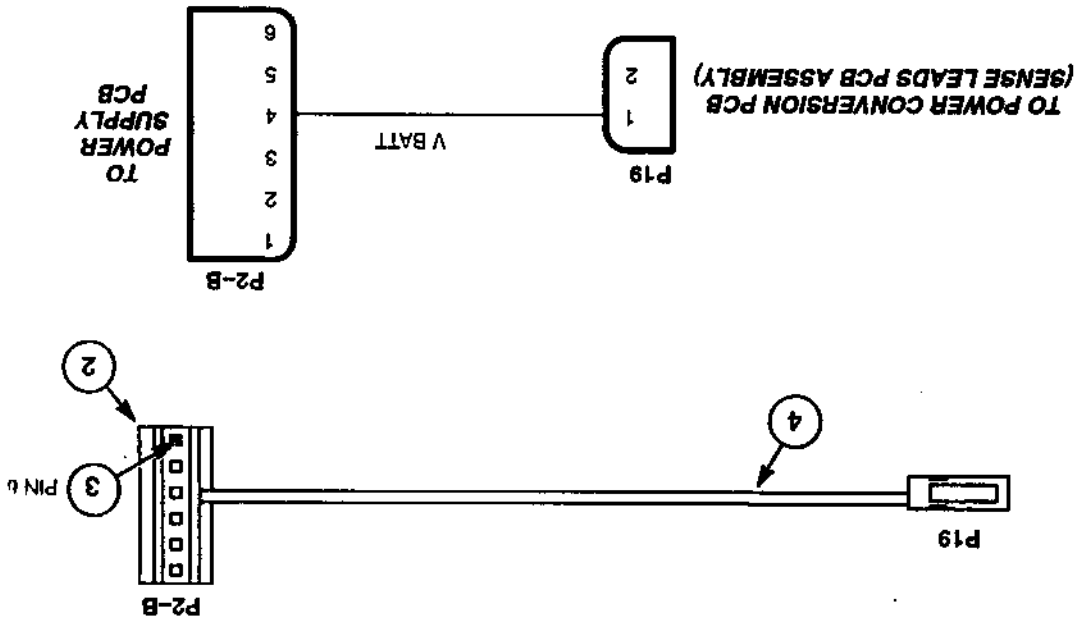
W2



5-15 Ref	Part Number	Description	Use Code	Qty
W2	803783-23	Power Conversion PCB/Power Supply PCB/Battery Wire Harness		
J28	202151-335	Connector, cable, 18 AWG, 6 contact		1
P2-A	202151-425	Connector, housing, feed-thru, 6 contact		1
P13	202151-056	Connector, housing, 18 AWG, 6 contact		1
2	202151-117	Cover, housing, strain relief, 6 contact		2
3	202151-436	Cover, housing, feed-thru, 6 contact		1
4	201535-078	Wire, semirigid, PVC, 300V, 18 AWG, black	A/N	
5	201535-079	Wire, semirigid, PVC, 300V, 18 AWG, red	A/N	
6	201535-087	Wire, semirigid, PVC, 300V, 18 AWG, white	A/N	

Figure 5-16 Battery Sensor/Power Supply PCB Wire Harness

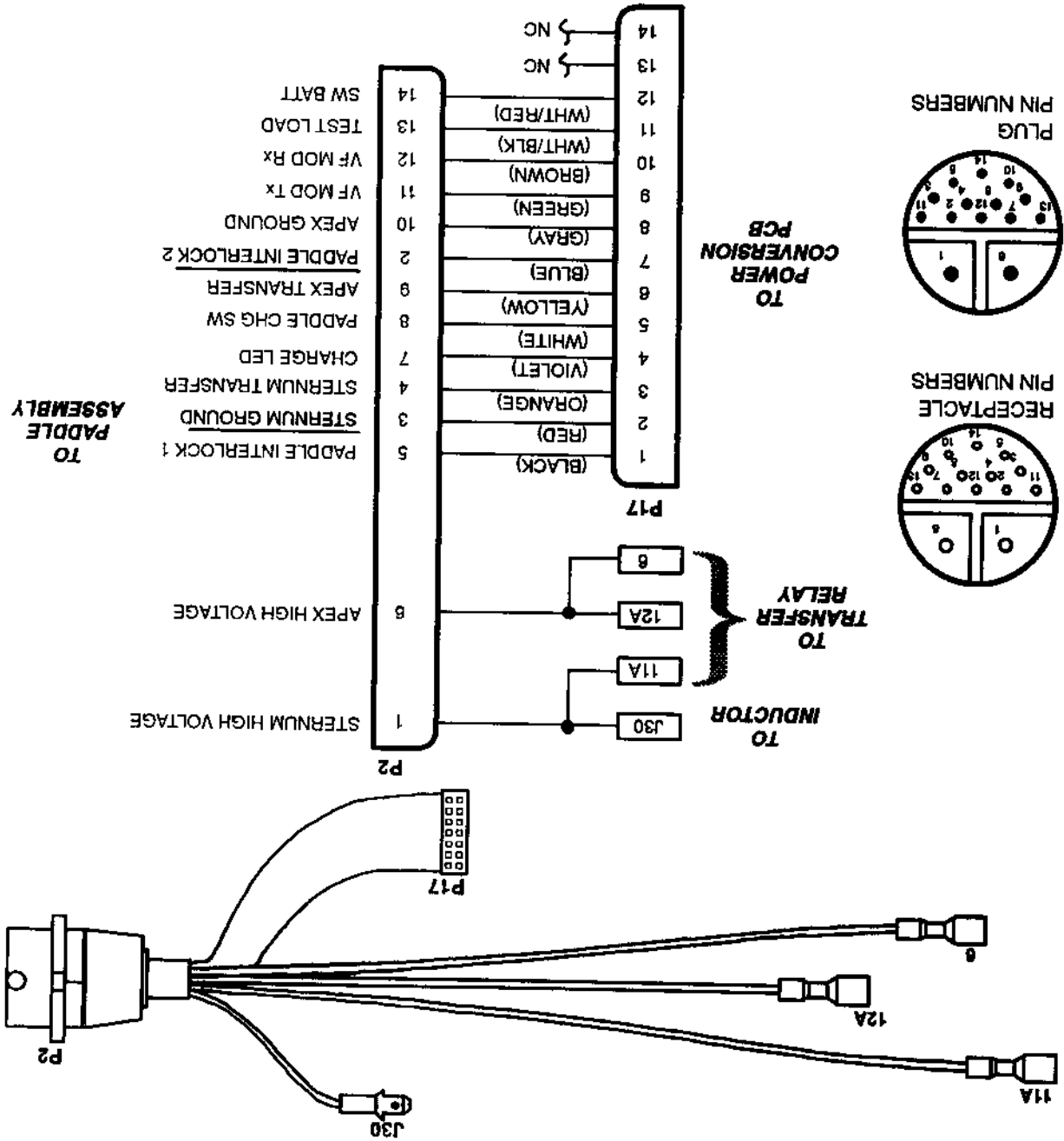
W3



5-16 Ref	Part Number	Description	Use Code
W3	803783-24	Battery Sensor/Power Supply PCB Wire Harness	fff
P2-B	202151-030	Connector, housing, 22 AWG, 6 contact	fff
P19	202125-024	Receptacle Assembly, single row, 2 contact	fff
2	202151-117	Cover, housing, strain relief, 6 contact	fff
3	202151-500	Plug, keying	fff
4	201535-019	Wire, semirigid, PVC, 300V, 22 AWG, red	fff

Figure 5-17 High Voltage Connector Cable Assembly

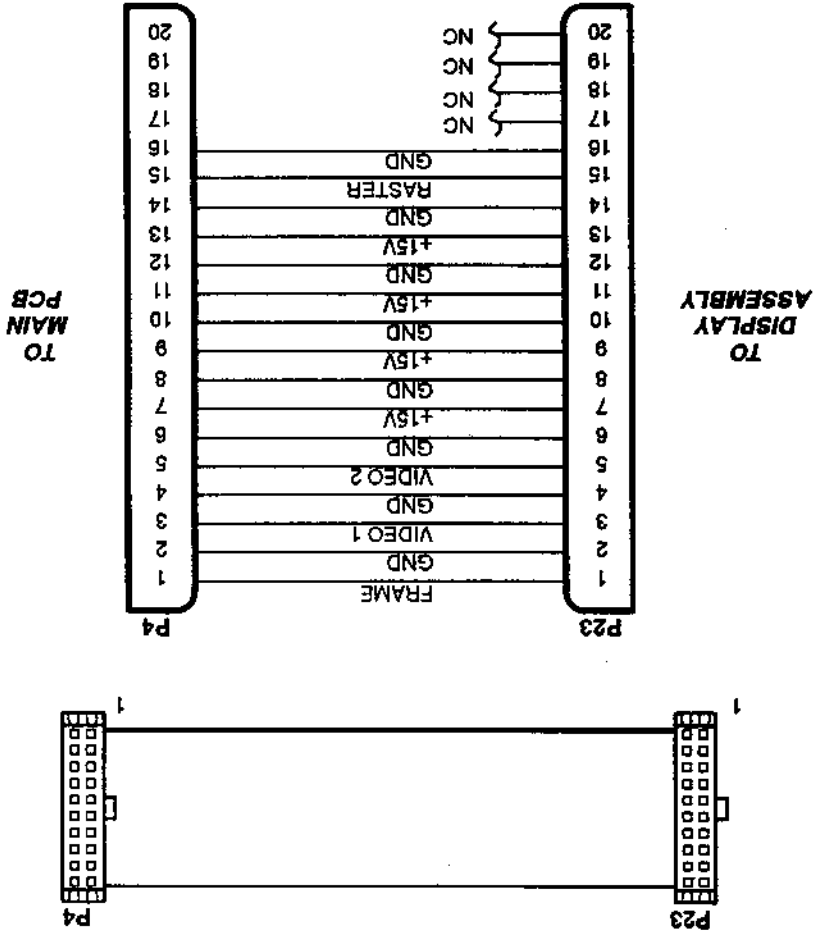
W4



Ref	Part Number	Description	Use Code	Qty
W4	803756-13	High Voltage Connector Cable Assembly		

Figure 5-18 Main PCB/Display Cable Assembly

WS

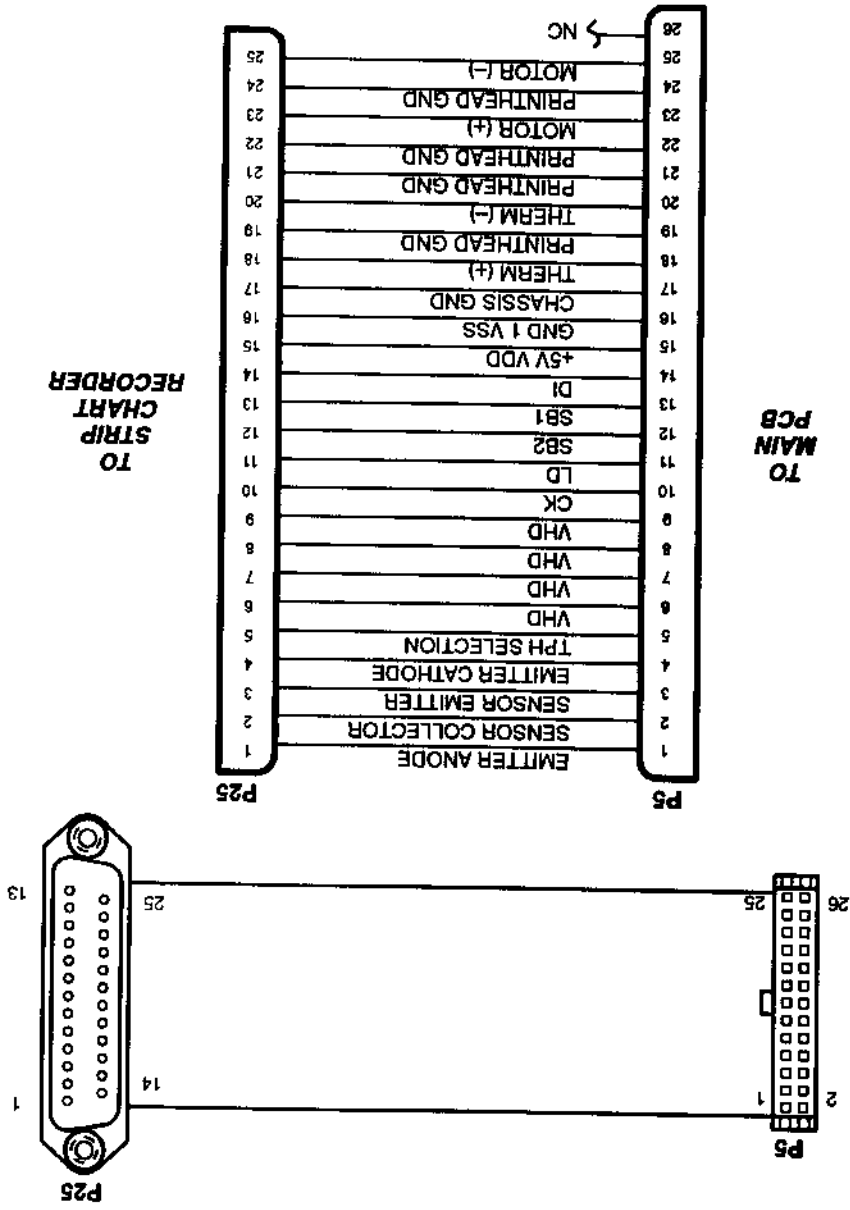


WS	803733-00	Main PCB/Display Cable Assembly	REF
5-18 Ref	Part Number	Description	Use Code



Figure 5-19 Main PCB/Recorder Cable Assembly

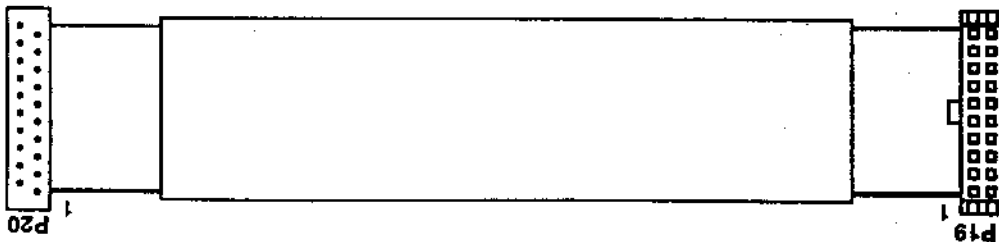
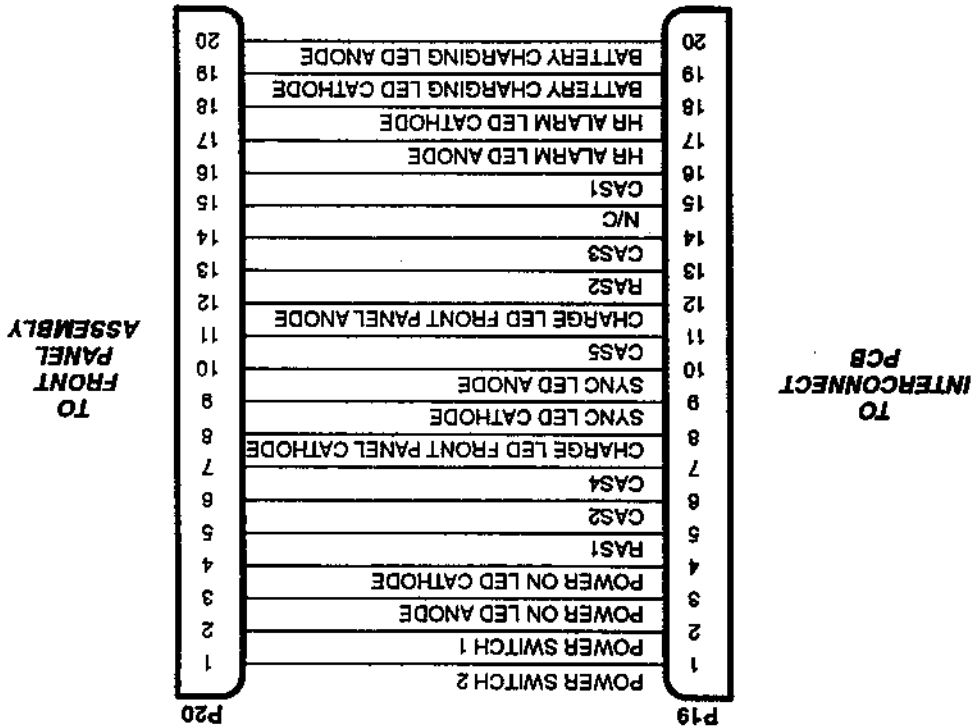
W6



Ref	Part Number	Description	Use Code
5-19	803773-00	Main PCB/Recorder Cable Assembly	
W6			

Figure 5-20 Interconnect PCB/Front Panel Cable Assembly

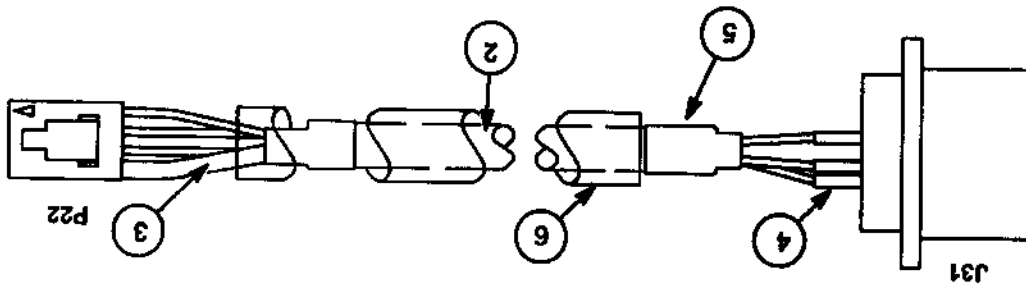
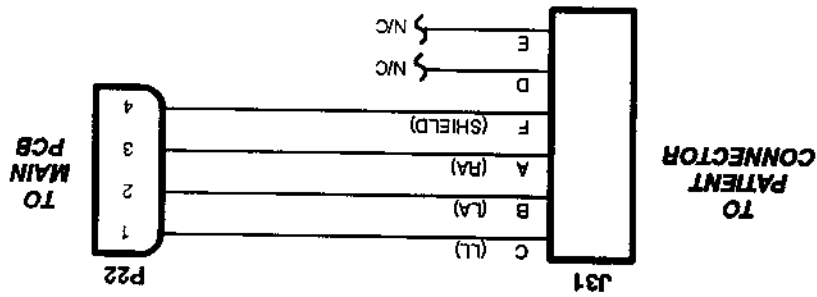
W7



Ref	Part Number	Description	Use Code
5-20	803772-00	Interconnect PCB/Front Panel Cable Assembly	

Figure 5-21 Main PCB/Patient Connector Wire Harness

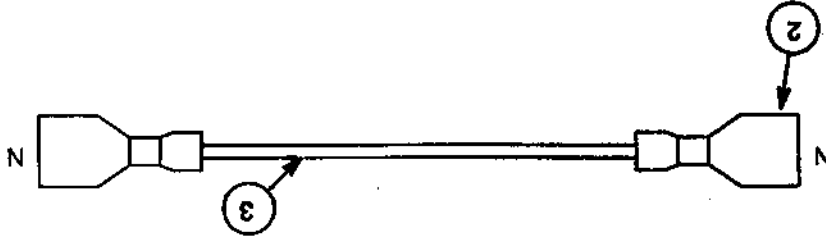
W8



5-21 Ref	Part Number	Description	Use Code	Qty
W8	803783-00	Main PCB/Patient Connector Wire Harness		
J31	801050-00	Connector, circular, chassis	I	1
P22	202125-026	Receptacle, 4 contact	I	1
2	200734-001	Cable, shield, stranded, 24 AWG, 300V, CSA	A/N	1
3	200283-014	Tubing, heat shrink, black, 0.046 ID	A/N	1
4	200283-017	Tubing, heat shrink, black, 0.125 ID	A/N	1
5	200283-018	Tubing, heat shrink, black, 0.187 ID	A/N	1
6	201756-020	Tubing, PVC, clear, 0.263 ID	A/N	1

Figure 5-23 AC Receptacle Wire Harness

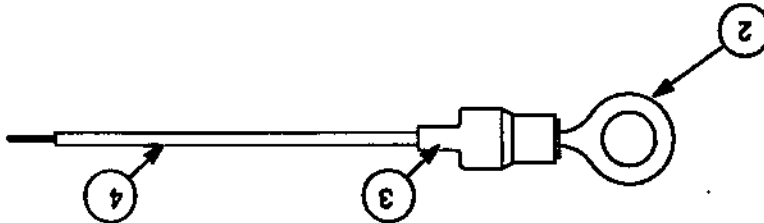
W10



5-23 Ref	Part Number	Description	Use Code
W10	803783-05	AC Receptacle Wire Harness	
2	200267-026	Terminal, receptacle, insulated, 22-18 AWG	
3	201535-084	Wire, semirigid, PVC, 300V, 18 AWG, blue	

Figure 5-22 AC Receptacle/Ground Wire Harness

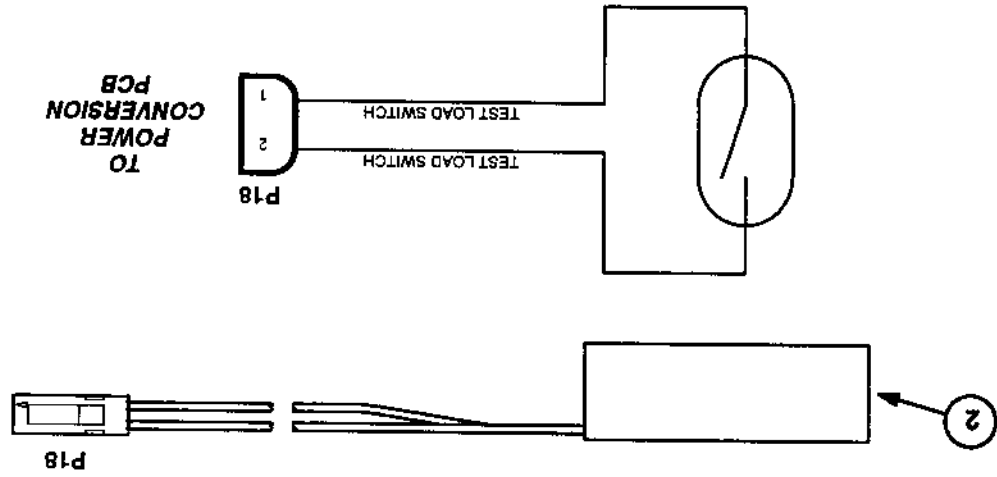
W9



5-22 Ref	Part Number	Description	Use Code
W9	803783-04	AC Receptacle/Ground Wire Harness	
2	200276-212	Terminal, lug, 22-16 AWG	
3	200283-018	Tubing, heat-shrink, black, 0.187 ID	
4	201535-090	Wire, semirigid, PVC, 300V, 18 AWG, green/yellow	

Figure 5-25 Power Conversion PCB/Harness Assembly Wire Harness

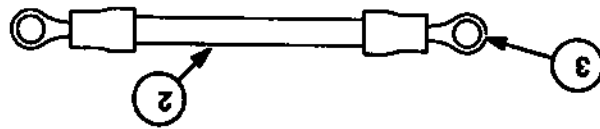
W12



5-25 Ref	Part Number	Description	Use Code
W12	803783-07	Power Conversion PCB/Reed Assembly Wire Harness	
P18	202125-024	Receptacle, 2 contact, 26-22 AWG	
2	808060-00	Reed Assembly, magnetic	

Figure 5-24 Test Load Contact/Resistor Wire Harness

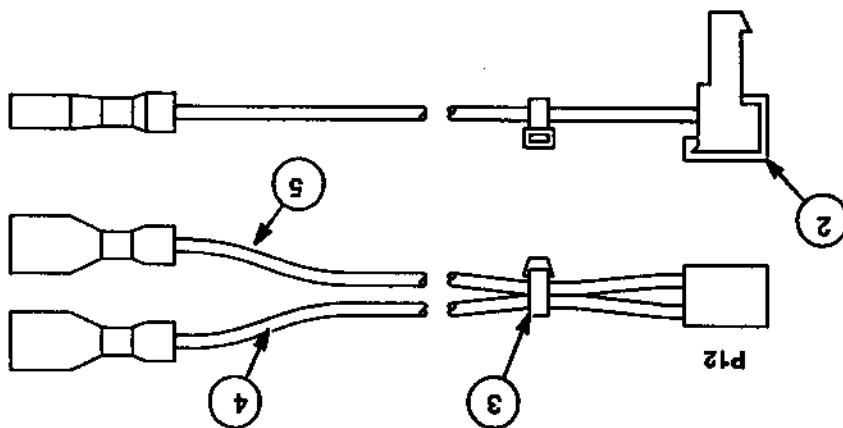
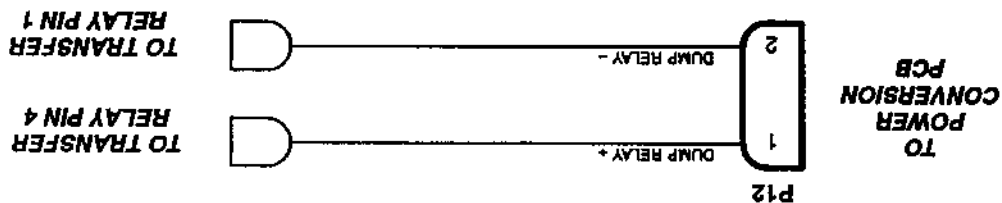
W11



5-24 Ref	Part Number	Description	Use Code
W11	803783-06	Test Load Contact/Resistor Wire Harness	
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD	
3	200276-211	Terminal, lug, 22-16 AWG	

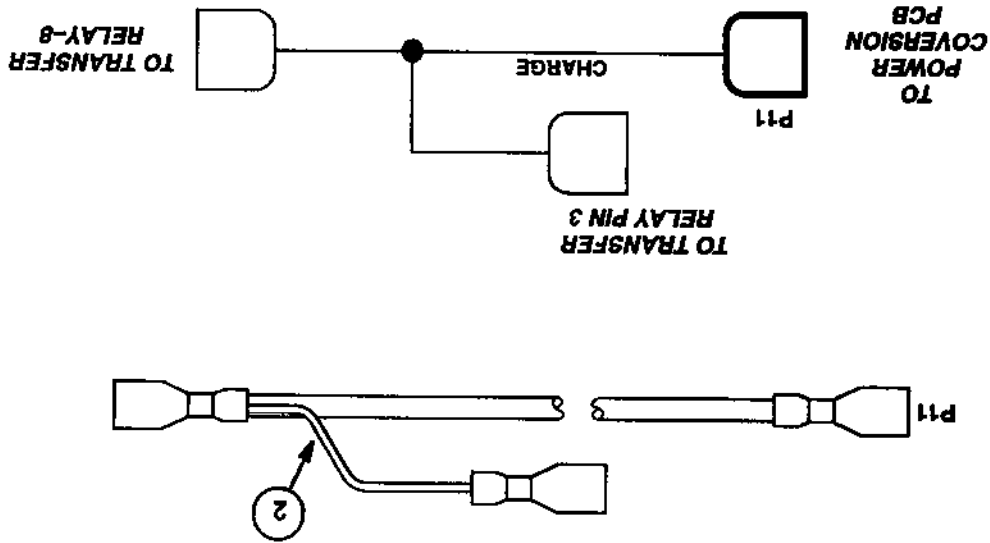
Figure 5-26 Power Conversion PCB/  
Dump Relay Wire Harness

W13



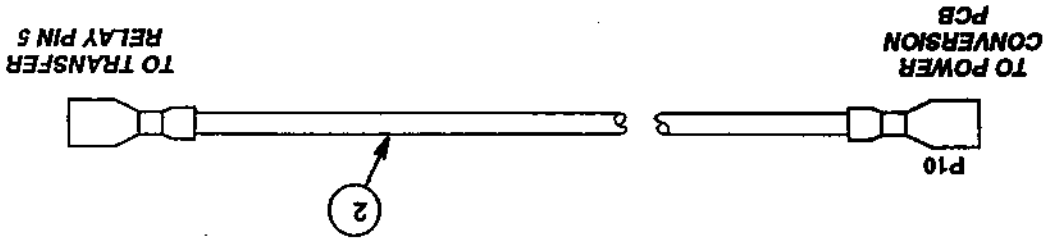
5-26 Ref	Part Number	Description	Use Code	Qty
W13	803783-08	Power Conversion PCB/Dump Relay Wire Harness		
P12	202151-026	Connector, housing, 22 AWG, 2 contact		
Relay 1A	200267-020	Terminal, receptacle, 22-18 AWG		
2	202151-113	Cover, housing, strain relief, 2 contact		
3	200536-001	Retainer, cable tie, nylon, 0.1 W x 4 L		
4	201535-021	Wire, semirigid, PVC, 300V, 22 AWG, orange		
5	201535-027	Wire, semirigid, PVC, 300V, 22 AWG, white		

W14  
 Figure 5-27 Power Conversion PCB/  
 Charge Relay Negative Wire  
 Harness



5-27 Ref	Part Number	Description	Use Code	Qty
W14	803783-09	Power Conversion PCB/Charge Relay Negative Wire Harness		
P11	200267-020	Terminal, receptacle, 22-18 AWG		3
2	201535-026	Wire, semirigid, PVC, 300V, 22 AWG, gray (Same as P11)		A/R

Figure 5-28 Power Conversion PCB/  
Charge Relay Positive Wire  
Harness  
W15

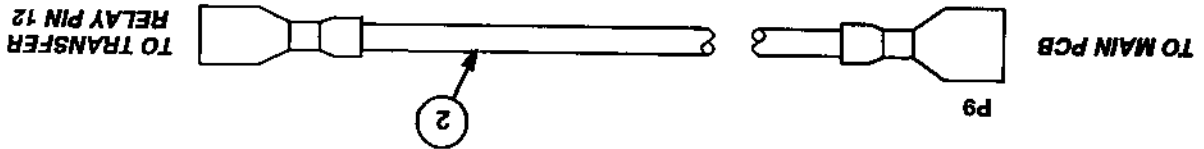


5-28 Ref	Part Number	Description	Use Code
W15	803783-10	Power Conversion PCB/Charge Relay Positive Wire Harness	HFF
P10	200267-020	Terminal, receptacle, 22-18 AWG (Same as P10)	
2	202190-000	Cable, high voltage, UI/CSA, 10KV, 0.0312 OD	CRB



Figure 5-30 Main PCB/Apex Relay Wire Harness

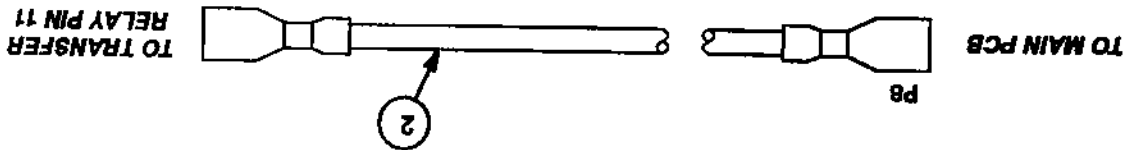
W17



5-30 Ref	Part Number	Description	Use Code	Qty
W17	803783-12	Main PCB/Apex Relay Wire Harness	REL	
P9	200267-026	Terminal, receptacle, 22-18 AWG		1
Relay 12	200267-020	Terminal, receptacle, 22-18 AWG		1
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD		A/N

Figure 5-29 Main PCB/Sternum Relay Wire Harness

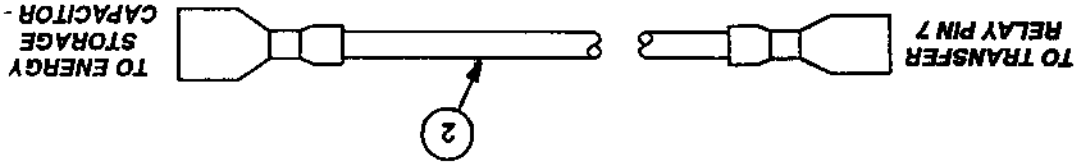
W16



5-29 Ref	Part Number	Description	Use Code	Qty
W16	803783-11	Main PCB/Sternum Relay Wire Harness	REL	
P8	200267-020	Terminal, receptacle, 22-18 AWG (Same as P8)		2
Relay 11	200267-020	Terminal, receptacle, 22-18 AWG		2
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD		A/N

Figure 5-32 Storage Capacitor Negative/Relay Wire Harness

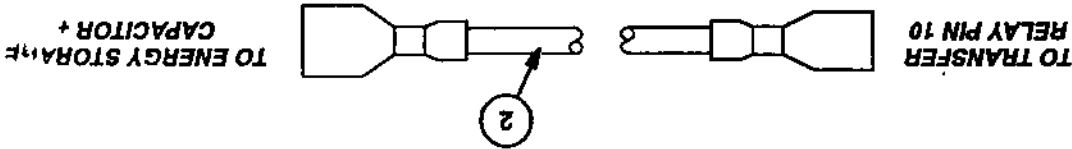
W19



5-32 Ref	Part Number	Description	Use Code
W19	803783-14	Storage Capacitor Negative/Relay Wire Harness	HEF
Relay 7	200267-020	Terminal, receptacle, 22-18 AWG, 0.187	
CAP-	200267-026	Terminal, receptacle, 22-18 AWG, 0.250	
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD	MR

Figure 5-31 Storage Capacitor Positive/Relay Wire Harness

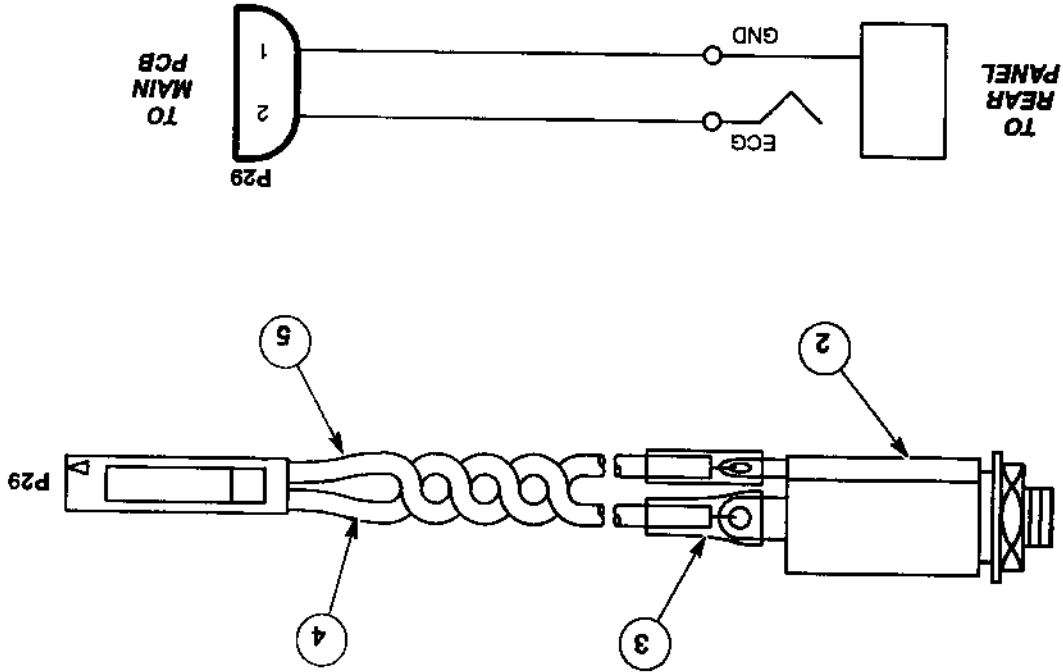
W18



5-31 Ref	Part Number	Description	Use Code
W18	803783-13	Storage Capacitor Positive/Relay Wire Harness	HEF
Relay 10	200267-020	Terminal, receptacle, 22-18 AWG, 0.187	
CAP+	200267-026	Terminal, receptacle, 22-18 AWG, 0.250	
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD	MR

Figure 5-33 ECG Out Wire Harness

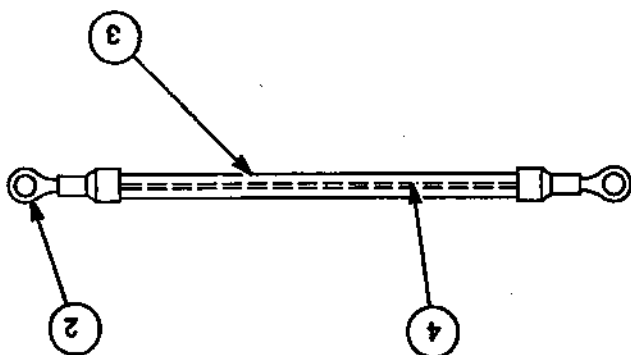
W20



5-33 Ref	Part Number	Description	Use Code
W20	803783-15	ECG Out Wire Harness	
P29	202125-024	Receptacle, 2 contact	
2	200317-002	Connector, phone jack	
3	200283-018	Tubing, heat shrink, black, 0.187 ID	
4	201535-021	Wire, 300V, 22 AWG, orange	
5	201535-027	Wire, 300V, 22 AWG, white	

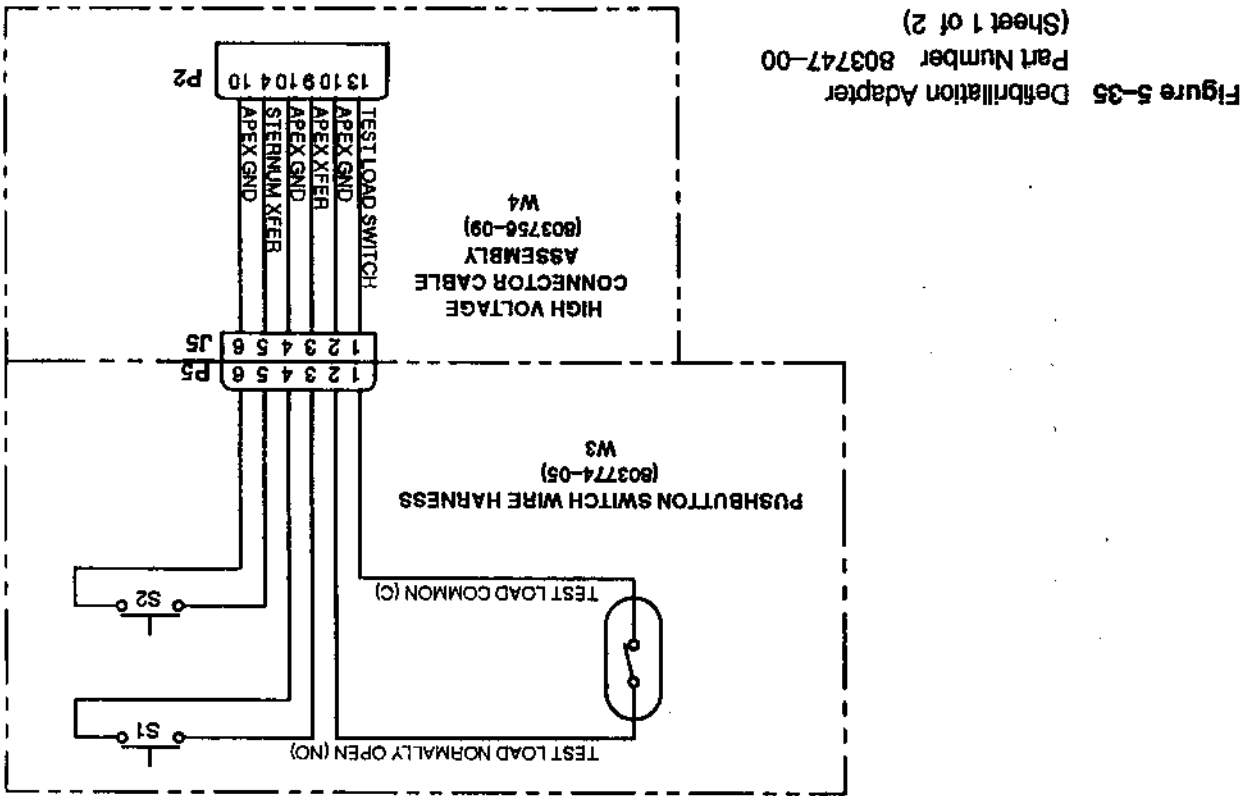
Figure 5-34 Recorder/Bracket Ground Wire Harness

W21



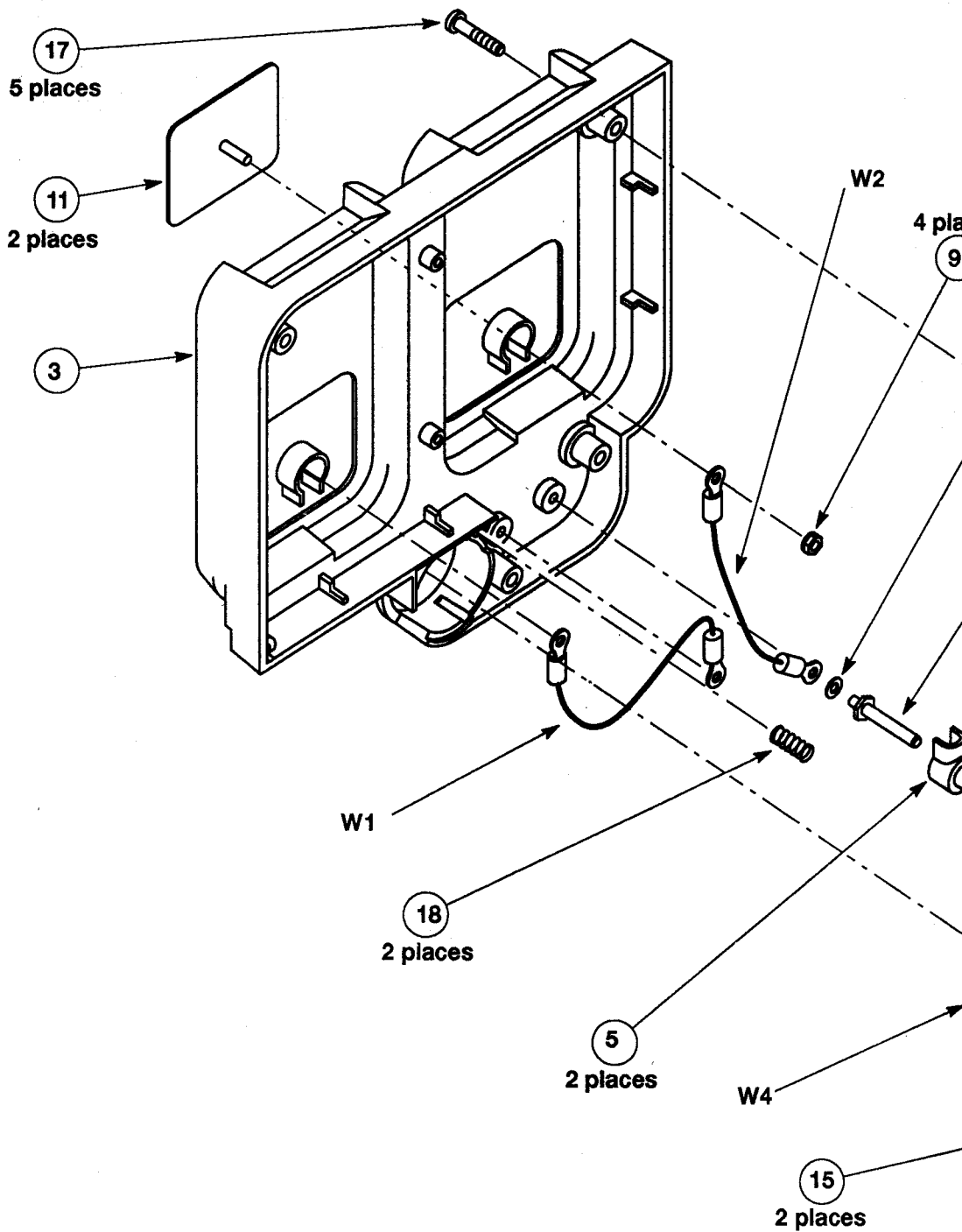
5-34 Ref	Part Number	Description	Use Code	Qty
W21	803783-19	Recorder/Bracket Ground Wire Harness		1
2	200276-209	Terminal, lug, ring, #10		2
3	201756-010	Tubing, PVC, clear, size 12		1
4	201535-023	Wire, semirigid, PVC, 300V, AWG 22, green		1

5-35 Ref	Part Number	Description	Use Code	Qty
	803747-00	Defibrillation Adapter, English, Domestic	A	RTF
	803747-01	Defibrillation Adapter, French, International	B	RTF
	803747-02	Defibrillation Adapter, German, International	C	RTF
	803747-03	Defibrillation Adapter, Spanish, International	D	RTF
	803747-04	Defibrillation Adapter, Spanish, Domestic	E	RTF
	803747-05	Defibrillation Adapter, French, Domestic	F	RTF
	803747-06	Defibrillation Adapter, French, CSA	G	RTF
	803747-07	Defibrillation Adapter, English, CSA	H	RTF
	803747-08	Defibrillation Adapter, English, UK	I	RTF
	803747-09	Defibrillation Adapter, Portuguese	J	RTF
	803747-10	Defibrillation Adapter, Italian	K	RTF
	803747-11	Defibrillation Adapter, Swedish	L	RTF
S3	803781-01	Switch, test load		
W1	803774-03	Test Load High Voltage Wire Harness (pg. 5-89)		
W2	803774-04	Test Load High Voltage Wire Harness (pg. 5-89)		
W3	803774-05	Pushbutton Switch Wire Harness (pg. 5-90)		
W4	803756-09	High Voltage Connector Cable Assembly (pg. 5-91)		
2	803738-11	Case, front		
3	803751-01	Case, rear		
4	803750-00	Cover, interior		
5	803765-00	Insulator, connector pin electrode		
6	803752-31	Label, defibrillation adapter, English	A.H.I.	
	803752-33	Label, defibrillation adapter, French	B.F.G.	
	803752-35	Label, defibrillation adapter, German	C	
	803752-37	Label, defibrillation adapter, Spanish	D.E	
	803752-38	Label, defibrillation adapter, Portuguese	J	
	803752-40	Label, defibrillation adapter, Italian	K	
	803752-42	Label, defibrillation adapter, Swedish	L	
7	803731-04	Label, serial number, English, Domestic (not shown, used on item 2)	A	
	803731-05	Label, serial number, French, International	B	
	803731-06	Label, serial number, German, International	C	
	803731-07	Label, serial number, Spanish, International	D	
	803731-08	Label, serial number, Spanish, Domestic	E	
	803731-09	Label, serial number, French, Domestic	F	
	803731-10	Label, serial number, French, CSA	G	
	803731-11	Label, serial number, English, CSA	H	
	803731-12	Label, serial number, English, UK	I	
	803731-26	Label, serial number, Portuguese	J	



Ref	Part Number	Description	Use Code
5-35			
8	803731-29	Label, serial number, Italian	K
8	805532-01	Fastener Plate, switch, test load	L
9	201508-003	Nut, lock, kep, 6-32	
10	803780-02	Pin, connector, electrode	
11	803725-02	Plate, test load	
	802935-08	Pushbutton, paddle, discharge, Domestic	A-E-H
	802935-09	Pushbutton, paddle, discharge, International	B-D-L
12	200536-001	Retainer, cable tie, nylon, 0.10 W x 4 L (not shown, used on W3)	
13	200530-002	Retainer, clamp, cable	
14	202039-000	Retainer, wire, adhesive mount (not shown, used on W3)	
15	202253-506	Screw, pan head, 2-56 x 0.375 L	
16	201874-001	Screw, pan head, 6-32 x 0.250 L	
17	201873-236	Screw, pan head, 6-32 x 0.750 L	
18	201625-173	Spring, compression, 0.240 OD, 0.562 L	
19	200283-003	Tubing, heatshrink, red 0.125 ID (not shown, used on S3)	
20	201575-004	Washer, lock, #6 x 0.288 OD, 0.018 T	

LIFEPAK 9 defibrillator/monitor



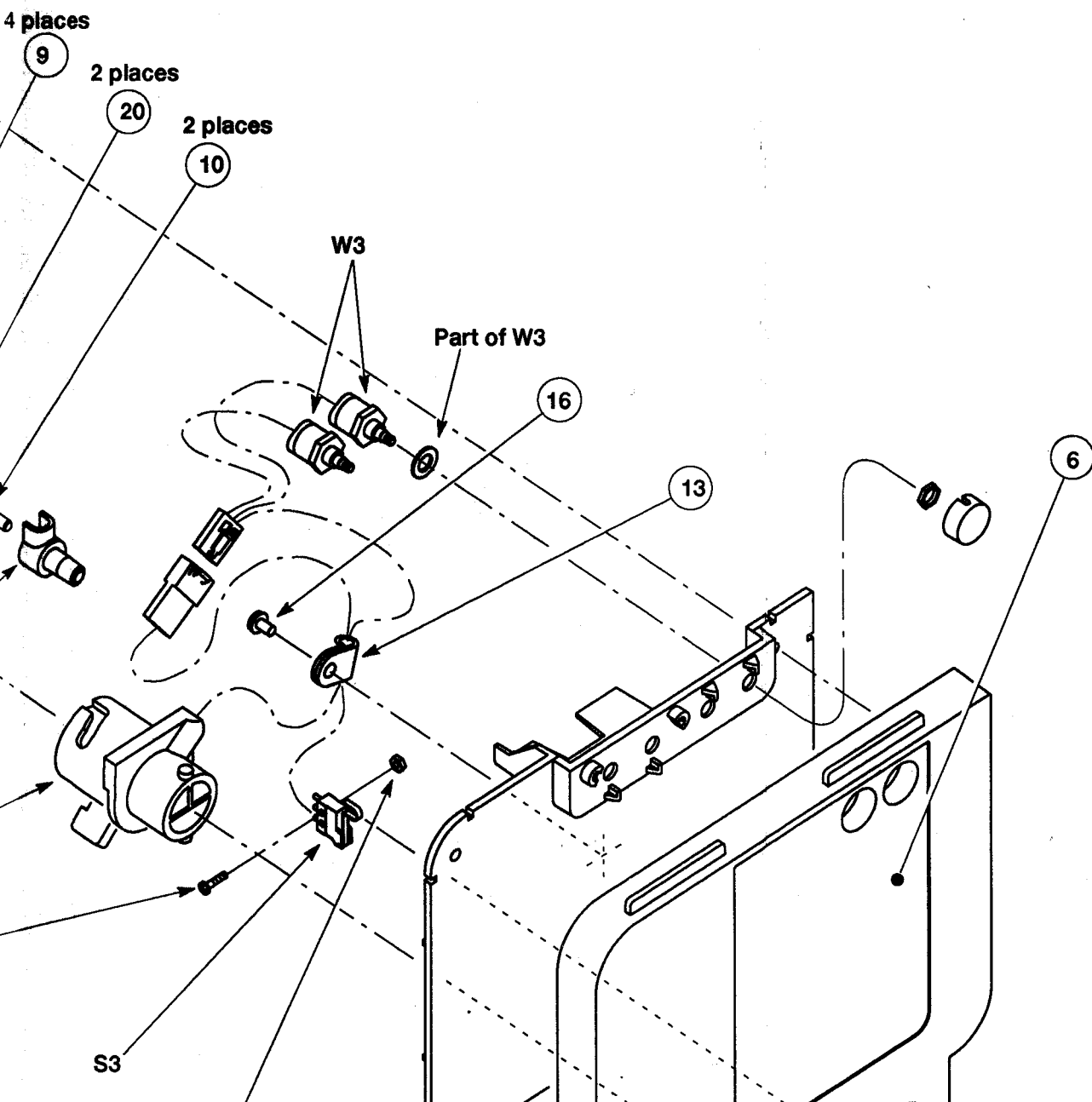
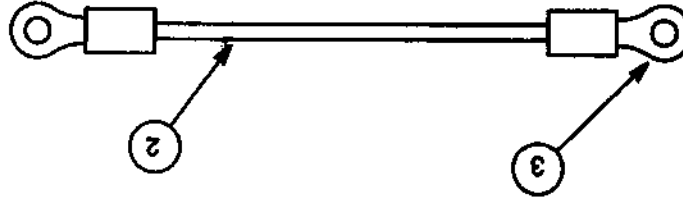




Figure 5-37 Test Load High Voltage Wire Harness

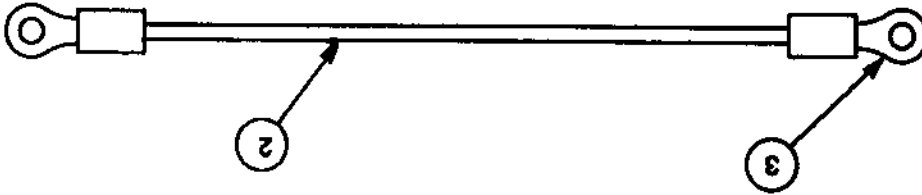
W2



Ref	Part Number	Description	Use Code
5-37	W2	Test Load High Voltage Wire Harness	
	803774-04		
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD	
3	200276-211	Terminal, lug, 22-16 AWG	

Figure 5-36 Test Load High Voltage Wire Harness

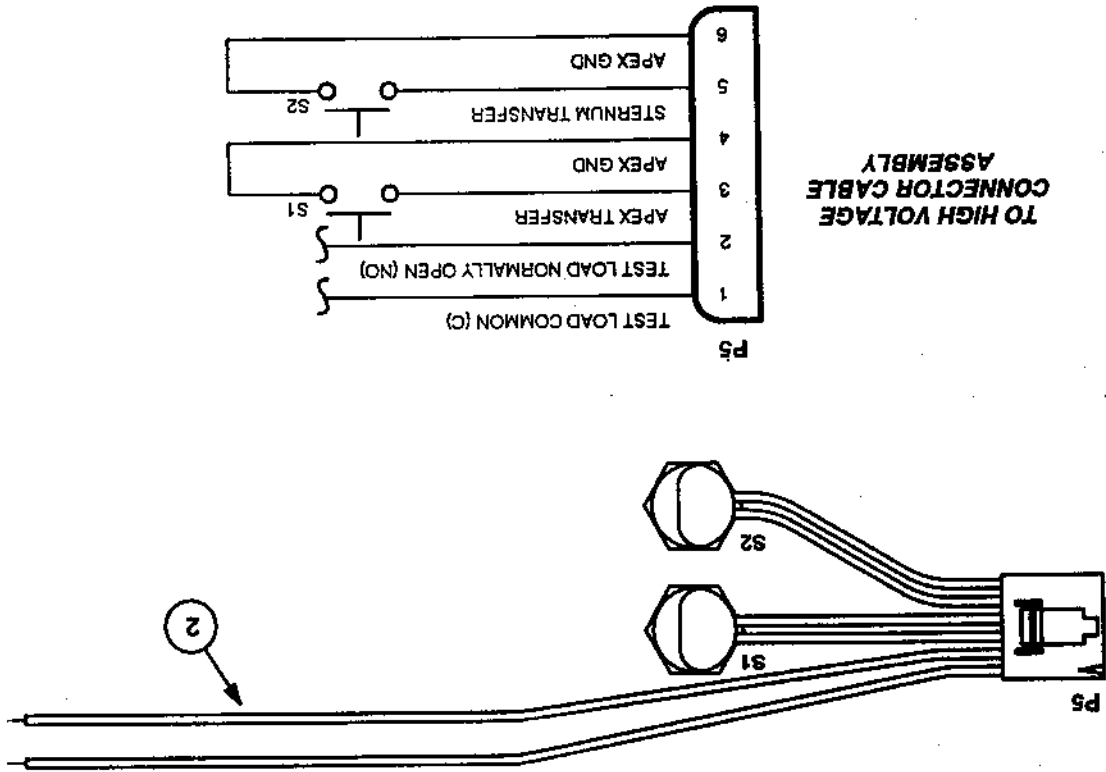
W1



Ref	Part Number	Description	Use Code
5-36	W1	Test Load High Voltage Wire Harness	
	803774-03		
2	202190-000	Cable, high voltage, UL/CSA, 10KV, 0.0312 OD	
3	200276-211	Terminal, lug, 22-16 AWG	

Figure 5-38 Pushbutton Switch Wire Harness

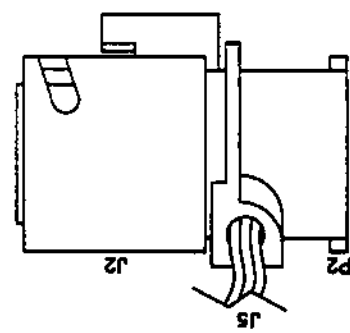
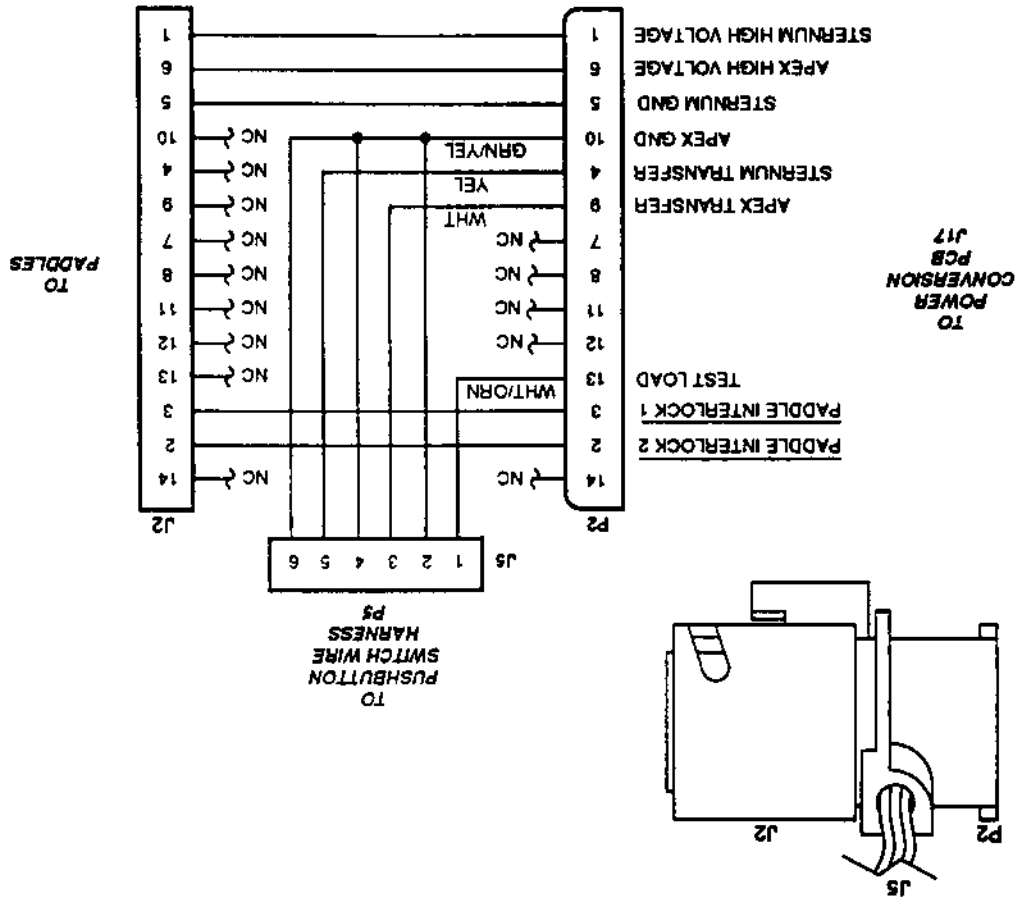
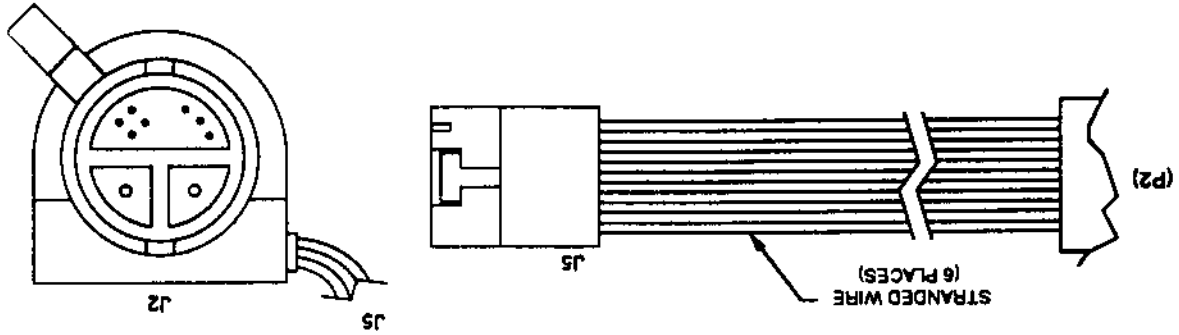
W3



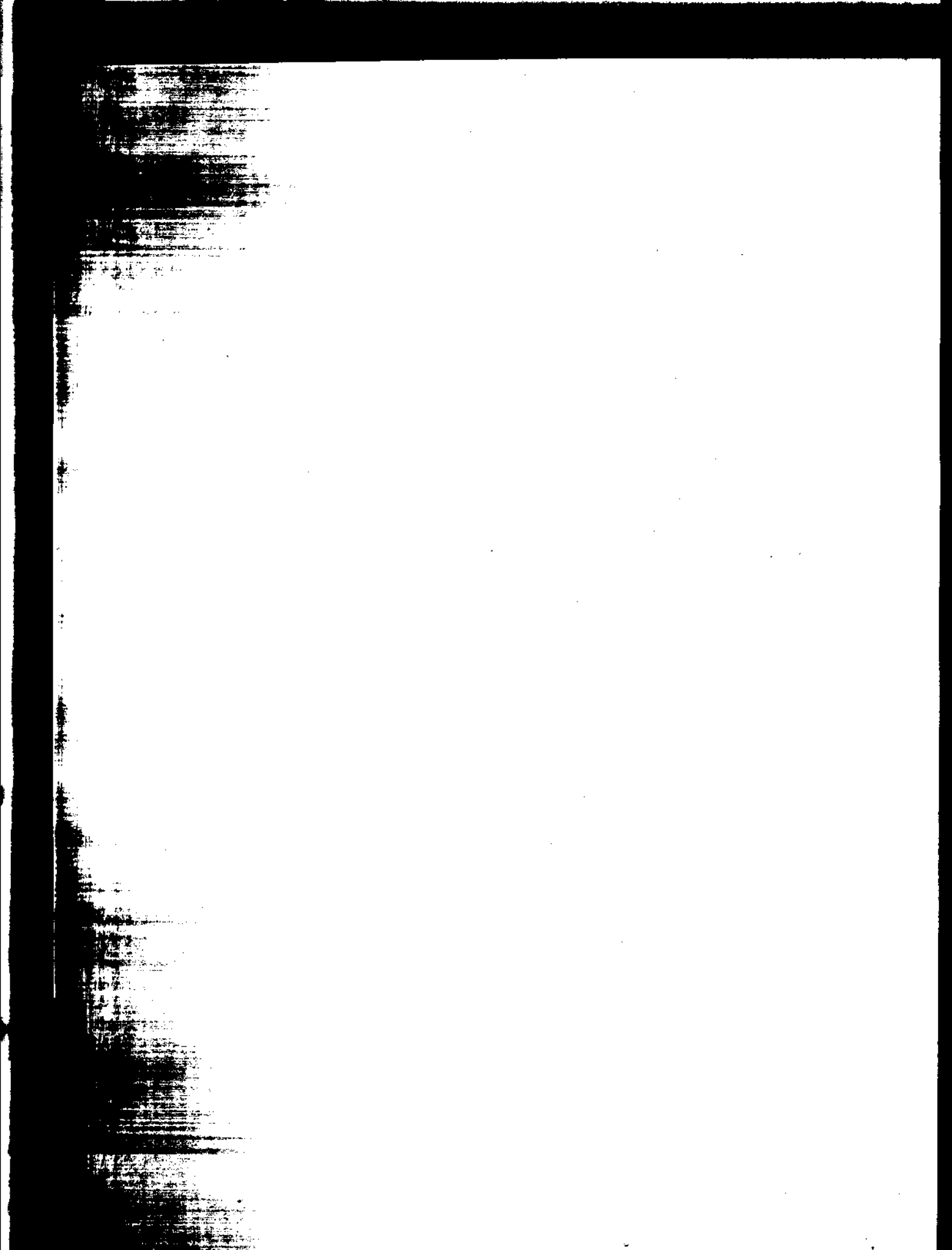
Use Code	Description	Part Number	Ref
	Pushbutton Switch Wire Harness	803774-05	W3
	Receptacle Assembly, polarized, latching, 6 contact Switch, pushbutton, SPST	202125-028 804697-04	P5 S1,S2
	Wire, semirigid, PVC, 300V, AWG 22, white	201535-027	2

Figure 5-39 High Voltage Connector Cable Assembly

W4



Part Number	Description	Use Code
W4	High Voltage Connector Cable Assembly	
5-39		
803756-09		



# Component Reference


## Introduction

This section contains component diagrams for integrated circuits selected from the PCB assembly schematics. Each figure contains some or all of the following information as an aid in circuit analysis and troubleshooting:

- Pin Configuration
- Function Table
- Block Diagram.

**Caution**

Potential Component Damage. Use special handling procedures on page 4-4 when handling static sensitive devices (SSDs). SSDs are identified in Table 6-1 with this symbol:



ATTENTION

**Table 6-1 Component Reference Diagrams**

Assembly	Ref Des.	IC Number	Type	Fig No.	Page No.
Interconnect (A5)	U1	74HC238	Decoder	6-8	6-6
Display (A4)	U201	TL494CN	Voltage Regulator	6-27	6-10
	U101	TDA1170N	Deflection Circuit	6-9	6-7

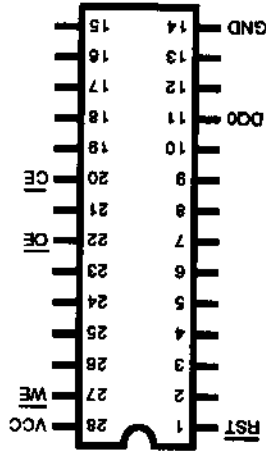
Table 6-1 Component Reference Diagrams

Fig No.	Type	IC Number	Ret Des.	Assembly
6-17	Microprocessor	63B03Y	U1,U30	Main (A1)
6-16	Gate Array, Recorder	4040	U3	
6-5	Counter	4040	U4	
6-18	Modulator, Pulse-Width	3525A	U5	
6-21	Oscillator	NCM031C	U10	
6-1	Buffer	74HCT244	U11,U12, U15	
6-24	Static RAM, 32k x 8	HM62256LP-12	U13,U21, U28A	
6-10	EPROM	27C256	U22	
6-11	Flip-Flop, D-Type	74HC74	U16	
6-12	Flip-Flop, D-Type	74HCT374	U19,U20	
6-7	Decoder	74HCT138	U25	
6-20	Multivibrator	74HC4538	U26	
6-2	Clock, Real-Time	DS1242Y	U28B	
6-15	Gate Array, Display		U29	
6-19	Multivibrator	74HC221	U31	
6-6	Counter	74HC161	U32	
6-13	Flip-Flop, D-Type	74HC174	U33	
6-14	Flip-Flop, J-K	74HC76	U36	
6-25	Switch, Analog	DG307, DG302	U40,U43	
6-26	Switch, Analog	DG509	U41,U42	
6-23	Regulator, Pulse-Width	3843	U3	Power Conversion (A3)
6-3	Converter, A/D	TLC1541	U9	
6-4	Converter, D/A	7541	U18	
6-22	Register, Shift	74HC164	U19,U20	

Figure 6-2 Real-Time Clock

PIN CONFIGURATION

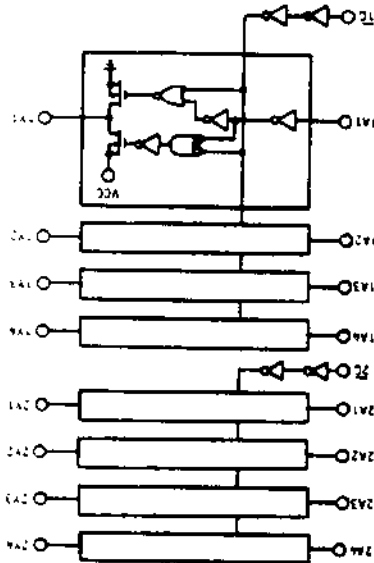
NOTE: ALL PINS PASS THROUGH EXCEPT PINS 20 AND 28



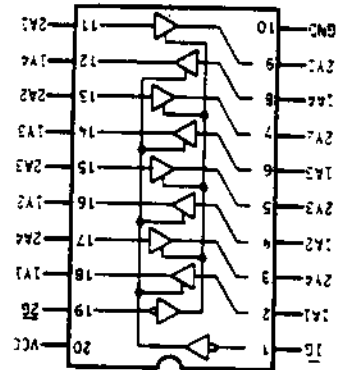
REF. DES.	IC NUMBER	LOCATION	TYPE
U28B	DS1216C	Main (A1)	Clock, Real-Time

Figure 6-1 Buffer

FUNCTIONAL DIAGRAM



CONNECTION DIAGRAM



FUNCTION TABLE

H = High level  
L = Low level  
Z = High impedance output

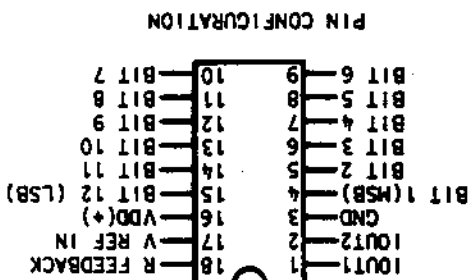
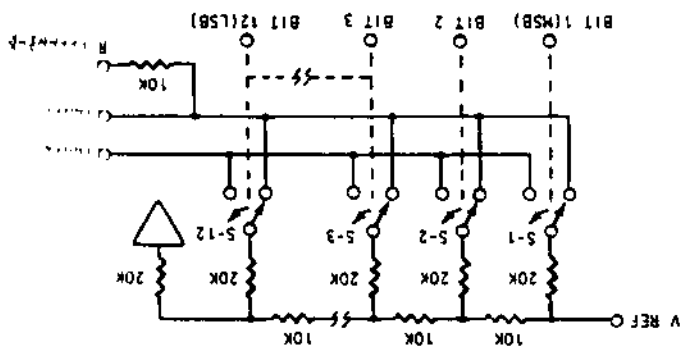
1C	1A	1Y	2C	2A	2Y
L	L	L	L	L	L
L	H	L	L	L	L
L	L	H	L	L	L
L	H	H	L	L	L
H	L	L	L	L	L
H	H	L	L	L	L
H	L	H	L	L	L
H	H	H	L	L	L

REF. DES.	IC NUMBER	LOCATION	TYPE
U11, U12	74HCT244	Main (A1)	Buffer

Figure 6-4 D/A Converter

FUNCTIONAL DIAGRAM

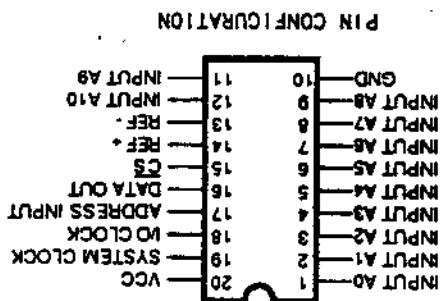
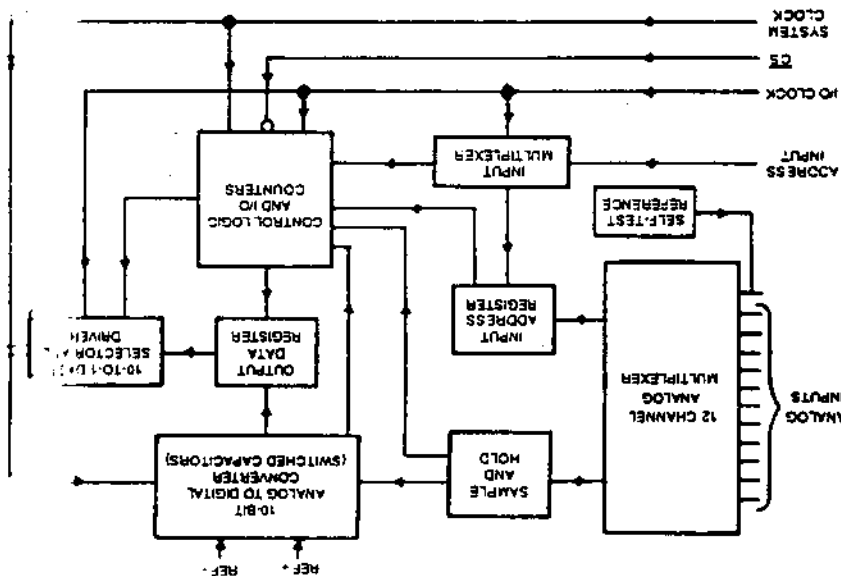
LOGIC: A SWITCH IS CLOSED TO IOUT1 FOR A DIGITAL INPUT IN A "HIGH" STATE.



Type	IC NUMBER	LOCATION	Ref. Fig.
Converter D/A	7541	Power Conversion (A3)	116

Figure 6-3 A/D Converter

BLOCK DIAGRAM



Type	IC NUMBER	LOCATION	Ref. Fig.
Converter, A/D	TLC1541	Power Conversion (A3)	115







Figure 6-10 EPROM

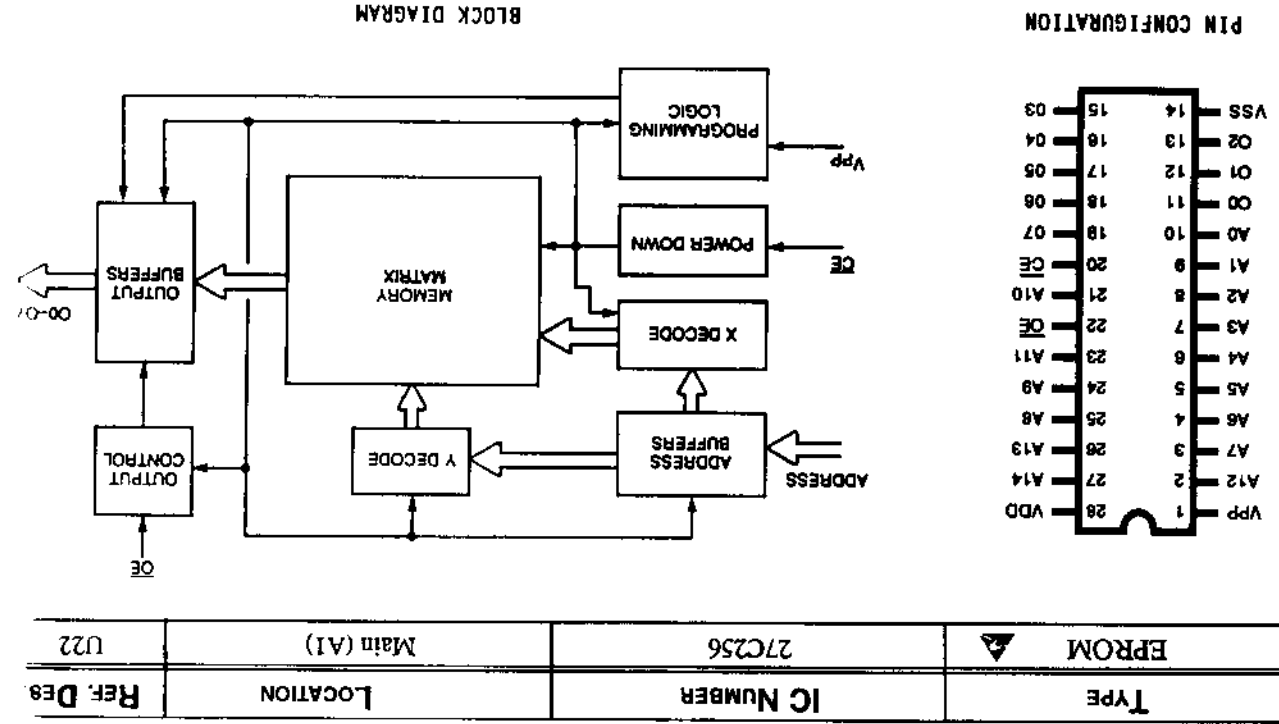


Figure 6-9 Deflection Circuit

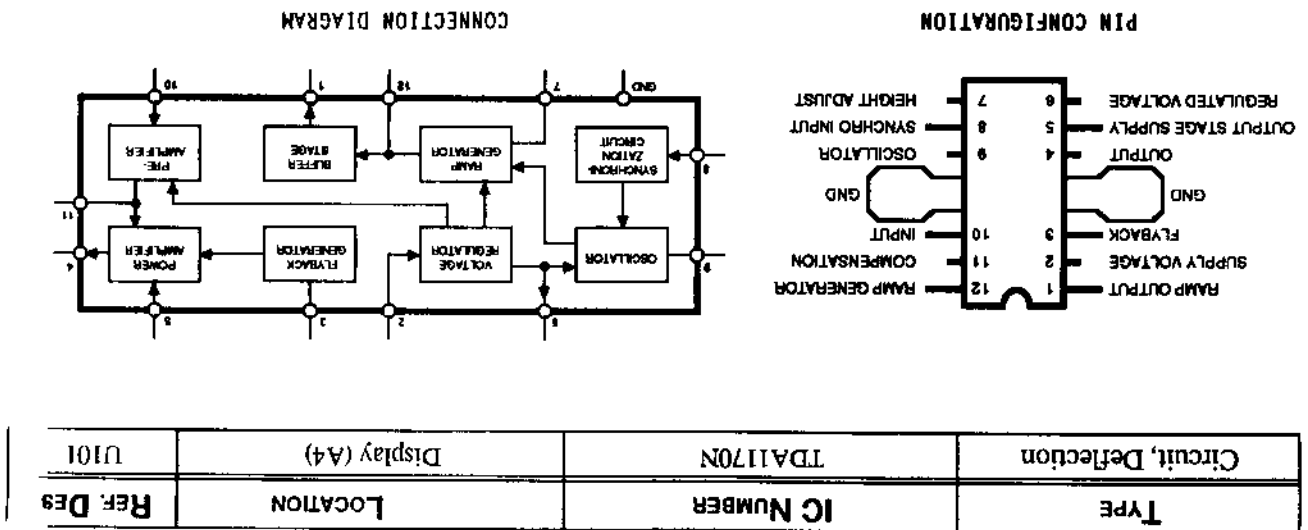
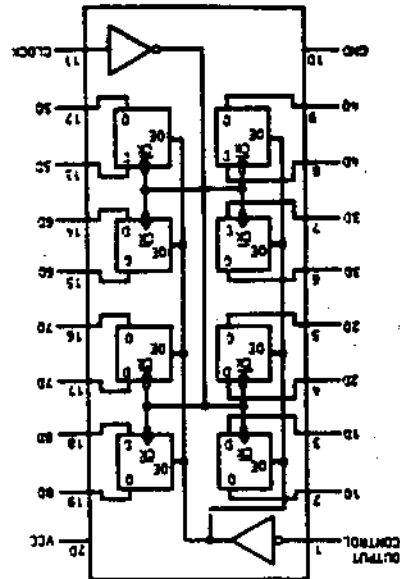


Figure 6-12 D-Type Flip-Flop CONNECTION DIAGRAM



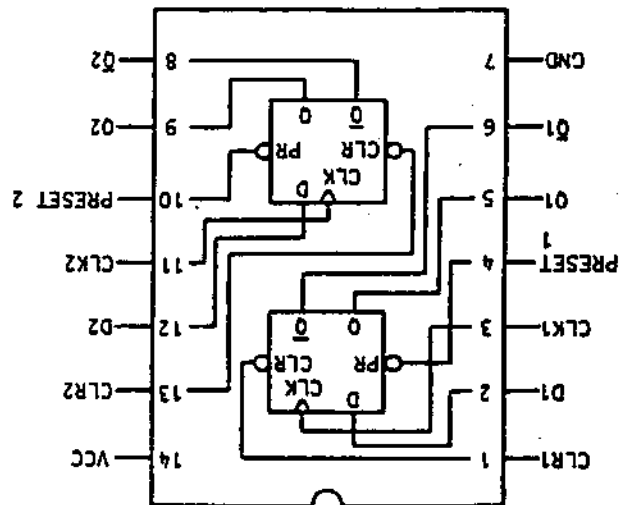
FUNCTION TABLE

H = HIGH LEVEL  
 L = LOW LEVEL  
 ↑ = TRANSITION FROM LOW-TO-HIGH  
 Z = HIGH IMPEDANCE STATE  
 00 = THE LEVEL OF THE OUTPUT BEFORE STEADY STATE INPUT CONDITIONS WERE ESTABLISHED

OUTPUT CONTROL	CLOCK	DATA	OUTPUT
H	↑	H	H
L	↑	L	L
L	↑	X	L
L	↑	X	L
L	↑	X	Z
L	↑	X	00
L	↑	X	00

TYPE	IC NUMBER	LOCATION	REF. DES.
Flip-Flop, D-Type	74HC174	Main (A1)	U19, U20

Figure 6-11 D-Type Flip-Flop CONNECTION DIAGRAM



FUNCTION TABLE

H = High level  
 L = Low level  
 X = Irrelevant  
 00 = The level of Q before the indicated already state input conditions were established.  
 \*This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (high) level.

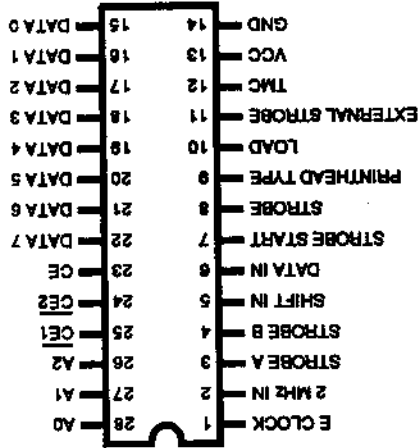
INPUTS		OUTPUTS	
PR	CLR	CLK	D
H	H	H	H
H	H	↑	H
H	H	↓	H
H	L	X	H*
L	L	X	H*
L	L	X	L
L	L	X	H
L	L	X	L
L	L	X	00
L	L	X	00

TYPE	IC NUMBER	LOCATION	REF. DES.
Flip-Flop, D-Type	74HC74	Main (A1)	U16



Figure 6-16 Recorder Gate Array

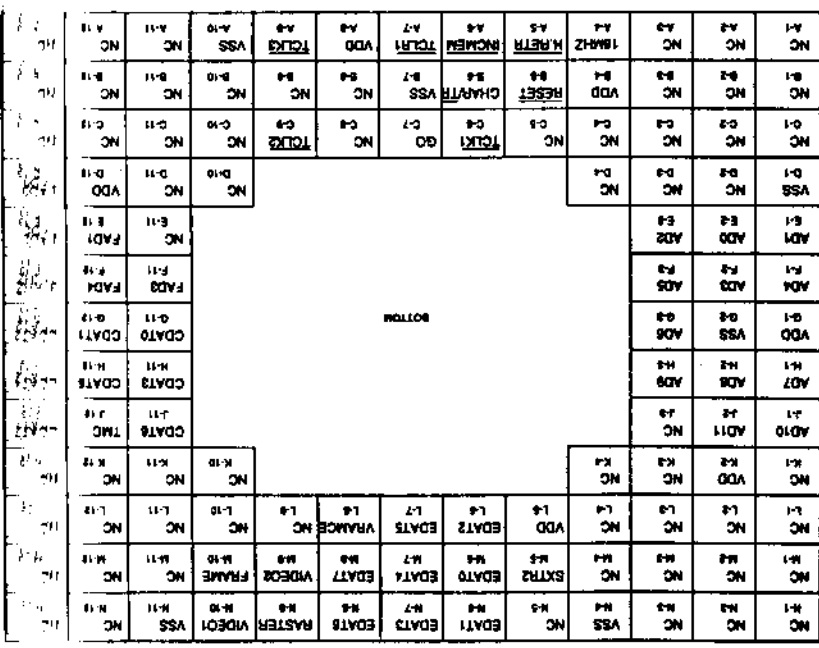
PIN CONFIGURATION



Type	IC NUMBER	LOCATION	REF. DES.
Gate Array, Recorder		Main (A1)	U3

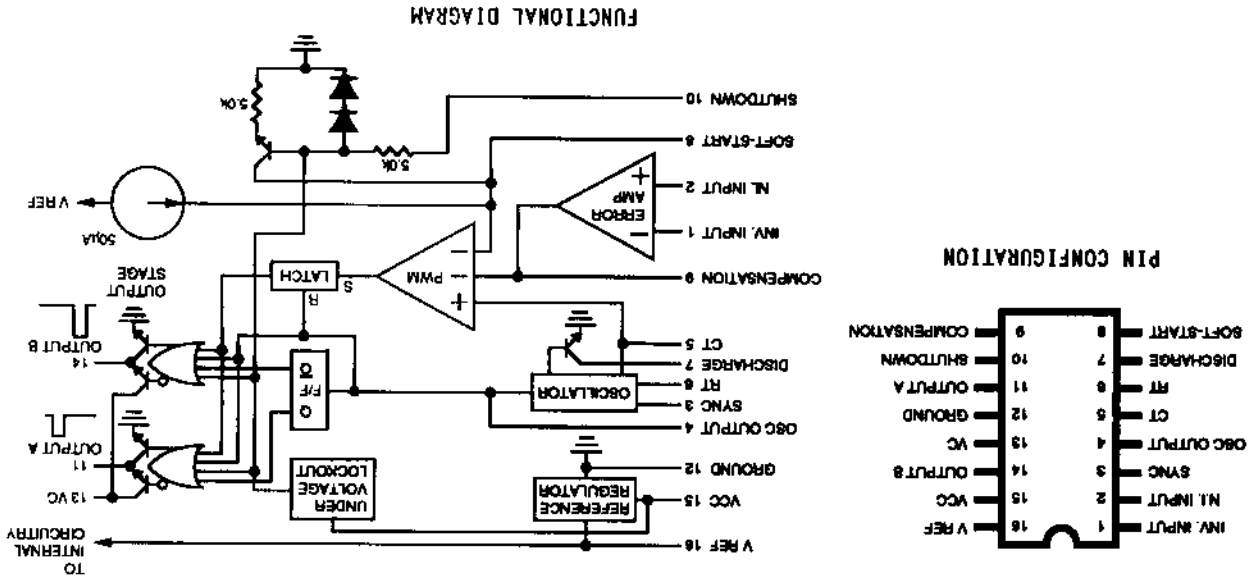
Figure 6-15 Display Gate Array

PIN CONFIGURATION

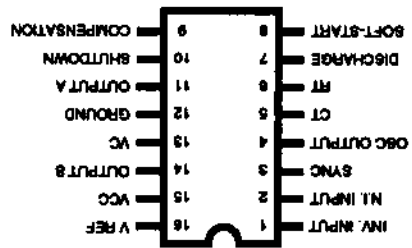


Type	IC NUMBER	LOCATION	REF. DES.
Gate Array, Display		Main (A1)	U29

Figure 6-18 Pulse-Width Modulator

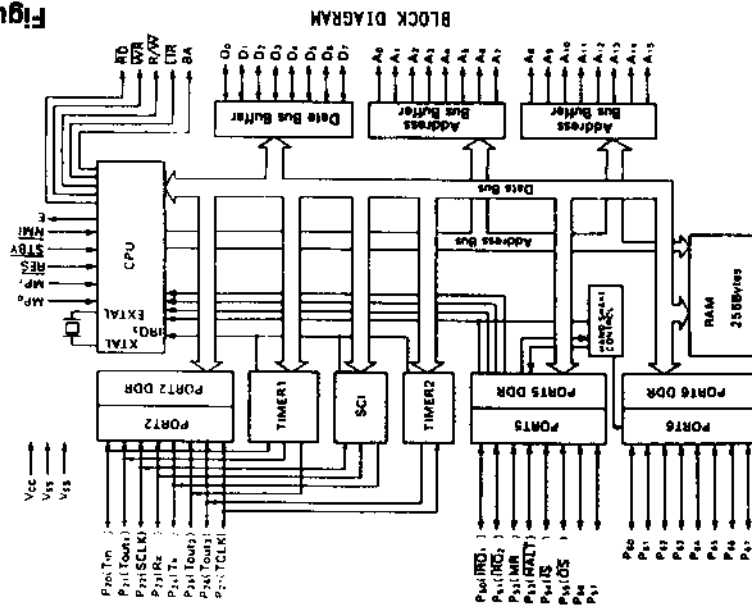


PIN CONFIGURATION

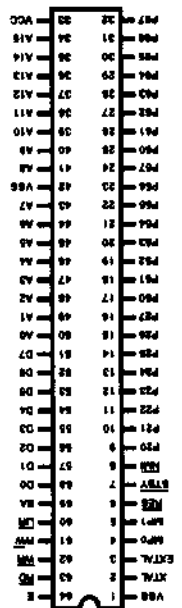


TYPE	IC NUMBER	LOCATION	REF. Des.
Modulator, Pulse-Width	3525A	Main (A1)	U5

Figure 6-17 Microprocessor

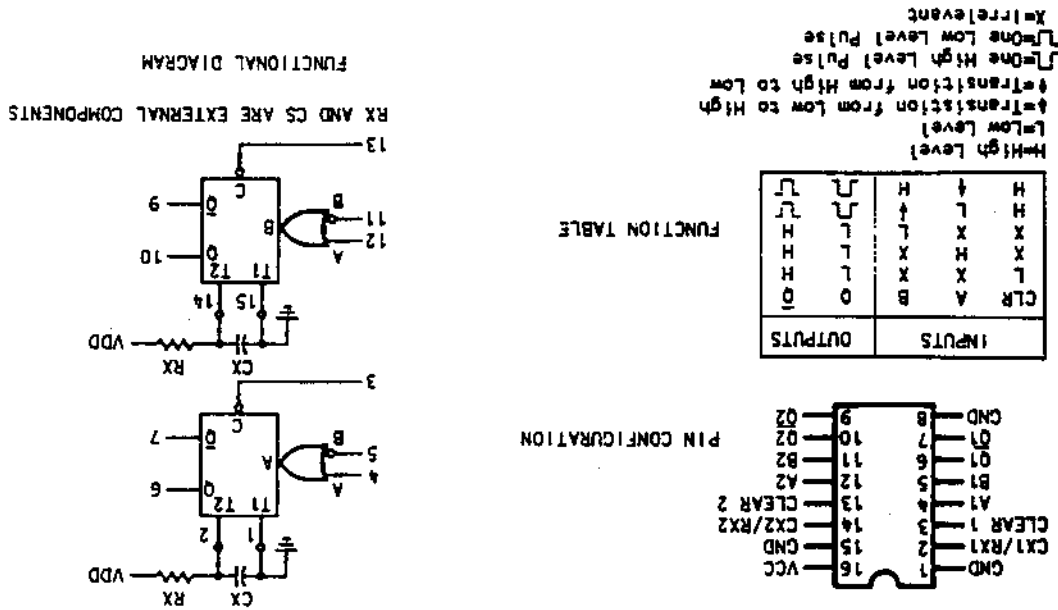


PIN CONFIGURATION



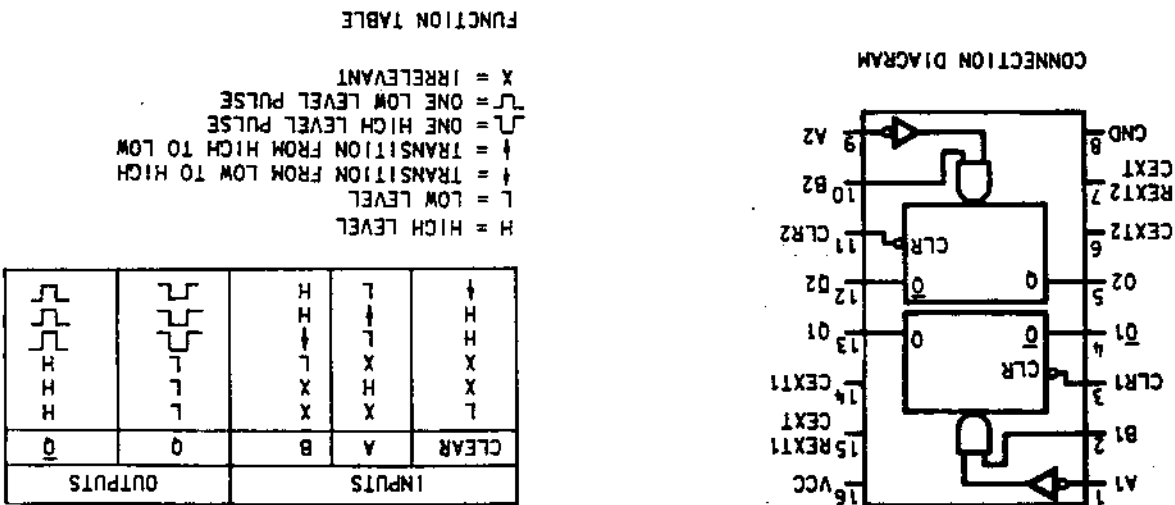
TYPE	IC NUMBER	LOCATION	REF. Des.
Microprocessor	63B03Y	Main (A1)	U1, U30

Figure 6-20 Multivibrator



Type	IC NUMBER	LOCATION	REF DES
Multivibrator	4538	Main (A1)	U20

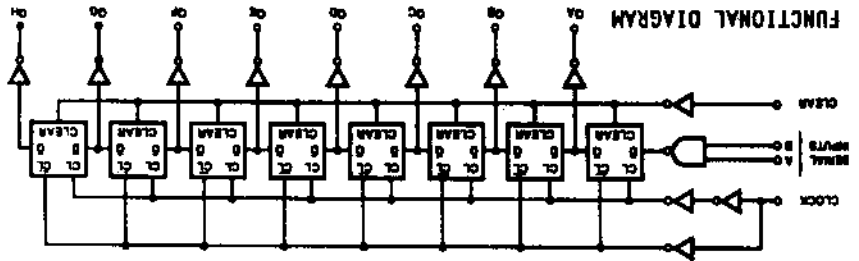
Figure 6-19 Multivibrator



Type	IC NUMBER	LOCATION	REF DES
Multivibrator	74HC221	Main (A1)	U31



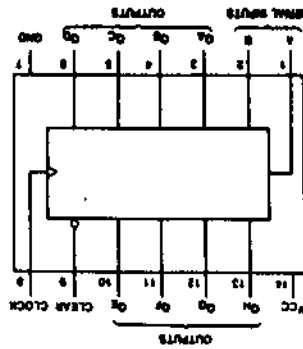
Figure 6-22 Shift Register



FUNCTION TABLE

H = High Level (steady state); L = Low Level (steady state)  
 X = Irrelevant (any input, including transitions)  
 ↑ = Transition from low to high level  
 ↓ = Transition from high to low level  
 QAn, QAn = The level of Qn or Qn before the most recent ↑ transition of the clock; indicated a one-bit shift.  
 QAn, QAn = The level of Qn or Qn before the most recent ↓ transition of the clock; indicated a one-bit shift.  
 QAn, QAn = The level of Qn or Qn before the most recent ↑ transition of the clock; indicated a one-bit shift.  
 QAn, QAn = The level of Qn or Qn before the most recent ↓ transition of the clock; indicated a one-bit shift.

Inputs		Outputs	
Clear	Check	A	B
H	X	L	L
H	X	L	X
H	X	H	H
H	X	H	X
L	X	L	L
L	X	L	X
L	X	H	H
L	X	H	X
L	X	L	L
L	X	L	X



CONNECTION DIAGRAM

TYPE	IC NUMBER	LOCATION	REF. DES
Register, Shift	74HC164	Power Conversion (A3)	U19, U20

Figure 6-21 Oscillator

PIN CONFIGURATION

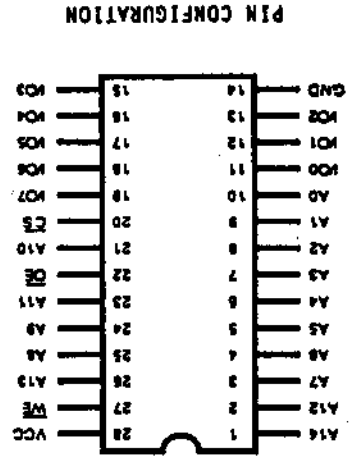
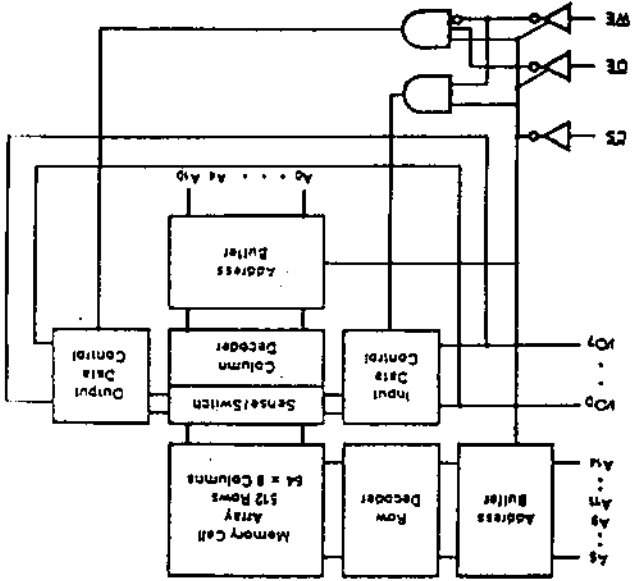
NC	1	14	VDD
NC	2	13	NC
NC	3	12	OUT (1/8)
NC	4	11	OUT (1/8)
NC	5	10	OUT (1/4)
NC	6	9	OUT (1/2)
GND	7	8	OUT (1/1)

FREQUENCY TABLE

OUTPUT FREQUENCY (in MHz)	BASE FREQUENCY	OUTPUT DIVIDING RATIOS
16,000	1/1	16,000 8,000 4,000 2,000 1,000
	1/2	1/4 1/8
	1/4	1/8 1/16

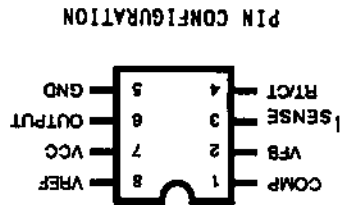
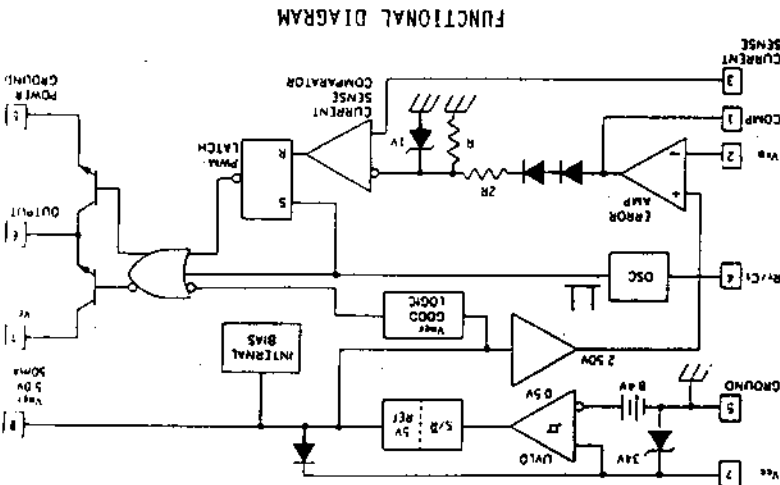
TYPE	IC NUMBER	LOCATION	REF. DES
Oscillator	NCM031C	Main (A1)	U10

Figure 6-24 Static RAM, 32k x 8



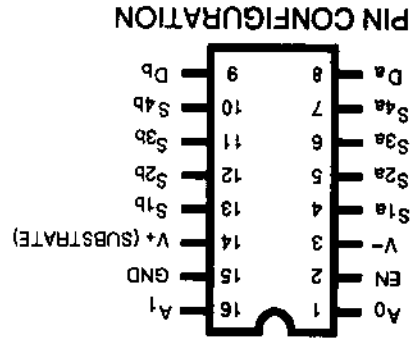
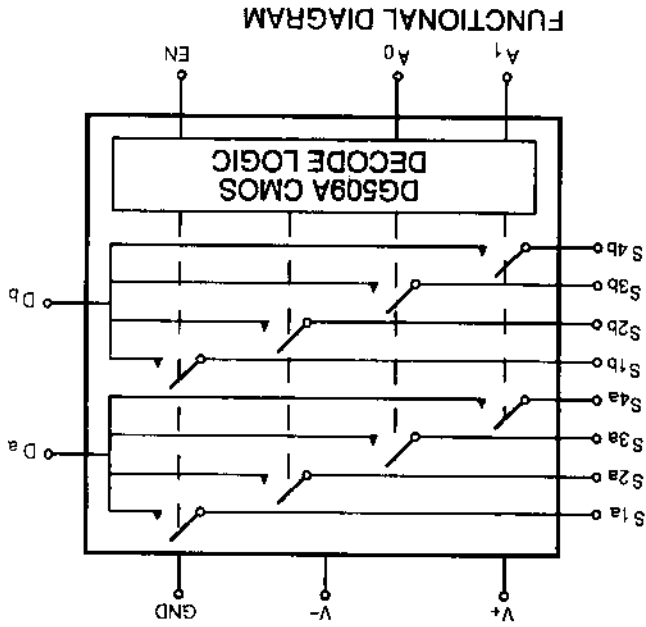
TYPE	IC NUMBER	LOCATION	REF. DES.
Static RAM, 32k x 8	HM62256LP-12	Main (A1)	U13, U14, U28A

Figure 6-23 Pulse-Width Regulator



TYPE	IC NUMBER	LOCATION	REF. DES.
Regulator, Pulse-Width	3843	Power Conversion (A3)	U3

Figure 6-26 Analog Switch

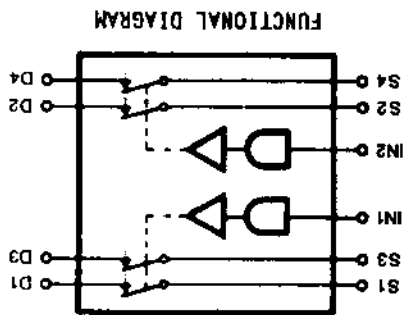


TYPE	IC NUMBER	LOCATION	REF. DES.
Switch, Analog	DG509	Main (A1)	U41, U42

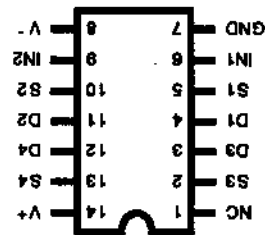
Figure 6-25 Analog Switch

FUNCTION TABLE

LOGIC SWITCH	1
0	OFF
1	ON

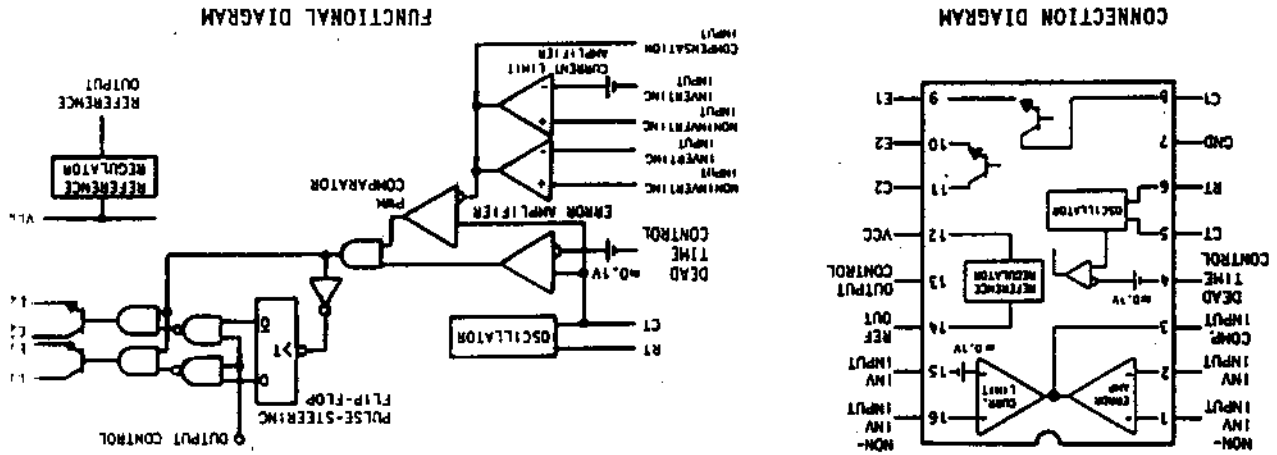


PIN CONFIGURATION

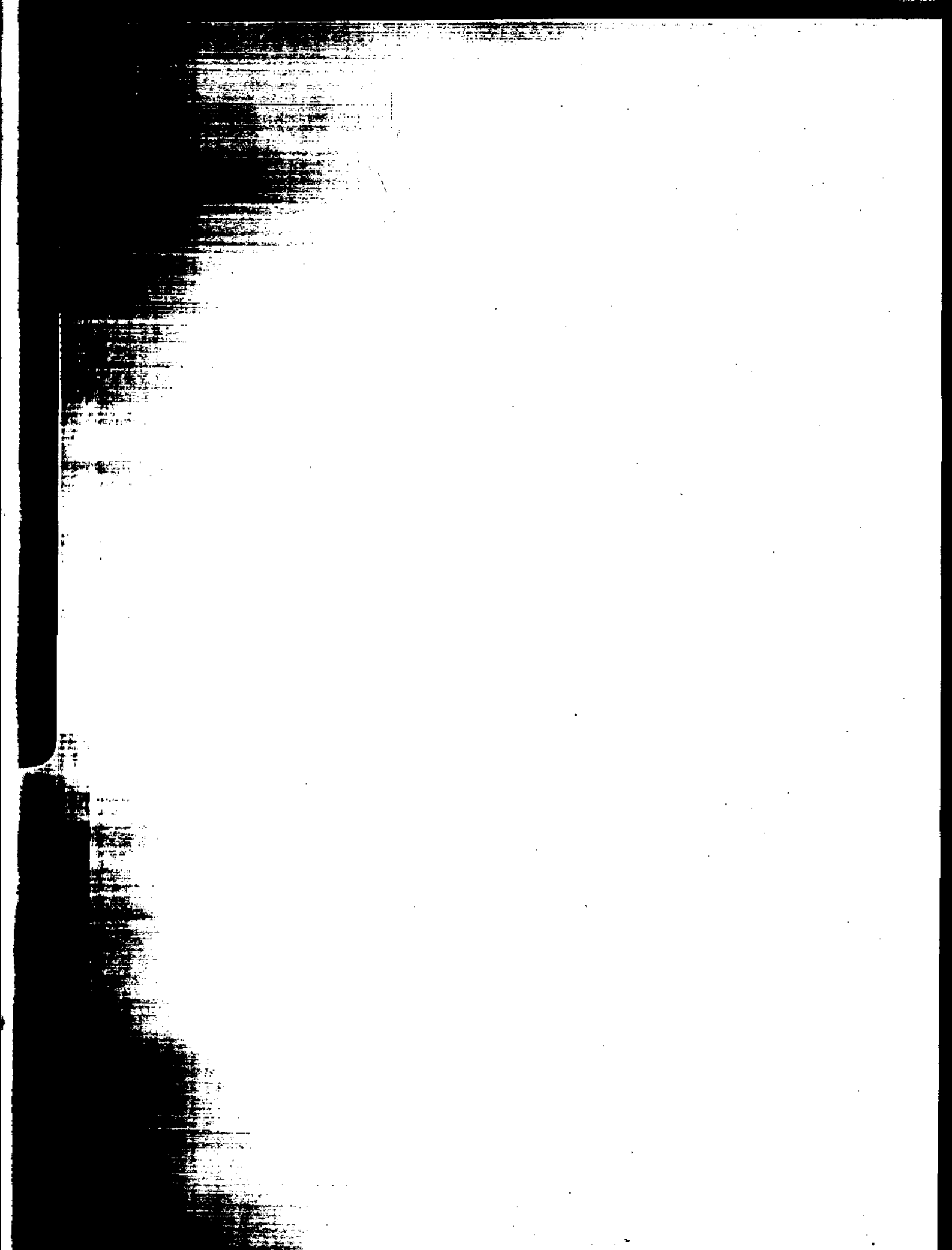


TYPE	IC NUMBER	LOCATION	REF. DES.
Switch, Analog	DG302	Main (A1)	U40, U43

Figure 6-27 Voltage Regulator



REF. DES	LOCATION	IC NUMBER	Type
U201	Display Assembly (A4)	TL494CN	Voltage Regulator



Charge, 2-3  
 CODE SUMMARY, 2-3  
 ECG Size, 2-3  
 Energy Select, 2-3  
 Energy Selection Display, 2-4  
 Heart Rate, 2-4  
 Alarm Limits, 2-4  
 HR Alarm, 2-3  
 Joules Selected Indicator, 2-4  
 Lead Select, 2-3  
 Lead Select Indicator, 2-4  
 Message Display, 2-4  
 On, 2-3  
 QRS Indicator, 2-4  
 Record, 2-4  
 Recorder, 2-4  
 Sync, 2-3  
 Trace, 2-4  
 LEAD SELECT, 2-3  
 Options, 2-7 thru 2-9  
 Info, 2-8  
 Setup, 2-7  
 Paddles Area  
 Apex Paddle, 2-5  
 Charge (Quik-Charge Control), 2-5  
 Charge Indicator, 2-5  
 Discharge Pushbuttons, 2-5  
 Patient Connector, 2-5  
 Sternum Paddle, 2-5  
 Test Load, 2-5  
 Rear Panel, 2-6  
 1mV CAL, 2-6  
 Ground, 2-6  
 Mode, 2-6  
 QRS Vol, 2-6  
 Sel, 2-6  
 Time/Day, 2-6  
 CRT Bias Generator, 1-35

## D

DC Restore, 1-21  
 Description  
 Functional, 1-5 thru 1-7

Capacitor Charge Control, 1-11  
 Charge Control, 1-24  
 Charge LED Drive, 1-14  
 Cleaning  
 Procedures, 4-11  
 External, 4-11  
 Interior, 4-11  
 Tools and Materials for, 4-10  
 Configuration Information, xvii  
 Controls and Indicators, 2-1 thru 2-6  
 Clock Setting Procedure, 2-9 thru 2-10  
 Front Panel, 2-3  
 BATT CHRG Indicator, 2-4  
 Calibrated Gain, 2-4  
 Cardioscope, 2-4

## C

BATT CHRG Indicator, 1-8  
 Battery  
 Low Thresholds, 3-17  
 Maintenance, 4-1  
 Power Supply PCB Assembly, 1-7  
 Recharging, 4-2  
 Recycling, 4-2

## B

Address Decode, 1-25  
 Analog Voltage Evaluation, 1-14  
 Assembly  
 Display, 1-32 thru 1-35  
 Interconnect PCB, 1-15 thru 1-16  
 Main PCB, 1-16 thru 1-32  
 Power Conversion PCB, 1-8 thru 1-15  
 Power Supply PCB, 1-7 thru 1-8  
 Audio Alarms, 1-23

## A

Physical, 1-1 thru 1-5

Disassembly Procedures, 4-4

Case Separation, 4-6

Front Panel Removal, 4-5

Handling Static Sensitive Devices, 4-4

Power Conversion PCB Removal, 4-6

Strip Chart Recorder Removal, 4-6

Display Assembly, 1-32 thru 1-35

Display Gate Array, 1-26

Display Recorder Controller, 1-24

## E

Echo, 1-21

Effective Pages, List of, xvi

Energy Dump, 1-13

Energy Monitor, 1-13

Energy Storage Capacitor Charger, 1-10

Energy Transfer, 1-12

External Control Input, 1-10

## F

Filtering, 1-20

Font EPROM, 1-28

Frame Sweep Generator, 1-33

Front and Rear Panel Controls Interface, 1-23

Front-End Protection, 1-18

Functional Description, 1-5 thru 1-7

Functional Test and Calibration Procedures, 3-15

Charge Reduction, 3-21

Charge Time, 3-20

CRT Frequency Response, 3-29

Defib Disarm and CHARGE LEDs check, 3-18

Display Calibration, 3-22

ECG Output, 3-29

Energy Dump, 3-21

Output Waveform, 3-21

Power Supply Calibration, 3-25

Recorder Calibration, 3-26

Recorder Frequency Response, 3-27

Servicing Guidelines, 3-15

Sync and HR Alarm LED Checks, 3-17

Test Equipment, 3-15

Test Load Calibration, 3-20

Test Mode, 3-18

Voltage Checks, 3-16

## I

I/O Protection, 1-24

Inspection Techniques, 4-9

Exterior Inspection, 4-9

Interior Inspection, 4-9

Instruction Decoding, 1-19

Instrumentation Amplifier, 1-19

Interconnect PCB Assembly, 1-15 thru 1-16

Isolated Power Supply, 1-18

## L

Lead Select, 1-18

Logic Power Monitor, 1-8

Low Energy Charge Rate, 1-11

## M

Main PCB

Block Diagram, 1-17

Display/Recorder Interface, 1-24 thru 1-33

Address Decode, 1-25

Display Gate Array, 1-26

Display Recorder Controller, 1-24

Font EPROM, 1-28

Motor Speed Control, 1-29

Pantthead Control, 1-30

Pantthead Resistance Evaluation, 1-31

Program EPROM, 1-29

Program RAM, 1-29

Recorder Power, 1-29

System Clock, 1-25

Video RAM, 1-28

Preamp, 1-18 thru 1-23

DC Restore, 1-21

Echo, 1-21

Filtering, 1-20

Front-End Protection, 1-18

Instruction Decoding, 1-19

Instrumentation Amplifier, 1-19

Isolated Power Supply, 1-18

Lead Select, 1-18

Optical Interface, 1-18

System Controller, 1-23 thru 1-24

Audio Alarms, 1-23

Charge Control, 1-24

Front and Rear Panel Controls Interface, 1-23

I/O Protection, 1-24

Main PCB Assembly, 1-16 thru 1-32

Functional Circuits, 1-16

Maintenance

Battery, 4-1

Repair and Cleaning, Tools and Materials for, 4-10  
 PCB Component Replacement, 4-13  
 Repair, Printed Circuit, Techniques for, 4-12  
 Regulation, 1-7  
 Reference Designator Key, 5-4  
 Recorder Power, 1-29  
 Raster Voltage Generator, 1-34  
 Raster Scan Oscillator, 1-33  
 Raster Generator, 1-34

## R

Program RAM, 1-29  
 Program EPROM, 1-29  
 Printhead Resistance Evaluation, 1-31  
 Printhead Control, 1-30  
 Pulse Widths, 1-20  
 Preamp, 1-18 thru 1-23  
 Power-On, 1-7  
 Regulation, 1-7  
 Power-On, 1-7  
 Overvoltage Protection, 1-7  
 Output Isolation, 1-7  
 Battery, 1-7  
 BATT CHRG Indicator, 1-8  
 Power Supply PCB Assembly, 1-7 thru 1-8  
 Voltage Checks, 3-17  
 Switching Power Supply, 1-10  
 Serial data Interface, 1-14  
 Power Control, 1-8  
 Low Energy Charge Rate, 1-11  
 Logic Power Monitor, 1-8  
 External Control Input, 1-10  
 Energy Transfer, 1-12  
 Energy Storage Capacitor Charger, 1-10  
 Energy Monitor, 1-13  
 Energy Dump, 1-13  
 Charge LED Drive, 1-14  
 Capacitor Charge Control, 1-11  
 Analog Voltage Evaluation, 1-14  
 Power Conversion PCB Assembly, 1-8 thru 1-15  
 Power Control, 1-8  
 Test Setup, 3-3  
 Test Load, 3-6  
 Sync/Async Annotation, 3-7  
 Recorder/CRT Noise, 3-7  
 Recorder Speed/Baseline Centering, 3-4  
 Recorder Annotation, 3-6  
 Rate Alarms/Alarm-Activated Record, 3-5  
 Physical Inspection, 3-2

PIP (Performance Inspection Procedure)  
 1mV CAL, 3-4  
 AC Power, 3-2  
 Battery Charge Legend, 3-2  
 Battery Power, 3-2  
 Charge Reduction, 3-9  
 Charge Time, 3-8  
 Checklist, 3-12  
 CRT Gain/Aspect Ratio, 3-5  
 Defib Disarm, 3-8  
 Delivered Energy, 3-10  
 Discharge Control/Open Air Discharge, 3-9  
 ECG Display, 3-4  
 Energy Dump, 3-9  
 Equipment Required, 3-1  
 Heart Rate, 3-5  
 Keypad Test, 3-3  
 Lead Select, 3-4  
 Leakage, 3-11  
 Paddle Polarity, 3-8

## P

Paddle Adapter Assemblies, 5-4  
 Parts Lists, Explanation of, 5-1  
 Physical Description, 1-1 thru 1-5  
 1mV CAL, 3-4  
 AC Power, 3-2  
 Battery Charge Legend, 3-2  
 Battery Power, 3-2  
 Charge Reduction, 3-9  
 Charge Time, 3-8  
 Checklist, 3-12  
 CRT Gain/Aspect Ratio, 3-5  
 Defib Disarm, 3-8  
 Delivered Energy, 3-10  
 Discharge Control/Open Air Discharge, 3-9  
 ECG Display, 3-4  
 Energy Dump, 3-9  
 Equipment Required, 3-1  
 Heart Rate, 3-5  
 Keypad Test, 3-3  
 Lead Select, 3-4  
 Leakage, 3-11  
 Paddle Polarity, 3-8

## O

Operation  
 Display Assembly  
 CRT Bias Generator, 1-35  
 Raster Generator, 1-34  
 Raster Scan Oscillator, 1-33  
 Raster Voltage Generator, 1-34  
 Video Signal Amplifier, 1-33  
 Power Supply PCB Assembly, 1-7 thru 1-8  
 Theory of, 1-7 thru 1-35  
 Display Assembly, 1-32 thru 1-35  
 Frame Sweep Generator, 1-33  
 Optical Interface, 1-18  
 Output Isolation, 1-7  
 Overvoltage Protection, 1-7



## S

**Safety**  
General Information, xii  
Symbols, xiv  
Terms, xii

**Schematic Diagrams, Explanation of, 5-2**  
Serial Data Interface, 1-14  
Service Information, xv  
Setup, 2-7  
Shipping Assembly, 4-14  
Specifications, General, 1-3  
Static Sensitive Devices, Handling, 4-4  
Strip Chart Recorder  
Cleaning, 4-3  
Protecting Printouts, 4-4  
Switching Power Supply, 1-10  
Symbols  
Explanation of, xiv  
Used in manual or on equipment, xiv

## T

**System Clock, 1-25**  
System Controller, 1-23 thru 1-24

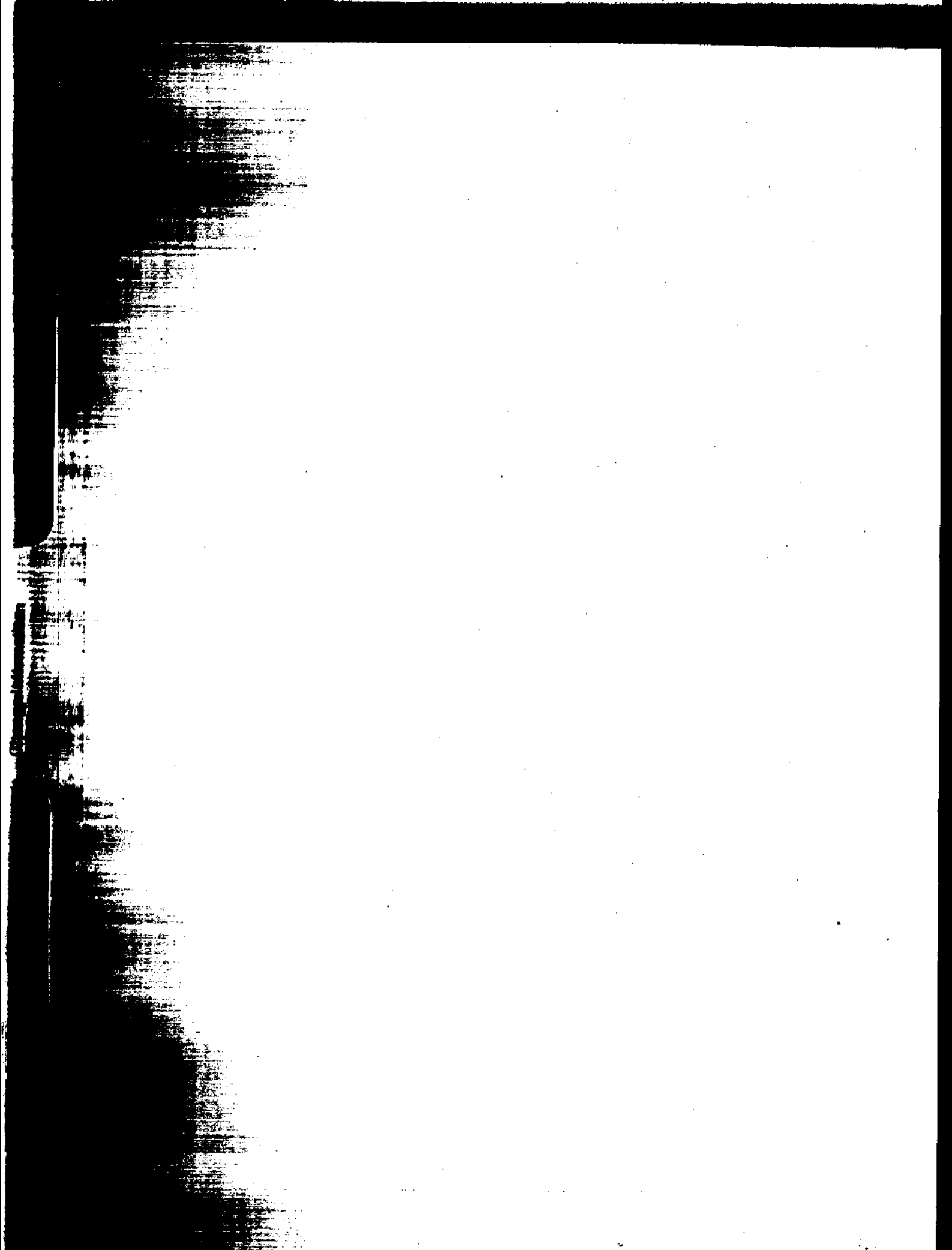
**Terms, Definition of, xii**  
Tools and Materials for Cleaning, 4-10  
Tools and Materials for Repair, 4-10

## V

**Video RAM, 1-28**  
Video Signal Amplifier, 1-33

## W

Warnings, xiii  
General, xiii



# Parts Lists and Schematic

## Introduction

This section includes lists of replaceable parts, component layouts or exploded views, and schematic diagrams for each major assembly of the LIFEPAK 9 defibrillator/monitor. Tables 5-1 and 5-2 list the figure and page number of the major assemblies. Table 5-3 lists standard reference designators for components. Supplies and accessories are listed in Table 5-4.

This section provides the following information:

- Supplies and Accessories
- Reference designators for components
- Replaceable parts
- Component layouts or exploded views
- Schematic diagrams for each major assembly

## Parts List

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

**Ref:** This column contains the reference designators or the assigned item number of replaceable parts. 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 heading of this column indicates the figure to which the parts list corresponds.

**Part Number:** 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:

